DRAFT (10/10/00)

PART I. INTRODUCTION

CHAPTER 1. PHILOSOPHY, ISSUE, and GOAL

The Philosophy

> ***The significant problems that we face cannot be solved at the same level of thinking we were at when we created them.*** **– Albert Einstein**

Legislative mandates for public involvement may have constituted the most dramatic shift that has occurred in natural resource management paradigms in this century. The National Environmental Policy Act of 1969 required all federal agencies to inform the public and accept public review comment on every proposed federal action that might significantly affect the environment. The National Forest Management Act of 1976 and the Federal Land Policy Management Act of 1976 simply enlarged on these requirements for the management of the national forests and rangelands.

These legislative mandates originated in the philosophical heart of democracy. A democracy is a group of people with a deep, abiding fear of being overwhelmed by its government. For the past three decades, American government agencies have assumed that information freely given to the citizenry would result in an informed consent to proceed. In matters of natural resource management, that assumption rarely has been true, and the road to implementation never has been smooth.

The process for developing the Clemson Experimental Forest Trails Plan has taken a different approach to planning. Three principles have guided this approach. First, *in a democracy, the citizens need to be empowered to participate in the decision-making process*. Citizens are the owners of the public lands, and they are the clients of the managers and scientists whom they have employed to manage and study these

lands[1]. On the other hand, as owners, employers and land-users, the citizens have an incumbent responsibility for informed decision-making.

Second, *intelligent conservation planning and implementation can be performed only by informed people*. Therefore, the communications among citizens, managers, and scientists must result in each group learning from all the others. Citizens can only begin making good decisions when they are objectively informed. Scientists and managers only can intelligently guide that decision-making when they understand the perspectives and values of the citizens. Scientists and managers simply dictating to the citizens what is best is not democratic process. Recent history has demonstrated the kinds of revolts that occur when this approach is used. Conversely, conservation decision-making based largely on emotion and loudness of outcry by the citizens has flirted with disasters in both conservation and economics.

Finally, *all conservation planning has to be guided by a land ethic*. In the social context, ethics are aimed at harmonizing the behaviors among people so that interactions do not destabilize relationships and place the future in jeopardy. A land ethic guides human behaviors toward the land so that current use of natural resources does not place in jeopardy the future health of the ecosystems upon which we depend.

Land ethicist Aldo Leopold wrote in his environmental cornerstone essay *The Land Ethic*[2]: "Conservation is a state of harmony between men and land." A land ethic is not possible without an *ecological conscience*, and an ecological conscience is not possible without *ecological awareness*. Objective, grassroots planning for conservation raises awareness, informs the conscience, and seeks harmony between the land and those who use it, as well as among the users.

The Issue

The demands for recreational opportunities on public forestlands have grown rapidly throughout the nation for the past half-century. That demand was traditionally dominated by hunting and fishing interests. Tourism and non-consumptive uses were primarily concentrated on public parklands, most of which prohibited hunting. Whereas in the earliest days of park establishment, these parklands were seen as the "pleasuring grounds" for the citizenry, today, almost all public lands are to some extent viewed in this context. Not only do non-consumptive users outnumber consumptive users, also the array of users has increased

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[1] A perspective articulated by Dr. Jack Ward Thomas, Chief, U.S. Forest Service, in a speech titled "This Time, Our Moment in History, Our Future." Forest Service Leadership Meeting, Houston, Texas, June 20-23, 1994.

[2] Leopold, A. 1949. The land ethic. pages 237-264 in *A Sand County Almanac with Essays on Conservation from Round River*. Ballentine Books, New York. 295p.

substantially. Recreational trail-users compose one of the groups that has increased the most in size and array of uses.

The need for the preservation of trails of historical significance, and the establishment and maintenance of other trails for recreation, as well as utilitarian purposes, has always been recognized as important by most land management agencies. However, in the last two decades, demands for trails for hiking, biking, off-highway vehicles, skiing, and horseback riding have grown dramatically. This growth has resulted in increasingly intensified user conflicts, and in many cases, in inappropriate impacts on the land.

The most *fundamental issue* is the need to create and manage trail systems that fit use to the capacity of the land to accommodate that use, thus harmonizing users with the land. Furthermore, the design and management of trail systems of the future must seek harmony among trail-users as most trails will have to accommodate shared-use.

The *specific issue* for the Clemson Experimental Forest (CEF) is that it has not been immune to the dramatic increase in demands for recreational trails. One of the provisions in the deeds that Clemson University holds on these lands is that they be managed for public purposes which has since been construed to mean multiple-use. Until the late-1980s, recreational trails were not considered to be a significant part of the array of uses. However, it is possible, even probable, that trail-use by horse and mountain bike enthusiasts has dominated the recreational use of the CEF in the 1990s.

This change has paralleled similar changes on state and federal forestlands throughout South Carolina. As South Carolina's land grant university, it seems incumbent upon Clemson to lead the way in developing methods for the integration of goals for recreational trails into the management of forests and their wide array of uses. Furthermore, implementation of a trails management strategy that inseparably integrates management, monitoring and research should serve the education and research purposes of the CEF.

Goal

The goal of the CEF Trails Plan is to implement a *passive mode, collaborative adaptive management* approach to the design, maintenance and regulation of a trail system that must serve the following purposes:

1. **Provide educational and research opportunities for the study of recreational trail management on the CEF.**

2. **Integrate management of a recreational trail system into the other uses of the CEF in a manner that is compatible with those uses.**

3. **Develop methods for minimizing and mitigating adverse ecological and aesthetic impacts of recreational trail establishment and use.**

4. **Develop methods for harmonizing trail uses among a wide array of trail users and other users of the CEF.**

5. **Provide a demonstration model of a trail system that is ecologically and economically sustainable.**

6. **Provide a conceptual model for design, maintenance, and regulation of a recreational trail system that might be applied to other public lands.**

CHAPTER 2. BACKGROUND

The Clemson Experimental Forest

Three documents have provided the basis for this brief account of the background on the CEF. In 1983, the Land-Utilization Committee of Clemson University[3] published *Clemson Experimental Forest – Present Use and Best Use*. In 1984, *The Clemson Experimental Forest - Its First Fifty Years* was prepared by Robert T. Sorrells[4]. The third document was the *Long-Range Plan for the Clemson Experimental Forest*[5] as approved by the faculty of the Department of Forestry in 1990.

History

Sorrell's account of the origins and development of the CEF impresses the reader with how callous it would be for anyone to take for granted the existence and availability of this forest. Unquestionably, without the fathering by Dr. George Aull, the CEF would not exist. Dr. Aull was a visionary, and a man of missionary zeal.

In the early 1930s, the "New Deal" of the Roosevelt Administration devised a host of natural and agricultural resource based agencies to improve the state of the national

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[3] Land-Utilization Committee of Clemson University. 1983. Clemson Experimental Forest – Present Use and Best Use. Clemson Univ., College of Forest and Recreation Resources, Dept. of Forestry. 18 pages.

[4] Sorrells, R.T. 1984. The Clemson Experimental Forest – Its First FiftyYears. Clemson Univ., College of Forest and Recreation Resources. 48 pages.

[5] Anonymous. 1990. Long-Range Plan for the Clemson Experimental Forest. Clemson Univ., Dept. of Forestry. 13 pages.

economy. In this national program, Aull saw the opportunity to improve the state of the impoverished people and degraded lands surrounding Clemson College. Against the odds of bureaucrats and bureaucratic red tape, and the waxing and waning support of college administrators and state politicians, Aull was steadfast in his commitment to a vision of what could be. A land economist himself, he saw clearly the relationship between poor people and poor land. He understood that intervention was required to heal and restore soils degraded by over-cropping with cotton. He understood that the relationship between people and land had to be redefined.

Aull's initial proposal for federal funding in 1933 was titled "Clemson College Community Conservation Project," an appropriate title as it addressed the problems of both people and land. Initial work began in 1934 with the hiring of a work force of 20 men, but it would eventually grow to include 1500 men. The Land Use Area stretched eight miles to the north and eight miles to the south of the campus and eventually combined 300 purchased parcels that totaled 29,665 ac. The purchase price was $13.00 per acre.

Project workers cleared stands of low-grade timber, built fire lanes, and planted pine and hardwood seedlings. Two Clemson College engineers were employed to design and build the dam to create Lake Issaqueena. In the period of the mid- to late 1930s, 15,000 ac of mostly worn out farmland were planted in trees. In addition, a fish hatchery was established and Lake Issaqueena was stocked with fish. Two fire towers, a number of recreational facilities, roads, and bridges also were constructed on the Forest.

Through these years, the Land Use Area was federally owned and administered. In 1939, Clemson entered into a lease agreement with the federal government that designated the College as administratively responsible for the project.

World War II diverted the attention of people from land reclamation and conservation to the immediate needs of a nation embedded in global warfare. Young men were leaving Clemson College, a military school, to go to war. Clemson also contributed a 135-acre area and Lake Issaqueena to be used as a practice bombing range in support of the war effort. The Forest that had been the object of so much attention went unattended during the war years.

In 1946, and with the War over, Mr. Norbert Goebel, was named by the president of Clemson to be the first forest manager of the Land Use Area. Dr. Koloman Lehotsky, a European- and American-educated forester, joined the Clemson faculty as a professor of forestry in 1947. Goebel and Lehotsky took the Land Use Area on to a management and policy path that lead to the Clemson Experimental Forest.

Through the efforts of U.S. senators Charles Daniel and Strom Thurmond, the Land Use Area was deeded to Clemson College in 1954. This was a major stroke for the

University even though some of the administrative "strokers" showed significant timidity in the process.

While the deed acquisition was a major policy event in the 1950s, the proposal by the U.S. Army Corps of Engineers to build Lake Hartwell would reshape, not only the boundaries of the Forest, but also its values. A large portion of the Forest fell within the project boundaries as surveyed by the Corps. About this time Mr. Marlin Bruner was hired to assist Goebel in the new management challenge. The Corps allowed the managers to sell as much timber as they could get harvested before clearing for the lake began. The College was compensated for the unharvested timber. Over $167,000 worth of timber was sold, and the Corps compensated Clemson for an additional $73,000.

In 1956, the complexion of forestry at Clemson changed to the direction that it still follows today. The Department of Forestry was formed in the College of Agriculture with Dr. Lehotsky as the department head. The position of forest manager of the Land Use Area was passed to Mr. Bruner. The Forest became a primary feature of the natural resource education and research processes at Clemson.

The Present Forest

In late 1976, Dr. Bob Allen, who had succeeded Dr. Lehotsky as department head, expanded the vision of the Forest as an educational and research resource. He requested that the Land Utilization Committee "… explore the possibility of how to best develop the overall management of the Forest in such a way that management is a research project in itself." The response to this request was the Management Alternatives Research Project (MARP) developed under the leadership of Mr. Larry Reamer, Forest Director. It was completed in 1978 and remains the primary guideline for the management of the Forest.

The MARP objectives are:

(1) to measure the biological, economic, and social responses to the effects of forest cultural practices;

(2) to interpret those responses in terms of the impacts on the environment, commerce, and society;

(3) to develop norms against which regional forest management can measure itself; and

(4) to maintain diverse forest conditions for the University's teaching and research programs.

The image of the Forest that is sometimes derived from descriptions of MARP as dividing the Forest into three forests may not be accurate. MARP has three management scenarios: a) maximized profits from timber production, b) multiple-use where revenues are one of many returns from the forest, and c) protection of aesthetic, environmental and cultural values where no immediate economic return is realized. These "treatment" areas are each about 1000 ac in size. There are two areas of each treatment (six areas) on the North Forest and two areas of each treatment (six areas) on the South Forest.

According to the Long-Range Plan[5] for the CEF, the forest contains 17,482 acres. Research and teaching are the primary uses of 61% and 7%, respectively, of this acreage. However, the secondary uses of these acreages must also be considered when picturing the complex use of these lands. For example, 41% of the primarily research acreage is also used for teaching as one of the secondary uses. Noteworthy is that while only 290 ac (1.6%) of the forest are devoted to recreation as primary use, 93% of the forest is available for recreation as a secondary use. The Long-Range Plan reveals 14 categories of uses and their complex interactions on the Forest. The cross-tabulation of these uses is shown in Table 1.

In 1990, the Department of Forestry envisioned a CEF that would be committed to education, research, and management demonstration. This vision was guided by MARP. Under the MARP plan 12,250 ac were devoted to long-term (>10 years to <300 years) teaching, research, and demonstration projects. In this area, timber rotations ranged from 35 to 100 years in length. This acreage also included areas of primary ecological or historical significance (752ac).

An additional 2,760 ac were blocked for short-term (<10 years) use for teaching, research, and demonstration. The remaining 2,422acres were unassigned for a priority use in 1990, but remained listed as reserve lands for future teaching and research projects.

The goals for the CEF as stated in the Long-Range Plan were clearly aimed at education, research and demonstration in the multiple-use management of forest systems. These goals were in alignment with all of the legislative policy on the management of the federal forest and rangelands of the nation. Furthermore, they clearly served the primary mandates for all land grant universities: education, research, and extension.

Primary Use Category	Acres	Secondary Use (acres) Research	Teach.	Demon-stration	Wildl.	Recreat.	Ecol. Reser.	Timber Prod.	Historic. Signif.	Admin-istration	Aquatic Habitat	Rights-of-Way	Leased	Mixed-Use	Other
Research	10,640		4,362	2341	10,640	10,640	438	10,252	19	10	167	489	37	0	49
Teaching	1,255	1,004		1,255	1,255	1,255	720	1,171	3	10	20	51	0	172	5
Demonstration	772	463	772		772	772	720	676	2	10	12	29	0	106	4
Wildlife	246	150	48	79		209	209	0	8	0	4	10	0	33	1
Recreation	290	174	21	13	290		1	140	0	0	0	0	0	40	1
Ecological Reserves	720	432	52	720	720	720		0	0	0	0	0	0	99	3
Timber Production	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Historical Signif.	32	24	8	0	32	8	0	0		0	0	0	0	8	8
Administration	10	10	10	10	10	0	0	0	0		0	0	0	0	0
Aquatic Habitat	275	165	110	12	275	275	0	0	0	0		0	0	38	0
Rights-of-Way	709	178	21	13	296	296	0	0	0	0	0		0	97	0
Leased	61	37	19	0	61	10	0	59	0	0	0	1		10	0
Mixed-Use	2396	719	172	106	2,396	2,396	99	2,154	8	0	38	97	6		76
Other	76	0	16	16	76	76	0	76	0	0	0	0	0	76	
Total	17,482	3,356	5,611	4,565	16,823	16,657	2,187	14,528	40	30	241	677	43	679	147
Primary plus Secondary		13,996	6,866	5,337	17,069	16,947	2,907	14,528	72	40	516	1,386	104	3075	223

Origins of the CEF Trail System

Historical Development[6]

Users and Uses

The CEF trial system began with the use of horses for recreational trail riding in the early 1960s. In 1961, local riders established a horse camp at Twin Lakes. It remained at that location until 1965 when it was moved to Locust Point, and later abandoned under orders by the Army Corps of Engineers. During this time, University students taking courses in horse production began to use the old logging roads in the Fants Grove Area for laboratory exercises. By the early 1970s, local 4-H clubs were occasionally using the Fants Grove trails for trail rides.

At Issaqueena and Todds Creek, trail use in the 1960s and 1970s was essentially all horse traffic and almost completely by residents living in the vicinity of the North Forest. Furthermore, even the horse traffic was very light. One exception to this pattern of use was the beginning of University student competition rides. Competition rides were sponsored by the Clemson University Pre-Vet Club. The first event was held at Issaqueena in 1967. The ride location was later changed to Fants Grove. It was held annually from 1967 through 1992.

The CEF Trail System under went fairly minor changes in user numbers, intensity of use, and use patterns from 1960 through 1980. However, in the 1980s, particularly in the mid-1980s, major changes began. On both portions of the Forest, horse use increased substantially and boomed after 1990. While establishment of the T. Ed Garrison Arena has been blamed for much of the increase in horse use of the Fants Grove trails, that is an unlikely explanation. First, trail use on the North Forest under went about the same relative change as did the South Forest. And second, trail use throughout the southeastern U.S. underwent major increases in use during this same time period.

Even given the dramatic increases in horse use of the CEF Trail System over the past decade, its magnitude lagged far behind that of the change in use by mountain bike enthusiasts, particularly competitive mountain bike interests. The increase in interest in mountain biking in the Clemson area seems to be well demonstrated by a report from a local retailer, the Sunshine Bike Company. The storeowner estimated that mountain bikes accounted for about 10 percent of his total stock from 1980-1985, 40 percent from 1986-1990, 50 percent from 1991-1995, and 90 percent from 1996 to the present (personal communication from owner Jeff McAleer to Ian

[6] The information under this heading is based on personal interviews with the people who were generally accepted to be the most knowledgeable of the development and use of the CEF Trail System. Those interviewed were: Mr. Larry Reamer, Director, CEF (retired), Mr. S.W. "Butch" Kennedy, Clemson University Horse and Sheep Herdsman (retired), Mr. Ian Davidson as best source for knowledge of mountain biking on the CEF, and Mr. Melvin Maw, local resident and horseman, as best source for knowledge of the Todds Creek trails.

Davidson). This change, possibly made more intensive by the first Olympic mountain bike competition, which was held at the 1996 Olympics in Atlanta, has generally paralleled the increased interest in mountain biking in the nation.

The current premier mountain bike enthusiast in the Clemson area is Mr. Ian Davidson. He averages at least 16 hours of event practice riding on the CEF trails each week throughout the year. While he rides entirely on the Issaqueena trails, he estimates that he encounters about three bikes for every horse seen during his riding. Based on these and other observations, in addition to the University's preliminary user survey information, it is reasonable to conjecture that mountain bike use currently dominates the use of the Issaqueena trails, and perhaps accounts for most of the use of the CEF Trail System as a whole.

Trail Development

The CEF Trail System developed from several origins. The first recreational trails were established on the Issaqueena Area during its early development under Dr. George Aull in the 1930s. Some of these are still in place. The most notable is the Lake Trail that is in close proximity to and parallels much of the Lake Issaqueena shoreline.

The second origin was abandoned logging roads that could be traversed by horses. Logging activity associated with the clearing for Lake Hartwell as well as that carried on as silviculture for the remaining forest left numerous skid trails and roads suitable for horseback riding. Most of the current trails on the Todds Creek Area are also of this origin.

The third origin was that of trail-user installation. Mr. S.W. "Butch" Kennedy, retired Clemson University Horse and Sheep Herdsman, was one of the first people responsible for the installation of significant amounts of new trail mileage on the CEF. Working with the Clemson Experimental Forest Director, Mr. Larry Reamer, he was responsible for establishing at least 75 percent of the 44 miles of trails in the Fants Grove Area between 1970 and 1985. Most of these trails were put in for teaching laboratory sessions of the University horse management course. They were used subsequently by students and the general public for pleasure riding. Of course, those trails with a view of the Lake Hartwell shoreline received the heaviest use then and continue to do so.

A second source of user installation was the Clemson Pre-Vet Club, which laid out trails for its competition rides. These trails were designed and "brushed out" by students with the approval of the Forest Director beginning in 1967.

The third group of trail installers was that of the mountain bikers. In the late 1980s and early 1990s the existing trail system was generally adequate for the level of

interest and level of intensity of use for this emerging group of users. However, by the mid-1990s there was a strong perception of need for more bike trail mileage.

While a significant amount of biking was being done on the Fants Grove Area during this period, the existing trail system apparently offered sufficient accommodations. However, the Issaqueena area became a much different scenario. The Issaqueena was popular with the bike interests from the beginning of this type of use. Given the factors of a "follow the leader tendency", the convenience of location, and a terrain that best suited the sport, Issaqueena quickly evolved into the center of mountain bike activity in the South Carolina Upstate region.

There are currently approximately 47 miles of trail on the Issaqueena Area. Of this mileage, Mr. Ian Davidson estimated that mountain bikers had installed about 30 miles since 1996 (personal communication). He further estimated that about 75 percent of this mileage was on old logging roads and skid trails. By his measurements (presumably for event purposes) 28.5 miles of these trails were located on the south side of East Dam Road. The installation of these trails was done with the cooperation of Mr. Knight Cox, CEF Research Specialist.

The Todds Creek Area with about 18.5 miles of trails is the only area that remains primarily in horse use. As on the other areas, these trails primarily originated on old abandoned farm and logging roads. Mr. Melvin Maw whose family for generations has lived in, owned, and farmed substantial portions of the area surrounding the Todds Creek Area of the CEF was responsible for the installation of much of this mileage and continues to be a primary user of these trails.

Current CEF Trail System

The currently existing trail system was entirely remapped during the period from late November 1999 through February 2000. The remapping was done by Dr. Gene Wood using current Global Positioning System (GPS) technology. Field data were then plotted on existing Geographic Information Maps (GIS) of the CEF. These maps had color infrared aerial photo backgrounds that had been digitized and rectified by CEF personnel. These photos were produced under the National Aerial Photography Program (NAPP) under the supervision of the U.S. Geological Survey in 1994. This work was done by Mr. Knight Cox or personnel under his supervision. (See accompanying trail maps of Fants Grove, Issaqueena, and Todds Creek areas.)

Based on the most recent mapping efforts, it is estimated that there are approximately 109 miles of trails in the CEF Trail System. The Fants Grove Area contains 43 miles of shared-use (foot, bike, and horse traffic) and about one mile of foot traffic only. The foot-traffic only trails are at Treaty Oak and the George Aull Natural Area. Some trails in the northeast corner of the Fants Grove Area have been closed because of concerns for trail user safety during the hunting season on trails along or in close proximity to private property boundaries. An additional

reason for these closures is the prevention of trespass by CEF trail users that might stray on to neighboring private property. Further, some trails were either closed or re-routed for conservation purposes; the principal purpose being erosion control. However, in the final trail system on the Fants Grove Area, more trail mileage has been added than has been closed for any purpose.

The primary trailhead for the Fants Grove Trails is the Butch Kennedy Trailhead located on Woodburn Road and southeast of the T. Ed Garrison Arena. Additional trailheads with small parking areas are located along Fants Grove Road approximately 0.5 miles southeast of Fants Grove Church and at the intersection of Ridge and Fants Grove roads.

The Todds Creek Area contains approximately 18.5 miles of trails that are all currently shared-use. There is no existing trailhead for this area. This situation alone likely has tended to suppress its use except by neighboring property owners.

The Issaqueena Area contains approximately 47 miles of trails. All of these trails are currently shared use except for the 2.7 miles of Lake Trail that is currently restricted to foot and bike traffic only.

The entire CEF Trail System has numerous sites of historical and landscape aesthetic significance. In addition, some trail signage for educational purposes has been attempted in the past decade, but vandalism has foiled most of these efforts.

CHAPTER 3. COLLABORATIVE ADAPTIVE MANAGEMENT

> ***Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.*** **– Margaret Mead**

In the U.S. Forest Service's forthcoming book, *Ecological Stewardship*, the co-authors of the "Adaptive Management" chapter[7] began with an appeal for *"partnerships for learning."* Adaptive management is primarily about designing one or more management strategies that use currently existing knowledge (science) to move management into the future while reserving the option to change strategies as the accumulation of knowledge in the future suggests a need for change, and how to change appropriately. Adaptive management recognizes that there are large amounts of uncertainty in ecosystems because ecological conditions are constantly changing. In addition, adaptive management recognizes that social values and economic values for ecosystems change, and that knowledge of ecosystems (ecological science) is constantly changing.

The National Environmental Policy Act of 1969 (NEPA) sought certainty in assurance that environmental quality would not be degraded as a consequence of any action of the federal government. The Act required all federal agencies to prepare either an "environmental assessment" or an "environmental impact statement" whenever an agency planned any action that might affect the human environment. Environmental effects included all aspects of impacts on natural resources. These evaluations had to review a reasonable array of alternative approaches that might be used to achieve some management goal, the predicted

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[7] **Bormann, B.T. et al. (in press). Adaptive management. in N.C. Johnson et al. , *Ecological Stewardship: A Common Reference for Ecosystem Management*. Elsevier, Amsterdam.**

impacts of each alternative, and a defense of why a particular alternative was chosen. All predicted adverse environmental effects had to be avoided or minimized and mitigated.

Almost 30 years of experience with NEPA in natural resource management has clearly demonstrated that, while well intended, the Act required a level of certainty that simply could not be attained within the realm of practicability for most of the national landscape. In addition, NEPA has provided enormous opportunities for litigation against federal land management agencies when they chose to implement some strategy that some citizen or citizen's group adamantly opposed. This approach to natural resource management which has entailed having agency officials prepare a plan, and then, as required by law, ask the citizens to find fault with that plan has not worked well. The citizens have always found a great deal of fault. To the extent that it has worked, the process has been referred to as a "zero sum game," i.e., some interests have "won big" while the rest have "lost big."

Adaptive management begins by inverting the traditional NEPA approach. *Stakeholders* (citizens and citizen groups) come to the table with the *managers* and *scientists* and actively and meaningfully participate in the management planning process. They bring a vision of what they want the public lands and resources to be now and into the future. *Managers* and *scientists* learn from the vast array of values, ideas, and experiences (knowledge) of these *stakeholders* who in fact own the public lands and employ the managers and scientists. *Managers* share with the *citizens* and *scientists* their organizational skills, a knowledge of the legislative mandates for their agencies, and their knowledge of the current technology for implementing management strategies. *Scientists* inform *citizens* and *managers* of the best currently available knowledge. They also identify needs for new knowledge and how to obtain and transfer that information.

This approach to natural resource conservation is *grassroots conservation – a completely democratic, bottom-up process.* By inverting NEPA's traditional top-down scenario, which frequently ended in disharmony at best, and litigation at worst, now all parties are a part of creating the plan, therefore, all parties share the responsibility for whatever plan is created.

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There are many variants of adaptive management. These can be grouped into three primary categories: a) reactive, b) active and c) passive. Adaptive management in the *reactive mode* has been the traditional approach to most natural resource management. That is, do not fix it until it breaks. It involved no efforts to predict an oncoming break or nor any accumulation of knowledge of how to take evasive or preventive actions. Most management was crisis management. Crises could be composed of actual ecological breakdowns (e.g. endangerment of species), or

economic or political crises. In the reactive mode, natural resource management increasingly became management by the judicial system.

Adaptive management in the *active mode* is heavily based on the scientific approach to management. Stakeholders and mangers have some inputs, but in effect, scientists run the show. The value in this mode lies primarily in the fact that it accumulates scientific knowledge at a very rapid rate, and it might quickly implement the newest science. The CEF MARP is an example of an active adaptive management paradigm.

In order to carry out active mode adaptive management, several strategies aimed at reaching a common goal are pursued as experiments. The strategy that achieves the goal with the least costs in time, money and natural resources is taken to be the preferred strategy. The downside is that such experiments require large landscapes to accommodate more than one experimental approach, and these various approaches should be replicated. In addition, this approach tends to minimize citizen inputs.

The *passive mode* of adaptive management maximizes citizen inputs and does not require large landscapes. It is a more customized approach to management in that the focus is on one particular area and the socioeconomic and ecological forces surrounding that area. This approach begins by assembling the currently available scientific and management information. Based on that body of knowledge, two things are done: a) information needs for the planning process are identified, and b) a management strategy is devised as a first approximation of how things should be done. Included in the management strategy are: a) management processes, b) resource monitoring processes, and c) anticipatory research needs.

The management processes are based on the currently available scientific knowledge and management technology. Monitoring schemes are based on scientific knowledge and experience in working with the resource(s). Anticipatory research targets points where, if the management strategy is not working, failure is most likely. This research seeks to identify the problem before adverse changes are significant, and they contribute information for an adaptive change in the management process. By following this process, the highest assurances against adverse environmental impacts of a management action can be attained in a practicable manner.

Changing the management strategy is the process of taking a corrective action. The correction adapts the strategy to something more appropriate to the goals for the resource(s). The point at which a change is made is called the *trigger point*. It is effected by combining information from two sources: a) monitoring and b) research. The monitoring data inform the managers of the status of the resource(s). If an adverse change is taking place the data should reflect that change. Adverse change data suggest that either something that is being done is wrong, or that something that is not being done needs to be done. Research must produce the information on

the cause of the adverse change, and what would constitute an appropriate corrective action. That research may entail only the analysis and interpretation of the monitoring data, or it may entail full scale research efforts.

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Passive mode adaptive management that maximizes citizen involvement begins with the formation of a *planning team*. The planning team is composed of *stakeholder representatives*, *managers* and *scientists*. Stakeholder representatives *must represent a wide array of viewpoints* on the project. Managers of public lands must not attempt to take the "high-ground" except where limitations on their activities are prescribed by law or point of contract (e.g. deed covenant). It may be prudent for scientists to participate primarily in an advisory role.

The planning process must be completely democratic, and all points of view must be heard and considered. There can be no closed meetings; any citizen can participate. However, and very importantly, there probably should be stratification of the planning team. That is, members that represent organizations that will participate in the implementation of whatever plan is created should have greater influence than those who have no intention of bearing any part of the burden of implementation.

The first thing that stakeholders must do is to agree on how their interest group will be represented on a planning team. Unorganized interest groups must organize themselves and select a representative. When the planning team is assembled, the first thing that it must do is create a set of by-laws (sometimes called "articles of partnership") under which it will conduct the planning process. A key point in these by-laws will be team stratification for the voting process. Once the by-laws are formed, they should be ratified by the interest groups.

When beginning the planning process, the team must identify the management goals. Next it must identify what information will be needed to plan the management and monitoring processes. The third requirement will be to identify deficits in information that will have to be made up in the implementation process. Fourth, the team must identify anticipatory research priorities. Fifth, it must deal with the issues of funding and time budgets for management, monitoring and research. This is a difficult process, but in this process, everyone is learning from everyone else about natural resource management goals and what it takes to attain those goals. It is *first about partnerships in learning*.

The final act of the planning team should be to create an *oversight committee* for the implementation process. The composition of the advisory committee should be recommended by the planning team. Also, the process for collaboration and cooperation between the oversight committee and the primary implementation organization should be prescribed.

CHAPTER 4. THE CUEF TRAIL SYSTEM PLANNING TEAM

The beginning of collaborative adaptive management planning is the formation of a planning team. While a high level of knowledge of the management and ecology of the CEF already exists within the University, these scientists and managers can not see the trail system through the eyes of the trail users. Even though collaborative adaptive management planning (collaboration between managers and scientists) is possible without the users and other interested citizens involved, an important set of perspectives is missing when that route is followed. Furthermore an opportunity is missed for the scientists and managers to inform these people about management constraints and the reasons for those constraints. Also, the users of the resources miss an opportunity to inform each other and the professionals on their perspectives of management procedures and products.

The first step in developing a collaborative adaptive management team for the CEF Trail System was to hold a public meeting at the Strom Thurmond Institute on the Clemson campus on January 22, 1998. The purpose of the meeting was to announce that the University was getting ready to undertake the development of a management plan for the trail system. In addition, it was explained that this effort would actively engage input from a group of people who were not natural resource professionals, but who could represent interested trail users and others with an interest in the CEF.

The second step was to conduct a workshop on adaptive management to familiarize potential planning team members with principles that drive this concept. The workshop was hosted by the School of Natural Resources, Clemson University, and taught by Dr. Gene Wood, Professor of Forest Wildlife Ecology and Extension Trails Specialist. The workshop was held on a Saturday, and lasted all day. There were 33 people in attendance.

In addition to participation in the lecture portion of the workshop, participants were divided into three groups and each group was charged with the same three questions:

1. **How large should the planning team be?**
2. **What should the composition of the planning team be?**
3. **When do you want to begin the process?**

Workshop participants decided that the team should be composed of 15 people. The group chose an odd number out of concern for tied votes. Based on the user composition, they recommended the following mix of representatives: mountain bikes - 6, equestrians - 6, hunters – 1, adjacent landowners – 1, and plant protection interests – 1. The recommendation was to begin monthly meetings in July 1998.

Sixteen people submitted written applications for the 15 openings for membership on the planning team. The University made the selections and the first team meeting was held on July 14, 1998. The team immediately began work on preparing a set of operational by-laws to guide the planning process. These by-laws were called *Articles of Partnership* and are contained in Appendix A. Dr. Gene Wood was appointed by Dr. Allen Dunn, Director, School of Natural Resources to coordinate the planning process. A list of planning team participants is provided in Appendix Table A-1.

PART II. TRAIL SYSTEM MANAGEMENT

CHAPTER 5. TRAIL DESIGN / RE-DESIGN

Design

The design of the existing trail system is the product of an evolution in trail usage. The early equestrian users tended to follow the logging roads, skid trails, abandoned farm roads, and trails established in the early years (1930s) of the Clemson Community Conservation Project. New trails were established as riders became familiar with the Forest and began to connect trails into loops and to establish trails along the lakeshores for aesthetic experience reasons. Other trails were established by the Clemson University Pre-Vet Club as they marked routes that would accommodate their competitive trail events.

In the early establishment of CEF trails, the guiding principles were more or less:

1. **Go from Point A to Point B.**
2. **Follow a route that a horse can traverse.**
3. **Challenge the horse and rider.**
4. **Establish scenic routes convenient for pleasure riders and University laboratory classes.**

Some trails were established on the ground by "dead reckoning." Others were based on U.S. Geological Survey topographic maps with 40-foot contours.

These trails tended to be only mildly sensitive to the capacity of the land to support them. This problem became more acute as the intensity of use rapidly expanded during the 1990s. Erosion and improper stream crossings (no water quality protection) were the situations of concern. The trails that had followed old logging roads were following designs developed for moving logs with wheeled vehicles in

generally dry weather and for only a few weeks or months of temporary use. These roads tended to run along ridge crests and points. Where the trail was on a ridge crest, the compacted soil held water in place and these muddy paths tended to become ditches unless they had a natural stone base. Where the trail descended the point of a ridge, water ran straight down the trail and it soon became a ditch. Some of these ditches on ridge points reached depths of four to five feet.

Locations of stream crossings largely depended on the nature of the streambed. Crossings were located where a horse would not bog down in mud. However, it was not uncommon for these crossings to have fairly steep banks that with use became short gullies with the dislodged soil ending up in the stream.

The rise of mountain bike use on the Forest in the late 1980s and early 1990s was accompanied by bicyclist wanting trails that suited their needs for challenging, competitive riding. As with the equestrian use, most of the early bike trails simply followed logging roads, skid trails, and pre-existing horse and foot trails. In addition, an attempt was made to convert the Corps boundaries along the lake into trails. However, as use intensified there was an increase in demand for more trail mileage that was designed primarily for bikes.

Trails established by bike interests were designed for distance mileage and terrain challenge. They tended to be more sensitive to erosion problems than had equestrian trails, and because of the nature of bicycles, tended not to be a major problem at stream crossings. The main problem with bike trails designed with the distance goal being heavily weighted was that they ended up with patterns that were attractive to competitive biking only. That is, in order to maximize mileage, numerous loops were installed with the legs of the loops often being only a few yards apart. Such trails had no aesthetic appeal to either hikers or equestrians, and because of the nature of competitive equestrian events, they were of no value for those riders. On the other hand, these problems have been totally confined to the Issaqueena Area.

At present, the University has no plans to design new trails that would be additive to the existing 109-mile CEF Trail System in the immediate future. Any new trails will simply replace existing trails that might be closed for protection of human safety, conservation purposes, research plot protection, or prevention of trail users straying on to neighboring private lands. Although no plans exist for the immediate future, it is possible that some new trail mileage could be installed to accommodate trail research objectives of University research scientists.

Design With Inherent Values

Tremendous opportunities exist to educate the recreational trail users on ecological, historical, and management aspects of the CEF. These inherent values give a trail system potential for educational as well as recreational experiences. The following

are examples of educational opportunities within the current design of the CEF Trail System:

- **I. Fants Grove Area**
  - **A. Historical sites**
    1. **Treaty Oak Trail**
    2. **Woodburn Place**
    3. **Lead Line Trail**
    4. **Fants Grove School Spring**
    5. **Hopewell-Keowee Church**
    6. **Stone quarry sites**
    7. **Abandoned railroad bed**
  - **B. Ecological sites**
    1. **George Aull Natural Area Trail**
    2. **Premier cove hardwood site**
  - **C. Management sites**
    1. **Clemson Beaver Pond Leveler**
    2. **Longleaf pine plantation**
    3. **Loblolly pine seed orchard**
  - **D. Research sites**
    1. **Yellow poplar studies**
    2. **Hardwood silviculture studies**
    3. **Christmas tree plantation studies**
    4. **Watershed studies**
- **II. Issaqueena Area**
  - **A. Historical sites**
    1. **Issaqueena Dam and Lake**
    2. **Issaqueena Lake Trail**
    3. **Issaqueena Lake Road**
       a. **Holly Springs Picnic Area**
       b. **Indian Springs Picnic Area**
       c. **Wildcat Creek Picnic Area**
       d. **Willow Springs Picnic Area**
    4. **Issaqueena Bombing Range**
    5. **Issaqueena Firing Range**
    6. **Colhoun Cemetery**
  - **B. Ecological sites**
    1. **Old Six Mile Road Falls**

2. **Six Mile Creek Falls**

C. **Management sites**
   1. **Longleaf pine plantation**
   2. **White pine plantations**

D. **Research sites**
   1. **Water monitoring weirs**
   2. **Yellow poplar studies**
   3. **Fire effects studies**

III. **Todds Creek Area**

A. **Historical sites**
   1. **Todds Creek Mill and Spring Site**
   2. **Todds Creek Dam**
   3. **Midwife House Site**

B. **Ecological sites**
   1. **Todds Creek Falls**
   2. **Waldrop Falls**

C. **Management sites**
   1. **Slash pine plantation**

Design/Re-Design Considerations for Ecosystem Protection

The primary design problem for trail systems is the prevention and minimization of soil erosion. Soil erosion is a process of ecosystem degradation characterized by deterioration of site productivity, water quality, and trail aesthetic value. In addition to ecosystem value problems, heavily eroded trails can pose user safety issues, and require a high level of maintenance investment.

Soil-Slope Conditions

The soils of the CEF are, in general, highly erodable. The predominate soil texture classes are sandy clays and clays[8]. Over most of the Forest, the original A horizon (topsoil) was washed away during the period of over-cropping and over-grazing. Under the current forest cover conditions, the A horizon is slowly rebuilding as

[8] The currently predominate clay and sandy clay surface soils appears to contradict existing soil maps that describe the surface textures as loams and clay loams. However, the current surface soils are the exposed lower horizons as a result of past erosion.

organic matter from tree litter accumulates and the biological, physical, and chemical processes return to the ecosystem.

The creation of a trail tread interrupts this process of soil profile rebuilding. Unless the soil contains large amounts of gravel or stone, the tread becomes compacted. Compaction lowers the amount of pore space in the soil thus downward movement (percolation) of water through the soil is impeded. At this point there are three remaining possibilities for water movement. The most desirable is for it to move to the side of and away from the trail. Such movement will leave the tread generally intact. The second is for it to run along the slope of the trail. Such movement erodes the tread as the volume of water increases with distance and the soil particle content increases thus scouring the tread like liquid sandpaper. The third possibility occurs in depressions where the water can not drain away from the site thus it accumulates to create a mud hole. Trail traffic through this mud hole will continue to deepen and widen it as the natural soil structure is destroyed to a greater depth and soil is removed from the site on hooves of horses or on bike tires.

The CEF trail system currently occurs in Anderson and Pickens counties. Soils maps for these counties were last issued for Anderson County in 1979 and for Pickens County in 1972. The soils on which the CEF Trail System lies are characterized as follows:

Fants Grove Area[9]

The Anderson County map shows that the trails on the Fants Grove Area lie primarily on the Cecil-Pacolet and Cecil-Hiwassee-Madison soil associations. East of Eighteen Mile Creek the Cecil series is totally dominant. "Cecil soils are deep, well-drained [vertical drainage through the soil profile], and gently sloping to steeply sloping. The gently sloping soils are on broad ridges. The strongly sloping soils are adjacent to drainageways. The surface layer is typically brown sandy loam. In eroded areas, it is red or yellowish red clay."[10] According to the soil map, the Cecil textures appear to be primarily sandy loams on slopes that range from 6 to 15 percent with about half of these being on slopes of 10-15 percent.

There are several Pacolet[11] soil sites of significant size in this area. These soils are yellowish brown sandy loams in the surface layer and grade to red clay and red clay loams in the lower horizons. They lie on slopes that typically range from 15-40 percent. These are obviously highly erodable conditions and great caution should be used when designing or re-designing trails that lie on them.

[9] USDA-Soil Conservation Service. 1979. Soil Survey of Anderson County, South Carolina. (see map sheets No. 15 and No. 16.)
[10] op. cit. page 3
[11] op. cit. pages 14-15

West of Eighteen Mile Creek, the soils of the Cecil and Pacolet series grade into the Madison[12] series that is predominate along Lake Hartwell. The textures are predominately sandy loams on gentle (6-10 percent) to steep (10-25 percent) slopes. The non-eroded surface soils are reddish brown in color and grade to red clay and red clay loams in the lower horizons.

Issaqueena Area[13]
The soils of this area are of the Cecil-Madison-Pacolet Soil Association. This association is characterized as being well drained with a "dominantly clayey subsoil", and located on steep to very steep slopes.

For purposes of soil map description, the Issaqueena Area can be divided into three sub-areas. The first is on the east side, and it is bounded by Old Six Mile Road and Highway 133. The soils of this area are almost entirely of the Cecil and Pacolet series. They are moderately to steeply sloped and highly eroded from past land management practices.

The second sub-area includes everything south of East Dam Road and west of Old Six Mile Road. Madison and Pacolet series are predominate with significant amounts of Hiwassee. The Hiwassee soils, where the surface horizon is intact, are a dusty red sandy loam. The lower horizons are a dark-red sandy clay loam in the upper part and dark red clay overlying a clay loam in the lower portion. Where they occur these soils are on moderate to steep slopes and are typically eroded to strongly eroded. The Madison soils of this sub-area are on moderate to steep slopes and are almost always eroded. The Pacolets are strongly to very steeply sloped (10-80%).

The rest of the Issaqueena Area is dominated by Madison sandy loams with significant amounts of Madison clay loams on moderate to steep slopes (6-25 percent). An exception is the section between the lower portion of Issaqueena Lake and Highway 183 where the Pacolets on steep to very steep slopes become predominant.

Todds Creek[13]
The Todds Creek trails lie almost entirely on Pacolet fine sandy loams and clay loams that are on moderate to steep (10-40 percent) slopes and eroded. Some are highly eroded. Trail design and redesign in this area must involve a great deal of serpentening in order to minimize erosion problems.

[12] op. cit. pages 13-14
[13] USDA-Soil Conservation Service. 1972. Soil Survey of Pickens County, South Carolina. (see soil map sheets No. 36 and No. 40)

Water Quality

The protection of water quality becomes an issue wherever trails approach or cross streams. By far the greatest cause for concern is the erosion of stream banks which results in abnormal sedimentation of the streambed. In addition, the disturbance of the stream bottom at the crossing may also cause abnormal changes in the physical structure and biological functioning of the streambed. The final significant cause for concern is the possibility of stream contamination with potentially disease-causing organisms associated with horse excrements.

Essentially all stream banks on the CEF are prone to erosion. Almost all of the stream crossings are on first and second order streams, and these streams are typically in a continuous process of cutting downward until they reach bedrock. Streamside zones that are on Pacolet soils on steep slopes will need the greatest protection and should be avoided whenever practicable. Wherever possible, the trail design should seek stream-crossing approaches that have gentle slopes. Some slope is preferred so that the water is carried away from the trail and the creation of a bog at or near the stream banks is prevented. The trail will need to be serpentined as it approaches the stream bank in order to prevent soil that is dislodged from the trail being directly washed into the stream.

Stream bank slope and height also must be considered. Sloped banks are preferred to vertical banks, and the lower the slope the better. High banks should be avoided. As the bank height increases, the amount of soil that will be washed into the stream will increase.

Whenever possible, crossings should be located along fairly straight sections of the stream. Water swirls at stream bends, and it is always eroding the bank against which it is swirling. Attempting to create a crossing in these situations aggravates and accelerates the erosion process at the site.

Stream crossings should be on firm streambeds. Bedrock is of course best when such a situation is available. Rocky streambeds are next in preference followed by those that are gravel. However, as the size of the stones decreases the amount of disturbance caused will increase. Abnormal changes in the distribution of particle sizes on these streambeds may have adverse effects on benthic (bottom dwelling) stream organisms.

Natural, firm sand streambeds may be used, but even these are easily and adversely changed. Silt and clay streambeds should be avoided. Recently deposited alluvial sand, silt and clay, such as near beaver dams and lake-edges, must be avoided as they have little capacity to support weight.

Finally, the issue of horse excrements introducing potentially disease-causing organisms to the streams has to be addressed. The two organisms of greatest concern have been *Crytosporidium* spp. and *Giardia* spp. Studies in the West have

suggested that there is little need for concern for potential introduction of these organisms into wild environments via horse excrement. Furthermore, even if such a happening should occur, the magnitude of the introduction would be so low it would be highly unlikely to cause a threat to human health.[14, 15] Nevertheless, this issue must be considered in trail design.

Plant Communities

There are two main areas of concern for the effects of trail systems on natural plant communities and plantings such as forest plantations and wildlife food plots: 1) direct damage to plants, 2) introduction of exotic species.

Direct Plant Damage

Most direct damage to plants will be caused by horses grazing on grasses and herbs or browsing on trees and shrubs or chewing on boles of trees. It is impossible to eliminate the effects of horses occasionally nipping at branches of trees and shrubs along the trail. On the CEF, unless research plots or some rare specimen of a species is located on the trail, this effect is of no significant ecological consequence. Where there are research plots or plant specimens of concern, the trail needs to be designed or re-designed to avoid these situations.

Horses chewing the bark from tree boles is a highly undesirable situation and should be avoided by regulations against tying horses to trees at all locations on the Forest. The adverse effects are primarily of an aesthetic nature, although chronic damage results in death of most trees.

Another form of direct damage that occurs to some extent on the CEF is root damage to shallow rooted trees and shrubs.[16] This problem can also be avoided by designing or re-designing trails to avoid very shallow soils with significant amounts of shallow rooted species. It can also be minimized by regulating against tying horses to trees where they may paw and trample the area at the base of the tree.

The actual biological effects of trails that cross wildlife food plots has never been studied. However, it is obvious that trails that are heavily used have compacted

[14] Johnson, E., E.R. Atwill, M.E. Filkins, and J. Kalush. 1997. The prevalence of shedding of *Cryptosporidium* and *Giardia* spp. based on a single fecal sample collection from each of 91 horses used for backcountry recreation. J. Vet. Diagnos. Invest. 9:55-60

[15] Ford, K.N., et al. 1998. The prevalence of *Cryptosporidium*/*Giardia* in the trail horse population utilizing public lands. Proc. 15th Equine Nutri. Physiol. Symp. Pages 223-237.

[16] This is mainly a problem in higher elevation forests where shallow rooted white pine (*Pinus alba*) and hemlock (*Tsuga canadensis*) occur on shallow soils.

and sometimes eroded soils. These conditions certainly do not add to the value of the food plot, and are, at the very least, aesthetically distractive. Where trails and food plots intersect, the trail should be designed to go along the edge of the opening. Grazing on these food plots should be avoided to the extent practicable. Browsing on shrubs planted for wildlife food and cover must be avoided by design and by regulation.

The dispersion of seeds of exotic plants on the wheels, tires and other parts of bikes and motorized vehicles and in the digestive tracts of horses has been a problem of great concern in the West. However, in the eastern United States the problem has been minimal. On the CEF, we have as yet not experienced any problems with exotic pest plant problems that have been caused by the trail system and its use.

Effects on Snags

Dead trees standing on or near trails are typically considered a safety hazard and a trail maintenance problem. There is no way to design a trail to avoid standing dead trees in a forest. These trees should be accepted as part of the natural design of the forest and an important wildlife habitat component. This issue is addressed in the trail maintenance strategy.

Direct Effects on Wildlife

General

At the present time we have no reason to believe that there are any significant direct effects of trail systems or their use on either the vertebrate or invertebrate fauna of the CEF. There is one wading bird rookery that is located remote from the trail. Trail design/redesign should always avoid such wildlife areas. A good rule, which could have exceptions in the future, is that trail design/redesign should always avoid sensitive wildlife areas. However, if a member or members of a species should elect to carry out some portion of their life processes (basically reproduction, feeding, sheltering) on or near a currently existing and used trail, that trail will not be closed.

State or Federally Listed Threatened or Endangered Species

The Endangered Species Act of 1973 defines species as "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." At the present time, we have no knowledge of any adverse effect that the trail system might have on any of these species. Trail design/re-design will avoid sites occupied by these species, or other species that may be listed subsequent to the preparation of this plan.

Design/Re-Design for Safety Purposes

There are three main concerns in designing/re-designing for safety purposes: 1) highway situations, 2) trail hazards, and 3) trail traffic. These are addressed as follows:

Highway Situations

Where trails cross highways (hard surfaced roads) there may be significant potential for trail user – road vehicle collisions. This problem is least for hikers, significant for bicyclists (particularly during racing practice and events), and may be greatest for horsemen (particularly those in group-ride situations). Trail design/re-design should strive to locate crossings where there is at least a 200-foot sighting distance to either side of the trail.

In the same vein of concern for highway crossings are cases where the trail lies along a public road. There are four notable situations of this problem on the Fants Grove Area: 1) lower Twin Lakes Road, 2) several sections of Fants Grove Road, 3) Woodburn Road from the Arena to Eighteen Mile Creek, and 4) the east end of West Queen St. from the horse farm to Highway 76/ 28. All of these situations can and should be resolved by re-designing the trail to stay inside of the forest while paralleling the road.

Issaqueena has trails located along public roads in four situations: 1) Old Six Mile Road, 2) Lake Road, 3) West Dam Road, and 4) East Dam Road. Because of the interspersion of private lands along the road frontage of Old Six Mile Road, this problem can not be resolved with any practicability by re-design. With respect to the Lake Road situation, this road is the primary access to most of the Issaqueena trails open to horses. The fact that it is closed to vehicular traffic from November 1 through March 15 neutralizes some of the problem by regulation. Setting appropriately low speed limits for the rest of the year may be another regulation necessary to addressing this situation.

The West Dam Road is closed on the same schedule as Lake Road, but as the Lake Trail will be restricted to foot traffic only, this road should receive minimal use by horses and bikes, and then only as an in-back out access to the dam area.

East Dam Road is a unique situation on the Forest. It is a generally narrow, improved forest road that dead ends at the dam site, but it is open all year, and it receives a considerable amount of vehicular traffic throughout the year. As the Lake Trail will be restricted to foot traffic only, it may be desirable to design a trail that gives horse and pleasure bike traffic access to the dam site for aesthetic value purposes.

The Todds Creek Area has no trails that lie along highways, although the trail crosses Maw Bridge Road at one point. That crossing has a sighting distance to either side of the trail of at least 200 feet.

The Fants Grove Area is definitely the highest risk area with respect to trail-highway intersections that may be improved on, but can not be avoided. In addition, this area has mainly horse traffic and the road traffic is very substantial. One recent improvement was made by the Anderson County Highway Department which erected a number of roadside signs alerting motorists to the locations of horse crossings.

Trail Hazards

The main trail hazards that can be addressed by design/re-design are steep slopes and proximity to dangerous precipices. Unless they are following old logging roads and skid trails, trails crossing steep slopes tend to be very narrow and often can not accommodate users moving in opposite directions unless one party gets off of the trail. Where such trails are necessary, they usually should be designed for and restricted to one-way traffic. This will be particularly important for shared use trails. In most cases, these trails should prohibit either bikes or horses.

Dangerous precipices have developed near trails that approach the Lake Hartwell shoreline where the shore faces the prevailing winds (westerly) across major expanses of open water. Wave action undercuts the banks along these shores until the banks cave into the lake. These sites are unstable and unpredictable. Trail design/re-design should always keep the trail at least 100 feet back from such conditions.

Trail Traffic

Design/re-design to accommodate various trail traffic conditions is a problem for shared-use trails and trails that are expected to accommodate competition events and practicing for those events. Competition and practice for competition is a use dominated by the mountain bike enthusiasts, although practice for competitive horse trail events is significant. It is likely that at least 75 percent of the competitive mountain biking is done on the Issaqueena Area. In addition, at least half of the trail mileage on this area was developed by mountain bike use.

Therefore, all existing trails, south of Lake Issaqueena and the Lake Road will be closed to horse traffic. The Lake Trail will be restricted to foot traffic only. East Dam Road and Doyle Bottom Road will remain shared use trails with planning being done to develop an aesthetic value trail loop for horses along the ridge crest on the south side of Issaqueena Lake. In addition, a horse trail will be constructed to provide access from the parking area at the junction of East Dam Road and Old Six Mile Road to Lake Road.

Trailhead Location and Design

There are presently four trailheads on the Fants Grove Area, one on the Issaqueena Area, and none on the Todds Creek Area. Current design problems and new location and design plans are as follows:

Fants Grove Area

Butch Kennedy Trailhead
This trailhead is located near the southeast corner of the Garrison Arena. It is, and will continue to be, the primary trailhead for the Fants Grove trails. It has the following attributes:

1) **centrally located,**
2) **easily accessed,**
3) **terrain that accommodates parking of a large number of horse trailers,**
4) **excellent sighting distances where road crossings are required, and**
5) **opens to trails in four different directions.**

The only change planned for this trailhead is to reroute the entrance to the trail running along the stream on the south side. The entrance to this trail currently requires riders to go on to Woodburn Road, cross the stream over a road culvert, enter the woods and travel parallel to the stream, ford the stream, and then continue a westward movement. By accessing the trail directly from the trailhead parking area the safety concerns of traveling on Woodburn Road and the water quality protection and stream bank management problems at the fords will be eliminated.

A concern that may develop in the future is that of parking area design. At the present, parking is best described as "helter skelter". Because of the size of the area available for parking and the terrain, this has not been a problem; however, it is a situation that should be periodically reviewed.

Fants Grove Road
This is a relatively new trailhead, and one that has received very little use. It is located on Fants Grove Road approximately one mile from Fants Grove Church. Two major sections of the trail system may be accessed from this location. Where the trail crosses Fants Grove Road, the sighting distance is excellent. Parking space will accommodate eight to ten four-horse trailers. No changes are planned for this trailhead.

The Oaks
This trailhead is located at the junction of Ridge Road and Fants Grove Road. Historically, it likely was the first trailhead on this portion of the CEF (Butch

Kennedy, personal communication). This site provides access to trails in two directions. The parking area recently has been improved with a good gravel surface, although space is limited and might accommodate six to eight four horse trailers if parking was organized. There are no present plans to change this site.

Seed Orchard Road
This trailhead is located at the junction of Seed Orchard Road and Cherry Farm Road. It is usable for bike and foot traffic trail users only. It will accommodate a maximum of six vehicles. There are no plans to make major adjustments in this site in the near future.

In addition to the above listed trailheads, opportunities for parking near trail access sites are located along the western portion of the Starkey Swine Farm Road as well as in the area of the junction of Woodburn Road and Highway 28/76.

Issaqueena Area

The East Dam Road Trailhead is currently the only designated trailhead on the Issaqueena Area. Additional parking has been available throughout the year for vehicles without trailers at the end of East Dam Road. From March 15 to October 31, parking also has been available along Lake Road and at the end of West Dam Road.

East Dam Road
This trailhead is located at the junction of East Dam Road and Old Six Mile Road. The portion adjacent to Old Six Mile Road currently will accommodate about eight vehicles without trailers. The trailer parking area will accommodate 12 to 14 four-horse trailers.

There are several problems at this site. First, from November 1 through March 14 practically all trail traffic departs from this site. As a result of this crowding, the trail access points clustered around this trailhead suffer substantial over-use at a time of year when they are highly vulnerable to erosion.

Second, on the average weekend, the demand for parking spaces substantially exceeds availability. The overflow parking ends up on the sides of Old Six Mile Road or on East Dam Road. Roadside parking along Old Six Mile poses substantial safety risks and should be prohibited.

And third, while use of the Issaqueena Area is dominated by mountain bike interests, on the weekends it also receives high levels of horse use. Having both user groups using the same congested trailhead has led to user conflicts in a number of cases.

In order to alleviate some of these problems the following processes are planned:

1) **Immediately create a new trailhead for mountain bike enthusiasts only. This site will be located in the field adjacent to the Wildlife Research animal holding pens. These pens are not in use except for storage purposes. It is expected that it will be abandoned in the near future. Horse trailer parking at this trailhead will be prohibited.**

2) **Immediately expand opportunities for trailer parking at the East Dam Trailhead to accommodate at least 20 four-horse trailers. In addition, create a new trail from the trailhead to Lake Road for horse use only.**

3) **Immediately, prohibit horse trailer traffic on East Dam and West Dam roads. Close the parking areas at the ends of these roads to trailer parking and parking of vehicles carrying bicycles for trail use. (Trail access points at these sites will be restricted to foot traffic only.)**

4) **Immediately, create a controlled access point to the trails at Wildcat Creek. On the north side of the creek the Lake Road is wide enough to accommodate some roadside parking. (The current cable-and-post fence used to protect the picnic area has been recently modified to allow passage of horses but not vehicles.)**

5) **In the near future, locate a new shared-use trailhead on the west side of Issaqueena near Old Seneca Highway. This site should be open throughout the year. It should redistribute the pressure on the trails by transferring some of the trail traffic to the west side during the winter months. It should also provide access to the Keowee Area on the west side of Old Seneca Highway. At the present time, the Keowee Area has no approved trails, but it may have in the future. The most likely location for the new trailhead would be in the vicinity of the junction of the Old Bombing Range Road and Old Seneca Highway.**

Todds Creek

There are currently no opportunities for trail user parking on University lands on the Todds Creek Area. This situation has traditionally limited use of Todds Creek to local residents and their guests or customers in the cases of commercial establishments. A trailhead is planned for immediate establishment adjacent to Rt. 187 at a point approximately one-half mile southeast of the junction of Waldrop Road and Route 187. Parking at this trailhead will be designed for trailer parking as these trails will be restricted to horse and foot traffic only. Approximately 15–20 four-horse trailers should be accommodated at this site. As this will be the only access point to these trails for the near future, some re-design of trails in the vicinity of the trailhead will be required to accommodate the new intensity of traffic.

CHAPTER 6: RULES AND REGULATIONS

Once a trail system is established, its use must be regulated. The following regulatory objectives will be pursued on the CEF:

1) **Protect the natural and cultural assets of the trail system.**
2) **Protect the integrity of the goals of the trail system design.**
3) **Limit the types of use and use intensity to the capacity of the land to accommodate those uses and levels of use.**
4) **Maximize user benefits in appropriate (non-abusive) recreational use of the land while learning about the land and the human history on it.**
5) **Minimize user interactions that detract from the trail recreational and learning experience.**
6) **Prevent the use of the trail system from interfering with other established educational and research goals of the CEF.**

Trail Ethics and Etiquette

Ethics are principles that guide human behavior towards other humans and the land. These principles guide us in differentiating between what is appropriate and acceptable and what constitutes inappropriate and unacceptable behaviors; in short, what is right and what is wrong. We practice ethical behavior when we voluntarily restrain ourselves from actions that seem expedient, and possibly fun, at the time but that have longer range consequences of degradation either in human relationships or in the relationship between humans and the land.

The land ethic as authored by Aldo Leopold stated: "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise." In the regulation of the CEF trail system, this ethic will be the fundamental guideline for ecosystem protection. The ecological integrity of the CEF trail system will be protected by a rule set that will minimize and require mitigation of soil and plant damage. The stability of the system will be protected by limiting types and intensities of use to those that the system can sustain without

degradation of the landscape. Finally, beauty will be protected first by preventing damage to aesthetic qualities of the trail, and second, by promoting an appreciation of the full ecological dynamic with humans as ecosystem component and human activity as ecological process. [17]

In the concluding statements in his essay on land ethics, Leopold wrote: "The road to conservation is paved with good intentions that prove to be futile, or even dangerous, because they are devoid of critical understanding either of the land, or of economic land-use." The purpose of the CEF is to continuously promote our understanding of the land and its economic use to provide the forest products essential to the well being of society while conserving ecological integrity. Traditionally, we have done this through formal teaching, research, and outreach activities. In the future, the trail system will itself become an educational medium for learning about forest ecosystems and the human roles in them. It is the clear recognition that humans must look to the land to be fed, clothed and sheltered, as well as for a recreational experience, that commits us to an ethical relationship with it.

Etiquette is an expression of respect for people and for the land. Trail etiquette encompasses our actions as we interact with other trail users and how we treat the trail and the land on which it lies. Trail etiquette is driven by a desire to develop and maintain a harmonious relationship with the land and with others with whom we share it.

Rules of the Road

Most trail users are familiar with the standard trail sign signifying that hikers and bikers yield to horses and that bikers yield to hikers. While well intended, this sign should not take the place of common sense and common courtesy. For instance, it is obvious that there are very few places on the CEF where the equestrian can not more easily move his/her horse off the trail to give the right-of-way to one or more bicyclists or hikers than it would be to have them yield. There are, however, situations in which the terrain requires that for safety sake the equestrian be given the right-of-way.

When one trail user is overtaking another, the slower traffic must yield by moving a safe distance from the side of the trail. The overtaking traffic should give a clear, courteous warning that it is approaching, and desires to move ahead. Of course, a polite signal of appreciation for yielding should always be given.

The above descriptions are intended only to illustrate good trail manners. The number of combinations of trail user encounters is too great to attempt description

[17] For a thorough treatise on the proposition that land ethics are an extension of social ethics see Leopold, A. 1949. The land ethic. pages 237-264 in *A Sand County Almanac with Essays From Round River*. Ballantine Books, New York, N.Y. (copyright 1966)

and recommend appropriate procedures for each of them. However, there will be very few times when trail etiquette that will enhance good relationships among trail users will not be obvious to anyone attempting to be thoughtful and considerate.

Rules and Regulations: General

Application of Clemson University Campus Rules and Regulations: All users of the CEF and its trail system are the guests of Clemson University. The CEF is a portion of the Clemson University Campus. All rules and regulations that apply to the protection of the campus apply to the CEF Trail System.

Permitted Uses: Public use of the CEF trail system is *open only to use* by *hikers, bicyclists, and horseback riders*. *Except for official University use, motorized vehicles* of all kinds are *prohibited* on the trail system *except* for Ridge Road on the Fants Grove Area, and Lake Road (March 15 through October 31) and East Dam Road on the Issaqueena Area. These roads are open to the public at the discretion of the Forest Director. All motorized vehicles on these roads must be licensed and insured according to South Carolina law.

Designated Trail Use Only: *Bicyclists and horsemen must stay on designated trails*. The development of shortcuts, exploratory riding, and the creation of new trails are strictly prohibited. *All trails and roads are closed to trail traffic unless posted open*.

Dogs on CEF Trails: Dogs on leashes are permitted on the CEF Trail System. Dogs accompanying trail users but that are not on leash must be under demonstrable control of the trail user. Dog owners are completely responsible for the dog's behavior, well being, and the prevention of accidents involving other trail users. Free ranging dogs are prohibited, and their owners will be subject to laws governing use of South Carolina game management areas.

No Camping on the CEF: No camping is permitted on the CEF except as permitted by the Forest Director for special use.

Open Fires Prohibited: No open fires are allowed on the CEF except for normal cooking fires at designated picnic areas and facilities.

Littering Prohibited: Littering of any portion of the CEF, including its trail system, is strictly prohibited. Littering is the most insidious and pervasive problem confronting management of this trail system. Trail users are encouraged to police themselves to prevent littering. Where individuals are deliberately degrading the trails by littering, they should be reported to the CEF Office and the Clemson University Campus Police, or other appropriate law enforcement agency for legal action.

Simple etiquette requires that if you hauled it in, then haul it out. Littering is a personal behavior characteristic that can be changed by conscientious thinking. ***Respect the land and those who share it with you.***

Alcoholic Beverages Prohibited: Clemson University regulations restrict use of alcoholic beverages to officially permitted and designated areas. Other state and county laws also control use of alcoholic beverages. ***The CEF Trail System is not a permitted area for alcoholic beverage use.***

Parking: Parking on the CEF to access the trail system is restricted to designated trailheads and other incidental opportunities along Lake Road on the Issaqueena Area and Ridge Road on the Fants Grove Area. ***Roadside parking must not create a traffic hazard. Parking in a manner that would interfere with official access to gated roads is strictly prohibited.***

Trail Closures: Clemson University officials may at their sole discretion close temporarily or permanently any portion of the CEF Trail System for, but not limited to, the protection of natural and cultural resources, or education and research activities, or for human safety reasons. Due to concern for human safety, all ***Fants Grove Area trails will be closed during the periods of gun hunts for deer on the Fants Grove Game Management Area.***

Limits on Trail Use: Clemson University officials may at their sole discretion limit the types, intensity, time periods, and the duration of use of any portion of the CEF Trail System for, but not limited to, the protection of natural and cultural resources, or education and research processes, or for human safety reasons.

Vandalism: Vandalism of any portion or component of the CEF, including any aspect of the trail system, is prohibited. Examples of vandalism include but are not limited to the willful and purposeful degradation and/or destruction of roads, trails, buildings and other facilities, signs, barricades and natural and cultural features of the forest and its trail system. ***A $500 reward will be paid by Clemson University for evidence leading to the arrest and conviction of anyone involved in acts of vandalism on the CEF.***

Rules and Regulations: Bicyclists

Clemson University Liability: Clemson University disclaims any and all liability for accidents associated with the use of bicycles on the CEF. The University assumes that all participants involved in the use of bicycles on forest roads and trails understand and accept that, by their very nature, such activities inherently involve substantial risks and that the participants accept personal responsibility for their own well being in the face of such risks.

Type of Bicyclists: Bicyclists will be divided into two groups for purposes of rules, regulations and suggested procedures for trail use: 1) pleasure riders, and 2) competition riders. Pleasure riders are those who are riding strictly for pleasure, exercise and general enjoyment of the trail and the landscape on which they ride. They are not riding competitively either with themselves or with others, nor are they practicing for competitive events. In comparison, competition riders are those who are focused on competition goals and who are engaged in attaining those goals or practicing to attain those goals. (*Note: The above definitions apply to the activity being conducted by any person at a given time on a given portion of the CEF. They have nothing to do with defining a particular person who engages either primarily or secondarily in one activity or another*.)

These riders are very different in their behaviors, impacts on trails, and expectations for the trail experience. It is therefore desirable to separate them in the regulatory process.

Pleasure Bicyclists

Trail Availability: All designated shared-use trails are available to pleasure bicyclists. Trails designated for bicycle use only are intended primarily for competition users although the pleasure bicyclists may use them with discretion. The pleasure rider must always yield the right-of-way to the competition rider. Trails designated for bicycle use only will be closed to pleasure riders during competitive events. The pleasure rider should become familiar with the times that the designated bike trails are being used heavily by competitive riders and avoid those trails at those times.

Safety Equipment: All bicyclists will be required to wear safety helmets when riding on CEF trails.

Competition Bicyclists

Trail Availability: Competition riding practice will be restricted to two locations. On the Issaqueena Area, the trails restricted to bicycle and foot traffic and the shared use trails south of Lake Road will be the only location available for competition bicycling on the North Forest. There are a total of 25 miles of trail available at this location for this activity. (This accounts for 53.1 percent of the total Issaqueena trail mileage.)

On the Fants Grove Area, competition riding practice will be allowed Monday through Friday *except* on the area bounded by Seed Orchard Road to the south, Cherry Road to the East, and Lake Hartwell to the north and west where no competition riding will be allowed.[18] Competition riding practice will be prohibited on the entire Fants Grove Area on Saturday and Sunday.

[18] There are 3.5 miles of trail in this portion of the Fants Grove Area, which accounts for 8.0 percent of the total Fants Grove trail mileage (44 miles).

Safety Equipment: All bicyclists will be required to wear safety helmets when riding on CEF trails.

Rules and Regulations: Equestrians

Current Coggins Test Required: *All horses* being brought to the CEF *must have with them a current Coggins Test document* that demonstrates that the horse has been tested within the previous 12 months, and that the test was negative. Any Clemson University official or University designated representative may request the presentation of Coggins Test papers. Horses that do not have a current Coggins Test document will be denied entry to the CEF, and must immediately leave Clemson University property.

South Carolina Equine Liability Immunity Act: Clemson University disclaims any and all liability for accidents associated with equine activities on the CEF under the protection afforded by Article 7, Chapter 9 of Title 47, Code of Laws of South Carolina, 1976.

In compliance with this Act, signs following the specifications stated in Section 47-9-730 will be placed at the following trailheads: 1) Butch Kennedy Trailhead, Fants Grove Area; 2) East Dam Road Trailhead, Issaqueena Area; 3) Wildcat Creek roadside parking location, Issaqueena Area, and 4) Todds Creek Trailhead, Todds Creek Area.

Tying Horses to Trees Prohibited: The tying of horses directly to trees for any purpose other than in the case of an accident resulting in a human being seriously injured, is strictly prohibited. Horses will chew on trees out of boredom, and create severely trampled areas around the base of the tree. The aesthetic qualities of these trees are degraded. Many ultimately die as a result of the damage.

At trailheads and other parking sites, horses must be tied to trailers or to picket lines or high lines that may be attached to trees in a manner that prevents damage to trees.

Tying Horses On or Immediately Adjacent to Trails Prohibited: The tying of horses to trees or other vegetation on or immediately adjacent to trails is strictly prohibited. Horses being tied while out on the trail must be tied to picket lines or high lines that are located at least 15 feet from the edge of the trail. These lines should be arranged so that damage to trees is avoided, and damage to other vegetation is minimized.

In addition, to the extent practicable, it would be wise to tie horses facing the trail so that the hindquarters are a maximum distance from the trail, and the horses have full view of passers-by. This procedure should minimize the probability that the

horse will be startled by other trail traffic. It is, of course, recognized that the horses will tend to move around, particularly under a highline.

Types of Equestrian Users: Equestrian trail users will be divided into the same activity-type groups as the bicyclists, and using the same definitions and rationale for separation.

Pleasure Riders

Trail Availability: All designated shared-use trails are available to pleasure riders. Trails designated for equestrian use only (Todds Creek Area) are intended primarily for pleasure riders although these trails will be shared with competition riders Monday through Saturday. Pleasure riders must yield the right-of-way to competition riders.

Shared use and equestrian use only trails that occasionally may be used for equestrian competitive events will be closed to all other bicycle and equestrian use during the time of the event.

Competition Riders

Trail Availability: With the exceptions listed below, all shared-use trails will be open to equestrian competition trail riding practice Monday through Saturday of each week. Pleasure riders will yield the right-of-way to competition riders on these trails.

Exceptions: Equestrian competition trail riding practice will be prohibited on the entire CEF Trail System on Sundays except for the portion of the Fants Grove Area east of Eighteen Mile Creek. This activity is prohibited at all times on the portion of the Fants Grove Area bounded by Seed Orchard Road to the south, Cherry Road to the East, and Lake Hartwell to the north and west.

Rules and Regulations: Right-of-Way to the Trail

As discussed earlier, common sense and common courtesy should guide resolution to most right-of-way questions on the trail. When these processes seem to be insufficient, the standard rule that bikes and hikers will yield to horses, and hikers will yield to bikes will be applied. However, when bikes or foot traffic (e.g. joggers) are overtaking horses, horses must yield by moving a safe distance from the trail to allow passing. A good practice for the trail user will be to *think ahead and be prepared*.

Monday through Friday on most shared use trails it will be possible for competition bicyclists and competition equestrians to encounter each other. The best course of action is to think ahead about such encounters, and plan for maneuvers that may be appropriate. Otherwise, the following rule will be in effect: If the two users are

approaching each other, the bike will move off of the trail. If one user is overtaking the other, the user being overtaken will move a safe distance from the trail to prevent an accident that may be initiated by a startled horse. In an event where one user is overtaking another, the party approaching from behind has the responsibility to give a clear signal from a safe distance that he/she is approaching and expects to pass.

Permits

Event Permits

An event is *defined* as any group-organized activity that involves 20 or more people in the group of participants. All events must be permitted and scheduled at least 30 days prior to the expected date of the activity. Permit applications for events must be filed with the Clemson Experimental Forest Office, Lehotsky Hall, Clemson University.

If the activity is permitted, the organizing group must sign a legally binding contract that specifies: 1) the permit fees and any other remuneration that will be paid to Clemson University; 2) the group's responsibilities for safety precautions, 3) emergency care of participants, 4) site clean-up, and 5) any other stipulations which the Forest Director may deem appropriate. (See the Event Permit Application Form in Appendix B.)

Finally, the Forest Director may, at his discretion and for the protection of natural and cultural features of the CEF or for the protection of human safety, cancel any permit granted for an event.

Annual Family and Individual User Permits

Annual family or individual user permits will be required of all bicycle and equestrian trail users. The purposes of these permits will be as follows:

1. **Give the University information on the numbers of people using the CEF trail system, who they are, and where they are coming from in order to access these trails.**
2. **Allow the University to completely inform the trail users about the trail system, and the rules and regulations that limit its availability and use.**
3. **Minimize the probability that users will unknowingly involve themselves in any activities that conflict with those of other users of the CEF.**
4. **Minimize the potential for users to unknowingly involve themselves in violations of the rules and regulations related to use of the CEF trail system and thus risk becoming involved in some legal action that could be taken by the University.**

5. **Help maximize the protection of the natural and cultural resources of the CEF while providing opportunities for trail recreational activities.**

Family Permits: A family permit will cover all of the members of a family living at the same home address. It will also cover one guest per family member and accompanied by a family member on any given trail outing. The family permit must be in possession of a family member present and involved in the outing on that day.

Any person officially designated to represent Clemson University on this matter or other law enforcement agency officials may request presentation of the user's CEF trail permit. Those who do not comply will be directed to leave the trail system. They will also be issued a trespass warning, and directed to refrain from using the trail system until they are in possession of the appropriate permit. Failure to comply with these directions will be a violation of South Carolina trespass law.

Family Permit Fee: The family permit fee will be $20.00 per year. Permits will be valid for one year beginning July 1 and ending the following June 30. Permits will be available from the T. Ed Garrison Arena at Clemson University, the CEF website, and designated local vendors.

Individual Permits: Individual permits will cover the person to whom the permit has been issued and two individual guests on any given occasion. The individual must be in possession of the permit when on the CEF trails. The individual must be in the company of anyone that is his/her guest on the trail system.

Any person officially designated to represent Clemson University on this matter or other law enforcement agency officials may request presentation of the user's CEF trail permit. Those who do not comply will be directed to leave the trail system. They will also be issued a trespass warning, and directed to refrain from using the trail system until they are in possession of the appropriate permit. Failure to comply with these directions will be a violation of South Carolina trespass law.

Individual Permit Fee: The individual permit fee will be $15.00 per year. Permits will be valid for one year beginning July 1 and ending the following June 30. Permits will be available from the T. Ed Garrison Arena at Clemson University, the CEF website, and designated local vendors.

Initiation of the Permit Fee System: The permit fee system will be initiated on July 1, 2001. Permits will go on sale on May 1, 2001.

Informational Materials Accompanying Permits: Accompanying each permit will be current maps of the CEF trail system, and the rules and regulations for use of the trail system as they apply to the particular year covered by the permit.

CHAPTER 7. TRAIL MAINTENANCE

Goals

Trail maintenance goals will be to:

1) **enhance safety of trail users,**
2) **minimize and mitigate the effects of trail traffic on the trail tread,**
3) **prevent or minimize adverse effects of trail use on natural and cultural features of the CEF, and**
4) **maintain the aesthetic qualities of the trail.**

There are seven primary maintenance problems that must be addressed in order to achieve these goals:

1) **trail tread erosion,**
2) **effects of stream crossings on water quality,**
3) **persistent mud holes or bog areas,**
4) **encroachment on trail space by living vegetation,**
5) **fallen trees on the trail,**
6) **damage to CEF signs, barricades, and facilities, and**
7) **litter left by trail users.**

Determination of Maintenance Needs

There will be two methods of detecting trail maintenance needs: 1) reports of problems that are made to the CEF Office by trail users, and 2) periodically conducted surveys of trail and trailhead conditions that are made by University personnel. Trail users will be informed by trailhead signage, as well as in written information received with the trail use permit, that they should report maintenance

problems to the CEF Office either in person, by letter, by phone, or by e-mail. The importance of reporting safety hazards on the trail will be stressed. CEF personnel will visit the reported site as soon as it is practicable, assess the problem, and make a determination of what needs to be done and the earliest possible date that the problem can be resolved. A log will be kept by the CEF Office showing maintenance needs reported, actions taken, and dates of actions taken that addressed the report.

Trailheads will be checked biweekly by CEF personnel for safety hazards, litter accumulation, and University property damage.

The entire trail system will be surveyed semi-annually by University personnel or selected trail volunteers for maintenance needs. One survey will be done in the spring and another in the fall. Records of the results of these surveys will be maintained in the CEF Office. Personnel doing trail maintenance surveys may travel on foot, by bicycle, or on horseback on all trails except for trails on sensitive sites as designated by the Forest Director. Standard report forms to be used for trail surveys will be devised by the CEF managers.

Accomplishing Trail Maintenance

CEF Management Crew

The CEF Forest Management crew will do all work that requires the operation of heavy equipment. Exceptions may be made by the Forest Director after due consideration of safety and liability issues.

Volunteer Groups

Most of the trail maintenance efforts will be labor intensive. Volunteer groups of trail users working under University personnel supervision will be asked to supply a great deal of this labor. University personnel will coordinate with volunteer group leaders to schedule workdays that are mutually convenient. Volunteers will not be allowed to use motor powered equipment, e.g. chainsaws, brush cutters, etc., without prior approval of CEF managers. (Also see Chapter 8 for guidelines for volunteer services on the CEF Trail System.)

University Student Labor

The University will employ student-labor for CEF trails work as funds become available for specific projects.

Maintenance Standards

Trail Tread

Maintenance standard: ***To the maximum extent practicable, keep the water off the trail.***

Two problems plague the trail tread – erosion and natural or created bog areas. To the extent practicable, erosion processes will be prevented by appropriate installation and maintenance of water bars. In addition, when practicable, where the trail is unavoidably predisposed to erosion, gullying will be mitigated by creating a tread of gravel. Chronically severe erosion problems will require assessment for either trail re-routing, limitations on use, or closure.

Natural bog areas in low-lying terrain should be avoided in the trail design/redesign considerations. However, it is not unusual for a trail to cross sites that have perched water tables. This situation occurs due to an anomaly in the soil horizons where a dense layer of soil occurs at a shallow depth in the soil profile. This dense layer, largely of clay texture (often referred to as a hardpan), prevents vertical drainage of the water, thus causing the horizon above it to become saturated. Often this saturated condition is seasonal. If the trail is installed during a dry time of the year, the potential for a bog condition may go undetected.

Once a natural bog spot is detected the first consideration that should be made is for re-routing. If re-routing is not desirable, then the use of geotextile material with gravel should be installed. A third possibility to consider would be the installation of drain tile if the terrain will accommodate this procedure.

Mud holes are bogs created by human manipulation of the soil surface. Due to the texture of the soil, vertical drainage of water is greatly impeded, and the geometry of the soil surface layer is such that the water can not escape the microsite by surface drainage. These holes tend to become wider and deeper over time if trail traffic continues through them. Horses remove large amounts of soil that is stuck to their hooves. Bicycle wheels also remove substantial amounts of soil. In addition, the more the mud is stirred by trail traffic, the longer it takes for the soil to dry, and the amount of soil structure destruction is greater.

Where unavoidable depressions occur in the trail, they should be filled with gravel or have geotextile material with gravel installed as soon as possible. Appropriate ditching or drain tile installation are additional considerations that are dependent upon the nature of the surrounding terrain.

Trail Vegetation Management

The CEF trail system has an inherent range of spatial (width and height dimensions) that include improved and maintained roads, woods roads that are not maintained, logging skid trails, and true woods trails. Vegetation management is a trail maintenance consideration in all but the first listed of these situations.

Maintenance standard: ***Vegetative growth that can be reasonably considered as an interference with normal trail use by hikers, bicyclists, and equestrians will be appropriately removed or pruned back to a minimum distance of 3 feet to either side of the trail centerline. In addition, vegetation interfering with safe trail use will be removed or pruned to a height of 10 feet.***

Falling or Fallen Trees

Maintenance standard: ***To the extent practicable, the trails will be kept free of these obstacles.***

Trees that have been wind thrown and large limbs of trees that have been broken by storm or ice damage pose significant safety hazards if they are hanging over trails. Trails will be cleared of these hazards as soon as is practicable following reports of these situations.

Trees and large limbs that that have fallen across trails pose safety hazards, interfere with normal trail usage, and cause unplanned trail re-routing by trail users. Trails will be cleared of these obstacles as soon as is practicable following reports of the situation. ***Special exceptions may be made*** **at the discretion of the CEF managers for the trails designated for mountain bike use only if these users should make such a request for the sake of creating trail obstacles that contribute to their sport.**

Stream Crossings

Maintenance standard: ***Stream sedimentation that results from trail crossings will be prevented wherever practicable, and otherwise minimized to the extent possible.***

The primary adverse effect that trails might have on streams is as a sedimentation source. CEF trail system design/redesign will be the most important preventive measure against stream sedimentation. Incorporating stream bridging in the trail design would be an example of prevention by design.

Where the trail must cross a stream without the benefits of a bridge, stream bank and streambed conditions must be carefully considered and managed. The stability of the stream banks where the trail enters and exits the stream must be developed

and maintained. These edges can be a constant source for sedimentation. Maintenance will include appropriate placement of riprap, logs, sawn timbers, or geotextile material that will be required to prevent trail bank and stream bank erosion. Protection will be given to natural trailside vegetation to help keep sediments out of streams.

Wherever possible, the trail should be designed to cross streams where the streambeds are bedrock, rocky, or gravelly. Streambeds should be sufficiently firm to support the weight of a horse without any miring. Where streambeds are insufficiently firm to prevent miring, a geotextile material will be installed and maintained.

All stream crossings will be considered as sensitive sites whether the stream is permanent or intermittent.

Signage

Maintenance standard: ***Trail and trailhead signage will be maintained in as good of a condition as is practicable.***

It is anticipated that vandalism will be the primary problem in maintaining trail and trailhead signage. Further, it is expected that the problems at trailheads will be greater than at remote locations on trails. Maintenance of signage may have to be prioritized. If this is the case, signage related to safety measures will have the highest priority followed by information on trail use regulations, trail names, educational information, and other general information (e.g. distances to given points).

Unless otherwise excepted by the Forest Director, all signage will be built and repaired by the CEF crew. Volunteers may be sought to retrieve damaged signs and replace them. All signage will conform to CEF signage standards as determined by the Forest Director.

Litter Control

Maintenance Standard: ***All trails and trailheads will be kept as free of litter as is practicable.***

In the context of aesthetic values, trail and trailhead litter control is perhaps our greatest maintenance problem. Some individuals may purposefully litter to demonstrate disrespect. Likely, most people that litter do so because they always have littered.

Voluntary litter pick up is an activity that may be conducted by any individual or group at any time or place without prior approval of or supervision by University

personnel. The CEF Office will provide litterbags upon request. Bags of litter may be left at trailheads for University personnel to remove.

Litter barrels will be appropriately placed at all trailheads. These barrels will be maintained by the CEF crew.

CHAPTER 8. GUIDELINES FOR VOLUNTEER ASSISTANCE IN TRAIL ESTABLISHMENT AND MAINTENANCE

While very little new trail mileage will be established on the CEF in the foreseeable future, substantial re-routing and maintenance work will be required in order to maintain a viable trail system. Substantial amounts of this work will be done by university personnel; however, due to budgetary constraints, much of it will have to be done with volunteered assistance from trail user groups. While this assistance will be needed and appreciated by the university, some guidelines must be set in place to insure a mutual understanding of expectations among the parties. For the foreseeable future, those guidelines will be as follows:

1. **Other than for litter pick-up, no individual or group of individuals may undertake trail maintenance activities that involve trail re-routing, changes of the trail tread, changes to trailside vegetation, or fallen tree removal from trails without supervision by University personnel.**

2. **Prior to undertaking any trail work, all volunteer workers must sign a wavier acknowledging:**

    a. **full awareness that such work involves normal hazards of working in forested areas,**
    b. **full awareness of the tasks to be done;**
    c. **full responsibility for true representation of his/her own work capabilities; and**
    d. **full responsibility for accurate description of his/her experience in operating tools and equipment that he/she may wish to operate as part of the trail work.**

3. **Planning of trail workdays may be initiated by either the CEF Office, or by a volunteer group for a particular location, date, and time that has prior approval of the CEF Office.**

4. **Volunteers may use personally owned hand tools and equipment or tools and equipment belonging to the University provided that:**

    a. **In the case of motorized equipment (e.g., chainsaws, weed and brush cutters, etc.), the individuals using that equipment will have been individually approved by the CEF managers as adequately competent to use such equipment in a safe and responsible manner.**

    b. **In the case of hand tools with sharp edges (e.g., axes, bush hooks, bush axes, machetes, etc.), approval of use of these tools by any individual will be at the discretion of the CEF managers keeping in mind that such use must be conducted in a safe and responsible manner.**

5. **Volunteers who hold a valid South Carolina driver's license may operate automotive vehicles owned by Clemson University if requested to do so by University personnel and if the volunteer wishes to grant such service.**

6. **Volunteers who injure themselves in the course of their volunteer activities in trails work are not eligible for workmen's compensation.**

7. **Volunteers who, within the scope of their volunteer duties, injure themselves may apply to the University for payment of medical expenses in an amount up to $1000.**

8. **Volunteers who, in the scope of their volunteer duties, negligently injure another person or property of third persons, will generally be covered under the University's tort insurance.**

9. **CEF managers may in their sole discretion refuse the volunteer services of any individual or group proposing to work on the CEF Trail System.**

10. **The CEF Office will maintain a record of all individuals who have performed volunteer services on the CEF Trail System. That record should include dates and duration of work efforts, and notable services performed when appropriate.**

PART III. TRAIL SYSTEM MONITORING

CHAPTER 9. ECOSYSTEM RESPONSES

Trail system management must view humans as ecosystem components and human activity as ecological process. Humans have played major roles in shaping both the functional and physical structure of North American ecosystems for at least 12,000 years. It is impossible for human activity to take place in these systems without impacting them in some way.

Human impacts on other ecosystem components and processes might be placed in the following general categories: 1) negligible, 2) noticeable but benign, 3) moderate modification, 4) major modification involving component and process displacement, and 5) catastrophic change in which the original landscape is no longer recognizable. The impact category preferred for trail systems is Category 2 - "noticeable but benign," although as trail use approaches site capacity to withstand that use, Category 3 –"moderate modification" impacts will become evident. Management must strive to maximize the trail mileage in Category 2, and prevent impacts from exceeding Category 3 level.

Ecosystem response monitoring results indicate to the manager that some management scenario is causing inappropriate impacts, or that a management scenario that would prevent or mitigate impacts is missing. Monitoring results may or may not identify these scenarios.

When devising and implementing monitoring strategies, the adaptive management paradigm of making appropriately justified changes in objectives and techniques for accomplishing those objectives must be kept in mind. The approaches described

here may change within a few years as information based on field experience, and accumulated data and available technologies change.

Trail Tread Responses

Once a trail is established, the tread on the forest floor changes in the following progression: 1) matted soil organic horizon, 2) exposure of mineral soil and rock, 3) compaction of mineral soil, and 4) soil displacement. The rate of the progression is of course determined by depth of the organic horizon, rate at which natural litter (leaves, needles, etc.) is added to the site, texture of the mineral soil, soil drainage, slope, and intensities of various types of use.

Trail tread monitoring will be of three types:

1. **an annual general survey using GPS technology to document the tread condition on the entire trail system;**

2. **water bar functionality for tread protection; and**

3. **site specific surveys that focus on identified locations that have particularly notable problems.**

Annual General Surveys

While the entire trail system tread will be assessed annually, various sections will be done at different times of the year as opposed to doing the entire system in one time block each year. There are two reasons for this approach. First, a complete survey done in a single span of days is logistically impossible for the foreseeable future given the financial and personnel availability constraints on the CEF. And second, a significant portion of the trail system should be visited in the winter to early spring period when water saturation of soils is most probable.

The GPS unit dictionary will contain the following tread assessment criteria:

1. **Trail origin**
   a. **existing forest roads**
   b. **abandoned haul or skid roads**
   c. **abandoned skid trail**
   d. **installed trail**

2. **Drainage potential**
   a. **vertical drainage potential**[19]
      1) **good**
      2) **moderate**
      3) **poor**

   b. **surface drainage (away from the trail) potential**
      1) **good**
      2) **moderate**
      3) **poor**
      4) **impossible**

3. **Trail tread condition**
   a. **potential for saturation (i.e., becoming boggy)**
      1) **none**
      2) **low**
      3) **moderate**
      4) **high**

   b. **depth of trail below original surface (due to compaction and/or soil displacement)**
      1) **0-2 inches**
      2) **3-6 inches**
      3) **7-12 inches**
      4) **greater than 12 inches**

   c. **erosion**
      1) **none**
      2) **minor**
      3) **moderate**
      4) **severe**

Trail tread condition will be assessed as an average condition over distances of not less than 100 feet where the trail tread is substantially variable over short distances. The person assessing the tread will use his/her discretion as to when to indicate a significant change in tread over distances greater than 100 feet.

When doing the GPS mapping of tread condition, the assessor will encounter a substantial number of mircosite problems. Microsites are substantially degraded segments of the trail that typically range in length from a few feet to 100 feet in length, and are particularly notable in their variation from the average conditions of the rest of the trail in close proximity to them. The GIS map should show these sites

[19] Vertical drainage has to do with the capacity of the soil to allow water to move vertically downward. The rate of vertical movement is called the percolation rate and it is dependent on soil texture, structure, bulk density, and degree of water saturation.

as points on the trail with particular tread conditions and that are in need of maintenance attention.

Monitoring records of tread conditions will be maintained on trail segment maps enlarged to a scale of 1:6000 (1 inch = 500 feet). These maps will be indexed on the Trail System maps, and cataloged for management reference and research study.

Water Bar Functionality

The monitoring of the functionality of trail water bars will be done in conjunction with the generalized annual tread survey. As the person doing the tread assessment encounters water bars on the trail, he/she will go to the GPS unit dictionary and record the following:

1. **Water bar type**
   a. **excavated**
   b. **log or timber**
   c. **flexible, artificial material**
   d. **other**

2. **Integrity**
   a. **intact according to design**
   b. **partially degraded**
   c. **heavily degraded**

3. **Functioning**
   a. **good (as intended)**
   b. **poor (partially functional)**
   c. **non-functional**

Site Specific Surveys

Site specific surveys for tread problems will target trail segments (typically microsites), except for stream crossings as they will be treated separately, that have been identified as having chronically severe erosion or bogginess problems. These locations will be mapped for reference purposes. They will be visited and reassessed at least once each calendar season.

These sites will be periodically measured for change in size. In the case of erosion problems, the length, width and depth of the eroded tread will be periodically measured following a measurement time schedule deemed appropriate by the monitoring scientists. Boggy sites also will be measured for length, width and the distance from the top of the bog to the original soil surface.

Stream Crossings

Stream crossings are of three types: 1) unimproved fords, 2) improved fords, and 3) bridges. Typically, all fords started as unimproved stream crossings. Trail users crossed the stream at that point because of some combination of circumstances that made it convenient and possible. However, there are two main problems inherent to fords. The first is the degradation of stream banks that results in increased sediment loading of the stream. The second problem is the disturbance of the streambed that could adversely impact natural stream biology. Proper bridging of streams tends to minimize the first problem and avoid the second.

The stream crossing monitoring process will begin with the assignment of an identification code that uniquely identifies each crossing. The code will be developed by the CEF managers and monitoring scientists.

Stream crossings will be assessed at least once each calendar season. The assessment format will approximate the following:

1. **Bridge**
   a. **bank erosion: none**
   b. **bank erosion: minor**
   c. **bank erosion: moderate**
   d. **bank erosion: severe**

2. **Improved ford**
   a. **banks improved (gravel, rock, geotextile, or timber steps added)**
      (1) **bank erosion: none**
      (2) **bank erosion: minor**
      (3) **bank erosion: moderate**
      (4) **bank erosion: severe**

   d. **banks unimproved**
      (1) **bank erosion: none**
      (2) **bank erosion: minor**
      (3) **bank erosion: moderate**
      (4) **bank erosion: severe**

   e. **streambed and edges improved (gravel, rock, or geotextile material added)**
      (1) **integrity of improvements**
         (a) **improvements intact**
         (b) **improvements degraded**
         (c) **improvements severely degraded**

      (2) **efficacy of improvements**
         (a) **stream entrance edge and bottom stabilized**

(b) stream entrance edge and bottom partially stabilized
(c) improvements non-functional

f. streambed and edges unimproved
(1) condition
(a) bedrock
(b) large rocks
(c) gravel
(d) gravel and sand
(e) firm sand
(f) firm soil
(g) boggy

(2) streambed and edge disturbance level
(a) negligible
(b) minor
(c) moderate
(d) severe

3. Unimproved ford
a. bank erosion
(1) none
(2) minor
(3) moderate
(4) severe

c. streambed and edge structural stability
(1) condition
(a) bedrock
(b) large rocks
(c) gravel
(d) gravel and sand
(e) firm condition
(f) boggy

(2) streambed and edge disturbance level
(a) negligible
(b) minor
(c) moderate
(d) severe

Streambeds and edges at crossings also will be periodically evaluated using measurements of bulk density, penetration resistance, and sheer resistance using standard techniques for measurement of soil physical properties. The periodicity of these measurements will be determined by the monitoring scientists.

Water Quality

Water quality issues currently are at the top of the list of concerns about human impacts on ecosystems. Furthermore, water quality has become the focus for assessing ecosystem health on the federal lands. Trail systems have the potential to adversely impact water quality, and that potential should be monitored.

The two primary concerns regarding the effects of trails on water quality are: 1) sediment loading, and 2) introduction of potentially pathogenic organisms. Sediment loading is the result of: 1) erosion of stream banks where the trail intersects the stream, and 2) erosion of the trail tread in close proximity to the stream.

In the absence of campgrounds in close proximity to streams, as is the case on the CEF, horses are the principle concern as a source of potentially pathogenic organisms in streams. The principle organism of concern is fecal coliform bacteria (*Eserachia coli*). While trail horses have been suspected as potential sources for stream contamination with the protozoans *Crytosporidium* and *Giardia* spp., studies done in the West have demonstrated that this is highly unlikely.[20, 21]

Monitoring for Sediment Loading

Practically all streams intersected by trails on the CEF are first and second order streams.[22] Even the second order streams tend to be shallow and have normal flows of less than 10 gallons per minute.

There are only three third order streams on the CEF: 1) Eighteen Mile Creek on the Fants Grove Area, 2) Six Mile Creek on the Issaqueena Area, and 3) Todds Creek on the Todds Creek Area. There are no trail crossings of Eighteen Mile Creek except at the highway bridge on Woodburn Road. Six Mile Creek has two fords. One has bank improvements made in connection with the logging road that crosses at the ford. The streambed is firm sand and bedrock. The uppermost ford on Six Mile Creek is an unimproved ford. The stream bottom is firm sand and bedrock. Todds Creek has two unimproved fords, and both of these have sand, gravel and bedrock bottoms. There is no visually obvious indication that the trail crossings on either Six Mile Creek or Todds Creek are having any measurable effect on stream sediment loads.

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[20] Forde, K.N., A.M. Swinkler, J.L. Traub-Dargatz, and J.M. Cheney. 1998. The prevalence of *Cryptosporidium/Giardia* in the trail horse population utilizing public lands. Proc. 15th Equine Nutritional Physiology Symposium. Pp. 223-237.

[21] Johnson, E., E.R. Atwill, M.E. Filkins, and J. Kalush. 1997. The prevalence of shedding of *Cryptosporidium* and *Giardia* spp. based on a single fecal sample collection from each of 91 horses used for backcountry recreation. Journal of Veterinary Diagnostic Investigation. 9:56-60.

[22] First order streams are those that originate from springs or seeps. Second order streams are those formed from two or more first order tributaries. Third order streams are formed from two or more second order tributaries.

Unfortunately the technology for sediment load sampling in small streams is not well developed. As practically all stream crossings on the CEF are on first and second order streams that have low flow volume rates, we will need to modify existing sampling techniques to make them appropriate to these situations. Monitoring scientists have already begun work on this problem.

Monitoring for Potentially Pathogenic Organisms

Monitoring for potentially pathogenic organisms is planned to be in two stages and using double sampling techniques. The first sampling stage will involve laboratory screening for fecal coliform bacteria. Samples taken from crossings of known heavy horse use and following weekends of particularly heavy horse use will be sub-sampled for serotyping to identify coliform bacteria likely to be associated with horses. Similar sub-samples may be taken for screening for the presence of *Cryptosporidium/Giardia* that might be associated with horse fecal material.

Initially, water samples may be taken on Friday and the following Monday as the weekends are the times of heaviest trail use by horses. Samples will be taken above and below the stream crossing on each sampling date. Double sampling will involve the process of taking Friday-Monday samples from possibly 10 selected crossings possibly every week. An additional 10 crossings may be selected to be sampled once each month on randomly chosen Friday-Monday pairs within the month. The importance of the double sampling will be to provide information on the minimum number of samples that may need to be taken, and the frequency of sampling that may need to be done, in order to accomplish adequate monitoring of the trail system.

Vegetation Damage

Most vegetation damage can be avoided by appropriate trail and trailhead design. Appropriate reconnaissance of the proposed trail area for sensitive species is the first step in avoiding problems. Trail users that do unauthorized cutting of brush and trees in order to prepare campsites and procure firewood are another problem source. However, as camping is not allowed on the CEF, such activities are not causing problems here at the present time.

There are two primary types of direct vegetation damage that occur on the CEF: 1) damage to root systems of trees growing in close proximity to the trail or trailhead, and 2) injury of the stems of trees and shrubs in close proximity to the trail or trailhead. Again, proper trail and trailhead design can avoid much of this problem, but not all of it, particularly with respect to root damage.

Root damage is most likely to occur in species that are naturally shallow-rooted, but it may also occur in normally deep-rooted species growing on shallow soils. Hikers, bicyclists, and horses may all cause damage to exposed roots.

Monitoring for root damage along trails should be done in conjunction with the trail tread surveys. The assessor should simply map root damage where it is detected and note it as moderate or severe.

Another notable type of vegetation damage is that resulting from horses chewing on trees. Under CEF regulations, the tying of horses to trees is prohibited. However, horses may chew on trees close to them wherever they are stopped. The problem is primarily one of concern for trail aesthetics, although sapling sized trees are usually killed when these injuries are substantial. Again most of this problem will be avoided by design and regulation, but it is of sufficient importance to warrant monitoring in conjunction with the trail tread evaluations and trailhead inspections. Problem points should be mapped and noted as minor, moderate, or severe.

CHAPTER 10. MONITORING TRAIL USE AND USER REACTIONS

Appropriate management of a trail system requires fitting the array of uses and intensities of use to the capacity of the land to accommodate these activities. Monitoring of users is required to know what types and levels of use are happening on the trail system, as well as the ecosystem responses to these happenings. Such knowledge is fundamental to attempting to harmonize and sustain human activities with the rest of the ecosystem.

A second aspect of monitoring use and users has to do with user reactions to the trail system and to others with whom they share it. People use trails in a wide variety of ways for recreation. If the process of recreating is cluttered with negative perceptions of trail conditions or conditions of the landscape that the trails traverse, the recreational experience is not likely to be good. Similarly, if the recreating process involves a number of negative experiences with other trail users, the recreation is substantially degraded.

The monitoring of trail system use and user reactions will be aimed at determining how well trail users are being harmonized with the land and with each other.

Monitoring Trail Use and Use Intensities

Windshield-Distributed Questionnaires

Pilot questionnaire studies of types of trail use and extent of use were conducted on the Fants Grove and Issaqueena areas in 1999. (Todds Creek was not included because there was no parking area at which trail users could be identified.) The work was accomplished by having a surveyor continuously moving from trailhead

to trailhead and placing questionnaires on vehicle windshields. Respondents were asked to fill out the questionnaire and place it in a questionnaire box that was provided at the site.

Among other things, this work demonstrated that: 1) the Issaqueena Area got the greatest amount of use of the three areas; 2) mountain bikers were the dominant users of the Issaqueena Area; 3) equestrians were the dominant users of the Fants Grove Area; 4) both bicyclists and equestrians frequently traveled from North Carolina and Georgia to access the CEF trails for non-event riding; and 5) total CEF Trail System use may have exceeded 25,000 user-hours per year. Given that the pilot study provided insight into the information that could result from such efforts, as well as the appropriate procedures to obtain this information, the questionnaire studies will be continued with some modifications. The modified questionnaire (Appendix C) will be placed on windshields at trailheads.

In the past, although collected continuously for several months at a time, the windshield-distributed questionnaire work was done only on weekends. In the future, one full week will be randomly chosen from each month, and questionnaires distributed every day of the sample week. This will provide 84 sample days evenly distributed throughout the year.

As in the past, as questionnaires are left on vehicles, information on the vehicle will be taken that will help interpret questionnaire data and degree of response. The vehicle information form that may be used is also shown in Appendix C.

Personal Interviews

The windshield-questionnaire surveys will be supplemented with personal interviews aimed at determining user satisfaction with their trail experiences and the degree to which the CEF Trail System provided an educational experience. The interview format for these studies will have to be designed and a sampling strategy developed by the monitoring scientists.

Trail Use and Users

Types of trail use and the numbers of users also will be surveyed using a monitoring system that involves mechanical counters, cameras (still and video), and direct human observation. The methods and sampling strategy will have to be developed by the monitoring scientists. The work will be aimed at documenting the types and intensities of use on various portions of the trail system.

Research and development work will need to be done to develop the use of vertical arrangement designs for counters that will provide for separation of counts of hikers, bikers, and equestrians. The development of the techniques will require

simultaneous sampling using human observers. Cameras synchronized with the counters may also be helpful. Data quality control in the application of the mechanical counter techniques will always require double-checking using synchronized photographic evidence and direct human observation.

The first aspect of the trail system to be monitored will be numbers of users and use behaviors at stream crossings. The first step in this procedure will be to establish mechanical counters at a number of crossings. In addition, human observers will be stationed at a selected subset of these crossings to record trail user behaviors. Of particular concern will be the behaviors of horses at these locations as such behaviors may affect water quality. These data may also help guide trail design with respect to considerations of the spacing of points where horses may drink from a stream. In addition to human observers, user behavior sampling may involve video cameras automatically triggered by the approach of trail users.

In addition to stream crossings, types and intensities of use of selected trail sections will be important. This will be of particular importance in areas where trail degradation is a chronic problem. These data should provide clues for appropriate regulation of use and maintenance efforts of such areas. Knowledge of use of other portions of the trail system may be important simply for accurate characterization of the trail system as a whole.

This work can be accomplished by establishing mechanical counter stations that are double sampled using cameras and human observers. The sampling strategy design that will accurately reflect use and changes in use in time and space will have to be developed by the monitoring scientists.

Part IV. TRAIL SYSTEM RESEARCH

This portion of the CEF Trail System Plan describes the minimal amount of research that needs to be done if the passive mode adaptive management process is to have legitimacy. On the other hand, there is no currently reserved source of funds to do that work. Research on the CEF Trail System will depend on the effectiveness of an interdisciplinary team of scientists to create a viable vision of a trails research program, and to obtain extramural funding to bring that vision to reality.

Chapter 11. ECOSYSTEM RESPONSE STUDIES

There is a great paucity of information on ecosystem responses to the establishment and use of trails. In considering trails research within the passive mode adaptive management framework, the fundamental steps of adaptive management must be kept in mind:

1) **Formulate and implement management procedures using the best scientific and experiential information available.**

2) **Monitor system changes to determine:**
   a) **The possibility that some adverse change is occurring due to an error in management decision-making or implementation.**
   b) **The possibility that some adverse change is occurring due to an outmoded management practice, i.e. the practice may have been appropriate for the conditions of the time, but conditions have changed with time.**
   c) **The possibility that some adverse change is occurring due to the absence of some management practice (including regulation).**

3) **Conduct research to:**
   a) **interrogate the monitoring data for validity of perceived change;**

b) **determine any connections between ecosystem change and management practices either in place or missing; and**
c) **develop alternative approaches that will avoid or minimize adverse ecosystem impacts.**

Trail Tread and Stream Crossings

The technology for measuring physical characteristics important in trail tread monitoring has been in existence for a long time. However, the application of the technology in a manner that will provide a characterization of an entire trail system has not been done. The most important aspect of this characterization is trail erosion. That a trail is either stable or eroding may be visually obvious. However, it is less obvious how to document the extent of erosion and the rate at which it is occurring throughout a large trail system, and yet it is important to do so if the management practices are to be evaluated.

A second aspect of trail erosion research must address the causes of erosion. When a trail is eroding, the fundamental mistake has been made of allowing some activity on a site that exceeds the site's capacity to accommodate it. Research must answer the following questions:

1. **Are the soils so highly erodable that they can not tolerate any kind of trail traffic disturbance?**

2. **Will the soils withstand disturbance if the trail is appropriately designed?**

3. **Are some types of use benign while others are degrading?**

4. **What are the limits on intensities of various types of use?**

These questions have never been addressed in a scientific manner on a trail system. Adaptive management efforts on the CEF Trail System must rise to this challenge.

Water Quality

Both the sediment loading and the potentially pathogenic organism aspects of water quality monitoring need research in the context of trail system impacts. Clemson scientists are already doing pilot studies on sampling methods to measure sediment loading caused by trail crossings on small streams. These studies will need to be enlarged to provide for development of an extensive monitoring system for which the techniques have been validated.

Research also will be needed to develop the techniques that can be accepted in the scientific literature that may report results of monitoring studies of coliform bacteria and potentially pathogenic protozoans (*Cryptosporidium/Giardia*) in stream waters and that may be traceable to trail horses. In this case, the water sampling process, particularly with respect to timing, is of concern, but of greater concern is how the samples should be analyzed after the samples are collected. These laboratory analyses are very expensive when taken to the final step of serotyping for final confirmation of source. The processes for doing these kinds of studies on an extensive trail system in a cost efficient but efficacious manner will need to be developed.

In addition to sampling streams for potentially pathogenic organisms that may originate in horse fecal matter, it may be desirable to study the trail horse population itself. Such an investigation would likely follow the study protocols used in Colorado and California investigations.

CHAPTER 12. STUDIES OF TRAIL SYSTEM USERS AND USES

Trail System Users

Of the kinds of monitoring planned for the CEF Trail System, the techniques for determining user reactions to trails and to each other are the best developed. Social scientists studying outdoor recreationists have developed these methodologies, and they can adapt them to the context of the CEF. However, development of the CEF Trail System so that it becomes an educational medium providing information on natural and cultural resources in an efficient and effective manner should be the object of future research.

Trail System Uses and Use Intensities

Monitoring arrays of use and respective use intensities of trail systems has been done, but the work usually required the investment of extensive efforts by human observers. The use of mechanical counters to continuously monitor large wild animal movements past selected points on trails has been in practice for more than a decade. But how a mechanical counter system might be devised such that types of trail users passing a selected point might be enumerated separately remains in need of research and development. To have such a technology is very important for large trail systems as the deployment of human observers alone to gather such information would be cost prohibitive. However, extensive data on type of use and respective use intensity will remain critical if the capacity, and changes in capacity, of the land to accommodate various uses are to be determined.

PART V. IMPLEMENTATION OF COLLABORATIVE ADAPTIVE MANAGEMENT

CHAPTER 13. ORGANIZING AND INITIATING THE PROCESS

The initiation of the collaborative adaptive management process requires that three things must happen once the management plan has been finalized:

1. **The management, monitoring, and research personnel that will implement the plan must come together to:**
   a. **establish their respective responsibilities;**
   b. **organize their lines of communication;**
   c. **document how they will organize management, monitoring, and research into interactive processes, and**
   d. **prioritize management, monitoring and research objectives.**

2. **The interdisciplinary team of scientists that will deal with monitoring and research must:**
   a. **be organized,**
   b. **develop a collaborative approach to the scientific study of the CEF Trail System, and**
   c. **seek extramural funding to finance these studies.**

3. **The advisory committee composed of trail users must be invited and organized with full consideration being given to:**
   a. **development of adequate representation of the full array of perspectives of CEF Trail System users;**
   b. **selection of individuals who have the capacity and means to accurately and effectively communicate with their respective interest groups;**
   c. **selection of individuals who have the desire, capability and commitment to communicate effectively with managers and scientists;**

d. **selection of individuals who understand that they are being invited into a process to communicate their perspectives as trail users to managers and scientists, and**
e. **selection of individuals who are willing to learn from managers and scientists, and pass that knowledge on to their trail user constituents.**

The CEF Director or his appointee will orchestrate the harmonizing of these processes.

Management, Monitoring, and Research Committee

The Management, Monitoring, and Research Committee (MMRC) will be composed of the CEF managers and the monitoring and research team scientists. The CEF managers and a coordinator for the Monitoring and Research Team will be constants on this committee. Individual scientists working on particular aspects of the adaptive management process may change with time as priorities change, as individual projects are completed, and as availability of funds changes. The CEF Director or his appointee will chair this committee.

The most fundamental issue that the MMRC must address immediately will be how to mold management, monitoring, and research into one integrated and interactive process. The first step to developing this process will be reaching an agreement that there will be no unilateral decision-making regarding primary issues affecting trails. The decision-making process on primary issues must be collaborative with scientists respecting the needs of the managers to "make something happen" and the managers respecting the need to maintain the scientific integrity of monitoring and research efforts. As soon as is practicable, the committee members need to produce a document that will guide the collaboration process.

The MMRC must also begin the process of formulating trigger points (see p. 16 for brief discussion of definition). The concept of "acceptable level of change" will be applicable here, but what will constitute acceptable level of change, and what will constitute acceptable statistical probability that the level has been exceeded must be determined.

A vision of acceptable level of change should be created with input from the Advisory Committee. The acceptable level of probability must be agreed upon by the managers and scientists, and they will be able to deliberate meaningfully on this problem only after some years of experience in data gathering in the context of the CEF Trail System.

The third thing that the MMRC should do is to produce an annual report that documents the array of uses and intensities of use of the trail system, management

actions taken, research and monitoring accomplishments and activities in progress, and presentations and publications related to adaptive management of the CEF Trail System. The report should be published on the CEF website or its own website with a CEF linkage.

Interdisciplinary Team of Scientists

The Interdisciplinary Team of Scientists will be a subset of the MMRC. The CEF Forest Director will appoint a coordinator for the Team. The coordinator will invite a broad array of scientists, including social scientists, to join the Team.

The Team should meet both with and separately from the MMRC. In its separate deliberations it must determine how the scientists will work both collectively and separately towards a common goal. The Team should mutually agree on the articulation of that goal and priorities for missions to reach that goal.

In the search for funding, the Team will need to develop viable proposals to be submitted to extramural funding sources that want to emphasize support for interdisciplinary research. In addition, the Team must be supportive of members who are able to obtain funding for individual projects.

While the scientists are developing the processes for interactions among themselves, they must also keep in mind that it is absolutely mandatory that all research planning be coordinated with the CEF managers, and that a flow of information between them and the Advisory Committee is absolutely essential.

Advisory Committee

The Advisory Committee will be appointed by the CEF Director with advice from and consent of the MMRC. Initially, the membership of this committee will be composed of three members that represent the mountain biking community, three members that represent the trail equestrian community, two members that represent the environmental community, and one member at large. The composition of the Advisory Committee may change if the Director and the MMRC determine that the current composition no longer represents the array of trail user interests on the CEF.

Advisory Committee members should serve terms of three years, and they should be eligible for appointment to one additional three-year term. At the beginning of the process, one bike member should be appointed for one year, one for two years, and one for three years. These separations should also be used for the equestrian community. The Director may use his/her discretion on the staggering of appointments of the rest of the committee.

The Director should charge the Advisory Committee with two responsibilities: 1) inform the MMRC of their values and perceptions, and 2) become informed about natural resource management, monitoring and research in the context of a trail system. It will be critical that the Director ascertain that potential appointees fully understand the importance of both of these tasks, and that each will be willing to communicate what they learn to their constituencies.

The Director may replace members of the Advisory Committee with advice from and consent of the MMRC if it is determined that such an action is in the best interest of the CEF Trail System adaptive management process and Clemson University.

CHAPTER 14. MAKING CHANGES

Adaptive management paradigms are justified by three real world phenomena:

1. **Ecosystems are always changing.**
2. **Our knowledge of ecosystems is always changing.**
3. **Societal values for ecosystems are always changing.**

Adaptive management principles are aimed at developing knowledge of change that will enable us to intelligently cope with change. Therefore changes in management strategies cannot be arbitrary. Such changes must be based on accumulated information, or the need to gain new information such as in the performance of an experiment or monitoring/research methodology.

However, there will be real world situations where change is mandated for reasons other than the availability of new scientific information. ***The CEF Director may, at his/her sole discretion, make changes in the Trail System when such changes are necessitated by concerns for human safety.*** **However, to the extent practicable, the Director should seek the advice of the MMRC as to how those changes can be made with minimal impacts on the integrity of scientific monitoring and research that is already in place.**

Furthermore, ***the CEF Director may, with the advice and consent of the MMRC, and advice from the Advisory Committee, change the Trail System when such change is deemed necessary for the protection of CEF: 1) natural resources, 2) cultural resources, 3) educational processes, and 4) research deemed to have a higher priority than knowledge being gained from the Trail System.***

Unless this Plan is amended by mutual agreement of the Director and the MMRC and with the advice of the Advisory Committee, ***any other changes must be justified on the basis that fundamentally new knowledge will be gained.*** **The CEF Director and the MMRC must agree that such is the case, and advice from the Advisory Committee must be obtained, before new changes can be implemented.**