

**National Park Service**  
**U.S. Department of the Interior**

**Carlsbad Caverns National Park**  
**New Mexico**



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**Cave and Karst Management Plan**  
**Environmental Assessment**

***September 30, 2006***



Cover Photo of Lebarge Borehole by Bill Storage

## SUMMARY

Carlsbad Caverns National Park proposes to update the park Cave and Karst Management Plan that guides activities that may have an effect on cave resources. Cave resources include not only the cave walls, floors, ceilings and speleothems, but any cultural or biological features contained within caves. Karst resources include all physical features that influence the underground system, including but not limited to soils, bedrock, and natural drainage systems. Visitor service operations, concession operations, cooperating association operations, and National Park Service personnel management are not within the scope of this management plan.

Park staff and external stakeholders identified six primary goals to use in developing and evaluating alternatives for the Cave and Karst Management Plan:

- 1) Protect, restore, and perpetuate natural cave and karst systems and processes.
- 2) Collect and maintain data sets on caves, karst and associated resources to high standards.
- 3) Encourage, facilitate, and conduct high-quality scientific study of cave and karst systems.
- 4) Provide a wide range of recreational opportunities for visitors to discover, appreciate, respect, and enjoy the park's cave and karst resources.
- 5) Support cave and karst systems education and outreach.
- 6) Promote safety of visitors and employees in and around caves and karst.
- 7) Do not allow major impacts or impairment to resources.

## ALTERNATIVES

**No Action Alternative** would provide a basis for comparing the management direction and environmental consequences of the proposed action. The current access, use, and safety policies would remain. Cave monitoring, data collection, and research would be conducted using existing guidelines and currently identified data sets. There would be some cave and karst education and outreach.

**Alternative A** would modify existing cave and karst management policies based on scientific research and management experience. Access and use policies would be developed based on desired conditions of individual resources. Safety policies would be expanded to include more formal and informal training and safety protocols. Cave monitoring, data collection, and research would be conducted by park personnel, researchers, and volunteers based on scientific and management needs. The scope of education and outreach would be expanded with the goal of making Carlsbad Caverns National Park one of the premier sources of cave and karst education and knowledge.

**Alternative B** would expand the activity level and scope of cave and karst management. Access and use of caves in the park would be expanded with additional gates and trails constructed. The park would provide safety and training for all people entering park caves and would conduct background checks of skills and qualifications. The park would

seek to expand data collection to as many sets as possible and would work with research partners and volunteers to collect and manage data. The park would develop a formal cave and karst education program, a learning center, and a research library.

**Environmentally Preferred Alternative.** Alternative A, Modified Cave and Karst Management would have the fewest adverse impacts to cave, karst, water, biological, cultural, and paleontological resources of all of the considered alternatives. Increased traffic to park caves under Alternative B would result in minor to moderate adverse impacts to resources. Poor or incomplete documentation of resources under the No Action Alternative would result in minor to moderate adverse impacts to resources.

**Alternatives Considered but Rejected: Minimized Cave Management**

This alternative would have eliminated access to all caves and areas not currently open for paid, public tours. There would be only limited safety information provided to the public through signs and visitor orientation talks. There would be no research or data collection in park caves and only minimal cave and karst information provided to the public. This alternative was rejected because it did not meet any of the stated goals of the plan.

**Alternatives Considered but Rejected: Open Access, Zero Management**

This alternative would have opened access to all caves and areas in the park, limited only by legal and administrative mandates. There would be only limited safety information provided to the public through signs and visitor orientation talks, but no information provided to backcountry cave users. Cave and karst research and monitoring would be conducted by researchers with little oversight from the park. No support for education and outreach would be provided. This alternative was rejected because it would have major adverse impacts and possible impairment to cave and karst resources and would not meet the stated plan objectives.

**Alternatives Considered but Rejected: Reduced Cave Management**

This alternative would reduce the level of active cave management. The current access, use, and safety policies would remain. Cave monitoring, data collection, and research would be conducted by volunteers and researchers based on their needs and with no oversight or direction by the park. Some information on cave and karst would be provided but there would be no formal education and outreach activities. Impact analysis of this alternative indicated that there would be major impacts and possible impairment to park resources, so would not meet the stated plan objectives.

## **PLANNING PROCESS**

This environmental assessment (EA) has been prepared as part of the process described under the National Environmental Policy Act (NEPA), and the National Historic Preservation Act (NHPA), Section 106. All major actions by the National Park Service (NPS) that are not categorically excluded from NEPA must be evaluated by an EA or an environmental impact statement (EIS). The process involves developing alternatives to accomplish well-defined goals and then evaluating the potential impacts of those alternatives (NPS, 2001a).

The public is invited to review the draft plan (this document) and make comments on the alternatives and the EA of those alternatives. Once the public comment period is completed, the park will screen the comments to determine whether any important new issues or reasonable alternatives have been suggested. If major substantive issues not covered adequately by the EA are raised or if the park wishes to consider new suggested alternatives, the EA will be rewritten to incorporate them and reissued for a second 30-day review. If commenters correct or add factual information that has no bearing on the determination of significant impact, the information will be added to the EA when possible. If any of the issues point to the potential for significant impacts, the park will publish a notice of intent to prepare an EIS. Otherwise, a Finding of No Significant Impact (FONSI) will be issued and the revised plan will be published and implemented.

### **Public Comment**

If you wish to comment on the environmental assessment, you may mail comments to the name and address below or post comments online at <http://parkplanning.nps.gov/>. This environmental assessment will be on public review for 30 days. It is the practice of the NPS to make all comments, including names and addresses of respondents who provide that information, available for public review following the conclusion of the environmental assessment process. Individuals may request that the NPS withhold their name and/or address from public disclosure. If you wish to do this, you must state this prominently at the beginning of your comment. Commentators using the website can make such a request by checking the box “keep my contact information private.” NPS will honor such requests to the extent allowable by law, but you should be aware that NPS may still be required to disclose your name and address pursuant to the Freedom of Information Act. We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

Cave and Karst Management Plan  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, NM 88220

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## PURPOSE AND NEED FOR ACTION

Carlsbad Caverns National Park contains more than 100 known caves, including world famous Carlsbad Cavern and Lechuguilla Cave. The purpose of this plan is to: 1) protect, restore, and perpetuate natural cave and karst systems and processes; 2) collect and maintain data sets on caves, karst and associated resources to high standards; 3) encourage, facilitate, and conduct high-quality scientific study of cave and karst systems; 4) provide a wide range of recreational opportunities for visitors to discover, appreciate, respect, and enjoy the park's cave and karst resources; 5) support cave and karst system education and outreach; 6) promote safety of visitors and employees in and around caves and karst and; 7) Prevent major impacts or impairment to park resources. The goals of this plan may be reached through the management measures outlined in the "Alternatives" section.

The National Park Service (NPS) is mandated to protect the caves of Carlsbad Caverns National Park. The Federal Cave Resources Protection Act of 1988, Section 2c states, "It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves." The 1916 NPS Organic Act mandates the park to "conserve the natural scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The 2001 National Park Management Policies Handbook (NPS, 2001b § 4.8.2.2) states:

"The Service will manage caves in accordance with approved management plans to perpetuate the natural systems associated with the caves, such as karst and other drainage patterns, air flows, mineral deposition, and plant and animal communities. Wilderness and cultural resources and values will also be protected."

The last revision of the park Cave and Karst Management Plan was completed in 1996. Since that time, a microbial study in Carlsbad Cavern (Barton, 2005) showed that the development of infrastructure and visitation has caused significant changes to microbial communities. Invertebrate transects throughout Carlsbad Cavern have shown that infrastructure has changed invertebrate habitat in the cave, and that materials left by visitors (trash, lint, etc.) have altered population distributions of cave invertebrates and altered the ecosystem (Krejca and Meyers, 2005). Studies in undeveloped caves have shown that even visitation by careful scientists and highly trained cave surveyors can adversely impact native microbe communities (Northup and others, 2000). Study of microbes in Spider and Lechuguilla Caves has been vital in improving our understanding of the role they play in geologic processes, and the role they may play in helping to develop treatments for human diseases such as cancer and HIV.

Oil and gas development has been expanding around and towards the park. The city of Carlsbad and other users are increasing the amount of water extracted from the Capitan Aquifer, a karst aquifer that underlies the park. These activities have the potential to adversely impact cave and karst resources in the park, so it is vital that the park identify and monitor those resources. This plan will be used to guide research and monitoring and to protect fragile cave resources while providing opportunities for the public to experience the underground resources of the park.



## **RELATIONSHIP TO OTHER PLANS AND ACTS**

The Carlsbad Caverns National Park General Management Plan (NPS, 1996) directs the park to evaluate methods and guidelines to reduce adverse impacts on cave resources throughout the park and restore areas that have been impacted in the past. The park GMP states that the park must develop specific guidelines for the preservation and protection of Lechuguilla Cave while promoting research on this important resource. Once developed, these methods and guidelines are to be incorporated into an updated Cave and Karst Management Plan (this document). The Carlsbad Caverns National Park Resource Management Plan (NPS, 1987) requires regular updates to individual resource management plans, particularly when significant changes in management have occurred due to increased knowledge or potential adverse impacts are identified.

The National Environmental Policy Act (NEPA), and the National Historic Preservation Act (NHPA), Section 106 require that all major actions by the National Park Service (NPS) that are not categorically excluded from NEPA must be evaluated by an EA or an environmental impact statement (EIS). The process involves developing alternatives to accomplish well-defined goals and then evaluating the potential impacts of those alternatives (NPS, 2001a).

## **SCOPING AND OBJECTIVES**

Internal scoping by NPS staff was completed in the park in April 2004 to develop goals and objectives for the resource protection plan. The NPS conducted public scoping meetings to identify other potential topics and concerns as well as goals for the plan. Public scoping was conducted at the National Speleological Society meeting in July 2004, and in the city of Carlsbad, New Mexico, on February 1, 2005. Park staff and external stakeholders identified seven primary goals to use in developing and evaluating alternatives for the Cave and Karst Management Plan:

- 1) Protect, restore, and perpetuate natural cave and karst systems and processes.
- 2) Collect and maintain data sets on caves, karst and associated resources to high standards.
- 3) Encourage, facilitate, and conduct high-quality scientific study of cave and karst systems.
- 4) Provide a wide range of recreational opportunities for visitors to discover, appreciate, respect, and enjoy the park's cave and karst resources.
- 5) Support cave and karst systems education and outreach.
- 6) Promote safety of visitors and employees in and around caves and karst.
- 7) Do not allow major impacts or impairment to resources.

Preliminary alternatives were developed using these goals, and were made available for external and internal review and comment from April – December 2005.

A meeting was held February 15, 2006, to perform a Choosing By Advantages (CBA) analysis of the alternatives and select a park-preferred alternative. In the CBA analysis, factors such as resource protection, visitor experience, and visitor and staff safety were used to evaluate each of the alternatives.

## **IMPACT TOPICS**

Issues and concerns affecting this project were identified by NPS specialists, as well as from the input of other federal, state, and local agencies. After public scoping, issues and concerns were distilled into distinct impact topics to facilitate the analysis of environmental consequences, which allows for a standardized comparison between alternatives based on the most relevant information. The impact topics were identified on the basis of federal laws, regulations, and orders; NPS Management Policies (NPS, 2001B); and NPS knowledge of limited or easily impacted resources.

The following resources were considered to be potentially impacted by actions under the considered alternatives: 1) rare, threatened, or endangered species; 2) cave and karst resources; 3) groundwater; 4) cultural resources; and 5) paleontological resources.

## **TOPICS DISMISSED FROM FURTHER ANALYSIS**

The Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to NRCS, none of the soils in the project area are classified as prime and unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed as an impact topic in this document.

The unconsolidated materials located on cave floors are not subject to the same conditions as surface soils, so potential impacts to cave floors will be considered under impacts to cave resources and not soils. The caves of the park do not contain vegetation beyond the entrances. Increased traffic to park caves could cause some compaction and erosion, but these effects would be localized and negligible. There are no actions under any alternatives that would result in adverse effects on soils and vegetation. The impact of the proposed and considered alternatives on soils and vegetation are therefore removed from further analysis.

There are no actions under any alternatives that would result in adverse effects on air quality. The impact of the proposed and considered alternatives on air quality are therefore removed from further analysis.

There are no wetlands or 100-year floodplains within the project area, the sections of the park containing rocks favorable to cave development. The impact of the proposed and considered alternatives on wetlands and floodplains are therefore removed from further analysis.

The proposed action would neither change local and regional land use nor impact local businesses or other agencies. Therefore, socioeconomic environment will not be addressed as an impact topic in this document.

There are no actions under any alternative that would limit visitation or access by the public to Carlsbad Cavern. There are no actions under any alternative that has a disproportional adverse impact to any population. The socioeconomic impact of the proposed and considered alternatives are therefore removed from further impact analysis.

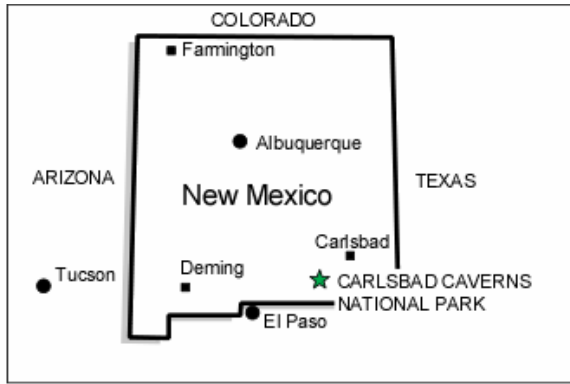
## BACKGROUND

Carlsbad Caverns National Park encompasses approximately 47,000 acres of wilderness and non-wilderness lands in the Guadalupe Mountains of southern New Mexico (see the Vicinity map, page 6). The park preserves and provides opportunities for visitors to view a large portion of the Capitan Reef, the best exposed Permian-age fossil reef in the world. The park also contains one of few protected northern Chihuahuan Desert ecosystems and contains species of plants and animals that are at the limits of their geographic distribution. Cultural resources in the park represent a long and varied history of human uses from prehistoric times to the present.

The park was designated a World Heritage Site in 1995 for containing “outstanding universal value with exceptional features, unique reef and rock formations, and containing major cave formations, gypsum chandelier speleothems, aragonite ‘Christmas trees,’ and hydromagnesite balloons.” The park includes several world-class caves including Carlsbad Cavern. The Big Room of Carlsbad Cavern is the largest, most easily accessible chamber in North America. Carlsbad Cavern is also home to a world-famous colony of migratory Brazilian (Mexican) free-tailed bats and one of the largest colonies of migratory cave swallows in the United States.

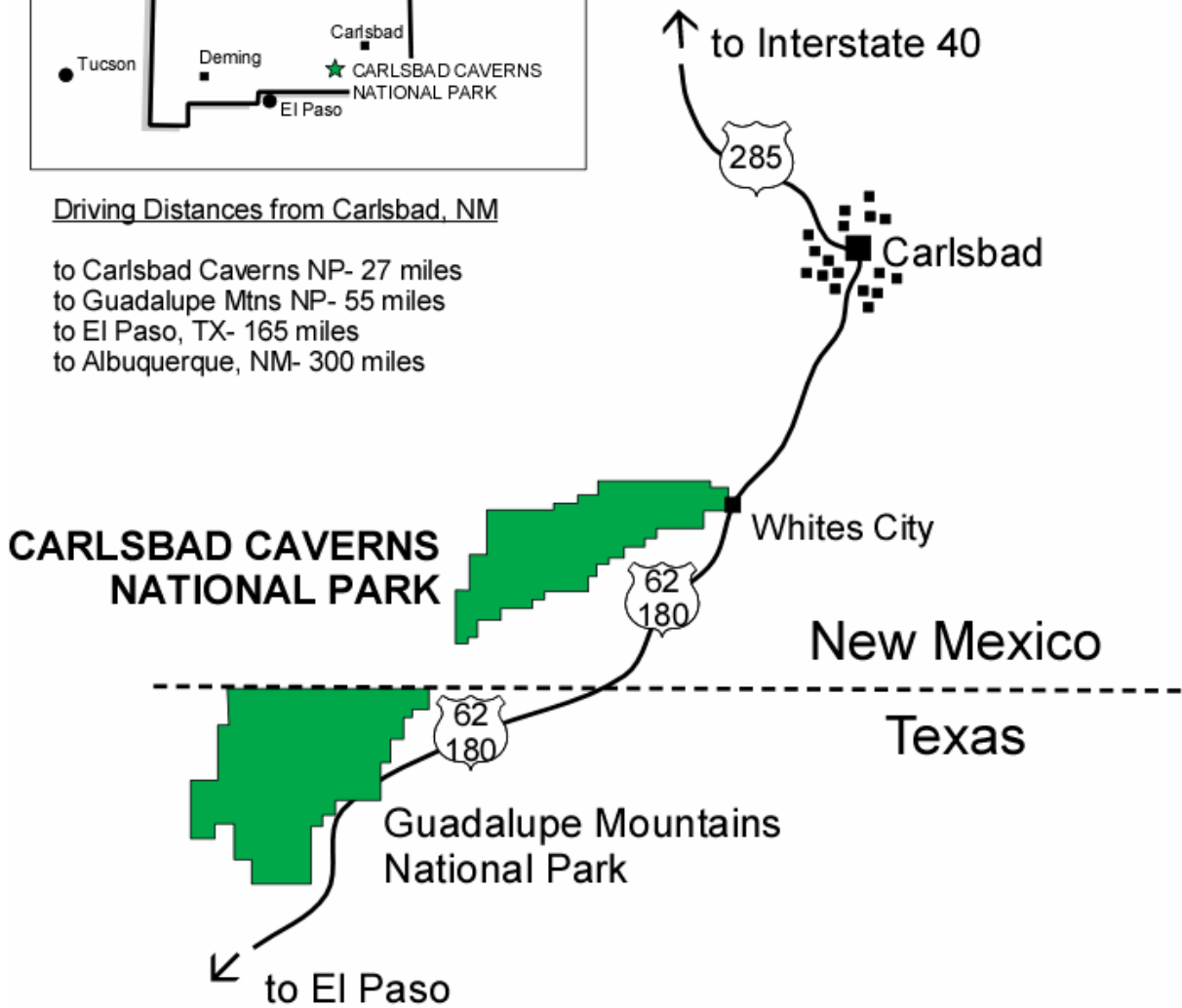
About 250 acres of surface area around Carlsbad Cavern have been developed to provide access and support for the 400,000-500,000 annual visitors to Carlsbad Caverns National Park. Cave tours began in the early 1900s and have continued to the present. Beginning in 1926, and to satisfy housing and park operational needs of the new and increasingly popular national park, offices, residences, and parking areas were constructed above Carlsbad Cavern near the natural entrance to the cave. The first elevator shaft was built in 1931, and a second shaft was excavated in 1954. Beginning in 1961-62, a period of major facility expansion in the NPS known as Mission 66, left its impact on the park. During the Mission 66 era, the visitor center and maintenance areas were expanded and additional buildings were constructed to provide housing for park personnel.

In 1986, a new discovery was made in Lechuguilla Cave, leading to more than 118 miles of cave passage, making it the longest cave in the park and one of the longest in the world. In the course of exploration of this pristine cave, geologists were able to gain a much better understanding of the geology of the Guadalupe Mountains and of the complex history of cave development in the area. Microbiologists have discovered hundreds of unique cave-adapted organisms that have led to a better understanding of the role of microbes in geologic processes and may lead to more insights into how these organisms may help lead to treatment for human diseases such as cancer. Biologists have also discovered the profound adverse impacts that humans can have on native microbe populations. These potential adverse impacts have changed the way the caves in the park must be managed and mitigation of these impacts is one of the primary goals of this plan.



#### Driving Distances from Carlsbad, NM

to Carlsbad Caverns NP- 27 miles  
 to Guadalupe Mtns NP- 55 miles  
 to El Paso, TX- 165 miles  
 to Albuquerque, NM- 300 miles



### Vicinity Map

#### **Carlsbad Cavern Cave and Karst Management Plan**

#### **Carlsbad Caverns National Park**

US Department of the Interior  
 National Park Service

## **SITE DESCRIPTION AND EXISTING CONDITIONS**

### **NATURAL RESOURCES**

Carlsbad Caverns National Park contains one of the best-preserved areas of the northern Chihuahuan Desert ecosystem. The escarpment is a mountainous ridge of limestone that has been lifted above the plains to the south and east. Below the escarpment, visitors can observe the transition from high desert scrubland into the grassland characteristic of the low Chihuahuan Desert.

#### **Surface Rare, Threatened or Endangered Species**

Federally threatened Mexican spotted owls are known to nest in cave entrances in the Guadalupe Mountains, particularly in areas where there are few large trees. The entrance areas of park caves are suitable habitat for the owls that are easily disturbed by visitation. Two federally listed cacti are present along trails leading to permitted park caves and some rare plants inhabit cliff faces near some cave entrances.

#### **Subsurface Rare, Threatened or Endangered Species and Species of Interest**

No threatened or endangered species listed by the federal or state government have been identified within the dark zone of park caves. The park has many non-threatened, non-endangered species of interest including bats, colonies of cave swallows, and cave invertebrates.

Park species of concern include any bat species listed by the state as sensitive that use caves and the summer maternity colony of Brazilian (Mexican) free-tailed bats. Bats known to occupy caves or rock crevices and that occur in the park listed as sensitive by the State of New Mexico include: cave myotis, fringed myotis, western small-footed myotis, long-legged myotis, big free-tailed, and the pale Townsend's big-eared. The park considers cave swallows as species of concern for management purposes. The entrance areas of several caves are occupied by colonies of cave swallows during the summer months.

Some aquatic invertebrates such as flatworms have been found in the pools of Carlsbad Cavern (Ek, 1991). Changes in pool chemistry and water level could adversely impact these organisms. A recent cave invertebrate survey was conducted in Carlsbad Cavern (Krejca and Meyers, 2005) and identified several species of crickets, spiders, pseudoscorpions, beetles, mites, and others that use park caves.

Researchers have also identified hundreds of species of microbes unique and native to cave environments in Lechuguilla Cave and Spider Cave (Northup and others, 1999; Northup and others, 1997; Northup and others, 1994; and Cunningham and others, 1995). Some of these microbes are providing researchers with a better understanding of the role of biology in geologic processes and of the potential for subterranean life on other planets. Some of the microbes found in park caves have also shown some promise towards finding a treatment for human diseases such as leukemia. These species are sensitive to changes in temperature, humidity, and chemistry as well as direct impact from contact with humans.

## **Cave and Groundwater Resources**

**Cave Setting.** The park defines caves as any dissolution feature longer than 50 feet where the entrance is not wider than the cave is long. The NPS has deemed that any feature defined as a cave within any park's boundaries is considered significant and is protected by the Federal Cave Resource Protection Act. The caves of Carlsbad Caverns National Park were formed 3-12 million years ago several hundred feet below the water table. As the Guadalupe Mountains were uplifted, the caves drained and surface erosion removed overlying rock to expose entrances. The majority of the caves in the park are in remote, rugged terrain and are difficult to locate.

**Cave Environment.** The caves of Carlsbad Caverns National Park require high levels of technical skill to enter and explore. They frequently contain vertical pits, some in excess of 300 feet, and long, exposed traverses. The caves are long and three-dimensionally complex. It can take skilled cavers more than 12 hours to reach remote areas of Lechuguilla Cave and trips into this cave usually require in-cave stays of more than five days.

Park caves do not contain active streams and have limited areas where there is dripping water. Because the cave-forming process has ceased and the caves are not active, recovery from impacts takes a great deal of time, if it occurs at all. Many of the caves are decorated with minerals such as gypsum, which are very sensitive to changes in humidity and direct human impact. Any changes to airflow (such as enlarging an entrance or constructing an elevator shaft), use and traffic patterns, and overlying land use can have a profound and permanent adverse effect on cave resources.

**Infiltration and Hydrology.** The average annual rainfall in the park is approximately 13 inches, generally concentrated in spring and fall storms. Much of the park consists of exposed bedrock outcrops sometimes covered in thin soil, so runoff is rapid. Water is concentrated in drainages and the water not used by plants or evaporated back into the atmosphere travels through fractures in the rock to become part of the groundwater system. In some cases, the water travels slowly, all the way to the regional water table, the Capitan Aquifer. The water can also flow downward into caves where it forms cave decorations and pools and is sometimes re-circulated by air movement. Eventually, this water will either be released back into the atmosphere or seep slowly to the water table.

The natural drainage and infiltration patterns above Carlsbad Cavern have been disrupted by park development. Under undisturbed conditions, most rainfall would be absorbed into the soil and taken up by plants or evaporated. Water would flow into Bat Cave Draw only during intense thunderstorms. Now, the buildings and paved areas, which are impervious to water, focus drainage into culverts, drains, and eventually, into Bat Cave Draw.

Chemical and hydrologic studies of the deepest part of Lechuguilla Cave, suggest that the cave encounters the Capitan Aquifer. Changes in water level and quality of this aquifer could have an adverse effect on this cave. Overpumping of the water from outside the park and contamination from land use such as oil and gas development could have a disastrous effect on park cave resources. Careful and diligent monitoring of water resources in the park is the key to identifying potential and real threats to the resources.

## CULTURAL RESOURCES

### Cultural Landscapes: Caverns Historic District

The Caverns Historic District, listed on the National Register of Historic Places, consists of an assemblage of NPS buildings and landscaped features surrounding the natural entrance of Carlsbad Cavern, dating from the mid-1920s through the early 1940s. These buildings and landscaped features are on the slopes and ridges above Bat Cave Draw and at the bottom of the draw where the terrain was leveled and terraced for visitor access to the cave. The earliest buildings and the terracing are constructed of limestone from the surrounding hillside. The architectural style of the buildings is of both the Pueblo Revival style and the New Mexican Territorial style.

The Caverns Historic District contains 13 administrative, residential, and maintenance buildings and their surrounding landscaping (Colby, 1988). Originally, 19 rock buildings were constructed on the north slope of the draw between 1926 and 1932. Six of these original structures have since been removed. Construction on the earliest park facilities, including the three-tiered parking area in Bat Cave Draw, began in 1926. In 1927-1928, construction was begun on several of the rough-cut stone buildings that remain today. These facilities were designed by the first park superintendent and built by park rangers. A second construction phase was undertaken in 1931-1932, which added several more stone buildings, including the elevator tower. Between 1938 and 1942, additional residential and maintenance buildings were designed and built above the cave entrance. The 1938-1942 construction was done by Civilian Conservation Corps (CCC) crews stationed at the nearby Rattlesnake Springs camp.

The visitor center was completed in 1957, encasing the original 1932 elevator tower. In 1961-1962, two additional multiple dwelling units, a maintenance building, and the tennis court area were constructed on the top of the hill on the north side of the draw. These projects were part of the NPS's Mission 66 design and construction program intended to revitalize the national parks through a massive 10-year program of capital investment to improve the deteriorating conditions of NPS facilities following World War II (Carr and Allabeck, 1998).

The Mission 66 residences are not considered eligible for the National Register of Historic Places. They do not meet the individual significance criteria under the National Historic Preservation Act for the following reasons:

*A. Association with events that have made significant contributions to the broad patterns of our history:* While the Mission 66 program marked a change in construction and design philosophies of the NPS, the hallmark of the program was the development of the central visitor centers, not necessarily individual housing units within parks. While the park Mission 66 housing was part of that broader national program, the housing complex at Carlsbad Caverns is typical of Mission 66 housing in many other national parks, including other parks in New Mexico.



*B. Associated with the lives of significant persons:* The park's Mission 66 housing was designed by staff of the NPS Western Office, Division of Design and Construction. The plans for the park's housing were one of many similar designs incorporated around many NPS units.

*C. Works of architecture that embody distinctive characteristics of a type, period or method of construction or that represent the work of a master, or that possess high artistic value:* The blocky, modernistic design of the park's Mission 66 housing does not represent any distinctive style or significant method of construction. In fact, the design of the Mission 66 residences departs from the previous NPS architectural style of rustic architecture designed to blend in with the local landscape. Again, several other highly similar examples of Mission 66 housing exist in other NPS sites within the state.

*D. Likely to yield information important in history:* The park holds complete design drawings of all of the Mission 66 residences, as well as project completion reports and photographs of the construction. The likelihood of any additional significant information coming from the buildings themselves is minimal.

This historic setting is managed as a "cultural landscape," which, in NPS terms, is defined as a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built (NPS, 1997). The character of a natural landscape is defined both by physical materials such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions. The buildings and designed landscape features represent the rustic theme for facility development used during the early years of NPS construction in parks. This philosophy emphasized the use of local materials and building techniques used in harmony with the natural setting of the landscape. The current Cultural Landscape Inventory for the Caverns Historic District defines the landscape as encompassing all of the designed buildings and landscaping from the tops of the ridges adjacent to Bat Cave Draw.

The period of significance for which both the Caverns Historic District and the cultural landscape of the Cavern entrance area are managed is 1907-1942. Several more buildings were added to the developed area after 1942. The Bat Flight Amphitheater was completed in 1963. The Mission 66 residences lie outside the boundaries of the Caverns Historic District, but are within the managed boundaries of the cultural landscape. However, since their construction does not fall within the historic district's and cultural landscape's period of significance, they detract from the cultural landscape the park is attempting to preserve.

## **Cultural Resources in Caves**

**Archeological Resources.** Caves in general, and Carlsbad Cavern in particular, play a significant role in the oral history and cultural traditions of many Native American tribes. The park is actively involved in consultations with 13 Native American tribes concerning their historic and cultural ties to park lands. The Caverns area should be considered as an ethnographic landscape because of archeological and ethnographic resources within the area.

Archeological sites within the developed area fall into two distinct types: prehistoric and historic Native American occupations and historic Anglo-American habitation of the area. The former consists of food processing sites, such as ring middens or hearth features, and lithic scatters. Ring middens, constructed and used to bake vegetal materials for human consumption, are large features and are the result of multiple usage, sometimes over centuries. Hearth features consist of small circular or amorphous scatters of burned rock and represent heating fires kindled by individuals or small groups, perhaps only for a single event. Many lithic scatters are small-scale sites of sparse artifacts. They most likely represent a single event where toolmaking, tool maintenance work, or use occurred. Many of these features are located near cave entrances and may reflect the use of caves as temporary shelter. Many cave entrances contain pictographs and other artifacts. Slaughter Canyon Cave contains one of the few pictograph sites located entirely in a cave's dark zone in the United States.

**Historic Structures.** The historic occupation of the area resulted in many sites, including campsites, temporary housing sites, quarries, guano mining-related sites, and trash dumps. Material in the area surrounding Carlsbad Cavern reflects the area's continued use from the late 19th century into present times. The Caverns Historic District is virtually a continuous scatter of cultural material reflecting activities related to ranching, guano mining, CCC construction, tourism, and NPS family life.

Many caves in the park contain old ladders and other remains from early cave exploration by local ranchers and other visitors. Carlsbad Cavern, Slaughter Canyon Cave, Ogle Cave and other caves in the park contain the remains of large guano-mining operations dating from the late 19<sup>th</sup> to early 20<sup>th</sup> century. Their protection from rain, snow, and sun has left them very well preserved. Carlsbad Cavern contains examples of CCC trail development and other resources related to exploration and development of the cave as a tourist attraction.

**Ethnographic Resources.** Many cave entrances contain pictographs and other artifacts reflecting temporary use and visitation. Other than the entrance of Carlsbad Cavern and one area in the dark zone of Slaughter Canyon Cave, there are no known ethnographic ties to specific park caves. The actions proposed under any of the considered alternatives would have no effect on ethnographic resources.

**Museum Collections.** The actions proposed under any of the considered alternatives would have no effect on museum collections.

## **PALEONTOLOGICAL RESOURCES**

### **Permian Fossils**

The Guadalupe Mountains, including all of Carlsbad Caverns National Park, are made up of rocks created when the area was covered in a large inland sea. As a result, the rock contains abundant fossils of Permian marine animals. Surface outcrops are badly weathered and fossil communities are frequently obscured by minerals and soil. Park caves provide geologists and paleontologists with a three-dimensional view of the relationships between ancient animal communities.

### **Pleistocene/Holocene Mammals**

Many remains from large and small extinct or locally extirpated mammals have been found in park caves (Santucci and others, 2001). Pleistocene shrub oxen, pronghorn, felines, dire wolf, horse, and ground sloth have been found along with the remains of marmots, shrews, birds, and an extinct species of free-tailed bat. The remains of modern animals such as ringtail cats have been found deep in park caves, indicating proximity to now-buried cave entrances. The remains of several bat species, not known to inhabit caves, have also been found.

### **Microfossils**

Fossil pollen and micro-invertebrates have been found preserved in cave formations near cave entrances. These microfossils have been used to reconstruct changes in climate and vegetation in the region.

## **ALTERNATIVES**

The considered alternatives provide for protection of cave and karst resources and the biological, cultural, and paleontological resources within them while providing a safe, quality experience to a wide range of park visitors. Each alternative includes some level of research and scientific monitoring to identify adverse impacts and to adjust cave management policies to mitigate those impacts. Most alternatives also include some education and outreach to increase public understanding of cave resources to protect not only park caves, but caves outside of the park.

### **OPTIONS COMMON TO ALL ALTERNATIVES**

All alternatives would include the development of written access policies for park caves and sections of park caves. All alternatives would include the development of guidelines for NPS maintenance activities in and around caves.

### **NO ACTION ALTERNATIVE**

Under the no action alternative, the current access, use, and safety policies would remain. Cave monitoring, data collection, and research would be conducted using existing guidelines and currently identified data sets. The park would oversee and manage research and provide some logistical support. There would be minimal cave and karst education and outreach.

#### **Cave and Karst Protection**

The desired conditions of cave resources would be defined as the same as existing conditions, and guidelines would be developed to maintain this condition. The existing, stratified system of access to sensitive information based on internal policy and legal mandates would be maintained.

Cave and karst conditions such as cave environment, human impact, geology and hydrology, would be monitored based on research needs, management concerns, and individual interest. Appropriate NPS and non-NPS activities would be defined based on legal mandates, internal policy, and historical use. Gates would be constructed and trails established in caves based on an evaluation of each situation. Cave restoration would be conducted based on management needs and volunteer interest, and in response to specific incidents or impacts.

#### **Data Collection and Management**

Data would be collected and maintained based on management and basic scientific needs.

#### **Research**

The park would facilitate both park-defined and external research based on management need and researcher interest. The park would provide some logistical support such as temporary housing and field assistance. The park would continue to provide letters of support for researchers to obtain grants.

**Recreation**

The park would maintain recreational, permitted access only to those caves that are currently available. No evaluations would be made on the potential to expand or reduce the number of available caves.

**Education and Outreach**

The Cave Resources Office would provide information to other divisions, individuals, and educational groups when asked. The park would conduct informational trainings and provide special programs within and outside of the park.

**Visitor and Employee Health and Safety**

The park would use existing policies, guidelines, and procedures as well as personal statements of skills to evaluate the qualifications of those interested in entering caves. Park personnel would conduct tailgate safety briefings and training classes for NPS staff. The Cave Resources Office would provide cave search and rescue training for both staff and non-NPS agencies and personnel.

The park would maintain rigging in caves and replace ropes and other hardware based on time and use. The park would maintain a gear cache for technical caving and cave rescue equipment.

**ALTERNATIVE A: MODIFIED CAVE MANAGEMENT (Park Preferred Action and Environmentally Preferred Alternative)**

This alternative would modify existing cave management policies based on scientific research and management experience. Access and use policies would be developed based on desired conditions of individual resources. Safety policies would be expanded to include more formal and informal training and safety protocols. Cave monitoring, data collection, and research would be conducted by park personnel, researchers, and volunteers based on scientific and management needs. The scope of education and outreach would be expanded with the goal of making Carlsbad Caverns National Park one of the premier sources of cave and karst education and knowledge.

**Cave and Karst Protection**

The desired conditions of cave resources would be defined based on a combination of factors including sensitivity, hazards, current or projected use, and existing conditions. Science-based guidelines and indicators would be developed to define desired conditions and to determine if desired conditions are being met or maintained. The park would monitor cave and karst conditions (cave environment, impact, geology and hydrology, etc.) based on the development of science-based indicators of change. The park would perform monitoring that addresses needs of resource management, interpretation, law enforcement, and maintenance.

The park would maintain a stratified system of access to sensitive information based on internal policy and legal mandates. Appropriate NPS and non-NPS activities would be defined based on legal mandates, internal policy, desired conditions, resource impairment, safety, and scientific knowledge.

Cave gates and trails would be built as needed, based on specific criteria for action and guidelines to improve trail and gate sustainability. The park would examine potential for reducing trails and gates to minimize maintenance requirements. The park would establish guidelines, evaluation criteria, goals, and priorities for cave and karst restoration based on desired conditions and sustainability.

### **Data Collection and Management**

Data would be collected based on management and basic scientific needs. The purpose and scope of data collection would be developed and timelines established for periodic review of data collection methods and protocols. The park would develop guidelines to ensure long-term preservation of data and knowledge derived from the data.

### **Research**

The park would facilitate research based on management need and researcher interest and gather input from external stakeholders and researchers to identify research needs and priorities. The park would provide some logistical support such as temporary housing and field assistance and would continue to provide letters of support for researchers to obtain grants.

### **Recreation**

Recreational, permitted access to those caves that are currently available would continue. The park would develop evaluation criteria for determining feasibility of expanding recreational opportunities and would evaluate those caves currently open for permitted access to determine if mitigation measures are required to reduce adverse impacts to resources.

### **Education and Outreach**

The Cave Resources Office would provide information to other divisions, individuals, and educational groups when asked. The park would conduct informational trainings and provide special programs within and outside of the park as appropriate.

The park would increase outreach to the community and educational partners to proactively provide information on cave and karst resources. The Cave Resources Office would work with partners and other divisions to help Carlsbad Caverns National Park become one of the premier sources of cave and karst education and knowledge. The park would increase its cave and karst information and education presence on the NPS website.

### **Visitor and Employee Health and Safety**

The Cave Resources Office would maintain standard qualifications for different activities, including recreational caving, staff training trips, cave research, and media work and develop qualifications for trip leaders. The park would develop procedures to determine how to adequately evaluate individual qualifications.

The park would provide cave search and rescue training for both staff and non-NPS agencies and personnel as appropriate. The park would conduct safety briefings and staff training classes.

The Cave Resources Office would maintain guidelines to determine an appropriate maintenance schedule to replace ropes and hardware in caves and maintain gear and equipment based on those guidelines. The park would maintain a gear cache for technical caving and cave rescue equipment and would develop guidelines for gear use.

## **ALTERNATIVE B: EXPANDED CAVE MANAGEMENT**

This alternative would expand the activity level and scope of cave management. Access and use of caves in the park would be expanded with additional gates and trails constructed as needed. The park would provide safety training for all people entering park caves and would conduct background checks of skills and qualifications. The park would seek to expand data collection to as many sets as possible and would work with research partners and volunteers to collect and manage the data. The park would develop a formal cave and karst education program, a learning center, and a research library.

### **Cave and Karst Protection**

The desired conditions of cave resources would be defined as a past condition and projects would be developed aimed at re-establishing those conditions. All caves and karst features would be restored to desired conditions. The park would expand oversight and use of volunteers and NPS staff to restore aesthetics and function of all areas. The park would expand cave and karst monitoring to include all reasonably measurable factors.

The park would expand use of cave and karst areas to include any activity not strictly disallowed by legal mandates. Cave gates would be constructed and trails established in all caves. The park would restrict all access to sensitive information and develop strict guidelines for limited data access on a case-by-case basis.

### **Data Collection and Management**

The park would expand data collection to include as many features and data sets as possible. The Cave Resources Office would work with researchers, partners, and the resource community to develop protocols and train NPS and volunteer staff to collect detailed data.

### **Research**

The park would facilitate both park-defined and external research based on management need and researcher interest. The scope of NPS-conducted research would be expanded and the park would work with external partners to increase research opportunities and support in the park. The park would expand capabilities to support research, including development of a research library, laboratory facilities, and increased living space for visiting researchers.

**Recreation**

The park would expand recreational, permitted access to more park caves and increase maintenance of gates and trails accordingly.

**Education and Outreach**

The Cave Resources Office would provide information to other divisions, individuals, and educational groups when asked. The park would conduct informational trainings and provide special programs within and outside of the park.

The park would increase outreach to the community and educational partners to proactively provide information on cave and karst resources. The Cave Resources Office would work with partners and other divisions to help Carlsbad Caverns National Park become one of the premier sources of cave and karst education and knowledge. The park would increase its cave and karst information and education presence on the NPS website. Additionally, the park would develop a formal cave and karst education program, a learning center, and a research library.

**Visitor and Employee Health and Safety**

The Cave Resources Office would conduct safety and technical caving certification classes and conduct detailed background skill checks of visiting cavers. The park would also provide formal safety training for everyone entering park caves. Cave search and rescue training for both staff and non-NPS agencies and personnel would be conducted regularly.

The park would maintain guidelines to determine an appropriate maintenance schedule for replacing ropes and hardware in caves and would maintain gear and equipment based on those guidelines. The park would maintain a gear cache for technical caving and cave rescue equipment and use already developed guidelines for gear use.

**ENVIRONMENTALLY PREFERRED ALTERNATIVE**

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that “[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA’s Section 101: (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradations, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety, of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life’s amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.”



All of the alternatives fully satisfy criteria one, two, five, and six. The considered alternatives differ in how well they address criteria three, safety and resource degradation, and criteria four, preservation of natural and cultural resources.

The No Action Alternative represents the current management direction for Carlsbad Caverns National Park. The current access, use, and safety policies would remain. Cave monitoring, data collection, and research would be conducted using existing guidelines and currently identified data sets. There would be some cave and karst education and outreach. The No Action Alternative satisfies all of the criteria, but preservation and protection of cultural and natural resources would be less than under Alternative A. Potential resource degradation would be greater under this alternative than Alternative A.

Alternative A would modify existing cave and karst management policies based on scientific research and management experience. Access and use policies would be developed based on desired conditions of individual resources. Visitor and employee safety would be improved (criteria 3) due to expanded safety policies that would include more formal and informal training and safety protocols. Cave monitoring, data collection, and research would be conducted by park personnel, researchers, and volunteers based on scientific and management needs. Improved research, inventory, and monitoring under Alternative A would provide the most protection and preservation of cultural and natural resources of all the considered alternatives.

Alternative B would expand the activity level and scope of cave and karst management. Access and use of caves in the park would be expanded with additional gates and trails constructed. Visitor and employee safety would be improved (criteria 3) due to expanded safety and training for all people entering undeveloped park caves and with background checks of skills and qualifications. The park would seek to expand data collection to as many sets as possible and would work with research partners and volunteers to collect and manage data. Improved research, inventory, and monitoring under Alternative B would provide elevated protection and preservation of cultural and natural resources, but increased traffic to park caves would result in gradual resource degradation.

After careful review of potential resource and visitor impacts, the environmentally preferred alternative is Alternative A, Modified Cave and Karst Management. Alternative A would have less adverse impacts to cave, karst, water, biological, cultural, and paleontological resources of all of the considered alternatives. Alternative B provides some slight additional improvements to visitor and employee safety over Alternative A. However, increased traffic to park caves under Alternative B would result in minor to moderate adverse impacts to resources. Poor or incomplete documentation of resources under the No Action Alternative would result in minor to moderate adverse impacts to resources.

## **ALTERNATIVES CONSIDERED BUT REJECTED**

**Minimized Cave Management.** This alternative would have eliminated access to all caves and areas not currently open for paid, public tours. There would be only limited safety information provided to the public through signs and visitor orientation talks. There would be no research or data collection in park caves and only minimal cave and karst information provided to the public. This alternative was rejected because it did not meet any of the stated goals of the plan.

**Open Access, Zero Management.** This alternative would have opened access to all caves and areas in the park, limited only by legal and administrative mandates. There would be only limited safety information provided to the public through signs and visitor orientation talks, but no information provided to backcountry cave users. Cave and karst research and monitoring would be conducted by researchers with little oversight from the park. No support for education and outreach would be provided. This alternative was rejected because it would have major adverse impacts and possible impairment to cave and karst resources and would not meet the stated plan objectives.

**Reduced Cave Management.** This alternative would reduce the level of active cave management. The current access, use, and safety policies would remain. Cave monitoring, data collection, and research would be conducted by volunteers and researchers based on their needs and with no oversight or direction by the park. Some information on cave and karst would be provided but there would be no formal education and outreach activities. Impact analysis of this alternative indicated that there would be major impacts and possible impairment to park resources, so would not meet the stated plan objectives.

Table 1. Comparative Summary of Alternatives and Extent to Which Each Alternative Meets the Project Objectives		
No Action Alternative	Alternative A - Modified Cave Management (Park and Environmentally Preferred Alternative)	Alternative B - Expanded Cave Management
There would be no changes to the current management of caves and karst.	Caves and karst would be managed similarly to current practices, but would be based on scientifically based desired resource conditions.	Caves and karst would be managed similarly to current practices, but would be based on scientifically based desired resource conditions.
Data collection, monitoring, and research would continue as needed based on researcher or management need.	Similar to No Action Alternative, but guidelines and protocols would be developed to ensure consistent long-term data collection and management.	Data collection, monitoring, and research would be expanded to include as many parameters as possible based on researcher or management need. Guidelines and protocols would be developed to ensure consistent long-term data collection and management.
Caves currently accessible for recreation would remain open.	Similar to No Action Alternative, but the park would develop evaluation criteria to determine potential to change recreational access to caves.	The park would expand the number of caves available for recreation and increase the maintenance of gates and trails accordingly.
The Cave Resources Office would continue to provide information, talks, and training sessions in support of outreach and education.	Similar to the No Action Alternative, but the park will work with partners to become a premier site for cave and karst knowledge.	Similar to Alternative B, but the park would develop a formal cave and karst education program, a learning center, and a research library.
The park would conduct safety talks and training as well as maintain technical equipment to ensure safety of visitors to park caves.	The park would conduct safety talks and training as well as maintain technical equipment to ensure safety of visitors to park caves.	The park would conduct safety talks and training as well as maintain technical equipment to ensure safety of visitors to park caves.
<b>Meets project objectives:</b> Partially, but there are no guidelines to ensure consistent, high-quality monitoring and research is conducted. Does not fully satisfy the goal of providing education and outreach.	<b>Meets project objectives:</b> Yes, cave resources would be protected while still allowing recreational and research activities to continue. High-quality monitoring and research would be ensured. Education and outreach and visitor safety goals would be met.	<b>Meets project objectives:</b> Partially, but increased visitation would lead to increased resource damage. High-quality monitoring and research would be ensured. Education and outreach and visitor safety goals would be met.

Table 2. Summary Comparison of Impacts

Impact Topic	No Action Alternative	Alternative A - Modified Cave Management (Park and Environmentally Preferred Alternative)	Alternative B - Expanded Cave Management
Cave Resources	Minor to moderate adverse impacts due to lost or poor documentation.	Minor adverse impacts but park-wide to national, moderate to major beneficial impacts due to improved knowledge and understanding.	Minor to moderate adverse impacts due to increased cave traffic. Moderate to major beneficial impacts due to improved knowledge and understanding.
Water Resources	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Minor to moderate adverse impacts due to increased cave traffic. Moderate to major beneficial impacts due to improved knowledge and understanding.
Threatened & Endangered Species, or Species of Park Interest	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Minor to major adverse impacts due to increased visitation.
Cultural & Paleontological Resources	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Negligible adverse impacts. Moderate to major beneficial impacts due to improved knowledge and understanding.	Minor to moderate adverse impacts due to increased visitation. Moderate to major beneficial impacts due to improved knowledge and understanding.
Visitor Use & Experience	Minor to major beneficial impacts due to protection and restoration of resources.	Minor to major beneficial impacts due to protection and restoration of resources.	Minor to moderate beneficial impacts due to restoration and expanded recreational opportunities. Minor to major adverse impacts due to degradation caused by increased traffic.

## ENVIRONMENTAL CONSEQUENCES

Impacts, both adverse and beneficial, were evaluated in terms of context (site-specific, local, or even regional), duration (short-term, lasting less than one year, or long-term, lasting more than one year), and intensity (negligible, minor, moderate, or major). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this environmental assessment.

In addition to determining the environmental consequences of the preferred and other alternatives, the NPS's *Management Policies 2001* (NPS, 2000) requires analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system is to conserve park resources and values. National Park Service managers must always seek ways to avoid or minimize adverse impacts on park resources and values. However, the NPS has the discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

To analyze potential impacts in this EA, the thresholds of change for the intensity of an impact are defined as follows:

**Negligible**-the impact is at the lowest levels of detection

**Minor**-the impact is slight, but detectable

**Moderate**-the impact is readily apparent

**Major**-the impact is a severe or adverse impact or of exceptional benefit

**Impairment**- a major, adverse impact to a key resource or value

The park was required to assess cumulative impacts in the decision-making process. Cumulative impacts are the environmental impacts that result from the alternative when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.

## CAVE RESOURCES

The thresholds used to evaluate impacts to cave resources are as follows:

*Negligible:* An action that could result in a change to cave resources, but the change would be so small that it would not be of any measurable or perceptible consequence.

*Minor:* An action that could result in a change to cave resources, but the change would be small and localized and of little consequence.

*Moderate:* An action that would result in a change to cave resources; the change would be measurable and of consequence.

*Major:* An action that would result in a noticeable change to cave resources; the change would be measurable and result in a severely adverse or major beneficial impact.

**No Action Alternative.** No new caves would be opened for recreational use. Inventory and monitoring of cave resources would continue without guidelines for long-term consistency or preservation of the information. The park would depend on existing park files and future resource managers to continue data collection. Documented resources would be considered when evaluating future activities that could adversely impact caves. The park would oversee cave research and ensure that it would not have more than negligible adverse impacts on cave resources. There could be minor to moderate adverse impacts to resources that were not documented well or where documentation has been lost.

**Alternative A.** No new caves would be immediately opened for recreational use. Criteria would be developed to ensure that there would not be more than minor adverse impacts to cave resources if recreational use was expanded.

Inventory and monitoring of cave resources would continue with guidelines for long-term consistency and preservation of the information. Documented resources would be considered when evaluating future activities that could adversely impact caves. The park would oversee cave research and ensure that it would not have more than negligible adverse impacts on cave resources. There could be minor adverse impacts to resources that were not documented well or where documentation has been lost. Quality inventory, monitoring, and research on cave resources would result in park-wide to national, long-term, moderate beneficial impacts on cave resources due to improved knowledge and understanding.

**Alternative B.** More caves would be opened for recreational use. Expanded inventory and monitoring data and access to researchers would result in more use of park caves. Increased traffic to park caves would result in a site-specific, long-term, minor to moderate adverse impacts to cave resources. Expanded inventory and monitoring and

research on cave resources would result in park-wide to national, long-term, moderate beneficial impacts on cave resources due to improved knowledge and understanding.

Cumulative Impacts: Reasonably foreseeable future actions such as rehabilitation of the electric lines and lighting system in Carlsbad Cavern, removal of old structures and rubble from developed areas in Carlsbad Cavern, and rehabilitation of the development (sewage lines, parking lots) above Carlsbad Cavern would have beneficial impacts to cave resources. Contamination of the cave from leaking sewage lines and parking lot runoff would be reduced or eliminated. Habitat altered or buried by trail and other infrastructure would be restored. Proposals included under Alternative A would contribute to the long-term cumulative beneficial impacts to resources.

Conclusion: There could be site-specific, long-term minor to moderate adverse impacts to cave resources under the No Action Alternative due to lost or poor documentation.

There could be site-specific, long-term, minor adverse impacts to cave resources under Alternative A due to incomplete documentation. Under this alternative there would be park-wide to national, long-term, moderate beneficial impacts on cave resources due to improved knowledge and understanding.

Under Alternative B, there would be site-specific, long-term, minor to moderate adverse impacts to cave resources due to increased traffic to more park caves. Under this alternative there would be park-wide to national, long-term, moderate beneficial impacts on cave resources due to improved knowledge and understanding.

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

## WATER RESOURCES

The thresholds used to evaluate impacts to cave resources are as follows:

*Negligible:* Neither water quality nor hydrology would be affected, or changes would be either non-detectable or if detected, would have effects that would be considered slight, local, and short-term.

*Minor:* Changes in water quality or hydrology would be measurable, although the changes would be small, would likely be short-term, and the effects would be localized. No mitigation measure associated with water quality or hydrology would be necessary.

*Moderate:* Changes in water quality or hydrology would be measurable and long-term but would be relatively local. Mitigation measures associated with water quality or hydrology would be necessary and the measures would likely succeed.

*Major:* Changes in water quality or hydrology would be readily measurable, would have substantial consequences, and would be noticed on a regional scale. Mitigation measures would be necessary and their success would not be guaranteed.

**No Action Alternative.** Water resources, including pool location, water chemistry, water levels, and areas of high infiltration would continue to be inventoried and monitored. There would be site-specific human impact on cave pools from trash, coins, and other materials left by visitors in Carlsbad Cavern. There would be site-specific impact to pools in undeveloped caves due to lint, hair, and skin cells dropped by volunteers and researchers, from water sampling for research, and in those pools used as a water supply for underground camps in Lechuguilla Cave. These impacts would be short-term and negligible.

The park would continue to allow researchers to conduct studies on water resources and provide oversight. There would be no guidelines for long-term consistency or preservation of the information. The park would depend on existing park files and future resource managers to continue data collection. Documented resources would be considered when evaluating future activities that could adversely impact water resources.

**Alternative A.** Water resources, including pool location, water chemistry, water levels, and areas of high infiltration would continue to be inventoried and monitored. The park would continue to allow researchers to conduct studies on water resources and provide oversight. The park would develop guidelines for long-term consistency and preservation of the information. The park would depend on high-quality data and documentation to evaluate future activities that could adversely impact water resources.

There would be site-specific human impact on cave pools from trash, coins, and other materials left by visitors in Carlsbad Cavern. There would be site-specific impact to pools



in undeveloped caves due to lint, hair, and skin cells dropped by volunteers and researchers, from water sampling for research, and in those pools used as a water supply for underground camps in Lechuguilla Cave. These impacts would be short-term and negligible.

**Alternative B.** Water resources, including pool location, water chemistry, water levels, and areas of high infiltration would continue to be inventoried and monitored. Research on water resources would be expanded and the park would provide oversight. The park would develop guidelines for long-term consistency and preservation of the information. The park would depend on high-quality data and documentation to evaluate future activities that could adversely impact water resources.

There would be site-specific human impact on cave pools from trash, coins, and other materials left by visitors in Carlsbad Cavern. There would be site-specific impact to pools in undeveloped caves due to lint, hair, and skin cells dropped by volunteers and researchers, from water sampling for research, and in those pools used as a water supply for underground camps in Lechuguilla Cave. Increased studies of water resources could lead to contamination and over-sampling could result in water chemistry changes and site-specific minor to moderate adverse impacts to water resources.

Cumulative Impacts: Reasonably foreseeable future actions such as repair of sewage lines, removal of underground storage tanks, and removal and rehabilitation of parking lots above Carlsbad Cavern have the potential to beneficially impact water resources in that area. There are no other reasonably foreseeable future actions that would adversely affect water resources in park caves.

Conclusion: There would be site-specific, short-term, negligible impacts to water resources under the No Action Alternative and Alternative A. There would be site-specific, minor to moderate adverse impacts on water resources under Alternative B. There would be local, long-term, moderate beneficial impacts to water resources under the No Action Alternative and Alternatives A and B, due to increased knowledge and understanding of water resources.

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

## **RARE, THREATENED, OR ENDANGERED SPECIES AND SPECIES OF INTEREST**

The thresholds used to assess impacts to listed species as follows:

*Negligible:* An action that would not affect any individuals of a sensitive species or their habitat within the park.

*Minor:* An action that would affect a few individuals of sensitive species or have very localized impacts upon their habitat within the park. The change would require considerable scientific effort to measure and have barely perceptible consequences to the species or habitat function.

*Moderate:* An individual or population of a listed species, or its critical habitat would be noticeably affected. The effect could have some long-term consequence to the individual, population, or habitat. Moderate effect would equate with a “may effect” determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of “likely...” or “not likely to adversely affect” the species.

*Major:* An action that would have drastic and permanent consequences for a sensitive species population, dynamics between multiple species, or almost all available critical or unique habitat area within the park. A sensitive species population or its habitat would be permanently altered from normal levels under existing conditions, and the species would be at risk of extirpation from the park.

**No Action Alternative.** Federally threatened Mexican spotted owls are known to nest in cave entrances in the Guadalupe Mountains and at least roost in park caves. Inventory and documentation of caves would identify habitat and prevent adverse impacts to owls from park and non-park activities. Inventory and monitoring could cause short-term, negligible adverse impacts to spotted owls. Once identified, roosting sites would not be accessed between March and August to prevent adverse impacts.

Two federally listed cacti are present along trails leading to permitted park caves and some rare plants inhabit cliff faces near some cave entrances. Documentation of these species would help reduce adverse impacts from future activities in areas where they occur by identifying protection areas and restricting activities in those areas. There are no other rare, threatened, or endangered species found in or near park caves.

The park has many non-threatened, non-endangered species of interest including colonies of cave swallows, bats, and cave invertebrates. Limited documentation and monitoring of these species would help reduce some adverse impacts caused by future activities within the park by identifying protection areas and restricting activities in those areas. The lack of guidelines for long-term consistency or preservation of information could result in some adverse impacts to animals or habitat.

Some park caves are known to contain cave-adapted microbes. Continued identification of sites and microbial research would help to develop management practices to mitigate

adverse impacts to microbes. The lack of guidelines for long-term consistency or preservation of information could result in some adverse impacts to animals or habitat.

**Alternative A.** Federally threatened Mexican spotted owls are known to roost and nest in cave entrances in the Guadalupe Mountains on U.S. Forest Service land and may roost and/or nest in cave entrances in the park. Under the preferred alternative, the park would identify potential nest or roost sites during the course of cave inventory and documentation efforts. If roost or nest sites are identified, the park would restrict access to these areas between March and August in order to protect the Mexican spotted owls.

The federally endangered Sneed pincushion cactus and the federally threatened Lee pincushion cactus are present along trails leading to permitted park caves. Access to the permitted caves is restricted to existing trails in order to protect the listed cacti. Previously undocumented locations of the listed cacti species would be recorded during the course of cave inventory and documentation efforts. Documentation of these species would enable the park to restrict future activities in areas where they occur. There are no other rare, threatened, or endangered species found in or near park caves.

The park has many non-threatened, non-endangered species of interest including colonies of cave swallows, bats, and cave invertebrates. Documentation and monitoring of these species would help reduce some adverse impacts caused by future activities within the park. Science-based guidelines for long-term consistency and preservation of information would result in best management practices to protect animals and habitat.

Some park caves are known to contain cave-adapted microbes. Continued identification of sites and microbial research would help to develop management practices to mitigate adverse impacts to microbes. Science-based guidelines for long-term consistency and preservation of information would result in better protection of animals and habitat.

**Alternative B.** Federally-threatened Mexican spotted owls are known to nest in cave entrances in the Guadalupe Mountains. Ongoing inventory and documentation of caves would help to identify nesting sites to mitigate adverse impacts to sites. Increased visitation to park caves would potentially adversely impact owls and owl habitat. There are no other rare, threatened, or endangered species found in park caves.

Two federally listed cacti are present along trails leading to permitted park caves and some rare plants inhabit cliff faces near some cave entrances. Increased visitation to park caves and poor documentation of their occurrence could adversely impact these species. Documentation of these species would help reduce adverse impacts from future activities in areas where they occur.

The park has many non-threatened, non-endangered species of interest including colonies of cave swallows, bats, and cave invertebrates. Documentation and monitoring of these species would help reduce some adverse impacts caused by future activities within the park. Science-based guidelines for long-term consistency and preservation of information would result in best management practices to protect animals and habitat.

Some park caves are known to contain cave-adapted microbes. Continued identification of sites and microbial research would help to develop management practices to mitigate adverse impacts to microbes. Science-based guidelines for long-term consistency and preservation of information would result in better protection of animals and habitat. Increased visitation has the potential to adversely impact animals and habitat, even with mitigation measures in place.

Cumulative Impacts: There are no reasonably foreseeable future actions that would have the potential to adversely affect rare, threatened, or endangered species in caves or other species of interest. None of the alternatives would contribute to the cumulative impacts on rare, threatened, or endangered species in caves or other species of interest.

Conclusion: There would be site-specific, short to long-term, minor to moderate adverse impacts to threatened species or species of interest under Alternative B. There would be site-specific, short-term, negligible adverse impacts to threatened species or species of interest under the No Action Alternative and Alternative A.

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

## CULTURAL AND PALEONTOLOGICAL RESOURCES

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Cultural resources have the potential to answer, in whole or in part, such research questions. In order for a cultural resource to be eligible for the National Register of Historic Places it must meet one or more of the following criteria of significance: 1) associated with events that have made a significant contribution to the broad patterns of our history; 2) associated with the lives of persons significant in our past; 3) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; 4) have yielded, or may be likely to yield, information important in prehistory or history. In addition, the cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association. For purposes of analyzing impacts to cultural resources either listed in or eligible to be listed in the National Register, the thresholds of change for intensity of an impact are defined below:

*Negligible:* The impact on cultural and paleontological sites or individual resources is at the lowest levels of detection, barely perceptible and not measurable.

*Minor:* The impact on cultural and paleontological sites or individual resources is measurable or perceptible, but it is slight and localized within a relatively small area of a site or group of sites. The impact does not affect the character defining features of a National Register of Historic Places eligible or listed cultural site and would not have a permanent effect on the integrity of any cultural or paleontological site.

*Moderate:* The impact is measurable and perceptible. The impact changes one or more character defining feature(s) of an cultural or paleontological resource but does not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized.

*Major:* The impact on cultural and paleontological sites is substantial, noticeable, and permanent. The impact is severe or of exceptional benefit. For National Register eligible or listed cultural sites, the impact changes one or more character defining feature(s) of a resource, diminishing the integrity of the resource to the extent that it is no longer eligible for listing in the National Register.

**No Action Alternative.** Cultural and paleontological resources would continue to be documented as they are found, but no guidelines would be developed for long-term preservation of the information. The park would depend on existing park files and on future resource managers to continue data collection. Documented resources would be considered when evaluating future activities that could adversely impact the resources. There could be minor to moderate adverse impacts to resources that were not documented well or where documentation has been lost.

**Alternative A.** Cultural and paleontological resources would be documented as they are found, and guidelines would be developed for consistency and long-term preservation of data. Cultural resources would be managed according to “The Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation” (DOI, 1983), NPS “Cultural Resource Management Guidelines” (NPS-DO28, 1997), and “DO28a: Archaeology” (NPS, 2004). Documented resources would be considered when evaluating future activities that could adversely impact the resources. There could be minor impacts to resources that were not previously discovered or documented well due to activities in those areas.

**Alternative B.** An effort would be made to fully document all cave cultural and paleontological resources, and guidelines would be developed for data consistency and long-term preservation of the information. This alternative would provide the most thorough documentation of cultural and paleontological materials. Cultural resources will be managed according to “The Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation” (DOI, 1983), NPS “Cultural Resource Management Guidelines” (NPS-DO28, 1997), and “DO28a: Archaeology” (NPS, 2004). Documented resources would be considered when evaluating future activities that could adversely impact sites. Increased traffic to caves would result in minor to moderate adverse impacts to resources that were not previously discovered or documented well.

Cumulative Impacts: There are no other reasonably foreseeable future actions that would have the potential to adversely affect cultural or paleontological resources in caves. Therefore, as all alternatives consider potential impacts, none would contribute to the cumulative impacts on cultural or paleontological resources.

Conclusion: There could be site-specific, long-term, minor adverse impacts to cultural and paleontological resources under Alternative A. There could be minor to moderate adverse impacts to resources under Alternative B and the No Action Alternative, due to increased visitation and poor documentation respectively. Under Alternatives A and B, there would be park-wide to regional, long-term, minor to moderate beneficial impacts to knowledge about cultural and paleontological resources due to careful documentation.

Because there are no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park’s general management plan or other relevant NPS planning documents, no considered alternatives would result in impairment to park resources or values.

#### National Historic Preservation Act of 1966 (as amended): Section 106 Summary

After applying the Advisory Council on Historic Preservation’s criteria of adverse effects (36 CFR §800.5, Assessment of Adverse Effects), the National Park Service concludes that implementation of the preferred alternative would have no adverse effect on the cultural resources of Carlsbad Caverns National Park. The implementation of the preferred alternative would have no adverse effect on paleontological resources.

## VISITOR USE AND EXPERIENCE

Thresholds for assessing impacts to visitor use and experience are as follows:

*Negligible:* Visitors would not be affected or changes in visitor use and/or experience would be below or at the level of detection. Any effects would be short-term. The visitor would not likely be aware of the effects associated with the alternative.

*Minor:* Changes in visitor use and/or experience would be detectable, although the changes would be slight and likely short-term. The visitor would be aware of the effects associated with the alternative, but the effects would be slight.

*Moderate:* Changes in visitor use and/or experience would be readily apparent and likely long-term. The visitor would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.

*Major:* Changes in visitor use and/or experience would be readily apparent and have important long-term consequences. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

**No Action Alternative.** There would be no decrease in the number of caves available for recreational use. The park would continue to offer a wide range of cave experiences for visitors.

Park caves would be managed to minimize deterioration from visitation and other adverse impacts to help ensure visitors of a high-quality cave experience. The park would continue to encourage and oversee restoration projects to improve the look and function of cave areas open to visitors.

**Alternative A.** There would be no immediate change in the number of caves available for recreational use. Criteria would be developed to ensure that there would not be more than minor adverse impacts to cave resources if recreational use was expanded. The park would continue to offer a wide range of cave experiences for visitors.

Park caves would be managed to minimize deterioration from visitation and other adverse impacts to help ensure visitors of a high-quality cave experience. The park would continue to encourage and oversee restoration projects to improve the look and function of cave areas open to visitors, and would prioritize projects to maximize the effectiveness of restoration work.

**Alternative B.** There would be an increase in the number of caves available for recreational use. Higher visitation would increase the rate of resource degradation in those caves and would reduce the quality of visitor experiences. The park would continue to offer a wide range of cave experiences for visitors.

Park caves would be managed to minimize deterioration from visitation and other adverse impacts to help ensure visitors of a quality cave experience. The park would expand the scope of monitoring and research to document adverse changes to resources due to increased visitation. The park would continue to encourage and oversee restoration projects to improve the look and function of cave areas open to visitors, and would prioritize projects to maximize the effectiveness of restoration work.

Cumulative Impacts: Reasonably foreseeable future actions such as rehabilitation of the visitor center and replacement of the cave lighting system, have the potential to beneficially impact the visitor experience at Carlsbad Cavern. Impact monitoring and active management and restoration of cave resources in Carlsbad Cavern would contribute to the cumulative beneficial impacts on visitor experience.

Conclusion: The No Action Alternative and Alternative A would have site-specific, long-term, minor to moderate, beneficial impacts on visitor experience at Carlsbad Caverns National Park.

Alternative B would have some site-specific, long-term, minor to moderate, beneficial impacts on visitor experience at the park due to restoration and expanded recreational opportunities. This alternative would also have site-specific, long-term, minor to moderate, adverse impacts on visitor experience at the park due to some degradation of cave resources caused by increased visitation.



## **CONSULTATION/COORDINATION**

Internal scoping by NPS staff was completed in the park in April 2004 to develop goals and objectives for the resource protection plan. The NPS conducted public scoping meetings to identify other potential topics and concerns as well as goals for the plan. Public scoping was conducted at the National Speleological Society meeting in July 2004 and in the city of Carlsbad, New Mexico on February 1, 2005. The goals developed during these meetings were: 1) Protect, restore, and perpetuate natural cave and karst systems and processes; 2) collect and maintain data sets on caves, karst and associated resources to high standards; 3) encourage, facilitate, and conduct high-quality scientific study of cave and karst systems; 4) provide a wide range of recreational opportunities for visitors to discover, appreciate, respect, and enjoy the park's cave and karst resources; 5) support cave and karst system education and outreach; 6) promote safety of visitors and employees in and around caves and karst; and 7) Prevent major impact or impairment to park resources. Preliminary alternatives were developed using these objectives, and were made available for external and internal review, to gather public comments from April – December 2005.

A meeting was held February 15, 2006, to perform a Choosing By Advantages (CBA) analysis of the alternatives and select a park-preferred alternative. In the CBA analysis, factors such as resource protection, visitor experience, and visitor and staff safety were used to evaluate each of the alternatives.

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### **Other Agencies**

New Mexico State Historic Preservation Office  
US Fish and Wildlife Service  
Bureau of Land Management, Carlsbad Field Office  
Southern Pueblos Agency  
Lincoln National Forest  
Eddy County Commission  
New Mexico Department of Game and Fish  
New Mexico Department of Tourism

Cultural Preservation Office, Pueblo of Isleta  
Cultural Preservation Office, Pueblo of Zia  
Cultural Preservation Office, Zuni Tribe of the Zuni  
Cultural Preservation Office, Jicarilla Apache National Park Service APACHE  
Cultural Preservation Office, Mescalero Apache Tribe  
Cultural Preservation Office, Ysleta Del Sur Pueblo  
Cultural Preservation Office , Hopi Tribe of Arizona  
Cultural Preservation Office, San Carlos Apache Tribe  
Cultural Preservation Office, White Mountain Apache Tribe  
Cultural Preservation Office, Apache Tribe of Oklahoma  
Cultural Preservation Office, Comanche National Park  
Cultural Preservation Office, Fort Sill Apache Tribe of Oklahoma  
Cultural Preservation Office, Kiowa Indian Tribe of Oklahoma  
Pawnee Nation of Oklahoma  
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State Engineer Office, Basin Supervisor

### **Organizations**

Bat Conservation International  
Carlsbad Environmental Monitoring Center  
The Wilderness Society  
National Speleological Society  
Cave Research Foundation  
Sierra Club  
American Cave Conservation Association  
Defenders of Wildlife  
National Parks Conservation Association  
The Nature Conservancy  
Public Lands Natural Resources Defense Council  
New Mexico Audubon Society  
Lechuguilla Exploration and Research Network  
New Mexico Wilderness Alliance  
National Park Foundation

### **Individuals/Stakeholders**

Hon. Jeff Bingaman  
Frank Hodnett, Cavern Supply Company  
Senator Vernon Asbill  
Hon. Pete Domenici  
Hon. Heather Wilson  
Hon. Tom Udall  
Rep. John Heaton  
Rep. Joe Stell  
Sen. Carroll Leavell  
Bill Richardson, New Mexico Governor  
White City

Apache Trading Post

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## APPENDICES

### Introduction

The following appendices represent the detailed implementation of the park's Environmentally Preferred Alternative. The appendices contain detailed plans and guidelines for documenting and managing the cave and karst resources and the features found within them.

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## **APPENDIX A – ENTERING CARLSBAD CAVERN OFF-TRAIL AREAS AND OTHER PARK CAVES**

### **Purpose**

The reason behind developing guidelines for entering Carlsbad Cavern off-trail (unpaved) areas and other park caves (except for Lechuguilla Cave; see Appendix B) is to allow limited access for scientific research, exploration when in association with survey and inventory, and NPS management-related trips while minimizing impact to park caves. Of primary importance are (1) the safety of all who enter and (2) minimizing impacts to park caves while (3) performing high quality research, survey and management tasks. Persons who are unsafe, do not use minimum-impact caving techniques, and do not adhere to these guidelines will not be allowed to enter park caves in the future.

### **Obtaining a Cave Permit**

All entry into park caves except public tours led by the Interpretation and Education Division require a cave permit. Permits applications may be obtained by contacting the park Cave Resource Office.

Cave Resource Office  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, NM 88220

Guidelines for entry into specific caves or areas of caves can be found in:

Appendix A - Entering Carlsbad Cavern Off-trail Areas and Other Park Caves  
Appendix B - Entering Lechuguilla Cave  
Appendix F - Recreational Permit Caving  
Appendix G - Ranger-Guided Trips for the Public to Unimproved Areas

Exceptions to any of the guidelines for entry into park caves must be made in advance and will be recorded on the signed cave permit.

### **Requirements for Entering Park Caves**

Everyone **must** sign a permit.

Expedition leaders are ultimately responsible for the personnel on their expedition. Expedition leaders should do their best to recruit cavers that are willing to follow these guidelines. Expedition leaders should select cavers that have the skills and physical fitness necessary to safely complete the trip and accomplish the desired tasks.

Every team entering a cave will have one designated team leader. Team leaders are responsible for the safety of their team and for the actions of their team members. If a team member is acting in an unsafe or careless manner and causing damage to the cave,

then it is the team leader's responsibility to correct that person's actions. If problems persist, then the team leader must abort the trip and have the team leave the cave. A team leader should gear team activities to the least experienced member of the team. This pertains to speed of travel as well as climbing abilities. A team should also stay together unless an emergency requires different actions.

Everyone entering park caves is responsible for their actions while in the cave. They are also responsible for reporting to the team leader acts by other team members that are unsafe, unnecessarily impact the cave or do not comply with these guidelines. It is everyone's responsibility to assure that Carlsbad Cavern and other park caves remain as pristine as possible and that each team member acts in a safe manner while in these caves.

Clothing, boots, and caving gear must be clean before entering park caves to minimize the introduction of foreign biological materials into these delicate ecosystems. Clean equipment will also prevent tracking and staining of clean cave surfaces.

**BOOTS MUST HAVE NON-MARKING SOLES.** If you are in doubt, scrape boot over white floor or limestone rocks outside the cave. Marking boots will definitely leave marks. Boots may have either white or black soles as long as they do not leave marks.

Carbide lights are not allowed in any park caves.

All working trips entering Carlsbad Cavern or other park caves must make the expedition leader or the Cave Resource Office aware of their "out time." Any team three hours overdue or later will have search crews initiated. The "out time" is the time you are physically back in the research huts.

### **Working in Park Caves**

All teams will typically have from three to six members. Survey teams will have no more than four members. Exceptions to these team numbers can only be made by the Cave Specialist.

All solid and liquid human wastes must be carried out of park caves. Used waste containers or bags may not be left along the trail to be picked up on the way out.

No use of tobacco or other products and no consumption of alcohol in park caves.

When traveling through park caves, stay on established trails. If trails are hard to see, either re-flag them immediately or notify the Cave Resource Office so the problem can be addressed. Flagging use in park caves is as follows: Orange, for marking the trails; White with Red Stripes, denotes sensitive areas such as gypsum crust, aragonite etc.; Blue, is utilized for survey stations; and White with Blue Stripes, indicates a lead. When flagging the trail, use plenty of flagging tape and flag both sides (see Appendix M - Cave Conservation and Restoration Activities). This helps keep the trail as narrow as possible.



Of primary importance is the preservation of all cave resources. In the past, “conservation,” and “resource” were not words associated with caves, consequently, Carlsbad Cavern has many trails through the same area. The park strives to minimize the number of trails through park caves and keep them as narrow as possible. Stay on these established trails. During original exploration, pick a trail path that will cause the least damage and mark it immediately and carefully.

Intentional damage to make travel easier will be treated as a serious violation and will be prosecuted. Persons displaying this attitude will be denied access to park caves. Continued occurrences may cause areas to be made off limits to everyone.

No cave material (minerals, speleothems, bones, etc.) may be removed from park caves without a valid scientific collecting permit, signed by the park superintendent. Collecting for someone else who has a valid collecting permit requires permission from the Cave Specialist.

Aqua Socks or other clean, non-marking shoes must be worn when crossing flowstone areas. Wearing boots or walking barefoot across these areas is not allowed. Before entering a flowstone area, remove or clean all dirty clothing, packs, helmets and other equipment. Take care when transitioning from dirty boots, clothing and gear to aqua socks to avoid contaminating the transition area with dirt. Frequently check to ensure that your aqua sock soles are clean and not tracking dirt.

There will be no wading or swimming in pools for any reason, including to reach cave passages or leads without the consent of the Cave Specialist. Any pools in newly discovered areas must remain pristine and untouched.

Any project within sight of a visitor trail in Carlsbad Cavern must have someone stationed on or near the trail to explain the activity. Expedition leaders should discuss activities that may take place within sight of the trail with team leaders and members before the activity happens.

Any activity within site of the visitor trails in Carlsbad Cavern must conform to the general park rules such as restrictions from eating, chewing gum, drinks other than water, using ungloved hands to touch rocks, etc.

### **Rigging and Climbing**

Everyone entering park caves is responsible for the inspection, care and protection of all ropes and rigging. Wear spots or other problems should be brought to the attention of the trip leader, who should fix the problem immediately, if necessary, or notify the Cave Resource Office of the concern. Ropes should not be re-rigged without permission from the Cave Resource Office unless an immediate threat is perceived. Please notify the Cave Resource Office of any changes or potential problems noticed. If possible, leave a note for other expedition members explaining the change in rigging and why it was necessary.

Permanently rigged rope and webbing should be white. Colored ropes and webbing can stain cave surfaces.

Aluminum carabiners should never be used for permanent rigging due to loss of strength from corrosion. Only stainless steel maillons should be used for permanent rigging.

Any bolt or bolt hanger that is to be left in place must be made from stainless steel. Permanent bolts should be at least 3/8" in diameter.

There are numerous climbs in park caves. Many have been done and some have not. Those wishing to do climbs should clear suggested climbs with the Cave Specialist before attempting any climb.

Expansion bolts should be used sparingly.

If possible, any bolt that will not be used after an initial climb should be removed.

All climbs must be surveyed.

If a climb has been completed and does not continue, a note on flagging tape should be left stating that the climb has been completed. The decision to remove ropes from a climb or not should be based on safety, future research and survey work necessary and ease of repeating the route.

If a climb has been completed and continues, a rope log must be filled out detailing rope length, age, condition, along with rigging information (see detailed rope log sheet in Appendix O - Standard Operating Procedures, Protocols, and other Supporting Document). Rigging changes or problems should be reported to the Cave Resource Office.

Ice crampons and other technological implements must be approved by the Cave Specialist before attempting their use in park caves.

## Resource Protection Zones

The following areas of Carlsbad Cavern, due to their sensitive, fragile nature or on-going scientific research, are off limits to all except with permission of the Cave Specialist. The areas of ongoing scientific research will be well flagged and you are cautioned not to go beyond a certain point. Do not visit or disturb these areas. Those entering these areas without permission will be denied future access to all off-trail areas of Carlsbad Cavern and other park caves. There may be other areas of special consideration or off limits. If you have any doubts, ask the Cave Specialist before entering.

- Aragonite Room
- Bell Cord Room
- Bifrost Room
- Cave Pearl Room
- Bat Cave: *All personnel entering Bat Cave must have been fit tested and wear an appropriate respirator. When bats are in residence, personnel must have current rabies pre-exposure vaccinations.*
- Quintessential Right
- Chocolate High
- Christmas Tree Room
- Spirit World
- Vegetable Garden
- Southern Splendor

## Unexplored Areas and Surveying

Exploration without surveying is strictly prohibited. Violators will be denied future access to park caves. Survey guidelines can be found in Appendix E and must be adhered to when surveying.

No digging, hammering, or breaking of formations, rocks, etc., may be performed without permission.

Discovery teams may name new areas, but names deemed inappropriate, distasteful, or named after living people will not be accepted by the park.

When moving into unexplored areas, trails should be established that minimize the damage to park caves. Persons setting stations at the front of the team should carefully evaluate the passage and choose the path that will do the least damage to the cave. Trails should be flagged immediately, so that those who will follow will have to stay on the established trail.

In extremely sensitive areas, such as aragonite bushes blocking the path, or other noteworthy speleothems deterring progress, stop and do not proceed. Notify the Cave Resource Office who will make the decision on how to proceed.

### **After Leaving Park Caves**

Any accident of a serious nature should be reported to NPS personnel as soon as possible. An incident report form, available in the Cave Resource Office, and other accident documentation must be filled out for any cave accident.

Any team entering park caves is required to fill out a trip report form and return it to the Cave Resource Office within one month. The report should include the date, personnel, places visited, and work accomplished including specifics such as types of information or samples collected. If survey was the objective, list the station numbers that were set.

## **APPENDIX B: ENTERING LECHUGUILLA CAVE**

### **Purpose**

The reason behind developing guidelines for entering Lechuguilla Cave is to allow limited access for scientific research, exploration when in association with survey and inventory, and NPS management-related trips while minimizing impact to the cave. Of primary importance are (1) the safety of all who enter and (2) minimizing impacts to the cave while (3) performing high quality research, survey and management tasks.

There have been many problems with careless and even purposeful actions leading to damage in Lechuguilla Cave. Cave pearls have been taken from the cave. Solid wastes have been left in the cave. Batteries have been intentionally buried in a cave camp. Corrosion residues have been thoughtlessly tracked across pristine flowstone. Individuals have not complied with the liquid waste disposal requirements. These problems and many others have led to the creation of these guidelines. Carelessness and purposeful actions that negatively impact Lechuguilla Cave will not be tolerated. Individuals or groups that do not cave in a safe manner, minimize impacts to the cave and follow these guidelines will not be allowed to enter Lechuguilla Cave in the future.

### **Obtaining a Cave Permit**

All entry into park caves except public tours led by the Interpretation and Education Division require a cave permit. Permits applications may be obtained by contacting the park Cave Resource Office.

Cave Resource Office  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, NM 88220

Guidelines for entry into specific caves or areas of caves can be found in:

- Appendix A - Entering Carlsbad Cavern Off-trail areas and other Park Caves
- Appendix B - Entering Lechuguilla Cave
- Appendix F - Recreational Permit Caving
- Appendix G - Ranger-Guided Trips for the Public to Unimproved Areas

Exceptions to any of the guidelines for entry into park caves must be made in advance and will be recorded on the signed cave permit.

## **Requirements for Entering Lechuguilla Cave**

Everyone **must** sign a permit.

Everyone must attend a pre-trip orientation to the guidelines for entering Lechuguilla Cave with Cave Resource Office staff.

Expedition leaders are ultimately responsible for the personnel on their expeditions. Expedition leaders should do their best to recruit cavers who are willing to follow the guidelines that have been established. Expedition leaders should select cavers who are physically fit, psychologically prepared and who have the proper caving skills.

Every team entering the cave will have one designated team leader. Team leaders have tremendous responsibilities. They are responsible for the safety of their team and for the actions of their team members. If a team member is acting in an unsafe manner or not being careful and causing damage to the cave, then it is the team leader's responsibility to correct that person's actions. If problems persist, then the team leader must abort the trip and have the team leave the cave. A team leader should gear team activities to the least experienced member of the team. This pertains to speed of travel as well as climbing. A team should also stay together unless an emergency requires different actions.

Everyone entering the cave is responsible for their actions while in the cave. They are also responsible for reporting to the team leader acts by other team members that are unsafe, unnecessarily impact the cave or do not comply with the Guidelines for Entering Lechuguilla Cave. It is everyone's responsibility to assure that Lechuguilla Cave remains as pristine as possible and that each team member acts in a safe manner while in the cave.

Everyone entering the cave must be experienced vertical cavers and be proficient in single rope techniques (SRT). Minimum SRT skills include tying basic knots, ascending, and descending ropes of up to 300 feet in length, changing over from ascending to descending, changing over from descending to ascending, passing knots and rebelaying all while tethering heavy packs. Team leaders should be familiar with basic single rope rescue techniques. Rebelaying, redirections, traverse lines and knots will be encountered in different sections of the cave.

Everyone entering the cave should be physically fit and psychologically prepared for the trip and the tasks to be undertaken. Do not enter the cave if you are sleep-deprived or sick.

The entrance to Lechuguilla Cave is at an elevation of about 4,640 feet. Cavers not used to this elevation should try to spend a couple of days at this elevation before entering the cave. The cave is 68 degrees Fahrenheit and 100% humidity. Heat exhaustion and dehydration can be a serious problem. Drink lots of water even if you are not thirsty and eat something every few hours. Those entering the cave for the first time are urged to talk to others concerning clothing to be worn.

Clothing, boots, and caving gear should be clean before entering the cave, in order to minimize the introduction of foreign biological materials into this unique ecosystem. Clean equipment will also prevent tracking and staining of clean cave surfaces.

**Boots must have non-marking soles.** If you are in doubt, scrape boot over white floor or limestone rocks outside the cave. Marking boots will definitely leave marks. Boots may have either white or black soles as long as they do not leave marks.

External frame packs are not allowed. Nylon or PVC packs specifically designed for cave are preferred. Non-caving packs are not designed for tethering and have extra straps that can catch on delicate formations.

Electric lights are required. No carbide lights or open-flame lights are allowed in Lechuguilla. Delicate, heat-sensitive gypsum hairs, flammable sulfur deposits and carbide disposal issues all contribute to the need for electric lights. Candles may be used in designated camps as long as all wax is contained and removed from the cave.

Everyone should be aware that histoplasmosis has been found in the entrance pit.

All teams entering Lechuguilla Cave must make the Cave Resource Office aware of their “out time.” Any team six hours late or later will have search crews initiated. In the case of multi-trip expeditions, expedition leaders should post sign-in, sign-out sheets for all trips into the cave.

### **Traveling Through the Cave**

All teams will typically have from three to six members. Survey teams will have no more than four members on a team. Exceptions to these team numbers must be approved prior to the trip by the Cave Specialist.

When traveling through the cave, stay on established trails. Everyone and every piece of equipment should stay within the flagged trails. Do not rest outside of the flagged trails. Do not place packs, tripods or flashes outside of the trails. Do not get outside of the orange flagging unless you have permission from the Cave Resource Office. If trail flagging needs maintenance, either fix the problem immediately or notify the Cave Resource Office. Flagging use in the cave in the past has been as follows: Bright orange, for marking the trail; White with Red Stripes, denotes sensitive areas such as gypsum crust, aragonite, etc.; and Blue, is utilized for survey stations. When flagging the trail, use plenty of flagging tape and flag both sides of the trail. This helps keep the trail as narrow as possible (see Appendix M - Cave Conservation and Restoration Activities).

Do not establish a new trail in any area that has a trail. This creates two impacted areas. Don’t make new trails for convenience. Use existing trails only.

When entering a designated urine dump site, wear park-provided tyvek boot covers to prevent contamination of other pristine areas. Care should be taken to remove the boot

covers before exiting the urine dump site area. All urine dump sites have clearly marked flagging indicating that boot covers should be worn beyond that point.

Use of tobacco or other similar products in the cave is prohibited.

No consumption of alcohol is allowed in the cave.

Lechuguilla Cave has numerous clays and corrosion residues. Research has indicated that the corrosion residues are related to microbes fixing iron and manganese from the bedrock. Limit your impact on these biologically important corrosion residues by keeping to single-footprint trails through corrosion residue areas and by not unnecessarily impacting any pristine corrosion residues. Be careful to avoid tracking these corrosion residues and clays throughout the cave.

The use of gloves is recommended; however, there are numerous areas in the cave that are signed “Gloves Off.” Gloves get very dirty, particularly in the corrosion residue areas. This corrosion residue must not be smeared over clean or delicate areas. Non-latex surgical gloves can be used in the “gloves off” areas to prevent skin oils from further staining the walls.

Aqua socks or other clean, non-marking shoes must be worn when crossing flowstone areas. Wearing boots or walking barefoot across these areas is not allowed. Before entering a flowstone area, remove or clean all dirty clothing, packs, helmets and other equipment. Take care when transitioning from dirty boots, clothing and gear to aqua socks to avoid contaminating the transition area with dirt. Frequently check to ensure that your aqua sock soles are clean and not tracking dirt. Wearing aqua socks as camp slippers makes them unsuitable for entering flowstone areas.

No material (minerals, speleothems, bones, etc.) may be removed from the cave without a valid, existing scientific collecting permit. Collecting for someone else who has a valid collecting permit requires permission from the permit holder and from the Cave Specialist.

No caches of food, water or other items are allowed in the cave unless an exception has been granted by the Cave Specialist.

When eating (either traveling through the cave or at camp) or preparing food, great care should be taken avoid dropping any crumbs, food particles or drink powders in the cave. Eating should take place over a plastic bag or camp ground cover.

Side trips for the purpose of “sight-seeing” are not allowed.



## **Human Waste**

All solid wastes must be carried out of the cave. Trips of two-day duration or less must carry out all liquid waste. On longer trips, everyone is encouraged to carry out all liquid wastes. Any excess liquid waste may be dumped in only the designated urine dump site at the camp you are staying in. **Liquid waste may not be deposited anywhere else in the cave.** Be sure to take enough containers to hold all liquid wastes.

**Designated Urine Dump Sites.** The following sites may be used for trips of two days or more:

### EASTERN BRANCH

Rusticles and Grand Guadalupe Junction

### SOUTHWESTERN BRANCH

Big Sky

### WESTERN BRANCH

Deep Seas

## **Photography**

Cave photography is an important tool that can be used to document cave resources, assist with cave research and to share the beauty of Lechuguilla Cave. However, much unnecessary cave impact has been caused by cave photographers who have placed the importance of their photography above the protection of the cave.

Cave photography should not interfere with the main goals of the trip.

Side trips should not be taken to photograph areas not being visited as part of the main goals of the trip without specific permission from the Cave Specialist.

Cameras, tripods, flashes and models should all be within the designated trails unless the Cave Specialist has authorized otherwise.

No models, flashes, lights or other camera equipment will be placed in pools.

Photographers are encouraged to add to the institutional photographic database of Lechuguilla Cave by submitting copies of images taken in Lechuguilla Cave to Carlsbad Caverns National Park. When submitting images, please include information concerning the location, date, models and appropriate uses of any images.

## **Pools and Drinking Water**

Pools in Lechuguilla have been shown to be incredibly rich in microbial life. These microbes are easily impacted by humans and our microbes. Great care must be taken in Lechuguilla to reduce human impact on pool microbes.

There will be no wading or swimming in pools to reach cave passages or leads without prior consent of the Cave Specialist. This includes the Lake Castrovalva area.

Pools must remain pristine for on-going microbiological research. Any contamination may compromise undiscovered microbes. Try to stay as far away as possible from any pools to avoid unintentional contamination.

Water quality in water supply pools may change over time. Individuals are encouraged to consider water filters or treatment prior to drinking water from the cave.

### **Designated drinking pools**

Drinking water should be collected from designated pools utilizing the pitchers or tubing that have been placed there. Under no circumstances should anyone place their canteen, hands, or any other object into the pool itself. Always hold the container you are filling in the designated filling areas. Avoid spilling water where it can transport contaminants into pools. Do not touch the pitcher or spigot with your water bottle. The following pools may be used for obtaining drinking water:

#### EASTERN BRANCH

- GA7 pool (pitcher)
- Lost Pecos River (pitcher)
- Ghost Town (aqua socks, pitcher)

#### SOUTHWESTERN BRANCH

- Lake Chandalar (pitcher)
- Big Sky (tubing)
- Lake Marguerite (pitcher)
- Underground Atlanta (pitcher)
- Atlantis (aqua socks, pitcher)

#### WESTERN BRANCH

- Lake Louise (pitcher)

Water will not be withdrawn from any pool containing subaqueous helictites or from the Dilithium Crystal Pool in the Southwestern Branch of the cave. Water should also not be taken from the Pink Dot Pool in the Western Branch of the cave.

Please take a couple of minutes to read and record pool staff gauges between the Entrance and Boulder Falls and in other locations. Leave all data-loggers alone.

## **Rigging and Climbing**

Safety lines are located throughout the cave as an aid to crossing traverses. Everyone must clip into all traverse lines. There have been several accidents directly due to failure to clip into the safety lines provided.

Everyone entering the cave is responsible for the inspection, care and protection of all ropes and rigging. Wear spots or other problems should be brought to the attention of the trip leader, who should fix the problem immediately, if necessary, or notify the Cave Resource Office of the concern. Ropes should not be re-rigged without permission from the Cave Resource Office unless an immediate threat is perceived. Please notify the Cave Resource Office of any changes or potential problems noticed. If possible, leave a note for other expedition members explaining the change in rigging and why it was necessary.

Permanently rigged rope and webbing should be white. Colored ropes and webbing can stain cave surfaces.

Aluminum carabiners should never be used for permanent rigging due to loss of strength from corrosion. Only stainless steel maillons should be used for permanent rigging.

Any bolt or bolt hanger that is to be left in place must be made from stainless steel. Permanent bolts should be at least 3/8" in diameter and 2" long.

There are numerous climbs in the cave. Many have been done and some have not. Those wishing to do climbs should clear suggested climbs with the Cave Specialist before attempting any climb.

Expansion bolts should be used sparingly. Lechuguilla Cave lies within a wilderness area and power hammer drills are not allowed for exploration purposes.

If possible, any bolt that will not be used after an initial climb should be removed.

All climbs must be surveyed.

If a climb has been completed and does not continue, a note on flagging tape should be left stating that the climb has been completed. The decision to remove ropes from a climb or not should be based on safety, future research and survey work necessary and ease of repeating the route.

If a climb has been completed and continues, a rope log must be filled out detailing rope length, age, condition, along with rigging information (see detailed rope log sheet in Appendix O – Standard Operating Procedures, Protocols, and other Supporting Documents). Rigging changes or problems should be reported to the Cave Resource Office.

Ice crampons and other technological implements must be approved by the Cave

Specialist before attempting their use in the cave.

Exploration ropes will be left in camp areas between trips unless otherwise approved by the Cave Specialist. In the past, numerous ropes were cached throughout the cave with no documentation of their location.

### **Resource Protection Zones**

Ongoing microbe research areas have been flagged off and marked throughout the cave. Do not go beyond the flagging or disturb these areas.

The following areas, due to their sensitive nature or on-going scientific research, are off limits to all entering Lechuguilla Cave unless you have prior permission from the Cave Specialist.

#### ENTRANCE TO EF JUNCTION

**Pool in Sugarlands** – Microbial study in progress. This pool is well marked.

#### WESTERN BRANCH

**Pellucidar/Barsoom areas** - Very fragile area, subaqueous helictites found here.

Anyone climbing into the Barsoom area above Pellucidar threatens the helictites.

**Little Lake of the Clouds** - Microbial study in progress. Pools.

**Part of the Blanca Navidad Room** - **The off-limits area is well-marked. Also, all pools in the room should be left alone. Drinking water may not be obtained from any of these pools.**

**Pink Dot Pool** - Bio-hazard pool. Do not drink the water from here.

**Pool Hall** - Pool with microbiological research.

**Tree House and Neverland** - Pristine flowstone areas.

**Hudson Bay** - Pools.

**Lake Okeechobee** - Pristine pool.

**Boomtown Pool** - Pristine pool.

**Red Lakes Passage** - Very fragile with soda straws dipping down to lake level. No attempt should be made to obtain water from this pool.

**Chocolate Lake in the Chocolate Factory** - Another microbe study pool.

**Oasis Pool** - Pools and pristine flowstone.

**Nativity Chamber and Promised Land** - Pools, flowstone and numerous transitions from clean to dirty clothes and equipment.

## SOUTHWESTERN BRANCH

**Darktown** - Very long, very fragile gypsum hairs hang in this room. They are hard to see and easy to destroy.

**Lake Castrovalva** - Very fragile, unique area. No one may swim in or enter the inner pool.

**Dilithium Crystal Pool** - Unique, fragile pool with selenite crystals growing underwater. This is a very rare occurrence.

**YO Acres** - Located beyond the Pearlsian Gulf and contains large amounts of corrosion residues. Special care must be taken to avoid contamination of the Pearlsian Gulf area.

**Temple of Dagon** - Located above the Pearlsian Gulf and has the potential for knocking debris into the pearl areas.

**Void Sulfur Area** - Unique, very fragile geological and microbiological resource.

**Sulfur Shores** - Rare and fragile folia are found in this area.

**Tower Place** - Microbial research in pool area. Flowstone area.

**Western side of the Sewing Room** - Extremely fragile gypsum needles found here.

**Ultra Primo** - This is a very heavily decorated, sensitive area.

**Vesuvius** - This is also a very heavily decorated, sensitive area.

## EASTERN BRANCH

**Ghost Town** - (1) Sulfur area in small passage off the NE portion of the room is fragile as well as scientifically important. (2) Balcony overlooking the room is very fragile. Damage will occur by anyone going there.

**Ghostbusters Hall** - Contains large sulfur deposits.

**H Survey** - Very delicate, very fragile. Damage occurs anytime anyone goes through this area.

**Bryce Canyon** - Contains fragile and delicate rillenkarren. Also a spectacular aragonite bush is in danger each time someone enters the area.

**Boundary Waters** - This is the upstream source for the Lost Pecos River drinking water. Also very delicate and fragile area.

**Wet Dreams** - Pool requires swimming.

**Lake of the Loose Marbles** - Pool requires wading to cross.

**Happy Hunting Grounds** - Requires a wade through water and is fragile.

**Lake of the White Roses** - Rare and fragile folia in a one-hundred foot vertical area.

**Burning Lakes** - A pristine area with pools.

**Quasimoto's Lair** - This is a very fragile, decorated area.

**Stud Lake** - Ongoing microbial study in Pool.

**Lower Section of Grapes of Wrath Maze** - Fragile, aragonite bushes.

**Kachina Lake** - Pool.

## Special Attention Areas

The following areas, though not strictly off limits, require special precautions when entering them. If these precautions are not followed and unacceptable damage occurs, then they may be moved into a Resource Protection Zone.

ENTRANCE TO EF JUNCTION - Move Carefully! Especially in the Rim City and Windy City area.

SOUTHWEST BRANCH - Land of the Lost, Pearlsian Gulf (clean clothes, aqua socks required). Pearlsian Gulf has been contaminated by careless cavers in the past and then restored. Further impacts will result in the closure of this area. Underground Atlanta.

EASTERN BRANCH - China Shop, Firefall Hall

All areas of the cave should be traveled through carefully. However, **EXTREME CAUTION** should be exercised when moving through the **Land of the Lost**. Move at a very slow, careful pace, being aware of the gypsum hairs, threads, and beards in the area. Also, when moving through the **China Shop**, camp packs should be removed and passed carefully through the aragonite bushes.

## Camping and Resting

Camping is allowed only in designated camps. No bivouacking is allowed without permission of the Cave Specialist. Teams entering the cave should inform the Cave Resource Office where they plan on camping. Designated camps and maximum numbers allowed at those camps are as follows:

### EASTERN BRANCH

Rusticles - 6

Grand Guadalupe Junction - 9

### SOUTHWESTERN BRANCH

Big Sky - 6

### WESTERN BRANCH

Deep Seas - 12

Camp on a clean, plastic ground cover. At the completion of the camp, fold the ground cover to capture any items that may have dropped onto it. Do not shake cover off in cave at the end of the trip.

Small stoves may be used in camp areas only. Propane/Isobutane/Butane and alcohol are the preferred fuels, but white gas may be used as well. Stoves may be used in other areas only with the permission of the Cave Specialist.

When eating (either traveling through the cave or at camp) or preparing food, great care should be taken avoid dropping any crumbs, food particles or drink powders in the cave. Eating should take place over a plastic bag or camp ground cover.

Toothpaste, soap and other materials should not be drained into the cave. Rinsing off and allowing contaminated water to drain into the cave is not acceptable. Moist towelettes that can be removed from the cave are the only option for bathing.

Every team is required to leave a note in a prominent place in camp with the following information on it: What day it is, who is on the team, and where in the cave you expect to be.

Thoroughly check camp surfaces for any stray organic or non-organic items that may have accidentally been left before exiting the cave.

### **Exploration and Surveying**

Exploration without surveying is strictly prohibited. Violators will be denied future access to park caves. Survey guidelines can be found in Appendix E and must be adhered to when surveying.

No digging, blasting, hammering, moving, or breaking of formations, rocks, etc., may be performed without prior permission from the Cave Specialist.

Discovery teams may name new areas, but names deemed inappropriate or distasteful, or named after living people will not be accepted.

When exploring new areas, strive to minimize impact. Transitioning to aqua socks, clean clothes and packs may be necessary and is time-consuming. Exploring and surveying the cave carefully is more important than exploring and surveying quickly.

When moving into unexplored areas, trails should be established that minimize the damage to the cave. Persons running lead tape position should carefully evaluate the passage and choose the path that will do the least damage to the cave. Trails should be flagged immediately, so that those who will follow will not have a choice as to where to walk and will have to stay on the established trail.

In extremely sensitive areas, such as aragonite bushes blocking the path (like the China Shop), or other noteworthy speleothems deterring progress, stop and do not proceed. Notify the Cave Resource Office who will make the decision on how to proceed.

### **After Leaving Park Caves**

Any accident of a serious nature should be reported to NPS personnel as soon as possible. An incident report form, available in the Cave Resource Office, and other accident documentation must be filled out for any cave accident.

Any team entering park caves is required to fill out a trip report form and return it to the Cave Resource Office within one month. The report should include the date, personnel, places visited, and work accomplished including specifics such as types of information or samples collected. If survey was the objective, list the station numbers that were set. Expedition leaders are responsible for ensuring that all required paperwork is submitted on time.



## APPENDIX C - CAVE SURVEY AND DATA MANAGEMENT

### Purpose

Cave surveys are performed to acquire information about the location, shape and content of cave passages in order to produce cave maps. Cave surveys and maps produced from them are essential tools for research, management, exploration and interpretation of caves. In order to impact the caves as little as possible while gathering a maximum of information from each survey trip, these survey standards must be adhered to by all parties surveying in the caves of Carlsbad Caverns National Park. The objective of surveying teams should be to safely obtain quality data while minimizing impacts to the cave resources.

A survey team may not have more than four individuals per team. Teams may be given permission to have more than 4 individuals if they can show a specific need. In addition, no one may enter unexplored or unsurveyed passages without surveying as they go. There are many passages in Lechuguilla Cave and Carlsbad Cavern that have been “scooped,” but not surveyed. In order to avoid further abuse by relatively few individuals, everyone must adhere to this policy.

Everyone performing cave survey will either be signed up as an NPS volunteer or be an NPS employee. All original notes will be kept in the park and stored in a locked, fire-proof safe. The notes should be turned in to the Cave Resource Office before leaving the park. Copies of notes will be provided to those doing the work upon request.

### Data Collection

#### Sketching

The sketcher is the most important person on the survey team and has the most responsibilities regarding the survey trip. He or she is responsible for the team’s work. The sketcher must ensure that any unsurveyed passage seen by any member of the team is surveyed on that trip. He or she must also ensure that backsights are read and recorded.

Once the team begins to survey, the sketcher is the leader of the team and controls the speed and ultimate direction the team takes. All other team positions should work with the sketcher to help accurately survey the cave passage.

Park-provided cover sheets and data sheets must be used to maintain consistency for all of the various cave surveys being performed in the park. All surveys must have a cover sheet and must be filled out completely. When filling out the cover sheet, be sure to record the name of the cave, the general area of the cave, and the more specific area if possible. Also record the full name of those individuals participating in the survey. Do not use abbreviations or nicknames.

Data sheets are straightforward and should make note-taking easier. Enter one station per box with the distance, front sight azimuth, back sight azimuth, front sight vertical angle, back sight vertical angle and passage dimensions in the corresponding boxes. Record all numbers using decimal points, not fractions; this makes it much easier for data entry. Back sight information can be recorded either as uncorrected or corrected. Maintain consistency by either correcting all

backsights or correcting none of them. If backsights are corrected, note this on the cover sheet.

Sketchers should have a list of used survey designations before entering the cave. These will be provided by the expedition cartographer or the Cave Resource Office. Ideally new survey designations will be as short as possible to avoid confusion. Survey designations will always be in capital letters. It is acceptable to use alphabetical designations such as EYR1A, EYR1B... and so on. To avoid confusion a number should never be added after an alphabetical designation such as EYR1A1. The sketcher and lead tape need to closely work together to ensure that the proper station label is read from previously existing stations and that station labels are recorded correctly.

The sketcher's task is to produce a quality sketch that accurately depicts the passage that has been surveyed and to record all necessary notes, numbers, etc. that accompany the sketch. The sketcher is responsible for making sure that all needed items are done correctly. There are three types of drawings that must be produced for all surveys: the plan, profile, and cross-sectional views. All drawings must be done to scale on graph paper, and with a north arrow and a distance scale on each page. The sketcher should use an appropriate scale for the passage being sketched. The sketch should not be so small that it is impossible to show any detail, but it should also not be too large to fit on the page. If the passage is small to medium in size, then 20 or 30 feet to the inch would work well. If the passage is large to extremely large, then 50 feet to the inch is appropriate. Almost all passages should be sketched in the range of 20 to 50 feet-to-the-inch.

Heavy dots or small triangles can be used to denote survey stations. Make sure the stations are marked accurately and labeled clearly on the sketch. If during the course of the survey, you change scales on your notes, clearly indicate that a scale change has taken place.

The sketcher must take legible notes that are clean and neat. Sketchers must number all pages and place their name and date at the top of each sketch page.

**Plan View.** This drawing must be done to scale and orientation with a protractor and ruler on graph paper. The plan view must concentrate mostly on floor detail. Cave walls, boulders, columns, flowstone, drops in the passage, etc. must be drawn in their proper positions and orientations. Smaller features must be added with general symbols such as gravels, sand, mud, dirt, etc. The use of floor slope symbols is OK and necessary in places, but the composition of the floor must also be apparent from your sketches. Writing a general statement such as "All floor detail is gypsum" is not an acceptable practice for most situations. Sketchers must take the time to fill all floor detail in on the plan view with the proper symbols.

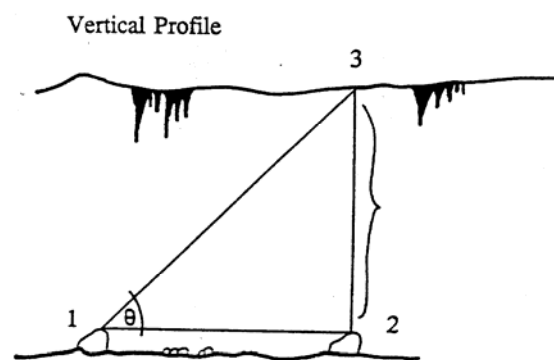
If you have plotted stations accurately, any major survey errors should show up in your sketch.

**Profile View.** A running profile, taken from survey point to survey point, should accurately depict ceiling height changes, floor changes, height of station above the floor, formations such as stalagmites, stalactites, soda straw areas, rocks, boulders, bedrock, and other important features that help relay more information about that particular passage. Include ceiling leads on the profile as well. The profile should also be plotted accurately. It can be located next to the plan sketch or done on a separate sheet of graph paper. Label the survey points with heavy dots or small triangles and the station name.

**Cross Sections.** Cross-sections are an important part of the sketch and should be done whenever there is a significant change in the character of the passage or every 100 feet or so. You can never have too many cross-sections. Make sure the cross-section and the view direction is clearly marked on your sketches. Like the profile view, they should depict all important features that are found when looking in cross-section at that particular point in the passage. Obviously, this should include the general shape of the passage. When surveying a large room, cross-sections as well as a running-profile down the middle of the room are very helpful.

Figure 1. GRAPHICAL SOLUTION FOR DETERMINING CEILING HEIGHTS

1. Using graph paper, pick a point on the ceiling to be measured. Establish station 2 directly under this point.
2. Measure the distance between station 1 and station 2 (Vertical angle MUST be 0).
3. Take the inclination between station 1 and the point on the ceiling directly above station 2 (3 on the illustration).
4. Plot this data in the survey book. Drop a perpendicular line from the point on the ceiling to station 2. This is the ceiling height which can be measured directly from the graph paper.



Vertical angle =  $\theta$

**Passage Dimensions.** Passage dimensions are most accurately recorded on the plan, profile, and cross-sectional sketches. However, it is very time-consuming for someone to go back over all sketches to retrieve needed data. It is much easier to record passage dimensions as the stations are being established. The goal is to record numbers for left-wall, right-wall, ceiling, and floor that best represent the actual passage dimensions at that point. Sometimes a station will be located in a position that is not indicative of the passage itself and it will be necessary to assume that the station is in the middle of the passage. In most cases, the distance from the floor and ceiling as well as left and right wall will be an estimate. For left and right wall try to estimate the distance across the passage from the station. Measure across if this is feasible and more helpful. If the ceiling height is very high, try to triangulate to a point on the ceiling and a point on the floor. Fig. 1 shows a graphical way for determining ceiling heights. Laser distance meters are extremely useful for measuring passage dimensions in larger passages.

**Mapping Rooms and Large Passages.** When mapping a large room, you can either pick a spot in the middle of the room and do a series of spray shots to determine wall locations or do a perimeter survey around the room. Figs. 2 and 3 are graphical representations of these two methods of surveying large rooms. Spray shots or perimeter surveys do not contribute to the cave's total length. These extra survey shots are used to firmly establish shapes and sizes of the larger rooms and passages.

The goal of each survey is to produce a quality set of notes with minimal impact on the cave features.

Figure 2. SPRAY SHOTS

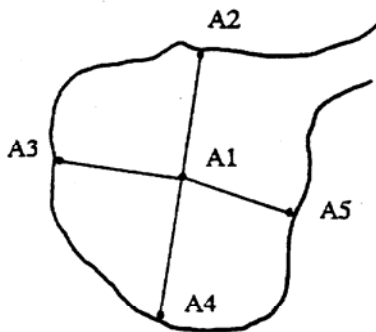
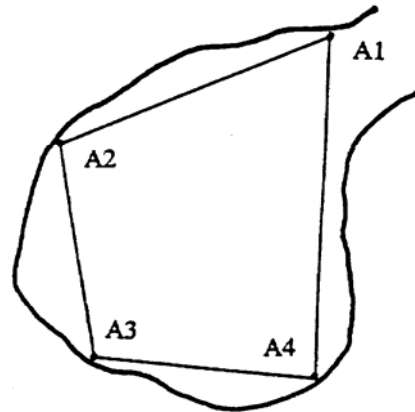


Figure 3. PERIMETER SURVEY



## **Reading Instruments**

Reading instruments is a very important position and one that requires diligence and care. This person is responsible for making sure the instruments are in good working order. Several different types of instruments may be used; however, they must all be in degrees and must be oriented to magnetic north. Instruments utilizing quadrants or degrees and minutes may not be used. Readings should be to at least 0.5 degrees, (i.e., 105.5 degrees). If the instrument reader can comfortably read to the nearest 0.25 degrees, then that is acceptable also.

In order to prevent loop closure errors, BACKSIGHTS as well as FORESIGHTS must be read whenever possible. When compared, the resultant readings should be no more than 2 degrees different. If a discrepancy of larger than 2 degrees occurs, then the readings should be redone. REMEMBER, the goal is to produce a QUALITY SURVEY. This is not a race. Sometimes, because of the difficulty of reading instruments between two particular stations, no amount of rechecking will provide agreement between the foresight and backsight. Usually, the instrument reader will have more confidence in either the foresight or backsight. He or she should communicate to the notekeeper which one is thought to be more accurate. The notekeeper will then circle the better reading. Certainly, this will not be the case at all stations, but should help when looking at loop closure errors. Loop closure errors of greater than 2 standard deviations are considered unacceptable and may show the need for resurveying a portion of that loop. In order to avoid resurvey, it is very important that the instrument person be experienced and careful.

Every effort to read backsights should be made; however, sometimes this is impossible. In these cases it is possible to read the foresight readings twice. Tight crawlways and other hard-to-get-to positions are examples of impossible conditions. This does not relieve the team of the responsibility to get backsight readings whenever possible. Once again, the real push is to produce a quality survey and as such it takes time.

For those using a Suuntos compass and inclinometer, be sure to use just ONE eye and move the instrument back and forth or move your eye up and down to accurately line up the station point and the line in the instrument. Using the two-eyed method always introduces errors in your readings due to the way that the brain fuses the image of the target and compass scale which are not at the same distance from each eye. Be careful to keep magnetic objects such as lights, batteries, metal glasses frames and steel plates away from the compass.

## **Running Lead Tape – Setting Stations**

This position on the survey team is as important as the sketcher and the instrument reader. The lead tape determines the route to take unless the sketcher overrides his decision. (Remember the sketcher controls the survey team at all times.) It is the responsibility of the lead tape to locate survey stations an optimum distance from the previous station while planning ahead to the next station. A station should also be set at any leads that will be surveyed at a later date. While setting stations, the lead tape must set them with the idea that the instrument person has to be able to read the instruments from that point.

The survey tape should be in feet and tenths/hundredths of feet or meters. Tapes measuring in feet and inches are not acceptable. Broken tapes should not be used as they can easily lead to a systematic survey error. Distance measurements should be to the nearest 0.05 foot.

The use of laser distance meters may make measuring survey distances easier and result in less impact than pulling a tape across a delicate floor. When using a laser distance meter to measure survey distances always use a laser target such as a piece of paper or survey book. Most laser distance meters can be set to read from the back or the front of the unit. Make sure to place the correct end of the unit on the survey station. Always take laser distance meter measurements twice to ensure that the proper distance is measured. Clearly communicate to all team members when turning a laser on and do not shine the laser in anyone's eye.

### **Survey Stations and Labels**

Blue surveyor's flagging with black sharpie station labels are used as survey station labels. When appropriate, survey stations should also be marked on the cave surface using a small black dot, "X" or circle. The size of these marks should not exceed one inch in diameter. Survey stations and labels must be recoverable, neat and legible. Much unnecessary impact has occurred to park caves due to illegible or incorrectly labeled survey stations and/or unrecoverable survey stations. The sketcher and lead tape need to work closely together to ensure that station labels from previously existing stations are read correctly and that new station labels are recorded correctly. These survey stations will need to be easily locatable for future surveys, research and management activities. Stations should not be located on extremely fragile formations.

The lead tape position is also responsible for flagging the trail as it is being surveyed so as to minimize the impact of future visitors to these areas. Other members of the team should help in this endeavor also.

### **Performing Inventory**

All surveys done within Carlsbad Caverns National Park must have an inventory done in conjunction with the survey. Ideally, someone other than the sketcher will perform the inventory since having one person sketching and inventorying would reduce the team's efficiency. Recognizing cave features is essential for whoever does the inventory process. Novices should not be doing the inventory. See Appendix F - Inventory Guidelines for more information.

### **Designated Surveyors**

In order to ensure that quality information is gathered on surveying trips, only approved sketchers will be allowed to sketch in park caves.

**Sketcher.** The Cave Resource Office will work with groups to approve and assist sketchers, but will have the final approval on anyone performing this task. Any group or expedition to survey in caves of the park should submit names of individuals that they would like to be sketchers to the Cave Resource Office. This should be done well before any expedition begins. Copies of notes taken on other cave trips by individuals unknown to our Cave Resources personnel should be included if they wish to be sketchers. Our cave specialists will then work with the Chief Cartographer or Expedition Leader of each group to establish the designated sketchers for that expedition. An evaluation will be provided to each sketcher after each expedition.

For those who have not sketched in caves of the park, to become a designated sketcher you must submit copies of sketches you have produced on trips outside the park.

**SPECIAL NOTE: SURVEY TEAMS NOT HAVING A DESIGNATED SKETCHER MAY NOT ENTER ANY CAVE IN THE PARK**

**Instrument Readers.** Instrument Readers who consistently show unacceptable loop closure errors will not be allowed to read instruments in park caves.

### **Survey Blunders**

Cave survey errors can occur during many steps of the cave survey process. Below is a partial list of some of the most common survey blunders:

- Using a survey designation that has already been used.
- Survey station label in cave is incorrect.
- Survey station name, tape or laser distance measurer is misread or not on target or in correct location.
- Compass or inclinometer is misread, capsule not floating freely or affected by magnetic objects, using incorrect target.
- Survey station name, distance, compass or inclinometer measurement mis-communicates with sketcher.
- Sketcher doesn't record survey station, distance compass or inclinometer information correctly.

The goal of a survey should be to have an accurate, blunder-free survey. All surveyed loops should ideally be less than one standard deviation. Any survey loop that exceeds 1.99 standard deviations is unacceptable. Standard deviations are calculated assuming a 2 degree uncertainty in compass and inclinometer readings and a 0.1 foot uncertainty in distance measurements.

### **Exploration**

It is essential that everyone do everything possible to minimize their impacts to park caves. NO ONE HAS PERMISSION to explore unsurveyed passages in any park caves without mapping. Survey is a required activity that must be done in conjunction with exploration. Looking at (scooping) passages without surveying them is totally unacceptable and will not be tolerated.

Park caves contain very fragile, very sensitive areas. Digging, breaking or altering formations, or enlarging any passages requires permission from the Superintendent or his designate. In extremely sensitive areas, such as aragonite bushes blocking the path, or other noteworthy speleothems deterring progress, stop and do not proceed. Notify the Cave Resource Office who will make the decision on how to proceed. This also includes wading in, swimming through, or disturbing any newly found pools. **FAILURE TO COMPLY WITH THESE CONDITIONS MAY THREATEN YOUR FUTURE ACCESS TO PARK CAVES.**

## CAVE MAP SYMBOLS FOR CARLSBAD CAVERNS NATIONAL PARK

### PASSAGE SYMBOLS

	Passage Walls
	Lower level passage
	Unsurveyed or indefinite walls
	Breakdown walls
	Passage too low
	Flowstone choke
	Breakdown choke
	Breakdown walls
	Flowstone walls
	Bedrock pillar
	Unexplored lead (Describe on lead list)
	Survey station

### FLOOR SYMBOLS



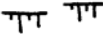




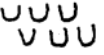


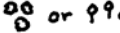








	Corrosion Residue
	Bedrock
	Sand or silt
	Mud or clay
	Gravel or cobbles
	Small breakdown or talus
	Large breakdown drawn to scale
	Gypsum
	Spar
	Guano
	Paleontological material
	Archeological material
	Paved trail
	Trail
	Sharp drop in floor, down in hatched direction
	Slope
	Pit; entrance pit if so indicated
	Ledge or drop in passage
	Canyon in floor
	Natural bridge

### CEILING AND WALL FEATURES


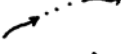






	Ceiling height
	Ceiling channel
	Ceiling lowers (hatch points to low side)
	Dripline



## SPELEOTHEMS

	Stalactites
	Stalagmites
	Soda straws
	Columns
	Helictites
	Flowstone on floor (bulged side downslope)
	Flowstone mound or large stalagmite
	Rimstone dams (drawn to shape and scale when possible)
	Flowstone on walls
	Drapery, bacon
	Popcorn
	Chandeliers
	Rafts
	Raft cones (hoodoos)
	Aragonite
	Gypsum flowers
	Boxwork
	Shields
	Moonmilk

## WATER SYMBOLS, ETC.

	Stream
	Intermittent stream
	Lake or pool with depth
	Sumped passage
	Air direction
	Scallop direction
	Strike and dip
	Fault, D side moved down relative to U side

**CARLSBAD CAVERNS NATIONAL PARK  
SKETCHER EVALUATION SHEET**

<b>SKETCHER:</b>			
<b>DATE:</b>			
<b>SURVEY:</b>			
<b>COVER SHEETS &amp; DATA PAGES</b>	<b>YES</b>	<b>PARTIAL</b>	<b>NO</b>
Is there a cover sheet and is it completely filled out?			
Are the data legible?			
Have the passage dimensions been recorded?			
<b>SKETCH</b>	<b>YES</b>	<b>PARTIAL</b>	<b>NO</b>
Is there a North arrow and scale on every sketch page?			
Is the passage drawn to scale and plotted at the measured orientation (plan & profile)			
Is the sketch drawn at a scale that shows adequate passage detail?			
Is the sketch legible?			
Is there adequate floor detail?			
Does the sketch contain cross sections?			
Is there a running vertical profile?			
Are the stations clearly labeled on the plan and profile?			
<b>OTHER</b>	<b>YES</b>	<b>PARTIAL</b>	<b>NO</b>
Have all the pages been numbered and labeled with the sketcher's name & date?			
Is there a lead list?			

**COMMENTS:**

## **Cave Survey Note and Data Management**

Hundreds of thousands of hours have been spent surveying park caves. The human effort and cave impact necessary to obtain this cave survey data along with its usefulness to researchers, explorers and managers makes the survey data extremely valuable. Survey notes and data should be managed in a meticulous way to protect the notes and provide for the most accurate data set possible. Use the checklist found at the end of this document when processing survey notes and data to avoid missing any steps.

### **Survey Notes**

Original survey notes are stored in locked, fire-proof file cabinets maintained by Carlsbad Caverns National Park. Original survey notes are filed by cave in a logical order. All survey notes are scanned as Portable Document Files (PDF) with a resolution of at least 150 x 150 DPI and in grayscale (initial scanning of survey notes began in January 2005). These digital survey notes are stored by cave in a logical order and backed up off-site. Hard copies of the original survey notes are produced and filed by cave in a logical order. Whenever possible, the hard copies or digital scans are used to protect the original survey notes by minimizing their use. Digital survey notes should be backed up in an off-site location no less than every six months to prevent catastrophic data loss.

### **Survey Data Management**

All survey data generated within Carlsbad Caverns National Park is managed using COMPASS software. Survey data should be entered as soon as possible and ideally no later than one month after it has been generated.

Before entering any survey data, record the number of good, bad and OK loops along with the overall standard deviation from the cave survey data you are about to update. This information is found in the Locate Blunders section of COMPASS.

The following fields need to be entered under the “Edit Heading” window:

Cave Name - Complete name of cave.

Survey Name - If possible, complete name of survey.

Survey Comment - Geographic names or complete survey name if it is too long to fit in the survey name field.

Survey Team - First and last name of surveyors starting with sketcher. No nicknames or abbreviations.

Survey Declination - Enter the magnetic declination calculated to the nearest hundredth as determined by the following method:

On a yearly basis magnetic declination is determined using the National Geophysical Data Center calculator located at:

*<http://www.ngdc.noaa.gov/seg/geomag/jsp/struts/calcDeclination>*

The entrance coordinates for Carlsbad Cavern are used to determine the magnetic declination:

NAD1927, elevation 4,400 feet

North 32 degrees 10 minutes 37 seconds.

West 104 degrees 26 minutes 26 seconds

The date entered for calculating the magnetic declination is January 1st. Declination calculation methods and results should be recorded in the data history files for Carlsbad Cavern and Lechuguilla Cave that is discussed in more detail later in this document.

After entering the heading data proceed to the “Edit Survey” window and enter the survey data. Entering survey data is a tedious task that must be performed with attention to detail. All surveys should have backsight information entered (initially implemented in January 2004). Be sure to enter the LRUD data in the proper location. After entering the survey data go to Block, validate backsights and validate the backsights of the file using the default of 2 degrees. This will help catch any data entry errors or survey blunders. After entering the survey data record the date and your name under the Data Entry (Date/Initials) section of the cover page. Double-check your data entry and record “checked” under the Data Entry (Date/Initials) section of the cover page.

Now process the survey data and record the number of blunders and overall standard deviation. Compare these numbers with the numbers you recorded earlier to see if any loops with a closure of  $>1.99$  standard deviation have been created. If so, check your data entry again and then proceed to try to determine and rectify the cause of the bad loop. Note any changes made in the original survey notes with the date and your full name.

Review survey notes using the Carlsbad Caverns National Park Sketcher Evaluation Sheet found in the Cave Survey Guidelines for Carlsbad Caverns National Park. Make one copy for the park files and send the original to the sketcher.

### **Data History File**

Every survey data file should have a digital data history text file stored with the digital data. These history files should be updated any time a change or addition is made to the data file. The following information should be contained in the data history file:

- Date
- Name of Files modified
- Name of person making change or addition
- Included length
- Number of stations
- Cave depth.
- Loop information including number and percentage of Good, OK and Bad loops along with overall standard deviation
- A short narrative of changes or additions made to the survey data

After entering survey data send updated copies of the survey data to sketchers, cartographers, researchers or others that need the updated survey data for their projects. Digital survey notes, data and data history should be backed-up in an off-site location no less than every six months to prevent catastrophic data loss.

## Cave Survey Note and Data Management Checklist

<b>Task</b>	<b>Completed</b>
Record loop closure statistics for cave.	
Enter heading information, especially declination.	
Enter survey data with backsights.	
Note data entry date and name on cover sheet.	
Validate backsights.	
Double check data entry.	
Note “checked” and initials on cover sheet.	
Process data and record loop closure statistics	
If bad loops are created, fix blunders and record on notes.	
Critique survey notes and send critiques to sketcher	
Update data history file.	
Scan original survey notes.	
Store original survey notes in fire-proof files.	
Store digital survey notes in proper files. For Lechuguilla and Carlsbad Cavern insert the survey notes into the appropriate EXCEL or WORD file.	
Print copies of digital survey notes and file.	
Distribute digital survey notes and survey data to sketchers, cartographers and other interested parties.	
Back-up digital survey notes, survey data and history files no less than every six months.	

## **APPENDIX D – CAVE FEATURE INVENTORY GUIDELINES**

### **Purpose**

The purpose of the cave feature inventory is to identify the locations and types of general features present within the caves of Carlsbad Caverns National Park. The cave feature inventory is not intended to be a substitute for detailed speleological research but is a tool that researchers can use to focus their efforts and maximize the effectiveness of their detailed research.

### **Prior to data collection**

Before entering the cave, review the cave inventory forms to see what features are being inventoried. Catalogs with drawings or photographs of the features in the cave inventories are available at Carlsbad Caverns National Park in each of the research huts and in the Cave Resource Office.

Personnel from the Cave Resource Office will discuss the general requirements for inventorying cave features during the orientation meeting at the beginning of the expedition or before the first trip into the cave. This is a good time to ask questions and get clarification of any cave features you are not familiar with prior to entering the cave.

### **Collecting data**

Fill out the cover page completely, including:

- Cave name

- Stations inventoried (Example: XJ1-23, XJ4A-G, XJ60-81, A1-10)

- Recorder – the person filling out the inventory form

- Other personnel – the names of the rest of the team

- Inventory date

You will not be able to complete the Stations Inventoried line until the end of the survey and/or inventory.

Inventory information is tied to the nearest survey station. At each survey station to be inventoried, scan the area halfway between the last station and the next station for any of the inventory items. Work your way through the inventory sheet recording which station the inventory items are located at. The first time there is an entry for a category, record the prefix (example: XJ3). When entering another station to a category that has a previous entry there is no need to use the prefix unless a new prefix has been selected (example XJ4,5,8, A3,9). If you have numerous stations that have an item, instead of writing A1,2,3 you can record them as A1-3. Only use commas and dashes between numbers.

If you conduct a side survey, make sure to list these stations separately on the inventory form with their own prefix. For example if you inventory stations A1-10 and a side survey A5A, A5B, A5C, etc. the inventory should read “A1-10, A5A-C” or “A1-5, 5A-C, 6-10” not just “A1-10.”

Only include stations you are surveying or resurveying and not tie-in stations. For example, if you are surveying B1-10 and tied into A12 and C20, only inventory B1-10. This prevents duplicating inventory and the need to reconcile multiple inventories of individual stations. If you are doing an inventory-only trip, inventory stations in long sequences, not scattered, unconnected stations all in the same area. For example S234-258, not S231, S465, Q87, LT33, etc.

Every station must have at least one entry in the floor section of the inventory. Each station can have multiple entries (i.e., breakdown and loose soils).

Do not leave any open-ended sequences such as “A2-” and double-check every few stations to make sure you are still seeing features you have left open. It is very common for people to leave a feature open and then try to guess where they actually stopped seeing them.

Sufficient space has been provided to make additional notes, observations, and drawings of features found in the cave that personnel were unable to identify or that do not appear on the pre-printed fields. Any sketch in these sections must include a scale.

### **Reviewing Data**

The data collector should go back through the inventory book at the end of each survey to make sure that there are no open sequences or missing information and that the cover page has been completed.

The trip leader should also review all of the inventory notes to make sure that everything has been filled out correctly before leaving the cave. The trip leader is ultimately responsible for the quality of the data provided to the Cave Resource Office. Expedition leaders should review all of the inventory notes from all of the teams as a final quality/completion check before the notes are turned into the Cave Resource Office.

## **Park Responsibilities**

### **Entering Data and Digital Data Storage**

All inventory data is stored in spreadsheets specific to each cave. For each station, a “Yes” or “No” is entered in each field to indicate whether or not it is present at each station. An inventory date is also entered for each station. There is space to enter optional notes at each station. An Excel macro has been created to help streamline the data entry process, but data can be entered manually as well.

The master inventory files for each cave must be stored in the appropriate section of the secure network drive (under **Cave Resources\Carlsbad Cavern\Inventory** in the case of Carlsbad Caverns). These files should also be digitally archived a minimum of every six months to reduce the chances of major data loss.

### **Feedback**

If the person entering the inventory data identifies deficiencies with the forms or inventory data, feedback should be provided back to both the trip/expedition leader and the data collector. Feedback is provided using the Inventory Evaluation Sheet found at the end of this appendix.

### **Hardcopy Storage**

Once the data has been entered, the original forms will be stored in the appropriate fireproof filing cabinets. For Carlsbad Cavern and Lechuguilla Cave, the forms will be stored in the horizontal filing cabinet in the cave technician’s office in the appropriate drawer for that cave. For other caves in the park, the inventory data will be stored with the cave survey data in each cave’s folder in the fireproof vertical filing cabinets in the Cave Specialist’s office.



## Cultural

**Artifacts** (record artifacts/approximate age)

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**Graffiti** (record graffiti/approximate age)

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Pictographs \_\_\_\_\_

Other \_\_\_\_\_

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**Notes**

## Carlsbad Cavern National Park Cave Inventory Form

Cave Name \_\_\_\_\_

Stations Inventoried \_\_\_\_\_

(Example: XJ1-23, XJ4A-G, XJ60-81, A1-10)

Recorder \_\_\_\_\_

Other Personnel \_\_\_\_\_

---

Inventory Date \_\_\_\_\_

### Instructions:

Inventory information is tied to the nearest survey station. At each survey station to be inventoried, scan the area halfway between the last station and the next station for any of the inventory items. Work your way through the inventory sheet recording which station the inventory items are located at. The first time there is an entry for a category, record the pre-fix (example: XJ3). When entering another station to a category that has a previous entry there is no need to use the pre-fix unless a new prefix has been selected (example XJ4,5,8, A3,9). If you have numerous stations that have an item, instead of writing A1,2,3 you can record them as A1-3. Only use commas and dashes between numbers.

### Contents by Page

- 1 Cover Sheet
- 2 Miscellaneous
- 3 Formations 1
- 4 Formations 2
- 5 Geology 1
- 6 Geology 2
- 7 Biology
- 8 Cultural

Computer entry date \_\_\_\_\_

Data entry person \_\_\_\_\_

## Miscellaneous

### Water

Surface Moisture \_\_\_\_\_

Dripping \_\_\_\_\_

Flowing \_\_\_\_\_

Pool (note size) \_\_\_\_\_

- < 1cubic foot \_\_\_\_\_

- > 1cubic foot \_\_\_\_\_

Paleo-Waterline \_\_\_\_\_

### Airflow

Airflow \_\_\_\_\_

(Indicate direction and velocity. Example: B45 to B46, faint)

### Floor (!note every station must have at least one floor feature!)

Sediment/Soil \_\_\_\_\_

Breakdown \_\_\_\_\_

Bedrock \_\_\_\_\_

Secondary Deposits \_\_\_\_\_

Pit \_\_\_\_\_

### Conservation

Flowstone shoes required \_\_\_\_\_

Gloves off area \_\_\_\_\_

Restoration projects \_\_\_\_\_

Other \_\_\_\_\_

### Obstacles

Crawl (anything difficult for a rescue litter) \_\_\_\_\_

Un-roped Climb or Chimney \_\_\_\_\_

Pit Requiring Rope (describe rigging, rope length, pit depth, quality of rope)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Other \_\_\_\_\_

## Notes

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Biology

### Vertebrate

Bat \_\_\_\_\_

Bat Bones \_\_\_\_\_

Bat Guano \_\_\_\_\_

Bat Scratches \_\_\_\_\_

Bones (Specify) \_\_\_\_\_

Mammals \_\_\_\_\_

Reptiles \_\_\_\_\_

Birds \_\_\_\_\_

- Swallows \_\_\_\_\_

- Owls \_\_\_\_\_

- other \_\_\_\_\_

Other \_\_\_\_\_

### Invertebrates

Beetles \_\_\_\_\_

- Eleodeus \_\_\_\_\_

- Embaphion \_\_\_\_\_

- Rhadine \_\_\_\_\_

Centipede \_\_\_\_\_

Crickets \_\_\_\_\_

- C. conicaudus \_\_\_\_\_

- C. carlsbadensis \_\_\_\_\_

- C. longipes \_\_\_\_\_

Diplurans \_\_\_\_\_

Harvestman \_\_\_\_\_

Isopod \_\_\_\_\_

Millipede \_\_\_\_\_

Pseudoscorpion \_\_\_\_\_

Spiders \_\_\_\_\_

Springtails \_\_\_\_\_

Other \_\_\_\_\_

Microbial Colonies (color/size) \_\_\_\_\_

## Notes

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Geology 2

### Karren

Drip pit, carbonate \_\_\_\_\_  
Drip pit, gypsum \_\_\_\_\_  
Pothole karren \_\_\_\_\_  
Rillenkarrren \_\_\_\_\_  
Spitzkarren \_\_\_\_\_

### Manganese

Crust \_\_\_\_\_  
Dendrite \_\_\_\_\_

### Silica

Quartz \_\_\_\_\_  
Rock Flour \_\_\_\_\_  
Silticle \_\_\_\_\_  
Silt Hoodoo \_\_\_\_\_

### Sulfates

Barite \_\_\_\_\_  
Celestite \_\_\_\_\_  
Epsomite/Mirabilite \_\_\_\_\_

### Sulfur

Crust \_\_\_\_\_  
Crystal \_\_\_\_\_  
Massive \_\_\_\_\_  
Nodular \_\_\_\_\_  
Platy \_\_\_\_\_

### Phosphate

Apatite \_\_\_\_\_

### Uranium

Tyuyamunite \_\_\_\_\_

#### Notes

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## Formations 1

### Calcite

Flowstone \_\_\_\_\_  
Stalactite \_\_\_\_\_

- deflected \_\_\_\_\_
- soda straw \_\_\_\_\_

Stalagmite \_\_\_\_\_

Column \_\_\_\_\_

Popcorn \_\_\_\_\_

Bell Canopy \_\_\_\_\_

Boxwork \_\_\_\_\_

Calcite Coating \_\_\_\_\_

Calcite Crust \_\_\_\_\_

Coral Pipes \_\_\_\_\_

Coral Stalagmite \_\_\_\_\_

Conulite \_\_\_\_\_

Drapery \_\_\_\_\_

Drip Pit Lining \_\_\_\_\_

Folia \_\_\_\_\_

Helictite \_\_\_\_\_

- antler \_\_\_\_\_
- beaded \_\_\_\_\_
- snake dancer \_\_\_\_\_
- subaqueous \_\_\_\_\_
- other \_\_\_\_\_

Mammillary \_\_\_\_\_

Pearl \_\_\_\_\_

Pool Finger \_\_\_\_\_

Raft \_\_\_\_\_

Raft Cone \_\_\_\_\_

Rim \_\_\_\_\_

Rimstone Dam \_\_\_\_\_

Shelfstone \_\_\_\_\_

Spar \_\_\_\_\_

- dogtooth \_\_\_\_\_
- nailhead \_\_\_\_\_
- chenille/pool \_\_\_\_\_

Shield \_\_\_\_\_

Splash Ring \_\_\_\_\_

Tray \_\_\_\_\_

#### Notes

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## Formations 2

### Aragonite

Anthodite \_\_\_\_\_  
Bush \_\_\_\_\_  
Frostwork \_\_\_\_\_  
Rim \_\_\_\_\_  
Stalagmite \_\_\_\_\_

### Gypsum

Beds, Massive \_\_\_\_\_  
Coating \_\_\_\_\_  
Cotton/Hair \_\_\_\_\_  
Chandelier \_\_\_\_\_  
Crust \_\_\_\_\_  
Crystal \_\_\_\_\_

- subaerial \_\_\_\_\_
- subaqueous \_\_\_\_\_

Flower \_\_\_\_\_  
Granular \_\_\_\_\_  
Needle \_\_\_\_\_  
Raft \_\_\_\_\_  
Rim \_\_\_\_\_  
Stalagmite \_\_\_\_\_

### Hydromagnesite

Balloon \_\_\_\_\_  
Crinkle Blister \_\_\_\_\_  
Moonmilk \_\_\_\_\_  
Powder \_\_\_\_\_  
Rim \_\_\_\_\_

### Notes

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## Geology 1

### Bedrock

Backreef \_\_\_\_\_  
Massive \_\_\_\_\_  
Forereef \_\_\_\_\_  
Breccia \_\_\_\_\_

- calcite matrix \_\_\_\_\_
- silt matrix \_\_\_\_\_

Dike \_\_\_\_\_  
Bedded Siltstone or Sandstone \_\_\_\_\_  
Pisolites \_\_\_\_\_  
Sand or Silt pods \_\_\_\_\_  
Sandstone Ripple Marks \_\_\_\_\_

### Fossils

Unidentified \_\_\_\_\_  
Algae \_\_\_\_\_  
Brachiopod \_\_\_\_\_  
Bryozoan \_\_\_\_\_  
Cephalopod \_\_\_\_\_  
Clam \_\_\_\_\_  
Coral \_\_\_\_\_  
Crinoid \_\_\_\_\_  
Fusulinid \_\_\_\_\_  
Gastropod \_\_\_\_\_  
Sponge \_\_\_\_\_

### Clays

Endellite \_\_\_\_\_  
Montmorillonite \_\_\_\_\_  
Massive Bank \_\_\_\_\_  
Residual red clay \_\_\_\_\_

### Corrosion Residue (include thickness if possible)

Red CR \_\_\_\_\_  
Brown CR \_\_\_\_\_  
Yellow CR \_\_\_\_\_

### Iron

Crust \_\_\_\_\_  
Rusticle \_\_\_\_\_  
Stalactite \_\_\_\_\_

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# CARLSBAD CAVERNS NATIONAL PARK INVENTORY EVALUATION SHEET

<b>INVENTORY PERSON:</b>			
<b>DATE:</b>			
<b>SURVEY:</b>			
<b>COVER SHEETS &amp; DATA PAGES</b>	<b>YES</b>	<b>PARTIAL</b>	<b>NO</b>
Is cover sheet completely filled out?			
Are all stations listed on cover sheet?			
Is data legible?			
<b>Inventory</b>	<b>YES</b>	<b>PARTIAL</b>	<b>NO</b>
Does every station appear in the Floor section?			
Are only dashes and commas used?			
Are the dashes and commas used clearly?			
Are all fields closed off (i.e. no open dashes “AB10-“)			

**COMMENTS:**

[illegible]

## **APPENDIX E - TECHNICAL SKILLS FOR EMPLOYEE VERTICAL ORIENTATION TRIPS**

### **Purpose**

Vertical orientation trips may be used as an educational tool to help employees better understand park caves and cave processes. Employee orientation trips into portions of Carlsbad Cavern, Spider Cave, Slaughter Canyon Cave, and Ogle Cave have been allowed for many years. As with all caving trips, they require an approved trip leader and, in some cases, the proper and safe use of vertical equipment employing Single Rope Techniques (SRT). This document provides information and guidelines for employee orientation trips that require the use of SRT for safely visiting areas in Carlsbad Cavern and Ogle Cave.

There are three types of vertical exposure that an employee will have to negotiate when traveling to certain areas in Carlsbad Cavern or when entering Ogle Cave. These are:

- Crossing a traverse;
- Steep slopes; and
- Vertical drop offs.

Employee orientation trip participants must possess all the necessary skills to safely participate in any trip prior to the trip taking place.

A trip leader will allow an employee to participate on a trip only if they meet the following criteria:

- If the trip requires knowledge and skills in vertical equipment use and proper techniques, then employee must have demonstrated this knowledge to the trip leader or another approved trip leader in advance of the trip.
- All gear must be in good working order.

Additionally, a trip leader must stop a trip and return to the surface if anyone is demonstrating unsafe use of equipment during the trip.

### **Crossing a Traverse & Descending/Ascending a Steep Slope**

The following minimum skills are required for participating in an employee orientation trip to areas that require crossing a traverse and/or descending or ascending a steep slope. The employee must have the ability to accomplish these skills unaided.

- Ability to safely descend a fixed rope using a rappel device.
- Ability to safely lock off the rappel device in mid-rappel, then unlock and resume the rappel.
- Ability to safely pass anchors on a traverse.
- Ability to safely climb steep slopes using an ascending device as a safety control.

Areas in Carlsbad Cavern where these skills are necessary are the route to and from Lake of the Clouds and entering and exiting Bottomless Pit in the Big Room.

### **Descending/Ascending Vertical Drop Offs**

An important aspect of negotiating vertical drops safely is learning and being comfortable with vertical ascending and descending systems. Practice with and knowledge of these systems will increase a participant's ability to notice and correct problems that may occur when using this equipment.

The following minimum skills are required to safely descend into and ascend out of vertical drop offs within caves.

- The skills listed above
- Ability to properly and safely use a rope climbing system
- Ability to safely change over from ascent to rappel during a climb and rappel to ascent during a rope descent

An area in Carlsbad Cavern where these skills are necessary is the route into and out of the New Mexico Room. Additionally, these skills are necessary to enter and exit the entrance to Ogle Cave.

### **Trip Leader Responsibilities**

It is the trip leader's responsibility when leading any orientation trip to work with employees signed up for their trip to ensure that they have the proper training, experience, and gear for the orientation area to be visited. Additionally, during an orientation trip, the trip leader must be aware of each employee's physical and mental safety as they negotiate cave passages as well as ensure the protection of cave resources. As mentioned above, if any problems arise during a trip that cannot be corrected immediately, the trip leader **must** abort the trip and return to the surface with the entire team.

If an employee does not have the needed skills and knowledge to participate in one of these vertical orientation trips, employees can learn these during the occasional training sessions offered by the Cave Resources Office or other vertically qualified leaders. The employee can also learn these from other outside sources and demonstrate their proficiencies to an approved trip leader.

### **Vertical Orientation Trip Participant Qualification Check-List for Designated Leaders**

Designated leaders for all vertical orientation trips offered by the park must adhere to the following standards when preparing participants for these types of trips. If the designated trip leader does not believe an employee is prepared for a trip, then that employee must not be allowed on that trip.

**Requirements for Participation on Vertical Orientation Trips.**

1. Prior to the trip, all proposed participants must understand this appendix and understand what is required of them to safely participate in vertical orientation trips.
2. Does the trip leader personally know if the proposed participant has the required vertical skills for the trip or can another vertically qualified designated trip leader vouch for the skills of the proposed participant?
3. Does the trip leader personally know if the proposed participant has the required general caving skills for the trip or can another qualified designated trip leader vouch for the skills of the proposed participant?
4. Does the trip leader personally know if the proposed participant has the required physical ability for the trip or can another vertically qualified trip leader vouch for the ability of the proposed participant?
5. Does the proposed participant have the required vertical caving equipment for the trip?  
Note: Each proposed participant must have his / her own vertical equipment. Vertical equipment may be checked out from the vertical caving cache. NO EQUIPMENT IS TO BE SHARED.
6. Does the proposed participant have the required general caving equipment for the trip?



## **APPENDIX F - RECREATIONAL PERMIT CAVING**

### **Purpose**

There are nine caves available within Carlsbad Caverns National Park for recreational caving: Goat, Lake, Corkscrew, Helens, Ogle, Wen, Chimney, Christmas Tree, and Deep. Experienced teams may visit eight of these on their own and one is a ranger-escorted trip that requires a fee. A cave permit from the Cave Resources Office must be obtained before any of these caves may be entered. This document will assist you in deciding which cave to visit based upon your caving experience, interests and abilities. Some caves in the park are difficult to locate and enter, requiring technical climbing skills, experience in reading topographical maps, extended hiking in very rough and potentially hazardous terrain, and adjusting to the extremes of a desert climate. Therefore, we suggest you acquire this type of experience before you visit park caves.

### **Obtaining a Cave Permit**

All entry into park caves except public tours led by the Interpretation and Education Division require a cave permit. Permits applications may be obtained by contacting the park Cave Resource Office.

To ensure availability, at least one month advance notice is requested for scheduling a trip. Reservations are on a first-come, first-served basis and available by mail, telephone or email. The park may deny a permit to any individual or group that does not have the proper equipment and/or experience to safely negotiate the cave. Once the permit application is approved, the permit will be returned to you by mail or you may arrange to pick it up in person. To receive a permit application, write to:

Cave Resource Office  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, NM 88220

NOTE: Reservations for ranger-led trips to Ogle Cave must be confirmed three days before the scheduled date, otherwise the trip will be cancelled.

Guidelines for entry into specific caves or areas of caves can be found in:

- Appendix A - Entering Carlsbad Cavern Off-trail Areas and Other Park Caves
- Appendix B - Entering Lechuguilla Cave
- Appendix F - Recreational Permit Caving
- Appendix G - Ranger-Guided Trips for the Public to Unimproved Areas

Exceptions to any of the guidelines for entry into park caves must be made in advance and will be recorded on the signed cave permit.

## **Requirements for Entering Park Caves**

Before entering the cave, everyone must sign the permit.

Most caves available for recreational caving permits are between one and four miles from the nearest road. Be sure to carry plenty of water, particularly in the summer, when daily requirements exceed one gallon a day per person.

Overnight camping is permitted only in the park's backcountry, and requires a separate non-fee camping permit that can be obtained at the visitor center. Overnight camping is not allowed in caves or within 300 feet of a cave entrance.

Any entry into an undeveloped cave may result in irreparable damage to the cave. All park caves will be carefully monitored for impacts. Caves affected by careless users will be closed. Please support this recreational caving program by caving in a safe manner and taking care to preserve cave features.

## **Age Limits**

Trip leaders must be at least 18 years of age. Visitors to vertical caves must be 16 years old for most caves, and at least 18 for Ogle or Deep Cave. Visitors to horizontal caves must be at least 12 years of age and if under 16 must have a legal parent or legal guardian with them. Visitors to permit caves under 18 years of age must have special permission in writing, signed by their parent or guardian, before entering any permit cave. This written permission must be received by the Cave Resources Office before the trip may take place.

## **Fees**

Entry into Ogle Cave requires a ranger escort and is subject to the following fee:

Age 18-62.....	\$15.00 per person
Golden Age or Golden Access Passport....	\$7.50 per person

As these trips are considered "special use," Golden Eagle passports are not applicable. No fee is charged for a permit to visit the other permitted caves.

## **Safety**

These caves are preserved in their natural state; therefore, potential hazards exist that require certain safety precautions:

- Take three dependable and independent sources of light.
- Wear sturdy shoes that protect the ankles and have non-leather, non-skid soles.
- Gloves and kneepads may be necessary in some caves.
- Helmets with chin straps must be worn when underground. Cavers visiting vertical caves must wear a caving/climbing helmet with a three-point chinstrap. These are also highly recommended for horizontal caves.
- Mount your main source of light on your helmet to free your hands for climbing.
- Three people are the minimum safe group size.
- There may be snakes in or around cave entrances and at the bottom of entrance pits. Do not disturb them.

NOTE: For caves requiring rope work, each person must have their own ascending and descending devices and be experienced in their use.

## **Natural History**

Rocks of the Guadalupe Mountains were deposited about 250 million years ago when this area was adjacent to the deep Delaware Basin, a large inland arm of the Permian Ocean. On the shelf surrounding this basin, limestone formed from the accumulation of vast numbers of the limy skeletons of various marine organisms and by direct precipitation from sea water. Eventually, water circulation in the basin was restricted, the water became very salty from evaporation, the reef organisms died, and the basin was filled to overflowing with salts.

About 15 to 25 million years ago, the Guadalupe Mountains began to uplift. Caves developed deep in the ground as fresh water beneath the mountains mixed with briny basin water and formed sulfuric acid that dissolved the limestone.

Continued uplift of the Guadalupe Mountains elevated some caves above the level of the ground water, causing them to drain and dry. Erosion by water removed the deposits above the limestone and cut deep rugged canyons into the rock and opened entrances to some caves. Water seeping through the rock into caves precipitated the dissolved minerals to create the fantastic array of beautiful cave formations that make Guadalupe caves world famous.

## **Cave Trail Markers**

Some routes are marked with flagging tape to reduce impact on delicate formations or floor material. Please stay on these routes and do not disturb the tape. Do not place any gear, photographic equipment, or other items outside of the marked trails.

## Conservation

Every entry into a cave, by any person, creates some disturbance. The cumulative impact of slight changes and disturbances, even innocent ones, can lead to dramatic alterations of the cave environment, and to the visitor's enjoyment. It is important to remember this fact as you enter caves within the park. Your actions while caving will be one of the greatest determining factors in the condition of cave resources and enjoyment of these caves by future generations. It is everybody's responsibility to respect the cave environment.

Boot scuff marks on rocks are among the more unsightly signs of human usage. They are very difficult if not impossible to remove. The use of non-marking boots is encouraged. It is important not to track mud through the cave. Periodic cleaning of hands during the trip and boot soles prior to the trip can contribute greatly to the wild caving experience for everyone else that follows.

Most of the caves have been used, at one time or another, by bats. Five of these caves are routinely used by various bat species. Several of these species are extremely sensitive to the presence of humans. To reduce stress and mortality levels in bats, please do not disturb them. Cavers should reduce the amount of time near bats, do not shine lights directly on them, do not make any sudden movements or loud noises, and do not take pictures of the bats.

Besides bats and cavers, other creatures inhabit caves. Often neglected or overlooked, cave invertebrates, including microbes, are more sensitive than many other dwellers of the cave environment, and no less interesting or deserving of respect. There are over 130 species of invertebrates found in caves within the park, several being true troglobites.

These caves are being managed to perpetuate the caves and their associated values, and to provide for educational and recreational interest now, as well as the future. You can affect not only the cave environment, but also future management decisions. If you are to affect caves, make it a positive one. People can impact caves far faster than nature can repair them, or create new ones - **please cave softly.**

## **Vertical Caves**

These caves require the use of vertical caving techniques. Groups must be experienced in vertical caving and may be required to show their vertical equipment and rope to Cave Resource staff before being issued a permit.

**IMPORTANT NOTE:** Each person must have his or her own ascending and descending devices. Do not attempt to pass vertical gear up and down the rope.

### **Chimney Cave**

Elevation: 4,328 feet

Distance from trailhead: 0.5 mile

Approximate hiking time: 30 minutes

Group size: minimum 3, maximum 6

Equipment: One rope at least 120 ft long and vertical gear for each person.

One 15 ft handline (optional)

Visitation limit: 2 trips per week

There is an awkward 8 ft free climb in the entrance to this cave; less experienced cavers may wish to use a handline. The main chamber is reached by the drop which is located well into the dark zone of the cave. This chamber is approximately 200 ft in diameter and contains large formations and a bell canopy.

### **Christmas Tree Cave**

Elevation: 4,892 feet

Approximate distance from trailhead: 1.25 miles

Approximate hiking time: 1.5 hours

Group size: minimum 3, maximum 6

Equipment: 50 ft handline, seat harness and a safety ascender

Visitation limit: 2 trips per week

The entrance of Christmas Tree Cave consists of a 15 ft vertical drop around a rock partition. Although the drop to the right (when facing the cave) can be free climbed with the assistance of a 50 ft handline, the use of a seat harness and a safety ascender are highly recommended. The entrance chamber is covered with breakdown and gradually slopes to the first level of the cave. Here one finds numerous delicate formations. At the rear of this chamber is a large pile of breakdown blocks, beyond which a lower chamber is reached. This room is silt covered and care must be taken not to track silt through the cave. This cave is well decorated and fragile. Cave swallows nest in the entrance area. Do not disturb them by lingering near the nests, making noise, or other activities that may affect the birds or nests.

## **Horizontal Caves**

### **Corkscrew Cave**

Elevation: 4,803 feet  
Distance from trailhead: 0.5 mile  
Approximate hiking time: 30 minutes  
Group size: minimum 3, maximum 4  
Visitation limit: 2 trips per week

People planning on entering this small cave should be experienced cavers. The entrance passage must be chimneyed. People with minimum climbing experience should be belayed with a rope. Portions of the cave are very delicate. A very large shield is present in the first chamber below the entrance passage.

### **Goat Cave**

Elevation: 4,614 feet  
Distance from trailhead: 2.25 miles  
Approximate hiking time: 1.5 hours  
Group Size: minimum 3, maximum 10  
Visitation limit: 3 trips per week

This is a good cave for beginning cavers. Cave swallows are sometimes found in the impressively large entrance to this cave. The cave consists mostly of one main corridor 1,130' long and from 40' to 200' wide, with a ceiling height of up to 100'. The first half of the floor is covered with burned goat manure; this ash can easily be kicked up and interfere with breathing. In the last 30 to 40 feet, the floor is covered with bat guano. If bats are present, please do not disturb them.

### **Lake Cave**

Elevation: 5,340 feet  
Distance from trailhead: 2.5 miles  
Approximate hiking time: 2.5 hours  
Group Size: minimum 3, maximum 6  
Equipment: 50' handline recommended  
Visitation limit: 2 trips per week

Lake Cave is closed from April 1 to November 1 each year to protect a sensitive maternity bat colony. Groups should be experienced hikers in good condition. The hike to the cave gains 1133 ft in elevation and is thus very long and steep. The cave runs NE for about 600 ft, with the first 350 ft at approximately the same level as the entrance. Two hundred feet from the entrance, the cave opens up into a 100 ft by 200 ft chamber, at the end of which is the Lake Room. The slope leading down to the Lake Room is 35 ft, guano-covered and slick; a 50-foot handline is recommended. The lake itself is 135 ft long, 20 ft to 30 ft wide, and up to 10 ft deep. Even though this cave has been extensively vandalized, it is still a very scenic cave. It contains many unusual speleothems which have been partly corroded by atmospheric condensates into strange, freeform shapes.

### **Deep Cave**

Elevation: 5,946 feet  
Distance from park boundary: .25 mile  
Approximate hiking time: 45 min.  
Group size: minimum 3, maximum 6  
Equipment: 350 ft rope and 150 ft handline to reach rig point  
Vertical gear for each person  
Visitation limit: 2 trips per week

This cave must be reached by traveling over rough dirt roads through the Lincoln National Forest; a high-clearance vehicle is needed. The entrance passage slopes down from the 50 ft diameter entrance at a 45° angle, coming to a ledge containing a large boulder and a small stalactite. The vertical drop requiring the use of the 350 ft foot rope is rigged from this ledge. This drop brings you to the top of a breakdown hill in a large, dome-shaped room. The passage then runs back another 500 ft. Except for one pool, the cave is dry, and is well decorated with totems (tall, narrow stalagmites), shields, dog-tooth spar, bell canopies and helictites.

### **Helens Cave**

Elevation: 4,580 feet  
Distance from trailhead: 1 mile  
Approximate hiking time: 1 hour  
Group Size: minimum 3, maximum 6  
Equipment: One rope at least 100 ft long and rope pads  
Vertical gear for each person  
Visitation limit: 2 trips per week

Though the entrance drop is only 30 ft, a 100 ft rope is needed due to the scarcity of anchor points. Below the entrance drop, the cave heads off in two directions. The right-hand passage ends in a crawlway after 50 ft. The main portion of the cave lies beyond a three foot high constriction on the left-hand side. The main chamber is decorated with a variety of delicate speleothems. Additional passage can be found up a 15 ft climb (no rope needed) on the left-hand side of the room. This passage is heavily decorated and requires extreme care not to damage the many fragile formations hanging from the ceiling.

### **Ogle Cave**

Ogle Cave is very delicate and still contains historic guano mining equipment. For these reasons, a ranger escort is required for all trips to this cave. Trips are also limited to a total of two per month. Trips must be arranged ahead of time. The fee for ranger-escorted trips is \$15 per person.

Elevation: 4,854 feet  
Approximate distance from trailhead: 1.25 miles  
Approximate hiking time: 1.25 hours  
Group size: minimum 2, maximum 6 plus park escort  
Equipment: One rope at least 250 ft long  
Vertical gear for each person  
Visitation limit: 2 trips per month

The rappel on the lower west side of the sinkhole drops into the main walking passage. Several rope pads are needed for this rappel. The main chamber extends to the south for approximately 1,450 ft. The Boulder Room leads off from the main chamber roughly 600 ft from the entrance. Ogle Cave, one of the largest in the park, contains shields, breccia, helictites and massive stalagmites. This cave also contains a 106 ft tall column, the “Bicentennial Column”, which is the tallest in the park and one of the tallest in the world. Escorted tours vary in length and are confined to a flagged trail.

### **Wen Cave**

Elevation: 4,747 feet

Distance from trailhead: 0.5 mile

Approximate hiking time: 30 minutes

Group Size: minimum 3, maximum 6

Equipment: One rope at least 100 ft long

Vertical gear for each person

Visitation limit: 2 trips per week

Wen Cave is a small, pretty cave decorated with very fragile formations. The entrance is roughly 7 ft by 5 ft and is somewhat hidden by vegetation. The entrance passage extends for about 20 ft, at which point it opens up into a 55 ft vertical drop. The lower chamber runs in two directions from the base of the drop. The southern passage continues for 100 ft and terminates in a room 30 ft in diameter with a 40 ft ceiling. To the north, the passage continues for about 175 ft and terminates in a flowstone block. Much of this area is decorated with flowstone, columns, shields and pool features.



## **APPENDIX G – RANGER-GUIDED TRIPS FOR THE PUBLIC TO UNIMPROVED AREAS**

### **Purpose**

In the past few years, ranger-guided trips for the public to off-trail areas in Carlsbad Cavern, to parts of Spider Cave, and to Slaughter Canyon Cave, have been made available by the Interpretation staff. This document sets the park policies for these trips. These trips are designed to give park visitors an interesting and educational look at areas of caves that are not developed or readily accessible, and to introduce inexperienced visitors to the difficulty, fun, and responsibility of safe caving. The trips also provide interpretive rangers with a greater breadth of experience.

Though some resource degradation is expected, the goal is to provide limited access to the public to these different areas with minimal cave impact. Use limits for each cave area are outlined below and must not be exceeded. All trips must also stay on approved trails. Taking visitors off these approved trails greatly increases the risks of damage to the fragile cave resources and may increase safety risks.

The Cave Resource Office is responsible for designating authorized trip leaders for off-trail trips for visitors based on the interpretive supervisor's recommendations. Each approved trip leader MUST accompany the group and will be responsible for the group's safety and conduct. Of primary importance are the preservation of all cave resources and the safety of all individuals on cave trips.

### **Obtaining a Cave Permit**

All entry into park caves except public tours led by the Interpretation and Education Division require a cave permit. Permits applications may be obtained by contacting the park Cave Resource Office.

Cave Resource Office  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, NM 88220

Guidelines for entry into specific caves or areas of caves can be found in:

- Appendix A - Entering Carlsbad Cavern Off-trail Areas and Other Park Caves
- Appendix B - Entering Lechuguilla Cave
- Appendix F - Recreational Permit Caving
- Appendix G - Ranger-Guided Trips for the Public to Unimproved Areas

Exceptions to any of the guidelines for entry into park caves must be made in advance and will be recorded on the signed cave permit.

## **Selection of Trip Leaders**

Persons wishing to be designated as a trip leader will notify the Cave Resource Office or the off-trail coordinator for the Interpretation and Education Division (I&E). The person wishing to become a trip leader will be required to satisfactorily demonstrate a working knowledge of the trip route, cave safety, application of procedures and trip leader responsibilities, and must have served as assistant trip leader before becoming a trip leader. Successful completion of a minimum of three trips into the requested cave area is required before the Cave Resource Office will evaluate the eligibility of the person wishing to become a trip leader. Recommendations may also be made by other authorized trip leaders. An off-trail leader application must be completely filled out, signed by the applicant's supervisor, and submitted to the Cave Specialist for final approval. Once approved, the person will be designated a trip leader only for those areas of the cave that were requested.

Designated trip leaders who have been away from the park for six months or more will be required to take one refresher trip before they are allowed to lead trips.

## **Trip Leader Responsibilities**

Only those persons with current approval to act as trip leaders may do so, and only for those areas specified. Trip leaders who do not follow these guidelines will have their off-trail leadership privileges revoked.

1. A trip leader's first priority is the safety of each member of the caving group. A trip leader's second priority is the preservation of all cave resources.
2. A trip leader must abort any trip for questionable safety practices or behavior that is contrary to park rules and regulations and/or cave conservation demonstrated by any individual(s).
3. A trip must be aborted if any member of the team cannot physically continue or has problems overcoming obstacles. Never leave a team member alone to await the rest of the group's return.
4. The trip leader is responsible for providing information and orientation concerning the area of the cave visited, including the natural and human history relevant to that area of the cave.
5. The trip leader must insure that each member of the group is physically able to complete the planned trip. Trips should be paced to the slowest member of the party.

6. The trip leader must inform each trip member of the rules and regulations that apply and enforce them. He or she also insures that all solid and liquid waste is packed out and that historic, prehistoric, and other cave resource features are not disturbed.
7. Trip leaders may lead trips only into approved areas and must insure that all trip members remain on approved trails at all times.
8. Trip leaders should teach visitors on proper low-impact caving techniques, including keeping all gear within taped trails, minimizing contact with cave walls, and reusing already-impacted hand and footholds instead of using new ones.
9. Trip leaders must carry three independent light sources.

### **Age Limits**

Trip Leaders must be at least **18** years old and approved by the Cave Specialist. Trip participants must be at least **16** years old.

Children **15** years or younger may participate, but must be accompanied by a responsible adult (either their parent or guardian).

Participation on off-trail trips by those under **12** is not encouraged and must be approved on a case-by-case basis. Special trips for children under **12** may be approved by the Superintendent.

No one under the age of **6** will be permitted in any off-trail area, except on specially approved trips to the Beach area of Left-Hand Tunnel.

**NOTE:** Trip leaders have the responsibility for the safety and conduct of all participants and will have the final say over trips they lead. If the leader is uncomfortable with a participant (regardless of age) because of concerns over their ability to physically traverse an area safely or in a manner that will not unduly impact cave resources, the leader is encouraged to not allow that person to participate.

### **Guided Trips for the Public**

Approved trip leaders may lead these visitor trips following the approved Interpretation and Education schedule. Verbal authorization from the Cave Resources Office prior to the proposed trip is not necessary if the trip is offered during normal business hours and offered to the public. The trip leader will ensure that everyone on the trip reads the guidelines for visiting off-trail areas. One or two extra staff members or trainees may only be added to visitor tours as rare exceptions. The Operations supervisor and Cave Resource Office must give prior approval in order to add staff to visitor tours.

## **CARLSBAD CAVERN**

Ranger-guided trips for the public may only occur in the following locations and are limited to the numbers of visitors and trips listed.

**Left Hand Tunnel.** During normal business hours, trips for the public along the main route in Left-Hand Tunnel to the trail ending prior to the Troll Town Traverse do not require a permit to be filled out. These trips must stop at the junction to Right-Hand Fork.

The Beach - A total of 27 people (25 visitors plus 2 leaders).

Start of Moonmilk and Pool Area - A total of 22 people (20 visitors plus 2 leaders).

Beyond the Iron Pool - A total of 17 people (15 visitors plus 2 leaders). All visitors must be physically fit and sure-footed to enter this area.

**Lower Cave.** Six (6) trips total per week may be taken.

Short Loop - A total of 14 people (12 visitors and 2 leaders).

Long Loop - A total of 10 people (8 visitors and 2 leaders).

**Hall of the White Giant.** Two (2) trips per week may be taken.

Tour Route - A total of 10 people (8 visitors and 2 leaders).

## **SPIDER CAVE**

Ranger guided trips for the public may only occur in the following locations and are limited to the numbers of visitors and trips listed. Two (2) trips per week may be taken.

Tour Route - A total of 10 people (8 visitors and 2 leaders).

## **SLAUGHTER CANYON CAVE:**

Ranger guided trips for the public may only occur in the following locations and are limited to the numbers of visitors and trips listed.

Main Tour Route - A total of 27 people (25 visitors and 2 leaders).

Tom Tucker Room - A total of 27 people (25 visitors and 2 leaders).

Fossil Alley - A total of 20 people (18 visitors and 2 leaders).

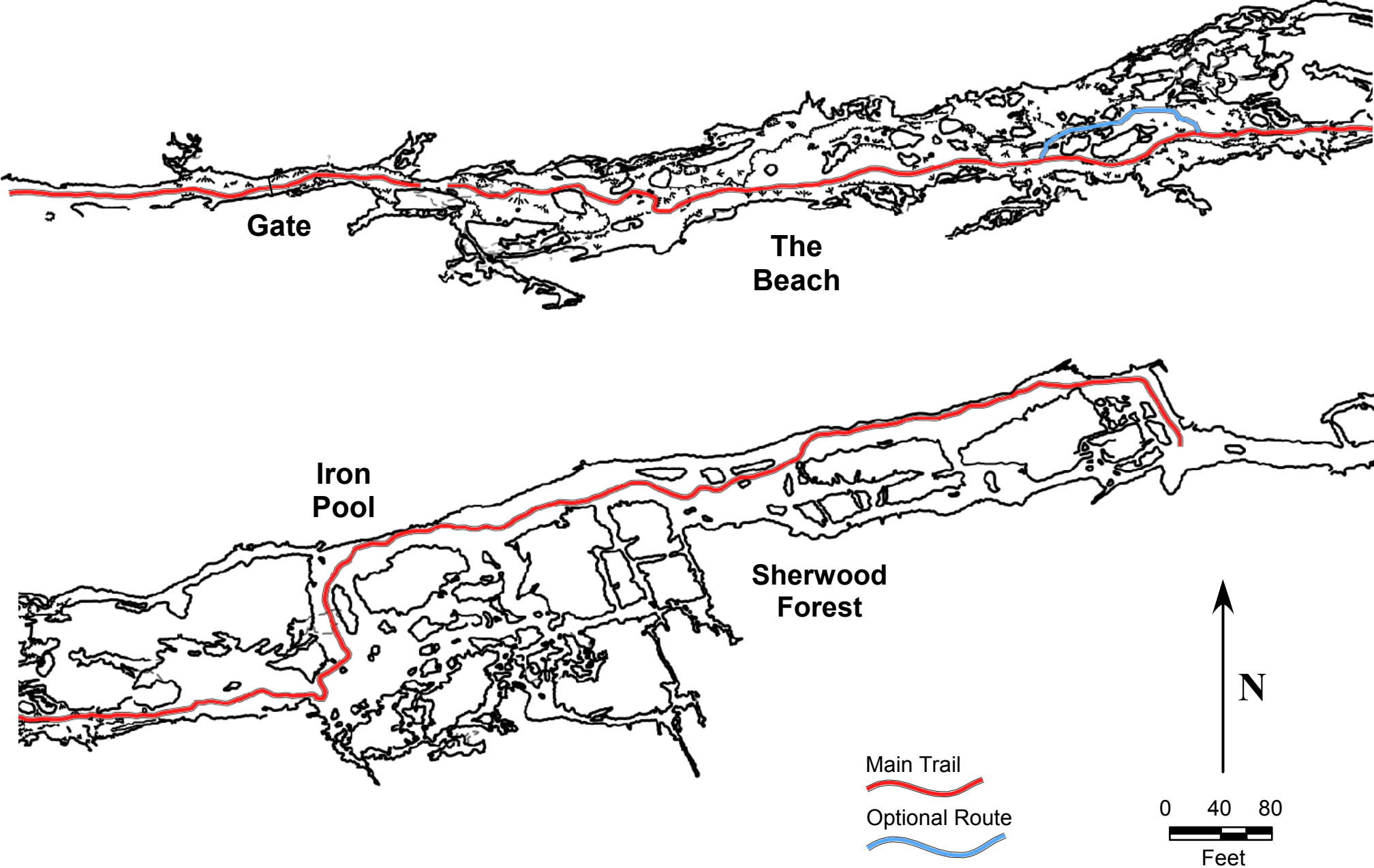
Mushroom - A total of 15 people (13 visitors and 2 leaders).

Pictograph Area – No more than 5 (4 visitors and 1 leader) at a time.

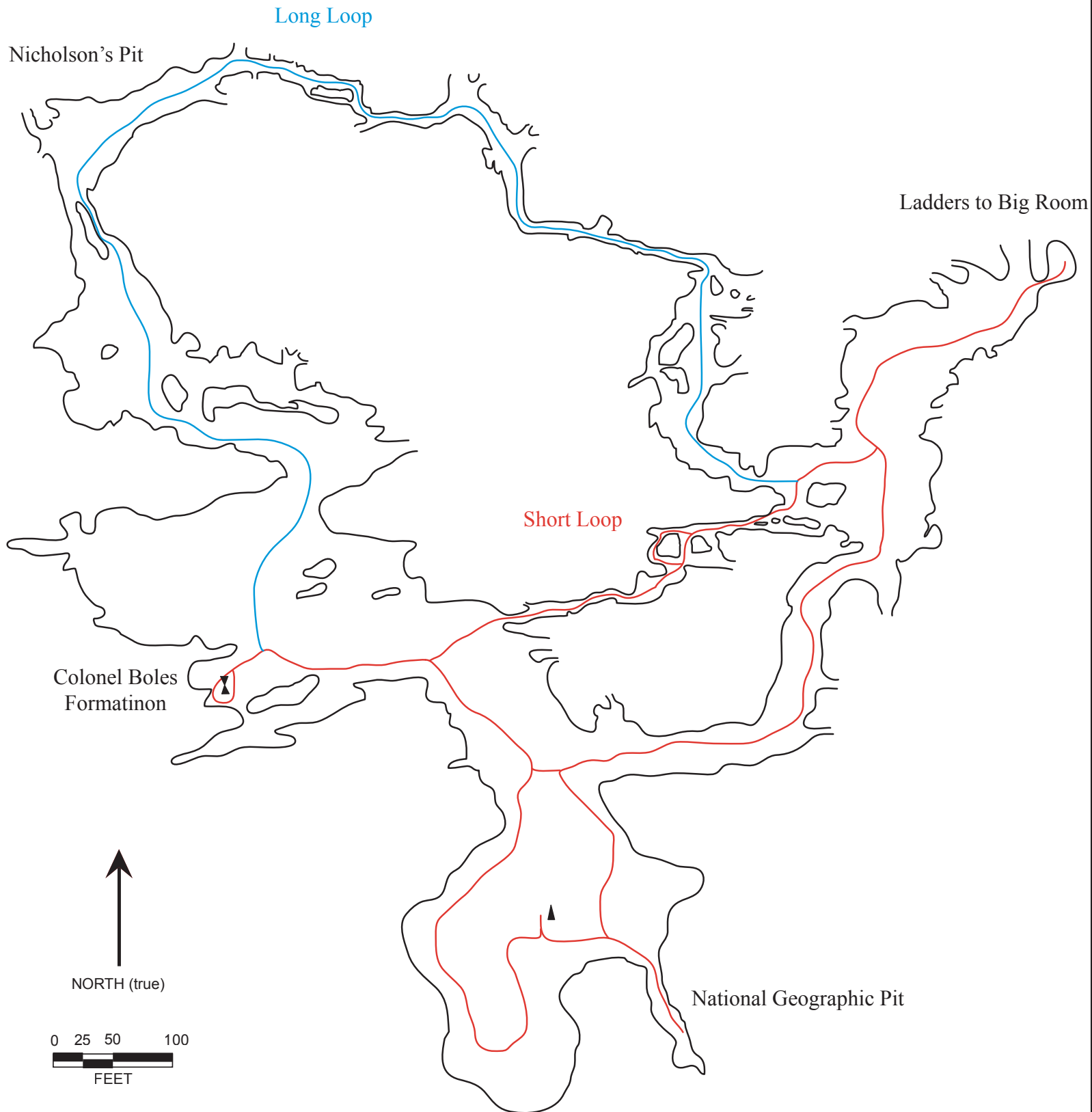
# Left-Hand Tunnel

## Route Map

Carlsbad Caverns National Park

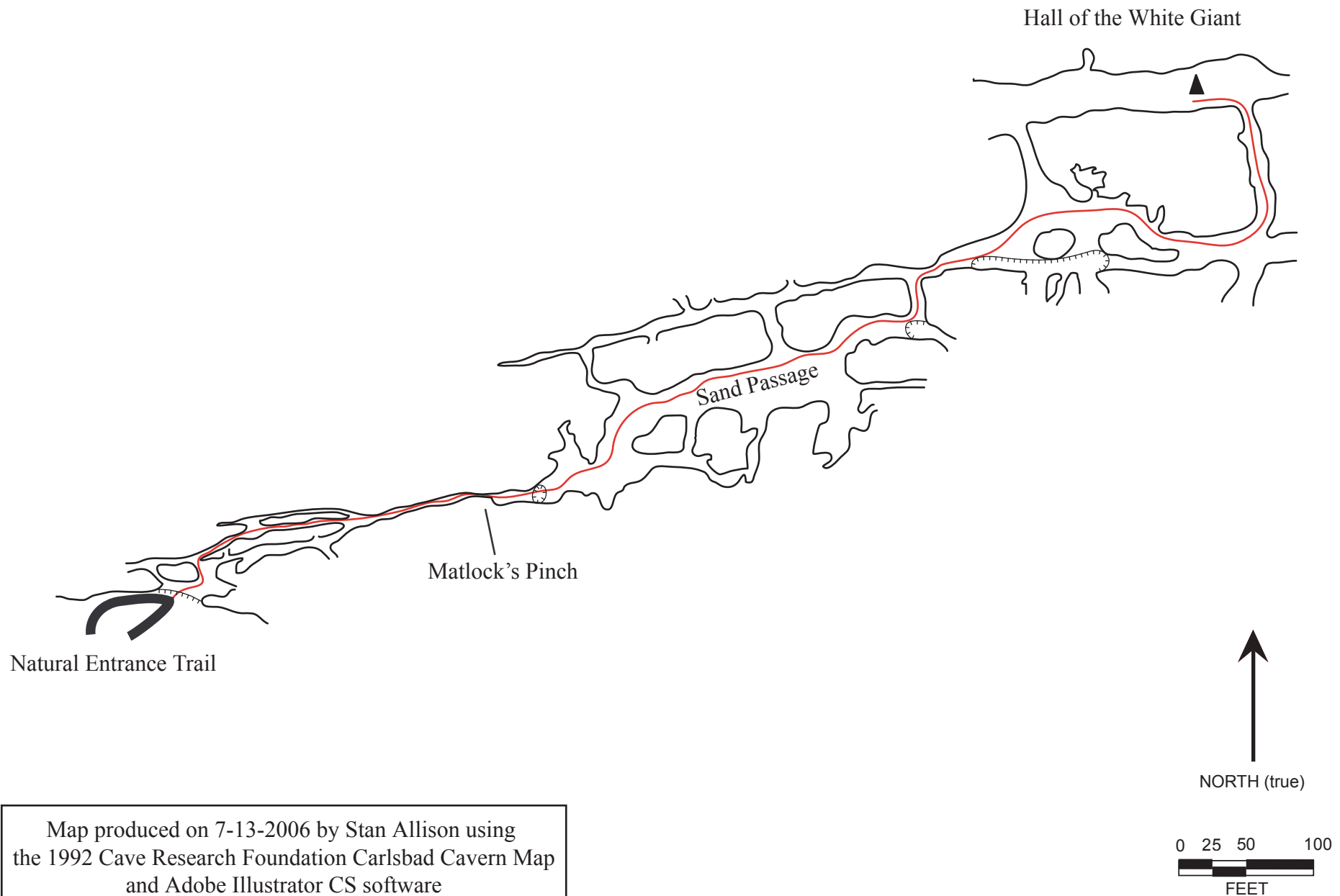


# Lower Cave Tour Route Map



Map produced on 7-15-2006 by Stan Allison using  
the 1992 Cave Research Foundation Carlsbad Cavern Map  
and Adobe Illustrator CS software

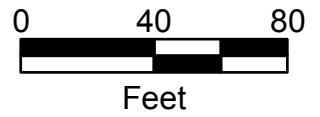
# Hall of the White Giant Tour Route Map



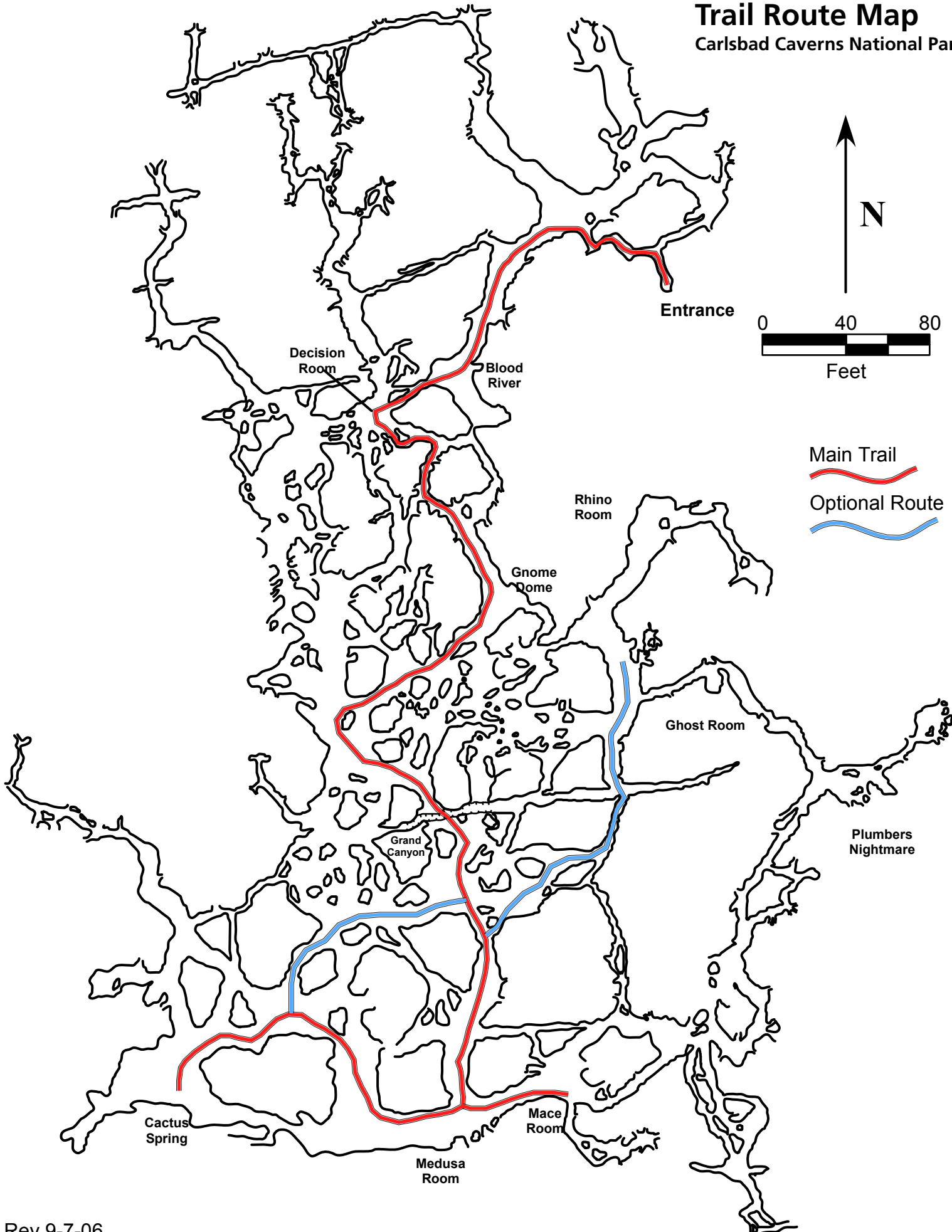
Map produced on 7-13-2006 by Stan Allison using  
the 1992 Cave Research Foundation Carlsbad Cavern Map  
and Adobe Illustrator CS software

# Spider Cave Trail Route Map

Carlsbad Caverns National Park



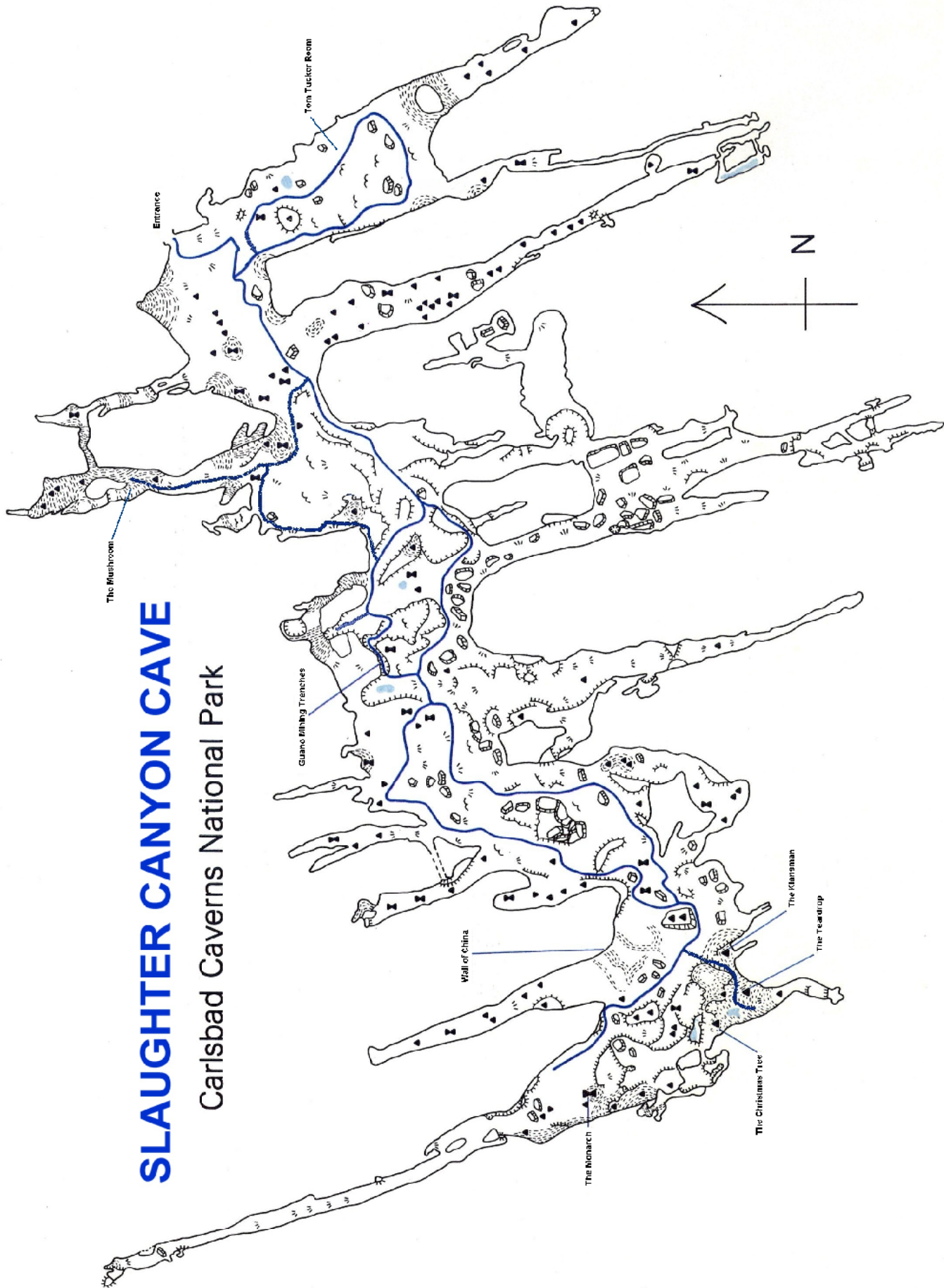
Main Trail  
Optional Route





# SLAUGHTER CANYON CAVE

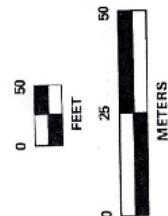
Carlsbad Caverns National Park



## LEGEND

- Trail
- Stalactite
- Stalagmite
- Column
- Flowstone
- Pool
- Slope
- Sharp Drop In Direction of Hatchure
- Breakdown
- Bat Guano

## SCALE



## **APPENDIX H – CAVE SEARCH AND RESCUE OPERATIONS**

### **Purpose**

Because of the technical nature of caves within the park, it is important for the park to maintain employee expertise in search and rescue activities. This expertise also extends to cave resource protection issues during a search or rescue event. In order to maintain an adequate level of preparedness, park employees should be trained in search and rescue, develop plans for performing rescue operations from frequently visited areas, and maintain rescue equipment in good condition.

### **Search and Rescue (SAR) Training**

It is important to maintain the ability to effect a search or rescue from caves within the park boundary. To accomplish a successful search or rescue operation means maintaining a readiness for action through equipment preparedness and employee (including volunteer) training. When personnel are available, SAR training will be provided to interested employees and volunteers several times during a year including a week long session on vertical rescue techniques. Agendas for this training will vary, but will cover basic items such as patient packaging, incident command, communications, rigging, horizontal rescues, low-angle and high-angle rescues, and other specific techniques.

When possible, these training sessions will also be available to outside agency personnel, especially employees from the BLM Carlsbad Field Area Office, Lincoln National Forest and the City of Carlsbad Fire Department.

### **Cave SAR Pre-plans**

Search and rescue SAR pre-plans will be developed, updated, and maintained for all off-trail visitor tour routes in Carlsbad Cavern, Slaughter Canyon Cave, Spider Cave, Ogle Cave, the main trade routes through Lechuguilla Cave, and for all caves available for recreational caving. These include Deep Cave, Christmas Tree Cave, Lake Cave, Goat Cave, Corkscrew Cave, Helen's Cave, Wen Cave, and Chimney Cave. These SAR pre-plans will be kept in an easy-to-find location within the Cave Resource Office and the SAR equipment cache in case of an emergency.

Pre-plans will include descriptions and photos of routes and obstacles with sufficient details to adequately provide rescuers with best practices on rigging and other aids to safely perform patient extraction from these remote areas.

### **SAR and Caving Equipment Cache Use Guidelines**

The Cave Resource Office maintains caving equipment and a SAR cache for use during short-term, work-related activities and emergency situations. In addition, caving ropes and hardware, such as bolts for rigging ropes, are left in-situ in park caves over long periods of time.

For work-related activities, including training in proper use of vertical caving gear, equipment can be checked out to employees for use. During an emergency, equipment for SAR activities will be provided to trained personnel.

**Caving Equipment Check-out/Check-in Procedures.** The following procedures outline the requirements and procedure for checking out caving gear.

- An employee will plan ahead and work with Cave Resource Office personnel to arrange a time to pick up equipment.
- Each item needed will be inspected to make sure it is in good working condition.
- Each item needed will be written on a check-out sheet with the name of the employee and date checked out.
- Equipment will be checked out as close to the date of use as possible and returned in a clean, working condition as soon as possible after the date of use
- Muddy or otherwise dirty ropes, webbing, and hardware will be cleaned before their return to the cache
- Any problems with the equipment will be relayed to the Cave Resource Office personnel when checked back in.
- The date of equipment return will be filled out to complete the check-out/check-in procedures.

**Maintenance Protocols.** The following protocols will be followed for assuring that all equipment is maintained in a good, safe working order.

#### Climbing Equipment

- Climbing equipment will be inspected at both check-out and check-in.
- Any adverse conditions that were encountered that could impact the condition of the equipment must be reported at the time of equipment check-in.
- Climbing equipment will be retired if it shows signs of corrosion.
- Climbing equipment will be retired if it has been dropped ten feet or more onto a hard surface.
- Climbing equipment will be retired if it shows signs of dropping or abuse.
- Carabiners and screw links will be inspected to assure that the gates close and lock securely.
- Gate hinge springs will be inspected (if visible) for signs of rust.
- Carabiners may be washed if grit or mud is preventing proper closure. Washed equipment will be thoroughly inspected after drying for signs of corrosion.
- If equipment needs lubrication, excess lubricant will be cleaned off.
- Webbing on climbing harnesses will be inspected to the same standards as all other webbing.
- Harnesses will be tagged with a purchase date.
- Harnesses will be retired if buckles or other hardware show signs of corrosion or abuse.
- Harnesses will be retired after 10 years of service.

## Ropes and Webbing

- Ropes and webbing will be tagged with length and year of purchase.
- Ropes and webbing should be retired, regardless of apparent condition after ten years.
- Ropes will be retired when sheath shows signs of heavy abrasion or ropes will be cut to remove abraded section and retagged to show new length.
- Ropes will be retired when there are indications of core damage such as lumps, kinks, soft-spots or gaps.
- Webbing will be retired if it shows signs of heavy abrasion. Heavy “fuzzy” appearance is an indicator of such abrasion.
- Webbing will be retired if it shows signs of nicks or cuts.
- Ropes or webbing will be retired if they show signs of sun fading.
- Ropes or webbing will be retired if they show signs of corrosive, oxidizer, or exposure to unknown chemicals.
- Retired ropes will be cut into sections of twenty feet or less and used for low to medium angle handlines (depending on condition), given to maintenance for securing loads, used for knot-tying practice, or thrown away. No other uses may occur for this retired rope.
- A fixed-line log is maintained with installation dates and rope length recorded.
- Dynamic ropes will be retired if they are subjected to a factor 2 fall.
- Dynamic ropes will be retired if they are older than ten years.
- Dynamic ropes will be retired when sheath shows signs of heavy abrasion or ropes will be cut to remove abraded section and retagged to show new length.
- Fixed ropes should be replaced every ten years regardless of apparent condition (or on the first trip into the area after the ten year deadline).

All load-bearing equipment, ropes, and webbing will be retired if subjected to a shock load greater than 50 percent of their rated capacity.

All equipment, ropes, and webbing will be retired if subjected to a static load greater than 75 percent of their rated capacity.

## **Initial Action Plan**

The intent of planning and executing a successful cave rescue is to: 1) maintain safety and health of all rescuers, 2) care for the patient in appropriate manner and extricate the patient as efficiently as possible, and 3) minimize impact to park resources.

## **General Sequence of Events in a Cave Rescue**

The following section outlines the sequence of events, response, and responsibilities in case of a cave rescue.

1. Caver is hurt or lost and the incident is reported to park staff.
  - Party may be overdue, or one member of patient's team exits cave and reports incident.
2. Incident Commander (IC) and possibly Underground Coordinator (UC) is established
  - The Incident Commander has overall responsibility for conducting the search or rescue.
  - The Underground Coordinator is responsible for overseeing all activities below the surface and carrying out directions from the IC.
  - The trip leader on the cave trip where accident occurs will typically be the first IC.
  - A trip participant that is sent out of cave for help becomes IC and the most experienced person remaining in the cave becomes Underground Coordinator.
  - The first NPS employee to be notified of the incident will assume the Incident Commander role from any previous IC.
  - When the IC contacts other NPS staff, he should inform the staff he is acting as the IC. NPS staff with more experience than the acting IC may assume the role of IC and must communicate this to everyone involved in the rescue.

3. Once an NPS employee is notified and assumes the IC role, he will ensure that the following notifications occur. These notifications are not limited to normal work hours only, but will include the need to notify officials at home as well.
  - If the incident occurs on a public off-trail tour the Interpretation Supervisor will be notified. The Interpretation Supervisor will notify the Chief of Interpretation and Education.
  - Law Enforcement (LE) will be notified. The Chief Ranger will be called first, then other LE staff if the Chief is not available.
  - The Cave Specialist will be notified. If the Cave Specialist is not available, other Cave Resource Office employees should be contacted.
  - The Cave Specialist will notify the Resources Stewardship and Science (RS&S) Division Chief.
  - The RS&S Chief will contact the Superintendent.
  - Depending on the complexity of the incident, one of the above may assume the IC role.
  - Retrieve the rescue pre-plan.

Rescue pre-plans for all public access caves, common off-trail areas of Carlsbad Cavern, and portions of Lechuguilla Cave are located in a notebook in the rescue cache at the Cave Resource Office. Each pre-plan includes a list of equipment that will be needed for each area. These materials should be assembled by the rescue team leader or his designee and be ready to go as soon as possible.

Many rescue supplies, including the tactical kits, are located in the locked steel cabinet on the east wall of the rescue cache. All law enforcement rangers and Cave Resources staff have a key to the cache and cabinet.

#### 4. Entrance Control is established

- Entrance control (EC) is established. A person should be located at the entrance to the cave or cave area to maintain control and record who and what equipment is entering or leaving the cave or cave area, their destination, and the time of their arrival or departure. No one shall be allowed to enter the cave or cave area without a valid task assignment. It is critical to assure that everyone is accounted for at the conclusion of the incident.
- If the incident is at Hall of the White Giant (HWG), Lower Cave, or Left Hand Tunnel, EC will be established at the HWG turn-off from visitor trail, the gate from the visitor trail to Lower Cave, or at the east end of the Underground Concessions area leading into Left Hand Tunnel. In other cases EC may station himself at the cave entrance or in some cases at the trailheads to caves such as the Slaughter Canyon Cave parking lot.
- Entrance control should have communications with the IC and rescue party.

#### 5. Initial Response Team (IRT) is sent into cave.

- Preferably, this party should have at least one medically trained person.
- The IRT is a small light team that can quickly get to the patient and assess the situation and provide more information to the IC.
- In the case of a search, this team should do a hasty search. A hasty search is a rapid search of the most likely routes or areas where the subject may be located.

#### 6. Communications Team is sent into cave if necessary.

- If the IC (based on IRT recommendations) determines the need for direct communications with the patient and the recovery team, a Communications (Comm) team will establish a field telephone at the entrance of the cave, typically where the EC is located.
- The Comm Team will roll out field telephone wire into the cave, establishing phones where appropriate (normally at major passage intersections and the top and bottom of pits).
- The Comm team will document all radio transmissions and field phone communications on paper.

7. Litter and litter hauling teams enter the cave if necessary.
  - The Underground Coordinator will direct the extraction of the patient.
8. Rigging teams enter the cave if necessary.
  - Based on SAR pre-plans and current conditions, the IC will coordinate and direct teams entering the cave for rigging vertical drops or other special needs areas in preparation for litter transport through those areas.
9. Support teams enter the cave if necessary.
  - Based on anticipated needs for all teams in the cave, it may be necessary for the IC to provide teams to transport food, water, and other items into the cave and transport trash, waste products, or other items out of the cave until the operation is completed.
10. If necessary, medical transport of patient is arranged via Carlsbad EMS.

### **Selection of Rescue Personnel**

Cave rescues must be conducted in the most safe, efficient manner and with minimal impact to the cave. Therefore, caving parties are encouraged to perform self-rescue if possible. If this is not possible, additional rescuers will be necessary. Cave rescues should be conducted with the minimum people necessary to safely and efficiently perform the rescue. Additional rescuers will create communication difficulties and logistical issues, and they can result in a slower and less safe rescue, and can be detrimental to the cave.

Personnel initially involved in a cave rescue will be NPS staff and cavers who are already in the cave or are on site for other projects.

Additional personnel may be called in from within the park, locally, or nationally, depending on the size and complexity of the incident and the particular skills that may be required.

Four rescue call-out lists (below) will be maintained. As the need for human resources grows, cavers and rescue personnel should be contacted in the following order, and if they have the appropriate skills:

1. NPS staff
2. Cavers within a 1 to 2 hour travel radius of CAVE
3. Cavers within a 2 to 12 hour travel radius
4. Cave rescue personnel from around the U.S.



The call-out lists will include work and home phone numbers, vertical caving skills, SAR skills, medical training, and familiarity with park caves. In the case of Lechuguilla Cave, the areas the caver is familiar with should be listed.

Cave rescue personnel contact information will be updated at least yearly.

Pre-plans will be maintained for all off-trail visitor tours, recreational permit caves and the main routes in Lechuguilla Cave. These pre-plans will be available and consulted in the case of a rescue.

To obtain a broad array of additional resources, the IC may notify NM State Police (885-3137) and request a state mission be initiated. The park will maintain control of the incident through a unified command structure.

Note: The State Police, NOT THE COUNTY, have jurisdiction over all SAR activities within the State of New Mexico except on NPS and military reservations. These agencies are assumed to have their own rescue capabilities and the state will only come in if requested.

State rescue resources are covered by insurance through the State Police if a state mission number is assigned, so they do not need to be signed up as park volunteers to be protected. Critical resources, including air support, may also be ordered through the State Police.

**In-park cave rescue contacts** (Current as of July 2006):

Tom Bemis (Cell 361-4572, W 785-3104, H 885-4572)  
Stan Allison (W 785-3105, H 628-3652)  
Nate Riegelmayr (Cell 361-4404, W 785-3338, H 785-1035)  
Dennis Milligan (Cell 406-679-0251, W 785-3337, H 785-1003)  
Dale Pate (W 785-3107, H 628-8384)  
Paul Burger (W 785-3106, Cell 302-3673)

Local cave rescue contacts:

Nate Skelton - Carlsbad Fire Department (Cell 302-3837, W 885-2111)  
Jim Goodbar - Bureau of Land Management (W 234-5929, H 236-1016)  
Harry Burgess - City of Carlsbad (W 887-1191)  
Pat Seiser - (Cell 361-2283, W 234-5570, H 887-7356)

Additional local manpower:

La Huerta Volunteer Fire Department (technically semi-skilled, state recognized)  
Joel Volunteer Fire Department (technically semi-skilled)  
Waste Isolation Pilot Project (technically semi-skilled)  
Happy Valley Volunteer Fire Department (unskilled, good logistics support)

## APPENDIX I - CAVE AND KARST FEATURE DOCUMENTATION

### Purpose

Documenting caves and karst features within the boundaries of Carlsbad Caverns National Park provides information for research, management and interpretation of these resources. In order to make this information more usable, it is necessary to collect and store these data in a standardized manner. Cave and karst feature names, locations, maps, trip reports, photograph and contents are sensitive information that should be managed according to all applicable laws, regulations and the “Sensitive Resources Information Standard Operating Procedure for Carlsbad Caverns National Park,” SOP 04-16 (in Appendix O - Standard Operating Procedures, Protocols, and other Supporting Documents).

### Definitions

The Federal Cave Resources Protection Act (FCRPA) of 1988 defines a cave as:

*Any natural occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other manmade excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance.*

The Department of Interior regulations (43 CFR Part 37) implementing the FCRPA state the following:

*The policy of the National Park Service . . . is that all caves are afforded protection and will be managed in compliance with approved resource management plans. Accordingly, all caves on National Park Service-administered lands are deemed to fall within the definition of “significant cave.”*

The following definitions are used by Carlsbad Caverns National Park:

Cave - A cave must be traversable by a human, must be a minimum of 50 feet long and its entrance cannot be as wide as the cave is long. A vertical cave must be at least 20 feet deep.

Karst Feature - Cavities, blowholes, or other solution features that seem to be cave-related, but do not fit the definition of a cave.

## **Cave and Karst Feature Numbers and Names**

All cave and karst features will be assigned numbers based on the chronological order of their discovery. Caves will be assigned numbers prefixed by a “C” and karst features will be assigned numbers prefixed by a “KF”. Caves and karst features may also be assigned names. Discoverers can name a new cave or karst feature, but it cannot be named after a living person nor be inappropriate or distasteful. Also, it may not be named after a geographic feature that could give away its location. All new names are subject to Cave Specialist approval.

## **Cave/Karst Feature Discovery Procedure**

When a cave or karst feature is observed, the initial discoverer should search for a brass cap near the entrance drip-line to determine if the cave is previously known. If a brass cap exists, the cave is a known cave and may not be entered without a permit. If the cave has no brass cap and is not documented, it may be entered for a distance of no more than 50 feet to determine if it is a cave or a karst feature. This initial entry should not be undertaken if it cannot be done safely or would cause more than minimal impact to the resource.

Once a cave or karst feature has been located, the Cave Specialist should be contacted. Based on the location and description of the cave or karst feature the Cave Specialist can determine whether the cave or karst feature is previously documented. If it is a new discovery, the Cave Specialist or designate will lead a return trip to document the cave or karst feature with the initial discoverer(s), if possible.

## **Cave/Karst Feature Documentation**

### **Caves**

All caves will have 3” diameter brass caps with the “C” number stamped on them placed at or near the entrance, preferably right at the drip-line. Cave names will not be placed on brass caps, although they may be found on pre-existing brass caps. The brass caps will be secured with a two-part epoxy. Brass caps will be placed with a hand drill within the designated wilderness areas of the park and may be placed with an electric hammer-drill in non-wilderness areas.

All brass caps will be located using differentially corrected GPS and the appropriate GPS metadata sheet will be filled out. It may be necessary to obtain a GPS location that is offset from the brass cap due to satellite shielding by cliffs and vegetation. These offsets will be surveyed using cave surveying equipment and documented in the GPS meta-data sheet. The processing and storing of these GPS locations is done in conjunction with the park GIS Office.

All caves will be surveyed in accordance with the “Cave Survey Guidelines for Carlsbad Caverns National Park” (Appendix C) as they are explored. All caves will be inventoried in accordance with the “Cave Feature Inventory Guidelines for Carlsbad Caverns

National Park” (Appendix D) as they are explored. No exploration will take place without survey and inventory. The brass cap will always be tied into the cave survey and ideally the first station in a cave survey will be the brass cap. All caves should be photo-documented at the entrance and within the cave. Information concerning photo location related to the nearest survey station, date and photographer should be recorded. All cave documentation and exploration trips are required to have a trip report that describe the “who, what, where, and when” for that trip.

### **Karst Features**

Karst features will either be GPS'd or have their locations marked on a topographic map. Karst features may be surveyed or sketched as appropriate. Karst features should be photographed. Trip reports should be written for karst features.

Karst features may contain scientifically important features. Features such as speleothems, archaeological or paleontological materials, or nests and other important biologic features will be noted in the trip report. Detailed inventory of features found in karst features may be warranted and must follow the guidelines outlined in Appendix D.

### **Cave/Karst Feature Data Management**

Every cave/karst feature should have at least one file with the following information: Cave/Karst Feature location map, GPS meta-data sheet, trip reports, inventory notes, survey notes, cave maps and photographs. These files are stored in the locked, fireproof backcountry cave file cabinet. Trip reports will be stored in chronological order. Survey data will be entered and managed as per the “Cave Survey Guidelines for Carlsbad Caverns National Park” (Appendix C). Inventory data will be entered and managed as per the “Cave Feature Inventory Guidelines for Carlsbad Caverns National Park” (Appendix D). Photographs should be referenced by the nearest survey station, date and photographer.

Spreadsheets should be maintained to track names and numbers for both caves and karst features. The cave spreadsheet will also include cave survey length, depth, presence of brass cap, location method (GPS or topographic map), inventory status, survey status, map status, availability of scanned survey notes, whether the cave is gated or not and what key is needed and photo-documentation status.

In addition to the paper files, digital files of cave and karst feature information should also be maintained. It is critical to store these digital files in a secure location as once digital data has been released it can spread extremely quickly through numerous digital networks. These files should be backed up on CDs or DVDs and stored in the fireproof, locked cave file cabinet.

## **APPENDIX J - CAVE MONITORING**

### **Purpose**

The purposes of monitoring various parameters in caves are: 1) to establish a baseline of data that can be used to gauge future impacts or potential impacts on cave and karst resources, 2) gather long-term data that can be used to increase our understanding of cave and karst systems to better protect them, and 3) to establish measurable parameters that may be used to develop thresholds that may trigger potential changes in management policies.

All monitoring studies in the park, including network-determined vital signs for caves and karst, hydrology, and cave biology will be developed using short-term study plans. These short-term studies will be used to develop long-term monitoring protocols that can be used to maintain consistent data collection, analysis, and storage.

### **Part I. Development of Study Plans and Protocols**

There are no universally-applicable protocols or methodologies that have been developed to monitor cave climate, impact, hydrology, biology, or microbiology. Scientific research has shown the environment surrounding and affecting the cave or cave area will govern the effective types and applicability of monitoring. To determine the applicability of different methods to the caves of Carlsbad Caverns National Park, multiple studies must be conducted. These studies must be well-documented and conducted in a consistent manner to determine which methods will be effective at the park.

To reduce the amount of trial and error involved in the development of strict monitoring protocols from scratch, cave monitoring methodologies will be developed using the following four-step process:

1. Review of existing literature
2. Study plan development
3. Review of results
4. Development of monitoring protocols

### **Review of Existing Literature**

Examine published literature and gray literature (studies done for other parks or agencies) for monitoring studies that were used to measure impacts or develop baseline data sets for the parameter to be measured. Critically evaluate the limitations, assumptions, and successes of those studies to determine their applicability to the cave and karst resources at Carlsbad Caverns National Park.

Consult with researchers, other cave managers, and other professionals for guidance that may not appear in published reports. Carlsbad Caverns has long-standing partnerships with many researchers and research organizations that should be used as resources to help develop monitoring programs.

### **Study Plan Development**

Use the information gathered from literature and consultation with experts to develop a study plan to evaluate monitoring methods. The study plan should have well-documented goals and initial methodology. By design, study plans are meant to adapt to changing knowledge and to preliminary evaluations of gathered data. During the course of a study plan, it may be necessary to change the sampling frequency, sample locations, equipment, or other aspects of the program. The study plan should have fixed times for critically evaluating the results and effectiveness of the method.

In general, the most effective way of documenting these types of studies is to establish a notebook that contains all of the information related to the study. Most notebooks would have the following information:

Purpose and goals of the study – What are the parameters being measured and why? What do you hope to get out of the study? How will the data be used for better understanding or management purposes?

Initial sampling procedures – What methods are you using? What equipment (type, serial numbers, software version, etc.) is being used and what is its accuracy and precision? Where are your sample locations and what is the frequency of data collection?

Survey design – What methods are you using? How are survey locations determined?

Data management and analysis – How will the data be managed, including ensuring redundant backup of both paper and electronic data? What methods will be used to analyze the data and why?

Timeline and method for evaluating results – Set a timeline for evaluating the results of preliminary data. For long-term studies of parameters that are not expected to change frequently, this timeline would likely be longer than a study that involved hourly data. Develop criteria for evaluating whether or not the monitoring is achieving your goals. Also establish a timeline for a full evaluation of the study (i.e., Is this a one-year or five-year study plan?).

Ongoing, sequential log of activities/changes associated with the study –

- Record each site visit/data download
- Record any damage to equipment or factors (i.e. dead batteries) that may affect the data or results
- Record removed, added, or changed sample locations
- Record changes in data collection frequency for loggers
- Record changes in methodology, etc.

A bound notebook is recommended for maintaining logs since pages cannot be lost or inserted and it is less prone to catastrophic loss. If a digital file is used as the scientific notebook, make sure that the information is backed up frequently and that hard copies are made and stored on a regular basis.

### **Review of Results**

At the end of the study plan, the methodology will need to be fully evaluated and the data analyzed. The results should be written up as a report subject to peer review. It is recommended that the results be critically evaluated by internal resource professionals and outside experts. This may be done by publishing the results in a peer-reviewed journal where the results will be evaluated before and after publication.

Once the results have been thoroughly reviewed, a new study plan may be developed to test a more effective method, or the study plan will be developed into a strict monitoring protocol.

### **Monitoring Protocol Development**

Once a study plan has been completed or the decision has been made to use pre-existing methods or protocols, park protocols will be developed. The monitoring protocol should contain the following sections:

Purpose and Need – Why the monitoring is being conducted and how it will be used to make management or other decisions.

Supporting Documentation – This section should contain references to the study plan or existing published methods in support of the protocol. This section should justify the selection of the method and document any limitations or assumptions that may affect the reliability of measurements.

Qualifications and Training – What are the required qualifications for personnel conducting the study? List the qualifications of those collecting the data as well as performing the analysis. If applicable, list the training requirements for those who are collecting and analyzing the data.

Methods – Detail the collection methods, equipment, frequency, quality assurance/quality control requirements (i.e., calibration), and sample handling and tracking requirements.

Data Collection, Storage, and Archiving – Detail how the data is collected and stored (either analog or digital data) and the requirements for long-term storage. If the data is to be stored digitally, include guidelines for data migration as software and hardware change.

Data Analysis – Detail the methods, limitations, and assumptions used to analyze the data. Include any standard outputs required for long-term comparisons of data.



Reporting Requirements – Detail the types and frequency of reports used to present or summarize the data either for scientific peer review or for use by management.

Monitoring protocols should be subjected to peer review prior to final implementation. Once the protocol has been reviewed and modified as needed, it should be amended to the most current Cave and Karst Management Plan as an appendix.

## **Part II. Summary of Current, Ongoing Studies**

### **Climate Monitoring**

#### Purpose

To characterize temperature and humidity within the caves of Carlsbad Caverns National Park. This includes monitoring how temperature and humidity change with time and spatially within park caves.

#### Study Plan General Methods

*Loggers.* Hobo™ loggers are used to constantly monitor changes in temperature and humidity. Loggers take a reading every two hours and data is collected from each logger once a month using a data shuttle. Every six months, loggers are changed out and batteries are replaced if needed. Data is compiled in Excel™ and is backed up onto the park server after each download and backed up onto CD every six months.

*Spot readings.* Readings are taken in additional locations and at other caves using a handheld thermohydrometer. Readings are taken in any new caves found in the park as well as multiple locations in longer caves to document the temperature and humidity of caves at different elevations, depths, and geomorphic characteristics.

### **Photomonitoring**

#### Purpose

To document damage caused by visitation in order to make management decisions concerning carrying capacity, access, and use of areas in park caves.

#### Study Plan General Methods

Photos are taken of specific areas from a well-documented, fixed point at a fixed angle to ensure consistency between photographs. Each site has a specified photo frequency based on traffic and other factors. Subsequent photos are compared to visually determine the amount of degradation occurring over time.

### **Impact Mapping**

#### Purpose

To document damage caused by visitation in order to make management decisions concerning carrying capacity, access, and use of areas in park caves.

#### Study Plan General Methods

The amount of impact on a specific section of cave floor is mapped on a plan view base map of the area. The level of impact is defined by the amount of damage caused by past traffic and divided into a relative, but carefully-defined scale (low to high). Each site has a specified mapping frequency based on traffic and other factors. Subsequent maps can be compared numerically (as a function of amount of each disturbance level) to determine the amount of degradation occurring over time.

## **Lechuguilla Water Level Monitoring**

### Purpose

To determine the nature of pool fluctuation in the cave and the potential adverse effects of visitation and use on these pools. One of the pools is connected to the regional aquifer system and is monitored to help understand the nature of fluctuations in the water table.

### Study Plan General Methods

*Loggers.* Two pools contain loggers that sample pool levels every two hours. The data are collected at least semiannually and stored in Excel™. The data are backed up onto the server after each download and yearly onto CD.

*Spot measurements.* Rulers have been set up in more than 10 pools in the cave. These water levels are read by volunteers conducting survey, inventory, and research in the cave and recorded on Mylar sheets that are left in the cave. Once a sheet becomes nearly filled with data, it is replaced and the old sheet is removed from the cave and the data is input into Excel™. The data are backed up onto the server after each transcription and yearly onto CD.

## **APPENDIX K – SAMPLE TRACKING**

### **Purpose**

To preserve geospatial information about samples taken from park caves, it is important to be able to track any sample back to its original location. Even if a sample will be completely destroyed during analysis, it needs to be tied to a physical location to ensure future reproducibility. This includes, but is not limited to water samples, rock or soil samples, fossil samples, and air samples. It is also important to tie temporary sample sites to a physical location, including monitoring stations, invertebrate traps, locations where glass or rock slides have been left, lint accumulation stations, dye trap locations, and drip collection locations.

### **Prior to collection**

Before any sampling may take place, the collector must have a signed, valid research permit that allows sampling. The permit will stipulate the type, number, and amount of sampling that is allowed. All research performed in Carlsbad Caverns National Park must be submitted through the on-line research permit system found at:

*<https://science1.nature.nps.gov/research>*

Each sample or sample location should have a unique identifier. In the case of research projects where accession numbers has been assigned by the park, that number can be used as a prefix for individual samples. Some researchers have a set method for identifying locations based on their project number, date, cave, or other information. The nearest survey station can also be used as a prefix for a unique sample identification number, but should not be used as the sole identifier because other researchers may collect samples near the same station or the researcher may collect multiple samples from the same general location. The recommended sample naming convention in preference order is:

- Park-assigned accession number (prefix) – Sample number
- Researcher – assigned accession number
- Survey Station (prefix) – Sample number

The naming convention should be decided prior to any sampling and should be identified in the research proposal, research plan, field notes, or field report.

## Data Collection

There are two basic kinds of data collected in the field, the park sample tracking form and the researcher field notes (including written notes, photographs, sketches, etc.). Original sample tracking forms must be returned to the park along with copies of field notes (physical or digital copies are acceptable). The next sections describe each of the fields that must be filled out in the sample tracking forms.

### *Sample Tracking Form – Header Information*

Collector \_\_\_\_\_ **Cave Name** \_\_\_\_\_  
Principal Investigator \_\_\_\_\_ Date Collected \_\_\_\_\_  
Permit Number \_\_\_\_\_

Collector – the person physically collecting the sample or establishing the sample site.

Principal Investigator – the permit holder for the research

Permit Number – the research number assigned by the National Park Service on-line research permitting and reporting system.

Cave Name – the name of the cave (if applicable), otherwise the general surface location of the sample or sampling site.

Date Collected – what day the sample was taken or sample site established.

### *Sample Tracking Form – General information*

Sample Type	Equipment left in cave:		
Rock _____	Type	Tracking #	Date
Corrosion residue _____			Removed
Water _____			
Mineral _____			
Other (specify) _____			
Notes:			

Sample Type – the general type of sample being collected.

Equipment left in cave – if a sampling or monitoring site is being established, the type, equipment serial number (or other unique identifier), or site identifier is entered here.

When the equipment is removed, the original form in the park files will be modified to include removal date.

Notes – any information that could be used to identify the type of sample, purpose of sampling, type of analysis, etc., that is not captured in other sections of the form.

### *Sample Tracking Form – Location information*

Survey to Sample or Science Station					
From Station	To Station	Distance	Azimuth	Inclination	Sample Notes

For samples or sites within a cave, all locations should be tied to survey stations, using survey instruments. The nearest survey station is the “From Station” and the sample site is the “To Station.” The name of the “To” station should be the unique sample identifier. In some cases, it will take several shots to reach a sampling station from the nearest station, so there will be several pairs of “From-To” stations entered on the form. For distance, either English or metric units are acceptable, but make sure to indicate what units are being used. Azimuth and inclination should be read in degrees.

For surface samples, GPS locations (preferred) or locations from topographic maps can be used in lieu of survey stations. The site name or sample identifier would be entered in the “To” field and the lat-long or other GPS information would be entered in the distance and azimuth fields. In the notes section, make sure to indicate which reference system is being used and be sure to include the units and direction (i.e. east or west).

Sample notes would include more detailed information such as Yates backreef sample, pink corrosion residue, brachiopod fossil, etc.

*Sample Tracking Form – Individual sample information*

<b>Individual Sample Tracking</b>				
Sample Number	Amount of sample	Type of test	Date sample returned to park	Date results reported to park

Sample Number – the unique sample or site identifier

Amount of sample – include approximate weight or dimensions as appropriate and include units.

Type of test – what type of analysis is being performed

Date sample returned to park – Upon receiving sample from investigator, this field would be completed by park. In cases where the sample will be destroyed, enter “NA” in this field.

Date results reported to park – Upon receiving preliminary or final report of analytical results, the park will complete this field on the original form.

### **Digital Tracking Forms**

The researcher may complete the forms digitally from field notes (provided that all of the required information is included) or from field copies of the tracking form. If the park receives only paper copies, the park will transfer the data to a digital version of the form. The files should be named using the following naming convention:

Sample Investigator Date (optional alpha suffix in cases where multiple forms were filled out on the same day).

For Example: **Sample Burger 2006-01-05 A.doc**

Digital forms will be archived by the park at least every six months in case of hard-drive crash or network failure.

**Paper Tracking Forms**

Sample tracking forms (originals and printed copies of the digital forms), along with copies of field notes, printed photographs and other supporting information should be filed into a sample tracking notebook for later reference and for completing sample information later.

**Sample Cataloging**

Samples not destroyed during analysis must be accessioned into the Park museum but may be retained by an approved university or institution. Samples not to be retained in an approved location outside the park must be returned to the park. Samples may not be kept in personal collections. Each sample should be clearly identified by accession number and unique sample identifier. When the sample is returned to the park, it should be recorded onto the original sample tracking form and then sent to the museum specialist or designate to accession permanently into the park archives and NPS database.

# Carlsbad Caverns National Park Cave Sample Tracking Form

Collector _____	Cave Name _____
Principal Investigator _____	Date Collected _____
Permit Number _____	

Sample Type

Rock \_\_\_\_\_.

Corrosion residue \_\_\_\_\_.

Water \_\_\_\_\_.

Mineral \_\_\_\_\_.

Other (specify) \_\_\_\_\_.

Equipment left in cave:

Type	Tracking #	Date Removed

Notes:

## **Survey to Sample or Science Station**

From Station	To Station	Distance	Azimuth	Inclination	Sample Notes

## **Individual Sample Tracking**

Sample Number	Amount of sample	Type of test	Date sample returned to park	Date results reported to park



Carlsbad Caverns National Park  
Cave Sample Tracking Form

Collector Grad Uate Student  
Principal Investigator Dr. Big Shot  
Permit Number 2000-13

Cave Name Spider Cave  
Date Collected 3/3/00

Sample Type  
Rock \_\_\_\_\_  
Corrosion residue \_\_\_\_\_  
Water x \_\_\_\_\_  
Mineral \_\_\_\_\_  
Other (specify) \_\_\_\_\_

Equipment left in cave:

Type	Tracking #	Date Removed
CR21x datalogger	#S1041-3128-WXB	
Orion temp probe	#Q87	
CR21x datalogger	#S1041-3183-WXB	
Humidity probe	#XG1	

Notes:

Water samples taken for chem analysis

Logger 3128 left at station XX2

Logger 3183 left at station WXB4A

**Survey to Sample or Science Station**

From Station	To Station	Distance	Azimuth	Inclination	Sample Notes
XX2	sXX2	10.5 ft	102	+15	Small pool near climb
WXB4A	SC-0013	11.6	237	-9.5	Black River science station
AB14	sAB14	2.3	88.5	0.5	Mineral coating on wall of Little Bear Room

**Individual Sample Tracking**

Sample Number	Amount of sample	Type of test	Date sample returned to park	Date results reported to park
XX2-01	250 ml	chemistry	destructive test	
XX2-02	250 ml	isotope	destructive test	
SC-0013	500 ml	chemistry	destructive test	
AB14-01	0.5 g	XRD	destructive test	

## **APPENDIX L – DESIRED FUTURE CONDITIONS**

### **Purpose and Goals**

Desired conditions establish goals for resource protection and restoration that may be achieved through management actions. Since different caves and different areas within the same cave have varying allowable activities, the desired conditions and associated management activities must be adaptive. The desired conditions established here are based on scientific observation and monitoring as well as Best Management Practices developed from more than 30 years of cave management at Carlsbad Caverns National Park and from practices developed at other NPS and non-NPS caves. The desired conditions for cave resources at Carlsbad Caverns National Park will be adapted as more research and monitoring is conducted, and a better understanding of current and desired conditions is obtained.

The primary goal of establishing desired conditions and taking mitigative actions is to prevent future damage to cave resources as well as restore more natural function and appearance to areas where adverse impacts have already occurred. The secondary goal is to establish consistent management practices that can be applied as uses for different areas change, such as establishing a new visitor route in an off-trail area.

### **Paved Trail Areas**

*(Applies to: Carlsbad Cavern)*

#### Definition

Carlsbad Cavern contains approximately three miles of paved trail. The pavement consists of epoxy with embedded emery chips for traction. Most of the trail system has rock walls up to 18 inches tall and stainless steel handrails. The paved trail areas also include an emergency phone system, electrical system, and in some places, water transmission lines. These utilities are buried or covered in some areas and are laid on top of natural cave floors in others. The paved trail areas include all places lit by electric lights and where staff needs to travel across cave floors to maintain utilities.

#### Current Conditions

Traffic on the paved trails causes inadvertent and intentional damage to the cave. Lint accumulates on the trails and areas adjacent to the trails. Decomposition of lint discolors and damages cave formations and other surfaces and upsets the natural ecosystem by putting nutrients into the cave. Trash, food, and other items are left along the trail system including off of the paved trails. These materials decompose and damage the cave and are a source of unnatural nutrients that upset the cave ecosystem. There has been some intentional damage caused to cave resources by vandalism and removal of cave formations, and trespass off of trails onto the natural cave floors.

Park activities such as changing lights, maintaining infrastructure, conducting research, and allowing commercial filming also have the potential to cause damage where these activities occur off of the paved trails. The current lighting system uses some lights that

emit heat into the cave and provide light wavelengths that allow algae to grow. Algae discolors and causes deterioration of cave formations. The park currently uses bleach to kills algae, but this practice introduces foreign chemicals into the cave environment. In addition to ongoing damage caused by visitation and park activities, past trail construction has led to burial of cave floors under mud and rubble, placement of structures, and installation of now-abandoned utilities that have on-going adverse impacts to cave resources.

#### Desired Conditions

The park has a zero-tolerance policy on vandalism to the cave, so there will be no allowable intentional damage to the cave or litter thrown by visitors. As little lint as possible will be left in the cave. Damage from maintenance, research, and other management activities to cave floors and features will be minimized. Algae growth due to the lighting system will be eliminated and heat emissions will be minimized. A more natural appearance and function will be restored to areas where natural habitat has been buried or where artificial structures have been put in place and are deteriorating and upsetting the natural ecosystem.

#### Management Actions

*Vandalism, litter, and trespass.* The park will continue to educate the public and monitor visitor activities along the trail. The park will remove trash from along the trail routes and will support volunteer activities to conduct cave cleanup trips. The park will maintain hand rails not only for visitor safety, but to make it more difficult for visitors to leave the paved trail. The park will continue to issue citations for damage to the cave. The park will record areas where there are ongoing problems with vandalism and trespass, so that mitigation measures can be developed.

*Lint reduction.* The park will continue to build and maintain rock walls where feasible to capture lint along the trail and will vacuum the trail and walls at least semiannually. The park will support restoration activities to remove lint from cave walls and floors.

*Damage from park activities.* The park will work towards re-routing of support infrastructure such as electric, water, and phone lines to minimize the amount of off-trail maintenance. The park will carefully consider the resource impacts of research and monitoring activities to minimize adverse impacts.

*Algae mitigation.* The park will investigate options to reduce or eliminate lights that promote algae growth. The park will continue to treat algae growth along the trail system.

*Habitat restoration.* Trail and other construction debris such as sediment and rubble will be removed from natural cave floors. Deteriorating structures will be removed or their effects mitigated.

## **Underground Rest and Facilities Area**

*(Applies to: Carlsbad Cavern)*

### Definition

The underground rest area includes the area designated for food service and other concessions, restrooms, and a maintenance area that includes the system for pumping sewage to the surface.

### Current Conditions

Organic matter from food preparation (microwaves), sewage pumping, restrooms, and other visitor activities promote microbial growth on the ceiling and walls. The area is also a gathering place for visitors buying concession items, participating in guided tours and for waiting to return to the surface via the elevators. The concentration of people results in lint being deposited on the cave ceiling, walls, and floor.

Trash, food, and other items are dropped on and off of the paved visitor use area. These materials decompose and damage the cave and are a source of unnatural nutrients that upset the cave ecosystem. Both raccoons and ringtails have been attracted to this area due to food and other items. There has been some intentional damage caused to cave resources by vandalism and removal of cave formations, and trespass off of trails onto the natural cave floors.

Noise and light from the underground facilities have been shown to disturb bats and other animals even after the cave has been closed to visitors.

### Desired Conditions

The park has a zero-tolerance policy on vandalism to the cave, so there will be no allowable intentional damage to the cave or litter thrown by visitors. As little lint as possible will be left in the cave. Deposition of organic matter from concession and park activities that promote microbial growth will be minimized.

### Management Actions

*Vandalism, litter, and trespass.* The park will continue to educate the public and monitor visitor activities in the underground rest area. The park will remove trash from along the trail routes and will support volunteer activities to conduct cave cleanup trips. The park will maintain clean restrooms and maintenance areas. The concessionaire will be required to pick up and dispose of trash left by visitors and generated by concession activities. Food and other items that may attract raccoons or other animals will be kept within enclosed cabinets during non-visitor hours. The park will maintain hand rails not only for visitor safety, but to make it more difficult for visitors to leave the paved trail. The park will continue to issue citations for damage to the cave. The park will record areas where there are ongoing problems with vandalism and trespass, so that mitigation measures can be developed.

*Lint reduction.* The park will continue to build and maintain rock walls where feasible to capture lint along the trail and will vacuum the trail and walls at least semiannually. The park will support restoration activities to remove lint from cave walls and floors.

*Organic matter.* The park will examine methods to filter or redirect air from the restrooms to prevent organic matter from adversely affecting the cave. The park will develop methods to mitigate or eliminate the adverse effects of sewage pumping. The park will work with the concessionaire to mitigate the adverse effects of food preparation and other activities.

### **Unpaved visitor trails**

*(Applies to: Carlsbad Cavern, Slaughter Canyon Cave)*

#### Definition

The park conducts daily guided tours to Left-Hand Tunnel and Lower Cave in Carlsbad Cavern, and through the main passages in Slaughter Canyon Cave. These trails are unpaved and not illuminated by electric lights; each visitor carries his or her own light. Some of the trails contain artificial walkways, rope handlines, dirt steps, and ladders. Most of the trails are marked by parallel strips of vinyl flagging tape laid on the floor.

#### Current Conditions

Traffic on the trails causes inadvertent and intentional damage to the cave. Lint accumulates on the trails and areas adjacent to the trails. Trash, food, and other items are occasionally left along the trail system. These materials decompose and damage the cave and are a source of unnatural nutrients that upset the cave ecosystem. There has been some intentional damage caused to cave resources by vandalism and removal of cave formations, and trespass off of trails. Unintentional damage occurs when visitors accidentally step off the trails, use the walls to keep steady, and if a slip or trip causes a visitor to fall to the floor or against a wall or cave formation.

Structures such as artificial walkways, ladders, and ropes have been placed in the cave to facilitate visitor use and protect fragile areas. Some of these structures such as those made of wood or steel deteriorate and introduce organic material and metals into the cave environment and disrupt the natural ecosystem.

Over time, the vinyl flagging tape breaks, gets stepped on, or gets moved. This causes the trail to become indistinct or wider and increases the footprint of the trail causing more damage to the cave. Some trails go through areas where mud can be easily tracked onto more pristine cave floors.

#### Desired Conditions

The park has a zero-tolerance policy on vandalism to the cave, so there will be no allowable intentional damage to the cave or litter thrown by visitors. There will be minimal inadvertent damage to cave features caused by poor trail marking or visitor accidents. There will be no organic materials or foreign chemicals introduced into the cave by structures placed along the trails.

### Management Actions

*Vandalism, litter, and trespass.* The park will continue to educate the public and monitor visitor activities on the trails. The park will remove trash from along the trail routes and will support volunteer activities to conduct cave cleanup trips. Inadvertent damage caused by visitors tripping or slipping will be reduced by the guides maintaining a safe pace appropriate for the whole group and by ensuring, to the greatest extent possible, that all visitors on the tour have the appropriate level of fitness.

*Trail maintenance.* The park will maintain good flagging trails along the sides of the designated path. The park will install and maintain walkways, ladders, or other structures to prevent tracking of mud and other materials onto more pristine areas and to prevent visitors from damaging cave features. These structures will be composed of materials suitable to the cave environment and that will not introduce foreign chemicals or organics.

*Structure removal.* The park will identify and remove or replace structures that are adversely affecting the cave environment.

### **Off-trail visitor routes**

*(Applies to: Carlsbad Cavern, Spider Cave)*

### Definition

The park conducts guided “adventure” caving tours into the Hall of the White Giant in Carlsbad Cavern and into Spider Cave. These trails are unpaved and are not illuminated by electric lights. Each visitor carries his or her own light mounted on a caving hardhat. Some of the trails contain rope handlines, dirt steps, and ladders. Visitors are required to crawl, climb, and chimney and are frequently in close proximity to cave walls and speleothems. Most of the trails are marked by parallel strips of vinyl flagging tape laid on the floor.

### Current Conditions

Traffic on the trails causes inadvertent and intentional damage to the cave. Lint accumulates on the trails and areas adjacent to the trails. Trash, food, and other items are occasionally left along the trail system. These materials decompose and damage the cave and are a source of unnatural nutrients that upset the cave ecosystem. There has been some intentional damage caused to cave resources by vandalism and removal of cave formations, and trespass off of trails. Unintentional damage occurs when visitors accidentally step off the trails, use the walls to keep steady, and if a slip or trip causes a visitor to fall to the floor or against a wall or cave formation.

Over time, the vinyl flagging tape breaks, gets stepped on, or gets moved. This causes the trail to become indistinct or wider and increases the footprint of the trail causing more damage to the cave. Some trails go through areas where mud can be easily tracked onto more pristine cave floors.

### Desired Conditions

The park has a zero-tolerance policy on vandalism to the cave, so there will be no allowable intentional damage to the cave or litter thrown by visitors. There will be minimal inadvertent damage to cave features caused by poor trail marking or visitor accidents.

### Management Actions

*Vandalism, litter, and trespass.* The park will continue to educate the public and monitor visitor activities on the trails. The park will remove trash from along the trail routes and will support volunteer activities to conduct cave cleanup trips. Inadvertent damage caused by visitors tripping or slipping will be reduced by the guides maintaining a safe pace appropriate for the whole group and by ensuring, to the greatest extent possible, that all visitors on the tour have the appropriate level of fitness.

*Trail maintenance.* The park will maintain good flagging trails along the sides of the designated path. The park will install and maintain ropes, ladders, or other structures for the safety of visitors and to prevent visitors from damaging cave features.

### **Recreational permit cave trails**

*(Applies to: Ogle Cave, Chimney Cave, Christmas Tree Cave, Corkscrew Cave, Deep Cave, Goat Cave, Helens Cave, Lake Cave, Wen Cave)*

### Definition

The park offers permits to nine backcountry caves. Eight of these caves are available to qualified caving groups and are self-guided. One cave, Ogle Cave, is guided by a park ranger. Six of the caves require ropes and technical vertical caving equipment to enter. These trails are unpaved and are not illuminated by electric lights. Each visitor carries his or her own light mounted on a caving hardhat and proper equipment to negotiate vertical areas of the caves. Visitors are required to crawl, climb, and chimney and are frequently in close proximity to cave walls and speleothems. Most of the trails are marked by parallel strips of vinyl flagging tape laid on the floor.

### Current Conditions

Traffic on the trails causes inadvertent and intentional damage to the cave. Lint accumulates on the trails and areas adjacent to the trails. Trash, food, and other items are occasionally left in the caves. These materials decompose and damage the cave and are a source of unnatural nutrients that upset the cave ecosystem. There has been some intentional damage caused to cave resources by unauthorized access to these caves, vandalism, and removal of cave formations, and trespass off of trails. Unintentional damage occurs when visitors accidentally step off the trails, use the walls to keep steady, and if a slip or trip causes a visitor to fall to the floor or against a wall or cave formation.

Over time, the vinyl flagging tape breaks, gets stepped on, or gets moved. This causes the trail to become indistinct or wider and increases the footprint of the trail causing more damage to the cave.

### Desired Conditions

The park has a zero-tolerance policy on trespass or vandalism to the cave, so there will be no allowable unauthorized visitation, intentional damage to the cave, or litter thrown by visitors. It is expected that qualified cavers will have the appropriate fitness and training, and equipment so there will be no allowable inadvertent damage to cave features caused by poor trail marking or visitor accidents.

### Management Actions

*Vandalism, litter, and trespass.* The park will continue to educate the public and monitor visitor activities in these caves. The park will monitor for unauthorized use of these caves and will take appropriate action to prevent future trespass if necessary. The park will maintain gates and locks on caves to prevent trespass. The park will remove trash from along the trail routes and will support volunteer activities to conduct cave cleanup trips. Inadvertent damage caused by cavers tripping or slipping will be eliminated by ensuring, to the greatest extent possible, that all permittees have the appropriate level of fitness and qualifications. The park will visit these caves at least twice per year to maintain flagged trails and inspect the cave for adverse impacts.

*Trail maintenance.* The park will maintain good flagging trails along the sides of the designated path.

### **Carlsbad, Spider, Lechuguilla primary non-visitor routes**

*(Applies to: Carlsbad Cavern, Spider Cave, Lechuguilla Cave)*

### Definition

To facilitate research and management of Carlsbad Cavern, Spider Cave, and Lechuguilla Cave, main travel routes have been established along the main arteries of each cave. Most of the trails are marked by parallel strips of vinyl flagging tape laid on the floor. These areas and caves are only open to highly qualified personnel conducting permitted research and management activities. All of these areas require technical caving equipment and in many cases, specialized vertical caving gear.

In Lechuguilla Cave, four locations have been designated as underground camps to facilitate research and management in remote areas requiring overnight stays. These camps include a sleeping/staging area, a designated pool for collecting drinking water (this area may be up to 20 minutes from camp), and a spot for disposal of liquid human waste. All solid waste must be removed from all caves.

### Current Conditions

There has been limited use of these areas, so most have seen relatively little damage. Traffic on the trails causes inadvertent damage to the cave due to touching of walls and cave formations, stepping off of the trail, or laying gear off of the trail. Lint accumulates on the trails and areas adjacent to the trails and especially in Lechuguilla camps where cavers spend more time in one place. There is some inadvertent litter (primarily trash and food crumbs) left in the cave in camps or in areas where cavers take breaks.



Over time, the vinyl flagging tape breaks, gets stepped on, or gets moved. This causes the trail to become indistinct or wider and increases the footprint of the trail causing more damage to the cave.

In Lechuguilla Cave, liquid human waste dumped in the designated spots introduces foreign chemicals and organic matter into the cave and adversely affects the cave ecosystem. These chemicals can be carried through the air and can cause adverse impacts far away from the designated sites. All human waste must be carried out of all other park caves besides Lechuguilla.

In Carlsbad Cavern, structures such as artificial walkways, ladders, and ropes have been placed in the cave to facilitate travel. Some of these structures such as those made of wood or steel deteriorate and introduce organic material and metals into the cave environment and disrupt the natural ecosystem.

#### Desired Conditions

It is expected that qualified cavers will have the appropriate fitness and training, and equipment, so there will be no allowable inadvertent damage to cave features caused by research and management activities. The trails will not be widened due to traffic or damage to flagging tape. There will be no trash or food left in the trail areas. The amount of lint left in cave camps will be minimized. There will be minimal amounts of liquid human waste deposited in Lechuguilla Cave. There will be no organic materials or foreign chemicals introduced into the cave by structures placed along the trails.

#### Management Actions

*Inadvertent damage.* Inadvertent damage caused by cavers tripping or slipping will be eliminated by ensuring, to the greatest extent possible, that all permittees have the appropriate level of fitness, qualifications, and equipment. Permittees will be required to follow the strict guidelines for entering any park cave (see appropriate appendices for details).

*Trail maintenance.* The park will maintain good flagging trails and signage along the designated main routes. Permittees will report any damage to trail flagging or markers to the Cave Resources Office.

*Litter and food.* The park will continue to monitor activities in these caves. Permittees will be required to capture all food crumbs and ensure no trash is left in the cave. Permittees using cave camps, must have a ground cloth to capture as much lint and other materials as possible to carry it out of the cave.

*Liquid waste.* The park will continue to require all human waste to be taken out of all park caves, except for Lechuguilla Cave. The park will require permittees to carry as much liquid waste as feasible out of Lechuguilla Cave. All solid waste must be removed from all caves. The park will pursue and support research into methods to remove, treat, or mitigate the adverse impacts of all liquid waste from Lechuguilla Cave and adapt park policies appropriately.

*Structure removal.* The park will remove or replace structures that are adversely affecting the cave environment.

### **Carlsbad Cavern and Lechuguilla Cave secondary routes**

*(Applies to: Carlsbad Cavern, Lechuguilla Cave)*

#### Definition

To facilitate research and management of Carlsbad Cavern and Lechuguilla Cave, secondary travel routes have been established. Most of the trails are marked by parallel strips of vinyl flagging tape laid on the floor, but some are only marked by occasional individual strips of flagging. These areas and caves are only open to highly qualified personnel conducting permitted research and management activities. All of these areas require technical caving equipment and in many cases, specialized vertical caving gear.

#### Current Conditions

There has been very limited use of these areas, so most show little damage. Traffic on the trails causes inadvertent damage to the cave due to touching of walls and cave formations, stepping off of the trail, or laying gear off of the trail. Lint accumulates on the trails and areas adjacent to the trails. There is some inadvertent litter (primarily trash and food crumbs) left in the cave in areas where cavers take breaks.

Over time, the vinyl flagging tape breaks, gets stepped on, or gets moved. This causes the trail to become indistinct or wider and increases the footprint of the trail. In some cases, moved trail markers make route finding difficult and causes more damage to the cave.

#### Desired Conditions

It is expected that qualified cavers will have the appropriate fitness, training, and equipment, so there will be no allowable inadvertent damage to cave features caused by research and management activities. The trails will not be widened due to traffic or damage to flagging tape. There will be no trash or food left in the trail areas.

#### Management Actions

*Inadvertent damage.* Inadvertent damage caused by cavers tripping or slipping will be eliminated by ensuring, to the greatest extent possible, that all permittees have the appropriate level of fitness and qualifications. Permittees will be required to follow the strict guidelines for entering each of the caves (see appropriate appendices for details). The park will limit the use of large cave packs, heavy gear, or other activities that could potentially cause more damage than a relatively unburdened caver with basic caving equipment. The park may require the use of specialized gear such as aquasocks to minimize adverse impacts to cave features.

*Trail maintenance.* The park will maintain good flagging trails and signage along the designated main routes. Permittees will report any damage to trail flagging or markers to the Cave Resources Office.

*Litter and food.* The park will continue to monitor activities in these caves. Permittees will be required to capture all food crumbs and ensure no trash is left in the cave.

### **New exploration routes**

*(Applies to: Carlsbad Caverns, Lechuguilla Cave, Spider Cave, and any new passages or caves discovered in the park)*

#### Definition

Original geographic exploration of park caves is vital to the understanding of the park cave resources and to future research and management. New exploration is the first documented human entry into a pristine cave or cave passage. Initial exploration, mapping, and inventory are conducted by highly trained personnel conducting permitted research and management activities. All of these areas require technical caving equipment and in many cases, specialized vertical caving gear.

#### Current Conditions

By definition these passages are pristine and only affected by the natural environment. The cave ecosystem is fully functioning and undisturbed by human activity or traffic.

#### Desired Conditions

Every step into a new area causes some amount of disturbance, visibly and invisibly. New exploration is a balance between research and management objectives and cave impact. It is expected that qualified cavers will have the appropriate fitness, training, and equipment, so there will be no allowable inadvertent damage to cave features caused by research and management activities. The passages are fully documented with minimal adverse impact such that it is possible that no other visitation is required to meet research or management goals.

#### Management Actions

*Minimize traffic.* The park will ensure that all survey, inventory, and other data is collected to high standards by highly qualified personnel. These data will be collected during initial exploration so the area may be maintained in as pristine a state as is possible.

*Inadvertent damage.* Inadvertent damage caused by cavers tripping or slipping will be eliminated by ensuring, to the greatest extent possible, that all permittees have the appropriate level of fitness and qualifications. Permittees will be required to follow the strict guidelines for entering each of the caves, conducting survey, and taking inventory (see appropriate appendices for details). The park will limit the use of large cave packs, heavy gear, or other activities that could potentially cause more damage than a relatively unburdened caver with basic caving equipment. The park may require the use of specialized gear such as aquasocks to minimize adverse impacts to cave features.

*Litter and food.* The park will continue to monitor activities in these caves. Permittees will be required to capture all food crumbs and ensure no trash is left in the cave.

*Access restrictions.* The park may restrict areas from exploration due to other resource concerns such as extremely delicate passages and areas that may have special microbiological concerns.

*Changes in use.* The park will carefully consider potential adverse resource impacts before allowing a new route to be used for regular travel. If the use changes, the desired conditions would also change and be subject to the management actions described under those desired conditions.

### **Backcountry Caves**

*(Applies to: All known caves except: caves open to the public for paid visitation, permitted recreational caves, and Lechuguilla Cave)*

#### Definition

There are more than 100 known caves in Carlsbad Caverns National Park. Portions of Carlsbad Cavern, Slaughter Canyon Cave, and Spider Cave are open for regular visitor tours. Nine caves are available to qualified technical cavers for recreational use. All other park caves are considered backcountry caves and are open only for research and management activities. Most of these caves do not have marked trails. Some of the caves are gated to protect cave resources and prevent trespass. Some caves are used by bats, cave, swallows, owls, and other animals which are easily disturbed by visitation.

#### Current Conditions

Some of the caves have had heavy visitation in the past and have been heavily vandalized. Others are in a near pristine state and have had only a few trips into them. Traffic on the trails causes inadvertent damage to the cave due to touching of walls and cave formations, stepping on or laying gear on delicate cave floors. Limited visitation by park staff or researchers causes minor incremental adverse impacts to cave resources by direct damage or disruption of the cave ecosystem. Some backcountry caves are more sensitive to visitation than others.

#### Desired Conditions

Each backcountry cave will be kept in its current state. It is expected that qualified cavers will have the appropriate fitness, training, and equipment, so there will be no allowable inadvertent damage to cave features caused by research and management activities. The passages are fully documented with minimal adverse impact such that it is possible that no other visitation is required to meet research or management goals.

#### Management Actions

*Minimize traffic.* The park will carefully consider all access requests against potential resource impacts. The park will ensure that all survey, inventory, and other data is collected to high standards by highly qualified personnel. These data will be collected during initial exploration or upon first management visit so the area may be maintained in as close to its current state as is possible. The park may gate caves to prevent trespass while minimizing disruption to the natural cave ecosystem.

*Inadvertent damage.* Inadvertent damage caused by cavers tripping or slipping will be eliminated by ensuring, to the greatest extent possible, that all permittees have the appropriate level of fitness and qualifications.

*Seasonal closures.* Disturbance of wildlife may be mitigated by placing seasonal closures or other restrictions to access to park caves.

## **APPENDIX M - CAVE CONSERVATION AND RESTORATION ACTIVITIES**

### **Purpose**

Throughout much of Carlsbad Cavern and other park caves, numerous impacts have occurred. These impacts range from tracking mud over flowstone, dumping rubble from blasting projects, crushing minerals found on large areas of the floors, speleothem vandalism along the paved trails, and lint from millions of visitors settling over everything close to the paved trails. To help protect the caves and enhance the visitor experience, conservation practices have been evaluated and put into place. In addition, restoration activities have been implemented to correct past mistakes and to return portions of the caves back to as natural a condition as possible. Many areas will never return to what they had been before discovery. As an example, floor areas that were once covered by popcorn and other mineral growth have been trampled leaving no natural features intact. By keeping people from walking over these areas now and into the future, natural conditions will be allowed to once again influence these fragile areas without continued human impact.

### **Education and Guidelines for Entering Park Caves**

Some of the most valuable tools for conserving fragile cave resources are through education and the development of guidelines for all who enter the caves to be aware of and follow. Education takes many forms and should include the casual visitor, those who work in the caves, and those who manage the caves. Guidelines developed to protect the caves while allowing access for various reasons must be adhered to by not only the workers, but by the visitors and managers as well. There are two separate appendices to this plan that focus entirely on providing guidelines to those entering park caves. For detailed information on entering park caves, please refer to Appendix A (Carlsbad Cavern and other park caves) and Appendix B (Lechuguilla Cave) of this plan.

## **Flagged Trails**

### **Background**

Trail delineation systems have been used in Carlsbad Cavern since its early exploration days. These systems were used for various reasons and have changed greatly throughout the years. Early explorers often left smoke marks on the cave walls to guide their way out. Other early accounts claim that explorers used the points of broken formations or the necks of empty bottles to point them to the entrance. As traffic increased in the cavern, some routes became well enough worn that no additional markers were needed. This had the unfortunate side effect, however, of creating a jumble of worn paths throughout the cave, many paralleling each other. In addition, frequently missed turns quickly turned into well-worn paths leading nowhere.

### **Trail Delineation System**

Currently, the park utilizes surveyor's flagging tape to mark trails and other critical features. The main benefit for using flagging tape is that it is very noticeable and instantly conveys information to the cave visitor. Main routes through the off-trail areas of caves in the park, including off-trail visitor tour routes, are flagged with double lines of fluorescent orange flagging tape with the understanding that one does not step outside of the flagged area. While this results in very heavy impact to a relatively small area within the flagging, the impact to the remainder of the cave floor remains relatively low. Keeping people to one trail helps protect untrampled areas and allows previously impacted areas to return to more natural conditions. The use of red and white striped flagging tape within or just outside the double flagged areas of fluorescent orange indicates a delicate or hazardous area to be exercise caution when near. While other colors of surveyor's flagging tape are used for other purposes, these two colors are the only ones that are used for trail delineation.

### **Trail Flagging Standards**

Off-trail routes once determined should be kept in the same locations unless there is a significant need to move the trail. These routes are flagged and are expected to receive all the traffic moving through that portion of the cave. The flagging that delineates off-trail routes becomes worn, torn, dirty, and moves around from being stepped on. It is important for employee and visitor safety as well as resource protection to keep the off-trail routes flagging system in good shape.

Teams moving through areas or the trail ranger on visitor tours can help maintain the flagging along these routes by making quick adjustments as needed. This will usually consist of moving portions of the flagging tape one direction or the other to recover the proper width of the tour route in that location. Additionally, volunteers or personnel from the Interpretation and Education Division (for visitor tour routes) can accompany Cave Resources personnel or work through their supervisor at times other than during a visitor tour to correct more serious problems that occur with flagging tape along flagged routes. In general, visitor tour routes will be flagged wider than the other routes in park caves.

## Protocols

The following protocols will be used to help keep off-trail route flagging in good shape.

- All routes, and especially visitor tour routes, should be easy to see and follow.
- Trail width will be kept as narrow as possible, while still allowing fairly easy travel. For the visitor tour routes, trail width will vary depending on the size of the tour groups and the area the route is going through. Trails should generally not be wider than 36 inches unless there is an absolute need. For other flagged routes, trails should generally not be wider than 24 inches.
- Very narrow passages need not be flagged except to protect delicate areas.
- When readjusting or replacing flagging, keep the flagging on the floor and not stretched through the air. This helps prevent its being snagged or becoming a tripping hazard as people move through an area.
- The flagging for all visitor tour routes is usually held in place by setting small rocks on the tape or by wrapping these same rocks with the tape. This helps the flagging tape from migrating out of its intended area. Most trails already have plenty of rocks in place to hold flagging and these should be reused before deciding to find others to use. If other rocks are needed, small rocks from nearby should be carefully chosen to minimize any damage to cave features. Broken speleothems should not be used for this purpose. As well, rocks or other items should not be brought into the cave for this purpose. The one exception to this rule is the Beach area of Left-Hand Tunnel where plastic pins are anchored in the sand to hold the flagging tape in place.
- Flagging will not be anchored to delicate speleothems, though more hardy speleothems such as an inactive stalagmite can be used to help hold the flagging tape in place. This can be accomplished by gently wrapping the flagging tape around the speleothem.
- As flagging gets old it becomes brittle and breaks. Occasional breaks in flagging may be repaired by retying or splicing in a segment. It will be replaced however, when there are frequent breaks resulting in small disconnected pieces of flagging on the floor. Dirty flagging should be cleaned or replaced when it becomes hard to see.
- Old flagging will be removed from the cave as it is replaced.
- Care will be taken when replacing flagging to insure that the new flagging follows the same path and is no wider than the original trail.



- The use of red and white striped flagging tape can help protect delicate features within an approved route or simply indicate that caution is needed for moving across or through an area. This type of flagging tape will be used only when necessary. Marking too many places within a flagged route can be confusing and will make the person traveling the tour route complacent.
- Rerouting the visitor tour route or flagging new routes is not authorized. If there is a perceived need to make minor adjustments to a tour route, requests should be made through an employee's supervisor. Cave Resource personnel along with the Interpretation Supervisor will evaluate the request and make immediate changes if needed for safety or resource protection. For other flagged routes, permission should be sought from the Cave Resource Office before rerouting trails. Requests to make major changes to a visitor tour route will require a more serious effort to determine the specific purpose and need for the change as well as a compliance document approved by the Superintendent.

## **Rubble Removal**

Rubble found in Carlsbad Cavern can be divided into two distinct types of rock, dust, and other debris. (1) The first type is found over large areas of floor where popcorn and other minerals have been crushed and broken by large numbers of people walking over them. (2) The second type of rubble is easily identified as consisting mostly of blasted and broken limestone rock and placed in areas of Carlsbad Cavern. The most significant rubble of this type was generated by the blasting of both sets of elevator shafts. This rubble and debris was dumped to the southwest of the elevator shafts in an area known as the Old Underground Lunchroom, under the paved floors of the Underground Concessions Area (UCA), and in the beginning portions of Left-Hand Tunnel to the east of the UCA.

(1) Crushed Popcorn & Other Minerals – Many visitor areas had this type of rubble cleanup many years ago and there is far less need now to do this type of restoration in park caves. Any project to cleanup this type of rubble should be justified before beginning, have a plan on what is to be accomplished that should answer questions such as where the debris will be deposited once cleaned up.

(2) Old Underground Lunchroom Debris – This is a long-term, specific project that was approved through the compliance process in 2001. The compliance document spells out methodologies, safety, and other aspects for this project. Any park personnel overseeing activities to remove rubble from this area should be familiar with this document and its requirements.

## **Restoring Flowstone and Other Impacted Areas**

Numerous areas throughout Carlsbad Cavern and other caves have been impacted by tracking mud and other debris onto them. While many areas may have the same type of impacts to restore, each area will need to be evaluated to determine what the final product should be. Careful consideration should be part of any planning effort. This type of restoration can be very tedious and should not be done by inexperienced restorers. There

are numerous techniques that can be employed to successfully complete restoration projects of this type. Many of these techniques are detailed in numerous publications including the *National Speleological Society Manual of Cave Conservation and Restoration* published in 2006. Other considerations when performing restoration projects in park caves include which tools or equipment to use to accomplish the project, to know if locally derived water is available, how and where to collect that water, how and where to deal with mud and other debris recovered from the restoration project, how to keep from re-contaminating cleaned areas, and any special needs for a successful restoration of the area. Every area to be restored will have different parameters and determining these basic needs and how to accomplish them must be completed before beginning any project. No chemicals will be used on any restoration project without specific approval by the Cave Specialist.

### **Speleothem Repair**

Broken speleothems are, at best, difficult to repair. Only volunteers, employees, or contractors with extensive experience in speleothem repair will be allowed to perform such work. Techniques and materials for this type of repair are constantly improving. Any speleothem repair will use the most recent information on techniques and materials such as epoxy to accomplish this fragile task. Speleothem repair will strive to leave the repaired speleothem in as natural a state as possible.

### **Lint Removal**

Carlsbad Cavern is an enclosed space that has had millions of visitors walk through it. By the mid 1980s, lint accumulations in Carlsbad Cavern had made much of the cave near the trail soiled and more difficult to see than it should have been. Lint stalactites could be seen along many walls. A dedicated group of volunteers and employees has started a long-term project to rid the cave of lint. A study of the effects of lint on speleothems showed that when left in place, the lint forms a layer that becomes slightly acidic when it becomes damp from the humidity in the air and slowly begins to dissolve the calcite it is covering. Not only is lint unsightly, it causes damage to speleothems. In the last 20 years, over 270 pounds of lint have been collected along the paved trails of Carlsbad Cavern.

Lint will be removed from all localities it is found in whenever possible to prevent accumulated buildup. Techniques to remove this material range from picking it out of popcorn with tweezers and brushes, to slow brushing, and in some cases lightly being sprayed with water and catching the accumulated material. Every area is unique and great care must be taken to not damage the crystals and minerals when removing lint. The use of special techniques or equipment to collect lint must be approved ahead of time by the Cave Specialist.

## **APPENDIX N - HISTORIC ARTIFACT DOCUMENTATION AND COLLECTION FROM PARK CAVES**

### **Purpose**

Beginning around the 1880s, settlers moved into the area now protected as Carlsbad Caverns National Park. These settlers established ranches and utilized some of the caves as holding pens for goats, sources of water, or places to get out of the sun from time to time. Guano mining began in 1903 in Carlsbad Cavern and also took place in several other park caves as late as the 1950s. As the extent and beauty of Carlsbad Cavern became more known, visitors began to explore its hidden chambers in larger and larger numbers. Trails, wooden staircases, lighting, and other structures were built to make it easier for visitors to experience Carlsbad Cavern. Some of these structures were in place before Carlsbad Cave National Monument was created in 1923. After this date, commercialization began in earnest and expanded development continued to refine the infrastructure within the cave. Artifacts from many of the above mentioned activities were discarded in park caves throughout much of this time.

Objects that were discarded in the cave included paper products such as newspapers, cut wood from old staircases, wooden flair handles (for holding flash powder for photographs), matches, flashlight batteries, light bulbs, coins, ceramic coffee cups, and a host of other items. Many of the discarded items have deteriorated in the high humidity and damp conditions impacting the cave. Some artifacts left in drier areas have survived quite well showing little deterioration. Some artifacts have left more serious impacts such as flashlights batteries showing severe corrosion and oozing an acidic substance.

For cave protection, artifact protection, or for other approved management reasons, it is necessary to document and remove some historic items from the harsh cave environment. This document provides guidance and procedures for the documentation and removal of individual or a small group of items deemed critical for resource protection or artifact protection. For larger groups of artifacts to be removed from a larger area, the project should be written up and approved through the park compliance process.

### **Procedures**

A historic artifact that needs immediate removal must first be approved for removal by the Cave Specialist. Once approved, a Historic Artifact Collection Form should be used to document that artifact. The artifact must be photographed and surveyed to in situ. This survey information must be recorded onto the collection form. The survey of this item must be tied into the cave survey for that cave. The field survey designation for the actual object will begin with an H to identify it was a historical item in the cave's survey data. Other items to fill out on the collection form include: cave name, general location within the cave, the assigned field number (obtained from the Cave Specialist), the type of artifact and what it is composed of (if known, who is collecting it, the date it was collected, how it is stored in the field (most of the time, the artifact will be placed in a plastic bag), the artifact's condition, and any observations that pertain to the artifact.

Once collected and removed, the artifact and the original collection form along with any photos taken should be given to the Cultural Resources Specialist. Caution and proper safety procedures should be used when collecting hazardous items, such as oozing flashlight batteries. These types of artifacts should be properly disposed following park hazardous materials protocols. The original collection form and photos (without the hazardous material) should be given to the Cultural Resources Specialist.

The Cave Resource Office will keep copies of the collection form and any additional reports, photos, etc and will enter the survey data into its data base for that cave.

A copy of the Historic Artifact Collection Form is found on the next page.

# HISTORIC ARTIFACT COLLECTION FORM

## CARLSBAD CAVERNS NATIONAL PARK

**DATE:**

**CAVE NAME:**

**GENERAL LOCATION:**

**DESIGNATED STATION NAME (FIELD NUMBER):** H

**TYPE OF ARTIFACT:**

**Collected by:**

**Field Storage:**

**Field Condition:**

**Photo Numbers:**

**Remarks:**

Attach Location Map and Photos

### SURVEY INFORMATION

	Distance	Azimuth	Angle
From: To:			
From: To:			
From: To:			
From: To:			

### FOR CURATORIAL USE ONLY

Accession No:

Catalog No:

Date

Received:

Condition upon receipt:

Treatment needed:

Remarks:

## **APPENDIX O – STANDARD OPERATING PROCEDURES, PROTOCOLS, AND OTHER SUPPORTING DOCUMENTS**

This appendix contains additional procedures, protocols, and forms used as guidance documents for some in-cave activity in the park.

### **Park Standard Operating Procedures**

- 04-16 Sensitive Resources
- 04-17 After-hours Entry and Off -trail Use
- 04-20 Food in Cave and School Group Eating

### **Resource Stewardship and Science Division Protocols**

- Assisting the Cave Resource Office in Lechuguilla Cave

### **Cave Resource Office Forms**

- Caving Job Hazard Analysis form
- Rope Log form



## **Assisting Cave Resources Office Personnel in Lechuguilla Cave**

### **NPS/CAVE employee participation in Cave Resource Office work trips to Lechuguilla Cave.**

At various times members of the cave resource office enter Lechuguilla Cave to perform approved tasks. These tasks include but are not limited to: downloading data from data loggers, replacing worn ropes and improving rigging, performing survey tasks, assisting researchers by accompanying them or collecting samples for them, performing trail maintenance, rescue pre-planning and accompanying both photographers and videographers. Some of these trips are short 1-2 hour trips to the top of Boulder Falls and others are 12-20 hour single-day trips or multi-day camp trips.

Lechuguilla Cave is currently the deepest limestone cave in the United States at -1,604.2 feet deep as well as the world's sixth longest cave. The cave temperature is 68 degrees and the relative humidity is nearly 100%. The long distances, multiple rope drops, heat and humidity along with large packs can make caving in Lechuguilla both physically and mentally challenging. Any rescue from Lechuguilla Cave will be extremely difficult and will result in a large amount of impact to the delicate cave resources.

When appropriate, the Cave Resource Office tries to incorporate other NPS employees in Lechuguilla trips when those employees have the skills to negotiate the cave safely and to accomplish the trip objectives. There are no recreational (sightseeing) or orientation trips in Lechuguilla Cave. Every trip into this delicate, challenging cave is required to be a work trip. In order to achieve safety and minimize impact to the cave, access to Lechuguilla Cave is limited to experienced vertical cavers. It is important to remember that Lechuguilla Cave is an internationally significant cave and that there are many extremely qualified cavers around the world who would like to have the opportunity to visit Lechuguilla Cave. Many more people desire to enter Lechuguilla Cave than can be accommodated for reasons of safety and cave impact.

Minimal skills required to visit Lechuguilla Cave include the following:

- Experience with Single Rope Techniques (SRT) including the following:

- Ability to rappel and ascend on free-hanging ropes up to 200 feet long.
  - Ability to change over from rappel to ascent and ascent to rappel.
  - Ability to pass knots.
  - Ability to climb with a tethered pack which may be very heavy.
  - Ability to negotiate rebelayes and redirects.
  - Ability to deal with hair, clothing or other items getting caught in rappel devices.
  - Basic knowledge of caving knots.
  - Ability to safely negotiate steep slopes using handlines.
  - Ability to safely cross rigged traverses, including while carrying a heavy pack.
  - Ability to recover (get back on route) from a short fall while attached to a fixed traverse line.
- Experience in horizontal caving and moving through delicate cave environments.
  - Ability to move with large and sometimes heavy caving packs.
  - Physical fitness necessary to safely complete the trip without excessive impact to the cave while accomplishing the trips objectives.
  - Ability to engage in strenuous exercise in a 68 degree and near 100% humid environment.

Additional skills that may be useful on Lechuguilla trips:

- Advanced SRT
  - Single rope pick-off training.
  - Vertical cave rescue training.
  - Ability to rig rebelayes.
  - Ability to place expansion bolt anchors and other advanced rigging skills.
- Previous experience in multi-drop vertical caves.
- Cave surveying skills.
- Cave rigging skills.
- Restoration skills.
- Sterile microbiology sampling techniques.
- Cave camping skills.

For more information on caving in Lechuguilla Cave please see Appendix F: Guidelines for entering Lechuguilla Cave in the Cave and Karst Management Plan for Carlsbad Caverns National Park (revised 9/26/1995). Or feel free to contact any of the Cave Resource staff with questions or ideas.



# United States Department of the Interior

## NATIONAL PARK SERVICE

Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, New Mexico 88220

IN REPLY REFER TO:

K18 (x)A5739

November 2, 2004

Memorandum

SOP 04-20

To: All Employees

From: Deputy Superintendent

Subject: Food in Cave and School-Group Eating Area.

The park's goal is to reduce the amount of food introduced into the cave environment. Food is ONLY allowed in the cave in the underground lunchroom—either bought from the concessioner or brought in by visitors. Absolutely no food may be eaten elsewhere in the cave to discourage animals from entering areas due to the smell or presence of food or its associated trash. When asked, orientation park rangers will inform visitors of the right to eat food only in the underground lunchroom, but they will not advertise the fact. They will continue to require visitors to leave candy, gum, and all drinks that they are consuming (except for water) at the cave entrance and elevator.

Because of an excessive amount of trash not properly disposed of, school groups and other large groups are no longer allowed to carry or eat their lunches in the underground lunchroom. The designated school group eating area is the picnic area at the southeast corner of the visitor center-east parking lot. A letter advising schools of this change in policy and procedures will be included in all school fee-waiver information. The message will include a strong admonition to control litter and use the appropriate trash and recycling receptacles in the picnic area.

The designated bus parking area for groups who bring their own lunches will be in the southeast corner of the visitor center's east parking lot. Temporary signs will be posted in the west parking lot directing busses to this area in the spring for the heavy school group visitation period. Rangers will provide maps to bus drivers and trash bags to collect trash. Busses will off-load students at the loading zone, and then proceed to the east parking area. At other times of the year, busses may continue to park in the west parking lot.

/s/

Chuck Barat



# United States Department of the Interior

## NATIONAL PARK SERVICE Carlsbad Caverns National Park

3225 National Parks Highway  
Carlsbad, NM 88220  
505-785-2232

IN REPLY REFER TO:

A5635

November 1, 2004

SOP No. 04-17 (Supersedes MPM 99-09)

To: All Employees

From: Deputy Superintendent

Subject: After-hours Entry and Off-Trail Use in Carlsbad Cavern and Entry into Spider and Slaughter Canyon Caves

This SOP covers the above subjects only. Access to other park caves is by permit only and is addressed in the Cave and Karst Management Plan for Carlsbad Caverns National Park (1995).

It is valuable to allow visitors, park employees, employees of Carlsbad Caverns Guadalupe Mountains Association and Cavern Supply Company the opportunity to learn more about Carlsbad Cavern. Entry into Carlsbad Cavern for orientation, education, management, or other purposes will sometimes need to occur after the cave is closed to the general public. Additionally, some areas of Carlsbad Cavern can only be accessed by leaving the paved trail. This memorandum establishes the policies for these activities in Carlsbad Cavern as well as for entry into Spider Cave and Slaughter Canyon Cave. For the protection of cave resources and the safety of participants, everyone involved in these activities must adhere to all park policies and rules.

### **SPIDER CAVE & SLAUGHTER CANYON CAVE**

An approved permit must be obtained from the Cave Specialist to enter or remain in either cave before or after a regular scheduled visitor tour. Additionally, everyone must stay within the flagged trails unless specifically approved by the Cave Specialist to enter other areas of these caves.

### **CARLSBAD CAVERN**

**After-Hours Entry** - This is defined as anyone entering or remaining in Carlsbad Cavern after the cave is closed to the public until the time of reopening the following morning.

All activities must be approved ahead of time through the appropriate Division Chief or the Superintendent with concurrence of the Cave Specialist to avoid overlaps or other scheduling conflicts.

**Off-Trail Use** - This is defined as anyone leaving the paved trails found throughout the main visitor areas of Carlsbad Cavern.

Unless an employee's duties require them to leave the paved trail, all employees need to remain on the paved trails in Carlsbad Cavern at all times. The Texas Trail in the Big Room should only be used as a short cut during emergency situations.

All employee orientation trips and some resource-related trips must obtain a permit from the Cave Specialist. Employees doing most routine maintenance and some resource-related activities do not have to obtain permits, but should keep a written record of their activities.

Everyone entering off-trail areas need to stay on flagged trails and to move carefully to avoid further impacts to the cave floors, walls and ceilings and for their own safety. Employees leaving the paved areas where there are no flagged trails for approved activities, such as for replacing light bulbs, need to be especially careful to stay in established trails and minimize their continuing impact to those areas.

When bats are present in the lower portions of Carlsbad Cavern (approximately May 1 through November 15), lights in the Main Corridor and the underground concessions/restroom area should not be on after 7:00pm.

**SE&VS Activities During Work Hours** - Approved activities other than performing scheduled duties may include: removing trash from within 5 feet of the paved trail, accessing emergency kits and the emergency restrooms, and resource management activities such as removing coins from pools within a few feet of the paved trail, and helping the Cave Resources Office maintain the flagged visitor off-trail tour routes in Carlsbad Cavern, Spider Cave, and Slaughter Canyon Cave.

**Ranger-led Tours for Visitors** - A special group tour policy for ranger-led, on paved trail, after-hours tours is found in Management Policy Memorandum 02-10. After-hours trips for visitors may also include off-trail trips along the approved visitor tour routes in Left-Hand Tunnel, Lower Cave and Hall of the White Giant in Carlsbad Cavern and in Spider and Slaughter Canyon Caves. These trips must be approved ahead of time by the appropriate Division Chief with concurrence of the Cave Specialist and led by a designated trip leader. Group size must not exceed already established limits for each area. A permit from the Cave Resources Office is required for this activity.

**Employee Orientation Trips** - Park employees, employees of Carlsbad Cavern Guadalupe Mountains Association and Cavern Supply Company can take orientation trips into approved locations within Carlsbad Cavern, Spider Cave, and Slaughter Canyon Cave. Orientation trips may only be led by a designated trip leader. Family members or friends can occasionally be taken on the off-trail visitor tour routes, though employees including official volunteers have priority for participating in orientation trips. These areas are: Left-hand Tunnel, Lower Cave (long or short loop), Hall of the White Giant, Spider Cave and Slaughter Canyon Cave tour routes.

Additionally, orientation trips can also visit other approved areas in Carlsbad Cavern, Spider Cave, and Slaughter Canyon Cave other than on the visitor tour routes. These orientation trips are only available to employees or others approved by the Superintendent.

Those wanting to become a designated trip leader can find information on procedures in the Cave and Karst Management Plan for Carlsbad Caverns National Park or can request this information from the Cave Specialist. The Cave Specialist is responsible for authorizing designated trip leaders for all off-trail areas. The SE&VS supervisor must also approve employees leading official visitor tours during normal working hours to off-trail areas before submitting the form to the Cave Specialist for final approval. Anyone leading or participating in an orientation trip is expected to follow all rules and policies.

Employees can enter Carlsbad Cavern after-hours along the paved trails to educate themselves about the cave and trail system. Friends and family members can occasionally accompany the employee on these types of trips. Everyone on such a trip must remain on the paved trails and should follow all rules and policies to be safe and to protect resources. A permit must be obtained from the Cave Specialist for this activity.

**Resource Management Activities** - The Cave Specialist coordinates and oversees all resource management related activities in Carlsbad Cavern, Slaughter Canyon Cave and Spider Cave. Cave Resources Office personnel are not required to sign permits for every entry into the one of the caves for routine resource management activities, though a trip report must be completed and filed. Volunteers working on projects for the Cave Resources Office must sign a permit and complete a trip report for all activities.

**Maintenance Activities** - Maintenance employees performing routine work in the cave are not required to obtain permits, but should keep the Cave Specialist informed of their work location and timing in Carlsbad Cavern if after hours. The policy for maintenance activities are outlined in the approved Standard Maintenance Practices List. The maintenance office should keep a record of any work done in the cave.

**Law Enforcement & Medical Duties** - The EMS Coordinator is responsible for the upkeep of the emergency medical kits that are located in off-trail visitor tours areas in Carlsbad Cavern, Spider Cave, and Slaughter Canyon Cave. No permit is required to maintain these kits, but as the coordinator for off-trail activities, the Cave Specialist should be kept informed of such trips before they occur.

**Special Use Permits** - Special use activities include but are not limited to filming permits, special visitor tours and other activities authorized by the Superintendent. All special use activities must be coordinated and supervised by one or more assigned employees. Film crews working after-hours or potentially off-trail in Carlsbad Cavern or in other park caves will be accompanied by staff from the Cave Resources Office.

Chuck Barat



# United States Department of the Interior

## NATIONAL PARK SERVICE Carlsbad Caverns National Park

3225 National Parks Highway  
Carlsbad, NM 88220  
505-785-2232

IN REPLY REFER TO:

A5635

November 1, 2004

SOP No. 04-16

To: All Employees  
From: Deputy Superintendent  
Subject: Sensitive Resources Information

Carlsbad Caverns National Park contains natural and cultural resources that are non-renewable and irreplaceable. Congress has passed numerous laws to protect these invaluable resources and we, the stewards of these resources, should be very careful about the release of information concerning these sensitive resources even among our own staff members. Being an employee of the National Park Service does not automatically entitle anyone to receive sensitive information concerning these resources. In order to protect these resources and to set guidelines, the following protocols will be followed by all employees. The information specified below will not be given out to visitors, researchers or other employees without the consent of the Superintendent or their designee. Anyone seeking information (including employees) on sensitive resources should be referred to the specialists listed below or the Chief of the Resources Stewardship and Science Division (RS&S).

At times, park employees may be asked to help with projects that are related to sensitive resources. The information that an employee learns or gathers during these projects should only be shared with specific project members and no other employee or visitor. Project leaders should emphasize that sensitive information is restricted to those staff or individuals working on the project. Additionally, park employees may learn of certain sensitive resources when hiking in the park. Discoveries should be reported to the specialist designated below, but should not be passed on to other employees or visitors.

From time to time, approved researchers and others may have the need to know about certain sensitive resources. The releasing of this information will be determined on a case-by-case and a need-to-know basis.

In some cases there is already written or other information in the public domain concerning park-related sensitive information. Much of this information was released years ago before it was understood how sensitive certain types of information are. In these cases, employees should consider the protection of the resources first and not pass on information to other employees or individuals.

### RARE, THREATENED, AND ENDANGERED SPECIES

Rare (sensitive), threatened, and endangered species (RTES) are defined as those plants or animals that (1) are recognized by state, federal, or local laws as in populations low enough to warrant special protections, (2) are endemic to a particular locale or region with a limited range or, (3) have an economic or other value that may target them for poaching (illegal collection).

With RTES, it is only the names of species that are found in the park that may be provided to employees or visitors, but no other information should be divulged. Anyone seeking more information should contact the Biology Branch Chief.

#### ARCHEOLOGICAL SITES

Prehistoric and historic sites exist throughout the park. Except for the sites listed below, location and content information for all other archeological sites should not be given out to employees or visitors.

1. The ring midden near the Carlsbad Cavern entrance.
2. The rock art in the entrance to Carlsbad Cavern.
3. The ring midden at the start of Walnut Canyon Desert Drive.
4. The rock shelter at Walnut Canyon Nature Trail and Rock Shelter Exhibit.
5. The ring midden on the north side of the eastern upper parking lot.
6. Some guided trips into Slaughter Canyon Cave are allowed to view the pictographs found in the dark zone of the cave.
7. The Rattlesnake Springs Historic District which includes the Ranger residence, the old Harrison homestead, the springs and the irrigation ditches.
8. The Caverns Historic District which includes many of the rock houses and the Bat Flight Parking area.

Anyone seeking more information should be referred to the Museum Curator.

#### CAVES

The park through its General Management Plan and Cave & Karst Management Plan provides for a number of types of experiences in different caves for the visiting public and park employees. The following is a list of cave and cave areas and the information that can be provided to visitors or employees.

1. Carlsbad Cavern – The location and other information needed for the visitor to find and enjoy the different tours of this cave.
2. Slaughter Canyon Cave – The location and other information needed for the visitor to find and enjoy the tour of the cave.
3. Spider Cave, Ogle Cave – General information of these two caves. Locations will only be given out to individuals who have purchased a tour ticket.
4. The recreational permit caves; Chimney Cave, Christmas Tree Cave, Corkscrew Cave, Deep Cave, Goat Cave, Helen's Cave, Lake Cave, Wen Cave – General information can be given out on these caves. Location of these caves will only be given out with an approved permit.
5. Lechuguilla Cave is considered a backcountry cave, but due to its immense size, falls into a special category all of its own. General information can be given out about this cave and anyone can be referred to the books on Lechuguilla Cave sold in the bookstore. However, location information should not be given out other than the general reference that the cave is about 4 miles from Carlsbad Cavern.

All other caves in the park that are not listed above are considered backcountry caves and no information should be given out or passed along. These caves are only open for research and limited management inventory and monitoring trips. The Cave Specialist oversees all activities concerning backcountry caves. The Cave Resources Office will continue to release the total number of caves known in the park, but not other information concerning them.

#### SUMMARY

It is a fine line that we tread in the protection of these sensitive resources versus what information we pass on to visitors and other employees. There are numerous examples of vandalism and destruction that have resulted from information being disseminated. The long-term survival of park sensitive resources depends on good stewardship practices. At Carlsbad Caverns National Park, these practices include being careful about what information is disseminated.

#### SUPPORTING LAWS & REGULATIONS

Numerous laws and regulations have been created to help the National Park Service and other federal agencies protect resources within their boundaries. The following is a selected list of those laws:

- The Antiquities Act of 1906
- The National Park Service Organic Act of 1916
- The Wilderness Act of 1964
- The National Environmental Policy Act of 1969
- The Endangered Species Act of 1973
- The Archeological Resources Protection Act of 1979
- The National Parks Omnibus Management Act of 1988
- The Federal Cave Resources Protection Act of 1988
- The Redwood National Park Act of 1988
- The Lechuguilla Cave Protection Act of 1993
- Code of Federal Regulations - Parks, Forests, and Public Property (CFR 36)
- Compendium of Regulations - Carlsbad Caverns National Park - 2004
- The National Park Service Management Policies 2001

Chuck Barat

## Location

Section of Cave: \_\_\_\_\_

Location / Name (eg. Boulder Falls): \_\_\_\_\_

Type of Pitch (rappel, traverse, rebelay, handline): \_\_\_\_\_

Currently Rigged (circle one)?      Yes      Stage Derigged      No

## Rigging (top of pit or entrance side of traverse line):

Nearest Survey Station to Rigging: \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chockstone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Rope:

Total Length of current: \_\_\_\_\_

Length of rope in rigging: \_\_\_\_\_

Type of rope, if known: \_\_\_\_\_

Condition of Rope (circle one):      1      2      3      4  
(1=sketchy, needs replacement, 2=ok for a while – replace when possible,  
3=ok, no need to replace, 4=good/new)

Optimum length of rope (if different from current length): \_\_\_\_\_

## Rigging (end of traverse line):

Nearest station to Rigging \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chock stone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Notes:

# Rope Log

Data Collection Form

*Carlsbad Caverns National Park*

Cave Name: \_\_\_\_\_

Personnel: \_\_\_\_\_

Date: \_\_\_\_\_

## Instructions:

- Fill in all blanks (incomplete forms are useless)
- Enter information for each pitch starting with the rigging at top of a rappel or on the entrance side of a traverse
- Use a tape measure to determine length of rope, estimate only when not possible to measure – DON'T FORGET KNOTS
- For **rebelay**s:
  - Note total length of rope and use separate entry for each pitch including length of rope between rebelay points.
- For **traverses**:
  - First rigging section for entrance side of traverse line and second rigging section for end of line rigging.
  - If line has intermediate anchor point, note type of anchor, condition and other comments in “notes” section
- If a pitch is **not permanently rigged**, please note and list all equipment needed to safely rig .
- **Stage derigged** means all equipment is present but rope and possibly the anchor has been derigged.
- Note potential improvements, rub spots which need padding.....

## Notes:

## Office Use:

Entered by: \_\_\_\_\_ Date: \_\_\_\_\_



## Location

Section of Cave: \_\_\_\_\_

Location / Name (eg. Boulder Falls): \_\_\_\_\_

Type of Pitch (rappel, traverse, rebelay, handline): \_\_\_\_\_

Currently Rigged (circle one)?      Yes      Stage Derigged      No

## Rigging (top of pit or entrance side of traverse line):

Nearest Survey Station to Rigging: \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chockstone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Rope:

Total Length: \_\_\_\_\_

Length of rope in rigging: \_\_\_\_\_

Type of rope, if known: \_\_\_\_\_

Condition of Rope (circle one):      1      2      3      4  
(1=sketchy, needs replacement, 2=ok for a while – replace when possible,  
3=ok, no need to replace, 4=good/new)

Optimum length of rope (if different from current length): \_\_\_\_\_

## Rigging (end of traverse line):

Nearest station to Rigging \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chock stone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Notes:

## Location

Section of Cave: \_\_\_\_\_

Location / Name (eg. Boulder Falls): \_\_\_\_\_

Type of Pitch (rappel, traverse, rebelay, handline): \_\_\_\_\_

Currently Rigged (circle one)?      Yes      Stage Derigged      No

## Rigging (top of pit or entrance side of traverse line):

Nearest Survey Station to Rigging: \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chockstone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Rope:

Total Length: \_\_\_\_\_

Length of rope in rigging: \_\_\_\_\_

Type of rope, if known: \_\_\_\_\_

Condition of Rope (circle one):      1      2      3      4  
(1=sketchy, needs replacement, 2=ok for a while – replace when possible,      3=ok, no  
need to replace, 4=good/new)

Optimum length of rope (if different from current length): \_\_\_\_\_

## Rigging (end of traverse line):

Nearest station to Rigging \_\_\_\_\_

Overall Quality of Rigging (circle one):      1      2      3  
(1=poor, needs improvement, 2=satisfactory, 3=bomber)

Type of Anchor(s) (eg. slung chock stone, 3/8in bolt, boulder):  
\_\_\_\_\_

Equipment used in rig:  
\_\_\_\_\_  
\_\_\_\_\_

## Notes:

<b>JOB HAZARD ANALYSIS</b>	JOB TITLE (and number if applicable): <b>Caving</b>	DATE: May 2003	<input type="checkbox"/> NEW <input type="checkbox"/> REVISED	PAGE 1 OF 3
	Title of Person Who Does the Job:		Analysis By: Stan Allison, Cave Technician	
Instructions On Reverse Side	Supervisor: Cave Resources Specialist	Reviewed By: Dale Pate, Cave Resources Specialist		
Park: CAVE	Division: Resources Stewardship and Science	Approved By:		
REQUIRED AND/OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:				
<b>SEQUENCE OF BASIC JOB STEPS</b>		<b>POTENTIAL HAZARDS</b>		<b>RECOMMENDED ACTION OR PROCEDURE</b>
<b>Planning Caving Trip</b>		Lack of leadership and communication.		One person for each trip will be designated as the trip leader. This person is responsible for providing leadership and clear communication concerning safety, minimizing impact to the cave resource and achieving the trip goals.
		Planning a caving trip that will exceed the abilities of any team member. These abilities include physical condition, technical skills and psychological aspects.		Ensure that trip plans are within the range of all team members. Discuss trip plans with team members and make sure each member understands the trip plans, is prepared to meet the challenges of the trip in terms of physical condition, technical skills and psychological aspects.
<b>Preparing Equipment</b>		Not bringing proper equipment to achieve the planned objectives.		Trip members will make sure they have the proper personal equipment for the trip. Trip leader will ensure that all group equipment is properly prepared.
		Equipment worn, broken or inoperable due to lack of proper maintenance.		Each trip member is responsible for regularly checking, cleaning and ensuring that all caving equipment is in proper working order.
		Team member not knowing how to properly use caving equipment.		All team members will have the training and knowledge as to proper usage of each piece of equipment used for their specific trip.

<b>Entering Cave</b>	Entrance Zone Animals	While in the Entrance area of a cave all team members should be alert and aware that mountain lions, porcupines, skunks, rattlesnakes, scorpions, centipedes, spiders and other potentially hazardous animals may be found.
<b>Horizontal Caving</b>	Running out of light and being unable to exit cave.	Every team member will have three independent sources of light. The main source will be helmet mounted and another source should be either helmet mounted or able to be helmet mounted. Extra batteries should be brought into the cave sufficient to provide light for the duration of the trip and extra in case of an un-planned delay. A repair kit consisting of spare bulbs, or other parts as necessary should be brought as well.
	Falling	Everyone will wear footwear with good traction and a caving helmet with a chinstrap.
		Everyone should move in a careful, controlled manner to avoid falling.
		When climbing test all holds to ensure that they can withstand the force being placed upon them.
	Exhaustion	Trip members will take in proper nutrition before, during and after caving trips.
		Should the trip become too much for one trip member, the whole trip plan will be modified to achieve a safe trip.
	Heat Exhaustion due to high temperatures and high humidity of some caves (68 degrees Fahrenheit and almost 100% humidity).	Team members will wear clothing appropriate to the cave environment that they are in. Generally wicking fabrics will provide the most comfort. Dressing in layers allows clothing to be removed while moving and then added while stationary to avoid becoming cold.
		Caving pace will be set so that no one will become overheated and succumb to heat exhaustion. Plans may have to be modified.
		The leader will adjust caving pace so that the slowest team member will not be endangered or exhausted.
	Dehydration	All team members will be properly hydrated before entering the cave and drink sufficient water during the trip to maintain a proper hydration.
	Rockfall	Cavers should locate themselves in places where they will not be exposed to rockfall from team members above them.
		Cavers will move carefully and thoughtfully so as not to knock rocks down on those below them.

		Should a team member accidentally knock down a rock that team member will clearly yell “Rock!” to inform those below of the impending danger.
		All team members will wear a caving helmet with a chinstrap. This helmet should not be removed when in an area with a potential for rockfall.
<b>Single Rope Technique</b>	Miscommunication resulting in someone entering the rockfall zone while another team member is still in a position to knock rocks down or while another team member is still on rope.	Clear signals will be used to avoid miscommunications. “On Rope” will be clearly shouted when entering the rockfall zone with the intent to rappel or ascend a rope. “Off Rope” will be clearly shouted after getting off rope and exiting the rockfall zone. A clearly shouted “OK” from the other team members should acknowledge either of these commands.
	Ropes and or rigging materials worn or damaged.	All ropes and rigging materials will be inspected for wear or damage before use. If necessary damaged or worn materials will be retired.
	Unsafe Rigging.	All rigging will be inspected before use to ensure that it is safe. If determined not to be safe, the rigging will be modified if possible or the trip halted until the rigging can be made safe.
	Rope damage encountered while on rope.	A butterfly knot will be used to eliminate the damaged section of rope from the life supporting rope. A note will be left both at the top and bottom of the rope informing cavers of the situation.
	Incident occurs where caver is forced to change over to ascent while descending or to descent while ascending.	Everyone participating in SRT will be required to have the equipment, training and knowledge to perform changeovers from ascent to descent and descent to ascent.
	Object becomes jammed in rappel device.	Everyone participating in SRT will be required to have the equipment, training and knowledge to safely lock off their rappel device and remove the jammed object without using a knife.
	Difficulty in passing a rebelay, traverse or other complex rigging situation.	All persons traveling to sections of cave with complex riggings will be required to have the equipment, training and knowledge to safely negotiate these complex riggings.
	Caver becomes exhausted, unconscious or injured resulting in immobilization on rope.	When someone becomes immobilized on rope, it is critical to remove that person from rope as soon as possible. Although not a requirement, ideally every trip should have at least one person capable of performing a pick-off.