

APPENDIX A: Acknowledgement of Risk / Waiver of Responsibility

This form is to be completed and signed by all persons taking part in any activity in undeveloped sections of Jewel Cave or any cave within Jewel Cave National Monument's boundaries.

I, the undersigned, have been warned and understand that the activity in which I am about to participate is strenuous and can be hazardous. I will abide by all applicable Monument rules and regulations.

Below is a list of the most pertinent rules and regulations which you are to observe:

1. No cave formations, rocks, or historical materials will be disturbed or removed from the cave.
2. Trash and human wastes will be removed from the cave. Items approved by the park, including survey markers, are excepted.
3. Signs, notes, maps, directional arrows, etc., will not be scratched or marked on cave surfaces.
4. Hard hats will be worn at all times.
5. Each person will have at least three independent light sources when in the cave.
6. Each group will have an adequate first aid kit or knowledge of the location of in-cave rescue stashes.
7. No passages will be enlarged or modified prior to official approval.
8. Group leaders are responsible for group conduct.
9. Photography is permitted if it does not significantly impact the purpose of the trip. The photographs may not be used for commercial purposes unless the photographer has obtained a filming permit.

Your Signature

Date

Signature of Parent or Guardian if under 18

Please print:

Name _____ D.O.B. _____

Address _____ City _____ State _____

Zip _____

Phone _____ Affiliation (if any) _____

Emergency Contact _____ Phone _____

Acknowledgement of Trip Leader Responsibility

As a trip leader at Jewel Cave National Monument, I promise to abide by all park-wide regulations, and to follow the guidelines established in trip leader training. Specifically, I will:

- Ensure safety of group members at all times
- Ensure protection of cave resources
- Properly care for equipment
- Communicate with cave management staff regarding impacts, injuries, or other problems, or any unusual circumstances.
- Ensure quality of survey, inventory, or other work (if applicable).
- Properly plan trips to maximize efficiency and productivity (i.e. bring adequate maps)
- Ensure the protection of sensitive data

Your Signature

Date

Please print:

Name_____

Address_____ City_____ State_____

Zip_____

Phone_____

APPENDIX B: Cave Search and Rescue Plan

CAVE SEARCH AND RESCUE PLAN Jewel Cave National Monument (updated July 2007)

Recommended: _____
Cave Specialist, Jewel Cave National Monument Date _____

Approved: _____
Superintendent, Jewel Cave National Monument Date _____

Jewel Cave National Monument Cave Search and Rescue Plan

Due to the nature of caves and the special conditions found within them, cave search and rescue (SAR) can vary significantly from traditional SAR activities. This plan highlights the special concerns and situations inherent in a cave SAR incident at Jewel Cave.

Difficult Nature of Cave SAR at Jewel Cave

Parts of Jewel Cave are extremely remote, requiring many hours of physically demanding travel for even highly skilled cavers. The park and cavers both must be aware that rescue in many parts of the cave will be slow and difficult. Moving an injured caver in a stretcher from the end of the cave would take *at least* three days, and could potentially involve the use of over 100 cavers. There are some situations where the body of a deceased caver would be interred within the cave, rather than needlessly endangering cavers to attempt a body recovery.

Fragile Nature of Jewel Cave

Parts of Jewel Cave are exceedingly fragile. SAR activities are likely to result in resource damage, and could severely impact areas where delicate formations are abundant. While the well-being of the patient will always be the top priority, NPS resource preservation mandates must be considered as well. These concerns may slow the progress of rescue teams through some areas.

Common Scenarios

The most likely cave SAR scenarios will be relatively low-profile events. Often these events will occur when a caving party fails to exit the cave at the pre-appointed time. This will usually be due to a slowly moving group (due to exhaustion or a slight injury to a group member), or possibly, miscommunications with the surface contact. The chances of an entire caving party failing to exit the cave are very low. Other possibilities include an individual becoming separated from the rest of the party and getting lost, or someone falling in the cave and becoming injured. In most instances, a reporting party from the group would exit the cave to notify the park.

Critical Resources

Information related to local and regional cavers, maps, taped routes, obstacles, rescue cache locations/contents, etc., are available in the Cave Search and Rescue file in the Resource Management Office.

Getting the First Teams In

Hypothermia concerns make it important to respond to a cave emergency as quickly as possible. However, an Initial Response Team should be dispatched *only after* certain conditions have been met:

1. First Notice

Either the trip's designated surface watch, or a returning member of a caving trip will contact a responsible NPS employee (see *Appendix 1*), who will assume the role of initial Incident Commander (IC).

2. First Actions

The initial IC's first actions should be to: 1) secure the reporting party to ensure that a detailed debriefing will be possible, and 2) to contact the initial Technical Specialist (TS) (see *Appendix 2*), who will aid the IC in assessing the situation and performing the initial callout. The TS will be a caver with extensive knowledge of the cave, its obstacles, and the cavers capable of overcoming those obstacles.

3. Entrance Control

Entrance control **must be established** before anyone enters or leaves the cave¹. All personnel are to be logged in and out, using an Entrance Control Log. It is essential to know who is in the cave, their destination, time of departure / expected return, and the equipment they are carrying². There are four entrances into Jewel Cave that will need to be secured in any incident: The Main and Basement elevator lobbies, the Portal Entrance, and the Historic Entrance. The Portal and Historic Entrances should be secured, regardless of the location of the incident.

4. Initial Callout

The IC, in consultation with the TS, assesses the situation and decides whether to call local cavers to be members of an Initial Response Team, or to put them on standby (see *Appendix 3*). The response plan can then be formulated during the time it takes the IR Team to prepare for action³.

5. Initial Response Plan

The type of initial response can be greatly influenced by information received from the returning member of the caving party. The plan should consider any known medical condition or injury sustained by the subject, and must **always anticipate hypothermia**. If available information indicates the need for a search, the IR Team must be properly instructed and qualified to conduct the search. A search in the cave environment is complicated by its remoteness, its three-dimensional complexity, and the fact that many existing passages do not appear on any map. Extensive resource lists containing information on taped routes, obstacles, rescue cache locations and contents, etc., are available in the Cave Search and Rescue file in the Resource Management Office.

6. Communications

The IR Team should not be sent in until an initial communications plan has been developed and communicated. There are a limited number of ways to establish *any* kind of communications in most parts of the cave. In the initial phases of a cave search or rescue, the IC's available communication methods will likely be limited to written messages issued by teams going in or out of the cave. This requires very careful planning and debriefing. Field phones can be used, although the plan must address the difficult and time-consuming nature of stringing wires through the cave. Jewel Cave has a cave radio that operates with Morse code communications. Its use requires transporting an antenna, transmitter, and battery to a predetermined spot in the cave, located precisely below a pre-determined spot on the surface. Maps showing these locations are in the Cave Search and Rescue file.

¹ This simply means that the IC must ensure that no unauthorized entry or exit occurs during the SAR operation. Control can be established by stationing personnel, physically blocking an entrance, or by switching locks. In the initial stages, the IC may elect to actively secure only one entrance. But control should be established at all the others as soon as possible.

² For example, entrance log information can be used to force tired people to come out of the cave for sleep.

³ This will be *at least* 2 hours, and as many as 10 hours, after the incident is reported.

7. Deploy Initial Response Team

The IR Team may enter the cave only after the above concerns have been addressed. The IR Team must be thoroughly briefed and an expected return time decided upon. Once the patient is reached, the team may need to split up. Two cavers should carry messages to the surface, especially those regarding the patient's medical condition. They will also provide information on cave conditions and extrication problems, and inform the IC of any hazards or needed equipment. The other team members will attempt to stabilize the patient. All team members will be debriefed immediately upon their return, by the IC or Documentation Coordinator.

General Callout

Once the IR Team has been deployed, the IC and TS will need to determine if a larger callout will be necessary. If so, several things must be kept in mind. First, word travels very quickly in the caving community, making it likely that many cavers will call to volunteer their services. It must be understood that many cavers are not physically up to the challenge of traveling to remote parts of the cave. The TS will be invaluable in advising the IC to avoid these individuals, who may inadvertently endanger themselves or others. Also, members of local surface search and rescue teams may begin to arrive or volunteer their services. While some of these individuals may be helpful for some tasks, **it is essential that these individuals be teamed with knowledgeable cavers, if they are used at all.** Jewel Cave presents other challenges, such as the potential for severe dehydration, especially to those not familiar with Black Hills caving. It is best to use cavers with extensive Black Hills caving experience, even if it means having to wait a little longer for them to arrive. General callout lists are available in the Cave Search and Rescue file in the Resources Management Office.

**Jewel Cave National Monument
Cave Search and Rescue Plan**

**Appendix 1
Initial Incident Commander List**

An initial Incident Commander (IC) for each cave SAR incident in Jewel Cave should be chosen (in priority order) from the following list:

Note: Contact information has been intentionally omitted from this draft.

Name	Address	Phone
Rick Mossman	Wind Cave	
Mike Henry	Wind Cave	
Mike Pflaum	Mt. Rushmore	
Don Hart	Mt. Rushmore	
Todd Suess	Jewel Cave	
Mike Wiles	Jewel Cave	
Rod Horrocks	Wind Cave	
Rene Ohms	Jewel Cave	
Marc Ohms	Wind Cave	
Dan Foster	Wind Cave	

**Jewel Cave National Monument
Cave Search and Rescue Plan**

**Appendix 2
Technical Specialist List**

A Technical Specialist (TS) for each cave SAR incident in Jewel Cave should be chosen (in priority order) from the following list:

Note: Contact information has been intentionally omitted from this draft.

Name	Address	Phone Number
Mike Wiles		
Rene Ohms		
Marc Ohms		
Larry Shaffer		
Stan Allison		
Dan Austin		
Kelly Mathis		
Herb and Jan Conn		
Paul Burger		
Steve Baldwin		
Dave Springhetti		

**Jewel Cave National Monument
Cave Search and Rescue Plan**

**Appendix 3
Local Resources**

Below are the names and phone numbers of local and regional cavers capable of assisting in the early hours of a cave SAR incident at Jewel Cave National Monument. Not all of these cavers can be used in an incident at the far reaches of the cave.

Note: Contact information has been intentionally omitted from this draft.

Name	Phone Numbers	Where
Mike Wiles		Entire Cave
Rene Ohms		Entire Cave
Marc Ohms		Entire Cave
Larry Shaffer		Entire Cave
Dan Austin		Entire Cave
Andy Armstrong		Entire Cave
Bonny Armstrong		East and West
Jason Walz		East and West
Matt Busch		East and West
Todd Suess		East and West
Carl Bern		East
Dave Springhetti		Some East and West
Steve Baldwin		Entire Cave
Sammi Langendorf		Some East

APPENDIX C: Underground Camping Policy

Updated July 2007

Introduction

Multi-day trips in Jewel Cave began in 1997, and have proven to be a productive aid to exploration and management efforts. Camping allows cave explorers to discover and survey a large amount of cave passage; on average, it would take at least five single-day trips to accomplish the same amount of surveying done on one four-day camp trip. This results in less impact to passages along the travel route. Camping also provides an extra measure of safety to the explorers, who are rested and refreshed as they make the return trip to the entrance from camp, rather than tiredly making their way out at the end of a 20-hour day. Without proper planning and preparation, camping can be a high impact activity. This document contains policies that will keep this impact to an absolute minimum.

Camp Sites

A written justification must be approved by the Cave Specialist in order to establish a new campsite. The number of sites will be kept to a bare minimum; currently there is only one campsite in Jewel Cave, at survey station TT2 near the Big Duh. Sites will normally be established in areas where round trip travel time¹ exceeds 12 hours. They will be permanent, rather than mobile, and established, when possible, on solid rock rather than in sediments -- to reduce physical and organic impact.² All camping activities will take place in a single area, not to exceed 300 square feet. This precludes individuals from sleeping in various locations scattered throughout a room.

Site Preparation

The entire site will be covered with plastic tarps with no intervening gaps. The site should be near a water source so that water will not have to be carried long distances. Supplies and equipment that will not deteriorate can be left at camp between trips. However, no garbage, human waste, or discarded or unserviceable equipment is to be left behind, either at camp or elsewhere in the cave. Jewel Cave has a firm policy of removing all human waste.

Procedures

The NPS will provide six sets of sleeping gear,³ as well as desiccant to keep them dry. Individuals must use a clean sleeping bag liner. Inexpensive liners will be provided by the park, but cavers may use their own liner if they have one. Cavers must bring clean camp clothes, which will be removed from the cave at the end of each trip. Equipment packs should be no larger than a Lost Creek Monster TAG pack or equivalent. Packs should not be worn on the back through delicate crawls, because dirt on a pack will easily transfer to the ceiling. Cavers should spot each other and pass packs along to each other as needed. The longest trip will be four days. This limitation is based primarily on the amount of urine that can be practically removed from the cave.

When settling into camp, cavers must remove caving clothes while standing on the trail and put on camp clothes before stepping into the plastic-covered camp area. All camping/cooking gear and supplies will be kept within the designated camp area.

¹ This relates to the travel time of experienced cavers who are familiar with the route.

² Organisms are more likely to flourish where a sediment substrate is found.

³ To be left at camp. This reduces the size of packs needed. Hauling heavy packs slows the trip unnecessarily and poses greater threats of impact along the travel route.

Group Camping Gear (these items remain in the cave)

Cooking Gear: 3 alcohol stoves (one per two people)
1 quart denatured alcohol (for six people on a four-day trip)
3 quart pots with 3 lids
2 lighters

Sleeping Gear: 6 full-length sleeping pads
6 20-degree synthetic fill sleeping bags

Individual Camping Gear (these items are not left in the cave)

Sleeping gear: 1 clean sleeping bag liner
1 balaclava

Camp Clothing: 1 polypro top
1 pair polypro bottoms
1 pair clean socks
Clean, smooth-soled, wipeable footwear⁴

Food: 2 dehydrated meals per day⁵
Sufficient supplemental food each day for a 12-hour caving trip.⁶
Container to eat from⁷
1 plastic spoon

Toiletries: Antibacterial baby-wipes to clean up before going to sleep
Toothbrush/toothpaste
4 - 6 cubitainers (“cubies”) for urine
4 fecal bags (each triple-bagged in heavy-duty zip-lock bags)
Several sheets of paper towels or toilet paper

Light Sources: Enough for at least 24 hours more than expected trip length.

Other: Personal first-aid kit
Wristwatch with alarm

⁴ For walking around camp (provided by park).

⁵ Usually oatmeal for breakfast and a freeze-dried backpacking meal for dinner

⁶ For example, energy bars, trail mix, tortilla sandwiches, etc.

⁷ Heavy-duty zip-lock bag, bowl, etc.

APPENDIX D: Guidelines for In-Cave Cultural and Historical Resources

Introduction

Jewel Cave's human history extends back to about 1900; the first time humans were able to enter the cave. The cave passages in the "historic section" may contain items of cultural and historic value. A small subset of this area is known to have a few items from the early 1900s. These include such things as rotted rope, newspaper fragments, and other incidental objects.

Beginning in the late 1950s, there was a significant increase in exploration activity, by Bill Eibert, then Dwight Deal – along with Herb and Jan Conn. The Conns conducted the majority of the work in the ensuing 20+ years. In the course of their caving activities, they placed signs and carbide markings, rope, rock cairns, and tools, etc., some of which are currently over 40 years old.

Since the time of the Conns, objects such as plaques, cairns, signs, ropes, and ladders have occasionally been left in the cave by explorers. These items have been placed in the cave over the last 25 years.

Potential Impacts

Potential impacts to cultural resources are dust accumulation, accidental breakage or trampling, and natural degradation in the cave environment. In some cases, a cultural resource may impact cave resources as it degrades (i.e. molds, rusts, etc.).

Policy

If a cultural or historical resource is encountered during any in-cave activity, that activity will be immediately discontinued if it would damage the resource. A report will be made to Jewel Cave's Cultural Resource Advisor (at the NPS Midwest Regional Office), and their input will be solicited before any more work is done.

Any cultural resource may be removed from the cave at the park's discretion. Reasons for removing an item of cultural value from the cave include degradation of the object itself and any resulting degradation of natural resources. Over the course of time, certain exploration aids (such as ladders) may come to be considered historic. These will occasionally need to be repaired or replaced; in such cases, the original item may be included in the park's museum collection after consultation with the Cultural Resource Advisor.

Before any object is removed from the cave, it must be documented. Documentation will include a written description, photograph(s), and location.

APPENDIX E: Trip Leader Training Program Outline

A. Working at Jewel Cave National Monument

1. NPS Mission
2. Cave management's responsibility
3. Significance of Jewel Cave
4. Legal issues
 - a. What does "Trip Leader" status mean
 - b. VIP Status (VIP Form, off-trail forms)
 - 1) Maintaining and losing status
 - 2) Nominating others for trip leader training
 - 3) Other training classes (sketcher, rescue, and inventory classes)

B. Rules and Policies

1. Camp Manager position (Coordinates use of surface facilities on a weekend devoted to exploration.)
 - a. Inventory of gear and checkout
 - b. Trip reports
 - c. Dry-erase board and checkout times and returns
 - d. Cleaning
 - e. Park liaison
 - f. Keys
 - g. Quiet hours
2. Park Conduct
 - a. Park buildings
 - b. Driving
 - c. Changing clothes in public
 - d. Drugs and alcohol
 - e. Dealing with public/tours

C. Jewel Cave Special Issues

1. Historic materials
2. Formations and delicate areas
3. Manganese tracking
4. Digging policy
5. Drinking water sites
6. Flagged trails
7. Packs (side mounted)
8. Travel (single file)
9. Closed areas
10. Wet areas, mud
11. Rescue caches
12. Waste disposal

D. Trip Leader Responsibilities

1. Cave management decisions
2. Arranging trips
3. Trip reports (Include a list of party members, survey totals, reasons for naming areas, accidents, leads, impact noticed, unusual speleothems or minerals.)

4. Computer and typing in survey data
 5. Park equipment
 - a. Check out gear
 - b. Report broken or lost equipment to camp manager (including pencils & sharpies)
 6. Rescue
 - a. In Cave:
 - 1) Lost team member
 - 2) Injury
 - 3) Fatigue
 - 4) Hypothermia
 - b. Callouts
 - c. First aid caches
 - 1) Contents
 - 2) Locations
 7. Personnel issues
 - a. When to call off a trip
 - b. Breaking rules – consequences
- E. Survey and Inventory
1. Survey policies
 - a. Project areas
 - b. Utilizing lineplots, maps, survey notes, trip reports
 2. Survey procedures
 - a. Park equipment only
 - b. Compass course – we take care of that
 - c. Backsights – when and how to use
 - d. Common compass errors, and how to avoid them
 - e. Survey designations, choosing prefixes and suffixes
 - f. Marking stations
 3. Major discoveries
 - a. Borehole fever
 - b. Survey everything you find
 - c. Project areas, keeping secrets, newsletter reports
 - d. Virgin cave – pick wisely, ensure the least amount of impact.
 - e. Breakouts – area belongs to discoverers
 4. Examples of good and bad surveys
- F. Inventory procedures
1. How the data is used, Access database
 - a. Who should complete
 - b. Procedures
 - c. Using notes and comments
 2. Use of photos
- G. NPS Support
- Survey support: lineplots, survey designation lists, individual surveys, maps, trip reports, equipment

APPENDIX F: Cave Entry Permit and Trip Report

JEWEL CAVE NATIONAL MONUMENT CAVE ENTRY PERMIT

Permit # _____

Permission is requested to enter the following undeveloped section of Jewel Cave:

Purpose: _____

Participants: _____ (leader)

The group will ENTER the cave at _____ on _____.
The group will EXIT the cave at _____ on _____.

SURFACE CONTACT: _____ Phone: _____

It is understood that those taking this trip are doing so at their own risk. Each member must have on file a Waiver of Responsibility and agree to abide by the terms and limitations stated therein. The trip leader is responsible for the proper care of government-owned equipment used on this trip, for the overall conduct of the group, and for returning no later than the specified time. The trip leader agrees to submit a full report of the trip to the Superintendent within one week. It is understood that this permit, when approved, covers only one cave trip on the date and to the place indicated above.

I agree to the above conditions, and to ensure that all group members do likewise.

Requested By:

Recommended By:

Approved By:

Trip Leader

Cave Specialist

Superintendent

Date

Date

Date

Affiliation

APPENDIX G: Cave Survey Standards and Cartographic Guidelines

Jewel Cave National Monument
April 2007

Introduction

The proper collection, maintenance, and safeguarding of data are essential to the effective management and protection of caves and karst resources. Map data provide the fundamental framework of knowledge needed to accomplish the major purposes of cave management: preservation, advancing scientific knowledge and understanding (including further exploration), and providing for the enjoyment of the public.

Maps aid in navigating through the cave, facilitating exploration, and establishing spatial relationships, particularly between the cave and the surface. They serve to document the extent and nature of cave passages.

As cave exploration progresses, newly discovered passages are documented by compass-and-tape survey. The methods used to collect the data, sketch the cave passages to scale, and incorporate this information into a master map meet the standards proposed in *National Cave Survey Data Collection Standards* (Yocum and Wiles, 1997). Symbology is based on NSS Standard Cave Map Symbols, but adapted to the unique needs of the Jewel Cave system.

Over 140 miles of passages have been surveyed at Jewel Cave, using standards that were originally adopted and developed by Herb and Jan Conn. The result is that Jewel Cave has an excellent survey, with good-to-excellent loop closures and complete records of all surveys. Because of the high integrity of the data, Jewel Cave has never needed a resurvey. All future data collection will meet or exceed the minimum standards proposed by Yocum and Wiles (1997).

Cartographic standards are designed to meet the specific management needs of Jewel Cave National Monument. They ensure that the map represents, to scale, the walls and floor morphology, at as many as five overlapping levels, in a single black-and-white drawing. With a master map of over 60 quadrangles drafted according to this standard, it is important to maintain substantial compatibility with these hand-drafted quadrangles – even as improvements are developed.

To this end, for all new surveys, sketches will include more floor detail than has been previously recorded, and will be based on the NSS Standard Map Symbols; cross-sections will be made at every survey station, and additional symbols denoting changes in ceiling height, ledge heights, and lead notation (such as “TT” for “too tight”) will be incorporated. The sketches will be archived separately from the master map, and any additional information that is not used on the hand-drawn quadrangles may then be incorporated in future digitized maps with layers. The archived survey notes will be scanned into PDF files.

Cave Survey Data Collection Standards

April 2007

Information Included with Each Survey

Cave Name

Survey notes of caves other than Jewel Cave will be kept separate, with the cave name at the beginning of each survey.

Date

Full date: mm/dd/yyyy

Personnel

Include the full name or initials of personnel in the sketch book. (If initials are used, the full name can be later determined from the cave trip permit or database.)

Duties

List the function(s) performed by each team member. Basic duties include:

- Book
- Compass/Clinometer
- Tape
- Inventory

These duties may be abbreviated: B = Book, C = Compass/Clinometer, T = Tape, I = Inventory.

Instruments

The serial number of each compass and clinometer must be recorded. If a laser distance meter is used, its number must also be recorded.

Procedures

Equipment

- Survey books, instruments, and tapes will be provided and maintained by the Monument.
- Instruments used at Jewel Cave will be calibrated annually.
- Broken survey tapes will be taken out of service.

Survey Designations

- New survey designations should be used sparingly. An extra effort should be made to use suffixes of the main survey for branching leads (but without fragmenting the survey – see below). New designations may be initiated when surveyors are reasonably sure the area they are mapping is really going somewhere.
- New survey designations should consist of two characters from the standard ASCII character set, which includes upper and lower case letters (so “AA” and “aa” are different), and punctuation. Examples include the “XO,” “db,” and “!!” surveys. These characters are followed by a number, from 1 to 999. For side passages, this number may be followed by one or two upper-case letters.
- Surveyors should avoid fragmenting the survey, especially a main survey; correct numerical order should be maintained. Obvious side leads should be sequenced with a single suffix (e.g. “XO121A,” “XO121B”). Side leads branching from a side lead should be named with a double

suffix (e.g. “XO121BA,” “XO121BB”). A fragmented sequence should only be used after a third level of branching.

- When possible, use the above “tree” format rather than “jumping around.”
- Do not follow a lettered suffix with a number.

Stations and Labels

- Each survey must begin at an existing unambiguous tie-in station that is clearly marked in the cave.
- Each shot will consist of a unique combination of “from” and “to” stations.
- All survey stations must be permanently marked, except in delicate areas, or in places where it is not possible (e.g., where the bedrock is crumbly).
- Stations must be marked with a prominent bull's eye (currently with a permanent marker) on bedrock, a loose rock, or rock cairn. The label should be written on a loose rock, which may be either the same rock as the station, or a separate one. In delicate areas, a smaller mark is preferred. The main shortcoming of using a permanent marker is that it does not mark well on punky bedrock, so an alternative method will be pursued, and adopted when available.
- When using a suffixed survey, just the suffix will suffice (e.g. “XO121A” can be labeled as “A”), except in confusing areas (e.g. where two suffixed surveys are near each other), in which case the full station name should be labeled.

Measurements

- Distance must be measured in decimal feet (feet and tenths) to the nearest .05 feet (e.g., 12.75).
- Azimuth must be measured in degrees to the nearest 0.5 degrees (e.g., 125.0 or 125.5)
- Inclination must be measured in degrees to the nearest 0.5 degrees (e.g. +9 or - 8.5)
- Passage dimensions may be either estimated or measured. The latter is preferred when a laser distance meter is being used.
- The compass should be set for 0 degrees magnetic declination, when applicable. Declination, determined annually to the nearest 0.25 degrees, will later be set in the cave survey software.
- Loops under 500 feet should close with less than 2% error. Loops over 500 feet should close with less than 1% error.

Backsights

- Normally, only foresights are used to process the survey data, to ensure the consistency of a single compass reader. The backsight reading is used to check for gross reading errors (“blunders”). If both readings are within two degrees of one another, there is no blunder; if the readings do not agree, both readings must be repeated. If no agreement can be reached, the reading from the station that was easiest to read from should be used.
- A backsight must be read for every survey shot, when possible. These readings may be taken with the same set of instruments, by the same person who read the foresight; or by two different people using two sets of instruments. If two sets are used, they must be checked before the trip to be sure they agree within one degree.
- Backsights are not necessary for dead-end shots.
- When backsights are used, the uncorrected values should be recorded. Each backsight must be denoted by a circled, upper case “B” before the station names, and the station names must *not* be reversed in the survey book.

Reading and Recording Data

- Instrument readings will be recorded as read. A backsight will be uncorrected, and the compass/clinometer reader will notify the note-taker of the fact that the reading is a backsight.
- All data must be clear and legible: decimal points must be dark, and each number or letter must be neatly written.
- Distances will be recorded with two digits after the decimal point; passage dimensions will be recorded with one digit after the decimal point, when not a whole integer. Azimuths must be recorded with one digit after the decimal point. A “+” or “-” must precede all inclinations.
- Each shot must be recorded on pre-printed survey sheets, either offset station format or in-line station format. A blank entry must be inserted between all non-consecutive shots.
- The first station name on each page must be written using the full station name. The remaining station names may be abbreviated.

Sketching

- Each page of the sketch should include an arrow pointing towards **magnetic** north (not corrected for the current declination), labeled as such in the survey book.
- Each page of the sketch should include a labeled bar scale, for distance. The default scale is 1 inch on the sketch equals 50 feet in the cave. The scale may be changed as needed, as long as this is clearly indicated.
- Cross-sections must be done at every survey station, at the same scale as the plan view. If a different scale is chosen, this must be clearly indicated.
- Each survey point or station should be labeled on the sketch, and station symbols should be placed at the correct distance and direction relative to one another. Distances should be foreshortened for vertical angles greater than or equal to 30 degree, and azimuths may be estimated to the nearest 10 degrees. Use of a protractor and ruler are encouraged.
- All text should be written so that, with the north arrow up, everything is easily readable.
- Sketches should conform to Jewel Cave standards, adapted from the NSS Standard Cave Map Symbols Any non-standard symbols must be defined in a legend.

Checking Leads

- Checking leads with no intention of survey (“scooping”) is not permitted.
- It is sometimes necessary for a member of the survey team to check a lead before it is surveyed (“scouting”), in order to determine which lead should be surveyed first, or how to efficiently place the stations. All passages entered by any member of the survey team must be documented, by either survey, sketch, and/or written description.
- Although it is preferable to survey all passages, there are times when the nature of the passage would make for difficult survey, the passage is too delicate, or it has a constriction where not every member of the survey team can fit. These need not be surveyed, but should be documented as thoroughly as possible.
- The person checking a particular lead should generally go no more than 100 feet before assessing a passage’s potential and turning around to report to the rest of the group.
- It is the sketcher’s ultimate responsibility to ensure that all lead-checking is carefully controlled and judicious. The main goal of any survey trip is to survey.

Passage Names

- The survey team that discovers a cave passage has the privilege of naming it.
- Carefully thought-out thematic names are encouraged, and must be agreed upon by all team members. Selected names should, in most cases, relate to the character of the passage, the features found in it, or significant events occurring on the trip.

- Cavers should strive for names that are “G-rated,” keeping in mind that these names may eventually appear on a map viewed by the general public. Any names deemed inappropriate or distasteful would not be accepted.

Guidelines for Cartographic Passage Representation

April 2005

Introduction

The following cartographic guidelines are for drafting the working maps of the cave on mylar quadrangles. Sketchers do not need to follow these specific guidelines, which differ from the NSS Standard Cave Map Symbols, but should be aware of them so they know how their sketch will ultimately be translated into a final map.

Drawing Standards

- Walls, passage names, and passage detail are drawn with the 0.30 mm pen
- Survey stations, survey lines, station labels, ceiling heights, and notes are drawn with the 0.25 mm pen
- All ceiling heights and station labels should be shown, unless the survey is overly complex
- Even line width and density should be maintained

Levels

Walls should be drawn as follows:

Loft:



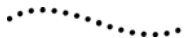
Chert:



Main:



Lower:

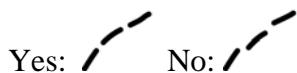


Basement:



Symbols

- Dashes line up end-for-end:



- Holes in the Floor:
 - Lines completely cross holes, and are evenly spaced (see images below):

Drawing a hole in a loft level:



Drawing a hole in a chert or sub-chert level:



Drawing a hole in a main level:



Drawing a hole in a lower level:



Drawing a large hole (lines do not need to cross entire hole):



- Holes Up:



- Hatch Marks on Ledges:

- Hatch marks should be same length
- Hatch marks should be perpendicular to edge line

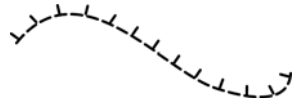
Hatch marks in a loft level:



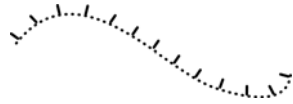
Hatch marks in a chert or sub-chert level:



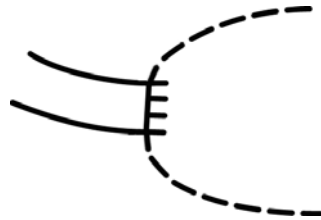
Hatch marks in a main level (hatches do not directly correspond to the dashes, to avoid misinterpretation as “T”s):



Hatch marks in a lower level:

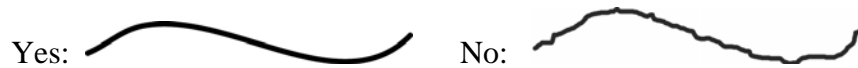


- Extend walls of upper passage into hatch marks at each end of ledge:



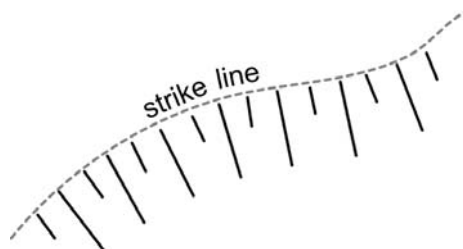
- Lines have smooth curvature

Proper line curvature:



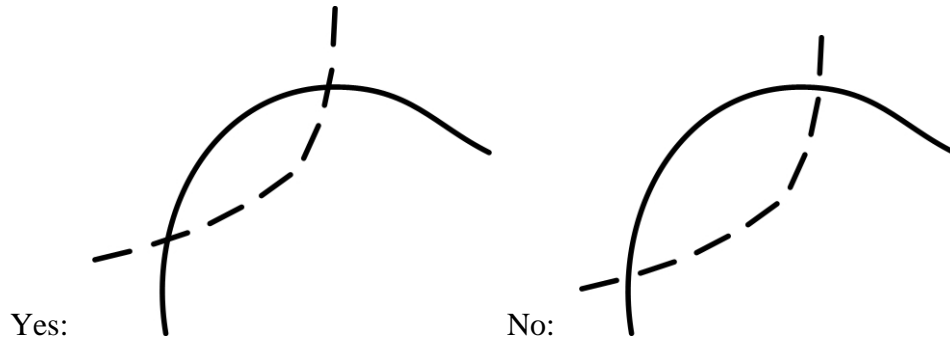
- Slopes:
 - Have invisible “strike” line
 - Hatches are evenly spaced
 - Hatches are of two lengths, which are consistent across the entire slope
 - Hatches should be perpendicular to the strike line
 - Hatches at either end should be short segments

Proper slope representation (“strike” line is imaginary):



- Crossing levels: Sub-chert level (for example) should cross directly over hatches of main level, *not* through spaces between hatches

Crossing levels (different level types):

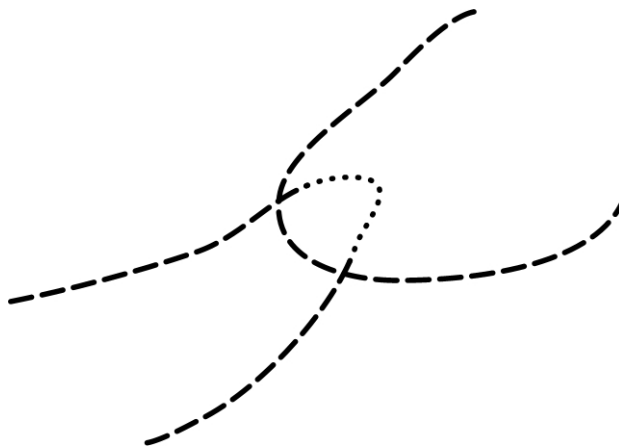


- Overlap of two passages of the same level type: Lower passage should be represented as if it were the next-lowest level where it crosses under the upper passage. The loft level (see below), is an exception.

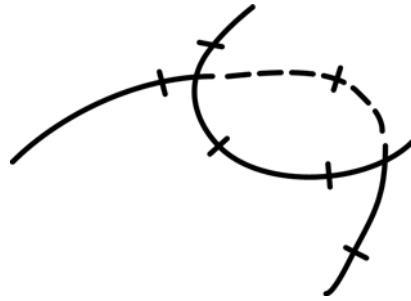
Crossing levels (chert/sub-chert level over chert/sub-chert level):



Crossing levels (main level over main level):

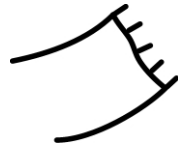


Crossing levels (loft level over loft level):



Ledges:

Ledge in a solid-line level:



Ledge in a hatched-line level:



Ledge in a dotted-line level:



Ledge heights

Use average or representative distance from edge of ledge to floor.

10

Ceiling Heights

When a passage's ceiling height is 1-19 feet, measurements are rounded in one-foot increments.

18

When a passage's ceiling height is 20 or more feet, measurements are rounded in five-foot increments.

25

Fonts

Names of rooms and passages will be written with all capital letters. Notes will be written with all lower-case letters. Station labels will consist of mixed upper- case, lower-case, and numeric characters.

Capitals:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Lower Case:

a b c d e f g h i j k l m n o p q r s t u v w x y z

Numeric:

0 or Ø 1 2 3 4 5 6 7 8 9

I use **I** in labels, **I** in names, and **i** in text

L use **I** in labels, **L** in names, and *l* in text

zero use Ø in ambiguous situations

SKETCHER EVALUATION SHEET
Jewel Cave National Monument
August 6, 2007

SKETCHER:	CAVE:			EVALUATED BY:
SURVEY:	DATE:			
<i>This sheet is designed to evaluate the pre-printed Cave Survey sheets (2/1/07)</i>	YES	PARTIAL	NO	COMMENTS
SURVEY SHEETS				
Were the pre-printed pages used as designed?				
Is the title page completely filled out?				
DATA PAGES				
Is the data complete, legible, and straightforward?				
Have passage dimensions been recorded for each station?				
Have all the pages been numbered? (Example: 1 of 3)				
Have backsights been recorded on all shots?				
Have distances been carried out to two decimal points, and azimuths and inclinations to one decimal point? (Example: 4.35 ft., 25.0 °, and -3.5 °)				
Do foresights and backsights agree within 2° for azimuth and inclination?				
SKETCH				
Is the cave name and date filled out for each page?				
Is the passage drawn to scale, and survey lines drawn in at the proper orientation (within 10°)?				
Are the stations clearly labeled?				
Is the sketch legible?				
Are standard symbols used?				
Are any non-standard symbols defined in a legend?				
Is there adequate floor and ceiling detail?				
Does the sketch contain sufficient cross sections?				
Is the nature of all leads indicated? (Example: "dig," "too tight," etc.)				
Have sufficient ceiling and ledge heights been included?				

Additional Comments:

APPENDIX H: Policy for Distribution of Cave Data

Jewel Cave is a significant cave under federal lands, and is therefore protected by the Federal Cave Resources Protection Act (FCRPA) of 1988. The FCRPA exempts cave location data from Freedom of Information Act (FOIA) requests. Cave location data is sensitive information. Over 45% of the known cave passages lie outside the NPS boundary, and unauthorized distribution could increase the potential for resource damage.

Jewel Cave National Monument will practice the following policy of limiting the distribution of cave location data, including maps:

General Public

Requests for cave maps or location data require the approval of the superintendent and may be denied.

Visiting Public

Map data in the Visitor Center will be limited to the wall map, a portion of the PowerPoint presentation in the Display Room, and the 1992 and 2007 sales maps. Brochures and other publications may contain subsets of maps, approved by the superintendent on a case-by-case basis. No other information may be disseminated.

Explorers

Individuals assisting the park in exploration do so under a Volunteer Agreement. Some cave location data may be distributed to current explorers. Subsets of digital survey data may be distributed when there is a demonstrable need. Subsets of the raw (hard copy) data may be exchanged to locate survey errors, etc. Appropriate subsets of detailed maps and line plots may be distributed to prepare for exploration trips, and to indicate the results of recent mapping. The Volunteer Agreements for exploration will specify that this information may not be reproduced or distributed in any way.

Researchers

Researchers may be given subsets of the survey data that meet a justifiable need in a park-approved project, provided that the cave specialist and superintendent determine that this will cause no significant risk of misusing the data in ways that could cause impact to the cave system.

Each researcher will sign an Agreement to 1) not copy, reprint, or distribute any cave location information (or any intermediate forms of the data) without the approval of the Superintendent, 2) to keep all data (digital or hardcopy) secure at all times, and 3) to completely destroy remaining data once the research is concluded.

The Superintendent has the authority to alter this policy when necessary.

APPENDIX I: Cave Feature Inventory Standards

Introduction

While surveying and mapping produces information on the shape and extent of cave passages, it does not provide detailed information on the features found within them. To meet this need, feature inventory data has been collected at Jewel Cave since 1987. The goal of the inventory is to collect broad-scale information, which can be recorded by someone with minimal expertise in the fields of geology, biology, mineralogy, etc. More detailed research or analyses may require additional trips to the area to collect additional data, but the initial inventory is still of great value. It delineates areas of interest for future study and also provides management with essential information, such as locations of dripping water.

Inventory data is always collected on exploration trips, simultaneously with the survey data. Although many survey stations in the cave have not yet been inventoried, there are no current plans to collect this data through dedicated inventory trips.

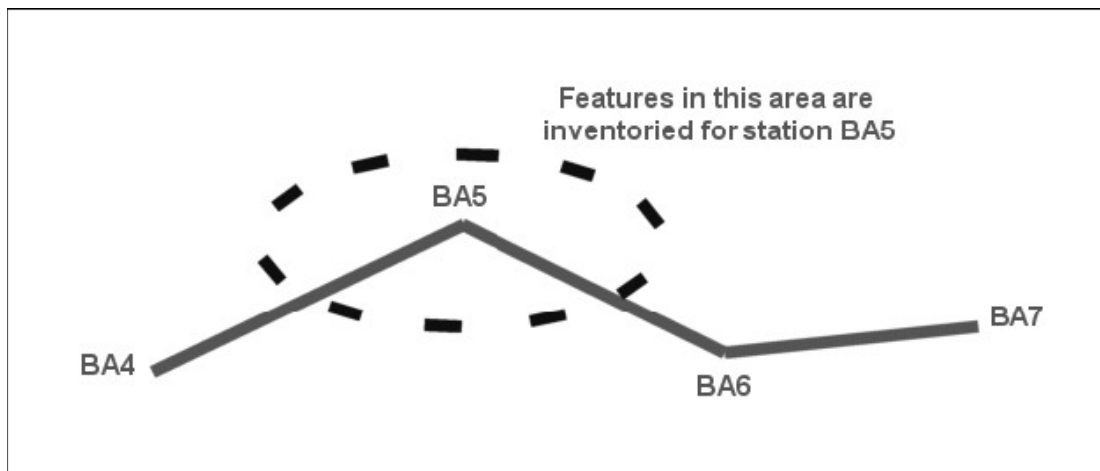
Data Collection

To simplify data collection, the most commonly found features in the cave are assigned two-letter codes, and the cave levels are assigned numbers. A list of these codes is in the front of each inventory book. The initials of the person collecting inventory data and the date are recorded at the top of the inventory data collection form.

The survey station name is recorded in the “Station” column. The stratigraphic level of the passage (at the floor elevation) is recorded in the “Level” column, as a number. The next column, “BD” is used to record the size (S, M, or L) of any breakdown found near the survey station. Small breakdown is smaller than a person; medium breakdown is person-to-car sized; large breakdown is bigger than a car. If no breakdown is present, a dash is placed in this column. The remaining columns are used to record two-letter codes of features found near the survey station. Comments can be recorded in the “Comments” column, in this format: “GN: up to 3” long.”

A digital camera (provided by the park) is used on every trip to document unusual inventory features. When a photograph is taken, the code “PH” is used, and the photo number must be recorded in the “Comments” field.

All features are inventoried in association with the station they are closest to. The halfway point between any two survey stations is the inventory boundary:



Example inventory form:

Station	Level	INVENTORY CODES										NAME	DATE
		BD										J E C	4 2 05
													COMMENTS
BA4	4	S	MN	GF	GN	FW	GL						GF: 14" long GN: hundreds, 1"-3" long
BA5	4	S	MN	GN	GL								
BA6	4	L	MN	GL									
BA7	3	S	MN	GL	CH	WR	WS						MN: calcified chunks
BA8	3	-	CH	WS									
BA9	3	M	CH	WS									
BA10	4	L	MN	GL	FW								

Data Management

Inventory data is currently entered in a Microsoft Access database designed by the park. The data is then linked to the cave survey data in GIS and complex queries can reveal spatial relationships of inventoried features.

Jewel Cave Inventory Codes

Level

- 1 Loft
- 2 Chert
- 3 Sub-Chert
- 4 Main
- 5 Lower
- 6 Basement

Speleogens

- BP Bedding Planes
- BX Boxwork
- BR Breccia
- CH Chert
- FL Fossil
- PF Paleofill
- SS Slickensides

Speleoclasts

- BD Breakdown
- CT Crust
- DD Dendrites
- MN Manganese
- MD Mud
- SD Sediment

Weathering Products

- CN Conulites
- DH Driphole
- VG Van Gogh Weathering
- WR Weathered Rock

Seepage/Evaporation Speleothems

- HB Hydromagnesite Balloons
- FW Frostwork
- MM Moonmilk
- PC Popcorn
- SH Shards
- VT Vent/Rim
- WS White Stuff

Crystal Speleothems

- CX Crystal
- DS Dogtooth Spar
- NS Nailhead Spar
- QC Quartz Crystal
- QS Scintillites

Gypsum Speleothems

- CC Cave Cotton
- GB Gypsum Beard
- GC Gypsum Crust
- GF Gypsum Flower
- GH Gypsum Hair
- GL Gypsum Luster
- GY Gypsum Misc.
- GN Gypsum Needles

Dripstone Speleothems

- CF Calcite Flakes
- CI Calcite Ice/Rafts
- CP Cave Pearls
- CL Column
- DR Drapery/Ribbon
- FS Flowstone
- RS Rimstone Dam
- ST Shelfstone
- HL Helictite
- LG Logomite
- PS Pseudomite (Popcorn Stalagmite)
- SC Stalactite
- SG Stalagmite

Water

- PD Pool Dry
- PI Pool Intermittent
- PL Pool Present
- WC Water Condensation
- WD Water Dripping
- WL Water Line
- WM Water Moist
- WT Water Trickling

Miscellaneous

- CR Corrosion Residue
- BS Bat Scratches
- BI Biological
- CA Carbide Markings
- DT Dirty
- FG Flagging
- FR Fragile
- GA Garbage
- HZ Hazard
- HS Historical
- OH Other
- PH Photo

Tape Color

BB	Black & Blue
BW	Black & White
BL	Blue
DB	Blue Dots
GR	Green
OR	Orange
OB	Orange & Black
OW	Orange & White
OD	Orange Dots
PK	Pink
RR	Red
RW	Red & White
RD	Red Dots
WH	White
WB	White & Blue
YL	Yellow
GS	Gypsum Snow
SP	Gypsum Spiders

APPENDIX J: Photography

The following guidelines will be observed for in-cave photography:

- Photography may be done on any trip, as long as it does not significantly detract from the purpose of the trip.
- If the photography is done with park equipment, the photographs belong to the park.
- If the photography is done with the photographer's own equipment, the photographer may donate photos or duplicate photos at his or her discretion. The park may then use the photographs as needed, with credit given to the photographer. The park may reimburse the cost of duplication.
- A filming permit will be required for commercial photography; to do trips for the sole purpose of amateur photography; or on other trips, if additional time, equipment, or setup procedures would be needed. There may be a monetary cost associated with a filming permit.