# RESOURCE MANAGEMENT PLAN

## OREGON CAVES NATIONAL MONUMENT

## APPENDIX B: CAVE MANAGEMENT PLAN

# TABLE OF CONTENTS

# I. INTRODUCTION

Oregon Caves National Monument, in southwestern Oregon, is located in the Siskiyou Mountains. Of the 10 known caves on the Monument, Oregon Caves, hereafter referred to as the Cave, is by far the largest and the only one in which public tours are given. With about 4.8 kilometers (three miles) of known passage, it is also one of the largest caves in the Pacific Northwest. The wide variety of rock types within makes the Cave unique among caves developed for public access.

## A. **Purpose and Significance**

The purpose of the Monument is defined by President William H. Taft's 1909 proclamation that established Oregon Caves as a National Monument:

> "Oregon Caves...are of unusual scientific interest and importance, and it appears that the public interests will be promoted by reserving these caves with as much land as may be necessary for the proper protection thereof."

Underwater and stream solution enlarged joints, faults, and bedding planes to form the Cave a few tens to hundreds of thousands of years ago. Bedrock, hydrology, climate, and human developments are presently the main influences on the Cave. A year-round underground stream and seepage from the Cave's ceiling respond to precipitation within days to weeks. It is likely that most of the water coming into the Cave comes from within or above the Monument.

Although not noted for large, cave-adapted animals, the Cave supports a subspecies of the Townsend's Big-eared Bat, which is state listed as threatened, and probably several previously undescribed, cave-adapted insects that may be endemic to the Monument.

Many cave processes are closely tied to the surface. Natural cave communities are almost entirely dependent on food from the surface and outside air strongly affects formation growth.

B. **Legislative and Administrative Requirements**

The Federal Cave Resources Protection Act (PL 100-691), hereafter known as FCRPA, directs federal agencies "to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people." The Act states "that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves." FCRPA defines a cave as "any naturally occurring void, cavity, recess, or system of interconnected passageways beneath the surface of the earth or within a cliff or ledge that is large enough to be traversed by people, whether or not the entrance is naturally formed or manmade."

The National Park Service (NPS) has been directed by Congress to manage the parks "To conserve the natural scenery and the natural and historic objects and wildlife 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 National Park Service Organic Act of 1916 - PL 64- 235.)

The mandate to protect caves is further defined in the NPS Management Policies Handbook (1988) which states that-

> "Caves will be managed to perpetuate their atmospheric, geologic, biological, ecological, and cultural resources in accordance with the action plans within this document. Natural drainage patterns, air flows, and plant and animal communities will be protected."

Guidelines for NPS cave management are in Chapter Two of NPS-77, Natural Resources Management Guideline.

# II. PRESENT RESOURCE STATUS

The Cave was extensively vandalized around the turn of the century. Cave formations, hereafter referred to as formations, include speleothems that result from deposition, bedrock and fill features, and speleogens that result from solution. Most of the fragile formations, especially stalactites, were broken near the 731 meter (2,400 feet) paved trail and there has been no detectable growth on most of the broken stalactites within the last hundred years. However, most of the Cave away from the main tour route is in relatively pristine condition except where tubular stalactites come or came close to the floor of the Cave and where small calcite crystals occur in small dry pools on the floor of the Cave.

Resources in the Cave include biological, geological, historical, and possible paleontologic features. No archeological remains have been found so far, although only a survey point--by-survey point (950 inventory sites) of unburied artifacts has been done so far.

A National Historic Landmark and District contain several examples of rustic architecture.

# III. DATA COLLECTION

Information will be gathered about cave resources and the people who use them. This information will provide the basis for management decisions.

A computerized data base allows easy storage, retrieval, and updating of data. This data base includes cave specific information (such as that found on inventory forms), cave visitation data, monitoring data, a directory of resource people, and a bibliography. Other computer files can be found in the Monument's Resource Management Specialist's PC, with file names of C:\WP51\DOCS*.*. Hereafter, only the *.* part of each file name will be used. Descriptions of all computer files can be located in ASKME. GSA Federal Information Resources Management Regulations will be followed in regard to all data.

In addition, open and closed paper files are maintained with alphabetized filenames (FILENAME) and henceforth are described as OPEN*.*. This material includes raw research and monitoring data, a duplicate set of which often will be in the museum safe under the appropriate accession folder. Other material unsuitable for computer storage, such as certain maps, will be kept in a cave-specific file folder in a map cabinet (MAPS.

The directory (PHONE.DIR) includes persons with expertise in relevant fields such as cave management, cave interpretation, natural and social sciences, persons who know park caves well, such as regular visitors and cavers, and any persons who are interested in assisting with cave-related projects. The directory also contains persons available to assist managers with cave-related search and rescue operations, with the person's name, group affiliation, and field of expertise or specialized skills.

Research is recognized as a necessary management strategy and is vital to a cave management program. Research is guided by policies identified in the NPS Management Policies. The issuance of Collecting Permits is provided for in CFR-36 and the FCRPA.

The NPS will fund studies to aid in the solving of cave management problems. However, any competent researcher with a proposed project consistent with Service policies and likely to contribute to the management and understanding of park resources will be encouraged to work in the park. Research proposals must be approved or denied by the monument's Superintendent.

The most extensive monitoring in the Cave has been cave climate, with continuous monitoring at six sites in the Cave since the spring of 1990 (OPEN\AIR).

The Monument is nearing completion of a baseline of the major types of water (diffuse, stream, dome pit, pool) in the Cave that will identify the type and source of such waters based on major ions, Ph, CO2, temperature, total dissolved solids and total organic carbon (OPEN\WATER, WATER.FUN).

A preliminary list of macro-invertebrates in the Cave has been compiled as result of ongoing trapping started in August of 1993 (OPEN\INVERT).

## A. **Cave Classification**

Since human safety is a prime NPS concern and rescues can impact even sturdy formations, access to a cave or cave passage depends on the sum of its fragility and hazard ratings. A cave's rating may be changed seasonally, as a result of further inventory, or by the alteration or removal of a hazard or resource responsible for the initial rating.

### 1. **Fragility Classes**

b. Fragility 1 Caves or Cave Passages

Fragility 1 caves or cave passages contain resources that, due to their size or their location within the cave, are not easily subject to vandalism, disruption or destruction. These are areas in which frequent visitation by cavers or other visitors will involve an acceptable level of degradation. Examples include smooth flowstone that is not used as a trail.

c. Fragility 2 Caves or Cave Passages

Fragility 2 caves or cave passages have resources so positioned that they are vulnerable to breakage, disturbance and/or vandalism. Examples include tubular stalactites less than 1.8 meters (six feet) from the floor.

d. Fragility 3 Caves or Cave Passages

Fragility 3 caves or cave passages have resources that are of unusual quality or rarity and which are delicate and susceptible to disturbance, or areas for which no inventories exist. Examples include calcite needle clusters in the middle of a floor.

2. **Hazard Classes**

a. Hazard 1 Caves and Cave Passages

Hazard 1 caves or cave passages offer the least hazard to the caver. Hazard 1 characteristics include:

(1) No known loose ceiling rocks.

(2) Well-defined main passageways with only dead-end lateral passages.

(3) No drops over three meters (10 feet).

b. Hazard 2 Caves

Hazard 2 caves contain structural hazards not found in Hazard 1 caves. Class 3 characteristics include:

(1) Maze-type passageways.

(2) Vertical drops up to 9 meters (30 feet).

(3) Loose rocks on ceilings over two meters in height. No known loose rocks on passages less than two meters (six feet).

(4) Balanced rocks on uneven floor.

c. Hazard 3 Caves and Cave Passages

Hazard 3 caves or cave passages are potentially the most hazardous. Characteristics include:

(1) Vertical drops over nine meters (30 feet).

(2) Loose ceiling rocks in crawlways under 1.5 meters (four feet).

3. **Management Zones**

a. Zone 1 Caves and Cave Passages

The fragility/hazard sum is 2 or 3. These developed areas include 731 meters (2,400 feet of the Cave that provide visitors with comfort and convenience (e.g. hard surfaced trails, handrails, electric lights). No special clothing, equipment, knowledge or skills is needed. All visitors must be accompanied by a certified concession tour guide or Park Service staff.

Off-trail areas may be visited without a permit or Park Service escort. Included are the small caves near the Cave exit and trails visible from the Cliff Nature Trail. Excluded is the Cave, except for public caving tours by concession guides certified as a wild cave trip leader. Public use of caves will not be advertised or encouraged except for public tours led by certified concession guides or NPS staff.

b. Zone 2 Caves and Cave Passages

The fragility/hazard sum is 4. These areas may be visited by permit without an NPS escort. Excluded is the Cave. Permittees are responsible for providing their own equipment. Evidence of incompetence, previous cave abuse or disregard for park regulations are grounds for denying a permit. All members of the group will stay within the trail zone bounded by tape.

c. Zone 3 Caves and Cave Passages

The fragility/hazard sum is 5. These areas may be visited only when scheduled in advance and when the visitor is accompanied by a designated National Park Service trip leader. Scheduling of trips into Zone 3 caves or cave passages will be subject to the availability of a qualified trip leader. Trip leaders will be responsible for interpreting the cave and for insuring that each group takes all feasible precautions to leave the cave unimpaired for future visitors.

Based on the recommendation of the resource management specialist, the Superintendent will designate qualified park employees to lead trips into Zone 3 caves. An individual will be designated to lead trips into a specific cave, caves or cave area, rather than Zone 3 caves in general. Trip leaders will be selected on the basis of their knowledge of the cave or cave area, first aid training, caving skills, and leadership abilities. Leading scheduled trips into Zone 3 caves will become an additional duty of these employees and will not supersede their regular duties.

If designated trip leaders are not available without interrupting normal park operations, the permit applicant will be asked to select an alternate date for the proposed trip.

d. Zone 4 Caves and Cave Passages

The fragility/hazard sum is 6. To obtain access, a collection permit must be approved by the Superintendent. The researcher must show in writing how potential damage to resources from research in a specific part of a cave will be more than balanced by knowledge gained that would protect park resources. Zone 4 designation does not exclude administrative entry to monitor research activity and impacts upon these caves.

## B. **Inventories**

Standardized and accurate surveys and inventories are crucial for establishing baselines and monitoring and mitigating human-caused changes in any cave. All cave inventories and monitoring in Monument caves will be tied into the nearest survey station. All future surveys will be combined with on-site inventories. Data will be entered on site into a data logger, except where physical conditions are so extreme as to warrant temporary storage on written survey and inventory forms and/or notebooks.

Inventory procedures consist of identifying cave locations and noting each cave's contents, significance, hazards, and other specific information. Uniformity of interpretation can best be accomplished by individuals experienced in caving using standard criteria.

### 1. **Cave Identification**

a. Cave Name: When a cave has an established name, this will be retained. In the case of a cave without an established name, one will be assigned.

b. Cave Markers: A brass cap will be set at the entrance of each cave. The cave name will be stamped on the cap.

c. Cave Map: Each cave will be plotted on a mylar and GIS overlay as part on a enlargement of the USGS 7 1/2 minute quadrangle that includes the Monument and is part of the GIS system. Cave locations will be designated by a circle. Cave names will be shown on the map.

## 2. **Survey and Exploration Standards**

Cave surveying and mapping are fields whose methods and results are subject to large amounts of variation. Different groups of surveyors use different equipment, different amounts of information are included in the survey, and different degrees of accuracy are obtained. Accurate and detailed maps are becoming increasingly important to cave management, making this degree of variability undesirable. What follows is a minimum set of standards which must be met by every survey party involved in the exploration of the Cave or other caves on the Monument.

Due to the nature of cave surveying, no map of a cave can be said to be truly accurate. There are only varying degrees of accuracy. It has been traditional to use loop closure as a means of measuring the accuracy of a survey. In the past, loops which failed to close to within 1% of their total length were deemed inaccurate, requiring resurveying. Studies have shown, however, that closure error is directly related to the length of the loop. Loops of shorter length are far more likely to have greater closure error. This is because of the error which is built into the instruments used in cave surveying. In a long loop, errors are more likely to cancel out. Therefore, it is more reasonable to have a scale of acceptable error based on loop length, rather than one standard with which all loops must comply. For the Monument, less than 1% closure error will be strived for with all loops greater than 500 feet in length. For loops of less than 500 feet in length, 2% closure error will be acceptable.

Any equipment which meets the following minimum set of conditions and which consistently performs within the acceptable range of accuracy may be used in the survey of Monument caves.

Compass - To avoid confusion, and to avoid unnecessary conversion, only compasses which measure in degrees will be used. Compasses which measure bearings (N64W, for example) are more prone to errors in reading and recording. Therefore, only compasses which output azimuths will be acceptable. Declination settings on the compass (if they exist) must be set to 0 degrees. In other words, all compass readings recorded in the notes will be relative to magnetic north.

Inclinometer - As with the compass, only inclinometers with output in degrees will be used. Percentage of grade or mils will not be acceptable.

Tape - Monument caves are currently measured in feet. All future measurement will be made in meters. Only metric tapes will be allowed.

All park equipment must stay within the park at all times. Tapes which have been broken are another major source of error. Therefore, any tape used in the survey of Monument caves must be absolutely complete from beginning to end. Since resource inventory will be tied to survey stations, no tape greater than 100 feet in length will be used.

Survey book - All survey books will be provided by Oregon Caves National Monument, and will remain the property of the park. Survey books must remain in the park at all times. Only photocopies of the original books will be allowed outside the park. Photocopies of survey notes will be provided to surveyors upon request. All maps and survey notes will be the property of the US government and will not be copyrighted.

Writing Instruments - For neater notes, only pencils will be used to record notes on surveys. Mechanical pencils with lead diameters of less than .7mm will be required.

Station Markers - To avoid unnecessary damage to the cave resources, the burning of station names onto cave rock is not allowed. Survey stations will consist of a small, unobtrusive indelible mark along with a reflective tape wrapped around a small loose rock located within one meter of the survey point. The tape will have the station name printed in indelible ink and repeated continuously on the entire length of the tape.

All new surveys will include an inventory of the newly discovered passages. Special forms will be provided by the park for this purpose. In general, this duty will not be performed by the regular notetaker for the survey. Ideally, the tape person, or a fourth person not involved with the survey, will do the inventory.

The preferred size for survey crews will be 3-5 persons. **The most highly skilled teams will be the ones allowed into sensitive and/or**

**promising sections of the cave**. The following will be the minimum standards of performance for each of the duties.

Tape/Inventory - Traditionally, this has been the easiest duty to perform on a survey. Careful distance readings to the nearest tenth of a foot, and wise placement of stations were the only requirements of the position. The relative level of inactivity which was usual for this position made it an ideal target for an additional responsibility - inventory. The importance of inventory cannot be overstated. Therefore, this person will have to be familiar not only with Oregon Caves, but with the inventory standards of the park as well. **Do not allow inexperienced people to occupy this position!** Any person who fails to provide inventory information in a satisfactory form will not be allowed to occupy this position.

Instruments - This duty will be performed by a person with experience with the type of instruments being used. Careful readings accurate to the nearest half degree are required. Any person who consistently fails to close loops to within acceptable limits will not be allowed to read instruments in Monument Caves.

Notes - Survey notes are of critical importance to a successful mapping effort. A good set of notes can provide far more information about the cave than simply where it is going. Properly taken notes can aid in detecting survey blunders (both in the cave and out). They can also provide managers with information on what resources are contained in the newly discovered passages. The following will be considered the minimum amount of information to be included in the notes of all surveys in Monument caves:

> Date - The date (month, day, and year) of the survey must be recorded somewhere in the notes for that day, preferably on the top of each page. This information is used in determining the correction factor for declination, which changes from year to year.

Personnel - The names of all the individuals involved with the survey must be included. Initials or nicknames are not acceptable. The duty which each person performed on the survey will be recorded next to their name.

Survey Name - The survey name, together with an explanation for that name (if there is one), will be included in the notes. A list of available survey names will be included in each survey book, and used surveys will be crossed off the list as they are used.

Equipment - The type of equipment used will be recorded. The type of tape used will be recorded, along with the units used (feet or meters, etc.). The color of the reflective tape on the station markers will also be noted.

North Arrow - A north arrow will be included on each page of the notes (see below for more on the orientation of the sketch).

Scale - An indication of scale will be included on each page of the notes. This scale may change from page to page if desired.

Sketch - Of all duties which must be performed on a survey, sketching requires the most patience. The sketch person must not be rushed, so it must be accepted that he/she will be the person setting the pace of the survey. All sketches will be oriented with magnetic north being the top of the book. Each station will be drawn and labeled **and placed at the proper distance and angle from the previous station.** Angles must be estimated to within 10 degrees maximum, and plotted distances must take slope into consideration (to within reason, of course). Notetakers unfamiliar with estimating angles to this degree of accuracy will use a protractor. Loops will come reasonably close to closing on sketches. This allows error checking to be performed in the cave as well as out. Passage dimensions will be drawn to scale, and ceiling heights will be noted at regular intervals (at least every 100 feet). The distance from the station to the right and left walls, as well as to the ceiling and floor will be included in the notes. Items of special interest in the inventory will be included in the sketch. Room names will be highlighted on the sketch. If non-standard symbols are used in the sketch, a legend will be included.

Miscellaneous - To avoid overcrowding on the sketch, no more than sixteen stations will be recorded on each page of the notes. All distances will be of absolutely consistent form. For example, if distances are recorded in feet and decimal form, all distances will have the decimal - even those that come out to an even foot (ie. 11.0', not 11'). All compass readings will be three digit numbers (with leading zeroes if necessary) followed by one decimal place. All inclinometer readings will be preceded by either a "+" or "-" and will be followed by one decimal place. This standardized form of recording numbers makes interpretation of sloppy handwriting much easier, and results in fewer errors. All backshots will be noted for each individual measurement in which it takes place (both azimuth and inclination if necessary) and only when readings have not been corrected in the field.

All notetakers in the Monument will be assigned a rating based on their adherence to the standards outlined in this document. The ratings will be assigned by the park's cave specialist. Possible ratings, and the areas of the cave these ratings allow a notetaker to sketch in, are as follows:

**Level 1**: Notetakers assigned to this level consistently meet and exceed these standards. Notes are never confusing and easily readable. Sketches show extreme attention to detail, and are always neat. Level 1 notetakers seldom, if ever, require critical evaluations of their work. Because of their abilities, Level 1 notetakers may perform their duties in all Zones in the Monument.

**Level 2**: Notetakers assigned to this level usually meet, and sometimes exceed, these standards. Sketches are neat, but may lack detail in one respect or another. Notes are usually not confusing and if they are not neat, they are at least readable. Level 2 notetakers occasionally require critical evaluations of their work, but the recommendations for improvement are usually minor in nature. Level 2 notetakers are allowed to take notes in all previously surveyed passages.

**Level 3**: A level 3 notetaker often fails to meet the standards set for notetaking in the Monument. Sketches are messy and often confusing, with little attention to detail. Notes are also messy and frequently confusing. Because they have demonstrated an inability to meet the minimum standards for notetaking, Level 3 notetakers are not allowed to take notes in the Monument until they have demonstrated the ability, through discussions with the park's resources management specialist, to do an acceptable job.

An identical rating system will be applied to inventory work as well. As above, Level 1 inventory personnel may perform inventory in all sections of the Monument's caves, including new ones. Level 2 inventory personnel may perform inventory only in previously surveyed areas. Level 3 inventory personnel are not allowed to perform inventories in the Monument until they have demonstrated the ability to perform acceptable work.

Cavers who have never performed notetaking or inventory duties before in the Monument are automatically assigned to Level 2. This enables new cavers to try their hand at these duties. However, at least one Level 2 (or better) caver for the duty being tried will be present on the same trip to provide guidance and answer questions.

Cavers can move up (or down) this scale by demonstrating the ability to perform better (or worse).

All survey trips in Monument caves will have notetakers and inventory personnel who are eligible for the area where the survey will take place. Specifically, all trips into Zone 3 or 4 areas will have **both** a Level 1 notetaker and a Level 1 inventory person. In theory this may be the same person, but that person would then need to perform both duties - a difficult and time consuming proposition at best. Survey trips to unsurveyed areas must have **both** a Level 2 (or better) notetaker and inventory person.

Resurveying will never be performed without prior approval from the park. No resurveying will be approved until evidence has been

produced that firmly suggests a previous survey is both inaccurate and is not correctable with standard blunder searching routines. If resurveying occurs, all old stations will be obliterated or removed, and all surveys and inventories which reference the old survey will reference the new one.

Since a lot of resurveying has been performed in the Cave over the years - usually without removing the old stations - many stations may be found in the cave which are not used on the map. A list of these "bad surveys" will be included in each book, and will be consulted before tieing in to any survey.

It is almost **never** necessary to travel through an area which would require breaking or stepping on sensitive cave features which include, but are not limited to, all types of speleothems, extensive or unique sediments, historical items, or items of biological interest. A caver entering an area which would requires destruction or modification of a sensitive cave feature, will **turn around**. The chances are excellent that there is another way of getting to the room or passage beyond the sensitive area. Even if a caver cannot find an alternate path, approval of the Superintendent or one of his representatives will be required prior to entering any sensitive area.

3. **Cave Files**

A file for each cave will be maintained separately from other files. Each cave file will contain the following:

a. When found

b. By whom

c. Other people present

d. How located

e. How and why named

f. Topographical map of area: showing the location of the cave.

g. Directions for reaching the cave entrance

(1) Walking distance, both vertical and horizontal from permanent and significant landmarks

(2) Approximate walking time at an average pace.

(3) Pedometer log and step log.

h. Hazards: Detailed descriptions of hazards present within the cave and/or in reaching the cave entrance, including recommended equipment and procedures for reaching, entering, and exploring the cave.

i. Inventory: Detailed description of major features of the cave, including biological, hydrological, geological, archeological, paleontological, etc. The Monument's basic cave inventory contains 100 data points (CRM-INV) which are entered into DBase 3+.

j. Restrictions: Recommendations on type and amount of use restrictions.

k. Map of the cave, including plan view, vertical section, and all survey computation notes.

l. Photographs showing the cave's entrance and the cave's major areas and features. Notation will include the photographer and the date the photograph was taken.

m. Trips: Significant trip reports and a Permanent record, listing date of each cave entry and number of cavers on each trip.

Cave management files will be created and maintained in the monument's Resource Management Specialist's office. The files will be separated into two groups. The first group, Open Files are available for public inspection upon request. Open Files will contain all non-confidential Cave Resource Files and any materials pertinent to those cave resources. The second group, Confidential Files, will be established to store files pertaining to caves, cave passages, or tour routes with confidential locations. These are areas with a Zone 4 rating. Secured under lock and key, access to confidential files will be limited to authorized personnel. Specific information stored in these files may be released to individuals after execution of a Cave Resource Access Request (CRAR). Under no circumstances will persons other than those authorized be allowed unsupervised access to the contents of the Confidential Files.

4. **Monitoring**

Monitoring is necessary for determining the sustainability of natural populations, ecosystems, and processes and for evaluating the success of cave restoration management.

a. Visitor Use

Due to the nonrenewable nature of most cave resources, it is important that the impact of various types and intensities of use be carefully and systematically documented so that acceptable levels of use can be anticipated and a reasonable carrying capacity established for each cave before irreparable damage is done. This process needs to be initiated in all caves and cave passages as soon as possible, particularly newly discovered areas. Due to individual variation, each cave must be monitored and its management evaluated separately.

Carrying capacity is established from the correlation of cave use and the measured condition of the resource associated with various levels of use. The resource used to evaluate impact must be accurately measurable with a consistent technique, and its condition must be correlated with the presence of people in each cave. Before sufficient data are available, carrying capacity will be set based on conservative estimates. Then, as data become available, visitation levels can be adjusted as necessary.

Use at the Cave is determined by tour guides counting the number of people on each tour. The cave permit provides use data for undeveloped caves or cave passages. In this way the impact of cave use can be tracked and the cave inventory constantly updated regarding the status of the features of the Cave. Some of the Cave areas where use is regulated are not gated; therefore, the accuracy of use data generated from approved permits is dependent largely on voluntary compliance with entry procedures.

At present the amount of use other than guided tours appears to be minimal. However, the resource management specialist will develop a priority list of caves, cave passages, or travel routes that will

be monitored as funding for electronic surveillance devices becomes available. The priority of each area will depend on the zone rating and the likelihood that there may be future or present unauthorized entry into those areas.

b. Audio-Visual

Quantitative and qualitative measurement of cave resources is generally more difficult than measuring visitation. Within the park, video inventories and, when possible, water quality and indicator species are principal indices of cave use impacts. In the Cave, cave microclimate and formation damage is also monitored.

Vistas are measured using a system of fixed photopoints and/or videopoints established at selected sites within the Cave. Each site is marked with an unobtrusive identification tag and inventoried as to the nearest survey point. Distance and orientation to the nearest survey point and direction the camera is pointing to, and height of the camera from the ground will be recorded.

Even with this information, a slide from a previous inventory will have to be taken in to the Cave in order to position and frame the camera accurately. These photos and videos provide comparative qualitative and quantitative data for any resources visible within the photograph. ASA 25 speed color slide film and a 50mm fixed lens and the same flash unit will be used. The adequate Fstop will be established and two identical shots taken of each photopoint every five years.

c. Water

Aquatic systems are vulnerable to alteration by people and include indices of change that are relatively easy to measure. Ions, turbidity, Ph, temperature, and other parameters likely to be altered by human activity will be monitored periodically where feasible to quantitatively measure any change within the Cave. Since all waters in Monument caves come from the surface, the basic Monument's water monitoring plan is detailed in the main body of the resource management plan.

d. Microclimate

Changes in airflow has been the greatest human impact on the Cave. Based on a 1989-1992 study of airflow at five stations within the Cave (Watson's Grotto, River Styx, Imagination, Miller's Chapel, and Wedding Cake Rooms) continuous readout hygrothermograph data indicate that about 90% of the airflow in the Cave has been restored due to installation of one airlock door each in the Connecting and Exit Tunnels. Airflow monitoring will continue at least until radon, carbon dioxide levels, and water quality data can be integrated with airflow data.

5. **Safety**

a. Caving and climbing

The Resource Management Specialist will train all prospective off-trail cave guides and park staff in safe, efficient, and relatively non-impacting methods of traversing uneven cave floors, crawling, and climbing. Standards will be derived from the most current National Speleological Society publications on caving techniques.

b. Search and Rescue

Cave related search and rescue activities and tactics are outlined in the park's Search and Rescue Plan, an appendix to the Emergency Operations Plan.

b. Radon

Cave radiation is caused primarily by radon 222. Some additional radiation is generated by radon 220 (Thorium). Working levels of alpha radiation are measured from the radon daughters and exposure records are maintained for all employees. In managing alpha radiation hazards the park will follow procedures specified in the NPS Cave Radiation Safety and Occupational Health Management Guidelines (NPS-14). Alpha radiation is virtually no threat to park visitors and the threat to employees appears to be minimal.

c. Rock Stress

Alongside the main trail in the Cave are boulders that have fallen from the ceiling. Rock falls are inevitable, natural, and extremely rare processes. Rock stress recorders could be installed to monitor vertical, horizontal and perpendicular movement in joints. The recorders can document past geologic activity at specific sites, but they cannot predict where

rock falls would occur. Every five years a USFS mining safety expert checks whether any large rocks are likely to fall on the main trail within a human lifetime and makes recommendations for their removal or support.

Ice commonly falls from Watson's Grotto during winter thaws. Tour guides are advised to briskly move their tours through this area during such times. During wet periods of freeze thaw, park maintenance will inspect the main Cave entrance for ice stalactites overhanging the trail and knock them down. During extreme conditions, the Superintendent may order the main entrance closed and the 110 Exit used instead.

# IV. RESOURCE PROTECTION

## A. Visitor Use

Payment of concession user fee authorizes visitor entry along the developed trail in the Cave during normal visiting hours.

The National Park Service Management Policies Handbook (1988) states that -

"Caves or portions of caves will be closed to public use, or use will be restricted to conducted tours, when such action are required for human safety or the protection of cave resources. Some caves or portions of caves may be managed exclusively for research, with access limited to approved research personnel."

### 1. Carrying Capacity

Cave study and recreation are appropriate activities in the monument. Yet, balancing resource preservation and user-caused impacts is a challenge, especially in caves, where any use is detrimental. Increased use, such as larger or more frequent cave tours, can also exceed social carrying capacity as well, resulting in unpleasant experiences to the visitor. The manager must set limits of acceptable degradation for each cave, then implement strategies to keep degradation below these limits. A measure of degradation must be based on known visitor use, current degradation, sensitivity of the resource, and the relative value of visitor use and cave preservation. Ultimately, determination of acceptable degradation is arbitrary and at the discretion of the manager.

2. **Caving Permits**

The Code of Federal Regulations (36 CFR, Section 7.49) states that:

"No person or persons shall be permitted to enter Oregon Caves unless accompanied by an approved National Park Service or concession employee who has successfully completed the training prescribed by the National Park Service.

The training program and certification standards for concession employees giving public tours on the paved trail is detailed in the current edition of "Performance Standards for Oregon Caves Tour Guides" (93-STANDARD) and the Operating Plan contained in the concession contract CC-ORCA001-87.

A training program exists for all National Park Service and concession employees who apply as a trip leader to lead trips off the paved trail. Each applicant accompanies the resource management specialist on at least one trip off the paved trail in the cave and guides the tour group back to the paved trail. The length of the tour will be at least one hour. Based on his/her observations, the ranger will recommend to the Superintendent that the individual be certified as a trip leader. If certified, the individual can lead a trip of other park staff or current certified concession employees to those Zone 3 areas for which he or she is certified. Prior to a proposed trip, a written application must be submitted for review by the Superintendent. The Superintendent has the authority to approve permits for Zone 3 caves or cave passages. Permits for Zone 4 must be approved by the Superintendent. A signature of approval on the application form constitutes a valid permit under the conditions of the form. Solo expeditions will not be permitted. No undeveloped cave or cave passage may be entered without an approved cave permit except for:

a. Maintenance of the lighting and trail system near the main trail in the Cave.

b. Public tours led by a certified concession tour guide to a Zone 3 area.

c. Administrative trips led by park staff.

d. Zone 1 or 2 areas outside the Cave.

Approval of permits is contingent on:

Hazard 1 trips will consist of at least two cavers, who observe caving safety rules and use hard hats, three light sources per person, boots with non-skid soles, and protective clothing.

Hazard 2 trips will consist of at least three cavers, two of whom have moderate caving experience (including vertical descent and climbing), who observe caving safety and vertical safety rules, and use the following basic equipment: hard hats, three light sources per person, boots with non-skid soles, vertical descent and climbing gear, and protective clothing with no loose or protruding attachments that might become entangled while doing vertical work. Each caver will have a complete set of climbing equipment. Vertical equipment may not be needed in some Zone 4 caves or cave passages.

Hazard 3 trips will consist of at least three cavers, all of whom have considerable caving experience (including vertical descent and climbing), who observe caving safety and vertical safety rules, and use the following basic equipment: hard hats, three light sources per person, with no loose or protruding attachments that might become entangled while doing vertical work, and vertical descent and climbing gear. Each caver will have a complete set of climbing equipment.

On Zone 3 and 4 trips, groups inexperienced in caving techniques will be accompanied by at least two experienced leaders to assist the group, help with emergencies and, in the event that one leader has to accompany someone back to the entrance, to assure that no one remains underground unescorted. Anyone that demonstrates incompetence, failure to cooperate, negligence or other actions detrimental to their own or the group's safety, or to the cave resources, will be decertified as a trip leader and/or denied a cave permit for a period of time based on the severity of the action. Citations will occur if CFR regulations are violated. All incidents will be documented and the Superintendent notified as soon as possible. Evidence of incompetence or past negligence will be cause to deny a permit request. Failure of all trip members to sign the permit request before entry into a cave invalidates the permit.

If hikers or cave explorers find a previously unknown cave it must be reported to park personnel. Exploration of the cave will not be

initiated without a permit approved by the Superintendent. Exploration will be in the company of the Superintendent or his/her designee.

Permits must be returned to a park ranger or the collection box at the Ranger Office located at the southwestern edge of the main parking lot within the Monument. If the permit is not returned, a park ranger must be notified within twenty four hours of the completion of the cave trip. This will help insure that trips are completed safely and that accurate records of cave use are kept. These records will be maintained by the resource management specialist. Failure to return a permit may be grounds for denial of a future permit.

## B. Interpretation

Interpretation is an extremely important management tool since it encourages voluntary compliance and cooperation in protecting essentially nonrenewable resources. People entering the interagency visitor center, contact stations at the Monument, or a cave will feel that caves are an important resource and that every user is personally responsible for maintaining the cave's integrity, beauty, and naturalness. Visitor contact methods include:

### 1. Publications

Free publications include the park brochure, brochures on geology and life of the Cave, and the park newspaper. Publications are being developed on Monument geology, regional endemic plants, and on the Monument's natural and cultural history. When printed, all will carry a cave preservation message and information on cave restoration. Publications that support or encourage destructive use or activities detrimental to Monument resources will not be sold by the Monument or its affiliates.

### 2. Interpretive Tours

Visitors participating in concession-guided tours through the Cave is about 65,000 per year, about 85% of the total visitation to the Monument. Over 80% of total visitation in the Cave is during June, July, and August.

A concession conducts all interpretive tours through the Cave for the general public. The Operating Plan states that "the NPS naturalist determines if the guide-in-training is sufficiently knowledgeable before he/she is certified to conduct cave tours." The certification standards require tour guides to give a theme that supports cave conservation and to have enough communication skills to protect park resources and ensure visitor safety and enjoyment. Park staff will ensure that resource protection and interpretive information is accurate and up-to-date.

### 3. Outreach Programs

Each year, at least one outreach program and one regularly scheduled evening program will deal mainly with cave preservation

and/or restoration. Monument or community sponsored contests (art, writing, etc.) and field seminars or special programs conducted by knowledgeable persons will be encouraged. All programs will carry a general conservation message.

4. **Audio-visual**

Most future exhibits, videos, slide programs, and sign systems on the Cave will contain a cave conservation and/or restoration message.

5. **Visitor Surveys**

Studies need to identify visitor expectations, so as to develop and market new recreational opportunities that will increase visitor enjoyment, protection of park lands, and support from a tourist-dependent local economy. Special visitor populations and their values and attitudes need to be known. Concession staff can and has asked large numbers of visitors specific questions, such as which type of new trail they prefer. Formal interviews authorized by the Office of Personnel Management need to be conducted that will supply systematic, statistically valid information.

C. **Ranger Patrols**

Periodic ranger patrols in the Cave and above the Cave will supplement both cyclic monitoring of possible degradation and announced and unannounced audits that evaluate the effectiveness of concession tour guides in protecting cave resources.

Federal regulations which can be specifically applied to caves at Oregon Caves National Monument are listed in the "Code of Federal Regulations, Part 36, Parks, Forests, and Public Property" include:

Section 2.1 (1) re: preservation of natural, cultural and archeological resources

Section 2.1(3) re: throwing rocks inside caves

Section 2.10(1) re: camping outside designated sites or areas

Section 2.21(b) re: smoking prohibited in caves

D. **Cave Locations**

The FCRPA states that "information concerning the specific location of any significant cave may not be made available to the public under section 552 of title 5, US Code, unless the Secretary determines that disclosure of such information would further the purposes of this Act and would not create a substantial risk of harm, theft, or destruction of such cave."

Since confidentiality of cave locations and survey data is critical to the protection of cave resources, cave maps showing ungated entrances will not be available for public viewing. Cave locations will not be advertised except for interpretive signs along Cave Exit trail and Cliff Nature Trail in front of obvious cave entrances next to the historic trails.

All cave entrances will be photographed with both color slide film and color print film. The color prints will be compiled into a notebook and indexed to appropriate maps or sketches of cave interiors to aid in identification of specific caves. An additional copy of the photograph will be placed in each cave file. Cave name and UTM coordinates will be recorded on each entrance photograph.

A Global Positioning System (GPS) device will be used to locate each cave as exactly as possible.
GPS units attached to long poles may have to be used to record entrances under heavy tree cover. UTM coordinates will then be recorded on the Master Cave inventory and in each individual cave file. All cave locations will be plotted on a current USGS topographic map.

E. **Gates**

Gates are an obtrusion on the aesthetic and historical integrity of the cave entrance, and are often deleterious to the ecology of a natural cave, hindering or entirely impeding airflow and the movement of bats and other organisms into and out of the cave. The use of gates to prohibit unauthorized entry is often unsuccessful against determined cavers. This technique will be used to protect park caves only where natural or cultural resources are threatened and an almost biologically neutral gate can be constructed. Interior gates may be used to restrict access to areas of significant hazards (e.g. Hazard 3) or which merit special resource protection (e.g. Fragility 3).

The bat-accessible gates now at the 110 and Carbide Room entrances are from a USFS design (American Cave Conservation, 1990). The only modification was the use of two angle irons for each crossbar so as to provide more complete attachment to the vertical bars and still maintain optimum orientation of the angle irons. Vertical height between angle irons is and will be 5 3/4 inches on all gates except for gates on the 110 Exit and the 110 Cave. These less visible gates have 6 inch heights.

F. **Cave Alteration**

During cave exploration an area may require enlarging to permit entry into virgin passageways or chambers. Permission to enlarge a constriction, or to dig through breakdown or cave fill, must be obtained in writing from the park Superintendent. Environmental alterations and potential damage to cave resources will be given the highest priority considerations before permission to alter a cave is given. If sediment removal is involved, an archeological clearance must first be given by an archeologist on the Pacific Northwest Region's staff or by the next most pertinent person on the Regional staff, accompanied by a on-site survey if deemed necessary by the Regional person. Explosive charges or mechanical devices, such as "rock splitters" or "jackhammers," will not be permitted for use in Monument

caves except for pre-approved construction uses on the main public tour route.

G. **Maintenance**

The FCRPA states that:

> "Developments such as artificial entrances, enlarged natural entrances, pathways, lighting, interpretive devices, ventilation systems, and elevator shafts, will be permitted only where necessary for general public use and when such development will not significantly alter any conditions perpetuating the natural cave environment or harm cultural resources. No potentially harmful development will be undertaken in, above, or adjacent to caves until it can be demonstrated that it will not significantly affect natural cave conditions, including subsurface water movements, or visitor use opportunities. Developments already in place above caves will be removed if they are significantly altering natural conditions."

The Maintenance Division is responsible for the upkeep of all underground facilities. This includes the necessary cleaning, repair and renovation of Cave trails, electrical systems, communication systems and lights.

Every maintenance employee will undergo an eight hour training session by the resource management specialist. The session will acquaint the maintenance staff to acceptable practices and procedures of cave resources management, including the protection and preservation of natural, historical and archeological resources that would or potentially could be encountered during both routine maintenance and one-time-only maintenance projects.

Any maintenance project taking place in the Cave will employ methods that will result in the least amount of impact to cave resources. Routine maintenance, such as changing lights, electrical wiring, and trash collection, often require stepping off developed trails. In these instances every effort will be made to obliterate any footprints on Cave floors. The bottom of footwear will be cleaned before stepping back onto the trail. Visible footprints on or off the trail could encourage visitors to leave the trail and damage delicate Cave areas. The new lighting systems will be installed with the view of minimizing damage to cave resource. Routes for replacing each light will be mapped and used so as to avoid delicate formations, unsafe areas, and disturbance of historical or potential/actual archeological

or paleontologic resources. During maintenance projects in the Cave, tools and materials left in work areas for extended periods and not in actual use will be concealed from public view. Exotic substances that will wash or roll off developed areas and enter and remain in natural Cave areas will not be used.

Cave trails may be washed to remove silt and foreign material buildups which create a slick and hazardous trail surface. The liquid will be collected and/or filtered and removed from the Cave. Human-caused foreign objects are to be concealed using natural features to the extent feasible, as long as the Cave is not significantly altered by such action. Flexible plastic or detachable cement/wire mesh layers will be used to hide wires if they cannot be otherwise hidden from view.

The use of any type of combustion, including internal combustion engines, will not be permitted in a cave environment. Such use would harm the biota of caves and be a health hazard.

H. **Cave Restoration**

Like the term resource management, restoration is anthropocentric because it implies that we know what is the prehistoric state of natural processes. However, when there is substantial evidence of significant human-caused impacts on natural processes, then well-thought-out attempts at mitigating these impacts usually are better than doing nothing at all.

Cave restoration in North America has an advantage over surface processes in that prehistoric human impacts on cave processes, as opposed to impacts on rock shelters, have been minimal, especially if a cave area is far from an entrance. Cave processes for the most part have evolved without human impacts. Consequently, there is no need to sort out which human actions are "natural" and which ones are not. Nearly all human impacts are foreign and will be mitigated or eliminated if possible.

Exceptions inside Oregon Caves include historic items and possible archeological items with substantial cultural integrity, such as the stone steps and Ghost Room platform. Removal of such items would also significantly impact cave resources either directly or through the loss of historic context and the preservation value of the cave's microclimate.

Most caves are low energy/food environments compared to surface environments. Caves usually have little wind, light, freeze-thaws, organics, etc. Thus, fragile minerals and species with low metabolisms normally thrive underground. Foot traffic, lighting systems, clothing lint, graffiti, vandalism, airflow changes, etc., are high energy/food impacts on the cave. Altered airflow patterns and visitors bring in lint, skin flakes, dust, mud, spores and seeds, all of which encourage plant growth. Lint and exotic plants dissolve cave formations.

Other human-caused impacts include movement of cave material, changes in water and species movement, coins, and the introduction of exotic species. To help maintain a natural environment, foreign materials will be routinely removed and, if possible, displaced native material moved back. Cave restoration work in both developed and undeveloped caves will be supervised by the resource management specialist. Restoration projects requiring specialized knowledge or skills not found among NPS staff will be performed by experienced persons on a contract basis.

No chemicals, aside from water and bleach, will be used in restoration work unless it can be shown that the chemicals will not spread in the Cave, are safe, will restore damaged formations, and do not significantly affect cave

life. Direct and indirect effects of all restoration techniques must be carefully monitored to help insure protection of the cave environment. A cave restoration log will be maintained to document both the details of restoration activities and the results of restoration impact monitoring. Individuals or groups involved in cave restoration work will be responsible for the removal of all evidence of their activities (e.g. footprints, muddy handrails, tools, etc.) from work areas.

1. **Rubble Removal**

Human-introduced material not part of a present trail system will be removed from all caves. Some obvious exceptions would include retaining walls that protect the trail from rock slides. Any object of possible historical or archeological interest will be evaluated by the park curator before removal. Removal will include introduced materials that were attached to cave formations or naturally cemented by flowstone, unless removal results in pitting of original flowstone or breakage of speleothems. The order of removal will begin at a point furthest from the trail to material closest to the trail in each particular area. Naturally occurring materials that had been displaced by human activities will be moved back to their original sites if possible. Where this is not possible, as in cave fill removed from a trail route to allow the public to walk through, then it will be removed from the Cave. This includes rock that has been blasted and shows more than 40% fresh surfaces. Breakdown with mostly natural surfaces can be moved to approximate the original contour of the Cave. For example, the amount of breakdown in many caves is roughly proportional to the size of the passage in which it occurs.

The final manicuring of each area will be a separate process from the fill removal process, and will not be done until it can be determined that there will be no or very limited future traffic near or over that particular area.

Washing will be done by using cave water or untreated water from nearby wells. The resulting water, if possible, will be contained, and removed from the Cave. If the waste water used for cleaning cannot be taken out of the Cave, then it will be filtered before allowing it to re-enter the cave-water system. Stiff nylon brushes will be used for a final manicuring but sometimes steel brushes are needed even though they may produce minor scratches. Such scratches seem to vanish within a few years if there is active

formation growth. Variable pressure cleaning systems using very small amounts of water, such as the "Hotsy" cleaning machine, will clean accumulated debris from most formations and walls without any abrasive contact. Wet-dry vacuum cleaners can be used in association with the cleaning machine to catch the water and debris. A significant concern with vacuum pickup machines is that the exhaust may just redeposit small material in the Cave. If the material picked up is wet, the risk is substantially reduced. If dry material is vacuumed up, machines with very effective filters will be considered. Such machines are available and are most often used in such hazardous material fields as asbestos removal or hazardous chemicals. These same vacuum cleaners can also be utilized for routine trail maintenance and are available in large wheel mounted and smaller back-pack versions.
All restored areas larger than ten square feet will be documented by still and video photography when possible. Before-still photographs will be double bracketed (three shots at different f-stops). After-photographs will not need this bracketing. When using a video camera, documentation will include both close-ups (frame less than one foot square) and overall scenes of a particular area. No after-restoration documentation will take place until the before-documentation photos and filming have been processed or developed. They can then be used in composing the after-restoration shots and the video filming.

All criteria will be considered together in determining whether there has been human disturbance. Usually no single criterion is sufficient. Criteria for determining whether fill has been placed by people into previously empty space include: **a**) Covering up of flowstone, dripstone, and/or cave popcorn (coralloids). **b)** Numerous small voids between wallrock and fill. **c)** Large numbers of buried, broken formations in un-cemented fill. **d)** Radical vertical changes in fill material. **e)** Easily removed clay and silt contacting wall rock. **f)** Pebbles have disintegrated in place (some shales and fractured cherts can fall apart within 50 years in a humid cave). **g)** Lack of distinct horizontal layering. **h)** Fresh exposures in pieces of rock on all or nearly all sides( e.g. blasted rock), and edges are sharp. **i)** Lack of bedding in the sediments and no sorting of materials or highly disturbed bedding. **j)** Numerous point impact marks on rock, such as pickaxe marks on fine-grained fill. Such marks will usually be light in color. **k)** Lack of cementation of fill material except in areas of high air flow. **l)** Loose fill that can be

removed by hand, and clay films, layers and/or stains that are easily removed by hand or by washing.

Criteria for determining whether fill has been previously removed include: **a)** Vertical or near-vertical cuts in flowstone. Edges of flowstone are sharp and fresh looking. Flowstone fragments are common. **b)** Vertical or near-vertical cuts in loose fill. **c)** Lack of natural means for transport of material. **d)** Lack of flowstone and/or other cave formations.

2. **Exotic Plant Control**

Plant growth made possible by artificial light systems can dissolve cave formations, discolor cave walls, and add organics to communities adapted to food-poor conditions. Even detergent-rich lint from clothing helps fertilize these plants. Formations and other cave surfaces can be discolored by smoke (torches, candles, and carbide lamps), lint, skin oils and flakes, exotic plants, and dust generated along Cave trails and from outside. Both blue-green algae (cyanobacteria) and a mixture of fungi, dust, and lint can also blacken Cave walls. Surface soil changes from forest fires, cuttings, altered plant growth and patterns, and acid rain may alter organic acids or minerals that color cave formations. However, only color changes caused by alien plants, fungi, or microbes can be readily treated.

Presently, there is no better treatment for the control of exotic plants than household bleach (5.25% sodium hypochlorite), although light filters and arranging the light differently can reduce algal growth. Bleach leaves no physical residue although it will increase the Ph of cave water. At least several years of testing with different spraying regimes is needed to find the least amount of bleach needed to control exotics. The growth rate of the exotic plants is largely dependent on temperature, moisture, airflow, and the effectiveness of the previous spraying. Spraying regimes range from once a year to once every few weeks, sometimes being done more often in the summer when algal growth rates tend to be higher in many caves. However, a complete spraying of exotic plants will be done every few years to reduce spore dispersal. This is especially important in caves with low airflow. Bright flashlight or portable floodlight examination of all dark cave surfaces is needed to locate at least 90% of the algae.

All spraying and eradication work will be conducted by at least two persons for the sake of safety. Cave personnel or volunteers spraying bleach in the Cave will wear goggles, rubber gloves, hard hats, headlamps, and respirator. This safety equipment is especially necessary when spraying directly overhead. The respirator and goggles may have to be removed temporarily to improve visibility when moving from one spray area to another. Filling the spray containers, or cleaning of equipment will be done on the surface. All spray equipment, containers, protective clothing, etc., will be removed from the Cave at the end of each spraying session. Any spillage in the Cave or excessive run-off of the bleach must be cleaned up immediately. Any container of bleach taken into the Cave must be in a non-breakable container. A portable eye/skin wash station will be full and ready for use at all times. All equipment must be thoroughly flushed with clear water at the end of each shift. Special attention must be given to the sprayer and the sprayer orifice. When working with bleach, exposure should be minimized. Spraying should be upwind and from bottom to top of a cave passage. The actual spraying time will not to exceed two hours for any one worker or volunteer. If fumes pose a problem to other personnel or cave visitors, then work will be delayed to after visitor hours to allow for overnight ventilation. Where airflow is variable or there is little air moving through the Cave, the project will be postponed until the air flow increases. The maximum amount of bleach used during any one period will be one gallon or less to keep the Ph balance in the Cave within normal range. At least 24 hours between spray periods must be provided.

Only safe, efficient methods of application will be used. Mist spraying will be adequate unless the sprayer can get no closer than four feet. Successive application trips on a tour route will be in opposite directions in order to see and treat surfaces from different perspectives. After completing all spraying with satisfactory results, the treated area will be cleaned of visible residual organic material one day after the spraying. Techniques described above for removing general debris will be used as a guide for cleanup.

Anyone experiencing any ill effects from the fumes or personal contact with the bleach will notify their supervisor immediately and complete a CA-1 form. Before any spraying or use of bleach in the

Cave begins, adequate warning signs will be in place advising the public of its use.

Incandescent lights over 80 watts will not be used in the Cave because they can produce noticeable temperature changes, alter or damage nearby minerals, and cause drying circles on flowstone. Compact fluorescent or E-bulbs (radio controlled) are preferred because most give off very little heat and use less than 80 watts of energy. Incandescents convert about 10% of their energy into light while compact fluorescents covert about 40% of their energy into light. Compact fluorescents last approximately 2 1/2 to three years for eight-hour-a-day use while E-bulbs may last up to 14 years. This lowers costs and reduces foot-traffic impact.

Hours of illumination will be determined by the frequency and timing of tours during the off-season and by total illumination during the summer. Although early summer is when algae grows fastest in the Cave, turning lights off between tours is not practical because of the close spacing of the tours. The exception is where additional lights exceeding a total of ten candle power averaged on cave surfaces are used in rooms to highlight certain areas for interpretive purposes. These will be turned on for no more than ten minutes at a time.

Flexible plastic layers, similar to those used in stage sets, can hide wire where shadows or in-place natural features cannot be used. Concrete "snakes" are unsightly, but are better than naked cables. The concrete will be poured on thick plastic and then the plastic removed so as to facilitate removal of the "snake" at some later date without damaging the underlying cave surface. An effort will be make to route cables to avoid such aesthetic problems.

3. **Cave Pools**

The major impacts to cave pools are evaporation from human-cause air flow changes and coins or organic matter tossed into the pools by visitors. Most coins contain copper, one of the most deadly elements to aquatic life. Removal can be done by using a long-handled spoon or, better, a pick-up tool at least 6-8 feet long. Removal will be prompt as even a few coins dramatically increases additional tossing. Airborne organics and human food deposited in the water can greatly reduce dissolved oxygen content. This

condition can react with iron to produce a black sulphate mass that can release sulfur dioxide into the cave air. Annual or even daily changes in cave air temperatures usually are enough to cause convective overturn and oxidation of the organics. In some rare cases, stirring the water with paddles may be needed. The black residue can be removed with electric pumps. Preventing most food from entering the Cave is preferred.

4. **Particulates**

Lint is generated, primarily from the constant rubbing and abrasive movement of clothing worn by visitors. This constant rubbing and abrasive movement generates large cumulative quantities of lint along the trail system. The walking action generates a slight current along the trail and these currents then carry the lint and associated debris up and away from the trail. These currents send the lint onto cave formations and surrounding walls especially on rough surfaced, constricted passages or at the downwind end of a constricted passage. Light to moderate amounts of lint are not easily detected with the naked eye, but under a long-wave ultraviolet light, the deposits show up quite readily. Lint serves as the basis for alien communities that can include spiders, mites, ants, and other exotic invertebrates. When wet, it can increase the numbers of naturally occurring and exotic bacteria and fungus. Except in very dry conditions, at least 80% of all lint from visitors clothing falls within two feet of the center of the trail. Installing curbs along the trail can inhibit movement of lint and confine a major portion of it on the trail where, with a regular maintenance program, a good percentage of any lint accumulations can be collected. A rough trail surface, grates, or other surfaces that tend to clean the bottom of shoes just before entering a cave can help prevent the spread of foreign matter into the cave.

5. **Air Flow**

Local additions or removal of material may change air flow patterns within that area, especially if the passages are small. Increasing the size of entrances increases upward airflow in winter and downward airflow in summer. This can increase air pollutants, which will darken upward-facing cave surface further from entrances. Enlarged cave entrances increase safety hazards due to increased frost wedging. There is no outgassing of construction materials. Greater airflow can cause erosion of formations by freezing, dehydration, or

dissolving of formations due to an increased carbon dioxide level. Cave species adapted to high humidity may be forced to retreat to small crevices in the cave or die off.

To restore naturally occurring airflow, airlock systems in tunnels will be considered and will be made of non-oxidizing materials. PVC plastic with stainless steel fittings and pressure-operated shut mechanisms work well. Plastic is a good insulator and therefore retards heat transfer between a cave and the surface, or between different parts of a cave, that normally would be separated. However, plastic changes temperature more slowly in response to airflow changes than does metal and therefore allows for unnatural condensation and possible corrosion. Plastics other than PVC may be needed for entrances subjected to very low temperatures. Cement used to surround the door will be of a type that contains little calcium hydroxide, which is more soluble than calcite and can increase speleothem growth. Clear lexan can be used as air restrictors on the sides of artificially deepened trails to restore the original cross-section of the passage. Placement will occur so as to avoid acidic condensation.

6. **Speleothem and Wallrock Repair**

Graffiti vandalism is sometimes difficult to distinguish from historical graffiti (more than 50 years old). As with coin tossing, graffiti not promptly removed or obscured will induce further graffiti. Graffiti can usually be removed by stiff nylon brushes and vinegar, but steel brushes and a 5% solution of sulfuric acid may be needed if the graffiti proves too stubborn for nylon brushes and vinegar or where mud splattered during blasting has hardened on cave walls. The acid can be used with a CO2 powered pressure washer such as those used to remove paint. All run-off will be trapped and collected if using these cleaning techniques.

Care will be taken to make sure that features other than exotic algae, non-historic graffiti, or lint are not removed. Some black blue-green algae does occur near lights but such algae away from lights may be native to the Cave and will not be sprayed. Lint and algae globs can resemble poorly-formed vermiculations, also called clay worms. These vermiculations usually are rounded, unconnected, dark clumps with a high water content and greasy feel. The naturally-formed clay worms usually have more complex forms, are mostly

clay, and have a nearby source of clay. They appear to be caused by the electrostatic attraction of clay particles when a film of water dries out and there are no longer enough water molecules to keep the clay particles apart. The globs also can resemble "cave slime," which are rounded, light-colored films of actinomycetes. Native to caves, these bacteria resemble very thin lichens and feed on incoming organics. They grow very slowly and as a result usually are not found on cave walls undergoing lint or travertine deposition or atmospheric corrosion. The lint may foster bacterial growth that competes with cave slime.

An ongoing inventory includes a count of broken formations, regrowth measurements, classifications of and a photo and video documentation of a cave's formations and artifacts. The inventory has mostly been completed within a few feet of the trail but the specific writings of most off-trail areas have not been recorded. The completed inventory will insure that only graffiti vandalism is promptly removed, not historical graffiti. All graffiti dated to less than fifty years ago will also be removed. A broken formation count will be conducted every two years after the initial one is completed. Only after two to three surveys will a fairly accurate baseline be established. Surveys will be done with headlamps since having the Cave's lights on will most likely result in only partial coverage. A minimum size of broken formations will be chosen, below which the breakage is not counted. Grouping of small, broken formations, such as popcorn, will be done. The diameter of the groups to be counted will vary from cave to cave but usually averages a few inches.

Broken formations can be repaired during the driest time of the year by a combination of fast-drying glue in the center of a broken area and slow-drying glues surrounding that area. Structural epoxies used in historic preservation can be adapted for speleothem repair by using crushed calcite as a base. The size of the calcite particles will be reduced until the mixture approximates the texture of the formation. Epoxies used in structural bonding also work. If heat is needed for proper setting of the epoxy, care will be taken not to burn and oxidize the epoxy. For stalactites and draperies, especially those with very small attachment areas, holes can be drilled for the attachment of expansion bolts, steel pins or screws. Because calcite cleaves easily, very small holes will be drilled and progressively enlarged with larger drill bits.

Drill holes, steps cut into flowstone, and other manmade modifications can be repaired by using terrazzo or a 5/1 ratio of cave mud to cement. Terrazzo is mostly crushed, bleached calcite and, therefore, closely resembles limestone cave formations. Altering its color to match adjacent cave features, is easier to do than altering the color of most types of cements.

7. **Water Flow**

Some trails that have been artificially deepened require retaining walls to prevent loose cave fill from falling onto the trail. If a naturally occurring water flow is inhibited because of the retaining wall then puncturing this wall may help restore water flow and still hold back sediments.

Water flow from surface structures (if any) and water flow from trails should be dispersed so as to prevent concentrated discharge that can erode natural sediments and cause dolines, etc.

8. **Oxidation**

Oxidation of skin oils and flakes can blacken formations after they have been touched only a few hundred times. Given protection, some blackened formations will return to their original colors in about fifty years. Abrasion and polishing occurs especially if rock fragments harder than limestone are present, such as minute grains of chert inadvertently rubbed on formations by visitor's hands. As in most cases, prevention through education, use of handrails and physical barriers deal with the problem best.
Railings of anodized aluminum are better than galvanized iron but are very susceptible to corrosion from water and salt from human skin. Using railings as intended or unintended electrical grounds may accelerate corrosion and produce aluminum gels. Type 317L, a low-carbon, high-chromium stainless steel with molybdenum, may be a good choice for the conditions in the Cave. Whatever metal is used, periodic rinsing with cave water to remove salt is still needed, especially in areas with high salt deposits, such as the start of steep stairways.

9. **Organics**

Organics (exotic plants, lint, skin flakes and oils, asphalt, temporary wooden walkways, slash burning on the surface, etc.) can cause cave animals adapted to a low-energy food environment to be out-competed by surface-adapted animals. Human-caused toxins are most likely to damage cave communities through bioaccumulation (because cave species tend to be long lived) and, to a lesser extent, through biomagnification (because some cave species are near the top of the food chain.
Because of their higher metabolisms, non-cave adapted species may be the most vulnerable to toxins. Removal of organic debris, such as wooden boards, older than 50 years, but not of historic value, will be gradual, as abrupt removal may disrupt cave communities. However, some biologists argue that such debris should be left in place.

Any caver entering Monument caves must show that he or she carries a spare carbide lamp bottom container with a cap for storage of spent carbide. Spent carbide less than a year old is toxic to cave life.

# V. NPS STAFF RESPONSIBILITIES

## A. **Individual Position Responsibilities**

### 1. **Superintendent**

a. Is directly responsible to the Crater Lake Superintendent for all cave management activities within the park.

b. Approves or disapproves management zone ratings, group size and trip frequency (where applicable) for each cave or cave passage.

c. Approves or disapproves permit applications to enter Zone 4.

d. Approves or disapproves enlargement of a cave passage.

e. Recommends, with the concurrence of the Crater Lake Superintendent, the monument's cave management plan to regional director.

f. Supervises the resource management specialist.

g. Provides commissioned law enforcement officers to enforce cave regulations.

h. Provides personnel for cave rescue operations.

i. Assists the park in acquiring funds for cave management projects.

j. Monitors overall condition of cave resources.

k. Approves press releases and interviews relating to the resources management of Monument caves.

3. **Resource Management Specialist**

a. Advises and consults the Superintendent on cave-related resource management problems, including research, restoration, maintenance, interpretation, and protection.

b. Inventories all known caves and keeps cave inventory files up-to-date with all pertinent information.

c. Monitors resource impacts in all park caves by use of photopoints, video monitoring and other techniques.

d. Reviews cave use permit applications and recommends approval or disapproval.

e. Serves as National Park Service liaison with cave researchers.

f. Monitors restoration projects staffed by park personnel to insure resources are being protected.

g. Conducts special trips and attends to the needs of special populations (researchers, VIP's, school and disabled groups, etc.).

h. Conducts training programs for personnel on safe caving practices, and cave and mountain rescue techniques.

i. Maintains the cave rescue cache so that equipment is always ready to be used.

j. Attends professional meetings on cave management.

k. Recommends trip leaders.

l. Supervises resource management seasonals and VIPs working on cave related projects.

m. Prepares and maintains cave maps and information pertinent to cave inventories.

n. Manages the cave management budget.

o. Prepares, reviews annually, updates, and revises the Cave Management Plan in collaboration with the monument's Superintendent.

p. Identifies necessary cave research.

q. Provides personnel for guided cave trips.

r. Answers public inquiries and prepares pertinent news releases on cave management activities within the park.

s. Coordinates scheduling of rope training and cave rescue training with other divisions and the concession.

t. Develops cave management goals in conjunction with the monument's superintendent and implements cave management programs and projects to accomplish these goals.

u. Provides technical expertise on radon, providing information to employees and management.

5. **Park Ranger (Interpretation and Law Enforcement**

a. Provides personnel to patrol trails above the caves and encourage compliance with park rules and regulations.

b. Responsible for enhancing visitor knowledge and respect for cave resources through interpretive media.

c. Conducts special trips and attends to the needs of special populations (researchers, VIP's, school and disabled groups, etc.).

d. Provides personnel for guided cave trips.

e. Renders EMS services.

f. Enforces CFR regulations and park polices.

4. **Resource Management Seasonal(s)**

a. Assists the resource management specialist in cave research, exploration, mapping, restoration, interpretive, and volunteer projects. Recommends modification of existing studies as data is received and analyzed.

b. Assists the resource management specialist in training and supervising personnel in caving, cave restoration, cave rescue, interpretive, and inventorying skills and techniques.

5. **Maintenance Foreman**

a. Responsible for the maintenance of developed cave facilities.

b. Provides personnel for cave rescue operations.

c. Notifies the resource management specialist of any maintenance problem or job that may substantially impact cave resources.

J. **Training**

1. Search and Rescue: A small team of park staff will be trained to conduct cave search and rescue operations (see Safety Plan for Crater Lake National Park). Cave search and rescue training that includes an in-cave mock rescue will be conducted at least once a year using the best human and technical resources readily available. The session will cover equipment use, organization, hypothermia, stabilization, transport and dealing with bystanders and the media.

2. Trip leaders for cave trips will receive training in proper caving techniques and safety. Their knowledge of cave geology, formation development and cave conservation practices will be supplemented with training sessions.

K. **Interagency Collaboration**

The National Park Service will collaborate with U.S. Forest Service (Siskiyou National Forest) and the Bureau of Land Management on cave management activities.

# VI. MANAGEMENT OBJECTIVES

A. **Protect** and maintain natural cave systems.

B. **Provide** education and recreational opportunities for a broad spectrum of visitors to discover, study, respect, appreciate, and enjoy the park's caves at their individual levels of interest.

C. **Provide** opportunities for scientific study that will better protect caves and cave processes and increase interpretive effectiveness, credibility, and opportunities.

D. **Classify** caves in management categories based on their resource and hazard characteristics and in accordance with the FCRPA.

E. **Establish** regulations, guidelines and a permit system that balances maximum safety for cave visitors to park caves and preservation of park natural and cultural resources while recognizing that no cave can ever be completely safe, and that hazards are part of the caving experience.

# VII. REVISIONS TO PLAN

Changes in this plan may be approved by the Regional Director upon recommendation by the Superintendent. The only exceptions to this procedure are: (1) grammatical corrections, (2) page numbering corrections, (3) deletion, correction or addition of sections in the appendices, (4) correction of the table of contents, and (5) addition of new computer file names. Offices maintaining copies of the plan will be promptly notified of any change. Revised pages will be dated in the lower right-hand corner of the page. Changes requiring the Regional Director's approval will be submitted with a new cover sheet for signature and dates, which will replace the existing cover sheet