APPENDIX H
KARST AND CAVE RESOURCES

Appendix H

Karst and Cave Resources

Karst Resources: Karst

I. Strategy

A. Maintain, to the extent practical, the natural karst processes and the productivity of the karst landscape while providing for other land uses, where appropriate. This strategy is designed to assess a karst resources vulnerability or sensitivity to a proposed land use, and recognize the differences in degree of karst development and glacial history across the karst landscape.

B. The key elements of the karst strategy focus on the openness of karst and its ability to transport surface water, nutrients, soil and debris, and pollutants into underlying hydrologic systems. Strive to maintain the productivity of the soils of the karst landscape after harvest, maintain the quality and quantity of the waters issuing from karst hydrologic systems, and protect the many resources values within underlying significant cave systems as per the requirements of the Federal Cave Resources Protection Act of 1988 (FCRPA).

II. Management

A. Maintain a karst resource management program that will identify, evaluate, and provide appropriate protection and mitigation for karst resources. Evaluate karst resources as to their vulnerability to land uses affecting karst systems, as described in the Karst and Cave Resource Significance Assessment, Ketchikan Area, Tongass National Forest, Alaska (Aley et al. 1993), Karst Landscapes and Associated Resources: A Resource Assessment (USDA Forest Service Gen. Tech. Rep. PNW-383) (Baichtal and Swanston 1996), Karst Management Standards and Implementation Review, Final Report of the Karst Review Panel (Griffiths et al. 2002), and the information provided herein.

B. Seek participation from interested individuals and organizations, such as caving groups, scientists, recreationists, and development interests in managing the karst resources.

C. Integrate and coordinate karst management with the management of other resources. Consider the function and biological significance of the entire karst landscape; recognize the importance of protection of karst systems, not solely specific karst features.

D. Public education and interpretative programs should be developed to ensure an increased understanding of the components and function of the karst landscape. Use research results to foster and promote conservation and further public education of karst resources.

E. Work with universities and other appropriate research facilities to foster partnerships to study and characterize the function and biological significance of karst landscapes. In order to maintain existing aesthetic and future scientific values, use non-consumptive research techniques as much as possible.

F. Manage the karstlands with an “adaptive management approach.” Guidelines should allow karst managers to exercise their professional judgment in developing karst management strategies and prescriptions. As knowledge is gained from implementation, monitoring, research, and studies, recommended practices should be modified to reflect the needed changes.

III. Karst Landscape Assessment

A. Karst lands impose land management challenges not encountered in non-karst areas because this three-dimensional landform functions differently than other landforms. Karst resources must be evaluated according to their vulnerability to land uses affecting karst systems. Vulnerability mapping recognizes that some parts of the karst landscape are more sensitive than others to surface activities and groundwater contamination. These differences in vulnerability may be a function of the extent of karst development, the openness of the karst systems, and the sensitivity of other resources that benefit from karst groundwater systems. Assess karst resource vulnerability for both large geographic areas and site-specific projects. Complete vulnerability assessments of large geographic areas for any karst area where land-disturbing activities are planned. Conduct site-specific vulnerability mapping on a project-by-project basis,

or as field verification of the larger scale karst vulnerability assessment. Karst lands will be classified as low, moderate, or high vulnerability. This four-step process is discussed below.

1. **Identify Potential Karst Lands.** Identify those lands underlain by carbonate rocks. As a practical matter, all lands underlain by carbonate rocks within the Forest should be considered a karst landscape. These include outcrops of limestone, marble, and dolomite. Karst has also developed within gypsum deposits on the Forest, and caves or tubes can be found within some lava flows.
2. **Inventory Karst Resources.** At the beginning of any land-disturbing project planning effort, determine the project's proximity to or position on a karst landscape. If it is determined that karst occurs in the project area, require an inventory adequate to characterize the resources. Assess the degree and location of karst development. If karst is present, at a minimum, record the information listed below.
   a. The degree to, which karst has developed, including the degree of epikarst development; the presence of caves, the presence of insurgences or sinking or losing water courses and resurgences or springs, sinkholes, collapse channels, and other karst features. If through initial inventory it is determined that the level of karst development and the density of karst features is so high that the landscape should be classified as high vulnerability, a complete inventory of all features is not necessary. It is important to document the level of karst development in the Karst Resource Report and the justification for the vulnerability classification. Document specific karst features on the “Karst Feature” form. Document characteristics of the karst in the area of concern on the “Karst Classification Summary” form.
   b. When caves are identified that may be affected by the proposed land management activity, they will be surveyed and inventoried in accordance with cave management guidelines. To maintain continuity of inventory reports and cave maps, specifications will be addressed prior to commencement of inventory work. During inventory work, caving ethics and protection of cave resources will be stressed.
   c. The relative position of karst features both within and adjacent to the planned activity.
   d. The slope of the land and the depth and nature of soil atop the karst.
   e. The presence of any Class I or Class II streams being significantly contributed to from the karst hydrologic systems. It is only intended that streams that have had sufficient residence time or contact with the carbonate bedrock and which show appreciable geochemical change be considered. Temperatures less than 8.5 degrees Celsius, pH ranging from 7.5 to 9.0, and specific conductance greater than 120 would be an indication of the highest value karst waters. It should be recognized that some normally dry drainage channels in a karst landscape would periodically carry large flows when the capacity of underlying conduits is exceeded during high flow events.
   f. Sensitive habitats and features that might be adversely affected by land use changes in the area being investigated. These habitats and features must specifically include, among other things, streams important to fisheries and streams or springs used as domestic water supplies, habitats that support cave adapted organisms, and critical bat winter habitat and/or roosts. When considering karst streams and springs, the inventory work must recognize that many sensitive habitats and features are likely to be located appreciable distances away from points where waters enter the karst groundwater system. The sensitive habitats may also include unique or unusual plant communities associated with surface karst features or carbonate outcrops.
   g. The results of the survey shall be documented and digitized onto the Forest’s GIS Database. The area's geology, location of karst features and caves, and the vulnerability of specific karst areas shall be recorded.
3. **Delineate Karst Hydrologic System and Catchment Area.** Define, to the extent feasible, the karst hydrologic system and the recharge area watershed or catchment area for each karst system. The character of the catchment area (i.e., the area, slope gradient, vegetation, water quality, soils, etc.) controls the nature of the receiving karst system and defines the volume of runoff available for infiltration into the system. Recharge area delineation is a crucial component of vulnerability mapping; it is important to know where the water comes

from and resurges to credibly assess and characterize possible impacts. At a minimum, record the information listed below.

a. During the inventory phase, record the location of all insurgences, sinking or losing streams, sinkholes, or other features appropriate for injection of tracing dyes. Estimate water volume entering or discharging from the groundwater system at the time of the visit. Record the position and characteristics of as many resurgences or springs as practical believed to be associated with the particular karst system of interest. Describe prevailing weather conditions at the time of the visit and the precipitation trends over the previous 24 hours.
b. Within each project area, the need to conduct tracer dye studies will be determined by a karst management specialist or other resource specialist such as a hydrologist with karst-specific experience or training. If tracer dye studies are determined to be necessary, the dye study needs to be carefully designed. Because subsurface flow paths are not predictable, an initial attempt to locate and sample all springs issuing from the karst area is necessary. Dye introduction sites should be selected to answer the particular resource concerns or threats. As an understanding of the systems complexity is established through initial successful traces, the sampling site strategy can be modified. Dye traces may need to be conducted at both low and high flows to determine the full extent of the karst groundwater system.
c. Record the results of the dye traces, indicating the relative position of the dye injection point and the position of the resurgence or spring where the dye was recovered. Record the tracer dye's travel time and concentration, if known. Record resurgences and streams that were sampled, but where no dye was recovered. Document and digitize results onto the Forest GIS Database.

4. **Assess Vulnerability of Karst Terrain to Management Activity.** The final step is to delineate the land under investigation into various vulnerability categories. An area's vulnerability rating must be sensitive to potential surface management practices based on the extent to which epikarst has developed and the openness of the karst system. Where recharge is diffused through deep soils, the underlying karst is less vulnerable to increased sediment inputs and other pollutants than in areas where recharge is discrete and soils are thin or nearly absent. Where soils are thin or nearly absent, surface disturbances will almost always result in exposure of the epikarst, providing an easy pathway for sediment and other pollutants to enter the subsurface drainage network. Discrete recharge areas are especially vulnerable to ground-disturbing activities because the flowing surface water can carry sediment and other pollutants directly to the subsurface drainage network. Karst vulnerability mapping recognizes the variability in karst terrain and uses the vulnerability concepts described here to assign a high, medium, or low vulnerability rating to an area of karst terrain. The proposed ground disturbing activity is considered when determining mitigation or applying karst management guidelines. The vulnerability categories and their criteria are discussed below.

   a. **Low Vulnerability Karst Lands**
      i. **Classification Criteria.** Low vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are not likely to be appreciably greater than those posed by similar activities on non-carbonate substrate. A generalized characterization of these lands include areas underlain by carbonate bedrock that are moderately well to well drained, most commonly internally drained, but surface streams may be present. Generally, these areas have been greatly modified by glaciation, and a deep (greater than 40 inches deep) covering of glacial till or mineral soil, and little or no epikarst showing at the surface. The epikarst may be buried and/or ground off, depending on the intensity of glaciation. These lands pose little or no threat to organic, sediment, debris, or pollutant introduction into the karst hydrologic systems beneath through diffuse recharge. Often these are areas of little or no slope (less than 20 percent). These tend to be at lower elevations (i.e., less than 500 feet); however, the elevation of low vulnerability karst will vary across the Forest.

ii. **Low Vulnerability Karst Management Objectives and Appropriate Land Uses.** These are areas where no special provision for the protection of karst values is considered necessary. Timber harvest and related activities could be conducted in such areas in a similar manner to those normally employed on lands underlain by insoluble bedrock. Partial suspension yarding may be required. No quarry shall be developed atop karst without adequate site survey and design. Quarries should be properly closed after abandonment. Recreational development would be appropriate with consideration of karst resource values. It is possible that karst areas with high vulnerability will be found within and adjacent to areas found to be of low vulnerability. Along such boundaries or margins, guidelines for protecting these high vulnerability areas outlined under "Moderate Vulnerability Karst Lands" (3.D. b. ii. (a)-(c)) shall apply.

b. **Moderate Vulnerability Karst Lands**

i. **Classification Criteria.** The moderate vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are appreciably greater than those posed by similar activities on low vulnerability karst lands. A generalized characterization of these lands include areas underlain by carbonate bedrock that are well drained internally. Surface streams are rare. The soils of moderate vulnerability areas are a mosaic of shallow organic (20 to 40 percent, McGilvery Soils) and mineral (80 to 60 percent, Sarkar [less than 20-inch depth] and Ulloa [greater than 20-inch depth] Soils) with minor amounts of glacial till. The epikarst is moderate- to well-developed and is visible at the surface. These areas tend to be at higher elevations (i.e., greater than 500 feet, and on knobs, ridges, and on the dip-slope of carbonate bedding planes when near the surface.) The surface of these areas tends to be irregular and undulating, following the epikarst development, which is the result of solution of the bedrock surface rather than solution and/or collapse features such as sinkholes. In other words, moderate vulnerability features are often the result of slow, diffuse processes rather than collapse or major subsidence processes, which typify high vulnerability features. Moderate vulnerability karst lands pose low risk to organics, sediment, and debris introduction into the karst hydrologic systems beneath. It is probable, but not always the case, that these areas contain or are adjacent to areas of high vulnerability.

Much difficulty lies in differentiating between the high end of the moderate vulnerability karst and the low end of the high vulnerability karst. In using a classification system, there is rarely an exact fit to the environment or specific area being investigated. As stated above, classification is dependent upon extent of karst development and openness of the system. This can be difficult when surrounded by an environment with no surface water streams and limited exposure to the development of the underground system, as is often the case in these 'gray areas' between moderate and high vulnerability karst. Aside from the level of development and the openness of the system, the density of both karst features and exposed epikarst can be used when classifying the vulnerability of an area. A high density of features and/or very well developed epikarst in a “gray area” would result in a high vulnerability classification, whereas a few minor features and moderate epikarst development with soil retained might be classified as a moderate vulnerability area. It is crucial to evaluate the immediate area as well as the surrounding environment and any contributing characteristics when using this vulnerability system.

ii. **Moderate Vulnerability Karst Management Objectives and Appropriate Land Uses.** Management objectives on these lands is to provide for other land uses while taking into account function and biological significance of the karst and cave resources within the landscape. Timber harvest and related activities could be conducted in such areas under more restrictive guidelines than normally employed on lands underlain by insoluble bedrock. To protect the fragile soils found here, at a minimum, the yarding system selected may be required to achieve partial suspension. Longer timber harvest rotational periods may be appropriate. Reduced timber harvest

unit size and a greater dispersal of harvest units may be required. Recreational development would be appropriate with consideration of the karst resource values listed above, particularly with respect to reducing disturbance of sensitive soils and use of construction methods that avoid erosion and diversion of natural and road drainage waters into karst features.

(1) Road Construction. Existing roads will be utilized in preference to the construction of new ones. Roads should avoid sinkholes and other collapse features as well as sinking or losing streams. Roads should not divert water to or from karst features. Measures shall be taken to reduce erosion and sediment transport from the road surface and cut slopes. Assess the need for ditches and culverts. Sediment traps, cut and fill slope revegetation, and road closure and revegetation may be appropriate. Because subsurface drainage networks may be more open to the surface in moderate vulnerability areas, additional design criteria may be required. Such criteria may relate to road construction methods, blasting, culvert placement and density, and sediment retention and erosion prevention. Road construction restrictions described below under “high-vulnerability prescriptions” may be required for these areas.

(2) Quarries. Existing quarries will be utilized in preference to the construction of new ones. No quarry shall be developed atop karst without adequate site survey and design. Quarries should be properly closed after abandonment.

(3) Karst Feature Buffers. It is probable that individual features or areas with high vulnerability will be found within and adjacent to areas found to be of moderate vulnerability. Along such boundaries or margins, the following guidelines shall apply:

   (a) No surface-disturbing activity such as timber harvest, road construction, and/or quarry development shall occur within a minimum of 100 feet of the edge of a cave, sinkhole, collapse channel, doline field, or other collapse karst feature. Manage an appropriate distance beyond the no-harvest zone to provide for a reasonable assurance of windfirmness (RAW) of that zone (pay special attention to the area within two site-potential tree heights of the no-harvest zone). The intent of the buffers surrounding karst features is to minimize the amount of woody debris and sediment entering a given karst system and to maintain, to the extent practical, the natural processes and environment surrounding those features. It is not intended that this level of protection would be applied for relatively minor, isolated features (i.e., where explicit or special management measures would not normally be required). Appropriate protection measures for minor features should be designed on a case-by-case basis as field assessed by a karst management specialist. When designing buffers to protect karst systems and their features, the buffer should be designed to be wind-firm. There is no credible standard buffer distance that will provide the assurance required to protect the systems from blow down of the forest within a given buffer. Each buffer must be carefully designed considering wind direction, blow down history, previous adjacent harvest, topography, and stand windfirmness. Delineated lands surrounding such features and systems must be of sufficient size to ensure protection even if blow down occurs. It is suggested that the specific design of the buffers be an Interdisciplinary Team (IDT) recommendation working with the karst management specialist during the planning process for any given project. Not all features will require the RAW buffer considering the specific characteristics of each.

   (b) No surface-disturbing activity such as timber harvest, road construction, and/or quarry development will occur on lands that overlie a known "significant" cave. "Overlie" is defined here as the area between lines projected from the outside walls of the cave passage at a 45-degree angle to the surface. In practice, lands that overlie a significant cave should be classed as high vulnerability even if other characteristics would suggest a lower rating.

As suggested above, the specific design of the buffers should be an IDT recommendation working with the karst management specialist during the planning process for any given project.

(c) As cave discoveries are made and those caves are mapped and inventoried, it is quite probable that very significant cave systems will be discovered. These might contain significant paleontological, cultural, or biologic resources, or the system is of a particular size to warrant an extra level of protection. Cave systems such as El Capitan Cave on Prince of Wales Island, Arabica and associated caves on Heceta Island, Solstice Cave on Chichagof Island, and the Calamity Creek Caves on Revillagigedo Island are examples. It is suggested that on a case-by-case basis for such caves, a Geologic Special Area be defined and managed as such to protect these systems.

(d) Require protection of all sinking or losing streams and their tributaries irrespective of whether the channels carry perennial, ephemeral, or intermittent flows. A non-harvest buffer is required at a minimum of 100 feet from the edge of a sinking or losing stream within no less than 0.25 mile (1,320 feet) upstream of their swallow hole or loss point. Additional protection beyond this point many be needed and should take into consideration parameters such as gradient, channel type, soil characteristics, and susceptibility to mass wasting and erosion along the stream's or tributary's course, or within the watershed. The karst management specialist should work in conjunction with hydrologists and soil scientists to design additional stream protection if needed. Manage an appropriate distance beyond the no-harvest zone to provide for a reasonable assurance of windfirmness of that zone (pay special attention to the area within two site-potential tree height of the no-harvest zone). In the event that the stream is less than 0.25 mile long, the stream will be buffered to the stream's source.

(e) The area surrounding resurgences should be protected to maintain the environment surrounding the springs and the quality of the waters flowing from them. Resurgences can, however, be classified as moderate or high vulnerability dependent upon their size, the habitat they provide, and the level of atmospheric connectivity between the resurgence and the underground karst system. Minor resurgences that seep out of the ground between gravels with almost no connectivity between the open atmosphere and the underground system will be classified moderate vulnerability. Appropriate protection measures for moderate vulnerability resurgences and springs should be designed on a case-by-case basis by a karst management specialist. All other resurgences will be classified as high vulnerability and protected as described above in Karst Feature Buffers. Special consideration should be given to the area immediately surrounding the springs to protect the flora and fauna often associated with the spring when considering the vulnerability.

c. **High Vulnerability Karst Lands**

i. **Classification Criteria.** The high vulnerability karst lands are those areas where resource damage threats associated with land management activities are appreciably greater than those posed by similar activities on low or moderate vulnerability karst lands. These are the areas contributing to or overlying significant caves and areas containing a high density of karst features. A generalized characterization of these lands is described below.

These are areas underlain by carbonate bedrock that are well drained internally. Surface streams are rare. Karst systems and epikarst are extremely well-developed and collapse karst features may be numerous. These include all collapse karst features, caves, sinking or losing streams, insurgences, open resurgences, and open grikelands (i.e., those without soil or moss infilling and with open connections to the subsurface). The highest vulnerability features are those that could produce and transport the greatest amount of sediment, debris, and/or organics if disturbed. These

include till-lined sinkholes and cave entrances accepting a sinking stream, whether intermittent or not. Also considered high vulnerability are karst lands in which the epikarst is well- or extremely well-developed and the soils are predominately (greater than 50 percent) very shallow organic (less than 10 inches deep, McGilvery) and (less than 50 percent) mineral (less than 20 inches deep, Sarkar). The subsurface drainage network is highly vulnerable to sediment, organic matter, logging debris, and other pollutants generated as the result of surface activities.

ii. **Karst Management Objectives and Appropriate Land Uses.** These areas shall be managed to ensure conservation of karst values through the implementation of a high level of protection. Timber management and related activities should be excluded from these lands. Limited recreational development may be appropriate. Recreational facilities and trails would have to consider karst resource values and objectives discussed above, particularly with respect to reducing disturbance of significant epikarst features and sensitive soils and use of construction methods that avoid erosion and diversion of natural drainage waters into karst features. Roads are considered inappropriate with the following exception if no other route or option is available and karst resource values would not be compromised. Small expanses of these areas may be crossed by roads to access areas where harvest is appropriate (i.e., low or moderate vulnerability karst lands and non-carbonate areas). If roads must be built across areas of high vulnerability, karst lands found to be of high vulnerability shall be identified and removed from the commercial forest lands suitable land base. If roads must be built across areas of high vulnerability, the following design and construction may be appropriate:

(1) Minimize clearing limits and grubbing. Flush cut stumps to the ground. Do not deck logs pioneered from the road clearing limits outside the clearing limits.
(2) Use a fill-type construction rather than a balanced cut and fill design. This most likely will be possible because the slope gradient of these areas are generally greater than 15 percent.
(3) Utilize log stringer bridges or similar structures to span across collapse features, if necessary. Geotextile should be used to keep aggregate overlay from falling into the collapse feature.
(4) Sediment traps and erosion control measures will be needed in most cases.
(5) Same-season re-vegetation of the cut and fill slopes should be required to minimize sediment production potential.
(6) A "plan-in-hand" review by the karst management specialist of the proposed road construction prior to actual construction is required.
(7) The karst management specialist needs to work closely with engineering to carefully design these roads and coordinate efforts with the planning team.
(8) No quarry development would be allowed on these lands.

IV. Catchment Area Management

A. The catchment areas for karst systems, comprised of carbonate or non-carbonate substrate, are an integral portion of those systems. Many karst watersheds receive part of their drainage from runoff originating on higher elevation non-carbonate rocks. This recharge originating from non-carbonate outcrops is called "allogenic recharge," and it usually sinks or recharges the carbonate aquifer at specific points. This water quickly enters and is transmitted through the conduit part of the aquifer and classified as concentrated "discrete" or "direct" recharge. Precipitation falling directly on the carbonate outcrop area is called "autogenic" recharge. It may rapidly enter the subsurface through sinkholes at discrete points or may percolate down through a soil or cover layer and enter the aquifer or cave systems as diffuse recharge. Catchment area management measures can be most effectively developed if both catchment types are delineated and their sensitivity to cumulative land use activities is evaluated. Difficulties arise because relative proportions of the two catchment types can be diverse and their sensitivities different; hence, different catchment assessment strategies need to be formulated for both types, each with its own set of guidelines.

The Forest currently does not have a catchment area management strategy for autogenic recharge areas (ARAs). As an interim measure, use the karst vulnerability assessment procedures to approximate the sensitivity of specific autogenic recharge areas. The Forest should pursue research opportunities that help to define and describe the parameters of both allogenic and autogenic recharge associated with karst catchments and recharge. Each karst system will have a unique set of recharge characteristics, which, in turn, will determine the level of catchment area management required. It is recommended that catchment area management strategies employ guidelines that can be adjusted and refined over time as more information is acquired.

V. Young-Growth Management on Karst

A. On lands underlain by carbonate, where either pre-commercial or commercial thinning is proposed, a karst resource inventory shall be conducted as described above. The openness of the underlying karst system, that systems vulnerability to surface disturbance, and the likelihood of additional sediment production or runoff by thinning the young-growth timber shall be determined. Pre-commercial thinning is appropriate on all karst lands when the karst management objectives can be met. Pre-commercial thinning to near the edge of karst features or the bank of sinking or losing streams is allowed; however, no slash or debris may fall or be placed in these features. It is probable that a zone equal to one tree height be left untreated to ensure that no slash or debris will be placed in these features. If any introduced slash or debris finds its way into karst features or losing streams, it must be removed by hand. Commercial thinning is appropriate on low to moderate vulnerability karst lands when the karst management objectives can be met. Generally, no thinning shall be permitted on lands determined to be of high vulnerability such as within 100 feet of a cave entrance, a karst feature accepting surface flow, or of the edge of a sinking or losing stream within 0.25 mile upstream of their swallow hole or loss point. On a case-by-case basis, other karst features will be assessed as to their susceptibility to surface disturbing activities, the proposed harvest method, and the thinning prescription. The area surrounding these features is still considered high vulnerability and should be mapped as such; however, thinning of this sensitive area might be considered permissible. All features not fully protected would be buffered from their center to just outside the lip of the sink allowing for thinning within the area that would normally be a non-harvest buffer. It is probable that a zone equal to one tree height be left untreated to ensure that no material will be placed in these features. All thinned timber will be directionally felled from the untreated area surrounding the karst feature and split yarded from the area. Any material landing on the slope break of the feature or within the feature will be hand removed. No yarding across or through the untreated area surrounding the feature will be allowed. Directional falling and split yarding away from the karst depressions and features should provide adequate protection for water quality and karst features. It is believed that the benefit of hydrologic recovery of the areas adjacent to these features outweighs the risk of harvest. Again this should be assessed on a case-by-case basis.

VI. Salvage of Windthrown Timber on Karst

A. On lands underlain by carbonate, where salvage of windthrown timber is proposed, a karst resource inventory shall be conducted as described above. The openness of the underlying karst system, that system's vulnerability to surface disturbance, and the likelihood of additional sediment production or surface runoff by harvesting the windthrown timber shall be determined. The appropriateness of salvage of windthrown timber on karstlands will be determined on a case-by-case basis in the field by a karst management specialist. Salvage is appropriate on low to moderate vulnerability karst lands when the karst management objectives can be met. Generally, no salvage shall be permitted on lands determined to be of high vulnerability, within 100 feet of a losing stream, a karst feature, or on lands that overlie a "significant cave." For relative minor, isolated features surrounded by low to moderate vulnerability karst, if the logging system to salvage the windthrown timber can be designed to not disturb the timber spanning or blown into the feature, salvage shall be permitted within 100 feet of the lip or edge of the feature. This salvage must be carefully designed. Before harvest, the sale administrator, purchaser representative, and karst management specialist should walk through the harvest unit to review the layout and resource management concerns.

VII. Mineral Development

A. The chemically pure carbonates of Southeast Alaska have long been considered for their commodity values. Values are not determined solely on chemical purity but on brightness as

well. The more pure the carbonate bedrock, the more conducive the bedrock is to karst development. It is not the intent of these standards and guidelines to restrict any lands from mineral development, though that may be appropriate if a specific project or area is allocated to the Special Interest Area Land Use Designation. The impacts of any proposed mineral development within the karst landscape can be analyzed through the environmental analysis that is triggered once a Plan of Operations is received.

Cave Resources: Cave

I. Management

A. Manage lands in a manner that, to the extent feasible, protects and maintains significant caves and cave resources. See direction in 36 CFR 290.3 and "definitions" for guidance determining cave significance.

B. Locate, map, and describe caves, and evaluate and document the resource values discovered, when appropriate. The significant cave designation process is an inventory process for identifying caves that will require some form of management. Carry out data storage and collection in a manner that is consistent, at a minimum, with the processes outlined in 36 CFR 290.3 and FSM 2881.42 for nomination, evaluation, and designation of significant caves.

C. Develop a comprehensive Cave Resource Management Strategy on known cave resources. At a minimum, the strategy should include components that outline processes for cave inventory, record keeping, cave naming, handling of confidential cave information, partnership opportunities, recreational use monitoring, cave access and entry permits, and cave resource evaluations.

1. **Cave Inventories and Designation.** The inventory of caves is an ongoing process. The Forest will continue to aggressively pursue collection of inventory data.
2. **Records.** On each management unit with caves, a file of permanent data will be maintained for each cave. A complete set of this information will be held on the Forest. This file will remain locked, with access provided on a need-to-know basis only.
3. **Naming of Caves.** A cave should never be named after a living person, nor should it be named after a geographic feature that discloses the location of the cave.
4. **Cave Locations.** Specific information concerning significant caves on the Forest will not be made available to the public in accordance with provisions of FCRPA and 36 CFR 290.4.
5. **Protection of Cave Entrances.** Cave entrances are both sensitive and critical to cave ecosystems. Disruption of this ecosystem by development or heavy recreational use should be avoided. Management of cave entrances should consider recreational use including camping when it is consistent with provisions of the FCRPA, providing narrow pathways to minimize disturbance, and prohibiting fires.
6. **Digging in Caves.** All digging, moving of rocks, or enlargement of passages to allow exploration requires a permit. Issue permits only when it has been determined that no damage to cave resources will take place. Digging should generally be minimal, and waste products disposed of, or graded in a manner specified in the digging permit. Excavations made as a part of scientific investigations will be backfilled and graded to natural contours. If formerly closed passages are opened, take measures to maintain former atmospheric conditions through use of airlocks or gates.
7. **Permanent Anchors.** In vertical caves, use natural anchors for rigging ropes when possible. Chocks, cams, and slings are acceptable low impact anchoring devices. The use of permanent anchors, such as expansion bolts, will be set only when approved in advance by the Forest Service and generally not in Wilderness. Acceptable reasons to set bolts would be lack of safe natural anchors, to direct ropes to avoid loose rocks, to reduce rope abrasion, or to protect fragile cave resources.
8. **Climbing.** Climbing in caves may be allowed when needed to overcome vertical obstacles during exploration. Sport climbing may be allowed in the vicinity of cave entrances when no risk of damage to cave resources is present. Climbing must not mar, deface, for leave visible signs of activity having taken place. The use of chalk to dry climber's hands, and which leave marks on handholds, is considered defacement and will not be permitted.
9. **Closed Caves/Cave Entry Permits.** All sensitive caves will be closed by order of the Forest Supervisor and, entry will be allowed by permit only. A sign at the entrance of each sensitive

cave will designate it as closed to visitation without a permit, and indicate the address and phone number where permit information may be obtained.

10. **Cave Evaluation.** All caves on the Tongass National Forest will be evaluated using the rating system described below. The system assigns values to various cave resources. The assigned values will be used in determining cave classification and making determinations of cave significance as provided by the implementation regulations for the Federal Cave Resources Protection Act of 1988 (FCRPA). If a cave has a value of "1" or greater, in one or more categories, the cave will be considered for designation as significant using the criteria in 36 CFR 290.3(c) and (d) (FCRPA Implementation Regulations 1994).
11. **Cave Classification.** Place caves into one of the classes described below based on management objectives consistent with identified cave resource values. As new caves are discovered, temporarily manage them as Class 1 until an analysis of resource values is completed.
    a. **Class 1. Sensitive Caves**. Caves considered unsuitable for exploration by the general public either because of their pristine condition, unique resources, or extreme safety hazards. They may contain resources that would be impacted by low levels of visitation. These caves are not shown on maps or discussed in publications (such as guides, brochures, or magazines) intended for general public use. Develop specific management guidelines for each sensitive cave for the purpose of protecting and maintaining their resources. Close these caves by order of the Forest Supervisor, and allow entry by permit only.
    b. **Class 2. Directed Access Caves**. Caves with directed public access and developed for public use. These caves are shown on maps or have signs directing visitor access. These caves also frequently have guided tours and artificial lighting. Regardless of the level of development, encourage public visitation. The caves may have sensitive resources that are protected.
    c. **Class 3. Undeveloped Caves**. Caves that are undeveloped but are suitable for exploration by persons who are properly prepared. In general, these caves contain resources that resist degradation by moderate levels of recreational use. Public attention will not be directed toward these caves. They will neither be shown on maps nor discussed in brochures or publications intended for general public distribution.
12. **Prohibitions.** The following acts will be prohibited by order of the Forest Supervisor pursuant to 36 CFR Section 261, 262, Subpart B:

    a. In bat caves, or caves with sensitive species (261.53), it is prohibited to go into or be upon any area that is closed for the protection of threatened, endangered, rare, unique, or vanishing species of plants, animals, birds, or fish.
    b. Applicable to all caves, except for purposes of research and exploration, it is prohibited to:
        i. [261.52(a)] Build, maintain, attend, or use a campfire or stove fire; fires may be allowed in regard to traditional Native ceremonies in compliance with the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act, their amendments and implementing regulations;
        ii. [261.52(c)] Smoke;
        iii. [261.58(e)] Camp;
        iv. [262.52(f)] Possess, discharge, or use any kind of fireworks or other pyrotechnic device;
        v. [261.58(m)] Discharge a firearm, air rifle, or gas gun; or
        vi. [261.58(s)] Possess a dog or cat.
13. **Collection or Removal of Cave Resources.** FCRPA authorizes the Secretary of Agriculture to issue permits for the collection and removal of cave resources under such terms and conditions as the Secretary may impose, including the posting of bonds to ensure compliance with the provisions of any permit. Specific guidelines are found for the issuance of such permits in FCRPA.