

# **AN ASSESSMENT OF TRAIL CONDITIONS IN GREAT SMOKY MOUNTAINS NATIONAL PARK**

*by:* Jeffrey L. Marion

Research Biologist/CPSU Unit Leader  
USDI National Biological Survey  
Cooperative Park Studies Unit  
Virginia Tech/Department of Forestry  
Blacksburg, VA 24061-0324

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## ABSTRACT

This research report presents results from trail surveys of 72 backcountry trails (328 miles), 25% of the park's formal trails and 35% of the total trail mileage (Appendix 1). The sample is broadly representative of the park's geographic regions, elevations, trail resource conditions, and use-related factors. Survey staff used measuring wheels to record information on all occurrences of 25 trail features in four topical categories: general inventory, resource condition, design and maintenance, and visitor attractions (Appendix 2). Data are presented which characterize the number, severity, and total lineal distance of significant resource impacts and the number and relative effectiveness of common maintenance features.

On a lineal distance basis, soil erosion and wet soil are the most common types of resource impact. Soil erosion exceeding one foot below the estimated post-construction tread surface averages 239 feet per mile with a cumulative total of 14.6 miles, 4.5% of the sampled trail miles. Relational analyses indicate that tread erosion is highest on trails located in upper-slope or ridgetop geographic positions with wet soils and heavy visitor use. The cumulative total mileage for wet and muddy soils on trails is 11.3 miles, 3.5% of the sampled trail miles. Wet soils are most common on trails that intercept water from springs and seeps, have substantial horse use, are located in drainage bottom positions, and are deeply eroded. ★

A total of 4,137 drainage dips and 3,804 water bars were observed, an average of 25.3 tread drainage features per trail mile. Drainage feature effectiveness ratings suggest that water bars are more effective than drainage dips. Analyses indicate that both the amount and type of trail use are important determinants of trail condition. Heavily used trails have significantly more soil erosion and tree root exposure, while trails receiving a high proportion of horse use are significantly wider, muddier, and have more multiple treads.

Research results provide managers with objective, standardized data for use in trail planning, trail maintenance, and trail management decision making. Potential applications and general recommendations under each of these topics are offered.

Why

What

How

Pre use or  
in spite of use

— Physical location

Use

Intensity

Duration

Ease of Access

## INTRODUCTION

This report describes results from a comprehensive assessment of a large sample of backcountry trails in Great Smoky Mountains National Park (GSMNP). Recently, both visitors and managers of the park, which is among the most heavily used in the nation, have raised concerns over the deteriorating condition of many of the park's trails. In particular, a number of complaints have been received from both individuals and groups who find the current trail conditions to be unacceptable. Such concerns may be due in part to declining park budgets, which have restricted trail maintenance activities, and to increases in trail use. Disproportionate resource impacts from horse use have also been cited as a potential cause. Responding to such concerns, this research effort was sponsored by the National Park Service (NPS) to provide objective data describing current trail resource conditions and to identify and describe critical factors that influence trail degradation.

NPS managers operate under legislative and administrative mandates directing them to balance the provision of appropriate park recreation experiences with the resource changes resulting from such use. Specifically, the NPS Organic Act of 1916 (16 *United States Code* (USC) 1) which established the Service, directed it to "promote and regulate the use ... [of parks] ... in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." What constitutes an impaired resource is ultimately a management determination, although public input is routinely sought and considered in management decision making. Other legislation, such as the National Environmental Policy Act of 1969 (42 USC 4321 *et seq*) and the park's enabling legislation, also provide guidance.

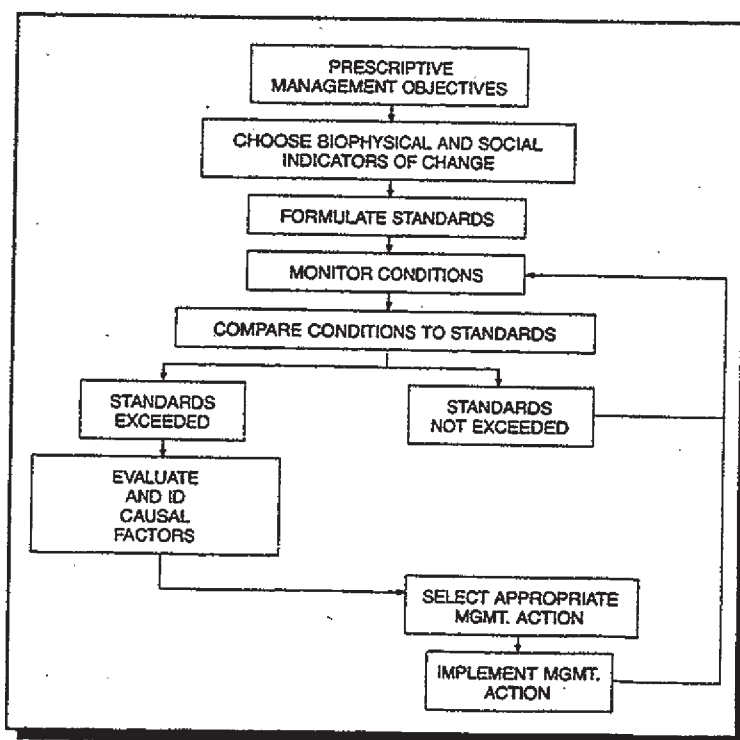
Authority to implement congressional legislation is delegated to agencies, who identify and interpret all relevant laws and formulate administrative policies to guide their implementation. A document titled *Management Policies* (NPS 1988) describes these policies to provide more specific direction to management decision making. For example, relative to the need for balancing visitor use and resource changes, *Management Policies* states that:

Backcountry use will be managed to avoid unacceptable impacts on park resources or adverse effects on visitor enjoyment of appropriate recreational experiences. The National Park Service will identify acceptable limits of impacts, monitor backcountry use levels and resource conditions, and take prompt corrective action when unacceptable impacts occur. (Chapter 8:3)

Finally, a series of management guidelines provide managers with the most specific guidance in implementing legislation and administrative policies. NPS-77, the *Natural Resources Management Guideline* (NPS 1991) states that "park managers must know the nature and condition of the resources in their stewardship, have the means to detect and document changes in those resources, and understand the forces driving the changes" (Chapter 5:20). A second *Natural Resources Inventory and Monitoring Guideline* (NPS 1992b) states that it is the policy of the NPS to "assemble baseline inventory data describing the natural resources under its stewardship, and to monitor those resources forever [and] to detect or predict changes that may require intervention" (Chapter 1:1).

A more complete review of relevant legislation, administrative policies and guidelines, and park planning documents may be found in Marion (1994). In general, current park planning documents embrace a carrying capacity approach including restrictions on visitation to control resource impacts resulting from visitor use. Management experience with this approach in other backcountry and wilderness areas has met with mixed success (Hammit and Cole 1987). Research has often shown that the amount of visitor use, while an influential determinant of change, can be less important than other factors, including many environmental attributes, the type of use and behavior of visitors, and managerial factors such as whether visitor use is dispersed or contained (Cole 1987). In response to these findings, new planning and management frameworks have been developed and applied to address this increased complexity. These frameworks evolved from and are currently replacing management approaches based on carrying capacities (Marion, Cole, and Reynolds 1985). Two of the leading frameworks are the *Limits of Acceptable Change* (LAC) (Stankey et al. 1985) and *Visitor Impact Management* (VIM) (Graefe, Kuss, and Vaske 1990) (Figure 1). The National Park Service, Denver Service Center, has combined elements from these approaches in developing a model known as VERP (Visitor Experience and Resource Protection) to guide the future development of park General Management Plans (NPS 1993a).

Under the LAC, VIM, and VERP frameworks, numerical standards can be set for individual impact parameters to specify the limits of acceptable change. These limits define the critical boundary line between acceptable and unacceptable conditions, establishing a measurable reference point to which future conditions can be compared. Visitor impact monitoring programs provide a critical element to these frameworks, furnishing information necessary to formulate realistic standards and to periodically evaluate resource conditions in relation to these standards. As noted earlier, the NPS *Management Policies* requires management approaches that identify and monitor acceptable limits of change in backcountry settings. The new management-by-objectives approaches meet this requirement and establish a more defensible decision-making process for defining and justifying appropriate and effective management actions.



**Figure 1.** Schematic illustrating the LAC/VIM planning and management frameworks.



# RESEARCH OBJECTIVES

## Research Objectives

The principal goal of this research is to design and apply an assessment of trail resource conditions for selected trail segments within GSMNP. Specific research objectives are listed in Figure 2.

1. Develop, refine, and apply a trail condition assessment survey for selected GSMNP trails. Survey must address all park information needs with procedures which are flexible, cost effective, and scientifically defensible.
2. Develop a comprehensive trail survey manual describing all procedures to standardize assessments and to enable future monitoring assessments.
3. Prepare a report that summarizes data from the trail assessments and describes relevant environmental, managerial, and use-related factors influential to trail conditions. Note management implications and formulate appropriate recommendations.

**Figure 2.** Research objectives.

The trail surveys are designed to provide park managers with standardized, quantitative, and reliable information describing trail segments, their condition, and existing maintenance features. Such information can be used to characterize different trail segments in terms of a variety of attributes, resource condition (impact), and maintenance features. Managers may find this information valuable in preparing and justifying trail management actions and trail maintenance budget and staffing requests. Data on individual trails may also be used to direct trail maintenance activities or to set priorities for needed work. The trail survey information can also identify relevant environmental, managerial, and use-related factors influential to trail conditions. Managers may find this information valuable in trail management decision making, including use in Limits of Acceptable Change frameworks, and in the selection of resistant and resilient locations for new trails or trail re-routes. Finally, trail survey information can be compared to data from future assessments (using the same procedures) for monitoring purposes: identifying trends in trail condition and evaluating the effectiveness of implemented management actions.

## LITERATURE REVIEW

### Visitor Impacts

Though a central purpose for the creation and management of parks, research has demonstrated that visitation inevitably degrades both park resources and the experiences of other visitors. This is particularly true along trails and at overnight campsites and day-use recreation sites, where visitation and its effects are concentrated. Potential ecological consequences of visitation include the trampling and subsequent loss of ground vegetation, shrubs, tree seedlings, and felling of saplings; erosion of surface litter and humus; exposure, erosion, and compaction of mineral soil; and exposure of tree roots and damage to tree trunks (see Table 1) (Cole 1987, Hammitt and Cole 1987, Marion 1984). Visitors also perceive recreational impacts. A recent survey of visitors to three eastern wilderness areas found that littering and human damage to campsite trees were among the most highly rated indicators affecting the quality of recreational experiences (Roggenbuck et al. 1993). These and other resource impact indicators, such as the amount of vegetation loss and bare ground around a campsite, were rated above many social indicators, including the number of people seen while hiking and encounters with other groups at campsites.

Table 1. Resource impacts caused by hiking, horse use, and camping activities.

| Vegetation Changes  | Soil Changes   | Additional Concerns  |
|---|--|--|
| <ul style="list-style-type: none"><li>• Loss of Vegetation Cover</li><li>• Alteration of Composition</li><li>• Damage to Trees</li><li>• Exposure of Tree Roots</li><li>• Loss of Tree Regeneration</li></ul> | <ul style="list-style-type: none"><li>• Loss of Organic Matter</li><li>• Erosion</li><li>• Compaction</li><li>• Reduction in Soil Moisture</li></ul> | <ul style="list-style-type: none"><li>• Littering</li><li>• Threats to Water Quality</li><li>• Threats to Human Health</li><li>• Threats to Wildlife</li></ul> |

The extent, location, and condition of trail resources are important to park managers for a number of reasons. First, trails represent a significant human "development" in park backcountry and wilderness environments managed for natural conditions and processes. Their presence and condition are more critical in these protected environments than in frontcountry environments where park developments are an appropriate means for accommodating visitor use. Second, trails serve an important functional role as backcountry transportation corridors supporting substantial traffic from both day and overnight visitors. Trail networks provide the primary means for accessing the backcountry in most parks and significantly shape visitor distribution patterns. Poor trail conditions can negatively affect this functional role by altering visitor distribution and threatening the safety of trail users. Third, visitors spend a significant portion of their time in the backcountry on trails. Poor trail conditions can lead to a loss in the quality of their experiences and conflicts between different trail user groups. Finally, trail

resources can represent a significant drain on limited park funds and staff. Trails which are unnecessary, poorly designed and located, or in poor condition pose a threat to park resource protection objectives and represent a significant and reoccurring financial burden.

Trail impacts include a wide variety of problems, including loss of vegetation cover, soil erosion and incision of the tread surface, widening of the tread, excessive muddiness, compaction of soil, introduction of exotic vegetation, proliferation of informal trails, and the results of depreciative behaviors such as cutting of trail switchbacks. Without proper trail design and maintenance these problems can alter natural patterns of water runoff, resulting in soil erosion and subsequent turbidity and deposition in streams and water bodies. These problems have been the subject of numerous recreation ecology studies which have sought to describe these changes and their relationships with influential factors. More complete summaries of these studies, which are briefly reviewed below, are provided by Cole (1987), Hammitt and Cole (1987) and Kuss et al. (1990).

The most significant environmental changes attributed to trails result from their initial construction. This work typically involves the removal of all vegetation and significant soil disturbance to construct an unobstructed tread and trail corridor. Water runoff and drainage patterns are also typically altered during construction activities. Trail layout and design are often described as a critical determinant of a trail's potential for future degradation but little research has specifically focussed on this issue. Once developed, a trail is subjected to both recreational use and natural erosional processes from rainfall and water runoff. Trail maintenance then plays a critical role in channelling both trail users and water, keeping the former on the tread and the latter off.

A number of studies have examined the role that environmental factors play in influencing trail degradation. Climatic and geologic factors are important because they control many other factors affecting the degradation process. For example, higher rainfall and lower vegetation growth and decomposition rates in alpine environments contribute to the rapid loss of their vegetation and highly organic soils when subject to trampling (Hartley 1976, Willard and Marr 1970). Vegetative factors influence trail degradation through the degree to which they contain use on a single tread, e.g. meadows and open forests permit trail widening and multiple tread development (Bright 1986). The density of forest types also determine the composition and trampling resistance of trailside vegetation, e.g. shade-intolerant grasses are considerably more trampling resistant than shade-tolerant broad-leaved herbs (Bratton et al. 1979, Burde and Renfro 1986, Cole 1988). Topographic characteristics such as the steepness of trail slope and sideslope gradients and the position of trails (upper-, mid-, or lower-slope positions) have also been shown to strongly influence such trail degradation factors as soil erosion and trail width (Bayfield 1973, Helgath 1975, Jubenville et al. 1987, Leung 1992, Teschner et al. 1979, Weaver et al. 1979). Finally, numerous studies have examined the influence of differing soil characteristics, including soil moisture, infiltration capacity, texture, and others (Bayfield 1973, Burde and Renfro 1986, Helgath 1975, Leung 1992, Weaver and Dale 1978).

The amount of trail use is also influential though less so than locational and design features (Cole, *in* Hendee et al. 1990). Recreation ecology studies have repeatedly documented a curvilinear relationship between amount of use and most forms of impact (Cole 1987). With



respect to trails, use above a threshold necessary to remove vegetative cover and surface litter becomes less critical in influencing resource change than many environmental factors. Foot traffic tends to compact soils and research has shown that even lug-soled boots contribute little to soil erosion (Kuss 1983, Whittaker and Bratton 1979). The principal effect of trampling, even on wet soils, is to create a more uneven and erodible soil surface; water, and in exposed areas, wind, are the actual erosional agents.

Type of use can also be an influential factor and a number of studies have compared the impacts of hikers with those of visitors on horseback or with packstock. Due to the complaints received by GSMNP and the concerns expressed by managers, the literature relating to horse impacts is reviewed more thoroughly. Impacts from horse use can be ecological: impacts to the resource, or social: impacts to the experiences of other visitors. Both types of impact serve to bring horse use concerns to the attention of managers. The scope of this report does not include the social impacts of horse use, some pertinent references on this topic include Hammitt and Cole (1987), Jacob and Schreyer (1980), McClaran (1989), and Watson et al. (in press).

Many studies demonstrate that trampling by a horse is more destructive to vegetation than trampling by foot (Nagy and Scotter 1974; Weaver and Dale 1978; Whittaker 1978). Whittaker (1978) found vegetation on horse trails to be churned up and often cut off at the roots, instead of flattened, as on hiking trails. An experimental trampling study by Nagy and Scotter (1974) found vegetation loss to be four to eight times greater from horse trampling than hiker trampling.

The greater vegetation loss from horse use tends to widen horse trails, which are often two to three times the width of hiker trails (Weaver and Dale 1978). The greater width of exposed soil and inherent characteristics of horses also contribute to the greater erosion potential of horse trails. A horse carries a heavy weight on a small, usually shod, hoof. This weight can exert as much as 1,500 lbs of pressure per square inch (Hendee et al. 1990). Horse traffic causes significant compaction to the underlying soil layers, thus reducing water infiltration and increasing surface runoff. In addition, the action of a horse hoof tends to dig up and puncture the soil surface (McQuaid-Cook 1978). Loose, unconsolidated soil is more prone to erosion than compacted soil and as a result, the potential for erosion increases on horse trails as compared to hiker trails. In a study comparing the erosional impacts of hikers, horses, off-road bicycles and motorcycles, the sediment yields from horse trails were greater than for any other type of use (Seney and Wilson 1991).

The same process that leads to erosion can result in the formation of muddy quagmires. Whittaker (1978) found loosening of the soil to be a precursor to muddy trail sections. Loose soil is more apt to form mud than compacted soil and the highly compacted subsurface soils prohibit water infiltration. The resulting impermeable basins which form retain water and mud long after rainfall. Muddy sections can be a temporary or seasonal problem, making travel difficult and often resulting in significant trail widening when trail users skirt around the edges of muddy areas.

Other trail problems attributed to horse use are the proliferation of informal trails and manure on trails (Hammitt and Cole 1987). Multiple trail formation is especially troublesome in meadows where stock parties tend to spread out rather than ride in single file (Hammitt and Cole 1987). Furthermore, user-created trails are often poorly routed and not maintained, resulting in an increased potential for degradation. Manure on trails is both an ecological and social problem. Manure often contains the seeds of exotic plants, although seeds may also be introduced from horse feed, equipment, and mud stuck to horses hooves. Excessive amounts of manure also pose a threat to water quality (Hammitt and Cole 1987).

While the majority of studies conclude that horse impacts are generally more detrimental to the environment than impacts from hikers, most acknowledge that the degree of difference is dependent on a variety of additional factors unrelated to type of use (McClaran 1989; McQuaid-Cook 1978; Summer 1980, 1986). McQuaid-Cook (1978) found trail impact to be more a function of slope and trail location than a result of user type. Nagy and Scotter (1974) concluded that although horse use generally causes more damage than hikers, the degree of difference depends on the soil, vegetation, topographic and climate characteristics. Summer (1980) identified the most influential landscape factors governing trail deterioration are parent material, grade of trail and sideslope, soil texture and organic content, rockiness, vegetation, and drainage. Measurements of physical changes along trails receiving a constant amount of horse use resulted in a wide spectrum of erosional impacts as influenced by one or more of the landscape factors listed above. Summer (1980, 1986) concludes that horse traffic is not the single most important agent contributing to trail degradation.

## Types of Trail Surveys

There are three general types of trail surveys (Table 2). Trail inventories serve to locate, map, and provide a variety of basic information on trail resources. Inventory information is useful for characterizing trails on the basis of their use, length, degree of hiking difficulty, or other features. Trail condition surveys seek to describe resource changes (impacts) and their relationships with influential environmental, use-related, or managerial factors. Census or sampling approaches may be used with either rapid surveys or more intensive measurements. Information from repetitive surveys can be compared to monitor trends in resource conditions and the effectiveness of management activities. Trail maintenance surveys provide information on the location and number of specific tread maintenance features and/or needs and can be used to prepare staffing and budgetary requests, set priorities, or direct actual trail work.

Alternative trail survey methods are reviewed by Cole (1983) and Hammitt and Cole (1987). Additional guidance on specific trail inventory and impact assessment survey techniques is provided by Bayfield and Lloyd (1973), Coleman (1977), Leonard and Whitney (1977), Rinehart, Hardy and Rosenau (1978), and Marion (1989). Only two publications were found which present methods for conducting trail maintenance surveys (Proudman and Rajala 1981, Williams and Marion 1993). A review of these approaches and of trail studies which have employed them is restricted to work done specifically in GSMNP.



Table 2. Description and uses of three types of trail surveys.

### Trail Inventory

- Locate and map all formal and informal trails.
- Identify and catalog trail features such as type of trail, use, segment length, natural and cultural features, hiking difficulty, bridges, and signs.

### Trail Condition

- Identify and quantify specific types of trail resource impacts.
- Summarize impacts by environmental, managerial, or use-related factors to detect and evaluate relationships.
- Aid in setting and monitoring management standards for trail resource conditions.
- Evaluate deterioration in trail resource conditions to suggest potential causes and effective management actions.
- Evaluate the effectiveness of resource protection measures.
- Identify and assign priorities to trail maintenance needs.

### Trail Maintenance

- Identify and locate trail tread deficiencies.
- Prescribe tread engineering solutions such as the location and type of tread drainage actions, rock steps, and bog bridging.
- Prescribe trail rerouting or new trail development needs.
- Provide written prescriptions to direct trail work.
- Summarize trail maintenance staff and funding needs.

GSMNP is fairly well-represented in the trail survey literature, although most of the work was conducted in the mid 1970's. Bratton, Hickler, and Graves (1978a 1978b 1978c) report results from a comprehensive inventory and condition assessment of the park's maintained trails. A variety of trail width and depth measurements and estimates (percent mud, rut, exposed roots, etc.) were taken at sample points each 1/3rd mile along trail segments. Data was summarized by geographic area and related to type of use, vegetation type, successional stage, and other environmental attributes. Comparisons to this data is facilitated by extensive tables of summarized field data and analyses contained in a set of four management reports.

Whittaker and Bratton (1979) conducted experimental studies to compare environmental changes from hiking and horseback riding on four trail surfaces in the park. The study concluded that horse use causes more rapid surface deterioration than foot use, particularly in sensitive mesic forest communities.

Renfro (1985) conducted an assessment of the Appalachian Trail within GSMNP. This work replicated some of Bratton's measurements but substituted the more accurate cross-sectional area technique for quantifying soil loss (Burde and Renfro 1986).

## STUDY AREA

Congress acted on May 22, 1926 to authorize acceptance of lands for the future establishment of Great Smoky Mountains National Park, stating that the park was set apart for the benefit and enjoyment of the people. The Park was formally established by the act of June 25, 1934 and its size has grown to include 514,885 acres. GSMNP was designated an International Biosphere Reserve in 1978, and is managed in accordance with the objectives of the "Man in the Biosphere" program. In addition, 69 miles of the Appalachian Trail dissect the park and 425,384 acres, 83 percent of the park's total acreage, are recommended for wilderness designation (with another 52,286 acres identified as potential wilderness). National Park Service policy dictates that all areas of potential wilderness be managed as de facto wilderness until released by Congress. (NPS 1988).

Great Smoky Mountains National Park's *General Management Plan* (GMP) states that the purpose of park management is to preserve its exceptionally diverse resources and to provide for public benefit from and enjoyment of them in ways that will leave the resources--and the dynamic natural processes of which they are components--essentially unaltered (NPS 1981). The GMP also defines a number of management zones with guidelines for appropriate types and intensities of recreational uses and permitted developments. The Park's backcountry is predominantly classified as a Natural Zone (478,184 acres, 93% of the park). Management practices for this zone seek to restore or continue natural processes that would have prevailed without the interference of non-native plants, animals and modern technological man.

GSMNP has two Districts, North and South, distinguished by the North Carolina/Tennessee state line that follows the mountainous divide and often paralleling the Appalachian Trail. The park also has 7 Ranger Subdistricts and 7 Maintenance Subdistricts, each separately defined.

The southern Appalachian Mountains including exceptionally diverse flora and fauna comprise the park's primary public attraction. Elevations range from 840 feet at the far western corner of the park to 6,643 feet at Clingman's Dome approximately in the center of the park. Twenty peaks rise above 6,000 feet in elevation and the topography is steep; only 10 percent of the park's lands have slopes of less than 10 degrees.

The park's climate is relatively moist, and due to the mountainous terrain, rainfall is among the highest in the eastern United States. Rainfall averages over 64 inches annually; increasing with elevation. Heavy thunderstorms are common, as are fully saturated soils from snowmelt or extended rainfalls. Sedimentary sandstones, conglomerates, and some limestone, along with metamorphic phyllite, slate and schist comprise the parent materials for most of the park's soils. Soils are deeper and often poorly drained in valley bottoms and can be quite thin on steep slopes or ridgelines. However, surprisingly little bedrock is exposed and only high elevation balds lack significant tree cover. Some plant communities, such as the heath balds and spruce fir forests, accumulate moist layers of organic humus. Major plant communities include cove hardwoods, hemlock, mixed oak, northern hardwood, pine and oak, beech, and spruce-fir, including the most extensive virgin forests in the eastern United States.

GSMNP reported 8.9 million recreation visits in 1992 making it one of the most heavily visited parks in the National Park system (NPS 1992a). While many of these visitors remain close to their cars, a considerable number also engage in day hiking activities. Data provided by a 1985 study place the number of day hikers at approximately 700,000 annually (Peine and Renfro 1988). Backcountry overnight stays reported by the park for 1992 were just over 90,027, sixth highest within the National Park system (NPS 1992a). These figures indicate that the trails of GSMNP are intensively used, perhaps more so than any other National Park. Use of many of the park's trails has been assessed in a set of related studies spanning the years 1988 to 1993. Use data was primarily gathered using buried, pressure-sensitive, mat counters, although some work was done with Super 8mm movie cameras triggered by electric eye units. Results, excepting the 1993 work, are presented in three reports, Van Cleave et al. (1990), Van Cleave and Beard (1993), and Van Cleave and Van Cleave (1993).

The park implemented a backcountry use permit system in 1976 in response to rapidly escalating backcountry use which peaked at 115,300 overnight stays in that year. Restrictions on campsite location and capacity, group size, and length of stay were also established in 1976. Currently, camping is restricted to 87 designated backcountry campsites and 18 shelter sites. In addition to obtaining a permit, overnight visitors must also obtain reservations if their anticipated trip includes one of 33 rationed campsites (as of 7/93). These actions, in addition to a marked decline in backcountry use, have resulted in noticeable recovery of visitor impacts at many campsites, particularly shelter sites, since the late 1970's.

GSMNP has 930 miles of official park trails and trail segments, 430 miles in the South District and 500 miles in the North District (Table 3). A large but unknown percentage of these trails are former roads, most of which are closed to all vehicles, including park vehicles. A few of these roads are passable by standard passenger vehicles, most are still passable by four-wheel-drive vehicles, and some are overgrown and narrowed to trail width. Some trails and roads are surfaced with gravel and a very small percentage is surfaced with asphalt. The majority of the trail system, including roads, was developed by the CCC Program from 1933 to 1943. Some of the roads are well-graded and have extensive stonework which is still in good condition. Some trails follow historic settler wagon roads or railroad grades, the latter associated with logging activities beginning about 1880. The wagon roads vary in design, often crisscrossing streams, ascending ridges, and showing evidence of severe erosion long

**Table 3.** Breakdown of GSMNP's 930 miles of trails.

| District | Trail Segments<br>(number) | Foot Trails<br>(miles) | Horse Trails<br>(miles) |
|----------|----------------------------|------------------------|-------------------------|
| North    | 143                        | 194                    | 236                     |
| South    | 152                        | 99                     | 401                     |
| Totals   | 295                        | 293                    | 637                     |

before their use as trails (Bratton et al. 1978a). The railroad grades are similar to the CCC trails, with reasonable grades, stonework, and bridges. Other roadbeds were built by the NPS, often to former fire towers or park structures.

According to the park trails database, 637 trail miles (68%) are open to horse use. Horseback riding has long been a traditional and popular activity within the park (off-trail horseback riding is prohibited but occurs). No use figures or estimates exist to document use trends or current use levels. A large portion of the horse use in the park is generated by five horse stables operating within the park under concession permits. However, the stables predominantly use frontcountry trails, many of which do not appear on park trail maps. Stock concession operators are required to routinely maintain the trails they use intensively. Discussions with concession owners reveal that the trails closest to their stables are "hardened" through the application of large stone (#4) to establish a base followed by finer gravel (#57) to enhance tread drainage. Management concern over resource impacts from horse use resulted in a restriction on the number of horseback riding concession permits (maximum of 7, currently 5 exist), with facilities and horse allotments frozen at 1975-76 levels (NPS 1981). Currently, the horse concessions do not offer overnight trips and few rides venture to higher park elevations.

Private stock account for much of the use on the backcountry trails surveyed in this study. There are no figures on day use by privately outfitted horse parties. While horseback riding is predominantly a day-use activity, 51 campsites (61%) and 13 shelter sites (72%) are open to visitors with horses. Hitch racks are provided at many of these sites. Park permits for rationed campsites indicate that visitors camp with over 2,000 horses in the backcountry each year. Visitors camp with an additional 8,000 horses road-accessed campsites within the park each year.

Currently, no trail surveys are conducted on a routine basis. Rather, trail conditions are informally observed and reported by Trails Foremen and Backcountry Rangers. The newly revised Backcountry Management Plan (BMP) calls for the development and use of standardized Annual Trail Evaluations and Prescriptive Maintenance Work Logs (NPS 1993b). Trail maintenance work is conducted by park trail maintenance crews and a number of volunteer organizations. Funding and staffing for this work is limited, however, and budget cuts over the past decade have greatly reduced the extent and effectiveness of these efforts.



## RESEARCH METHODS

The GSMNP trails assessment was conducted along with a companion study (reported separately) to develop and implement a campsite impact monitoring system for the park. Data from the campsite assessments will also be used to evaluate three campsite impact management strategies: designated site camping as practiced at GSMNP, and dispersed camping and area closures to camping as practiced at Shenandoah National Park. The trails assessment, which was not originally included in the campsite research proposal, began in 1992 as a volunteer effort supervised by park staff and Rebecca Van Cleave using students from the University of Tennessee. The students used modified rapid trail assessment survey procedures originally developed, but never applied, by the author. Park staff consulted with the author in modifying the procedures for GSMNP. Problems were both expected and encountered in using part-time volunteers to conduct the trail assessments. While a great deal was learned from the experience, problems with incomplete data and quality assurance led to a decision to expand the scope of the campsite study to include the trail assessments in the 1993 field season.

Trail assessment procedures were refined in the spring of 1993 through a more thorough review of the trail impact assessment literature, discussions with park staff, and field trials at GSMNP. Preliminary trail assessment procedures were then presented to park administrative, resource management, and maintenance staff to ensure that all park information needs would be met. Finally, a comprehensive Trail Assessment Manual was developed to provide detailed guidance to field staff. This manual, included in Appendix 2, describes all assessment procedures, including pre-established parameter coding and a standardized form. Labelled black and white and color photographs, depicting selected types of trail impacts, were also included to improve the consistency of subjective judgements.

The rapid trail assessment procedures call for field staff to push a standard four foot diameter measuring wheel along each surveyed trail segment while searching for and recording specified information on trail features. Specifically, staff observed and recorded information on 25 separate parameters under 4 topical categories (Table 4). Some parameters, such as water bars, are point features and a single distance from the measuring wheel (in feet) was recorded on the survey form. Other parameters, such as wet soil, are lineal features and beginning and ending distances were recorded on the form. Additional information was recorded in a Comments section of the form for some parameters, such as trail names, elevations, and soil texture. Refer to Appendix 1 for detailed field procedures.

This rapid trail survey approach was selected because it permitted a large amount of managerially relevant information to be collected in a highly efficient manner. This approach combines information and capabilities of each of the trail survey types listed in Table 2. Specifically, the survey yields a variety of general inventory information on each trail segment, characterizes the number, severity, and total lineal distance of important resource impacts, documents the number and relative effectiveness of common maintenance features, and notes the presence of scenic attraction features.

**Table 4.** Trail survey parameters by topical categories.

| Inventory Parameters                           | Design and Maintenance Parameters                    |
|--|--|
| New Trail Segment <sup>L</sup>                 | Graveled Tread <sup>L</sup>                          |
| End Trail Segment <sup>L</sup>                 | Excessive Grade: > 20% <sup>L</sup>                  |
| Use Type: Pedestrian <sup>L</sup>              | Trail Corduroy <sup>L</sup>                          |
| Use Type: Horse/Pedestrian <sup>L</sup>        | Drainage Dip (3 effectiveness ratings) <sup>P</sup>  |
| Tread Width: Trail 2-6 ft <sup>L</sup>         | Water Bar (3 effectiveness ratings) <sup>P</sup>     |
| Tread Width: Trail on Road 2-6 ft <sup>L</sup> | Lateral Drain (3 effectiveness ratings) <sup>P</sup> |
| Tread Width: Road > 6 ft <sup>L</sup>          | Retaining Wall <sup>P</sup>                          |
| Reference Point <sup>P</sup>                   | Culvert <sup>P</sup>                                 |
|  | Step <sup>P</sup>                                    |
| Resource Condition Parameters                  | Attraction Feature Parameter                         |
| Soil Erosion (1 foot categories) <sup>L</sup>  | Attraction Feature <sup>P</sup>                      |
| Root Exposure <sup>L</sup>                     |  |
| Excessive Width: 3-6 ft <sup>L</sup>           |  |
| Excessive Width: > 6 ft <sup>L</sup>           |  |
| Wet Soil <sup>L</sup>                          |  |
| Running Water on Trail <sup>L</sup>            |  |
| Multiple Tread <sup>L</sup>                    |  |

L = Lineal feature parameters, P = Point feature parameters

The trail survey was applied by four paid and four Student Conservation Association volunteer field staff working in pairs. Trail assessments were conducted between June 15 and August 30, 1993 (all park campsites and shelters were also assessed during this time). Seven staff were undergraduate college students with majors in the natural sciences and extensive backcountry camping experience. One staff member, Yu-Fai Leung, is a doctoral candidate in the Virginia Tech Department of Forestry, Forest Recreation Section. He has previously conducted a trail degradation study of a mountainous trail outside of Hong Kong for his M.S. Thesis and plans to use the GRSMNP campsite and trail assessment data in his Ph.D. dissertation. Peter Williams, a Virginia Tech graduate student with extensive trail maintenance and survey experience, provided routine assistance and direction to the field staff. One week of pre-season training, periodic meetings, and one mid-season quality assurance exercise were conducted by the author and graduate students. For the quality assurance exercise, the four pairs of field staff independently evaluated a common trail segment.

Weather for the summer was somewhat drier than normal. Precipitation measured at Elkmont for the months of June through August was 11.7 inches, while the previous five year average was 15.3 inches (Renfro, Uplands Research Lab). Field procedures directed staff to be liberal in making judgements for the parameters "wet soil" or "running water on trail" during dry spells but data on these parameters likely still underestimate conditions which would prevail under a summer with more typical rainfall.

The trail assessment procedures were applied to 72 trail segments, including some 328 trail miles. This sample includes 25% of the park's trail segments (295) and 35% of the park's trail miles (950). Trail segments, defined by the park's official trail database, were selected by a committee of park managers (no selection criteria were defined). However, the sample is large and relatively representative of the park's overall trail system. The sample includes trail segments distributed evenly from all geographic regions of the park. The sample includes a fairly even distribution of trails by geographic position and elevation. For example, 9 trail segments (36 miles) occur in lower slope (drainage bottom) positions, 38 trail segments (144 miles) occur in midslope positions, and 18 trail segments (105 miles) occur in upper slope (ridgetop) positions. All of the Appalachian Trail within the park was included in the sample. All or portions of 50 (69%) of the sampled segments are open to horse use, including 219 (67%) of the sampled trail miles. Although the sample includes most of the park's heavily used and impacted trails, field staff and results indicate that the sample included many lightly used and lightly impacted trails as well. In conclusion, although the sample was not randomly drawn, it is a large sample which includes a wide range of geographic and use-related conditions.

Trail survey data were directly entered into a dBASE III Plus database, containing 12,733 records and 11 fields. Data were verified and edited and programming was used to create additional fields, including "difference" variables for lineal parameters with beginning and ending distances. The dBASE IV report generator was used to print a listing of all trail survey data, included in an Addendum to this report (under separate cover in a binder format). The report generator was also used to develop the summarization tables for each trail segment included in the Results section. Data from these tables were used to create a second trail segment summary database containing one record of information and over 150 fields for each trail segment. New parameters added to this database included geographic position (described earlier), Park Ranger and Maintenance Subdistricts, trail use, and percent horse use. Trail use figures (persons/day) were obtained from Becky Van Cleave, who has conducted extensive use monitoring on park trails from 1988-93 (Van Cleave et al. 1990, Van Cleave and Beard 1993, Van Cleave and Van Cleave 1993). Estimates of percent horse use, in 10% classes, were obtained from backcountry managers most familiar with each surveyed trail segment. Total elevation change (ft/mi) was also computed by summing elevation gain and loss, obtained by counting the number of contour lines crossed by a trail on 1/24,000 scale maps, and dividing by the trail's length. SPSSPC+, a statistical package, was used to conduct all relational analyses reported in the Results section.

Further analyses will be conducted with the trail survey dataset for Mr. Leung's doctoral dissertation. In particular, these analyses will investigate spatial relationships using a Geographic Information System and multivariate statistics. Analysis, interpretation, and refinement of the trail survey quality assurance investigation will also be included. Completion of the dissertation is expected to require an additional 1 1/2 years.



## RESULTS AND DISCUSSION

As noted in the Methods section, an Addendum to this report contains complete listings of actual data from the 72 surveyed trail segments. This data can be reviewed in printed or electronic formats to yield additional information not contained in this report. In particular, the specific locations of trail or maintenance features and resource problems can be identified. For example, in many instances tread drainage problems are concentrated in a limited number of areas along a trail. The trail survey listings should provide useful information for directing future trail maintenance work.

The trail survey data also provide a baseline of trail resource conditions and maintenance features. Such data could be used for comparison with data from future surveys conducted using the same procedures (Appendix 2). Data therefore serve a monitoring function and provide a basis for management planning and decision making using models such as the Limits of Acceptable Change. Resource condition parameters could serve as indicators for which numeric standards can be set to indicate when trail conditions exceed acceptable levels of change. Standards could vary by management zone or by trail use type.

A note of caution is offered regarding use of the trail survey data for monitoring purposes. The trail surveys conducted in this study were rapid surveys employing a census rather than a sampling methodology for resource condition observations. Rapid surveys use less precise impact assessments but apply them to large numbers of trails and trail miles. Therefore, monitoring data comparisons or standards should be restricted to data aggregated over several miles of trail rather than to impacts at specific locations. For example, monitoring might legitimately compare summarized data for an entire trail or Maintenance subdistrict. A standard for multiple treads might read: "Less than an average of 125 feet/mile of parallel treads", with a qualifier that a minimum of 5 miles of trail must be surveyed.

Trail survey results are presented in three sections: Individual Trail Summaries, Grouped Trail Summaries, and Relational Analyses. The first section presents summary tables for each of the 72 trail segments, including trail-specific discussions and recommendations. Surveywide results and data summarized by park Ranger and Maintenance subdistricts and the Appalachian Trail are presented in the second section. In the final Relational Analyses section, data is analyzed by a variety of environmental and use-related factors to evaluate and describe the primary factors influencing trail resource conditions.

### Individual Trail Summaries

This section presents tables summarizing the inventory, resource condition, and design and maintenance parameters for each of the 72 trail segments surveyed. Trails are grouped by geographic area based on and ordered alphabetically by the first two letters of the park's trail name codes (see Appendix 1). Maps illustrating trail locations are included but scales vary. Dashed lines represent trails restricted to pedestrian use, solid lines represent trails open to both pedestrian and horse use. Arrows indicate trail segment endpoints. Information necessary to

interpret the tables is presented in Figure 3 and in the following comments:

- Trail summary tables present information only for those parameters observed along each trail segment (one or more occurrences). The number of parameters therefore varies among tables.
- A dashed line separates lineal feature parameters (e.g. wet soil) from point feature parameters (e.g. water bars). Total lineal distance information is not applicable to point feature data.
- Two columns of data from the tables facilitate comparisons among different trail segments: Occurrences (#/mi) and Total Lineal Distance (%). Data in these columns are not affected by varying trail lengths as are data in the remaining columns. However, for resource impacts the total lineal distance in feet or miles is likely a greater management concern than the percentage of a trail affected. For example, a 10 mile trail with 50% wet soil has 5 miles of wet soil, while a 2 mile trail with 50% wet soil has only 1 mile of wet soil. For this reason, percentiles for all lineal feature parameters were computed from the total lineal distance in feet to provide a ranking measure based on absolute change. For example, a trail segment with a percentile of 95 for wet soil indicates that 95% of all trail segments surveyed ( $.95 \times 72 = 68$  segments) have fewer lineal feet of wet soil. For all resource condition parameters, the eight worst trail segments have percentiles between 90 and 99 and are highlighted in the tables by bold print. Percentiles for point feature parameters were computed from the number of occurrences per mile and indicate the relative ranking in terms of their density for different trails. For example, a trail segment with a percentile of 95 for ineffective drainage dips indicates that 95% of all trail segments surveyed have a lower density (#/mi) of ineffective drainage dips.

Discussion associated with each table describe trail location, length, type of use, notable resource problems, maintenance features, design deficiencies, and recommendations. Recommendations reflect the judgement of the author based on the data and the comments of field staff; additional onsite reviews by qualified trail management personnel are also viewed as necessary to more fully describe the range of options and their relative merits.

This section concludes with a two-part table that ranks all trails by total lineal distance in feet per mile for each resource condition parameter. This measure, the number of feet per mile of trail exhibiting a particular resource problem, provides the most appropriate means for comparing the extent of resource change among trail segments.

### Trail Survey Parameter Descriptions

#### Inventory Parameters

Use Type: Pedestrian<sup>L</sup> - Segment is restricted to pedestrian use.

Use Type: Horse/Pedestrian<sup>L</sup> - Segment is open to horse use.

Tread Width: Trail 2-6 ft<sup>L</sup> - Segment is of trail width (2-6 ft).

Tread Width: Trail on Road 2-6 ft<sup>L</sup> - Segment is on a road which has narrowed to 2-6 feet in width.

Tread Width: Road > 6 ft<sup>L</sup> - Segment is on a road > 6 ft in width.

#### Resource Condition Parameters

Soil Erosion: 1-1.9 ft<sup>L</sup> - Segment has eroded an estimated 1-1.9 feet below original, post-construction, tread surface ... and so on for more highly eroded sections (2-2.9, 3-3.9, etc).

Excessive Root Exposure<sup>L</sup> - Segment has severe tree root exposure, tops/sides of roots are exposed.

Excessive Width: 3-6 ft<sup>L</sup> - Recreational use has caused a 3-6 foot expansion in trail width.

Excessive Width: >6 ft<sup>L</sup> - Recreational use has caused a >6 foot expansion in trail width.

Wet Soil<sup>L</sup> - Segment has wet soils on more than half of the tread width. Includes muddy soils or mud-holes with standing water reflecting "normal" soil moisture conditions.

Running Water on Trail<sup>L</sup> - Segment has water from a seep or stream running on the tread.

Multiple Tread<sup>L</sup> - Segment has more than one definable tread.

#### Design and Maintenance Parameters

Graveled Tread<sup>L</sup> - Tread of segment has had gravel applied.

Excessive Grade: >20%<sup>L</sup> - Segment has a grade exceeding 20%.

Trail Corduroy<sup>L</sup> - Segment has wood bridging for crossing wet soils.

Drainage Dip: Very Effective, Partially Effective, Ineffective<sup>P</sup> - An obvious human-constructed dip and berm configured to divert water from the tread. Effectiveness in diverting water also assessed.

Water Bar: Very Effective, Partially Effective, Ineffective<sup>P</sup> - A wooden or rock structure configured to divert water from the tread. Effectiveness in diverting water also assessed.

Lateral Drain<sup>P</sup> - Ditch along up-slope side of trail to collect and carry water.

Retaining Wall<sup>P</sup> - Wall or cribbing constructed of logs or rocks to retain soil.

Culvert<sup>P</sup> - Metal, rock, or wooden structure for carrying water across the tread.

Step<sup>P</sup> - Obviously human-placed rock or wooden structure that facilitates travel up or down a steep slope, including soil dams designed to retain soil in eroded treads.

Data from these parameters are summarized to provide the following:

**Occurrences:** Number and Number/Mile - The number of locations along a particular trail where a parameter was observed; divided by the trail segment length to derive the number of occurrences per trail mile.

**Total Lineal Distance:** Feet, Miles, and Percent - The sum of lineal distances from each occurrence of a lineal feature parameter expressed in feet, miles, or as a percent of total trail length.

**Percentiles:** Values which indicate the percentage of trail segments with parameter values below that of a given trail segment. For lineal feature parameters the percentiles are computed from the total lineal distance in feet for a given trail segment; for point feature parameters the percentiles are computed from the number of occurrences/mile for a given trail segment.

Figure 3. Trail survey parameter descriptions for interpreting trail summary tables.

Note: L = Lineal feature parameters have begin/end distances recorded to allow computation of the total lineal distance (feet and percent) of the trail segment that is representative of the parameter.

P = Point feature parameters reflect observation of items at single points.



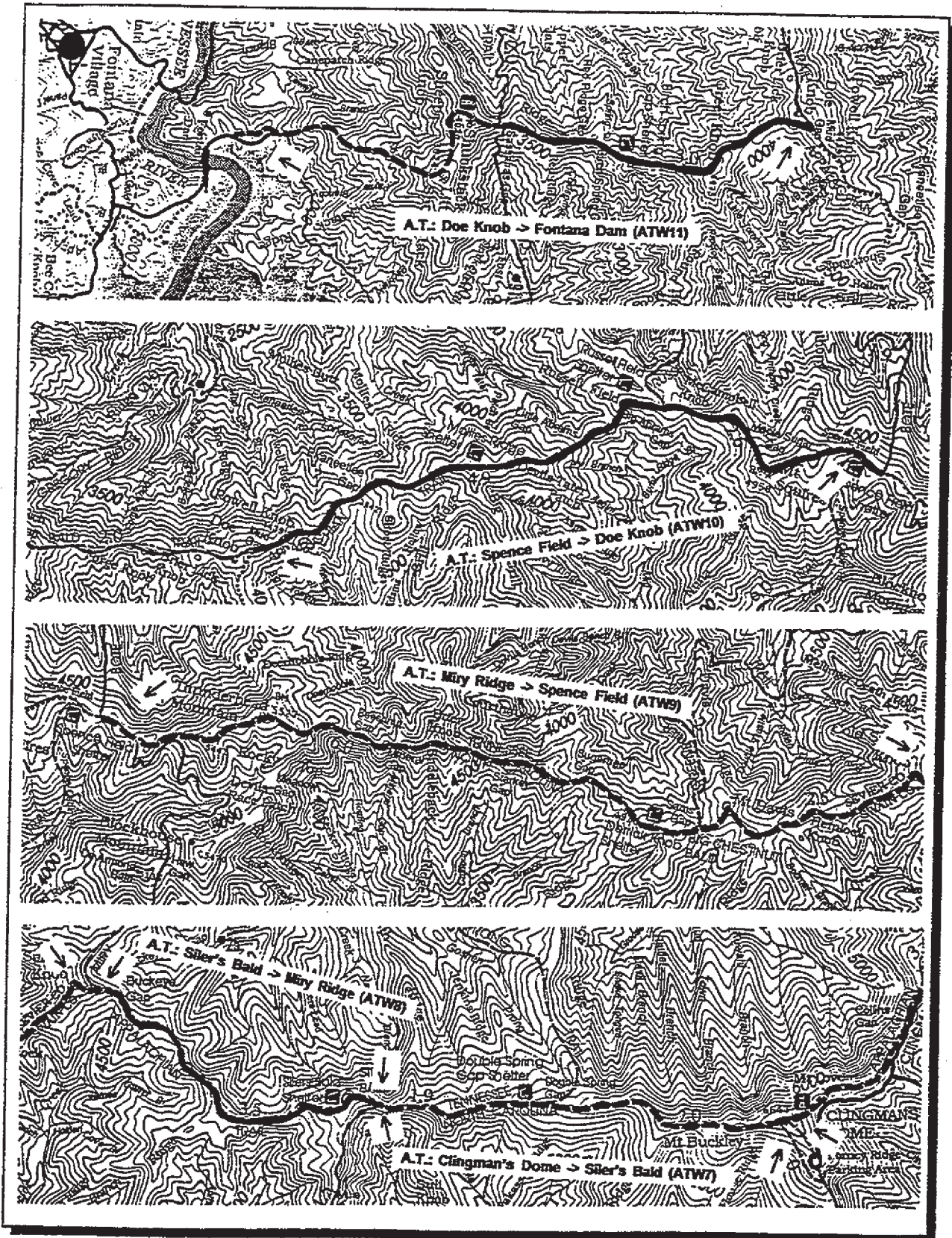


Figure 4. Topographic map of trail locations for the Appalachian Trail Corridor.



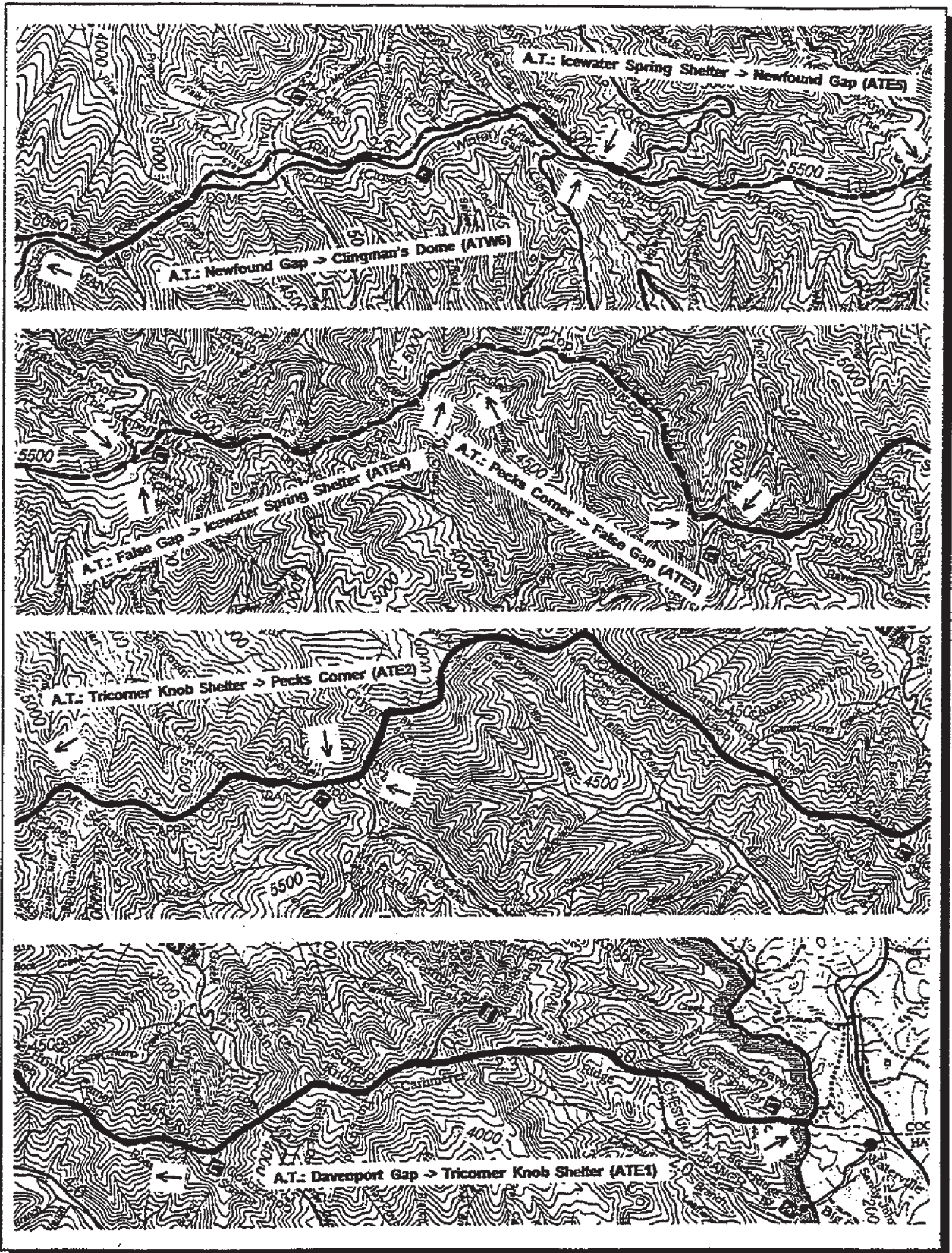


Figure 4. (continued)

## Results and Discussion: Appalachian Trail Corridor

**Table 5.** Appalachian Trail: Davenport Gap to Tricorner Knob Shelter (ATE1) resource and maintenance summary table.

Mileage: 16.04      Total Use: 13.4 persons/day      Horse Use: 20 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 19          | 1.2    | 3226                  | 0.61  | 3.8        | 91  |
| Soil Erosion: 2-2.9 ft      | 1           | 0.1    | 155                   | 0.03  | 0.2        | 79  |
| Multiple Tread              | 36          | 2.2    | 1533                  | 0.29  | 1.8        | 96  |
| Excessive Root Exposure     | 4           | 0.2    | 295                   | 0.06  | 0.3        | 83  |
| Width: Trail 2-6 ft         | 1           | -      | 84704                 | 16.04 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 84704                 | 16.04 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 3           | 0.2    | 170                   | 0.03  | 0.2        | 83  |
| Wet Soil                    | 19          | 1.2    | 714                   | 0.14  | 0.8        | 77  |
| Running Water on Trail      | 9           | 0.6    | 488                   | 0.09  | 0.6        | 88  |
| -----                       |             |        |                       |       |            |     |
| Culvert                     | 1           | 0.1    |                       |       |            | 57  |
| Drainage Dip: Ineffective   | 121         | 7.5    |                       |       |            | 74  |
| Drainage Dip: Part. Effect. | 159         | 9.9    |                       |       |            | 80  |
| Drainage Dip: Very Effect.  | 101         | 6.3    |                       |       |            | 80  |
| Lateral Drain               | 1           | 0.1    |                       |       |            | 70  |
| Retaining Wall              | 31          | 1.9    |                       |       |            | 92  |
| Water Bar: Ineffective      | 95          | 5.9    |                       |       |            | 79  |
| Water Bar: Part. Effective  | 48          | 3.0    |                       |       |            | 70  |
| Water Bar: Very Effective   | 80          | 5.0    |                       |       |            | 72  |

This 16.04 mile section of the Appalachian Trail runs from Davenport Gap (elevation 2,040 feet) to the Tricorner Knob Shelter spur trail (elevation 5,920 feet). The overall design of the trail is excellent. The trail ascends gradually with switchbacks before running the ridgetop for most of the segment. This segment is open to horses and hikers and is of trail width.

From Low Gap to Cosby Knob and from the Chestnut Branch Trail to Mount Cammerer, the drainage of the tread is often poor, however many new drainage dips are present. Erosion is a problem on the descents into these areas with the tread occasionally eroded to clay or rock. There are 19 occurrences of soil erosion, 1-1.9 feet, in this section including 3.8% of the trail's length. User impacts (including horses) do not seem to be a problem on the ridge line portions of the segment, however, impacts from horses are particularly noticeable on the steeper climbs and descents. Other notable impacts include 36 occurrences of multiple treads, 19 occurrences of wet soil, and 9 occurrences of running water on the trail. This segment of trail seems to be well maintained, with a fair number of drainage dips and water bars. Many of the drainage features have been recently cleared although 36% of these features are ineffective.

**Summary/Recommendations:** This section of the Appalachian Trail is in good condition where it runs the ridgetops but fair condition in many areas where slopes are steeper. For most areas the number of tread drainage features are sufficient although many require cleaning.



Table 6. Appalachian Trail: Tricorner Knob Shelter to Pecks Corner (ATE2) resource and maintenance summary table.

| Mileage: <u>5.19</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>30</u> % of total use |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 15                               | 2.9    | 1148                                | 0.22 | 4.2        | 77  |
| Soil Erosion: 2-2.9 ft      | 2                                | 0.4    | 68                                  | 0.02 | 0.4        | 81  |
| Multiple Tread              | 7                                | 1.3    | 248                                 | 0.05 | 0.9        | 59  |
| Excessive Root Exposure     | 4                                | 0.8    | 77                                  | 0.01 | 0.3        | 55  |
| Width: Trail 2-6 ft         | 1                                | -      | 27388                               | 5.19 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 27388                               | 5.19 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 2                                | 0.4    | 58                                  | 0.01 | 0.2        | 66  |
| Wet Soil                    | 12                               | 2.3    | 463                                 | 0.09 | 1.7        | 69  |
| Running Water on Trail      | 2                                | 0.4    | 76                                  | 0.01 | 0.3        | 48  |
| -----                       |                                  |        |                                     |      |            |     |
| Drainage Dip: Part. Effect. | 1                                | 0.2    |                                     |      |            | 24  |
| Retaining Wall              | 22                               | 4.2    |                                     |      |            | 95  |
| Step                        | 2                                | 0.4    |                                     |      |            | 88  |
| Water Bar: Ineffective      | 48                               | 9.3    |                                     |      |            | 88  |
| Water Bar: Part. Effective  | 56                               | 10.8   |                                     |      |            | 94  |
| Water Bar: Very Effective   | 81                               | 15.6   |                                     |      |            | 91  |

The original design and layout of the trail is excellent with the trail following the ridge line from Tricorner Knob Shelter spur trail (elevation 5,920 feet) to the junction with Hughes Ridge Trail (elevation 5,360 feet). The entire 5.19 mile segment is of trail width and is open to horse use.

The principal resource problems on this segment are erosion and wet soils, especially along the lower slopes of Mount Chatman. Fifteen occurrences of soil erosion, 1-1.9 feet, and 12 occurrences of wet soil are noted. However, the trail's overall condition is good for the amount of use it receives. Horse impacts are minimal, possibly due to the ridge top location and dry characteristics for most of the segment. Erosion appears to be starting in many areas where erosion of less than one foot is evident. The segment contains a fair number of maintenance features, particularly water bars and retaining walls. Furthermore, most of the water bars (44%) are very effective.

Summary/Recommendations: As for segment ATE1, the trail is in good condition in ridgetop locations and fair condition on steeper slopes. Soil erosion and wet soil problems appear to require additional drainage features and more frequent maintenance of existing features.

## Results and Discussion: Appalachian Trail Corridor

**Table 7.** Appalachian Trail: Pecks Corner to False Gap (ATE3) resource and maintenance summary table.

|                             |                                   |                                    |                       |      |            |
|-----------------------------|-----------------------------------|------------------------------------|-----------------------|------|------------|
| Mileage: <u>3.91</u>        | Total Use: <u>9.3</u> persons/day | Horse Use: <u>0</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                    | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                               | (#/mi)                             | (ft)                  | (mi) | (%)        |
| Excessive Grade: >20%       | 1                                 | 0.3                                | 50                    | 0.01 | 0.2        |
| Width: Trail 2-6 ft         | 1                                 | -                                  | 20567                 | 3.90 | 100.0      |
| Use Type: Pedestrian        | 1                                 | -                                  | 20567                 | 3.90 | 100.0      |
| -----                       |                                   |                                    |                       |      |            |
| Drainage Dip: Part. Effect. | 2                                 | 0.5                                |                       |      |            |
| Retaining Wall              | 30                                | 7.7                                |                       |      | 33         |
| Water Bar: Ineffective      | 16                                | 4.1                                |                       |      | 99         |
| Water Bar: Part. Effective  | 17                                | 4.4                                |                       |      | 77         |
| Water Bar: Very Effective   | 38                                | 9.8                                |                       |      | 80         |
|                             |                                   |                                    |                       |      | 84         |

This 3.90 mile segment of the Appalachian Trail is well designed to follow the ridge line on the contours. The segment begins at the Hughes Ridge Trail (elevation 5,360 feet) and ends at False Gap (elevation 5,233 feet). The segment is of trail width and is restricted to pedestrian use.

The trail appears to be well drained due to its position on the ridge top with well maintained drainage features. The tread is also prevented from eroding on the narrow ridge tops by numerous stone retaining walls. As for many other sections of the Appalachian Trail, trampling resistant grasses and sedges closely parallel the tread in more open areas, playing a significant role in preventing soil erosion. Because of the grasses, the tread width is less than one foot for the entire segment. The ridge top characteristics of the segment seem to be highly resistant to hiker impacts.

**Summary/Recommendations:** Overall the segment is in very good condition. No actions are necessary at this time.



Table 8. Appalachian Trail: False Gap to Icewater Spring Shelter (ATE4) resource and maintenance summary table.

| Mileage: <u>3.80</u>        | Total Use: <u>35.2</u> persons/day |        | Horse Use: <u>0</u> % of total use |       |            |     |
|-----------------------------|------------------------------------|--------|------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |       | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                               | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 8                                  | 2.1    | 869                                | 0.16  | 4.3        | 72  |
| Soil Erosion: 2-2.9 ft      | 2                                  | 0.5    | 213                                | 0.04  | 1.1        | 87  |
| Multiple Tread              | 3                                  | 0.8    | 67                                 | 0.01  | 0.3        | 31  |
| Excessive Root Exposure     | 7                                  | 1.8    | 220                                | 0.04  | 0.8        | 73  |
| Width: Trail 2-6 ft         | 1                                  | -      | 20081                              | 3.80  | 100.0      | -   |
| Use Type: Pedestrian        | 1                                  | -      | 20081                              | 3.80  | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 1                                  | 0.3    | 15                                 | <0.01 | 0.1        | 54  |
| Wet Soil                    | 1                                  | 0.3    | 23                                 | <0.01 | 0.1        | 27  |
| Running Water on Trail      | 2                                  | 0.5    | 271                                | 0.05  | 1.3        | 73  |
| Drainage Dip: Ineffective   | 1                                  | 0.3    |                                    |       |            | 26  |
| Drainage Dip: Part. Effect. | 2                                  | 0.5    |                                    |       |            | 33  |
| Drainage Dip: Very Effect.  | 3                                  | 0.8    |                                    |       |            | 56  |
| Retaining Wall              | 18                                 | 4.7    |                                    |       |            | 98  |
| Step                        | 1                                  | 0.3    |                                    |       |            | 85  |
| Water Bar: Ineffective      | 9                                  | 2.4    |                                    |       |            | 65  |
| Water Bar: Part. Effective  | 15                                 | 3.9    |                                    |       |            | 77  |
| Water Bar: Very Effective   | 21                                 | 5.5    |                                    |       |            | 74  |

The design and layout of this 3.80 mile segment of the Appalachian Trail is excellent. This segment follows the ridgeline and contours from False Gap (elevation 5,233 feet) to the Icewater Spring Shelter spur trail (elevation 5,920). The segment is of trail width and is restricted to hikers.

Due to the segment's ridge line location, water accumulation and erosion are minimal. Well maintained drainage features also aid in drainage of the tread. Large stone retaining walls in many areas, keep the tread from eroding off of the narrow ridge tops. However, high use up to Charlie's Bunion contributes to serious deterioration of the tread. Soil erosion and excessive root exposure are reoccurring problems. Once the trail passes Charlie's Bunion use declines and tread conditions improve considerably.

Summary/Recommendations: Extremely high use contributes to tread deterioration as far as Charlie's Bunion, however, trail maintenance is generally good and the trail is well-designed and resistant to impacts. A high level of maintenance will always be necessary to prevent erosion on high use sections of the segment.

## Results and Discussion: Appalachian Trail Corridor

**Table 9.** Appalachian Trail: Icewater Spring Shelter to Newfound Gap (ATE5) resource and maintenance summary table.

| Mileage: <u>3.06</u>       | Total Use: <u>156.4</u> persons/day |        | Horse Use: <u>0</u> % of total use |       |            |     |
|----------------------------|-------------------------------------|--------|------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                         |        | TOTAL LINEAL DISTANCE              |       | PERCENTILE |     |
|                            | (#)                                 | (#/mi) | (ft)                               | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 16                                  | 5.2    | 3552                               | 0.67  | 22.0       | 92  |
| Soil Erosion: 2-2.9 ft     | 1                                   | 0.3    | 131                                | 0.02  | 0.8        | 76  |
| Soil Erosion: 3-3.9 ft     | 1                                   | 0.3    | 25                                 | <0.01 | 0.2        | 87  |
| Multiple Tread             | 22                                  | 7.2    | 669                                | 0.13  | 4.2        | 77  |
| Excessive Root Exposure    | 24                                  | 7.9    | 975                                | 0.18  | 6.0        | 95  |
| Width: Trail 2-6 ft        | 1                                   | -      | 16135                              | 3.06  | 100.0      | -   |
| Use Type: Pedestrian       | 1                                   | -      | 16135                              | 3.06  | 100.0      | -   |
| Trail Corduroy             | 1                                   | 0.3    | 41                                 | 0.01  | 0.3        | 98  |
| Excessive Width: + 3-6 ft  | 2                                   | 0.7    | 44                                 | 0.01  | 0.3        | 61  |
| Wet Soil                   | 6                                   | 2.0    | 180                                | 0.03  | 1.1        | 50  |
| -----                      |                                     |        |                                    |       |            |     |
| Drainage Dip: Ineffective  | 2                                   | 0.7    |                                    |       |            | 33  |
| Retaining Wall             | 4                                   | 1.3    |                                    |       |            | 85  |
| Water Bar: Ineffective     | 55                                  | 18.0   |                                    |       |            | 95  |
| Water Bar: Part. Effective | 35                                  | 11.5   |                                    |       |            | 95  |
| Water Bar: Very Effective  | 16                                  | 5.2    |                                    |       |            | 73  |

The original design of this 3.06 mile segment is good as the trail extends along the ridgeline from the Icewater Spring Shelter spur trail (elevation 5,920) before descending to Newfound Gap (elevation 5,035). The entire segment is of trail width and restricted to hikers.

Heavy foot traffic to Charlie's Bunion seems to be the most significant reason for the resource problems in this segment. Sixteen occurrences of soil erosion, 1-1.9 feet, for 22% of the segment's length is the most significant problem. Excessive root exposure (24 occurrences) and multiple treads (22 occurrences) are also problems. The tread throughout most of the segment has been eroded down to clay or rock. The highly compacted soil seems to contribute to poor drainage in some locations. Water bars are abundant although many (52%) are ineffective, a number of which allowed water to flow under the water bars.

**Summary/Recommendations:** Significant traffic to Charlie's Bunion has caused some significant tread erosion. The current number of tread drainage features may be sufficient but most require work to increase their effectiveness. The trail's design is good and the environment is highly resistant to impacts.

Table 10. Appalachian Trail: Newfound Gap to Clingman's Dome (ATW6) resource and maintenance summary table.

|                             |                                   |                                    |                       |      |            |
|-----------------------------|-----------------------------------|------------------------------------|-----------------------|------|------------|
| Mileage: <u>7.87</u>        | Total Use: <u>6.0</u> persons/day | Horse Use: <u>0</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                    | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                               | (#/mi)                             | (ft)                  | (mi) | (%)        |
| Soil Erosion: 1-1.9 ft      | 83                                | 10.5                               | 4012                  | 0.80 | 10.2       |
| Soil Erosion: 2-2.9 ft      | 9                                 | 1.1                                | 561                   | 0.11 | 1.4        |
| Soil Erosion: 3-3.9 ft      | 2                                 | 0.3                                | 72                    | 0.01 | 0.2        |
| Excessive Grade: >20%       | 3                                 | 0.4                                | 91                    | 0.02 | 0.2        |
| Multiple Tread              | 1                                 | 0.1                                | 27                    | 0.01 | 0.1        |
| Excessive Root Exposure     | 10                                | 1.3                                | 255                   | 0.05 | 0.6        |
| Width: Trail 2-6 ft         | 1                                 | -                                  | 41552                 | 7.87 | 100.0      |
| Use Type: Pedestrian        | 1                                 | -                                  | 41552                 | 7.87 | 100.0      |
| Trail Corduroy              | 12                                | 1.5                                | 498                   | 0.09 | 1.2        |
| Wet Soil                    | 45                                | 5.7                                | 3485                  | 0.66 | 8.4        |
| Running Water on Trail      | 6                                 | 0.8                                | 197                   | 0.04 | 0.5        |
| -----                       |                                   |                                    |                       |      |            |
| Culvert                     | 8                                 | 1.0                                |                       |      | 79         |
| Drainage Dip: Part. Effect. | 4                                 | 0.5                                |                       |      | 33         |
| Lateral Drain               | 14                                | 1.8                                |                       |      | 98         |
| Retaining Wall              | 15                                | 1.9                                |                       |      | 92         |
| Step                        | 350                               | 44.5                               |                       |      | 99         |
| Water Bar: Ineffective      | 57                                | 7.2                                |                       |      | 83         |
| Water Bar: Part. Effective  | 110                               | 14.0                               |                       |      | 99         |
| Water Bar: Very Effective   | 266                               | 33.8                               |                       |      | 99         |

This 7.87 mile section of the Appalachian Trail runs from Newfound Gap (elevation 5,048 feet) to the summit of Clingman's Dome (elevation 6,640 feet). The trail was well-designed to follow the shoulder or crest of the main ridge ascending gradually with occasional switchbacks. This highly accessible segment receives heavy use by hikers but horse use is prohibited.

The principal resource problems on this segment are erosion and wet soil. Eighty-three occurrences of soil erosion, 1-1.9 feet, and nine occurrences of erosion, 2-2.9 feet, were noted. These problems comprise 11.6% of the trail's length, occurring primarily in areas with steeper slopes. In some locations trails have eroded down to bedrock and are therefore stable. Wet soil was found in 45 locations over 8.4% of the trail segment. The amount and quality of trail maintenance was good, particularly for the section between Indian Gap and Mount Collins. High quality maintenance features were evident in many areas, including extensive trail corduroy, stairs, soil dams, bridges, and lateral drains along raised treads. These measures appear to alleviate most of the wet soil conditions often associated with the highly organic soils of spruce-fir forests. The amount of maintenance found on this section may not be possible to attain or necessary on other less accessible and lower use trails. The remaining areas also appeared to receive significant maintenance attention.

**Summary/Recommendations:** This segment of the Appalachian Trail is in fair condition, primarily due to its long history of intensive use. Good original design and more recent high quality maintenance contribute to preventing further deterioration on this heavily used section. Some additional maintenance attention to resolve wet soils on the trail are needed.

## Results and Discussion: Appalachian Trail Corridor

**Table 11. Appalachian Trail: Clingman's Dome to Silers Bald (ATW7) resource and maintenance summary table.**

| Mileage: <u>4.42</u>       | Total Use: <u>30.2</u> persons/day |        | Horse Use: <u>0</u> % of total use |       |            |     |
|----------------------------|------------------------------------|--------|------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |       | PERCENTILE |     |
|                            | (#)                                | (#/mi) | (ft)                               | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 44                                 | 9.9    | 4960                               | 0.94  | 21.2       | 96  |
| Soil Erosion: 2-2.9 ft     | 3                                  | 0.7    | 192                                | 0.04  | 0.8        | 84  |
| Excessive Grade: >20%      | 2                                  | 0.5    | 56                                 | 0.01  | 0.2        | 64  |
| Multiple Tread             | 8                                  | 1.8    | 307                                | 0.06  | 1.3        | 62  |
| Width: Trail 2-6 ft        | 1                                  | -      | 23356                              | 4.42  | 100.0      | -   |
| Use Type: Pedestrian       | 1                                  | -      | 22457                              | 4.25  | 96.2       | -   |
| Use Type: Horse/Pedestrian | 1                                  | -      | 899                                | 0.17  | 3.8        | -   |
| Excessive Width: + 3-6 ft  | 1                                  | 0.2    | 23                                 | <0.01 | 0.1        | 55  |
| Wet Soil                   | 24                                 | 5.4    | 1773                               | 0.34  | 7.6        | 90  |
| <hr/>                      |                                    |        |                                    |       |            |     |
| Lateral Drain              | 1                                  | 0.2    |                                    |       |            | 77  |
| Retaining Wall             | 1                                  | 0.2    |                                    |       |            | 58  |
| Step                       | 18                                 | 4.1    |                                    |       |            | 98  |
| Water Bar: Ineffective     | 92                                 | 20.8   |                                    |       |            | 98  |
| Water Bar: Part. Effective | 51                                 | 11.5   |                                    |       |            | 96  |
| Water Bar: Very Effective  | 86                                 | 19.4   |                                    |       |            | 95  |

This section the Appalachian Trail follows the ridgeline with gradual grades for the majority of the distance from Clingman's Dome (elevation 6,640 feet) to Silers Bald (elevation 5,607 feet). This 4.42 mile segment is of trail width and is restricted to hikers, excepting a short segment beyond the junction with the Welch Ridge Trail.

The amount of use and frequency of maintenance were noticeably lower, in comparison to the Newfound Gap/Clingman's Dome section. Water bars were often deteriorated and the trail was overgrown in some areas. Erosion, in the form of deep rutting, was a problem in the bald areas, where the trail is narrow, and on the steep sections approaching Silers Bald. Forty-four occurrences of soil erosion, 1-1.9 feet, were noted, affecting 21.2% of the segment. Many additional sections with obvious rutting less than one foot in depth are also evident. Wet soil was a problem in some of these areas, with 24 occurrences noted (7.6% of the segment). Horse use is permitted beyond the intersection with the Welch Ridge Trail, however, horse use was not evident. Problems with multiple trails were minimal in the bald areas, in comparison to other similar areas in the park.

**Summary/Recommendations:** This section of the Appalachian Trail is in fair condition, with soil erosion and wet soil the primary problems. Refurbishing existing waterbars and placing new drainage features and soil dams in eroded areas would alleviate the major problems found in this section.



Table 12. Appalachian Trail: Silers Bald to Miry Ridge (ATW8) resource and maintenance summary table.

| Mileage: <u>3.11</u>       | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>10</u> % of total use |      |            |     |
|----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                            | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 20                               | 6.4    | 1242                                | 0.24 | 7.6        | 80  |
| Soil Erosion: 2-2.9 ft     | 2                                | 0.6    | 92                                  | 0.02 | 0.6        | 72  |
| Excessive Grade: >20%      | 2                                | 0.6    | 235                                 | 0.04 | 1.4        | 69  |
| Multiple Tread             | 1                                | 0.3    | 41                                  | 0.01 | 0.2        | 22  |
| Width: Trail 2-6 ft        | 1                                | -      | 16416                               | 3.11 | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                | -      | 16416                               | 3.11 | 100.0      | -   |
| Wet Soil                   | 14                               | 4.5    | 568                                 | 0.11 | 3.5        | 73  |
| <hr/>                      |                                  |        |                                     |      |            |     |
| Drainage Dip: Ineffective  | 8                                | 2.6    |                                     |      |            | 48  |
| Drainage Dip: Very Effect. | 3                                | 1.0    |                                     |      |            | 61  |
| Water Bar: Ineffective     | 21                               | 6.8    |                                     |      |            | 81  |
| Water Bar: Part. Effective | 25                               | 8.0    |                                     |      |            | 88  |
| Water Bar: Very Effective  | 50                               | 16.1   |                                     |      |            | 92  |

This section of the Appalachian Trail begins at Silers Bald (elevation 5,607 feet) and ends at the Miry Ridge Trail junction (elevation 4,900 feet). The 3.11 mile segment is generally level with occasional steeply ascending and descending stretches along the ridge crest. The segment is open to horse use and is of trail width.

The trail is in good condition with moderate levels of use. Tread rutting was a problem in some areas, with 20 occurrences of soil erosion, 1-1.9 feet. Some wet soil was also evident although the segment had numerous waterbars which were generally in good condition.

Summary/Recommendations: Soil erosion in the form of rutting is the only notable resource problem for this section of the Appalachian Trail. The number and condition of existing tread drainage features appear to be sufficient to prevent further degradation.

## Results and Discussion: Appalachian Trail Corridor

**Table 13.** Appalachian Trail: Miry Ridge to Spence Field (ATW9) resource and maintenance summary table.

| Mileage: <u>9.00</u>        | Total Use: <u>14.8</u> persons/day |        | Horse Use: <u>0</u> % of total use |      |            |     |
|-----------------------------|------------------------------------|--------|------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |      | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                               | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 28                                 | 3.1    | 2176                               | 0.41 | 4.6        | 88  |
| Soil Erosion: 2-2.9 ft      | 1                                  | 0.1    | 51                                 | 0.01 | 0.1        | 65  |
| Excessive Grade: >20%       | 27                                 | 3.0    | 5691                               | 1.08 | 11.7       | 99  |
| Multiple Tread              | 12                                 | 1.3    | 1293                               | 0.24 | 2.7        | 94  |
| Width: Trail 2-6 ft         | 1                                  | -      | 47541                              | 9.00 | 100.0      | -   |
| Use Type: Pedestrian        | 1                                  | -      | 47541                              | 9.00 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 1                                  | 0.1    | 120                                | 0.02 | 0.3        | 77  |
| Wet Soil                    | 13                                 | 1.4    | 617                                | 0.12 | 1.3        | 76  |
| -----                       |                                    |        |                                    |      |            |     |
| Drainage Dip: Ineffective   | 13                                 | 1.4    |                                    |      |            | 36  |
| Drainage Dip: Part. Effect. | 4                                  | 0.4    |                                    |      |            | 30  |
| Retaining Wall              | 1                                  | 0.1    |                                    |      |            | 53  |
| Step                        | 2                                  | 0.2    |                                    |      |            | 81  |
| Water Bar: Ineffective      | 126                                | 14.0   |                                    |      |            | 94  |
| Water Bar: Part. Effective  | 61                                 | 6.8    |                                    |      |            | 85  |
| Water Bar: Very Effective   | 60                                 | 6.7    |                                    |      |            | 76  |

This 9.0 mile section of the Appalachian Trail begins at the junction with the Miry Ridge trail (elevation 4,900 feet) and follows the main ridge to Spence Field (junction with Bote Mountain Trail (elevation 4,900 feet). The trail remains on the ridgecrest, steeply ascending and descending to the numerous knobs and gaps. The segment is restricted to hikers and is of trail width.

The trail is not well designed in places, lacking switchbacks for the majority of its ascents and descents. Twenty-seven occurrences of grades in excess of 20% were noted (11.7% of the segment's length). In particular, the Thunderhead Mountain area was highly eroded and excessively steep. The switchbacks installed here do seem to make a difference though. The trail was most often narrow, and slightly rutted. Use levels appeared to be low. Trail maintenance is poor, with 126 (51%) of the water bars rated as ineffective in removing water from the tread.

**Summary/Recommendations:** Overall, the trail is in good condition, considering the potential for serious erosion on the many steep sections. Maintenance on existing tread drainage features is an immediate need. The installation of additional switchbacks, particularly in places like Briar Knob (30% + grades) is also recommended.

Table 14. Appalachian Trail: Spence Field to Doe Knob (ATW10) resource and maintenance summary table.

Mileage: 7.70 Total Use: 17.4 persons/day Horse Use: 30 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 30          | 3.9    | 6095                  | 1.15 | 15.0       | 98  |
| Soil Erosion: 2-2.9 ft      | 2           | 0.3    | 96                    | 0.02 | 0.2        | 73  |
| Excessive Grade: >20%       | 6           | 0.8    | 2357                  | 0.45 | 5.8        | 96  |
| Multiple Tread              | 21          | 2.7    | 1218                  | 0.23 | 3.0        | 92  |
| Width: Trail 2-6 ft         | 1           | -      | 40678                 | 7.70 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 40678                 | 7.70 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 15          | 1.9    | 1455                  | 0.28 | 3.6        | 98  |
| Excessive Width: + >6 ft    | 4           | 0.5    | 289                   | 0.05 | 0.7        | 96  |
| Wet Soil                    | 11          | 1.4    | 1411                  | 0.27 | 3.5        | 87  |
| Drainage Dip: Ineffective   | 21          | 2.7    |                       |      |            | 50  |
| Drainage Dip: Part. Effect. | 5           | 0.6    |                       |      |            | 37  |
| Drainage Dip: Very Effect.  | 2           | 0.3    |                       |      |            | 42  |
| Water Bar: Ineffective      | 89          | 11.5   |                       |      |            | 91  |
| Water Bar: Part. Effective  | 41          | 5.3    |                       |      |            | 84  |
| Water Bar: Very Effective   | 63          | 8.2    |                       |      |            | 80  |

This segment of the Appalachian Trail extends from Spence Field (Bote Mountain Trail junction) (elevation 4,900 feet) to its junction with the Gregory Bald Trail at Doe Knob (elevation 4,440 feet). The entire 7.70 mile segment is open to horses and is of trail width.

This segment of the Appalachian Trail was similar to others, with the trail ascending and descending knobs on a ridgetop position. Soil erosion, 1-1.9 feet, was the primary resource problem, with 30 occurrences and affecting 15% of the segment. Other problems included multiple treads (21 occurrences) and excessive width (19 occurrences). Horse use appears to be heavy between Spence Field and Russell Field, contributing significantly to resource problems. Tread maintenance is generally poor, with too few and mostly ineffective drainage features. A number of waterbars within this section were massive enough to cause trail users to walk around them. Improved placement, length, and sizing is needed to prevent this problem.

Summary/Recommendations: This section of the Appalachian Trail is in fair to good condition. Tread rutting with multiple treads and trail widening are the primary resource problems. Additional tread maintenance work is needed to contain use to the main tread and refurbish old drainage dips and water bars.

# Results and Discussion: Appalachian Trail Corridor

Table 15. Appalachian Trail: Doe Knob to Fontana Dam (ATW11) resource and maintenance summary table.

| Mileage: <u>6.88</u>        | Total Use: <u>16.6</u> persons/day |        | Horse Use: <u>10</u> % of total use |       |            |     |
|-----------------------------|------------------------------------|--------|-------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE               |       | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                                | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 11                                 | 1.6    | 882                                 | 0.17  | 2.4        | 73  |
| Excessive Grade: >20%       | 9                                  | 1.3    | 1561                                | 0.30  | 4.3        | 94  |
| Multiple Tread              | 2                                  | 0.3    | 359                                 | 0.07  | 1.0        | 65  |
| Width: Trail 2-6 ft         | 1                                  | -      | 16501                               | 3.13  | 45.5       | -   |
| Width: Trail on Road 2-6 ft | 1                                  | -      | 19775                               | 3.75  | 54.5       | -   |
| Use Type: Horse/Pedestrian  | 1                                  | -      | 16501                               | 3.13  | 45.5       | -   |
| Use Type: Pedestrian        | 1                                  | -      | 19775                               | 3.75  | 54.5       | -   |
| Wet Soil                    | 1                                  | 0.1    | 25                                  | <0.01 | 0.1        | 28  |
| -----                       |                                    |        |                                     |       |            |     |
| Culvert                     | 1                                  | 0.1    |                                     |       |            | 57  |
| Drainage Dip: Ineffective   | 2                                  | 0.3    |                                     |       |            | 26  |
| Drainage Dip: Part. Effect. | 2                                  | 0.3    |                                     |       |            | 27  |
| Drainage Dip: Very Effect.  | 1                                  | 0.1    |                                     |       |            | 36  |
| Step                        | 3                                  | 0.4    |                                     |       |            | 80  |
| Water Bar: Ineffective      | 24                                 | 3.5    |                                     |       |            | 73  |
| Water Bar: Part. Effective  | 26                                 | 3.8    |                                     |       |            | 75  |
| Water Bar: Very Effective   | 33                                 | 4.8    |                                     |       |            | 70  |

This 6.88 mile section of the Appalachian Trail extends from Doe Knob (Gregory Bald Trail) (elevation 4,440 feet) to Fontana Dam (elevation 1,700 feet). The first portion of this segment traverses several knobs before making a final descent from the Shuckstack down to Fontana Dam. Almost half of the segment is open to horses and is of trail width, with the remainder following a dirt woods road.

This section is well designed and in relatively good condition. Resource problems included only 11 occurrences of soil erosion, 1-1.9 feet (2.4% of the segment), in spite of 9 occurrences of excessive grade (4.3% of the segment). The section from Shuckstack to Fontana Dam was particularly well-designed, with numerous switchbacks. Relatively few trail maintenance features were noted.

Summary/Recommendations: This section of the Appalachian Trail is in good condition. Existing maintenance features were sparse but for the most part are sufficient for current use levels.



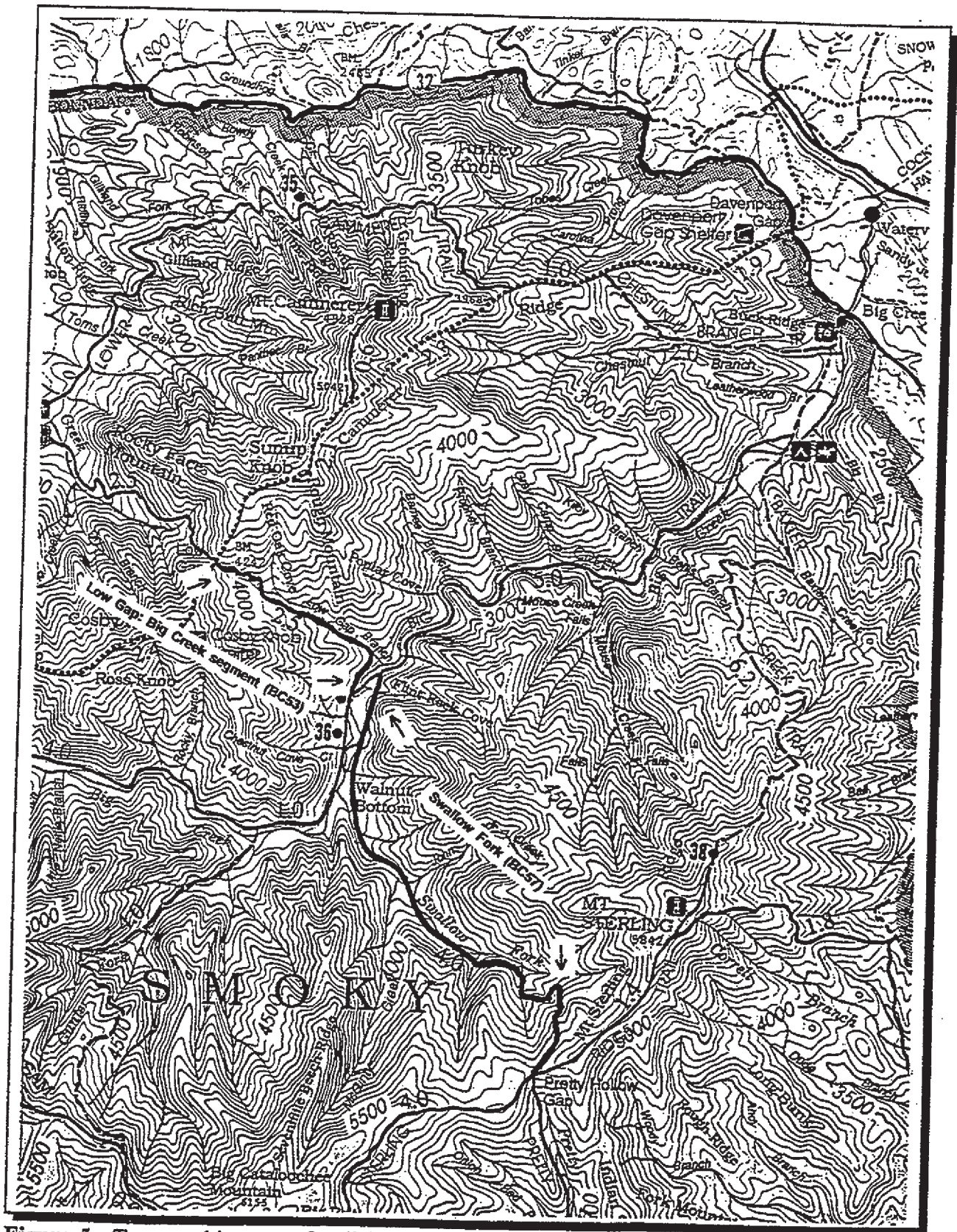


Figure 5. Topographic map of trail locations for the Big Creek area.

## Results and Discussion: Big Creek Geographic Area

Table 16. Low Gap Trail: Big Creek segment (BC53) resource and maintenance summary table.

|                            |                                  |                                     |                       |       |            |     |
|----------------------------|----------------------------------|-------------------------------------|-----------------------|-------|------------|-----|
| Mileage: <u>2.74</u>       | Total Use: <u>UK</u> persons/day | Horse Use: <u>50</u> % of total use |                       |       |            |     |
| TRAIL ATTRIBUTE            | OCCURRENCES                      |                                     | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|                            | (#)                              | (#/mi)                              | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 19                               | 6.9                                 | 3688                  | 0.70  | 25.5       | 94  |
| Soil Erosion: 2-2.9 ft     | 3                                | 1.1                                 | 206                   | 0.04  | 1.4        | 85  |
| Multiple Tread             | 1                                | 0.4                                 | 26                    | <0.01 | 0.2        | 17  |
| Excessive Root Exposure    | 10                               | 3.6                                 | 833                   | 0.16  | 5.7        | 94  |
| Width: Trail 2-6 ft        | 1                                | -                                   | 14491                 | 2.74  | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                | -                                   | 14491                 | 2.74  | 100.0      | -   |
| Excessive Width: + 3-6 ft  | 1                                | 0.4                                 | 88                    | 0.02  | 0.6        | 73  |
| Wet Soil                   | 2                                | 0.7                                 | 146                   | 0.03  | 1.0        | 46  |
| Running Water on Trail     | 2                                | 0.7                                 | 334                   | 0.06  | 2.3        | 80  |
| -----                      |                                  |                                     |                       |       |            |     |
| Drainage Dip: Ineffective  | 2                                | 0.7                                 |                       |       |            | 33  |
| Retaining Wall             | 2                                | 0.7                                 |                       |       |            | 74  |
| Water Bar: Ineffective     | 2                                | 0.7                                 |                       |       |            | 47  |

The design of this segment of the Low Gap Trail mostly follows the contours from Walnut Bottoms (elevation 3,000 feet) up to Low Gap and the Appalachian Trail (elevation 4,240 feet), a distance of 2.74 miles. The trail is of trail width and is open to horses.

The trail is in good condition where it parallels Big Creek and the Low Gap Branch, but tread conditions deteriorate on the long steep sections as the trail begins to ascend the ridge. The survey revealed 19 occurrences of soil erosion, 1-1.9 feet, for a full quarter of the trail's length. Excessive root exposure is a related problem, with 10 occurrences and affecting 5.7% of the trail. These problems appear to be due to inefficient drainage. Only four tread drainage features are found on this segment. However, the tread is very rocky and impact resistant, even tolerating horse use well in many areas.

Summary/Recommendations: The trail is generally impact resistant due to rocky soils and is in good condition in areas lacking steep slopes. However, maintenance features are almost entirely lacking and treads on steep slopes are experiencing significant erosion. Immediate maintenance should be a high priority for this segment.

Table 17. Swallow Fork Trail (BC57) resource and maintenance summary table.

| Mileage: <u>3.98</u>       | Total Use: <u>UK</u> persons/day | Horse Use: <u>50</u> % of total use |                       |      |            |     |
|----------------------------|----------------------------------|-------------------------------------|-----------------------|------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                      |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|                            | (#)                              | (#/mi)                              | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 10                               | 2.5                                 | 679                   | 0.13 | 3.2        | 69  |
| Multiple Tread             | 3                                | 0.8                                 | 224                   | 0.04 | 1.1        | 55  |
| Width: Trail 2-6 ft        | 1                                | -                                   | 21004                 | 3.98 | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                | -                                   | 21004                 | 3.98 | 100.0      | -   |
| Excessive Width: + 3-6 ft  | 1                                | 0.3                                 | 50                    | 0.01 | 0.2        | 64  |
| Wet Soil                   | 3                                | 0.8                                 | 196                   | 0.04 | 0.9        | 51  |
| Running Water on Trail     | 3                                | 0.8                                 | 249                   | 0.05 | 1.2        | 72  |
| -----                      |                                  |                                     |                       |      |            |     |
| Drainage Dip: Ineffective  | 13                               | 3.3                                 |                       |      |            | 53  |
| Retaining Wall             | 1                                | 0.3                                 |                       |      |            | 64  |
| Step                       | 1                                | 0.3                                 |                       |      |            | 85  |
| Water Bar: Ineffective     | 6                                | 1.5                                 |                       |      |            | 57  |

The 3.98 mile Swallow Fork Trail follows the contours from Walnut Bottoms (elevation 2,980 feet) to the Mount Sterling Ridge Trail (elevation 5,146 feet). The horse/hiker trail is of trail width.

Running water on the tread and soil erosion are the most significant resource problems, but neither are particularly bad or difficult to resolve. Although horse use is permitted, their impacts are minimal. In places treads have shifted downslope from the original tread, possibly due to excessive outslipping of the original tread. Maintenance features are lacking or ineffective.

Summary/Recommendations: The trail is in fair condition. Immediate maintenance work is necessary to correct problems with tread drainage.







Table 18. Mount Sterling Ridge Trail (CA60) resource and maintenance summary table.

| Mileage: <u>5.38</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>50</u> % of total use |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 24                               | 4.5    | 1798                                | 0.34 | 6.3        | 84  |
| Soil Erosion: 2-2.9 ft      | 1                                | 0.2    | 67                                  | 0.01 | 0.2        | 66  |
| Excessive Grade: >20%       | 2                                | 0.4    | 1491                                | 0.28 | 5.3        | 92  |
| Multiple Tread              | 12                               | 2.2    | 1085                                | 0.21 | 3.8        | 87  |
| Width: Trail 2-6 ft         | 1                                | -      | 28397                               | 5.38 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 28397                               | 5.38 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 16                               | 3.0    | 1758                                | 0.33 | 6.2        | 99  |
| Excessive Width: + >6 ft    | 4                                | 0.7    | 392                                 | 0.07 | 1.4        | 98  |
| Wet Soil                    | 52                               | 9.7    | 3993                                | 0.76 | 14.1       | 95  |
| Running Water on Trail      | 9                                | 1.7    | 440                                 | 0.08 | 1.5        | 85  |
| <hr/>                       |                                  |        |                                     |      |            |     |
| Drainage Dip: Ineffective   | 35                               | 6.5    |                                     |      |            | 66  |
| Drainage Dip: Part. Effect. | 15                               | 2.8    |                                     |      |            | 60  |
| Drainage Dip: Very Effect.  | 3                                | 0.6    |                                     |      |            | 52  |
| Water Bar: Ineffective      | 1                                | 0.2    |                                     |      |            | 29  |

The Mount Sterling Ridge Trail follows the ridgeline from the junction with Balsam Mountain Trail (elevation 5,520 feet) to Mount Sterling (elevation 5,840 feet). The majority of the 5.38 mile trail is situated on the shoulder of the ridge, with occasional ridgetop positions in areas that are wide and flat. Over its entire length the trail is open to horses and is of trail width.

Wet soil (52 occurrences and comprising 14.1% of the trail's length) was the most significant resource problem, particularly near Pretty Hollow Gap. Sections located on the wide flat ridgecrest had numerous areas of standing water with wet muddy soil. These areas consisted of highly organic soil in spruce/fir forest and were poorly drained. As a consequence, trail widening (20 occurrences) and multiple treads (12 occurrences) were also problems. Soil erosion was also evident, with 25 occurrences and affecting 6.5% of the segment. Drainage dips were present along the steeply sloped sections but insufficient in number and typically either partially or completely ineffective. Use appeared to be low, comprised of both horse users and hikers.

Summary/Recommendations: The Mount Sterling Ridge Trail is in fair condition, primarily due to poor location in some areas and limited maintenance. Additional tread drainage is needed and partial relocations may be necessary to avoid problem areas.

Table 19. Pretty Hollow Gap Trail (CA61) resource and maintenance summary table.

Mileage: 5.50 Total Use: 10.3 persons/day Horse Use: 70 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 17          | 3.1    | 1299                  | 0.25 | 4.5        | 81  |
| Soil Erosion: 2-2.9 ft      | 1           | 0.2    | 177                   | 0.03 | 0.6        | 83  |
| Excessive Grade: >20%       | 3           | 0.5    | 568                   | 0.11 | 2.0        | 80  |
| Multiple Tread              | 3           | 0.5    | 135                   | 0.03 | 0.5        | 42  |
| Excessive Root Exposure     | 4           | 0.7    | 88                    | 0.02 | 0.3        | 57  |
| Width: Trail 2-6 ft         | 1           | -      | 19247                 | 3.65 | 66.3       | -   |
| Width: Road > 6 ft          | 1           | -      | 9387                  | 1.78 | 32.3       | -   |
| Width: Trail on Road 2-6 ft | 1           | -      | 413                   | 0.08 | 1.4        | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 29047                 | 5.50 | 100.0      | -   |
| Trail Corduroy              | 1           | 0.2    | 28                    | 0.01 | 0.1        | 96  |
| Excessive Width: + 3-6 ft   | 3           | 0.5    | 83                    | 0.02 | 0.3        | 72  |
| Wet Soil                    | 44          | 8.0    | 3474                  | 0.66 | 12.0       | 92  |
| Running Water on Trail      | 2           | 0.4    | 103                   | 0.02 | 0.4        | 57  |
| <hr/>                       |             |        |                       |      |            |     |
| Culvert                     | 6           | 1.1    |                       |      |            | 82  |
| Drainage Dip: Ineffective   | 13          | 2.4    |                       |      |            | 43  |
| Drainage Dip: Part. Effect. | 10          | 1.8    |                       |      |            | 55  |
| Drainage Dip: Very Effect.  | 2           | 0.4    |                       |      |            | 48  |
| Lateral Drain               | 6           | 1.1    |                       |      |            | 94  |
| Water Bar: Ineffective      | 15          | 2.7    |                       |      |            | 66  |
| Water Bar: Part. Effective  | 17          | 3.1    |                       |      |            | 72  |
| Water Bar: Very Effective   | 11          | 2.0    |                       |      |            | 57  |

The 5.50 mile Pretty Hollow Gap Trail begins at the parking lot at the end of the Cataloochee Road (elevation 2,920 feet) and ascends the Pretty Hollow Creek drainage to Pretty Hollow Gap and its junction with the Mount Sterling Ridge Trail (elevation 5,140 feet). Two-thirds of the horse/hiker trail is of trail width, one-third is of road width.

The design of the Pretty Hollow Gap Trail is good for foot use; the trail follows a creek and is never very steep. However, the trail is positioned poorly for horse use. Excessive soil moisture in the valley bottom, along with organic and loamy soils combine to make this trail very susceptible to horse traffic. Forty-four occurrences of wet soil, 12% of the trail's length, are primarily the result of horse traffic on these wet organic soils. Poor tread hardening and insufficient drainage features add to the problem. Soil erosion, 1-1.9 feet, (17 occurrences) is most pronounced on the higher, steeper portions of the trail. In many areas erosion of less than one foot is evident. These areas will worsen if drainage features are not implemented.

**Summary/Recommendations:** This trail is in poor condition and worsening. It is a valley bottom trail and the physical characteristics of wet organic soils are not resistant to the heavy weight of horses. Increased maintenance is not a cost-effective solution. Alternative routes should be found or developed so that horse use can be removed from this trail. Considerable additional tread drainage work is necessary to resolve the problems highlighted above.

Table 20. Palmer Creek Trail (CA63) resource and maintenance summary table.

| Mileage: <u>3.30</u>        | Total Use: <u>9.1</u> persons/day |        | Horse Use: <u>70</u> % of total use |      |            |     |
|-----------------------------|-----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                               | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 6                                 | 1.8    | 161                                 | 0.03 | 0.9        | 50  |
| Soil Erosion: 2-2.9 ft      | 1                                 | 0.3    | 70                                  | 0.01 | 0.4        | 69  |
| Multiple Tread              | 4                                 | 1.2    | 178                                 | 0.03 | 1.0        | 48  |
| Excessive Root Exposure     | 1                                 | 0.3    | 113                                 | 0.02 | 0.6        | 59  |
| Width: Trail 2-6 ft         | 1                                 | -      | 17412                               | 3.30 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -      | 17412                               | 3.30 | 100.0      | -   |
| Wet Soil                    | 17                                | 5.2    | 475                                 | 0.09 | 2.7        | 70  |
| Running Water on Trail      | 4                                 | 1.2    | 99                                  | 0.02 | 0.6        | 55  |
| -----                       |                                   |        |                                     |      |            |     |
| Drainage Dip: Ineffective   | 58                                | 17.6   |                                     |      |            | 92  |
| Drainage Dip: Part. Effect. | 26                                | 7.9    |                                     |      |            | 76  |
| Drainage Dip: Very Effect.  | 7                                 | 2.1    |                                     |      |            | 69  |
| Retaining Wall              | 2                                 | 0.6    |                                     |      |            | 72  |
| Water Bar: Very Effective   | 2                                 | 0.6    |                                     |      |            | 45  |

The 3.30 mile Palmer Creek Trail follows the Palmer Creek drainage from the Pretty Hollow Gap Trail (elevation 2,989 feet) to the Balsam Mountain Road (elevation 4,508 feet). The trail is open to horses and is of trail width over its entire length.

The lower half-mile of the trail is located on the valley floor, where wet organic soils are highly susceptible to the effects of horse traffic. Wet soil in this area is the greatest problem. The remainder of the trail is more appropriately designed, staying higher on the sideslope above Palmer Creek. The tread in these areas is often dry, in part also due to a good outslope which keeps the tread well drained. The trail also ascends the ridge top at a gradual grade following the contour of the land. Drainage features are abundant, but they appear poorly maintained with 64% rated as ineffective. Soil erosion is a problem in several areas, including worsening sections where erosion is less than one foot in depth.

Summary/Recommendations: Most of the trail is in good condition, illustrating how the positioning of a tread on mountain sideslopes away from streams can eliminate problems with wet organic soils. Soil erosion is a problem, however, due to a large number of ineffective drainage dips.

Table 21. Rough Fork Trail (CA64) resource and maintenance summary table.

Mileage: 6.41 Total Use: 13.7 persons/day Horse Use: 50 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Graveled Tread              | 1           | -      | 388                   | 0.07 | 1.1   | -          |
| Multiple Tread              | 19          | 3.0    | 1877                  | 0.36 | 5.5   | 98         |
| Width: Trail 2-6 ft         | 1           | -      | 28430                 | 5.38 | 84.1  | -          |
| Width: Trail on Road 2-6 ft | 1           | -      | 5394                  | 1.02 | 15.9  | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 33824                 | 6.41 | 100.0 | -          |
| Excessive Width: + 3-6 ft   | 2           | 0.3    | 82                    | 0.02 | 0.2   | 70         |
| Wet Soil                    | 27          | 4.2    | 1523                  | 0.29 | 4.5   | 88         |
| <hr/>                       |             |        |                       |      |       |            |
| Drainage Dip: Ineffective   | 44          | 6.9    |                       |      |       | 73         |
| Drainage Dip: Part. Effect. | 37          | 5.8    |                       |      |       | 72         |
| Drainage Dip: Very Effect.  | 45          | 7.0    |                       |      |       | 84         |
| Lateral Drain               | 1           | 0.2    |                       |      |       | 77         |
| Step                        | 11          | 1.7    |                       |      |       | 96         |
| Water Bar: Ineffective      | 19          | 3.0    |                       |      |       | 70         |
| Water Bar: Part. Effective  | 17          | 2.7    |                       |      |       | 67         |
| Water Bar: Very Effective   | 20          | 3.1    |                       |      |       | 64         |

The 6.41 mile Rough Fork Trail begins at the end of the Cataloochee Road (elevation 2,700 feet) and ascends Balsam Mountain to Polls Gap and the Balsam Mountain Road (elevation 4,900 feet). The majority of the trail is of trail width (84%) and the entire trail is open to horses and hikers.

The design and maintenance of this trail is generally good. Most parts of the trail are aligned at sidehills and the grades are gentle. Multiple treads are a common problem (19 occurrences), particularly between Polls Gap and the junction with Caldwell Fork Trail. This is often due to the level and grassy trailside areas on ridges, which allow users to wander off the trail tread. Wet soils are also common (27 occurrences) but are not a serious problem. Although not excessive, several segments have steep slopes where erosion is beginning to occur. Water bars and drainage dips are effective in most cases but insufficient in number for the steeper sections.

**Summary/Recommendations:** In summary, the trail is in fair condition. The major resource problems are multiple treads, wet soil, and developing soil erosion. Additional tread drainage features are needed for the segments with steep grades and wet soils and responsible trail use should be further advocated.



Table 22. Caldwell Fork Trail (CA65) resource and maintenance summary table.

Mileage: 6.29 Total Use: 41.5 persons/day Horse Use: 50 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 12          | 1.9    | 770                   | 0.15  | 2.3        | 70  |
| Multiple Tread              | 16          | 2.5    | 849                   | 0.16  | 2.6        | 83  |
| Excessive Root Exposure     | 2           | 0.3    | 59                    | 0.01  | 0.2        | 51  |
| Width: Trail 2-6 ft         | 1           | 0.2    | 33218                 | 6.29  | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | 0.2    | 33218                 | 6.29  | 100.0      | -   |
| Trail Corduroy              | 2           | 0.3    | 5                     | <0.01 | <0.1       | 92  |
| Excessive Width: + 3-6 ft   | 20          | 3.2    | 1079                  | 0.20  | 3.2        | 95  |
| Excessive Width: + >6 ft    | 2           | 0.3    | 79                    | 0.01  | 0.2        | 92  |
| Wet Soil                    | 97          | 15.4   | 6313                  | 1.20  | 19.0       | 96  |
| Running Water on Trail      | 8           | 1.3    | 468                   | 0.09  | 1.4        | 87  |
| -----                       |             |        |                       |       |            |     |
| Culvert                     | 1           | 0.2    |                       |       |            | 61  |
| Drainage Dip: Ineffective   | 53          | 8.4    |                       |       |            | 77  |
| Drainage Dip: Part. Effect. | 7           | 1.1    |                       |       |            | 46  |
| Water Bar: Ineffective      | 2           | 0.3    |                       |       |            | 35  |

The 6.29 mile Caldwell Fork Trail begins at the Cataloochee Road (elevation 2,200 feet) and gradually ascends the Caldwell Fork drainage up to its intersection with the Rough Fork Trail (elevation 4,000 feet). The trail is of trail width and is open to horses and hikers.

The original design of this trail is quite poor, largely due to its close proximity to the stream and poorly drained soils. As a result, wet soils were very common (97 occurrences) affecting 19% of total trail length. This problem is largely responsible for an additional 22 occurrences of excessive width and 16 occurrences of multiple treads. Excessive soil erosion was also common (12 occurrences and 2.3% of the trail). Heavy horse use appears to be a substantial contributor to these impacts; the trail is not well-suited to support this use. Tread drainage features were insufficient in number and most were rated ineffective.

Summary/Recommendations: The Caldwell Fork Trail is in very poor condition, due to poor location (drainage bottom position) and heavy horse use. Wet, muddy soils are common and contribute to many other resource impacts. The existing tread is not suited for horse use due to the predominance of wet organic soils. Additional maintenance is needed but is unlikely to resolve the current problems. An alternative route for horse use should be investigated.

Table 23. Mount Sterling Trail (CA171) resource and maintenance summary table.

| Mileage: <u>2.35</u>        | Total Use: <u>8.0 persons/day</u> | Horse Use: <u>50 % of total use</u> |                       |      |            |     |
|-----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|                             | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 1                                 | 0.4                                 | 47                    | 0.01 | 0.4        | 35  |
| Excessive Grade: >20%       | 1                                 | 0.4                                 | 953                   | 0.18 | 7.7        | 90  |
| Maintained Gravel           | 1                                 | -                                   | 2605                  | 0.49 | 21.0       | -   |
| Width: Road > 6 ft          | 1                                 | -                                   | 2605                  | 0.49 | 21.0       | -   |
| Width: Trail on Road 2-6 ft | 1                                 | -                                   | 9777                  | 1.85 | 79.0       | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -                                   | 12382                 | 2.35 | 100.0      | -   |
| Wet Soil                    | 10                                | 4.3                                 | 1006                  | 0.19 | 8.1        | 80  |
| Running Water on Trail      | 1                                 | 0.4                                 | 35                    | 0.01 | 0.3        | 40  |
| -----                       |                                   |                                     |                       |      |            |     |
| Drainage Dip: Ineffective   | 45                                | 19.2                                |                       |      |            | 94  |
| Drainage Dip: Part. Effect. | 42                                | 17.9                                |                       |      |            | 87  |
| Drainage Dip: Very Effect.  | 16                                | 6.8                                 |                       |      |            | 83  |
| Retaining Wall              | 2                                 | 0.9                                 |                       |      |            | 81  |
| Water Bar: Ineffective      | 2                                 | 0.9                                 |                       |      |            | 51  |
| Water Bar: Part. Effective  | 2                                 | 0.9                                 |                       |      |            | 53  |

The 2.35 mile Mt. Sterling Trail begins in the Mount Sterling Gap (elevation 3,888 feet) at its intersection with the Cataloochee Road and ascends Mount Sterling to its junction with the Mount Sterling Ridge Trail (elevation 5,800 feet). The trail follows an old roadbed originally constructed to provide access to the Mount Sterling fire tower. The first half mile, to the intersection with Long Bunk Trail, is graveled and is of road width; the remainder has narrowed to trail width. The entire segment is open to horses.

The trail's design and placement on the slope allow for proper drainage with minimal erosion evident. The only excessive grades are on the upper section of the trail. The trail is on loamy soil with natural gravel and stone in places. This allows for good drainage. The lower section is well maintained with a sufficient number of drainage dips although 44% were rated as ineffective. Wet soil (10 occurrences, 8.1% of the trail) was the only notable resource impact. Horse use appears to be high along the lower section from users going to and from the Cataloochee area via the Long Bunk Trail. However, the trail's original design and construction as a road makes it resistant to such use.

Summary/Recommendations: The Mount Sterling Trail is in good condition with the exception of some wet soils. The trail is well-designed and maintained although maintenance is needed to improve the effectiveness of drainage dips.

Table 24. Long Bunk Trail (CA232) resource and maintenance summary table.

| Mileage: <u>3.54</u>        | Total Use: <u>8.1</u> persons/day | Horse Use: <u>70</u> % of total use |                       |      |            |     |
|-----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|                             | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 17                                | 4.8                                 | 2164                  | 0.41 | 11.6       | 87  |
| Soil Erosion: 2-2.9 ft      | 1                                 | 0.3                                 | 80                    | 0.02 | 0.4        | 70  |
| Excessive Grade: >20%       | 2                                 | 0.6                                 | 242                   | 0.05 | 1.3        | 70  |
| Multiple Tread              | 10                                | 2.8                                 | 1310                  | 0.25 | 7.0        | 95  |
| Excessive Root Exposure     | 4                                 | 1.1                                 | 71                    | 0.02 | 0.7        | 62  |
| Width: Trail 2-6 ft         | 1                                 | -                                   | 11026                 | 2.09 | 59.1       | -   |
| Width: Road > 6 ft          | 1                                 | -                                   | 1106                  | 0.21 | 5.9        | -   |
| Width: Trail on Road 2-6 ft | 1                                 | -                                   | 6542                  | 1.24 | 35.0       | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -                                   | 18674                 | 3.54 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 14                                | 4.0                                 | 886                   | 0.17 | 4.7        | 94  |
| Excessive Width: + >6 ft    | 7                                 | 2.0                                 | 421                   | 0.08 | 2.3        | 99  |
| Wet Soil                    | 25                                | 7.1                                 | 12474                 | 2.36 | 66.8       | 99  |
| Running Water on Trail      | 3                                 | 0.8                                 | 140                   | 0.03 | 0.7        | 64  |
| -----                       |                                   |                                     |                       |      |            |     |
| Culvert                     | 3                                 | 0.8                                 |                       |      |            | 75  |
| Drainage Dip: Ineffective   | 15                                | 4.2                                 |                       |      |            | 59  |
| Drainage Dip: Part. Effect. | 5                                 | 1.4                                 |                       |      |            | 49  |
| Drainage Dip: Very Effect.  | 14                                | 4.0                                 |                       |      |            | 76  |
| Lateral Drain               | 1                                 | 0.3                                 |                       |      |            | 84  |
| Water Bar: Ineffective      | 1                                 | 0.3                                 |                       |      |            | 35  |
| Water Bar: Very Effective   | 1                                 | 0.3                                 |                       |      |            | 34  |

The Long Bunk Trail serves as a 3.54 mile connector between the Little Cataloochee Trail (elevation 3,060 feet) and the Mount Sterling Trail (elevation 4,000 feet). The trail generally follows along a stream corridor passing through old growth forests. The entire segment is open to horses and is of trail width over 59% of its length, following an old roadbed for the remainder.

The design and maintenance of this trail is deficient given the heavy horse use it receives. The most significant resource problem was wet soil, with 25 occurrences and affecting two-thirds of the trail's length. The exceptionally muddy conditions make pedestrian use extremely difficult. Highly organic soils underlain by clay restrict tread drainage on some sections. Deep pock marks from horse hooves tend to retain water and prevent tread drainage. Trail sections adjacent to the stream have deep mudholes and ruts. These conditions contributed to multiple treads (10 occurrences, 7% of the trail's length) and trail widening, 3-6 feet wider than normal (14 occurrences). An additional 7 occurrences of tread widening greater than 6 feet (20 feet in several locations) was also observed. The behavior of horse users in riding off-trail to circumvent muddy sections seems to be the main contributor to these problems. Soil erosion, 1-1.9 feet, was also a notable problem affecting 11.6% of the trail's length. Trail maintenance is inadequate, particularly in number but also in quality.

Summary/Recommendations: This trail is in exceptionally poor condition. Both the design and existing level of maintenance are inadequate given the amount of horse use it receives. Furthermore, the drainage bottom position of this trail makes it very susceptible to impacts from horse use. Soils are difficult to adequately drain and maintenance is not likely to provide a cost-effective solution. Serious consideration to a closure to horse use or a complete reroute is recommended.

Table 25. Little Cataloochee Trail (CALCT) resource and maintenance summary table.

| Mileage: <u>4.89</u>        | Total Use: <u>15.9</u> persons/day |        | Horse Use: <u>50 %</u> of total use |      |            |     |
|-----------------------------|------------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 3                                  | 0.6    | 575                                 | 0.11 | 2.2        | 66  |
| Soil Erosion: 2-2.9 ft      | 1                                  | 0.2    | 488                                 | 0.09 | 1.9        | 91  |
| Excessive Grade: >20%       | 2                                  | 0.4    | 911                                 | 0.17 | 3.5        | 86  |
| Graveled Tread              | 1                                  | -      | 12499                               | 2.37 | 48.4       | -   |
| Multiple Tread              | 3                                  | 0.6    | 517                                 | 0.10 | 2.0        | 72  |
| Width: Road > 6 ft          | 1                                  | -      | 12499                               | 2.37 | 48.4       | -   |
| Width: Trail 2-6 ft         | 1                                  | -      | 13311                               | 2.52 | 51.6       | -   |
| Use Type: Horse/Pedestrian  | 1                                  | -      | 25810                               | 4.89 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 8                                  | 1.6    | 1180                                | 0.22 | 4.6        | 96  |
| Excessive Width: + >6 ft    | 2                                  | 0.4    | 194                                 | 0.04 | 0.8        | 95  |
| Wet Soil                    | 19                                 | 3.9    | 7911                                | 1.50 | 30.7       | 98  |
| Running Water on Trail      | 7                                  | 1.4    | 1194                                | 0.23 | 4.6        | 99  |
| -----                       |                                    |        |                                     |      |            |     |
| Culvert                     | 27                                 | 5.5    |                                     |      |            | 95  |
| Drainage Dip: Ineffective   | 14                                 | 2.9    |                                     |      |            | 51  |
| Drainage Dip: Part. Effect. | 14                                 | 2.9    |                                     |      |            | 62  |
| Drainage Dip: Very Effect.  | 6                                  | 1.2    |                                     |      |            | 64  |
| Lateral Drain               | 7                                  | 1.4    |                                     |      |            | 95  |
| Retaining Wall              | 2                                  | 0.4    |                                     |      |            | 67  |
| Water Bar: Ineffective      | 29                                 | 5.9    |                                     |      |            | 79  |
| Water Bar: Part. Effective  | 13                                 | 2.7    |                                     |      |            | 67  |
| Water Bar: Very Effective   | 10                                 | 2.0    |                                     |      |            | 57  |

The Little Cataloochee Trail begins at Mount Sterling Gap at a gated entrance off a dirt road (NC 284) skirting the eastern park boundary (elevation 3,000 feet) and cuts across several drainages to join the Palmer Creek Trail (elevation 2,880 feet). The 4.89 mile trail follows an old graveled woods road for nearly half its length and is open to both hiker and horse use.

The trail begins as a well maintained gravel road leading to cemeteries and historic buildings in the Little Cataloochee stream valley. The roadbed is in excellent condition with culverts, lateral drains, and good bridges. The road narrows to a trail when it passes over the mountain to the Palmer Creek valley. This section has erosion, multiple trails, excessive grades and problems with wet soils. Excessive grades and extensive gullying erosion were found when the trail ascended and descended a ridge without switchbacks. Multiple treads caused by horses riding off-trail are also evident in this section. The trail then follows a stream very closely and extensive muddy sections, including locations where the stream runs onto the trail, were found. This entire section of trail, which receives heavy horse use from the Cataloochee area, is not well-designed or maintained to sustain horse traffic.

Summary/Recommendations: The trail is in excellent condition where it follows the preexisting graveled roadbed. However, the section which is of trail width has extensive sections of wet muddy soil and is poorly designed and maintained for the level of horse traffic it receives. Additional tread drainage will alleviate some of the problems but reroutes to place the trail away from streams is also needed.





Figure 7. Topographic map of trail locations for the Cades Cove area.

Table 26. Hatcher Mountain Trail (CC2) resource and maintenance summary table.

|                             |                                   |        |                                     |       |            |     |
|-----------------------------|-----------------------------------|--------|-------------------------------------|-------|------------|-----|
| Mileage: <u>2.80</u>        | Total Use: <u>9.1</u> persons/day |        | Horse Use: <u>50</u> % of total use |       |            |     |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |        | TOTAL LINEAL DISTANCE               |       | PERCENTILE |     |
|                             | (#)                               | (#/mi) | (ft)                                | (mi)  | (%)        | (%) |
| Multiple Tread              | 1                                 | 0.4    | 35                                  | 0.01  | 0.2        | 20  |
| Width: Trail 2-6 ft         | 1                                 | -      | 14764                               | 2.80  | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -      | 14764                               | 2.80  | 100.0      | -   |
| Wet Soil                    | 1                                 | 0.4    | 41                                  | 0.01  | 0.3        | 32  |
| Running Water on Trail      | 1                                 | 0.4    | 15                                  | <0.01 | 0.1        | 33  |
| -----                       |                                   |        |                                     |       |            |     |
| Drainage Dip: Ineffective   | 16                                | 5.7    |                                     |       |            | 65  |
| Drainage Dip: Part. Effect. | 50                                | 17.9   |                                     |       |            | 87  |
| Drainage Dip: Very Effect.  | 28                                | 10.0   |                                     |       |            | 90  |
| Water Bar: Very Effective   | 1                                 | 0.4    |                                     |       |            | 39  |

The 2.80 mile Hatcher Mountain Trail joins the Abrams Falls Trail (elevation 1,400 feet) to the Cooper Road Trail (elevation 1,540 feet). The trail is open to horses and hikers and the tread is of trail width.

The design and construction of this trail is very good in that it works well with the contours. Most parts of the trail are on ridges or sidehills with limited possibility of trail widening and water-related problems. Wet soil does exist in the vicinity of stream crossings but that is not common. Drainage dips are numerous and in good condition though some are either clogged or too shallow to collect the runoff from treads. Horse use appears to be light and horse-related problems (e.g. mudholes) are absent on this trail.

Summary/Recommendations: To sum up, the good condition of this trail can be attributed to good design and maintenance as well as the low level of horse use. No immediate work is needed.

Table 27. Gregory Bald Trail (CC3) resource and maintenance summary table.

Mileage: 7.45 Total Use: 27.6 persons/day Horse Use: 60 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft      | 4           | 0.5    | 218                   | 0.04 | 0.6   | 54         |
| Excessive Grade: >20%       | 6           | 0.8    | 2388                  | 0.45 | 6.1   | 98         |
| Multiple Tread              | 21          | 2.8    | 1131                  | 0.21 | 2.9   | 90         |
| Excessive Root Exposure     | 14          | 1.9    | 533                   | 0.10 | 1.4   | 91         |
| Width: Trail 2-6 ft         | 1           | -      | 39327                 | 7.45 | 100.0 | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 39327                 | 7.45 | 100.0 | -          |
| -----                       |             |        |                       |      |       |            |
| Drainage Dip: Ineffective   | 60          | 8.1    |                       |      |       | 76         |
| Drainage Dip: Part. Effect. | 60          | 8.1    |                       |      |       | 77         |
| Drainage Dip: Very Effect.  | 4           | 0.5    |                       |      |       | 50         |
| Water Bar: Ineffective      | 4           | 0.5    |                       |      |       | 40         |
| Water Bar: Part. Effective  | 8           | 1.1    |                       |      |       | 57         |
| Water Bar: Very Effective   | 30          | 4.0    |                       |      |       | 68         |

The design and construction of the 7.45 mile Gregory Bald Trail works well. The trail begins at Parsons Branch Road (elevation 2,750 feet) and ascends the ridge to Sheep Pen Gap and campsite 13 before ascending to Gregory Bald (elevation 4,949 feet). From here the trail follows the ridge across to Doe Knob and its termination with the Appalachian Trail (elevation 4,300 feet). The entire trail is of trail width and is open to both horses and hikers.

A few problem areas exist in the form of excessive grade (approximately 6% of the trail) and multiple tread (21 occurrences). However, the loamy soil seems to be fairly resistant to the moderate amount of use this section of trail is receiving. From the AT to Sheep Pen Gap, maintenance is good. From Sheep Pen Gap to Parsons Branch Road maintenance is deficient as indicated by ineffective drainage dips, numerous multiple treads and areas of severe root exposure.

Summary/Recommendations: The trail is in good condition from the AT to Sheep Pen Gap and fair condition from Sheep Pen Gap to Parsons Branch Road. Additional maintenance, primarily cleaning of water bars, is needed in this latter section.



Table 28. Abrams Falls Trail (CC6) resource and maintenance summary table.

Mileage: 4.25      Total Use: 278.9 persons/day      Horse Use: 0 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Multiple Tread              | 3           | 0.7    | 74                    | 0.01 | 0.3   | 32         |
| Excessive Root Exposure     | 3           | 0.7    | 175                   | 0.03 | 0.8   | 68         |
| Width: Trail 2-6 ft         | 1           | -      | 22433                 | 4.25 | 100.0 | -          |
| Use Type: Pedestrian        | 1           | -      | 22433                 | 4.25 | 100.0 | -          |
| Excessive Width: + 3-6 ft   | 1           | 0.2    | 46                    | 0.01 | 0.2   | 62         |
| Running Water on Trail      | 11          | 2.6    | 511                   | 0.10 | 2.3   | 90         |
| -----                       |             |        |                       |      |       |            |
| Culvert                     | 3           | 0.7    |                       |      |       | 72         |
| Drainage Dip: Ineffective   | 11          | 2.6    |                       |      |       | 48         |
| Drainage Dip: Part. Effect. | 17          | 4.0    |                       |      |       | 66         |
| Drainage Dip: Very Effect.  | 7           | 1.6    |                       |      |       | 67         |
| Water Bar: Ineffective      | 1           | 0.2    |                       |      |       | 29         |
| Water Bar: Part. Effective  | 1           | 0.2    |                       |      |       | 41         |
| Water Bar: Very Effective   | 4           | 0.9    |                       |      |       | 48         |

This heavily used trail runs along Abrams Creek from the Rabbit Creek Trail (elevation 1,800 feet) to the Hatcher and Hannah Mountain Trails (elevation 1,400 feet). However, the 4.25 mile trail keeps well above the valley bottom mostly running along sidehills. The entire route is of trail width and is restricted to hikers. The drainage condition is generally good except for several locations where small seeps and streams cross the trail to join the stream. The trail cuts across several entering drainages but the ups and downs are mostly steady. The segment between Hannah Mountain Trail junction and Abrams Falls is in good condition and the level of use is low. However, the section between the Cades Cove Loop Road and Abram Falls is heavily used by day hikers. Fortunately, the good design and maintenance and the rocky tread itself make the trail resistant to this level of use. The most noticeable problem on this part of trail is a large number of impromptu trails to the water.

Summary/Recommendations: The trail is generally in good condition. Problems include 11 occurrences of running water on the trail, requiring additional drainage, and a large number of impromptu trails leading to Abrams Creek. Some access trails may need to be developed in order to discourage the large number of user-created trails. Additional user-education, perhaps in the form of "Stay on trail" signs, may also be effective.



Table 29. Rich Mountain Trail (CC8) resource and maintenance summary table.

|                             |                                   |                                     |                       |      |            |
|-----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>2.34</u>        | Total Use: <u>7.2</u> persons/day | Horse Use: <u>80</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Multiple Tread              | 1                                 | 0.4                                 | 52                    | 0.01 | 0.4        |
| Excessive Root Exposure     | 2                                 | 0.9                                 | 44                    | 0.01 | 0.4        |
| Width: Trail 2-6 ft         | 1                                 | -                                   | 12380                 | 2.34 | 100.0      |
| Use Type: Horse/Pedestrian  | 1                                 | -                                   | 12380                 | 2.34 | 100.0      |
| -----                       |                                   |                                     |                       |      |            |
| Drainage Dip: Ineffective   | 11                                | 4.7                                 |                       |      | 62         |
| Drainage Dip: Part. Effect. | 4                                 | 1.7                                 |                       |      | 52         |
| Drainage Dip: Very Effect.  | 2                                 | 0.9                                 |                       |      | 59         |
| Water Bar: Ineffective      | 2                                 | 0.9                                 |                       |      | 51         |
| Water Bar: Part. Effective  | 2                                 | 0.9                                 |                       |      | 53         |
| Water Bar: Very Effective   | 1                                 | 0.4                                 |                       |      | 39         |

This trail runs from the Rich Mountain Road (elevation 1,500 feet) to the Rich Mountain/Indian Grave Gap Trail junction (elevation 3,500 feet). The layout and construction of the Rich Mountain Trail is generally good as it ascends the ridgeline. The entire 2.34 mile trail is of trail width and is open to horse use.

The Rich Mountain Trail appears to be receiving only light use. No significant resource problems are evident, but from Rich Mountain down to Rich Mountain Road a small channel is forming in the tread. Only limited trail maintenance is evident although a maintenance crew was about to begin work when the trail was surveyed.

Summary/Recommendation: This trail is in good condition in spite of limited maintenance. No additional immediate maintenance work is likely necessary beyond that conducted in 1993.

Table 30. Russell Field Trail (CC10) resource and maintenance summary table.

Mileage: 3.52 Total Use: 12.0 persons/day Horse Use: 70 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 15          | 4.3    | 1020                  | 0.19  | 5.5        | 76  |
| Excessive Grade: >20%       | 3           | 0.9    | 542                   | 0.10  | 2.9        | 79  |
| Multiple Tread              | 9           | 2.6    | 625                   | 0.12  | 3.4        | 76  |
| Excessive Root Exposure     | 8           | 2.3    | 341                   | 0.06  | 1.8        | 85  |
| Width: Trail 2-6 ft         | 1           | -      | 18587                 | 3.52  | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 17808                 | 3.37  | 95.8       | -   |
| Use Type: Pedestrian        | 1           | -      | 779                   | 0.15  | 4.2        | -   |
| Excessive Width: + 3-6 ft   | 1           | 0.3    | 31                    | 0.01  | 0.2        | 58  |
| Wet Soil                    | 7           | 2.0    | 165                   | 0.03  | 0.9        | 48  |
| Running Water on Trail      | 1           | 0.3    | 24                    | <0.01 | 0.1        | 37  |
| -----                       |             |        |                       |       |            |     |
| Drainage Dip: Ineffective   | 7           | 2.0    |                       |       |            | 42  |
| Drainage Dip: Part. Effect. | 26          | 7.4    |                       |       |            | 74  |
| Drainage Dip: Very Effect.  | 48          | 13.6   |                       |       |            | 92  |
| Water Bar: Ineffective      | 1           | 0.3    |                       |       |            | 35  |
| Water Bar: Part. Effective  | 5           | 1.4    |                       |       |            | 59  |
| Water Bar: Very Effective   | 64          | 18.2   |                       |       |            | 94  |

The Russell Field Trail ascends from Anthony Creek Trail (elevation 2,480 feet) to the Appalachian Trail (elevation 4,360 feet), a distance of 3.52 miles. The route is of trail width and most (96%) is open to horse use.

Trail design is not good as there are many sections throughout its length which have problems with organic soils. Consequently, 5.5% of the trail has excessive soil erosion, 1-1.9 feet, and wet soil and mudholes are a problem. Problems stemming from the organic soils are evident even in sections which are well-maintained with effective drainage features. Other resource problems include excessive grade and multiple treads, 2.9% and 3.4%, respectively, of the trail's length. Horse traffic was rerouted from the trail near the Russell Field Shelter to avoid a spring. This action appears to be effective in protecting the spring but the alternative horse route is receiving substantial tread damage. There are a moderate number of tread drainage features, most of which are effective.

Summary/Recommendations: The organic and loamy soils underlying the trail retain moisture and are highly susceptible to the trampling from horses. Hiker impact is minimal as the soils are merely compacted. However, the weight of horses punch holes into the soil, which collect water and turn into mud holes. This is a problem even in areas on the ridge away from streams. These conditions are likely manageable with continued heavy maintenance but alternative routes for horse traffic, at least in susceptible areas, should be further investigated.

Table 31. Anthony Creek Trail (CC11) resource and maintenance summary table.

Mileage: 3.51 Total Use: 19.5 persons/day Horse Use: 70 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Graveled Tread              | 1           | -      | 8180                  | 1.55 | 44.2  | -          |
| Multiple Tread              | 4           | 1.1    | 208                   | 0.04 | 1.1   | 53         |
| Excessive Root Exposure     | 7           | 2.0    | 203                   | 0.04 | 1.1   | 72         |
| Width: Trail 2-6 ft         | 1           | -      | 10218                 | 1.94 | 55.2  | -          |
| Width: Road > 6 ft          | 1           | -      | 8302                  | 1.57 | 44.8  | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 18520                 | 3.51 | 100.0 | -          |
| Wet Soil                    | 2           | 0.6    | 36                    | 0.01 | 0.2   | 29         |
| Running Water on Trail      | 1           | 0.3    | 74                    | 0.01 | 0.4   | 47         |
| -----                       |             |        |                       |      |       |            |
| Culvert                     | 5           | 1.4    |                       |      |       | 85         |
| Drainage Dip: Ineffective   | 6           | 1.7    |                       |      |       | 37         |
| Drainage Dip: Part. Effect. | 4           | 1.1    |                       |      |       | 46         |
| Drainage Dip: Very Effect.  | 1           | 0.3    |                       |      |       | 42         |
| Retaining Wall              | 1           | 0.3    |                       |      |       | 64         |
| Water Bar: Ineffective      | 1           | 0.3    |                       |      |       | 35         |
| Water Bar: Part. Effective  | 7           | 2.0    |                       |      |       | 62         |
| Water Bar: Very Effective   | 109         | 31.1   |                       |      |       | 96         |

The design of Anthony Creek Trail was well planned. This 3.51 mile trail begins at the Cades Cove Campground (elevation 1,965 feet) and ascends Anthony Creek to the Bote Mountain Trail (elevation 3,760 feet). One aspect of proper planning is that the trail was not placed directly next to the creek but parallels it at some distance. One and one-half miles (45%) of the trail follows a graveled roadbed with the remainder of trail width. All of the trail is open to horse use.

Maintenance on this trail is excellent in all aspects, including amount, quality, and effectiveness. This trail also seems highly resistant to the impacts of horses and hikers. This seems to be credited to the loaminess of the soil in combination with numerous and very effective water bars. A few occurrences of multiple treads and excessive root exposure are the only notable resource problems.

Summary/Recommendation: Overall, this trail is in excellent condition and no further immediate work appears to be needed.

Table 32. Rabbit Creek Trail (CC101) resource and maintenance summary table.

Mileage: 7.75 Total Use: 10.7 persons/day Horse Use: 40 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 1           | 0.1    | 17                    | <0.01 | <0.1       | 31  |
| Multiple Tread              | 4           | 0.5    | 143                   | 0.03  | 0.3        | 43  |
| Width: Trail 2-6 ft         | 2           | -      | 30084                 | 5.70  | 73.5       | -   |
| Width: Road > 6 ft          | 2           | -      | 1774                  | 0.34  | 4.3        | -   |
| Width: Trail on Road 2-6 ft | 1           | -      | 9050                  | 1.71  | 22.1       | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 40908                 | 7.75  | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 1           | 0.1    | 59                    | 0.01  | 0.1        | 68  |
| Wet Soil                    | 3           | 0.4    | 133                   | 0.03  | 0.3        | 44  |
| Running Water on Trail      | 8           | 1.0    | 703                   | 0.13  | 1.7        | 94  |
| -----                       |             |        |                       |       |            |     |
| Culvert                     | 2           | 0.3    |                       |       |            | 64  |
| Drainage Dip: Ineffective   | 73          | 9.4    |                       |       |            | 79  |
| Drainage Dip: Part. Effect. | 28          | 3.6    |                       |       |            | 64  |
| Drainage Dip: Very Effect.  | 33          | 4.3    |                       |       |            | 77  |
| Retaining Wall              | 1           | 0.1    |                       |       |            | 53  |
| Water Bar: Part. Effective  | 1           | 0.1    |                       |       |            | 37  |
| Water Bar: Very Effective   | 1           | 0.1    |                       |       |            | 29  |

The layout of the Rabbit Creek Trail works well as it follows the contours of the mountain from the Abrams Falls parking lot (elevation 1,700 feet) to the Abrams Creek Ranger Station (elevation 1,100 feet). The entire 7.75 mile trail is open to horse and hiker use, although both uses appear to be light. Approximately one-quarter of the trail followed a dirt woods road, most of which has narrowed to a trail width.

The trail is generally in good condition, in part due to the loaminess of the soil, which appears to be fairly resistant to user impacts. However, eight occurrences of running water on the trail and three occurrences of wet soil indicate that tread drainage is a problem in some areas. Relatively little trail maintenance is evident and most drainage dips are either ineffective or partially effective.

Summary/Recommendations: Current amount and type of use do not appear to be causing any pronounced problems. A moderate amount of trail maintenance to clean and improve drainage dips is necessary to resolve some tread drainage problems.



Table 33. Indian Grave Gap Trail (CC105) resource and maintenance summary table.

|                             |                                   |                                     |            |
|-----------------------------|-----------------------------------|-------------------------------------|------------|
| Mileage: <u>2.54</u>        | Total Use: <u>5.1</u> persons/day | Horse Use: <u>90</u> % of total use |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       | TOTAL LINEAL DISTANCE               | PERCENTILE |
|                             | (#)    (#/mi)                     | (ft)    (mi)    (%)    (%)          |            |
| Soil Erosion: 1-1.9 ft      | 1      0.4                        | 22    <0.01    0.2                  | 32         |
| Width: Trail on Road 2-6 ft | 1      -                          | 13393    2.54    100.0              | -          |
| Use Type: Horse/Pedestrian  | 1      -                          | 13393    2.54    100.0              | -          |
| -----                       |                                   |                                     |            |
| Drainage Dip: Ineffective   | 49    19.3                        |                                     | 95         |
| Drainage Dip: Part. Effect. | 33    13.0                        |                                     | 83         |
| Drainage Dip: Very Effect.  | 18    7.1                         |                                     | 85         |
| Water Bar: Very Effective   | 1    0.4                          |                                     | 39         |

The 2.54 mile Indian Grave Gap Trail is situated on an old dirt jeep road. The trail's grade is gentle as it forms a loop from the Rich Mountain Loop Trail (elevation 3,200 feet) to a junction with the Scott Mountain and Crooked Arm Ridge Trails (elevation 3,200 feet).

The trail is in good shape and no impact problems are evident. The trail is suitable to horse use although the present use level is not high. Maintenance of drainage dips along this trail is poor and most of the dips are either partially effective or ineffective. In addition to the accumulation of litter and sediment in the trenches of dips, some trenches are elevated above tread erosional channels, making them ineffective.

**Summary/Recommendations:** The trail is in good condition, likely because it follows an old roadbed and is not heavily used. Cleaning and improvements to existing drainage dips are needed.

Table 34. Rich Mountain Loop Trail (CC205) resource and maintenance summary table.

Mileage: 3.34 Total Use: 13.0 persons/day Horse Use: 90 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft      | 9           | 2.7    | 427                   | 0.08 | 2.4   | 65         |
| Excessive Grade: >20%       | 3           | 0.9    | 675                   | 0.13 | 3.8   | 81         |
| Multiple Tread              | 15          | 4.5    | 433                   | 0.08 | 2.5   | 68         |
| Excessive Root Exposure     | 6           | 1.8    | 176                   | 0.03 | 1.0   | 69         |
| Width: Trail 2-6 ft         | 1           | -      | 17609                 | 3.34 | 100.0 | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 17609                 | 3.34 | 100.0 | -          |
| Excessive Width: + 3-6 ft   | 2           | 0.6    | 213                   | 0.04 | 1.2   | 87         |
| Excessive Width: + >6 ft    | 1           | 0.3    | 56                    | 0.01 | 0.3   | 90         |
| Wet Soil                    | 1           | 0.3    | 89                    | 0.02 | 0.5   | 37         |
| -----                       |             |        |                       |      |       |            |
| Drainage Dip: Ineffective   | 22          | 6.6    |                       |      |       | 68         |
| Drainage Dip: Part. Effect. | 77          | 23.1   |                       |      |       | 94         |
| Drainage Dip: Very Effect.  | 48          | 14.4   |                       |      |       | 94         |
| Water Bar: Part. Effective  | 2           | 0.6    |                       |      |       | 48         |
| Water Bar: Very Effective   | 11          | 3.3    |                       |      |       | 65         |

This trail stretches from the Cades Cove Loop Road (elevation 1,950 feet) up Rich Mountain to the Indian Grave Gap Trail (elevation 3,200 feet). The trail is open to horses and hikers and its tread is of trail width.

Most parts of the trail are situated at sidehills and the grades are moderate. However, there are several segments of the trail where grades exceed 20%. The moderate slopes and the horse use on this trail may contribute to the common occurrence of excessive erosion, excessive width, and root exposure. Multiple treads are also common (15 occurrences) and often related to the steep trail grades. There are large numbers of drainage features although many are only partially effective. The nature of the tread and the design of the trail can support hiker and horse use well if the erosion problems are addressed by improving water drainage on the trail.

Summary/Recommendations: The trail is in fair to good condition with the problem areas mainly associated with steep grades. Reroute possibilities for the steeper sections should be investigated. The number of current tread drainage features appears to be adequate, although the effectiveness of some should be improved.

Table 35. Crooked Arm Ridge Trail (CC242) resource and maintenance summary table.

Mileage: 2.16 Total Use: 13.8 persons/day Horse Use: 80 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|-------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft      | 17          | 7.9    | 623                   | 0.12  | 5.5   | 68         |
| Multiple Tread              | 21          | 9.7    | 534                   | 0.10  | 4.7   | 73         |
| Excessive Root Exposure     | 1           | 0.5    | 18                    | <0.01 | 0.2   | 46         |
| Width: Trail 2-6 ft         | 1           | -      | 11469                 | 2.16  | 100.0 | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 11469                 | 2.16  | 100.0 | -          |
| -----                       |             |        |                       |       |       |            |
| Drainage Dip: Ineffective   | 11          | 5.1    |                       |       |       | 64         |
| Drainage Dip: Part. Effect. | 43          | 19.9   |                       |       |       | 90         |
| Drainage Dip: Very Effect.  | 19          | 8.8    |                       |       |       | 88         |
| Water Bar: Part. Effective  | 6           | 2.8    |                       |       |       | 69         |
| Water Bar: Very Effective   | 19          | 8.8    |                       |       |       | 81         |

The design of the 2.16 mile Crooked Arm Ridge Trail is good. The trail leaves the Rich Mountain Loop Trail (elevation 2,000 feet) and ascends the ridge to a junction with the Indian Grave Gap and Scott Mountain Trails (elevation 3,200 feet). The horse/hiker trail has a tread that is of trail width.

The trail's grade is not steep and most sections of the trail are located at sidehills. The primary resource problems on this trail are 21 occurrences of multiple treads (many from switchback shortcutting) and excessive erosion (17 occurrences and 5.5% of the trail). The design of switchbacks, which are often bunched together, encourages shortcuts. Drainage dips are generally only partially effective in diverting water off the trail, however, waterbars are mostly in good condition.

Summary/Recommendations: The trail is in fair condition with soil erosion and multiple treads the predominant problems. Maintenance to clear and possibly add drainage dips is needed to address soil erosion. Actions to prevent switchback cutting are also needed.





Figure 8. Topographic map of trail locations for the Cosby area.



Table 36. Maddron Bald Trail: Gabes Mountain Trail to Snake Den Ridge Trail (CO48) resource and maintenance summary table.

| Mileage: <u>6.35</u>        | Total Use: <u>15.8 persons/day</u> |        | Horse Use: <u>0 % of total use</u> |      |            |     |
|-----------------------------|------------------------------------|--------|------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |      | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                               | (mi) | (%)        | (%) |
| Graveled Tread              | 1                                  | -      | 4778                               | 0.90 | 14.2       | -   |
| Multiple Tread              | 1                                  | 0.2    | 126                                | 0.02 | 0.4        | 39  |
| Excessive Root Exposure     | 3                                  | 0.5    | 110                                | 0.02 | 0.3        | 58  |
| Width: Trail 2-6 ft         | 1                                  | -      | 27965                              | 5.30 | 83.4       | -   |
| Width: Trail on Road 2-6 ft | 1                                  | -      | 5565                               | 1.05 | 16.6       | -   |
| Use Type: Pedestrian        | 1                                  | -      | 33530                              | 6.35 | 100.0      | -   |
| Wet Soil                    | 2                                  | 0.3    | 107                                | 0.02 | 0.3        | 42  |
| Running Water on Trail      | 4                                  | 0.6    | 164                                | 0.03 | 0.5        | 65  |
| -----                       |                                    |        |                                    |      |            |     |
| Culvert                     | 5                                  | 0.8    |                                    |      |            | 75  |
| Drainage Dip: Ineffective   | 105                                | 16.5   |                                    |      |            | 90  |
| Drainage Dip: Part. Effect. | 92                                 | 14.5   |                                    |      |            | 84  |
| Drainage Dip: Very Effect.  | 113                                | 17.8   |                                    |      |            | 98  |
| Lateral Drain               | 1                                  | 0.2    |                                    |      |            | 77  |
| Retaining Wall              | 1                                  | 0.2    |                                    |      |            | 58  |
| Water Bar: Ineffective      | 6                                  | 0.9    |                                    |      |            | 51  |
| Water Bar: Part. Effective  | 8                                  | 1.3    |                                    |      |            | 58  |
| Water Bar: Very Effective   | 6                                  | 0.9    |                                    |      |            | 48  |

This segment of the Maddron Bald Trail begins at the Old Settlers/Gabes Mountain Trail junction (elevation 2,400 feet) and ascends to join the Snake Den Ridge Trail (elevation 5,600 feet). The first mile of this 6.35 mile hiker trail follows an overgrown graveled road bed which turns to trail width for the remaining five and one-half miles.

The road bed is in good condition and requires little maintenance; the rockiness of the trail tread seems to have prevented erosion problems and easily withstands the impacts of hikers. The number of maintenance features on this trail appears satisfactory although 105 of the drainage dips (34%) are ineffective. A few occurrences of running water on the trail and wet soil are the only notable resource problems.

Summary/Recommendations: The overall condition of this trail is good and further trail maintenance is not critical at this time.

Table 37. Snake Den Ridge Trail (CO49) resource and maintenance summary table.

Mileage: 5.24 Total Use: 14.3 persons/day Horse Use: 10 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 3           | 0.6    | 82                    | 0.02 | 0.3        | 42  |
| Multiple Tread              | 19          | 3.6    | 843                   | 0.16 | 3.0        | 81  |
| Excessive Root Exposure     | 19          | 3.6    | 463                   | 0.09 | 1.7        | 88  |
| Width: Trail 2-6 ft         | 1           | -      | 27681                 | 5.24 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 27681                 | 5.24 | 100.0      | -   |
| Wet Soil                    | 1           | 0.2    | 237                   | 0.04 | 0.9        | 55  |
| Running Water on Trail      | 7           | 1.3    | 205                   | 0.04 | 0.7        | 69  |
| -----                       |             |        |                       |      |            |     |
| Culvert                     | 8           | 1.5    |                       |      |            | 87  |
| Drainage Dip: Ineffective   | 257         | 49.0   |                       |      |            | 99  |
| Drainage Dip: Part. Effect. | 131         | 25.0   |                       |      |            | 95  |
| Drainage Dip: Very Effect.  | 68          | 13.0   |                       |      |            | 91  |
| Lateral Drain               | 1           | 0.2    |                       |      |            | 77  |
| Retaining Wall              | 3           | 0.6    |                       |      |            | 72  |
| Water Bar: Ineffective      | 11          | 2.1    |                       |      |            | 62  |
| Water Bar: Part. Effective  | 11          | 2.1    |                       |      |            | 64  |
| Water Bar: Very Effective   | 7           | 1.3    |                       |      |            | 51  |

The layout of Snake Den Ridge Trail seems to work well with the contours of the ridge it follows from the Cosby Campground (elevation 2,560 feet) up to the Appalachian Trail (elevation 5,760 feet). Evidence also suggests that this 5.24 mile horse and hiker trail is fairly resistant to resource impacts; especially horses. At the higher elevations the trail is rather rocky but at lower elevations clay became the dominant soil type. Some areas at the base of the mountain have patches of leaf and organic litter.

Trail conditions are fair, primarily from moderate to heavy use and tread drainage features that are inadequately maintained. Multiple treads and excessive root exposure, each with 19 occurrences, are the primary resource problems. Some running water on the trail and soil erosion are also problems in a few areas. The trail seems to have a sufficient number of drainage dips but most are ineffective (257, 56%) or partially effective (131, 29%).

Summary/Recommendations: In general, the Snake Den Ridge Trail is in fair condition. Relatively high use and poorly maintained drainage features appear to be the cause. Work is needed to improve the effectiveness of drainage features.

## Results and Discussion: Cosby Geographic Area

**Table 38.** Maddron Bald Trail: Boundary to Gabes Mountain Trail (CO131) resource and maintenance summary table.

| Mileage: <u>1.20</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>0</u> % of total use |      |       |            |
|-----------------------------|----------------------------------|--------|------------------------------------|------|-------|------------|
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE              |      |       | PERCENTILE |
|                             | (#)                              | (#/mi) | (ft)                               | (mi) | (%)   | (%)        |
| Graveled Tread              | 1                                | 0.8    | 6345                               | 1.20 | 100.0 | -          |
| Width: Road > 6 ft          | 1                                | 0.8    | 6345                               | 1.20 | 100.0 | -          |
| Use Type: Pedestrian        | 1                                | 0.8    | 6345                               | 1.20 | 100.0 | -          |
| <hr/>                       |                                  |        |                                    |      |       |            |
| Culvert                     | 10                               | 8.3    |                                    |      |       | 99         |
| Drainage Dip: Part. Effect. | 1                                | 0.8    |                                    |      |       | 39         |
| Lateral Drain               | 4                                | 3.3    |                                    |      |       | 99         |

This 1.20 mile segment of the Maddron Bald Trail begins at a gated gravel road off the Cosby Highway (Route 321) (elevation 1,900 feet) and ascends gradually to the Old Settlers/Gabes Mountain Trail junction (elevation 2,400 feet). The trail follows a well-maintained gravel road and is restricted to hikers.

No resource problems were noted and existing maintenance features are adequate.

Summary/Recommendations: This trail segment is in excellent condition and is quite resistant to hiker impacts. No additional maintenance is needed at this time.

# Results and Discussion: Cosby Geographic Area

Table 39. Low Gap Trail: Cosby Creek segment (CO132) resource and maintenance summary table.

| Mileage: <u>2.68</u>        | Total Use: <u>10.9</u> persons/day |        | Horse Use: <u>10</u> % of total use |      |            |     |
|-----------------------------|------------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Excessive Grade: >20%       | 6                                  | 2.2    | 911                                 | 0.17 | 6.4        | 86  |
| Graveled Tread              | 1                                  | -      | 2027                                | 0.38 | 14.3       | -   |
| Multiple Tread              | 2                                  | 0.7    | 156                                 | 0.03 | 1.1        | 45  |
| Width: Trail 2-6 ft         | 1                                  | -      | 12294                               | 2.33 | 87.0       | -   |
| Width: Road > 6 ft          | 1                                  | -      | 1842                                | 0.35 | 13.0       | -   |
| Use Type: Horse/Pedestrian  | 1                                  | -      | 12914                               | 2.45 | 91.4       | -   |
| Use Type: Pedestrian        | 1                                  | -      | 1222                                | 0.23 | 8.6        | -   |
| Culvert                     | 4                                  | 1.5    |                                     |      |            | 87  |
| Drainage Dip: Ineffective   | 44                                 | 16.4   |                                     |      |            | 87  |
| Drainage Dip: Part. Effect. | 74                                 | 27.6   |                                     |      |            | 96  |
| Drainage Dip: Very Effect.  | 40                                 | 14.9   |                                     |      |            | 95  |
| Lateral Drain               | 1                                  | 0.4    |                                     |      |            | 87  |
| Retaining Wall              | 3                                  | 1.1    |                                     |      |            | 84  |
| Step                        | 1                                  | 0.4    |                                     |      |            | 88  |
| Water Bar: Very Effective   | 1                                  | 0.4    |                                     |      |            | 39  |

This 2.68 mile segment of the Low Gap Trail leads from the Cosby Campground (elevation 2,460 feet), ascending the Cosby Creek drainage to Low Gap and the Appalachian Trail (elevation 4,240 feet). The trail begins on a graveled road which narrows after a third of a mile to trail width. All but two-tenths of a mile of the trail (8.6%) is open to horse use.

The original design and construction of the trail is excellent. Considerable stone construction is evident in cribbing and culverts. The trail has some steep grades in excess of 20% (6.4% of the trail), but the superb maintenance of the segment has kept the sandy soil from eroding. The trail has ample drainage features, the majority of which are intermediate in effectiveness. Horse impacts are not noticeable.

Summary/Recommendations: The trail is in good condition with no immediate additional maintenance necessary. An excellent example of a trail which avoids the impact-susceptible valley bottoms through placement of the tread higher on the valley slopes.



## Results and Discussion: Cosby Geographic Area

**Table 40.** Albright Grove Loop Trail (CO239) resource and maintenance summary table.

Mileage: 0.66      Total Use: 13.3 persons/day      Horse Use: 0 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Excessive Root Exposure     | 11          | 16.6   | 228                   | 0.04 | 6.5   | 74         |
| Width: Trail 2-6 ft         | 1           | -      | 3508                  | 0.66 | 100.0 | -          |
| Use Type: Pedestrian        | 1           | -      | 3508                  | 0.66 | 100.0 | -          |
| Excessive Width: + >6 ft    | 1           | 1.5    | 51                    | 0.01 | 1.5   | 88         |
| -----                       |             |        |                       |      |       |            |
| Drainage Dip: Ineffective   | 7           | 10.5   |                       |      |       | 81         |
| Drainage Dip: Part. Effect. | 8           | 12.0   |                       |      |       | 81         |
| Drainage Dip: Very Effect.  | 11          | 16.6   |                       |      |       | 96         |
| Lateral Drain               | 1           | 1.5    |                       |      |       | 96         |

The 0.66 mile Albright Grove Trail is a short loop trail off the Maddron Bald Trail (elevation 3,200 feet) which takes visitors through a beautiful, old growth/virgin forest. The trail is open only to hikers. As a result of being at the foot of the mountain, this area is generally flat, has loamy soil, and seems to stand up well to the impact of hikers.

The trail's primary resource impact is excessive root exposure, 11 occurrences with 6.5% of the trail affected. The amount, quality, and the effectiveness of maintenance are fair.

Summary/Recommendations: Trail condition is good, excepting numerous areas of severe root exposure. Maintenance to alleviate this problem is needed.



Table 41. Sugarland Mountain Trail (EL23) resource and maintenance summary table.

Mileage: 11.86 Total Use: 15.2 persons/day Horse Use: 0 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 5           | 0.4    | 100                   | 0.02  | 0.2        | 44  |
| Soil Erosion: 2-2.9 ft      | 1           | 0.1    | 30                    | 0.01  | <0.1       | 62  |
| Multiple Tread              | 2           | 0.2    | 311                   | 0.06  | 0.5        | 64  |
| Excessive Root Exposure     | 7           | 0.6    | 126                   | 0.02  | 0.2        | 61  |
| Width: Trail 2-6 ft         | 1           | -      | 62634                 | 11.86 | 100.0      | -   |
| Use Type: Pedestrian        | 1           | -      | 62634                 | 11.86 | 100.0      | -   |
| Wet Soil                    | 6           | 0.5    | 231                   | 0.04  | 0.4        | 54  |
| Running Water on Trail      | 2           | 0.2    | 41                    | 0.01  | 0.1        | 42  |
| -----                       |             |        |                       |       |            |     |
| Drainage Dip: Ineffective   | 22          | 1.9    |                       |       |            | 40  |
| Drainage Dip: Part. Effect. | 24          | 2.0    |                       |       |            | 57  |
| Drainage Dip: Very Effect.  | 40          | 3.4    |                       |       |            | 74  |
| Retaining Wall              | 2           | 0.2    |                       |       |            | 58  |
| Water Bar: Ineffective      | 27          | 2.3    |                       |       |            | 64  |
| Water Bar: Part. Effective  | 9           | 0.8    |                       |       |            | 50  |
| Water Bar: Very Effective   | 20          | 1.7    |                       |       |            | 54  |

The Sugarland Mountain Trail follows a ridge ascending from the Laurel Falls parking area (elevation 2,200 feet) to a junction with the Appalachian Trail (elevation 6,400 feet). The general layout or positioning of this 11.86 mile hiker trail along the ridge is excellent.

Although this trail does have several problem areas of wet soil, severely exposed roots, and soil erosion, with proper maintenance such problems can be avoided. Particular attention is needed in the first two miles of trail descending from the Appalachian Trail. Due to very limited maintenance this area of the trail is experiencing significant soil erosion. The trail resembles a dry creek bed in a few areas.

Summary/Recommendations: Overall, the trail is in fair condition. The number of tread drainage features is currently inadequate and a significant amount of work, particularly in the higher elevations, is needed immediately.



Table 42. Huskey Gap Trail (EL24) resource and maintenance summary table.

|                             |                                   |                                    |                       |       |            |     |
|-----------------------------|-----------------------------------|------------------------------------|-----------------------|-------|------------|-----|
| Mileage: <u>2.13</u>        | Total Use: <u>9.2</u> persons/day | Horse Use: <u>0</u> % of total use |                       |       |            |     |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                    | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|                             | (#)                               | (#/mi)                             | (ft)                  | (mi)  | (%)        | (%) |
| Graveled Tread              | 1                                 | -                                  | 23                    | <0.01 | 0.2        | -   |
| Multiple Tread              | 1                                 | 0.5                                | 38                    | 0.01  | 0.3        | 21  |
| Width: Trail 2-6 ft         | 1                                 | -                                  | 11221                 | 2.13  | 100.0      | -   |
| Use Type: Pedestrian        | 1                                 | -                                  | 11221                 | 2.13  | 100.0      | -   |
| Running Water on Trail      | 1                                 | 0.5                                | 16                    | <0.01 | 0.1        | 35  |
| -----                       |                                   |                                    |                       |       |            |     |
| Drainage Dip: Ineffective   | 8                                 | 3.8                                |                       |       |            | 55  |
| Drainage Dip: Part. Effect. | 3                                 | 1.4                                |                       |       |            | 49  |
| Retaining Wall              | 1                                 | 0.5                                |                       |       |            | 69  |
| Water Bar: Ineffective      | 1                                 | 0.5                                |                       |       |            | 40  |
| Water Bar: Part. Effective  | 1                                 | 0.5                                |                       |       |            | 45  |
| Water Bar: Very Effective   | 1                                 | 0.5                                |                       |       |            | 43  |

The 2.13 mile Huskey Gap Trail ascends from the Little River Trail (elevation 2,500 feet) to Huskey Gap where it intersects with the Sugarland Mountain Trail (elevation 3,100 feet). The loaminess of the soil and the excellent layout of this trail contribute to its resistance to impacts. The trail is restricted to pedestrian use and is of trail width.

Trail conditions are generally good due to low use. Problems include only one section of multiple treads and one location with running water on the trail. Few maintenance features are present and most of these are ineffective.

Summary/Recommendations: Overall, trail conditions are good due to good trail layout and low use. Little maintenance is evident, more is needed but not critical at this time.



Table 43. Goshen Prong Trail (EL26) resource and maintenance summary table.

|                             |                                  |                                    |                       |      |            |
|-----------------------------|----------------------------------|------------------------------------|-----------------------|------|------------|
| Mileage: <u>4.43</u>        | Total Use: <u>UK</u> persons/day | Horse Use: <u>0</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |                                    | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                              | (#/mi)                             | (ft)                  | (mi) | (%)        |
| Soil Erosion: 1-1.9 ft      | 9                                | 2.0                                | 328                   | 0.06 | 1.4        |
| Multiple Tread              | 6                                | 1.4                                | 201                   | 0.04 | 0.9        |
| Width: Trail 2-6 ft         | 1                                | -                                  | 20687                 | 3.92 | 88.4       |
| Width: Trail on Road 2-6 ft | 1                                | -                                  | 2724                  | 0.52 | 11.6       |
| Use Type: Pedestrian        | 1                                | -                                  | 23411                 | 4.43 | 100.0      |
| Wet Soil                    | 2                                | 0.5                                | 70                    | 0.01 | 0.3        |
| Running Water on Trail      | 6                                | 1.4                                | 182                   | 0.03 | 0.8        |
| -----                       |                                  |                                    |                       |      |            |
| Drainage Dip: Part. Effect. | 12                               | 2.7                                |                       |      | 58         |
| Drainage Dip: Very Effect.  | 6                                | 1.4                                |                       |      | 65         |
| Retaining Wall              | 8                                | 1.8                                |                       |      | 90         |
| Water Bar: Ineffective      | 1                                | 0.2                                |                       |      | 29         |
| Water Bar: Very Effective   | 1                                | 0.2                                |                       |      | 31         |

A portion of the Goshen Prong Trail was surveyed, from its intersection with a spur trail up the Fish Camp Prong drainage to campsite number 25 (elevation 3,320 feet) to the Appalachian Trail (elevation 5,760 feet), a distance of 4.43 miles. The trail is restricted to hikers and is of trail width for 88.4% of its length.

The design of this trail segment is excellent as the trail ascends the drainage remaining on the sideslope above the stream. The tread appears to stay relatively dry despite the very limited number of drainage features. However, there are six occurrences of water running on the trail. On the steeper portion of the segment soil erosion becomes more evident, including areas with less than one foot of soil loss. Due to the location of the trail, the tread resists foot use impacts and tread width is never greater than 1.5 feet.

Summary/Recommendations: The trail is in good condition largely because of its design and soils. Some wet areas and advancing soil erosion require some limited immediate tread drainage work, however.

Table 44. Jakes Creek Trail (EL27) resource and maintenance summary table.

Mileage: 3.28 Total Use: 39.1 persons/day Horse Use: 30 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Graveled Tread              | 1           | -      | 6140                  | 1.16 | 35.4  | -          |
| Multiple Tread              | 3           | 0.9    | 81                    | 0.02 | 0.5   | 33         |
| Excessive Root Exposure     | 31          | 9.4    | 1005                  | 0.19 | 5.8   | 96         |
| Width: Trail 2-6 ft         | 1           | -      | 11195                 | 2.12 | 64.6  | -          |
| Width: Road > 6 ft          | 1           | -      | 6140                  | 1.16 | 35.4  | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 17335                 | 3.28 | 100.0 | -          |
| Excessive Width: + 3-6 ft   | 4           | 1.2    | 139                   | 0.03 | 0.8   | 79         |
| Wet Soil                    | 2           | 0.6    | 260                   | 0.05 | 1.5   | 57         |
| Running Water on Trail      | 2           | 0.6    | 123                   | 0.02 | 0.7   | 58         |
| -----                       |             |        |                       |      |       |            |
| Culvert                     | 14          | 4.3    |                       |      |       | 94         |
| Drainage Dip: Ineffective   | 22          | 6.7    |                       |      |       | 70         |
| Drainage Dip: Part. Effect. | 15          | 4.6    |                       |      |       | 69         |
| Drainage Dip: Very Effect.  | 9           | 2.7    |                       |      |       | 70         |
| Lateral Drain               | 1           | 0.3    |                       |      |       | 84         |
| Water Bar: Ineffective      | 11          | 3.4    |                       |      |       | 72         |
| Water Bar: Part. Effective  | 5           | 1.5    |                       |      |       | 61         |
| Water Bar: Very Effective   | 37          | 11.3   |                       |      |       | 87         |

The 3.28 mile Jakes Creek Trail ascends from Elkmont (elevation 2,340 feet) to Jakes Gap (elevation 4,000 feet). The first 1.16 miles is a graveled road-bed which then narrows to trail width. The trail is open to both hikers and horse users.

The trail is in good condition where graveled but conditions deteriorate further into the backcountry. Use from horses and hikers appears to be heavy, resulting in 31 occurrences of excessive root exposure (9.4 per mile, 5.8% of the trail's length). Other resource problems include wet soil, running water on the trail, trail widening, and multiple treads. Maintenance of the graveled portion of the trail is good but tread work is inadequate for the remainder given the heavy use this trail receives.

Summary/Recommendations: Overall, this trail is in fair condition, additional maintenance of the trail beyond the graveled section is needed.

Table 45. Cucumber Gap Trail (EL237) resource and maintenance summary table.

| Mileage: <u>2.35</u>       | Total Use: <u>14.3</u> persons/day |        | Horse Use: <u>0</u> % of total use |       |            |     |
|----------------------------|------------------------------------|--------|------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |       | PERCENTILE |     |
|                            | (#)                                | (#/mi) | (ft)                               | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 1                                  | 0.4    | 15                                 | <0.01 | 0.1        | 29  |
| Excessive Root Exposure    | 11                                 | 4.7    | 437                                | 0.08  | 3.5        | 87  |
| Width: Trail 2-6 ft        | 1                                  | -      | 12413                              | 2.35  | 100.0      | -   |
| Use Type: Pedestrian       | 1                                  | -      | 12413                              | 2.35  | 100.0      | -   |
| Excessive Width: + 3-6 ft  | 1                                  | 0.4    | 111                                | 0.02  | 0.9        | 76  |
| Wet Soil                   | 5                                  | 2.1    | 100                                | 0.02  | 0.8        | 40  |
| Running Water on Trail     | 3                                  | 1.3    | 93                                 | 0.02  | 0.7        | 53  |
| Culvert                    | 5                                  | 2.1    |                                    |       |            | 91  |
| Drainage Dip: Ineffective  | 3                                  | 1.3    |                                    |       |            | 35  |
| Drainage Dip: Very Effect. | 2                                  | 0.9    |                                    |       |            | 59  |
| Retaining Wall             | 2                                  | 0.9    |                                    |       |            | 81  |
| Water Bar: Ineffective     | 4                                  | 1.7    |                                    |       |            | 58  |
| Water Bar: Part. Effective | 2                                  | 0.9    |                                    |       |            | 53  |
| Water Bar: Very Effective  | 6                                  | 2.6    |                                    |       |            | 61  |

The 2.35 mile Cucumber Gap Trail passes through Cucumber Gap connecting the Jakes Creek and Little River drainages, from the Jakes Creek Trail (elevation 2,500 feet) to the Little River Trail (elevation 2,600 feet). The trail is restricted to hikers and is of trail width for its entire length.

Soil texture ranges from loam to silt and clay and many areas seem to be susceptible to soil erosion. Trail use is light. Excessive root exposure is the most prevalent problem but wet soil and running water on the trail are also problems. Few tread drainage features were noted.

Summary/Recommendations: The condition of this trail is good, largely due to its relatively light use. Additional maintenance is needed if use levels increase.



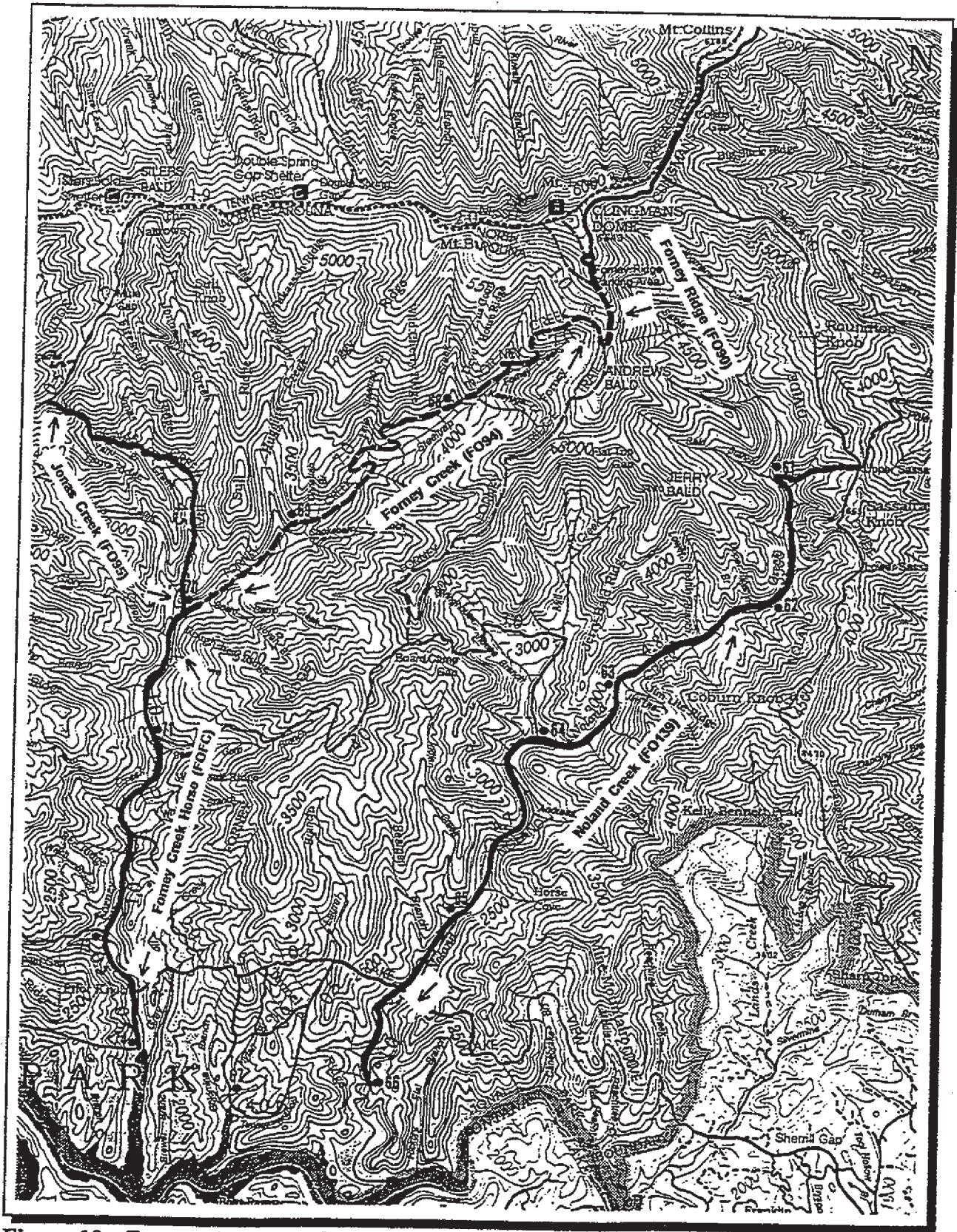


Figure 10. Topographic map of trail locations for the Forney Creek area.



Table 46. Forney Ridge Trail (FO90) resource and maintenance summary table.

| Mileage: <u>1.07</u>        | Total Use: <u>60.3</u> persons/day | Horse Use: <u>0</u> % of total use |                       |      |            |     |
|-----------------------------|------------------------------------|------------------------------------|-----------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |                                    | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|                             | (#)                                | (#/mi)                             | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 3                                  | 2.8                                | 197                   | 0.04 | 3.5        | 53  |
| Graveled Tread              | 1                                  | -                                  | 51                    | 0.01 | 0.9        | -   |
| Multiple Tread              | 2                                  | 1.9                                | 98                    | 0.02 | 1.7        | 36  |
| Width: Trail 2-6 ft         | 1                                  | -                                  | 5655                  | 1.07 | 100.0      | -   |
| Use Type: Pedestrian        | 1                                  | -                                  | 5655                  | 1.07 | 100.0      | -   |
| Wet Soil                    | 3                                  | 2.8                                | 70                    | 0.01 | 1.2        | 34  |
| Running Water on Trail      | 7                                  | 6.5                                | 1087                  | 0.21 | 19.2       | 98  |
| -----                       |                                    |                                    |                       |      |            |     |
| Drainage Dip: Ineffective   | 2                                  | 1.9                                |                       |      |            | 40  |
| Drainage Dip: Part. Effect. | 3                                  | 2.8                                |                       |      |            | 60  |
| Drainage Dip: Very Effect.  | 6                                  | 5.6                                |                       |      |            | 79  |
| Water Bar: Ineffective      | 2                                  | 1.9                                |                       |      |            | 61  |
| Water Bar: Part. Effective  | 1                                  | 0.9                                |                       |      |            | 53  |
| Water Bar: Very Effective   | 1                                  | 0.9                                |                       |      |            | 48  |

Only a 1.07 mile portion of the Forney Ridge Trail was surveyed, from its junction with the Forney Creek Trail (elevation 5,580 feet) to the Clingman's Dome parking lot (elevation 6,400 feet). This segment is restricted to hikers and its tread is of trail width.

Trail design is generally good as the trail is situated on slopes with mostly gentle grades. Resource conditions are fair, in spite of fairly heavy day-use hiker traffic. The most significant problem is running water on the trail, primarily from seeps and springs, affecting 19.2% of its tread. However, the tread is very rocky with little soil to be eroded. Soil erosion, 1-1.9 feet, and multiple treads are also problems. The number of tread drainage features are insufficient given the current conditions.

Summary/Recommendations: The trail is in fair to poor condition, largely due to problems with water and wet soils. Additional tread drainage actions are an immediate maintenance need.

**Table 47. Forney Creek Trail (FO94) resource and maintenance summary table.**

|                             |                                    |                                    |                       |       |            |     |
|-----------------------------|------------------------------------|------------------------------------|-----------------------|-------|------------|-----|
| Mileage: <u>6.98</u>        | Total Use: <u>11.4</u> persons/day | Horse Use: <u>0</u> % of total use |                       |       |            |     |
| TRAIL ATTRIBUTE             | OCCURRENCES                        |                                    | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|                             | (#)                                | (#/mi)                             | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 3                                  | 0.4                                | 77                    | 0.01  | 0.2        | 40  |
| Soil Erosion: 2-2.9 ft      | 1                                  | 0.1                                | 29                    | 0.01  | 0.1        | 61  |
| Excessive Grade: >20%       | 4                                  | 0.6                                | 1039                  | 0.20  | 2.8        | 91  |
| Multiple Tread              | 3                                  | 0.4                                | 87                    | 0.02  | 0.2        | 35  |
| Excessive Root Exposure     | 1                                  | 0.1                                | 10                    | <0.01 | <0.1       | 44  |
| Width: Trail 2-6 ft         | 1                                  | -                                  | 36855                 | 6.98  | 100.0      | -   |
| Use Type: Pedestrian        | 1                                  | -                                  | 36855                 | 6.98  | 100.0      | -   |
| Trail Corduroy              | 1                                  | 0.1                                | 4                     | <0.01 | <0.1       | 91  |
| Excessive Width: + 3-6 ft   | 1                                  | 0.1                                | 30                    | 0.01  | 0.1        | 57  |
| Wet Soil                    | 13                                 | 1.9                                | 298                   | 0.06  | 0.8        | 61  |
| Running Water on Trail      | 17                                 | 2.4                                | 881                   | 0.17  | 2.4        | 96  |
| -----                       |                                    |                                    |                       |       |            |     |
| Culvert                     | 5                                  | 0.7                                |                       |       |            | 72  |
| Drainage Dip: Part. Effect. | 2                                  | 0.3                                |                       |       |            | 27  |
| Drainage Dip: Very Effect.  | 2                                  | 0.3                                |                       |       |            | 42  |
| Water Bar: Ineffective      | 7                                  | 1.0                                |                       |       |            | 54  |
| Water Bar: Part. Effective  | 1                                  | 0.1                                |                       |       |            | 37  |
| Water Bar: Very Effective   | 1                                  | 0.1                                |                       |       |            | 29  |

The 6.98 mile Forney Creek Trail ascends the Forney Creek drainage from a sign restricting horse use (elevation 2,500 feet), located 1,500 feet upstream from the Jonas Creek Trail, to its junction with the Forney Ridge Trail (elevation 5,580 feet). Most parts of the trail are close to Forney Creek, which it crosses in several places. The lower portion of the trail follows an old railroad bed with many deteriorating old bridges at stream crossings. The current tread is of trail width and horses are excluded although some horse use is evident.

Trail layout and construction are good, grades are typically gentle and the tread surface is fairly resistant to impacts. Overall, the trail is in good to fair condition. The most common resource problems are 17 occurrences of running water on the tread and 13 occurrences of wet soil. Several sections with excessive grade are also evident but erosion is not excessive. The shoulders of switchbacks are often too close together and therefore shortcuts and informal trails at the switchbacks are common. Tread drainage features are almost entirely lacking.

**Summary/Recommendations:** The trail is in fairly good condition, in part due to a resistant original design and exclusion of horses. Additional tread drainage actions are needed to address areas with running water on the trail and wet soils.

Table 48. Jonas Creek Trail (FO95) resource and maintenance summary table.

|                             |                                  |        |                                     |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| Mileage: <u>4.12</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>40</u> % of total use |      |            |     |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 3                                | 0.7    | 223                                 | 0.04 | 1.0        | 55  |
| Soil Erosion: 2-2.9 ft      | 2                                | 0.5    | 118                                 | 0.02 | 0.5        | 74  |
| Soil Erosion: 5-5.9 ft      | 1                                | 0.2    | 202                                 | 0.04 | 0.9        | 95  |
| Multiple Tread              | 7                                | 1.7    | 849                                 | 0.16 | 3.9        | 83  |
| Width: Trail 2-6 ft         | 1                                | -      | 13325                               | 2.52 | 61.2       | -   |
| Width: Trail on Road 2-6 ft | 1                                | -      | 8442                                | 1.60 | 38.8       | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 21767                               | 4.12 | 100.0      | -   |
| Wet Soil                    | 18                               | 4.4    | 1013                                | 0.19 | 4.7        | 81  |
| Running Water on Trail      | 4                                | 1.0    | 321                                 | 0.06 | 1.5        | 76  |
| -----                       |                                  |        |                                     |      |            |     |
| Water Bar: Ineffective      | 3                                | 0.7    |                                     |      |            | 47  |

The Jonas Creek Trail begins at the Forney Creek Trail (elevation 2,400 feet) and ascends to the Welch Ridge Trail (elevation 4,530 feet). The 4.12 mile horse/hiker trail is of both trail width (39%) and road width (61%).

The trail is well designed as it gradually ascends out of the Jonas Creek valley. Trail use appears to be very low, with the lower section receiving more use than the upper section. The trail passes directly through campsite number 70. Trail problems include some switchback cutting and numerous areas of wet soil on the lower section. The numerous stream crossings were sometimes difficult with most bridges washed out. Informal trails on either side of the stream were found, apparently created by users searching for safe places to cross. One short section of user-created trail to reach a stream crossing was exceptionally eroded by horse traffic and should be maintained. The only tread drainage features noted were 3 ineffective water bars.

Summary/Recommendations: The trail is in good condition on the upper section where soils are well-drained and use is light. Conditions are somewhat poorer on the lower section where the trail parallels the creek due to poorly drained soils. Bridges and designated stream crossings for horses would reduce the number of impacted informal trails along the stream corridor.

**Table 49. Noland Creek Trail (FO139) resource and maintenance summary table.**

Mileage: 11.20      Total Use: 13.1 persons/day      Horse Use: 50 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 5           | 0.4    | 282                   | 0.05  | 0.5        | 58  |
| Soil Erosion: 2-2.9 ft      | 2           | 0.2    | 408                   | 0.08  | 0.7        | 90  |
| Soil Erosion: 3-3.9 ft      | 1           | 0.1    | 91                    | 0.02  | 0.2        | 94  |
| Excessive Grade: >20%       | 8           | 0.7    | 913                   | 0.17  | 1.5        | 88  |
| Multiple Tread              | 12          | 1.1    | 963                   | 0.18  | 1.6        | 85  |
| Width: Trail 2-6 ft         | 1           | -      | 18187                 | 3.44  | 30.8       | -   |
| Width: Road > 6 ft          | 1           | -      | 29474                 | 5.58  | 49.9       | -   |
| Width: Trail on Road 2-6 ft | 2           | -      | 11451                 | 2.17  | 19.4       | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 54970                 | 10.41 | 93.0       | -   |
| Use Type: Pedestrian        | 1           | -      | 4142                  | 0.78  | 7.0        | -   |
| Trail Corduroy              | 1           | 0.1    | 17                    | <0.01 | <0.1       | 95  |
| Excessive Width: + 3-6 ft   | 5           | 0.4    | 349                   | 0.07  | 0.6        | 90  |
| Excessive Width: + >6 ft    | 1           | 0.1    | 25                    | <0.01 | <0.1       | 85  |
| Wet Soil                    | 14          | 1.3    | 823                   | 0.16  | 1.4        | 79  |
| Running Water on Trail      | 10          | 0.9    | 660                   | 0.13  | 1.1        | 92  |
| -----                       |             |        |                       |       |            |     |
| Culvert                     | 13          | 1.2    |                       |       |            | 84  |
| Drainage Dip: Part. Effect. | 2           | 0.2    |                       |       |            | 24  |
| Lateral Drain               | 9           | 0.8    |                       |       |            | 91  |
| Retaining Wall              | 2           | 0.2    |                       |       |            | 58  |
| Water Bar: Part. Effective  | 1           | 0.1    |                       |       |            | 37  |
| Water Bar: Very Effective   | 28          | 2.5    |                       |       |            | 59  |

The 11.20 mile Noland Creek Trail begins at the Noland Divide Trail at Upper Sassafras Gap (elevation 4,240 feet) and descends the Noland Creek Drainage, ending at Fontana Lake (elevation 2,000 feet). Almost two-thirds of the trail follows a dirt woods road with the remainder of trail width. Most of the trail (93%) is open to horse use.

The first section of trail starts as a narrow footpath descending steeply from the Noland Divide Trail. The layout of this section of trail is poor with several grades measuring over 35%. As a result, this portion of the trail had extensive erosion, over two feet in some areas. Upon reaching Noland Creek the tread turns onto an old woods road on the valley floor. For this section wet soil and running water on the trail are the most significant problems. Horse use is churning up the wet soils, resulting in numerous large muddy sections. These problems have in turn resulted in the development of excessive tread widths and multiple treads. At campsite 64 the tread follows a maintained woods road that has recently been graded. The road stays close to Noland Creek, crossing it several times. Lateral drains and culverts are the only maintenance features documented on this portion of trail. Horse and hiker impacts on the road are negligible. After passing under the Road to Nowhere the roadbed becomes an unmaintained woods road from which horses are restricted. This final section is in relatively good condition although no maintenance features are evident. The trail ends abruptly at the edge of Fontana Lake as if in the recent past the water level of the lake had risen.

**Summary/Recommendations:** The condition of the trail ranges from good on the maintained road and hiker-only sections, to fair and poor in the sections descending from the Noland Divide Trail and paralleling Noland Creek. Both sections should be examined for possible reroutes to avoid steep grades and wet organic soils. Horse use is problematic for these sections if the trail is not rerouted and additional maintenance will not likely provide an effective solution.



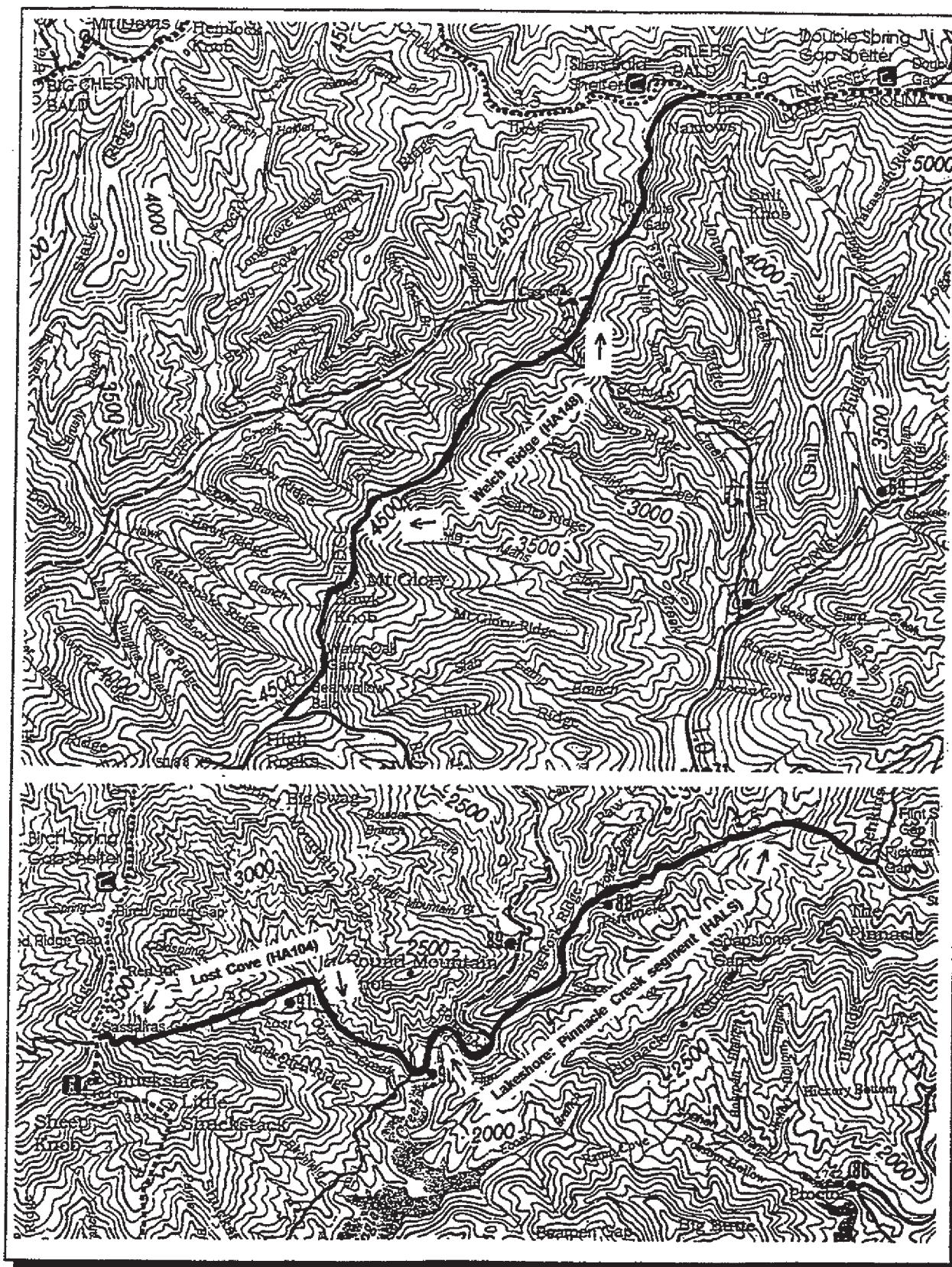
Table 50. Forney Creek Horse Trail (FOFC) resource and maintenance summary table.

| Mileage: <u>4.45</u>       | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>40</u> % of total use |      |            |     |
|----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                            | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 6                                | 1.3    | 348                                 | 0.07 | 1.5        | 61  |
| Soil Erosion: 2-2.9 ft     | 5                                | 1.1    | 808                                 | 0.15 | 3.4        | 96  |
| Soil Erosion: 3-3.9 ft     | 1                                | 0.2    | 54                                  | 0.01 | 0.2        | 88  |
| Excessive Grade: >20%      | 3                                | 0.7    | 301                                 | 0.06 | 1.3        | 73  |
| Multiple Tread             | 2                                | 0.4    | 61                                  | 0.01 | 0.3        | 29  |
| Width: Trail 2-6 ft        | 1                                | -      | 23474                               | 4.45 | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                | -      | 23474                               | 4.45 | 100.0      | -   |
| Wet Soil                   | 9                                | 2.0    | 398                                 | 0.08 | 1.7        | 68  |
| Running Water on Trail     | 5                                | 1.1    | 330                                 | 0.06 | 1.4        | 79  |
| -----                      |                                  |        |                                     |      |            |     |
| Drainage Dip: Ineffective  | 2                                | 0.4    |                                     |      |            | 28  |
| Lateral Drain              | 1                                | 0.2    |                                     |      |            | 77  |
| Water Bar: Ineffective     | 1                                | 0.2    |                                     |      |            | 29  |
| Water Bar: Part. Effective | 15                               | 3.4    |                                     |      |            | 73  |
| Water Bar: Very Effective  | 15                               | 3.4    |                                     |      |            | 66  |

The Forney Creek Horse Trail runs from campsite number 74 on Fontana Lake (elevation 1,760 feet) 4.45 miles up Forney Creek to a sign where horses are excluded from the remainder of the trail (elevation 2,500 feet) (sign is located 1,500 feet upstream from the Jonas Creek Trail junction). The trail is open to horses and the tread is of trail width.

The layout, environmental and resource conditions are similar to those of the Forney Creek Trail (FO94). However, the trail here is more level and becomes wider. The trail is in poor condition, largely due to excessive soil erosion, which is common and exceeded three feet in some places. Some of the erosion is attributable to excessive grades and wet soils. However, insufficient tread drainage is also an important factor. Although horse use is permitted the resource impacts related to this use are not serious. This contrasts with the remarkable horse impacts on campsites along this trail.

Summary/Recommendations: The Forney Creek Horse Trail is in poor condition. A large number of additional tread drainage features are needed to address common problems with soil erosion and wet soils.



**Figure 11.** Topographic map of trail locations for the Hazel Creek area.

Table 51. Lost Cove Trail (HA104) resource and maintenance summary table.

|                             |                                  |                                     |                       |      |            |
|-----------------------------|----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>4.33</u>        | Total Use: <u>UK</u> persons/day | Horse Use: <u>40</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                              | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Soil Erosion: 1-1.9 ft      | 3                                | 0.7                                 | 51                    | 0.01 | 0.2        |
| Excessive Grade: >20%       | 8                                | 1.8                                 | 736                   | 0.14 | 3.2        |
| Multiple Tread              | 11                               | 2.5                                 | 1112                  | 0.21 | 4.9        |
| Excessive Root Exposure     | 7                                | 1.6                                 | 243                   | 0.05 | 1.1        |
| Width: Trail 2-6 ft         | 2                                | -                                   | 21216                 | 4.02 | 92.8       |
| Width: Trail on Road 2-6 ft | 1                                | -                                   | 1652                  | 0.31 | 7.2        |
| Use Type: Horse/Pedestrian  | 1                                | -                                   | 22868                 | 4.33 | 100.0      |
| Excessive Width: + 3-6 ft   | 2                                | 0.5                                 | 58                    | 0.01 | 0.3        |
| Wet Soil                    | 7                                | 1.6                                 | 292                   | 0.06 | 1.3        |
| Running Water on Trail      | 3                                | 0.7                                 | 71                    | 0.01 | 0.3        |
| -----                       |                                  |                                     |                       |      |            |
| Drainage Dip: Ineffective   | 2                                | 0.5                                 |                       |      |            |
| Drainage Dip: Part. Effect. | 1                                | 0.2                                 |                       |      |            |
| Step                        | 20                               | 0.7                                 |                       |      |            |
| Water Bar: Ineffective      | 12                               | 2.8                                 |                       |      |            |

The Lost Cove Creek Trail begins at the Eagle Creek/Lakeshore Trail junction (elevation 1,800 feet) and ascends the Lost Cove Creek drainage to the Appalachian Trail/Twenty Mile Trail junction at Sassafras Gap (elevation 3,440 feet). The 4.33 mile segment is predominantly of trail width (93%) and is open to both hikers and horse users.

The original layout of the trail is poor, especially from the head of Lost Cove Creek to the Appalachian Trail. The trail in this area ascends steeply up the mountain with few switchbacks. Eight occurrences of grades in excess of 20% are recorded (one of nearly 50%) and including 3.2% of the trail's length. Maintenance features are virtually absent except for some areas where check dams are in place. As a result, soil erosion and excessive root exposure are problems in some areas. These problems would likely be more severe except that the trail appears to receive very little use. In several areas the trail is overgrown and fallen trees block the trail, resulting in the development of multiple treads. Switchback short-cutting is also a problem.

**Summary/Recommendations:** The trail is in fair condition primarily due to its low use. Limited maintenance is needed to clear treefalls and block switchback shortcuts to prevent continued use of multiple treads. If the trail begins to receive additional use a reroute of the steeper portions is needed to prevent soil erosion.



Table 52. Welch Ridge Trail (HA148) resource and maintenance summary table.

| Mileage: <u>6.43</u>       | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>10</u> % of total use |      |       |            |
|----------------------------|----------------------------------|--------|-------------------------------------|------|-------|------------|
| TRAIL ATTRIBUTE            | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      |       | PERCENTILE |
|                            | (#)                              | (#/mi) | (ft)                                | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft     | 3                                | 0.5    | 243                                 | 0.05 | 0.7   | 57         |
| Multiple Tread             | 1                                | 0.2    | 46                                  | 0.01 | 0.1   | 24         |
| Width: Trail 2-6 ft        | 1                                | -      | 33968                               | 6.43 | 100.0 | -          |
| Use Type: Horse/Pedestrian | 1                                | -      | 33968                               | 6.43 | 100.0 | -          |
| Retaining Wall             | 2                                | 0.3    |                                     |      |       | 64         |

The Welch Ridge Trail connects Bear Creek Trail at High Rocks (elevation 4,800 feet) and ascends Welch Ridge to the Appalachian Trail near Silers Bald (elevation 5,400 feet). The 6.43 mile trail generally follows the crest of the ridge or just below on the shoulder. The horse/hiker trail is of trail width throughout its length.

The trail receives extremely low use throughout. Many sections are overgrown with briars and dense vegetation making the tread difficult to discern at times. Slumping of the tread was also noted on some steep sideslopes creating places where travel was treacherous. Very few maintenance features were found. Trail signs, some tied to trees, were often deteriorated and illegible. An excellent spring exists near Hawk Knob and this area presents a logical place for a designated campsite (facilitating travel between the Forney and Hazel Creek valleys).

Summary/Recommendations: The Welch Ridge Trail receives very little use and is in fairly good condition. Additional use, possibly from the creation of a designated campsite, might help to keep the tread open. Additional tread work will be necessary if use is increased.



Table 53. Lakeshore Trail: Pinnacle Creek segment (HALS) resource and maintenance summary table.

|                             |                                  |                                     |                       |       |            |
|-----------------------------|----------------------------------|-------------------------------------|-----------------------|-------|------------|
| Mileage: <u>4.02</u>        | Total Use: <u>UK</u> persons/day | Horse Use: <u>40</u> % of total use |                       |       |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |                                     | TOTAL LINEAL DISTANCE |       | PERCENTILE |
|                             | (#)                              | (#/mi)                              | (ft)                  | (mi)  | (%)        |
| Soil Erosion: 1-1.9 ft      | 3                                | 0.7                                 | 66                    | 0.01  | 0.3        |
| Soil Erosion: 2-2.9 ft      | 2                                | 0.5                                 | 69                    | 0.01  | 0.3        |
| Excessive Grade: >20%       | 2                                | 0.5                                 | 105                   | 0.02  | 0.5        |
| Multiple Tread              | 4                                | 1.0                                 | 225                   | 0.04  | 1.1        |
| Excessive Root Exposure     | 10                               | 2.5                                 | 194                   | 0.04  | 0.9        |
| Width: Trail 2-6 ft         | 1                                | -                                   | 14763                 | 2.80  | 69.6       |
| Width: Trail on Road 2-6 ft | 1                                | -                                   | 6445                  | 1.22  | 30.4       |
| Use Type: Horse/Pedestrian  | 1                                | -                                   | 21208                 | 4.02  | 100.0      |
| Excessive Width: + 3-6 ft   | 2                                | 0.5                                 | 102                   | 0.02  | 0.5        |
| Excessive Width: + >6 ft    | 1                                | 0.2                                 | 22                    | <0.01 | 0.1        |
| Wet Soil                    | 24                               | 6.0                                 | 1033                  | 0.20  | 4.9        |
| Running Water on Trail      | 3                                | 0.7                                 | 91                    | 0.02  | 0.4        |
| -----                       |                                  |                                     |                       |       |            |
| Culvert                     | 4                                | 1.0                                 |                       |       |            |
| Lateral Drain               | 1                                | 0.2                                 |                       |       |            |
| Water Bar: Ineffective      | 1                                | 0.2                                 |                       |       |            |
|                             |                                  |                                     |                       |       |            |

This 4.02 mile segment of the Lakeshore Trail begins at the Eagle Creek Trail junction (elevation 1,800 feet) ascending the Pinnacle Creek drainage to the Jenkins Ridge Trail (elevation 2,960 feet). The horse/hiker trail is of trail width for 2.8 miles (70%) before joining a narrow dirt roadbed near Pickens Gap.

The original location and design of the trail is poor. The trail parallels and crosses Pinnacle Creek 16 times over the first 1.5 miles. Maintenance features are absent and large quagmires of mud have developed. Twenty-three occurrences of wet soil are noted in this section. Once the trail passed campsite number 88, the trail begins to ascend Jenkins Ridge. Maintenance features are still absent, but the condition of the tread improves considerably. Soil erosion is a problem in some areas but is not yet extensive.

Summary/Recommendations: The current location of the trail where it follows Pinnacle is in poor condition and is not suitable for horse or hiker use. Extensive rerouting to move the tread on the sideslopes away from the creek is recommended. The remaining section of trail is in better condition but requires the addition of tread drainage features to halt further soil erosion.

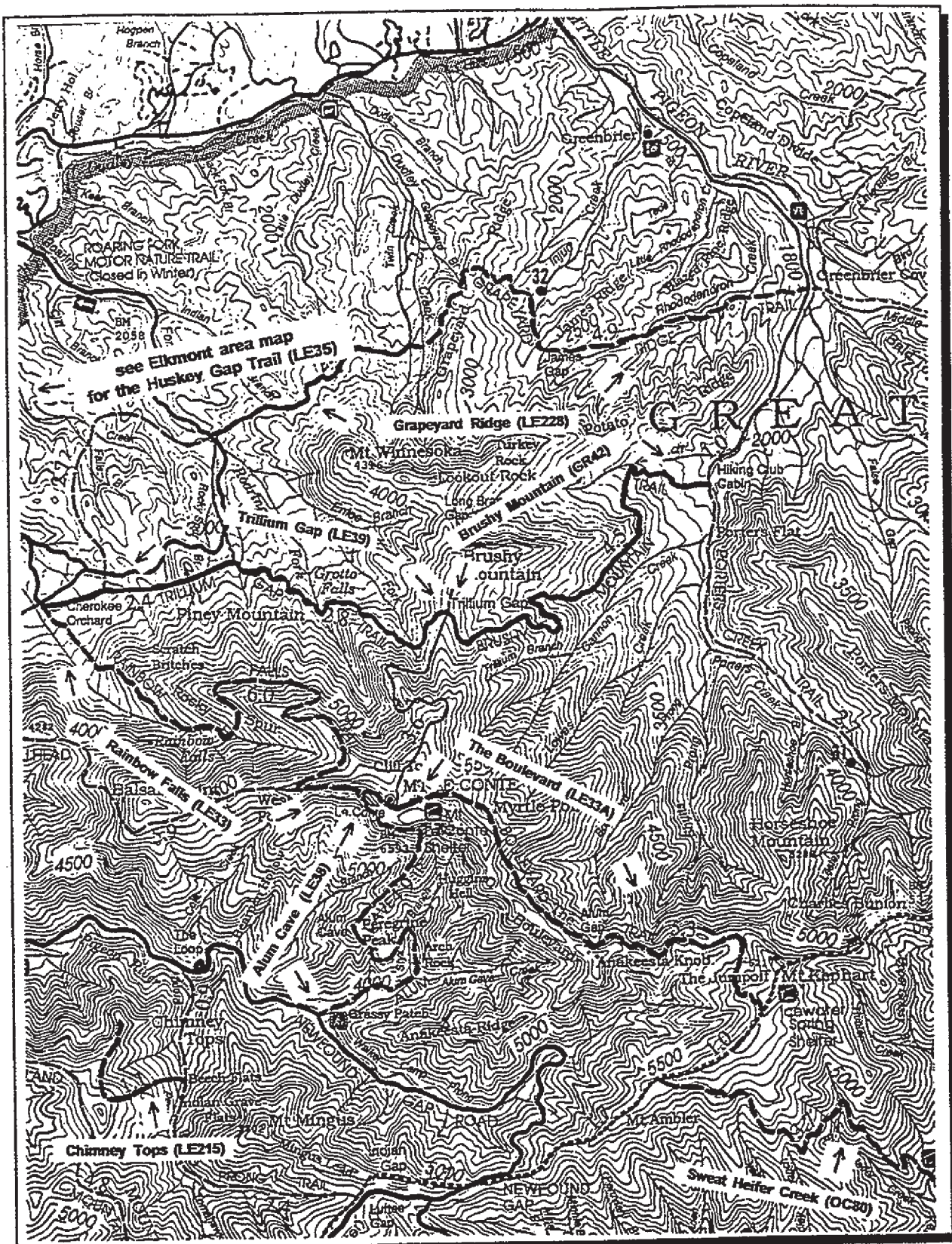


Figure 12. Topographic map of trail locations for the Mount LeConte area.

Table 54. Brushy Mountain Trail (GR42) resource and maintenance summary table.

| Mileage: <u>4.50</u>        | Total Use: <u>2.7</u> persons/day | Horse Use: <u>0</u> % of total use |                       |      |            |     |
|-----------------------------|-----------------------------------|------------------------------------|-----------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                    | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|                             | (#)                               | (#/mi)                             | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 7                                 | 1.6                                | 1209                  | 0.23 | 5.1        | 79  |
| Soil Erosion: 2-2.9 ft      | 1                                 | 0.2                                | 35                    | 0.01 | 0.1        | 64  |
| Soil Erosion: 3-3.9 ft      | 1                                 | 0.2                                | 55                    | 0.01 | 0.2        | 90  |
| Multiple Tread              | 5                                 | 1.1                                | 120                   | 0.02 | 0.5        | 40  |
| Excessive Root Exposure     | 1                                 | 0.2                                | 63                    | 0.01 | 0.3        | 53  |
| Width: Trail 2-6 ft         | 1                                 | -                                  | 23739                 | 4.50 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -                                  | 23739                 | 4.50 | 100.0      | -   |
| Wet Soil                    | 5                                 | 1.1                                | 319                   | 0.06 | 1.3        | 65  |
| -----                       |                                   |                                    |                       |      |            |     |
| Culvert                     | 3                                 | 0.7                                |                       |      |            | 72  |
| Drainage Dip: Ineffective   | 59                                | 13.1                               |                       |      |            | 84  |
| Drainage Dip: Part. Effect. | 16                                | 3.6                                |                       |      |            | 64  |
| Drainage Dip: Very Effect.  | 15                                | 3.3                                |                       |      |            | 73  |
| Retaining Wall              | 4                                 | 0.9                                |                       |      |            | 81  |
| Water Bar: Ineffective      | 3                                 | 0.7                                |                       |      |            | 47  |
| Water Bar: Part. Effective  | 1                                 | 0.2                                |                       |      |            | 41  |
| Water Bar: Very Effective   | 1                                 | 0.2                                |                       |      |            | 31  |

The Brushy Mountain Trail begins at Porters Flat in Greenbrier Cove (elevation 2,240 feet) and ascends the shoulder of Brushy Mountain to Trillium Gap (elevation 4,680 feet). The 2.38 mile trail is open to horses and is of trail width.

This trail is well-designed and maintained but appears to receive little use; horse use was not evident. The only notable resource problem was soil erosion with 7 occurrences and evident for 5.1% of the trail's length. The lower section had numerous drainage dips which had recently been cleared and were in good condition. The trail ascends the ridge gradually following the contours and switchbacking often. The trail here was narrow (< 2 feet wide) and well drained. Some sections were very narrow with slippery roots and rocks, large treefalls in the virgin forests, and some tread slumping along steep side slopes. In combination these conditions make this a poor trail for horse use in its current state.

Summary/Recommendations: The Brushy Mountain trail is in good condition and is fine for pedestrian use. Given current physical conditions and apparent lack of horse traffic, consideration should be given to closing the trail to horse use.



Table 55. Rainbow Falls Trail (LE33) resource and maintenance summary table.

| Mileage: <u>6.61</u>        | Total Use: <u>127</u> persons/day |        | Horse Use: <u>0</u> % of total use |      |            |     |
|-----------------------------|-----------------------------------|--------|------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |        | TOTAL LINEAL DISTANCE              |      | PERCENTILE |     |
|                             | (#)                               | (#/mi) | (ft)                               | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 48                                | 7.3    | 10420                              | 1.97 | 29.8       | 99  |
| Soil Erosion: 2-2.9 ft      | 12                                | 1.8    | 2251                               | 0.43 | 6.4        | 99  |
| Soil Erosion: 3-3.9 ft      | 2                                 | 0.3    | 190                                | 0.04 | 0.5        | 96  |
| Soil Erosion: 4-4.9 ft      | 1                                 | 0.2    | 62                                 | 0.01 | 0.2        | -   |
| Excessive Grade: >20%       | 1                                 | 0.2    | 57                                 | 0.01 | 0.2        | 65  |
| Graveled Tread              | 1                                 | -      | 32361                              | 6.61 | 100.0      | -   |
| Multiple Tread              | 30                                | 4.5    | 7136                               | 1.35 | 20.4       | 99  |
| Excessive Root Exposure     | 17                                | 2.6    | 573                                | 0.11 | 1.6        | 92  |
| Width: Trail on Road 2-6 ft | 1                                 | -      | 32361                              | 6.61 | 100.0      | -   |
| Use Type: Pedestrian        | 1                                 | -      | 32361                              | 6.61 | 100.0      | -   |
| Excessive Width: + >6 ft    | 1                                 | 0.2    | 100                                | 0.02 | 0.3        | 94  |
| Wet Soil                    | 13                                | 2.0    | 582                                | 0.11 | 1.7        | 74  |
| Running Water on Trail      | 4                                 | 0.6    | 91                                 | 0.02 | 0.3        | 51  |
| -----                       |                                   |        |                                    |      |            |     |
| Culvert                     | 1                                 | 0.2    |                                    |      |            | 61  |
| Drainage Dip: Ineffective   | 45                                | 6.8    |                                    |      |            | 72  |
| Drainage Dip: Part. Effect. | 4                                 | 0.6    |                                    |      |            | 37  |
| Drainage Dip: Very Effect.  | 2                                 | 0.3    |                                    |      |            | 42  |
| Lateral Drain               | 1                                 | 0.2    |                                    |      |            | 77  |
| Retaining Wall              | 19                                | 2.9    |                                    |      |            | 94  |
| Step                        | 1                                 | 0.2    |                                    |      |            | 81  |
| Water Bar: Ineffective      | 58                                | 8.8    |                                    |      |            | 87  |
| Water Bar: Part. Effective  | 65                                | 9.8    |                                    |      |            | 92  |
| Water Bar: Very Effective   | 211                               | 31.9   |                                    |      |            | 98  |

The 6.61 mile Rainbow Falls Trail begins at Cherokee Orchard off the Roaring Fork Motor Nature Trail (elevation 2,576 feet) and ascends to its junction with the Boulevard and Trillium Gap Trails on Mount LeConte (elevation 6,400 feet). The trail is restricted to hikers and is of trail width.

This heavily used trail provides access to Rainbow Falls, and beyond, to Mount LeConte. The majority of resource problems, primarily soil erosion, occur in the lower section leading to the falls. For the entire segment, 48 occurrences of soil erosion, 1-1.9 feet, were noted, including 29.8% of the trail's length. More extensive soil erosion, with soil loss up to 5 feet, was also documented. Another significant resource problem was multiple treads (30 occurrences, 20.4% of the trail), primarily from switchback cutting. Numerous steep, highly erodible informal cuts have been created by trail users. This activity removes vegetation, increases visibility between switchbacks, and further contributes to the behavior. Some informal trails were found in correlation with large waterbar placements, which apparently confuse users and direct traffic off-trail. The result of this off-trail hiking is the creation of a maze of innumerable informal trails along the trail corridor to the falls. Beyond the falls these resource problems lessen considerably. Trail maintenance along the trail was extensive; drainage dips were largely ineffective but water bars were numerous and 63% were rated very effective.

Summary/Recommendations: The Rainbow Falls Trail is among the worst surveyed in terms of soil erosion and multiple treads. Much of the soil erosion is from a long history of high use and possibly poor maintenance in the past (although current maintenance is good). User behavior seems to be a significant factor contributing to degradation. Trail design is also at fault, as switchbacks were laid out too close to one another, encouraging shortcutting. Furthermore, soil erosion is so extensive in some areas that tread drainage is made difficult or impossible. Given these problems serious consideration to trail rerouting should be given and/or an intensive program of maintenance including soil dams and the addition of gravel.



Table 56. The Boulevard Trail (LE33A) resource and maintenance summary table.

| Mileage: <u>6.60<sup>1</sup></u> | Total Use: <u>32.2</u> persons/day |        | Horse Use: <u>0</u> % of total use |      |            |     |
|----------------------------------|------------------------------------|--------|------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE                  | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |      | PERCENTILE |     |
|                                  | (#)                                | (#/mi) | (ft)                               | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft           | 3                                  | 0.5    | 170                                | 0.03 | 0.5        | 51  |
| Soil Erosion: 2-2.9 ft           | 2                                  | 0.3    | 539                                | 0.10 | 1.5        | 92  |
| Excessive Grade: >20%            | 6                                  | 0.9    | 502                                | 0.10 | 1.4        | 77  |
| Multiple Tread                   | 10                                 | 1.5    | 771                                | 0.15 | 2.2        | 79  |
| Excessive Root Exposure          | 3                                  | 0.5    | 165                                | 0.03 | 0.5        | 66  |
| Width: Trail 2-6 ft              | 1                                  | -      | 34846                              | 6.60 | 100.0      | -   |
| Use Type: Pedestrian             | 1                                  | -      | 34846                              | 6.60 | 100.0      | -   |
| Running Water on Trail           | 1                                  | 0.2    | 124                                | 0.02 | 0.4        | 59  |
| -----                            |                                    |        |                                    |      |            |     |
| Drainage Dip: Very Effect.       | 1                                  | 0.2    |                                    |      |            | 37  |
| Retaining Wall                   | 9                                  | 1.4    |                                    |      |            | 87  |
| Step                             | 9                                  | 1.4    |                                    |      |            | 95  |
| Water Bar: Ineffective           | 87                                 | 13.2   |                                    |      |            | 92  |
| Water Bar: Part. Effective       | 29                                 | 4.4    |                                    |      |            | 80  |
| Water Bar: Very Effective        | 20                                 | 3.0    |                                    |      |            | 62  |

The Boulevard Trail runs from the Appalachian Trail (elevation 6,080 feet) along a ridge to Myrtle Point, Mt. LeConte, and to a junction with the Rainbow Falls and Trillium Gap Trails (elevation 6,400 feet). The 6.60<sup>1</sup> mile trail is restricted to hikers and its tread is of trail width.

The trail's original location and design is excellent. The tread, which mostly follows the ridgeline, is generally well-drained and in good condition. Resource problems occur on the shoulders of Mt. LeConte, primarily in steep sections (there are six occurrences of grades in excess of 20%). Soil erosion is the most significant problem, in places up to three feet of soil have been lost from the tread. The number of tread drainage features in these areas are insufficient. Another steep section, where the trail descends from the Appalachian Trail, has an adequate number of drainage features but most are ineffective and require cleaning. However, the majority of the trail is in excellent condition. Impacts due to hiker use are minimal, and the tread in most places is less than one foot wide.

Summary/Recommendations: The trail is in good condition except for eroded sections on the shoulders of Mt. LeConte. These areas require additional tread drainage features and other areas, including the section descending from the Appalachian Trail, require routine maintenance.

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1 - Discrepancy with park records that indicate trail is 5.3 miles in length. If park distance is correct, field staff may have included a spur trail to Myrtle Point in the survey. Future survey staff should verify distance using reference points and distances provided in the trail survey listing, report addendum.

Table 57. Huskey Gap Trail (LE35) resource and maintenance summary table.

| Mileage: <u>2.01</u>        | Total Use: <u>13.8</u> persons/day |        | Horse Use: <u>0</u> % of total use |       |            |     |
|-----------------------------|------------------------------------|--------|------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE              |       | PERCENTILE |     |
|                             | (#)                                | (#/mi) | (ft)                               | (mi)  | (%)        | (%) |
| Excessive Root Exposure     | 2                                  | 1.0    | 77                                 | 0.01  | 0.7        | 55  |
| Width: Trail 2-6 ft         | 1                                  | -      | 10607                              | 2.01  | 100.0      | -   |
| Use Type: Pedestrian        | 1                                  | -      | 10607                              | 2.01  | 100.0      | -   |
| Running Water on Trail      | 1                                  | 0.5    | 15                                 | <0.01 | 0.1        | 33  |
| <hr/>                       |                                    |        |                                    |       |            |     |
| Drainage Dip: Ineffective   | 7                                  | 3.5    |                                    |       |            | 54  |
| Drainage Dip: Part. Effect. | 67                                 | 33.4   |                                    |       |            | 99  |
| Drainage Dip: Very Effect.  | 50                                 | 24.9   |                                    |       |            | 99  |
| Lateral Drain               | 1                                  | 0.5    |                                    |       |            | 89  |
| Water Bar: Ineffective      | 1                                  | 0.5    |                                    |       |            | 40  |
| Water Bar: Part. Effective  | 1                                  | 0.5    |                                    |       |            | 45  |
| Water Bar: Very Effective   | 4                                  | 2.0    |                                    |       |            | 57  |

The 2.01 mile Huskey Gap Trail is particularly well designed as it ascends the contours of the mountain from the Newfound Gap Road (elevation 1,900 feet) to Huskey Gap (elevation 3,100 feet) and its junction with the Sugarland Mountain Trail. The trail is restricted to hikers and is of trail width.

The soils and layout of this trail seems to be resistant to current use levels. This segment of the Huskey Gap Trail also seems to be receiving adequate maintenance, with most tread drainage features rated as effective or partially effective.

Summary/Recommendations: Overall, trail condition and maintenance is good. No immediate work is needed.

**Table 58. Alum Cave Trail (LE38) resource and maintenance summary table.**

Mileage: 5.97      Total Use: 277.4 persons/day      Horse Use: 0 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft      | 9           | 1.5    | 984                   | 0.19 | 3.1   | 74         |
| Soil Erosion: 2-2.9 ft      | 8           | 1.3    | 688                   | 0.13 | 2.2   | 95         |
| Soil Erosion: 3-3.9 ft      | 1           | 0.2    | 69                    | 0.01 | 0.2   | 91         |
| Excessive Grade: >20%       | 11          | 1.8    | 1579                  | 0.30 | 5.0   | 95         |
| Multiple Tread              | 6           | 1.0    | 434                   | 0.08 | 1.4   | 69         |
| Excessive Root Exposure     | 5           | 0.8    | 162                   | 0.03 | 0.5   | 65         |
| Width: Trail 2-6 ft         | 1           | -      | 31505                 | 5.97 | 100.0 | -          |
| Use Type: Pedestrian        | 1           | -      | 31505                 | 5.97 | 100.0 | -          |
| Excessive Width: + 3-6 ft   | 2           | 0.3    | 79                    | 0.01 | 0.3   | 70         |
| Excessive Width: + >6 ft    | 1           | 0.2    | 35                    | 0.01 | 0.1   | 87         |
| Wet Soil                    | 1           | 0.2    | 39                    | 0.01 | 0.1   | 31         |
| Running Water on Trail      | 3           | 0.5    | 439                   | 0.08 | 1.4   | 84         |
| -----                       |             |        |                       |      |       |            |
| Culvert                     | 10          | 1.7    |                       |      |       | 90         |
| Drainage Dip: Ineffective   | 15          | 2.5    |                       |      |       | 45         |
| Drainage Dip: Part. Effect. | 6           | 1.0    |                       |      |       | 44         |
| Lateral Drain               | 1           | 0.2    |                       |      |       | 77         |
| Retaining Wall              | 26          | 4.4    |                       |      |       | 94         |
| Step                        | 8           | 1.3    |                       |      |       | 96         |
| Water Bar: Ineffective      | 24          | 4.0    |                       |      |       | 76         |
| Water Bar: Part. Effective  | 29          | 4.9    |                       |      |       | 83         |
| Water Bar: Very Effective   | 44          | 7.4    |                       |      |       | 79         |

The 5.97 mile Alum Cave Trail ascends steeply from the Newfound Gap Road (elevation 3,800 feet) to a junction with the Rainbow Falls Trail (elevation 6,320 feet) near the summit of Mt. LeConte. The trail is restricted to hikers and its tread is of trail width.

The original layout of the tread is good, excepting 11 occurrences of grade in excess of 20%. Much of the tread appears to be cut directly into the bedrock and the amount and quality of maintenance is very good. There is ample drainage of the tread although most of the drainage dips are ineffective. Soil erosion is a problem in some areas, but the loamy soil typically has eroded to bedrock. Although the trail receives heavy use the tread appears to be in good condition. Impacts are restricted to the tread except in attraction areas such as Alum Cave.

**Summary/Recommendations:** The trail is in surprisingly good condition given the heavy use it receives and the elevation gain it covers. Soil erosion, exceeding three feet in one location, is the primary resource problem. A high level of trail maintenance will always be necessary to prevent further erosion on this popular trail.

Table 59. Trillium Gap Trail (LE39) resource and maintenance summary table.

Mileage: 5.27 Total Use: 348.7 persons/day Horse Use: 20 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 23          | 4.4    | 2455                  | 0.46 | 8.8        | 90  |
| Soil Erosion: 2-2.9 ft      | 1           | 0.2    | 166                   | 0.03 | 0.6        | 80  |
| Multiple Tread              | 6           | 1.1    | 741                   | 0.05 | 0.9        | 61  |
| Excessive Root Exposure     | 28          | 5.3    | 1710                  | 0.32 | 6.1        | 99  |
| Width: Trail 2-6 ft         | 1           | -      | 27843                 | 5.27 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 27843                 | 5.27 | 100.0      | -   |
| Wet Soil                    | 3           | 0.6    | 270                   | 0.05 | 1.0        | 58  |
| Running Water on Trail      | 1           | 0.2    | 34                    | 0.01 | 0.1        | 39  |
| -----                       |             |        |                       |      |            |     |
| Culvert                     | 5           | 0.9    |                       |      |            | 77  |
| Drainage Dip: Ineffective   | 35          | 6.6    |                       |      |            | 68  |
| Drainage Dip: Part. Effect. | 23          | 4.4    |                       |      |            | 68  |
| Drainage Dip: Very Effect.  | 6           | 1.1    |                       |      |            | 62  |
| Retaining Wall              | 4           | 0.8    |                       |      |            | 77  |
| Water Bar: Ineffective      | 44          | 8.3    |                       |      |            | 85  |
| Water Bar: Part. Effective  | 23          | 4.4    |                       |      |            | 80  |
| Water Bar: Very Effective   | 24          | 4.6    |                       |      |            | 69  |

The 5.27 mile Trillium Gap Trail runs from its junction with the Rainbow Falls Trail (elevation 2,580 feet) to Trillium Gap on the shoulder of Brushy Mountain (elevation 4,720 feet). The segment is of trail width and is open to horse use.

The design of the trail is good. The trail can be divided into three distinct sections of topography and use. The section from the Rainbow Falls Trail to the Grotto Falls parking lot off the Roaring Fork Nature Trail receives low use and is well designed and maintained as it traverses the rolling terrain. The section from the parking lot to Grotto Falls is heavily used and extremely impacted. This one mile section is generally flat and well designed to follow the contours above the stream it parallels. Much of the excessive root exposure (28 occurrences) and soil erosion (23 occurrences) were found along this wide, highly compacted section. The final upper section between Grotto Falls and Trillium Gap receives moderate use and is in generally good condition as it ascends the Brushy Mountain. Tread drainage features appear to be present in sufficient numbers although 55% of the drainage dips and 48% of the water bars were rated as ineffective.

Summary/Recommendations: With the exception of the heavily used Grotto Falls section, the Trillium Gap Trail is in good condition. Improved trail maintenance, limited rerouting, and possibly the addition of gravel is recommended on the middle section to further harden the tread to user traffic and to prevent further root exposure.



Table 60. Chimney Tops Trail (LE215) resource and maintenance summary table.

| Mileage: <u>1.16</u>       | Total Use: <u>306.4</u> persons/day |        | Horse Use: <u>0</u> % of total use |      |            |     |
|----------------------------|-------------------------------------|--------|------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                         |        | TOTAL LINEAL DISTANCE              |      | PERCENTILE |     |
|                            | (#)                                 | (#/mi) | (ft)                               | (mi) | (%)        | (%) |
| Excessive Grade: >20%      | 3                                   | 2.6    | 813                                | 0.15 | 13.2       | 84  |
| Multiple Tread             | 4                                   | 3.4    | 178                                | 0.03 | 2.9        | 48  |
| Excessive Root Exposure    | 8                                   | 6.9    | 304                                | 0.06 | 4.9        | 84  |
| Width: Trail 2-6 ft        | 1                                   | -      | 6148                               | 1.16 | 100.0      | -   |
| Use Type: Pedestrian       | 1                                   | -      | 6148                               | 1.16 | 100.0      | -   |
| Excessive Width: + 3-6 ft  | 3                                   | 2.6    | 155                                | 0.03 | 2.5        | 80  |
| Running Water on Trail     | 1                                   | 0.9    | 129                                | 0.02 | 2.1        | 61  |
| -----                      |                                     |        |                                    |      |            |     |
| Culvert                    | 7                                   | 6.0    |                                    |      |            |     |
| Water Bar: Ineffective     | 21                                  | 18.0   |                                    |      |            | 96  |
| Water Bar: Part. Effective | 14                                  | 12.0   |                                    |      |            | 96  |
| Water Bar: Very Effective  | 13                                  | 11.2   |                                    |      |            | 98  |
|                            |                                     |        |                                    |      |            | 85  |

This short, 1.16 mile trail, climbs steeply from the Road Prong Trail (elevation 3,900 feet) straight to the summit of Chimney Tops (elevation 4,700 feet). As a result, the grades of the trail are exceedingly steep, as high as 75% near the summit. The trail receives heavy hiker use (horses are not permitted) and the tread is of trail width.

The steep slope and the loose tread surface material (weathered shale) pose a safety problem on the upper part of this trail. A remarkable thirteen percent of the trail has grades in excess of 20%. The unstable trail tread, due to poor design, is the major cause of resource impacts. These problems have resulted in extremely severe root exposure (8 occurrences, 4.9% of the trail), particularly in the upper section. Multiple treads and excessive trail width also occur.

Summary/Recommendations: Resource impacts will worsen unless the trail is rerouted to avoid steep sections or considerably hardened, including the installation of numerous steps. Given the deficiencies of this trail's layout, traditional maintenance activities will likely be ineffective and cost-prohibitive in controlling further resource degradation.

Table 61. Grapeyard Ridge Trail (LE228) resource and maintenance summary table.

| Mileage:                    | <u>7.61</u> | Total Use: | <u>2.4 persons/day</u> | Horse Use: | <u>60 % of total use</u> |
|-----------------------------|-------------|------------|------------------------|------------|--------------------------|
| TRAIL ATTRIBUTE             | OCCURRENCES |            | TOTAL LINEAL DISTANCE  |            | PERCENTILE               |
|                             | (#)         | (#/mi)     | (ft)                   | (mi)       | (%)                      |
| Soil Erosion: 1-1.9 ft      | 21          | 2.8        | 1443                   | 0.27       | 3.6                      |
| Soil Erosion: 2-2.9 ft      | 6           | 0.8        | 352                    | 0.07       | 0.9                      |
| Soil Erosion: 3-3.9 ft      | 1           | 0.1        | 341                    | 0.06       | 0.8                      |
| Excessive Grade: >20%       | 2           | 0.3        | 254                    | 0.05       | 0.6                      |
| Multiple Tread              | 5           | 0.7        | 224                    | 0.04       | 0.6                      |
| Width: Trail 2-6 ft         | 1           | -          | 40157                  | 7.61       | 100.0                    |
| Use Type: Horse/Pedestrian  | 1           | -          | 14453                  | 2.74       | 36.0                     |
| Use Type: Pedestrian        | 1           | -          | 25704                  | 4.87       | 64.0                     |
| Excessive Width: + 3-6 ft   | 1           | 0.1        | 60                     | 0.01       | 0.1                      |
| Wet Soil                    | 21          | 2.8        | 1110                   | 0.21       | 2.8                      |
| Running Water on Trail      | 3           | 0.4        | 211                    | 0.04       | 0.5                      |
| Drainage Dip: Ineffective   | 4           | 0.5        |                        |            | 30                       |
| Drainage Dip: Part. Effect. | 7           | 0.9        |                        |            | 41                       |
| Drainage Dip: Very Effect.  | 6           | 0.8        |                        |            | 56                       |
| Water Bar: Ineffective      | 71          | 9.3        |                        |            | 90                       |
| Water Bar: Part. Effective  | 18          | 2.4        |                        |            | 65                       |
| Water Bar: Very Effective   | 12          | 1.6        |                        |            | 53                       |

The Grapeyard Ridge Trail begins at Greenbrier Cove (elevation 1,640 feet), ascends Rhododendron Creek and Grapeyard Ridge, and descends to the Roaring Fork Motor Nature Trail (elevation 2,500 feet). The 7.61 mile trail is restricted to pedestrian use from Greenbrier Cove to a horse trail ascending the Dudley and Twin Creek drainage (5.87 miles). Remaining mileage to the Motor Nature Trail is open to horses. The entire tread is of trail width.

In general, the design and layout of the trail is good, except for several rather steep segments. The trail can be divided into two parts in terms of resource condition. The 4.87 mile segment beginning at Greenbrier Cove is in good condition. Level of use is low as evidenced by the overgrown tread. The maintenance features are mostly effective. The only problem in this part is excessive soil loss (1-3 feet). Soil type and trail slope may have contributed to this problem. In contrast, the remainder of the trail to the Roaring Fork Motor Nature Trail is generally in bad condition. In addition to excessive soil erosion, wet soil and running water on the trail are common in this section. Seventy percent of the waterbars are ineffective.

Summary/Recommendations: The majority of the Grapeyard Ridge Trail is in good condition. However, the 2.7 mile segment open to horse use is in poor condition and requires immediate maintenance. Although the design of the trail is generally good, the current amount and effectiveness of maintenance is poor.

Table 62. Sweat Heifer Creek Trail (OC80) resource and maintenance summary table.

Mileage: 4.75 Total Use: 7.8 persons/day Horse Use: 5 % of total use

| TRAIL ATTRIBUTE        | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|------------------------|-------------|--------|-----------------------|------|-------|------------|
|                        | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft | 2           | 0.4    | 141                   | 0.03 | 0.6   | 47         |
| Soil Erosion: 2-2.9 ft | 2           | 0.4    | 152                   | 0.03 | 0.6   | 77         |
| Multiple Tread         | 4           | 0.8    | 201                   | 0.04 | 0.8   | 51         |
| Width: Trail 2-6 ft    | 1           | -      | 25106                 | 4.75 | 100.0 | -          |
| Use Type: Pedestrian   | 1           | -      | 25106                 | 4.75 | 100.0 | -          |
| Running Water on Trail | 5           | 1.1    | 371                   | 0.07 | 1.5   | 83         |
| -----                  |             |        |                       |      |       |            |
| Retaining Wall         | 4           | 0.8    |                       |      |       | 77         |
| Step                   | 1           | 0.2    |                       |      |       | 81         |
| Water Bar: Ineffective | 3           | 0.6    |                       |      |       | 44         |

The Sweat Heifer Creek Trail begins at the Kepart Prong Trail (elevation 3,900 feet), near the Kepart Shelter, and ascends the ridge to the Appalachian Trail (elevation 5,600 feet). The 4.75 mile trail is restricted to hikers and its tread is of trail width.

The layout of the trail takes a very steady but not excessive grade up the ridge. Almost no maintenance features are found on the segment, however, the tread is in good condition. The trail appears to be used infrequently and much of the trail is overgrown and has numerous fallen trees. Hiker impacts are not noticeable.

Summary/Recommendations: The Sweat Heifer Creek Trail is in good condition largely due to its low use. If use increases, additional tread maintenance will be necessary.



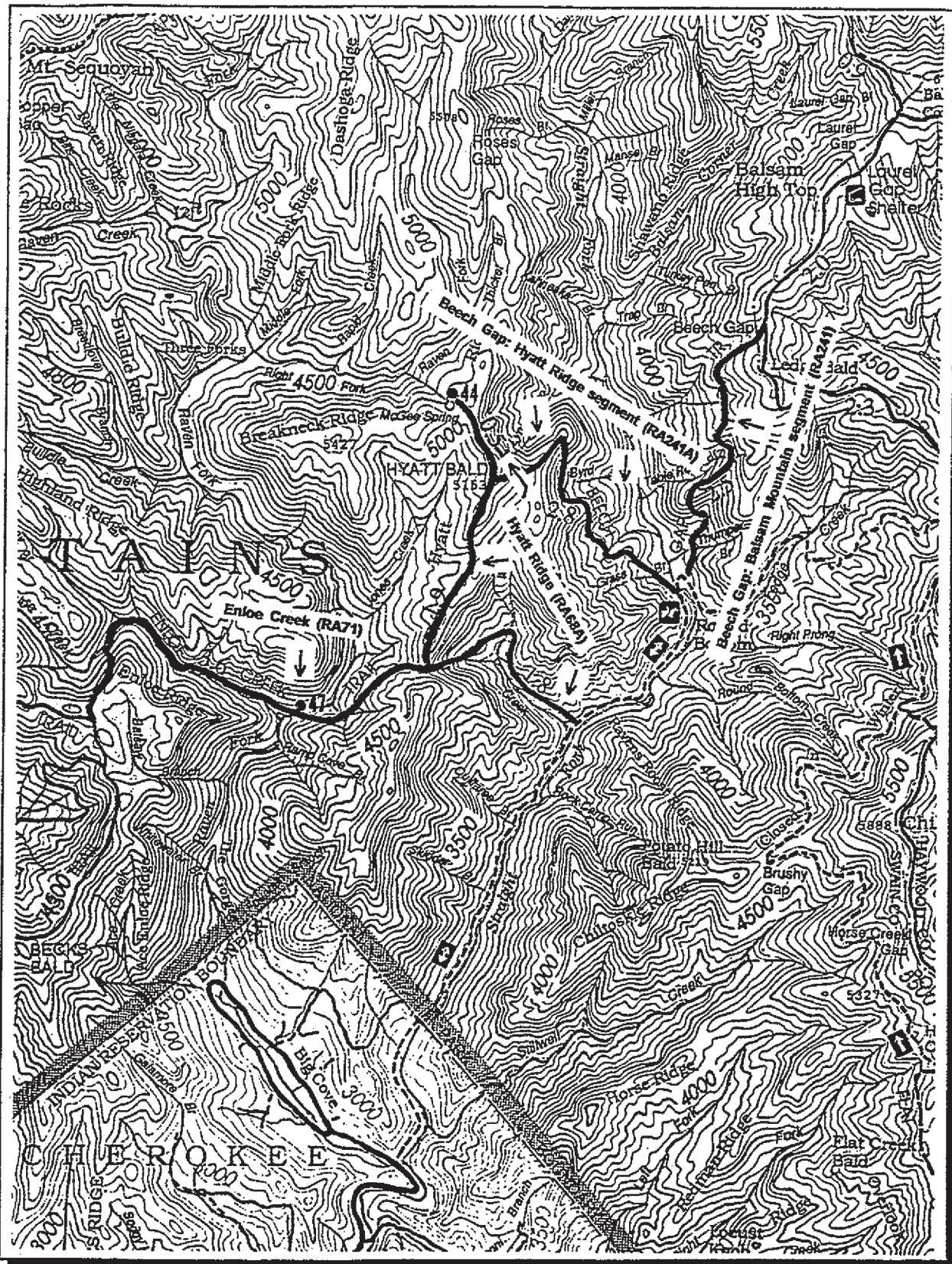


Figure 13. Topographic map of trail locations for the Raven Fork area.



Table 63. Hyatt Ridge Trail (RA68A) resource and maintenance summary table.

Mileage: 4.50 Total Use: 13.1 persons/day Horse Use: 40 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)        | (%) |
| Excessive Grade: >20%       | 3           | 0.7    | 450                   | 0.09 | 1.9        | 76  |
| Graveled Tread              | 1           | -      | 5354                  | 1.01 | 22.6       | -   |
| Multiple Tread              | 2           | 0.4    | 46                    | 0.01 | 0.2        | 24  |
| Width: Trail 2-6 ft         | 1           | -      | 20938                 | 3.97 | 88.2       | -   |
| Width: Trail on Road 2-6 ft | 1           | -      | 2800                  | 0.53 | 11.8       | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 23738                 | 4.50 | 100.0      | -   |
| Wet Soil                    | 4           | 0.9    | 197                   | 0.04 | 0.8        | 53  |
| Running Water on Trail      | 7           | 1.6    | 318                   | 0.06 | 1.3        | 75  |
| -----                       |             |        |                       |      |            |     |
| Culvert                     | 1           | 0.2    |                       |      |            | 61  |
| Drainage Dip: Ineffective   | 19          | 4.2    |                       |      |            | 59  |
| Drainage Dip: Part. Effect. | 8           | 1.8    |                       |      |            | 55  |
| Drainage Dip: Very Effect.  | 3           | 0.7    |                       |      |            | 54  |
| Water Bar: Ineffective      | 17          | 3.8    |                       |      |            | 74  |
| Water Bar: Part. Effective  | 17          | 3.8    |                       |      |            | 75  |
| Water Bar: Very Effective   | 33          | 7.3    |                       |      |            | 77  |

The Hyatt Ridge Trail begins at the Straight Fork Road (elevation 3,000 feet) and ascends Hyatt Ridge and Hyatt Bald, before it dead ends at campsite number 44 (elevation 5,100 feet). The 4.50 mile trail is open to horses and hikers and the majority of its tread (88%) is of trail width, with the remainder on a roadbed. The roadbed and a portion of the trail has a gravelled tread.

The design and layout of this trail is good. Most parts of the trail are situated at sidehills or on ridges with mostly gentle grades. The trail segment below the junction with Enloe Creek Trail is essentially an old road maintained with gravel. No significant trail impacts are evident except for several locations with running water on the tread surface. Waterbars on this segment are generally in good condition while drainage dips are largely ineffective. The remaining trail segment from Enloe Creek Trail to campsite number 44 is situated on ridges. The condition of this portion of trail is very good with a few cases of wet soil and running water on the trail. Evidence of horse use was limited on the upper segment.

Summary/Recommendations: This trail is in good condition due to good design, gravelled tread surfaces, and resistant ridgetop positions. Limited maintenance work on tread drainage is needed.

Table 64. Enloe Creek Trail (RA71) resource and maintenance summary table.

| Mileage: <u>3.62</u>       | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>40</u> % of total use |      |            |     |
|----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                            | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Excessive Grade: >20%      | 1                                | 0.3    | 40                                  | 0.01 | 0.2        | 61  |
| Width: Trail 2-6 ft        | 1                                | -      | 19121                               | 3.62 | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                | -      | 19121                               | 3.62 | 100.0      | -   |
| Excessive Width: + 3-6 ft  | 1                                | 0.3    | 33                                  | 0.01 | 0.2        | 59  |
| Wet Soil                   | 13                               | 3.6    | 300                                 | 0.06 | 1.6        | 62  |
| Running Water on Trail     | 17                               | 4.7    | 748                                 | 0.14 | 3.9        | 95  |
| -----                      |                                  |        |                                     |      |            |     |
| Drainage Dip: Very Effect. | 1                                | 0.3    |                                     |      |            | 42  |
| Water Bar: Ineffective     | 10                               | 2.8    |                                     |      |            | 68  |
| Water Bar: Part. Effective | 27                               | 7.5    |                                     |      |            | 87  |
| Water Bar: Very Effective  | 49                               | 13.5   |                                     |      |            | 90  |

The Enloe Creek Trail begins at its junction with the Hyatt Ridge Trail, descends to the Raven Fork drainage and ascends Enloe Creek and Ridge to join the Hughes Ridge Trail (elevation 4,660 feet). The 3.62 mile trail is open to horse use and is of trail width.

In general, the trail is in good condition in spite of limited maintenance (mostly waterbars). The trail tread is narrow and is mostly situated at sidehills with a gentle slope. The low level of use on the trail is the major reason for its good condition. The primary resource problem on this trail is running water on the trail (17 occurrences) and wet soil (13 occurrences), mostly in the vicinity of stream crossings. There was little evidence on horse traffic on this trail.

Summary/Recommendations: The Enloe Creek Trail is in good condition primarily due to its low level of use. Existing maintenance is mostly effective but additional tread drainage is needed to resolve problems with running water on the tread and wet soils.

# Results and Discussion: Raven Fork Geographic Area

Table 65. Beech Gap Trail: Balsam Mountain segment (RA241) resource and maintenance summary table.

| Mileage: <u>2.38</u>        | Total Use: <u>4.1</u> persons/day |        | Horse Use: <u>40</u> % of total use |       |            |     |
|-----------------------------|-----------------------------------|--------|-------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                       |        | TOTAL LINEAL DISTANCE               |       | PERCENTILE |     |
|                             | (#)                               | (#/mi) | (ft)                                | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 24                                | 10.1   | 1906                                | 0.36  | 15.2       | 85  |
| Soil Erosion: 2-2.9 ft      | 1                                 | 0.4    | 26                                  | <0.01 | 0.2        | 59  |
| Excessive Grade: >20%       | 1                                 | 0.4    | 424                                 | 0.08  | 3.4        | 74  |
| Width: Trail 2-6 ft         | 1                                 | -      | 12366                               | 2.34  | 98.5       | -   |
| Width: Trail on Road 2-6 ft | 1                                 | -      | 184                                 | 0.03  | 1.5        | -   |
| Use Type: Horse/Pedestrian  | 1                                 | -      | 12550                               | 2.38  | 100.0      | -   |
| Trail Corduroy              | 1                                 | 0.4    | 8                                   | <0.01 | 0.1        | 94  |
| Wet Soil                    | 4                                 | 1.7    | 150                                 | 0.03  | 1.2        | 47  |
| Running Water on Trail      | 3                                 | 1.3    | 323                                 | 0.06  | 2.6        | 77  |
| -----                       |                                   |        |                                     |       |            |     |
| Culvert                     | 1                                 | 0.4    |                                     |       |            | 67  |
| Drainage Dip: Ineffective   | 6                                 | 2.5    |                                     |       |            | 45  |
| Drainage Dip: Part. Effect. | 4                                 | 1.7    |                                     |       |            | 52  |
| Drainage Dip: Very Effect.  | 1                                 | 0.4    |                                     |       |            | 48  |
| Water Bar: Ineffective      | 19                                | 8.0    |                                     |       |            | 84  |
| Water Bar: Part. Effective  | 21                                | 8.8    |                                     |       |            | 91  |
| Water Bar: Very Effective   | 27                                | 11.4   |                                     |       |            | 87  |

This segment of the Beech Gap Trail begins at the Round Bottom Road (elevation 3,200 feet) and ends at its intersection with the Balsam Mountain Trail at Beech Gap (elevation 5,070 feet). This 2.38 mile segment is open to horse use and the majority (98.5%) of its length is of trail width.

The trail leaves the valley and ascends the ridge abruptly. The steep grade lacks switchbacks and soil erosion is common. Following this initial steep climb the trail begins to switchback and ascend more gradually. The majority of erosion ends beyond this point. The remainder of the trail is well designed, following the contours of the ridge and gradually gaining elevation. The lower section of the trail consisted of loamy soils which had eroded in places to rock. The tread on the upper ridge was well drained and varied from dry clay soils to more loamy moist soils. Use levels were previously much higher due to the recent closure of the Round Bottom Road, limiting access. Former heavy use and impact was evident, but recent use is obviously low, as evidenced by unpulverized leaf litter in the main tread.

Summary/Recommendations: Overall the trail is in good condition, especially on the upper section. Maintenance features are sufficient for current use levels.

Table 66. Beech Gap Trail: Hyatt Ridge segment (RA241A) resource and maintenance summary table.

|                            |                                   |                                     |                       |      |            |
|----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>2.88</u>       | Total Use: <u>6.5</u> persons/day | Horse Use: <u>40</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE            | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                            | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Multiple Tread             | 2                                 | 0.7                                 | 115                   | 0.02 | 0.8        |
| Width: Trail 2-6 ft        | 1                                 | -                                   | 15186                 | 2.88 | 100.0      |
| Use Type: Horse/Pedestrian | 1                                 | -                                   | 15186                 | 2.88 | 100.0      |
| Wet Soil                   | 13                                | 4.5                                 | 559                   | 0.11 | 3.7        |
| Running Water on Trail     | 10                                | 3.5                                 | 565                   | 0.11 | 3.7        |
| -----                      |                                   |                                     |                       |      |            |
| Water Bar: Ineffective     | 70                                | 24.3                                |                       |      | 99         |
| Water Bar: Part. Effective | 25                                | 8.7                                 |                       |      | 90         |
| Water Bar: Very Effective  | 26                                | 9.0                                 |                       |      | 83         |

The 2.88 mile Hyatt Ridge segment of the Beech Gap Trail begins at the Straight Fork Road (elevation 3,100 feet) and ascends Hyatt Bald to the Hyatt Ridge Trail (elevation 5,150 feet). The tread of this horse/hiker segment is of trail width.

The design of this trail is excellent. The trail's layout works exceptionally well with the contours, traversing steep sideslopes while maintaining gentle grades. Poor trail drainage adjacent to stream crossings are the only notable resource problems. In spite of a large number of tread drainage features there are ten occurrences of running water on the trail and 13 occurrences of wet soil. Horse use is permitted on this trail but use is minimal. Maintenance work on this trail appears to be quite old. However, the low level of use and the good design compensate for the lack of current maintenance.

Summary/Recommendations: The trail is in good condition due to good trail design and a low level of use. The primary maintenance need is the improvement of tread drainage at stream and creek crossings.



Table 67. Turkey Pen Ridge Trail (TR13) resource and maintenance summary table.

|                             |                                   |                                     |                       |      |            |
|-----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>3.57</u>        | Total Use: <u>7.6</u> persons/day | Horse Use: <u>80</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Soil Erosion: 1-1.9 ft      | 3                                 | 0.8                                 | 93                    | 0.02 | 43         |
| Multiple Tread              | 3                                 | 0.8                                 | 1195                  | 0.23 | 91         |
| Excessive Root Exposure     | 15                                | 4.2                                 | 266                   | 0.05 | 81         |
| Width: Trail 2-6 ft         | 1                                 | -                                   | 18838                 | 3.57 | 100.0      |
| Use Type: Horse/Pedestrian  | 1                                 | -                                   | 18838                 | 3.57 | 100.0      |
| Excessive Width: + 3-6 ft   | 7                                 | 2.0                                 | 427                   | 0.08 | 92         |
| Wet Soil                    | 8                                 | 2.2                                 | 359                   | 0.07 | 66         |
| Running Water on Trail      | 3                                 | 0.8                                 | 138                   | 0.03 | 62         |
| -----                       |                                   |                                     |                       |      |            |
| Drainage Dip: Ineffective   | 62                                | 17.4                                |                       |      | 91         |
| Drainage Dip: Part. Effect. | 19                                | 5.3                                 |                       |      | 70         |
| Drainage Dip: Very Effect.  | 2                                 | 0.6                                 |                       |      | 52         |
| Retaining Wall              | 2                                 | 0.6                                 |                       |      | 72         |

The Turkey Pen Ridge Trail follows the contours of the mountain from School House Gap Trail (elevation 1,300 feet) to its junction with the Finley Cane Trail (elevation 1,700 feet). This 3.57 mile trail is open to both hikers and horse users.

The trail is in poor condition due to a variety of factors. The tread is comprised of organic and clay soils which have limited resistance to the heavy horse use the trail receives. Nearby springs and streams contribute to the problem, resulting in numerous occurrences of wet soil and running water on the trail. Deep mud holes and pockets have formed in areas with poor drainage. Other common problems include excessive root exposure (15 occurrences), multiple treads (6.3% of the trail), and excessive width (7 occurrences, 2.3% of the trail). Three occurrences of soil erosion, 1-1.9 feet, are also noted, with soil erosion a worsening problem in many areas. The number of tread drainage features are inadequate and most are ineffective (62, 75%).

Summary/Recommendations: This trail is in poor condition due to heavy horse use, susceptible soils, and limitations in the number and effectiveness of tread drainage features. The trail should be surveyed for possible relocations and made a high priority for maintenance work. Furthermore, soils may not be suitable to support the current type and levels of use.

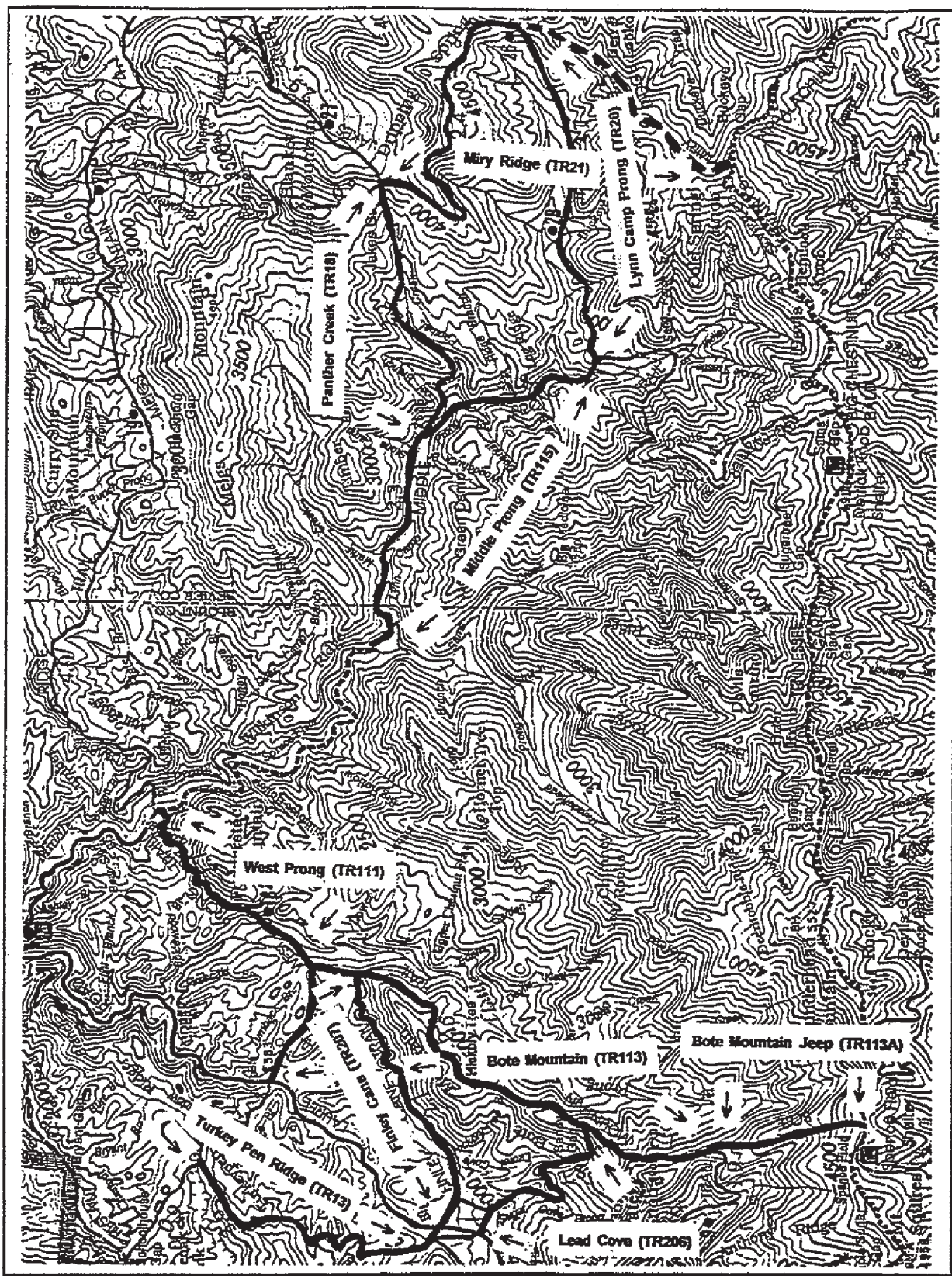


Figure 14. Topographic map of trail locations for the Tremont area.

Table 68. Panther Creek Trail (TR18) resource and maintenance summary table.

|                             |                                  |        |                                     |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| Mileage: <u>2.24</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>90</u> % of total use |      |            |     |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 7                                | 3.1    | 160                                 | 0.03 | 1.3        | 48  |
| Multiple Tread              | 2                                | 0.9    | 156                                 | 0.03 | 1.3        | 45  |
| Excessive Root Exposure     | 10                               | 4.5    | 234                                 | 0.04 | 2.0        | 77  |
| Width: Trail 2-6 ft         | 1                                | -      | 11853                               | 2.24 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 11853                               | 2.24 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 8                                | 3.6    | 378                                 | 0.07 | 3.2        | 91  |
| Excessive Width: + >6 ft    | 1                                | 0.4    | 56                                  | 0.01 | 0.5        | 90  |
| Wet Soil                    | 44                               | 19.6   | 1775                                | 0.34 | 15.0       | 91  |
| Running Water on Trail      | 7                                | 3.1    | 343                                 | 0.06 | 2.9        | 81  |
| -----                       |                                  |        |                                     |      |            |     |
| Drainage Dip: Ineffective   | 55                               | 24.5   |                                     |      |            | 98  |
| Drainage Dip: Part. Effect. | 1                                | 0.4    |                                     |      |            | 30  |
| Retaining Wall              | 2                                | 0.9    |                                     |      |            | 81  |
| Water Bar: Ineffective      | 3                                | 1.3    |                                     |      |            | 55  |
| Water Bar: Part. Effective  | 1                                | 0.4    |                                     |      |            | 43  |
| Water Bar: Very Effective   | 1                                | 0.4    |                                     |      |            | 39  |

The design and construction of the 2.24 mile Panther Creek Trail does not work well for the area. This trail ascends from the Middle Prong Trail (elevation 2,500 feet) to Jakes Gap (elevation 4,000 feet). It ascends through a valley with very organic, loamy soil and closely parallels the creek. This combination of circumstances contribute to considerable impact susceptibility.

Trail conditions are poor, due to the trail's heavy horse use and poor location, soils, and tread drainage. The most significant resource problems are 44 occurrences of wet soil (15% of the trail's length) and running water on the trail (7 occurrences, 2.9% of the trail's length). Other problems include excessive tread width and root exposure, soil erosion, and multiple treads. The remoteness of the trail may contribute to its limited maintenance. Nearly all of the drainage features are ineffective.

Summary/Recommendations: The Panther Creek Trail is in poor condition. A significant amount of additional maintenance work could improve the trail's condition but tread relocations or alternative routes should be considered. The trail's layout and soils are also not capable of sustaining heavy horse use.



Table 69. Lynn Camp Prong Trail (TR20) resource and maintenance summary table.

| Mileage: <u>3.65</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>90</u> % of total use |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 1                                | 0.3    | 29                                  | 0.01 | 0.2        | 33  |
| Graveled Tread              | 2                                | -      | 1867                                | 0.35 | 9.7        | -   |
| Multiple Tread              | 14                               | 3.8    | 605                                 | 0.11 | 3.1        | 74  |
| Excessive Root Exposure     | 2                                | 0.5    | 32                                  | 0.01 | 0.2        | 47  |
| Width: Trail 2-6 ft         | 1                                | -      | 11526                               | 2.18 | 59.7       | -   |
| Width: Road > 6 ft          | 1                                | -      | 7768                                | 1.47 | 40.3       | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 19294                               | 3.65 | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 6                                | 1.6    | 179                                 | 0.03 | 0.9        | 84  |
| Wet Soil                    | 40                               | 10.9   | 1208                                | 0.23 | 6.3        | 85  |
| Running Water on Trail      | 2                                | 0.5    | 59                                  | 0.01 | 0.3        | 44  |
| <hr/>                       |                                  |        |                                     |      |            |     |
| Culvert                     | 4                                | 1.1    |                                     |      |            | 82  |
| Drainage Dip: Ineffective   | 88                               | 24.1   |                                     |      |            | 96  |
| Drainage Dip: Part. Effect. | 108                              | 29.6   |                                     |      |            | 98  |
| Drainage Dip: Very Effect.  | 6                                | 1.6    |                                     |      |            | 67  |
| Lateral Drain               | 1                                | 0.3    |                                     |      |            | 84  |

The 3.65 mile Lynn Camp Prong Trail<sup>1</sup> begins at the end of the Middle Prong Trail (elevation 3,300 feet) and ascends a drainage to the Miry Ridge Trail (elevation 4,400 feet). The first one and one-half miles follows a roadbed until reaching designated campsite number 28 before narrowing to trail width beyond. The trail is open to both hikers and horse users.

Trail condition is good where the trail follows the old roadbed, however, beyond campsite 28 the trail's condition deteriorates. Organic soils in wet areas adjacent to the stream are highly susceptible to the formation of mudholes and erosion from horses hooves. The survey revealed forty occurrences of wet soil including 6.3% of the trail's length. Trail widening resulting from trail users seeking to circumvent these wet areas is a significant problem in these locations. Multiple treads (14 occurrences) are another notable resource problem. Trail drainage features are numerous (55 per mile) but nearly all are ineffective or partially effective.

Summary/Recommendations: In general, this trail is in good condition where the trail follows a graveled roadbed. However, conditions are poor where the trail narrows and follows the stream with wet organic soils. Poor maintained tread drainage features and heavy horse use in these areas compounds the resulting problems. Alternative routing, a reduction or change in type of use are recommended. In particular, cleaning of trail drainage features is an immediate maintenance concern.

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1 - Discrepancy with park trails database. The Lynn Camp Prong Trail should begin at Campsite 28 and run to the Miry Ridge (TR21) intersection near Campsite 26.



Table 70. Miry Ridge Trail (TR21) resource and maintenance summary table.

| Mileage: <u>4.97</u>        | Total Use: <u>UK</u> persons/day |        | Horse Use: <u>10</u> % of total use |      |            |     |
|-----------------------------|----------------------------------|--------|-------------------------------------|------|------------|-----|
| TRAIL ATTRIBUTE             | OCCURRENCES                      |        | TOTAL LINEAL DISTANCE               |      | PERCENTILE |     |
|                             | (#)                              | (#/mi) | (ft)                                | (mi) | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 2                                | 0.4    | 51                                  | 0.01 | 0.2        | 37  |
| Multiple Tread              | 14                               | 2.8    | 449                                 | 0.09 | 1.7        | 70  |
| Excessive Root Exposure     | 35                               | 7.0    | 1056                                | 0.20 | 4.0        | 98  |
| Width: Trail 2-6 ft         | 1                                | -      | 26263                               | 4.97 | 100.0      | -   |
| Use Type: Horse/Pedestrian  | 1                                | -      | 13207                               | 2.50 | 50.3       | -   |
| Use Type: Pedestrian        | 1                                | -      | 13056                               | 2.47 | 49.7       | -   |
| Excessive Width: + 3-6 ft   | 4                                | 0.8    | 213                                 | 0.04 | 0.8        | 87  |
| Wet Soil                    | 6                                | 1.2    | 111                                 | 0.02 | 0.4        | 43  |
| -----                       |                                  |        |                                     |      |            |     |
| Drainage Dip: Ineffective   | 60                               | 12.1   |                                     |      |            | 83  |
| Drainage Dip: Part. Effect. | 46                               | 9.2    |                                     |      |            | 79  |
| Retaining Wall              | 2                                | 0.4    |                                     |      |            | 67  |
| Step                        | 3                                | 0.6    |                                     |      |            | 91  |

The 2.74 mile Miry Ridge Trail connects the Jakes Creek Trail at Jakes Gap (elevation 4,055 feet) to the Appalachian Trail (elevation 4,920 feet). Horse use is permitted on two and one-half miles (50%) of the trail, from the junction of Lynn Camp Prong Trail to Jakes Gap. All of the trail is of trail width.

The section from the Lynn Camp Prong Trail to the Appalachian Trail, which is restricted to hikers, is almost pristine looking. Dense vegetation covers most of the trail providing protection against soil erosion and light user impacts. Maintenance features are lacking in this section; however, there is little evidence they are needed. A few minor problems in the form of multiple treads and excessive root exposure are the only resource problems. In the lower section from the Lynn Camp Prong Trail intersection to Jakes Gap, impacts are more prevalent. Notable problems are excessive root exposure, multiple treads, and wet soil. Maintenance is deficient, all tread drainage features are ineffective or partially effective.

**Summary/Recommendations:** In general, the trail is in good condition with little maintenance from the Appalachian Trail to the Lynn Camp Prong Trail intersection and in fair condition with little effective maintenance for the lower section ending at Jakes Gap. Additional maintenance is needed for the lower section to add and increase the effectiveness of drainage dips.

Table 71. West Prong Trail (TR111) resource and maintenance summary table.

| Mileage: <u>3.33</u>       | Total Use: <u>15.0</u> persons/day |        | Horse Use: <u>50</u> % of total use |       |            |     |
|----------------------------|------------------------------------|--------|-------------------------------------|-------|------------|-----|
| TRAIL ATTRIBUTE            | OCCURRENCES                        |        | TOTAL LINEAL DISTANCE               |       | PERCENTILE |     |
|                            | (#)                                | (#/mi) | (ft)                                | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft     | 3                                  | 0.9    | 385                                 | 0.07  | 2.2        | 64  |
| Graveled Tread             | 1                                  | -      | 102                                 | 0.02  | 0.6        | -   |
| Excessive Root Exposure    | 5                                  | 1.5    | 230                                 | 0.04  | 1.3        | 76  |
| Width: Trail 2-6 ft        | 1                                  | -      | 17588                               | 3.33  | 100.0      | -   |
| Use Type: Horse/Pedestrian | 1                                  | -      | 17588                               | 3.33  | 100.0      | -   |
| Wet Soil                   | 1                                  | 0.3    | 22                                  | <0.01 | 0.1        | 25  |
| -----                      |                                    |        |                                     |       |            |     |
| Culvert                    | 1                                  | 0.3    |                                     |       |            | 64  |
| Drainage Dip: Ineffective  | 15                                 | 4.5    |                                     |       |            | 61  |
| Drainage Dip: Very Effect. | 1                                  | 0.3    |                                     |       |            | 42  |
| Retaining Wall             | 5                                  | 1.5    |                                     |       |            | 88  |
| Water Bar: Ineffective     | 6                                  | 1.8    |                                     |       |            | 59  |
| Water Bar: Very Effective  | 1                                  | 0.3    |                                     |       |            | 34  |

The West Prong Trail ascends from the end of the Tremont Road (elevation 1,360 feet) to the Bote Mountain Trail (elevation 1,840). The 3.33 mile trail is open to horses and its tread is of trail width.

The trail's design is good as it follows the contours and is never excessively steep. There are few drainage features and most are ineffective. However, soil erosion and excessive root exposure are problems only in isolated areas, although some erosion of less than one foot is evident. These problems will worsen if the tread drainage is not improved. Horse use is permitted, but horse impacts are minimal. Impacts are confined to the tread which is composed of highly compacted clay.

Summary/Recommendations: The West Prong trail is generally in good condition with some limited sections with soil erosion and root exposure. Some additional tread drainage is needed.

Table 72. Bote Mountain Trail (TR113) resource and maintenance summary table.

| Mileage: <u>5.19</u>        | Total Use: <u>19.5 persons/day</u> | Horse Use: <u>60 %</u> of total use |                       |      |            |
|-----------------------------|------------------------------------|-------------------------------------|-----------------------|------|------------|
| TRAIL ATTRIBUTE             | OCCURRENCES                        |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                                | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Graveled Tread              | 1                                  | -                                   | 27403                 | 5.19 | 100.0      |
| Multiple Tread              | 1                                  | 0.2                                 | 401                   | 0.08 | 1.5        |
| Width: Trail on Road 2-6 ft | 1                                  | -                                   | 27403                 | 5.19 | 100.0      |
| Use Type: Horse/Pedestrian  | 1                                  | -                                   | 27403                 | 5.19 | 100.0      |
| Wet Soil                    | 1                                  | 0.2                                 | 96                    | 0.02 | 0.4        |
| -----                       |                                    |                                     |                       |      |            |
| Culvert                     | 35                                 | 6.7                                 |                       |      | 98         |
| Drainage Dip: Part. Effect. | 5                                  | 1.0                                 |                       |      | 44         |
| Lateral Drain               | 5                                  | 1.0                                 |                       |      | 92         |
| Retaining Wall              | 1                                  | 0.2                                 |                       |      | 58         |

This section of the Bote Mountain Trail ascends the flank of Bote Mountain from the Laurel Creek Road (elevation 1,580 feet) to its junction with the Anthony Creek Trail (elevation 3,780 feet). The 5.19 mile segment follows an old graveled woods road and is open to both hikers and horse users.

The trail is well designed as it follows the contours up the mountain. Some sections are steep, with sheet and rill erosion evident. The segment appears to be well used, including considerable horse traffic. The former road appears to drain well and is resistant to impact -- an ideal trail for horse users. Few maintenance features, excepting culverts, were present or needed. Culverts were old and deteriorating.

Summary/Recommendations: This section of the Bote Mountain Trail is in good condition, in spite of considerable horse traffic. This is primarily due to excellent design and use of a well-drained graveled roadbed. An upgrade of maintenance features, especially on steep sections, is needed to prevent soil erosion from worsening.

Table 73. Bote Mountain Jeep Trail (TR113A) resource and maintenance summary table.

Mileage: 1.70 Total Use: 20.3 persons/day Horse Use: 60 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |       | PERCENTILE |     |
|-----------------------------|-------------|--------|-----------------------|-------|------------|-----|
|                             | (#)         | (#/mi) | (ft)                  | (mi)  | (%)        | (%) |
| Soil Erosion: 1-1.9 ft      | 1           | 0.6    | 102                   | 0.02  | 1.1        | 46  |
| Soil Erosion: 2-2.9 ft      | 7           | 4.1    | 1701                  | 0.32  | 19.0       | 98  |
| Soil Erosion: 3-3.9 ft      | 4           | 2.4    | 1939                  | 0.37  | 21.6       | 99  |
| Multiple Tread              | 2           | 1.2    | 49                    | 0.01  | 0.5        | 27  |
| Excessive Root Exposure     | 1           | 0.6    | 33                    | 0.01  | 0.4        | 48  |
| Width: Trail 2-6 ft         | 1           | -      | 7233                  | 1.37  | 80.6       | -   |
| Width: Road > 6 ft          | 1           | -      | 1741                  | 0.33  | 19.4       | -   |
| Use Type: Horse/Pedestrian  | 1           | -      | 8974                  | 1.70  | 100.0      | -   |
| Excessive Width: + 3-6 ft   | 3           | 1.8    | 208                   | 0.04  | 2.3        | 85  |
| Running Water on Trail      | 1           | 0.6    | 21                    | <0.01 | 0.2        | 36  |
| -----                       |             |        |                       |       |            |     |
| Culvert                     | 1           | 0.6    |                       |       |            |     |
| Drainage Dip: Ineffective   | 17          | 10.0   |                       |       |            | 69  |
| Drainage Dip: Part. Effect. | 35          | 20.6   |                       |       |            | 80  |
| Drainage Dip: Very Effect.  | 11          | 6.5    |                       |       |            | 91  |
| Water Bar: Ineffective      | 1           | 0.6    |                       |       |            | 81  |
| Water Bar: Part. Effective  | 1           | 0.6    |                       |       |            | 44  |
| Water Bar: Very Effective   | 1           | 0.6    |                       |       |            | 48  |
|                             |             |        |                       |       |            | 45  |

The design and construction of the 1.70 mile Bote Mountain Jeep Trail, the section from the Anthony Creek Trail (elevation 3,760 feet) to the Appalachian Trail (elevation 4,900 feet), is poor. It appears that this horse/hiker trail has been a heavily used trail for a very long time; evident from exceptionally pronounced soil erosion which has produced deep gullies throughout the entire section of trail. The trail is of road width for one-third of a mile and trail width for the remainder (80.6%).

This trail is in exceedingly poor condition with erosion greater than 1 foot deep extending over 42% of its length. Surveyors tried to assess only the more recent soil erosion, finding erosion in excess of three feet extending for over one-fifth of the trail's length. If combined with much older erosion (where erosional surfaces have been colonized by mature woody vegetation), total erosion often exceeded six feet. Poor design and the current inability to remove water from deeply entrenched treads render soil textures inconsequential. Organic and loamy soils are washing away but even the remaining gravelly soil shows evidence of movement during significant rain events. Silt backups are quite common and quickly fill in and render the drainage dips and waterbars ineffective. The number of drainage features seems adequate but the effectiveness of most is limited by the depth of the eroded tread.

Summary/Recommendations: Both trail condition and the effectiveness of tread drainage features are very poor. Natural ongoing erosional forces appear to be of more consequence than existing use in the continuing erosion of this trail. The degree of maintenance necessary to prevent further erosion is most likely not cost effective. A search for alternative routes or a complete rerouting of the existing trail is recommended. The current tread is a prime candidate for a major trail restoration project, including large check dams to prevent soil erosion and revegetation to speed natural recovery.



Table 74. Middle Prong Trail (TR115) resource and maintenance summary table.

|                             |                                  |                                     |                       |      |            |
|-----------------------------|----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>3.94</u>        | Total Use: <u>UK</u> persons/day | Horse Use: <u>70</u> % of total use |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                      |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                              | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Graveled Tread              | 1                                | -                                   | 20798                 | 3.94 | 100.0      |
| Width: Road > 6 ft          | 1                                | -                                   | 20798                 | 3.94 | 100.0      |
| Use Type: Horse/Pedestrian  | 1                                | -                                   | 20798                 | 3.94 | 100.0      |
| Excessive Width: + >6 ft    | 1                                | 0.3                                 | 37                    | 0.01 | 0.2        |
| Wet Soil                    | 3                                | 0.8                                 | 78                    | 0.01 | 0.4        |
| Running Water on Trail      | 2                                | 0.5                                 | 93                    | 0.02 | 0.4        |
| -----                       |                                  |                                     |                       |      |            |
| Culvert                     | 13                               | 3.3                                 |                       |      | 92         |
| Drainage Dip: Ineffective   | 16                               | 4.1                                 |                       |      | 57         |
| Drainage Dip: Part. Effect. | 68                               | 17.3                                |                       |      | 85         |
| Drainage Dip: Very Effect.  | 11                               | 2.8                                 |                       |      | 72         |
| Lateral Drain               | 2                                | 0.5                                 |                       |      | 89         |

The 3.94 mile Middle Prong Trail<sup>1</sup>, a preexisting graveled roadbed, ascends from the trail's parking lot (elevation 1,900 feet) to its junction with the Greenbrier Ridge Trail (elevation 3,300 feet). The trail is open to horse and hiker use.

Due to the graveled surface, design, and low grade, the trail is in good condition. A few occurrences of wet soil and running water on the trail are the only notable resource problems. Tread drainage is rather poor, however, and conditions are beginning to deteriorate.

Summary/Recommendations: The trail is in good condition and is fairly resistant to the impacts of horse and hiker use. Some improvement in trail drainage is needed in a few areas.

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1 - Discrepancy with park trails database. The Middle Prong Trail should end at Campsite 28 where the Lynn Camp Prong Trail (TR20) begins.

Table 75. Lead Cove Trail (TR206) resource and maintenance summary table.

Mileage: 1.78 Total Use: 15.1 persons/day Horse Use: 60 % of total use

| TRAIL ATTRIBUTE             | OCCURRENCES |        | TOTAL LINEAL DISTANCE |      |       | PERCENTILE |
|-----------------------------|-------------|--------|-----------------------|------|-------|------------|
|                             | (#)         | (#/mi) | (ft)                  | (mi) | (%)   | (%)        |
| Soil Erosion: 1-1.9 ft      | 3           | 1.7    | 383                   | 0.07 | 4.1   | 62         |
| Multiple Tread              | 14          | 7.8    | 797                   | 0.15 | 8.5   | 80         |
| Excessive Root Exposure     | 13          | 7.3    | 499                   | 0.09 | 5.3   | 90         |
| Width: Trail 2-6 ft         | 1           | -      | 9421                  | 1.78 | 100.0 | -          |
| Use Type: Horse/Pedestrian  | 1           | -      | 9421                  | 1.78 | 100.0 | -          |
| -----                       |             |        |                       |      |       |            |
| Drainage Dip: Ineffective   | 29          | 16.3   |                       |      |       | 85         |
| Drainage Dip: Part. Effect. | 40          | 22.4   |                       |      |       | 92         |
| Drainage Dip: Very Effect.  | 13          | 7.3    |                       |      |       | 87         |

This 1.78 mile horse/hiker trail follows the sideslope of the mountain, from the Laurel Creek Road (elevation 1,850 feet) to its junction with the Bote Mountain Trail (elevation 3,200 feet). The Lead Cove Trail is of trail width over its entire length.

This trail is in fair condition, in part due to loamy dry soils. Problem areas noted include excessive root exposure (13 occurrences), soil erosion, 1-1.9 feet (4.1% of the trail's length), and multiple tread (14 occurrences, 8.5% of the trail's length). Judging from the accessibility of this trail to Laurel Creek Road, it is not only supporting horse users but high day use as well. The quantity of trail drainage features would appear to be sufficient but most are ineffective (35%) or partially effective (49%).

Summary/Recommendations: The trail is in fair condition, in spite of high horse and day use. Existing trail drainage features require immediate cleaning.

Table 76. Finley Cane Trail (TR207) resource and maintenance summary table.

|                             |                                   |                                     |                       |      |            |
|-----------------------------|-----------------------------------|-------------------------------------|-----------------------|------|------------|
| Mileage: <u>2.74</u>        | Total Use: <u>6.9 persons/day</u> | Horse Use: <u>60 % of total use</u> |                       |      |            |
| TRAIL ATTRIBUTE             | OCCURRENCES                       |                                     | TOTAL LINEAL DISTANCE |      | PERCENTILE |
|                             | (#)                               | (#/mi)                              | (ft)                  | (mi) | (%)        |
| Multiple Tread              | 7                                 | 2.6                                 | 238                   | 0.05 | 1.6        |
| Excessive Root Exposure     | 9                                 | 3.3                                 | 140                   | 0.03 | 1.0        |
| Width: Trail 2-6 ft         | 1                                 | -                                   | 14444                 | 2.74 | 100.0      |
| Use Type: Horse/Pedestrian  | 1                                 | -                                   | 14444                 | 2.74 | 100.0      |
| Excessive Width: + 3-6 ft   | 5                                 | 1.8                                 | 163                   | 0.03 | 1.1        |
| Wet Soil                    | 10                                | 3.7                                 | 310                   | 0.06 | 2.1        |
| Running Water on Trail      | 2                                 | 0.7                                 | 43                    | 0.01 | 0.3        |
| -----                       |                                   |                                     |                       |      |            |
| Culvert                     | 1                                 | 0.4                                 |                       |      |            |
| Drainage Dip: Ineffective   | 45                                | 16.4                                |                       |      |            |
| Drainage Dip: Part. Effect. | 18                                | 6.6                                 |                       |      |            |

The 2.74 mile Finley Cane Trail provides access from the Laurel Creek Road (elevation 1,800 feet) to the Bote Mountain Trail (elevation 2,500 feet). This horse and hiker trail is of trail width throughout its length. Its layout through wet organic soils and adjacent to a stream make it particularly susceptible to the heavy horse traffic it receives.

Problem areas are most common along the stream edge and in areas with poor drainage. The wet organic soils are easily punched into mud holes by horse hooves, which in turn cause problems with excessive root exposure (9 occurrences) and trail widening (5 occurrences). Trail drainage is also poor, all drainage dips are either ineffective or partially effective.

Summary/Recommendations: In summary, both trail condition and effectiveness of tread drainage features are poor. However, additional maintenance is unlikely to resolve the existing problems with wet soils and mudholes. Trail rerouting or use of alternative routes for horses is recommended. Alternatively, additional maintenance should be a high priority.

Table 77 presents rankings of trails by the number of feet per mile of trail exhibiting each type of resource impact. This measure standardizes the lineal length of impact on a per mile basis to provide the most legitimate means for comparing the extent of resource change among trail segments. Values for total lineal distance in feet are also included to show the cumulative amount of change. However, this measure is affected by trail length, longer trails often have larger values. To facilitate their interpretation, soil erosion and excessive tread width parameters were aggregated to form single parameters. Trails for which a particular type of impact was not observed were omitted from the table.

On a per mile basis, the most severely eroded trails are the Bote Mountain Jeep Trail (2,201 feet/mile) and the Rainbow Falls Trail (1,955 feet/mile). Other trails with soil erosion exceeding 1000 feet/mile include the Low Gap: Big Creek Trail and two segments of the Appalachian Trail, Icewater Spring to Newfound Gap and Clingman's Dome to Silers Bald. The proportion of trail miles with exposed roots is greatest for the Albright Grove Loop, the Trillium Gap Trail, and the Appalachian Trail from Icewater Spring to Newfound Gap. Excessive width is a pronounced problem for the Mount Sterling Ridge, Long Bunk, and Little Cataloochee Trails.

Also on a per mile basis, the muddiest trails include the Long Bunk, Little Cataloochee, and Caldwell Fork trails, all in the Cataloochee area. Trails with the greatest proportion of running water on the tread include the Forney Ridge, Little Cataloochee, Enloe Creek, and Beech Gap: Hyatt Ridge Trails. Multiple treads are most common on the Rainbow Falls and Lead Cove Trails.

The total lineal distance values presented in the tables provide the best cumulative absolute measure of change for each trail. These values are often but not always closely correlated with the feet per mile values. For example, the 16 mile segment of Appalachian Trail from Davenport Gap to Tricorner Knob includes some 3,381 lineal feet of severely eroded tread but is ranked in the middle of the distribution in terms of lineal feet per mile. Conversely, the 0.66 mile Albright Loop Trail includes only 228 lineal feet of tread with severe root exposure but is ranked first on a per mile basis. While the lineal feet per mile measure provides the most legitimate method for comparison, managers may be more appropriately concerned with total lineal distances affected by each type of trail impact.

Finally, it is interesting to note that relatively few trails have significant deterioration for several different types of impact. For example, only two trails are ranked in the top ten for as many as four different types of impact. The Panther Creek Trail is ranked 4th for wet soil, 5th for running water on trail and excessive width, and 10th for root exposure. The Long Bunk Trail is ranked 8th for soil erosion, 2nd for excessive width, 1st for wet soil, and 3rd for multiple treads. Trails with 3 top ten rankings include Low Gap: Big Creek (soil erosion, root exposure, running water on trail), Appalachian Trail: Icewater Springs to Newfound Gap (soil erosion, root exposure, multiple tread), Chimney Tops (root exposure, excessive width, running water on trail), Mount Sterling Ridge (excessive width, wet soil, multiple tread), and Little Cataloochee (excessive width, wet soil, running water). Nine trails have two top ten rankings.



# Results and Discussion

**Table 77.** Trails ranked by total lineal distance (feet/mile) for six resource condition parameters. Trails with zero values omitted. Refer to Appendix 1 for a listing of trail names and related information for each trail code.

| Soil Erosion: > 1 Foot |           |            | Root Exposure |           |            | Excessive Width: > 3 Feet |           |            |
|------------------------|-----------|------------|---------------|-----------|------------|---------------------------|-----------|------------|
| Trail Code             | Feet/Mile | Total Feet | Trail Code    | Feet/Mile | Total Feet | Trail Code                | Feet/Mile | Total Feet |
| TR113A                 | 2201      | 3742       | CO239         | 345       | 228        | CA60                      | 400       | 2150       |
| LE33                   | 1955      | 12923      | LE39          | 324       | 1710       | CA232                     | 369       | 1307       |
| BC53                   | 1421      | 3894       | ATE5          | 319       | 975        | CALCT                     | 281       | 1374       |
| ATE5                   | 1212      | 3708       | EL27          | 306       | 1005       | ATW10                     | 226       | 1744       |
| ATW7                   | 1166      | 5152       | BC53          | 304       | 833        | TR18                      | 194       | 434        |
| RA241                  | 812       | 1932       | TR206         | 280       | 499        | CA65                      | 184       | 1158       |
| ATW10                  | 804       | 6191       | LE215         | 262       | 304        | LE215                     | 134       | 155        |
| CA232                  | 634       | 2244       | TR21          | 212       | 1056       | TR113A                    | 122       | 208        |
| ATW6                   | 626       | 4930       | EL237         | 186       | 437        | TR13                      | 120       | 427        |
| LE39                   | 497       | 2621       | TR18          | 104       | 234        | CC205                     | 81        | 269        |
| ATW8                   | 429       | 1334       | CC10          | 97        | 341        | CO239                     | 77        | 51         |
| CA60                   | 347       | 1865       | CO49          | 88        | 463        | TR207                     | 59        | 163        |
| LE38                   | 292       | 1741       | LE33          | 87        | 573        | TR20                      | 49        | 179        |
| CC10                   | 290       | 1020       | TR13          | 75        | 266        | EL237                     | 47        | 111        |
| GR42                   | 289       | 1299       | CC3           | 72        | 533        | TR21                      | 43        | 213        |
| CC242                  | 288       | 623        | TR111         | 69        | 230        | EL27                      | 42        | 139        |
| ATE4                   | 285       | 1082       | ATE4          | 58        | 220        | FO139                     | 33        | 374        |
| LE228                  | 281       | 2136       | CC11          | 58        | 203        | BC53                      | 32        | 88         |
| FOFC                   | 272       | 1210       | HA104         | 56        | 243        | HALS                      | 31        | 124        |
| CA61                   | 268       | 1476       | CC205         | 53        | 176        | LE33                      | 15        | 100        |
| ATE2                   | 254       | 1316       | TR207         | 51        | 140        | CA61                      | 15        | 83         |
| ATW9                   | 247       | 2227       | HALS          | 48        | 194        | ATE5                      | 14        | 44         |
| CALCT                  | 217       | 1063       | CC6           | 41        | 175        | HA104                     | 13        | 58         |
| TR206                  | 215       | 383        | LE35          | 38        | 77         | ATW9                      | 13        | 120        |
| ATE1                   | 211       | 3381       | CA232         | 38        | 134        | CA64                      | 13        | 82         |
| FO90                   | 184       | 197        | CA63          | 34        | 113        | BC57                      | 13        | 50         |
| BC57                   | 171       | 679        | ATW6          | 32        | 255        | ATE2                      | 11        | 58         |
| FO95                   | 132       | 543        | LE38          | 27        | 162        | CC6                       | 11        | 46         |
| ATW11                  | 128       | 882        | LE33A         | 25        | 165        | ATE1                      | 11        | 170        |
| CC205                  | 128       | 427        | TR113A        | 19        | 33         | TR115                     | 9         | 37         |
| CA65                   | 122       | 770        | CC8           | 19        | 44         | RA71                      | 9         | 33         |
| TR111                  | 116       | 385        | ATE1          | 18        | 295        | CC10                      | 9         | 31         |
| LE33A                  | 107       | 709        | CO48          | 17        | 110        | LE228                     | 8         | 60         |
| EL26                   | 74        | 328        | CA61          | 16        | 88         | CC101                     | 8         | 59         |
| TR18                   | 71        | 160        | ATE2          | 15        | 77         | ATW7                      | 5         | 23         |
| CA63                   | 70        | 231        | GR42          | 14        | 63         | FO94                      | 4         | 30         |
| FO139                  | 70        | 781        | EL23          | 11        | 126        | ATE4                      | 4         | 15         |
| OC80                   | 62        | 293        | CA65          | 9         | 59         |                           |           |            |
| HA148                  | 38        | 243        | TR20          | 9         | 32         |                           |           |            |
| HALS                   | 34        | 135        | CC242         | 8         | 18         |                           |           |            |
| CC3                    | 29        | 218        | FO94          | 1         | 10         |                           |           |            |
| TR13                   | 26        | 93         |               |           |            |                           |           |            |
| CA171                  | 20        | 47         |               |           |            |                           |           |            |
| CO49                   | 16        | 82         |               |           |            |                           |           |            |
| FO94                   | 15        | 106        |               |           |            |                           |           |            |
| HA104                  | 12        | 51         |               |           |            |                           |           |            |
| EL23                   | 11        | 130        |               |           |            |                           |           |            |
| TR21                   | 10        | 51         |               |           |            |                           |           |            |
| CC105                  | 9         | 22         |               |           |            |                           |           |            |
| TR20                   | 8         | 29         |               |           |            |                           |           |            |
| EL237                  | 6         | 15         |               |           |            |                           |           |            |
| CC101                  | 2         | 17         |               |           |            |                           |           |            |

-- continued --

Table 77. Continued.

| Wet Soil   |           |            | Running Water on Trail |           |            | Multiple Tread |           |            |
|------------|-----------|------------|------------------------|-----------|------------|----------------|-----------|------------|
| Trail Code | Feet/Mile | Total Feet | Trail Code             | Feet/Mile | Total Feet | Trail Code     | Feet/Mile | Total Feet |
| CA232      | 3524      | 12474      | FO90                   | 1016      | 1087       | LE33           | 1080      | 7136       |
| CALCT      | 1618      | 7911       | CALCT                  | 244       | 1194       | TR206          | 448       | 797        |
| CA65       | 1004      | 6313       | RA71                   | 207       | 748        | CA232          | 370       | 1310       |
| TR18       | 792       | 1775       | RA241A                 | 196       | 565        | TR13           | 335       | 1195       |
| CA60       | 742       | 3993       | TR18                   | 153       | 343        | CA64           | 293       | 1877       |
| CA61       | 632       | 3474       | RA241                  | 136       | 323        | HA104          | 257       | 1112       |
| ATW6       | 444       | 3495       | FO94                   | 126       | 881        | CC242          | 247       | 534        |
| CA171      | 428       | 1006       | BC53                   | 122       | 334        | ATE5           | 219       | 669        |
| ATW7       | 401       | 1773       | CC6                    | 120       | 511        | FO95           | 206       | 849        |
| TR20       | 331       | 1208       | LE215                  | 111       | 129        | CA60           | 202       | 1085       |
| HALS       | 257       | 1033       | CC101                  | 91        | 703        | CC10           | 178       | 625        |
| FO95       | 246       | 1013       | CA60                   | 82        | 440        | TR20           | 166       | 605        |
| CA64       | 238       | 1523       | OC80                   | 78        | 371        | CO49           | 161       | 843        |
| RA241A     | 194       | 559        | FO95                   | 78        | 321        | ATW10          | 158       | 1218       |
| ATW10      | 183       | 1411       | CA65                   | 74        | 468        | LE215          | 153       | 178        |
| ATW8       | 183       | 568        | FOFC                   | 74        | 330        | CC3            | 152       | 1131       |
| LE228      | 146       | 1110       | LE38                   | 74        | 439        | ATW9           | 144       | 1293       |
| CA63       | 144       | 475        | ATE4                   | 71        | 271        | CA65           | 135       | 849        |
| TR207      | 113       | 310        | RA68A                  | 71        | 318        | CC205          | 130       | 433        |
| TR13       | 101       | 359        | BC57                   | 63        | 249        | LE33A          | 117       | 771        |
| FOFC       | 89        | 398        | FO139                  | 59        | 660        | CALCT          | 106       | 517        |
| ATE2       | 89        | 463        | EL26                   | 41        | 182        | ATE1           | 96        | 1533       |
| LE33       | 88        | 582        | EL237                  | 40        | 93         | FO90           | 92        | 98         |
| RA71       | 83        | 300        | CA232                  | 40        | 140        | TR21           | 90        | 449        |
| EL27       | 79        | 260        | CO49                   | 39        | 205        | TR207          | 87        | 238        |
| FO139      | 73        | 823        | TR13                   | 39        | 138        | FO139          | 86        | 963        |
| GR42       | 71        | 319        | EL27                   | 38        | 123        | TR113          | 77        | 401        |
| ATW9       | 69        | 617        | ATE1                   | 30        | 488        | LE38           | 73        | 434        |
| HA104      | 67        | 292        | CA63                   | 30        | 99         | TR18           | 70        | 156        |
| FO90       | 65        | 70         | LE228                  | 28        | 211        | ATW7           | 69        | 307        |
| RA241      | 63        | 150        | CO48                   | 26        | 164        | CC11           | 59        | 208        |
| ATE5       | 59        | 180        | ATW6                   | 25        | 197        | CO132          | 58        | 156        |
| BC53       | 53        | 146        | TR115                  | 24        | 93         | BC57           | 56        | 224        |
| LE39       | 51        | 270        | HALS                   | 23        | 91         | HALS           | 56        | 225        |
| BC57       | 49        | 196        | CC11                   | 21        | 74         | CA63           | 54        | 178        |
| CC10       | 47        | 165        | LE33A                  | 19        | 124        | ATW11          | 52        | 359        |
| CO49       | 45        | 237        | CA61                   | 19        | 103        | LE39           | 49        | 259        |
| ATE1       | 45        | 714        | HA104                  | 16        | 71         | ATE2           | 48        | 248        |
| RA68A      | 44        | 197        | TR20                   | 16        | 59         | EL26           | 45        | 201        |
| FO94       | 43        | 298        | TR207                  | 16        | 43         | OC80           | 42        | 201        |
| EL237      | 43        | 100        | CA171                  | 15        | 35         | RA241A         | 40        | 115        |
| CC205      | 27        | 89         | ATE2                   | 15        | 76         | LE228          | 29        | 224        |
| TR21       | 22        | 111        | LE33                   | 14        | 91         | GR42           | 29        | 130        |
| TR115      | 20        | 78         | TR113A                 | 12        | 21         | TR113A         | 29        | 49         |
| EL23       | 19        | 231        | EL24                   | 8         | 16         | EL23           | 26        | 311        |
| TR113      | 18        | 96         | LE35                   | 7         | 15         | EL27           | 25        | 81         |
| CC101      | 17        | 133        | CC10                   | 7         | 24         | CA61           | 25        | 135        |
| CO48       | 17        | 107        | LE39                   | 6         | 34         | CC8            | 22        | 52         |
| EL26       | 16        | 70         | CC2                    | 5         | 15         | CO48           | 20        | 126        |
| CC2        | 15        | 41         | EL23                   | 3         | 41         | CC101          | 18        | 143        |
| CC11       | 10        | 36         |                        |           |            | EL24           | 18        | 38         |
| TR111      | 7         | 22         |                        |           |            | ATE4           | 18        | 67         |
| LE38       | 7         | 39         |                        |           |            | CC6            | 17        | 74         |
| ATE4       | 6         | 23         |                        |           |            | FOFC           | 14        | 61         |
| ATW11      | 4         | 25         |                        |           |            | ATW8           | 13        | 41         |
|            |           |            |                        |           |            | CC2            | 13        | 35         |
|            |           |            |                        |           |            | FO94           | 12        | 87         |
|            |           |            |                        |           |            | RA68A          | 10        | 46         |
|            |           |            |                        |           |            | BC53           | 9         | 26         |
|            |           |            |                        |           |            | HA148          | 7         | 46         |
|            |           |            |                        |           |            | ATW6           | 3         | 27         |

## Grouped Trail Summaries

### Surveywide Results

Table 78 presents the trail survey data aggregated across all surveyed trails. Recall that this sample includes 72 (25%) of the park's 295 trail segments and 328 miles (35%) of the park's 950 miles of trail.

Inventory Parameters. Of the 72 trails sampled, all or parts of 49 (68%) are open to horses and hikers and 23 (32%) are restricted to hikers (Table 78). Of the 328 surveyed trail miles, 213 (66%) are open to horses and hikers and 115 (34%) are restricted to hikers. The majority of trail mileage (85%, 278 miles) is constructed as trails two to six feet in width. However, backcountry roads comprise 48 miles of the sample, most of which are closed even to park vehicles. A little over one-half of the road mileage (27 miles) has narrowed to two to six feet in width.

Resource Condition Parameters. Soil erosion of trail treads is among the most common and perhaps the most significant resource impact assessed on the trails surveyed. Soil erosion exceeding one foot below the estimated post-construction tread surface was observed in 734 locations, 100 of which exceeded two feet (Table 78). A total of 14.60 miles of trail (4.5% of the sample) has soil erosion exceeding one foot. On average, 239 feet per mile of trail has at least this much soil erosion for an average of 1,071 feet per trail. Excessive root exposure was observed in 365 locations, affecting 2.44 miles of trail and 1% of the surveyed trail mileage.

Water, muddy soils, and rutted treads are among the leading contributors to excessive tread width. Thus this impact is typically caused by trail users seeking to avoid poor or treacherous trail conditions in the main tread. Tread widths exceeding three feet wider than is typical for adjacent treads were observed in 176 locations, affecting 2.23 miles of trail and 0.7% of the surveyed trail mileage. Multiple treads, another form of trail expansion, is more common; 470 occurrences were observed. As measured on the main tread, 6.40 miles of parallel multiple treads (two or more) affecting 1.8% of the surveyed trail mileage was recorded. Multiple treads are typically caused by trail users seeking to circumvent tree falls, poor trail conditions, switchbacks, or, in meadows, from users travelling two or more abreast or confused as to which tread should be followed.

In spite of a drier than average summer, wet soil was the most common tread resource problem, with 752 observations and an average of 2.3 occurrences and 184 feet per trail mile. Wet soil included any saturated soil, including mudholes and muddy soils from seeps or tread depressions that last more than a few days following rains. A total of 11.30 miles of tread (3.5%) were assessed as wet soil, making it a leading cause of excessive trail widening. Running water from streams, springs, or seeps observed on the tread were recorded as running water on trail rather than wet soil. However, this effectively adds an additional 227 occurrences and 2.60 miles of wet soil. Running water on trails was assessed separately due to the greater potential for rapid soil erosion. Trail survey review comments by park staff emphasize that problems with wet soils are far more extensive during years of average rainfall

Table 78. Summary of number of occurrences and total lineal distance of trail attributes for all surveyed trails (N=72, 328 miles). Dashed line separates lineal feature parameters from point feature parameters.

| Trail Parameter                   | Occurrences |        | Total Lineal Distance <sup>1</sup> |         |         |           |
|-----------------------------------|-------------|--------|------------------------------------|---------|---------|-----------|
|                                   | Number      | No./Mi | Miles                              | Percent | Ft/Mile | Mean (ft) |
| <b>Inventory</b>                  |             |        |                                    |         |         |           |
| Use Type: Pedestrian              | 28          | -      | 114.81                             | 33.5    | -       | 8,419     |
| Use Type: Horse/Pedestrian        | 49          | -      | 212.96                             | 66.2    | -       | 15,617    |
| Tread Width: Trail 2-6 ft         | 68          | -      | 277.62                             | 84.4    | -       | 20,359    |
| Tread Width: Trail on Rd 2-6 ft   | 17          | -      | 27.06                              | 8.1     | -       | 1,984     |
| Tread Width: Road > 6 ft          | 14          | -      | 20.79                              | 7.1     | -       | 1,525     |
| <b>Resource Condition</b>         |             |        |                                    |         |         |           |
| Soil Erosion: 1-1.9 ft            | 634         | 1.90   | 12.10                              | 3.5     | 185     | 887       |
| Soil Erosion: 2-2.9 ft            | 84          | 0.26   | 1.92                               | 0.7     | 35      | 141       |
| Soil Erosion: >3.0 ft             | 16          | 0.06   | 0.59                               | 0.4     | 19      | 43        |
| Root Exposure                     | 365         | 1.58   | 2.44                               | 1.0     | 53      | 179       |
| Excessive Width: 3-6 ft           | 150         | 0.50   | 1.90                               | 0.6     | 32      | 140       |
| Excessive Width: >6 ft            | 26          | 0.10   | 0.33                               | 0.1     | 6       | 24        |
| Multiple Tread                    | 470         | 1.48   | 6.40                               | 1.8     | 96      | 469       |
| Wet Soil                          | 752         | 2.33   | 11.30                              | 3.5     | 184     | 829       |
| Running Water on Trail            | 227         | 0.78   | 2.60                               | 1.0     | 54      | 191       |
| <b>Design and Maintenance</b>     |             |        |                                    |         |         |           |
| Graveled Tread                    | 17          | 0.08   | 23.39                              | 8.0     | -       | 1,715     |
| Excessive Grade: >20%             | 131         | 0.35   | 4.91                               | 1.4     | -       | 360       |
| Trail Corduroy                    | 19          | 0.04   | 0.11                               | <0.0    | -       | 8         |
| Drainage Dip: Very Effective      | 837         | 3.05   |                                    |         |         |           |
| Drainage Dip: Partially Effective | 1,522       | 5.68   |                                    |         |         |           |
| Drainage Dip: Ineffective         | 1,778       | 5.99   |                                    |         |         |           |
| Water Bar: Very Effective         | 1,671       | 4.67   |                                    |         |         |           |
| Water Bar: Partially Effective    | 891         | 2.52   |                                    |         |         |           |
| Water Bar: Ineffective            | 1,242       | 3.40   |                                    |         |         |           |
| Lateral Drain                     | 62          | 0.21   |                                    |         |         |           |
| Retaining Wall                    | 235         | 0.64   |                                    |         |         |           |
| Culvert                           | 208         | 0.77   |                                    |         |         |           |
| Step                              | 414         | 0.79   |                                    |         |         |           |

<sup>1</sup> - Miles - Distance in miles, summed across all trails; Percent - Percent of each trail, averaged across all trails; Ft/Mile - Number of feet/mile for each trail, averaged across all trails, Mean - Distance in feet, averaged across all trails.



than are reflected by this survey's findings. This represents an important deficiency that should be considered when interpreting both the individual trail summaries and these surveywide results.

Design and Maintenance Parameters. The surfaces of some backcountry roads are graveled, presumably from a long time ago. The addition of gravel, however, binds with soils to create a tread highly resistant to use impacts. Seventeen occurrences were noted with a total of 23.39 miles of graveled tread, 8% of the surveyed trail mileage. Trail designers typically avoid grades in excess of 15-20% due to the difficulty of maintaining a stable non-eroding tread surface and to concerns for visitor enjoyment and safety. However, excessive grades are surprisingly common, with 131 occurrences of trail grades in excess of 20% observed. A total of 4.91 miles, 1.4% of the surveyed trail mileage, is classified as having excessive grades. This problem, a result of poor trail design, was often associated with excessive soil erosion.

Good tread drainage is critical to the prevention of most trail problems, particularly soil erosion and wet soils, which in turn often cause trail widening and multiple treads. The two most common trail maintenance features used to remove water from trail treads are drainage dips and water bars. Drainage dips are simply angled trenches dug across the tread, with removed soil placed on the downslope tread to create a berm. When properly installed and maintained, all water running down the tread is diverted, by the trench and berm, off the tread. Water bars work in a similar fashion, with either rocks or wood embedded in the downslope berm to reduce erosion, extending the life of the tread drainage feature. Drainage dips require less time to install but are not as long-lasting as water bars. Both should receive annual maintenance to clear drainage channels and reinforce berms.

Both the presence and estimated effectiveness of all obviously human-constructed drainage dips and water bars were documented for all trails surveyed. A total of 4,137 drainage dips were observed, averaging 14.7 per trail mile. Water bars were employed only slightly less frequently, 3,804 were observed, averaging 10.6 per trail mile. Combined, there are 7,941 tread drainage features, an average of 25.3 per trail mile.

A larger percentage of the water bars were judged to be very effective, compare 44% versus 20%. Conversely, a greater percentage of drainage dips were judged to be ineffective, compare 43% to 33%. To evaluate the effectiveness of tread drainage features further, a weighted effectiveness scale variable was created:

*Drainage Dip Effectiveness* =  $[(1 \times \text{No. of Ineffective Drainage Dips}) + (2 \times \text{No. of Partially Effective Drainage Dips}) + (3 \times \text{No. of Very Effective Drainage Dips})] / \text{Total No. of Drainage Dips}$

Division by the total number of drainage dips results in a scale which reflects only effectiveness, not drainage dip numbers, which vary among trails. Trails with fewer than two drainage dips per mile were excluded from the scale to remove bias introduced by small sample sizes. For example, a trail with only one very effective drainage dip would receive a 3.0 rating, the largest possible effectiveness value. According to this scale, the average drainage dip effectiveness for 52 qualifying trails is 1.7, on a scale of 1.0 to 3.0. In contrast,

average water bar effectiveness from an identical scale with 49 qualifying trails is 2.0. These findings imply that water bars are more effective than drainage dips. However, factors such as the relative ages, quality of installation, and annual maintenance of the tread drainage features, as well as the subjectivity of our ratings, make it difficult to derive any *definitive* statements about their relative effectiveness. On the other hand, these findings are somewhat compelling because the sample size is extremely large and includes considerable diversity in terms of soil types, elevations, slopes, expertise of installers and maintainers, and other factors.

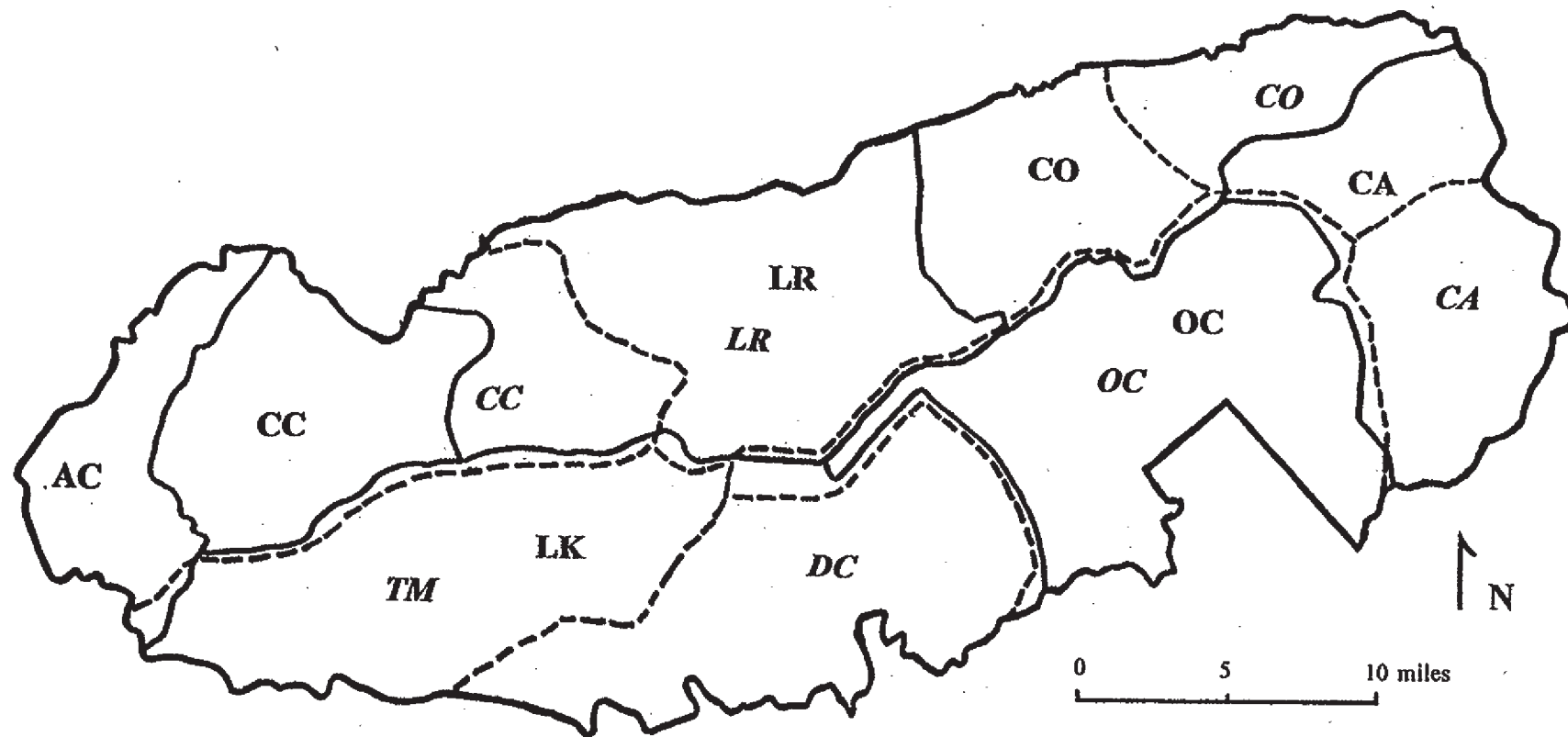
Lateral drains are simply ditches, dug on the upslope sides of trails, which collect and carry water parallel to the trail. Very few lateral drains were observed, a total of 62 or 0.2 per trail mile. Lateral drains appeared to be rarely maintained and were often clogged with silt and leaves. Because of this and their off-trail locations, some lateral drains may have been overlooked by survey staff. Retaining walls were defined as any rock or wood wall or cribbing designed to retain soil. Observers recorded only 235 retaining walls, 0.64 per trail mile. Culverts were defined as metal, rock, or wooden structures which carry water from one side of the tread to the other (open or closed). Only 208 culverts, primarily on backcountry roads, were observed. Comments indicated that many were clogged with leaves and silt. Finally, steps were defined as an obviously human-placed rock or wooden structure designed to harden the tread on steep slopes. These were not distinguished from soil dams, which are more similar to water bars with the rock or wooden bar arranged perpendicular to the tread so that soil is retained rather than flushed off the tread. Steps and soil dams are very rare for the majority of trails surveyed, only 414 steps were observed, 350 are on a single segment of the Appalachian Trail (Newfound Gap to Clingman's Dome).

### Ranger Subdistrict Results

Results are summarized by Ranger and Maintenance subdistricts (Figure 15) to facilitate their use by park staff. Each trail was assigned entirely to the district containing a majority of its mileage, excepting the Appalachian Trail, for which formal park district assignments were available. Results are presented in three-part tables based on type of parameter: inventory, resource condition, and design and maintenance.

Inventory Parameters. Table 79a characterizes the Ranger subdistricts in terms of the number and mileage of trail's sampled and their type of use and tread width. The Little River subdistrict has the largest number and mileage of trails sampled (20 trails, 89 miles) while the Cosby and Oconaluftee subdistricts have the least (tied at 8 trails and 32 miles). Horse trail mileage is highest in the Cataloochee subdistrict (60 miles), followed by the Cades Cove subdistrict (50 miles), and the Lake subdistrict (45 miles). For 5 of 6 Ranger subdistricts, 80-85% of the trails are of trail width and do not follow backcountry roads. All subdistricts have at least some trail mileage on roads, ranging from 13 miles in the Little River subdistrict to only half a mile in the Oconaluftee subdistrict.

Resource Condition Parameters. Table 79b characterizes the Ranger subdistricts in terms of trail resource conditions. Soil erosion and excessive width parameters have been collapsed to single parameters and values for the four most appropriate condition measures are reported. Interpretation of the four measures is emphasized in the discussion for soil erosion. The



**Figure 15.** GSMNP Ranger and Maintenance subdistricts.

**Ranger Subdistricts:** AC = Abrams Creek, CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, LK = Lake.

**Maintenance Subdistricts:** CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, DC = Deep Creek, TM = Twentymile.

**Table 79a.** Summary of number of occurrences and total lineal distance of general trail parameters by park Ranger subdistrict.

| Trail Inventory Parameters             | Ranger Subdistrict <sup>1</sup> |       |       |       |       |       | All Districts |
|--|---------------------------------|-------|-------|-------|-------|-------|---------------|
|  | CC                              | LR    | CO    | CA    | OC    | LK    |               |
| <b>Use Type: Pedestrian</b>            |                                 |       |       |       |       |       |               |
| Total Lineal Distance (miles)          | 4.40                            | 60.84 | 19.95 | 0.00  | 13.70 | 15.93 | 114.8         |
| Total Lineal Distance (%)              | 6.9                             | 62.0  | 63.6  | 0.0   | 37.5  | 26.2  | 33.5          |
| <b>Use Type: Horse/Pedestrian</b>      |                                 |       |       |       |       |       |               |
| Total Lineal Distance (miles)          | 50.24                           | 27.34 | 11.83 | 60.41 | 18.56 | 44.59 | 213.0         |
| Total Lineal Distance (%)              | 93.1                            | 37.5  | 35.4  | 100.0 | 62.5  | 73.9  | 66.2          |
| <b>Tread Width: Trail 2-6 ft</b>       |                                 |       |       |       |       |       |               |
| Total Lineal Distance (miles)          | 42.96                           | 75.10 | 29.17 | 52.82 | 31.69 | 45.89 | 277.6         |
| Total Lineal Distance (%)              | 80.6                            | 85.6  | 82.8  | 82.0  | 98.3  | 80.0  | 84.3          |
| <b>Tread Width: Trail on Rd 2-6 ft</b> |                                 |       |       |       |       |       |               |
| Total Lineal Distance (miles)          | 9.44                            | 6.51  | 1.05  | 4.19  | 0.57  | 5.30  | 27.1          |
| Total Lineal Distance (%)              | 14.8                            | 5.1   | 2.1   | 11.9  | 1.7   | 9.6   | 8.1           |
| <b>Tread Width: Road &gt; 6 ft</b>     |                                 |       |       |       |       |       |               |
| Total Lineal Distance (miles)          | 2.24                            | 6.57  | 1.55  | 4.85  | 0.00  | 5.58  | 20.8          |
| Total Lineal Distance (%)              | 4.6                             | 8.8   | 14.1  | 9.8   | 0.0   | 5.0   | 7.1           |
| <b>Trail Mileage</b>                   | 55                              | 89    | 32    | 60    | 32    | 61    | 328           |
| <b>Number of Trail Segments</b>        | 15                              | 20    | 8     | 11    | 8     | 10    | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, LK = Lake.



Table 79b. Summary of number of occurrences and total lineal distance of resource impact parameters by park Ranger subdistrict.

| Resource Condition Parameters    | Ranger Subdistrict <sup>1</sup> |      |      |      |      |      | All Districts |
|----------------------------------|---------------------------------|------|------|------|------|------|---------------|
|                                  | CC                              | LR   | CO   | CA   | OC   | LK   |               |
| <b>Soil Erosion: &gt;1 ft</b>    |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 1.70                            | 2.21 | 0.79 | 2.74 | 3.66 | 2.41 | 2.22          |
| Total Lineal Distance (miles)    | 1.24                            | 5.20 | 0.67 | 2.96 | 1.64 | 2.90 | 14.61         |
| Total Lineal Distance (%)        | 4.0                             | 5.0  | 1.4  | 6.0  | 4.6  | 5.0  | 4.5           |
| Total Lineal Distance (ft/mi)    | 213                             | 266  | 73   | 316  | 242  | 267  | 239           |
| <b>Root Exposure</b>             |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 1.70                            | 2.75 | 2.63 | 0.56 | 0.26 | 0.42 | 1.58          |
| Total Lineal Distance (miles)    | 0.46                            | 1.38 | 0.16 | 0.29 | 0.06 | 0.08 | 2.44          |
| Total Lineal Distance (%)        | 1.0                             | 1.9  | 1.1  | 0.7  | 0.1  | 0.2  | 1.0           |
| Total Lineal Distance (ft/mi)    | 52                              | 102  | 58   | 38   | 6    | 11   | 53            |
| <b>Excessive Width: &gt;3 ft</b> |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 0.47                            | 0.63 | 0.20 | 1.54 | 0.09 | 0.44 | 0.60          |
| Total Lineal Distance (miles)    | 0.23                            | 0.29 | 0.02 | 1.22 | 0.02 | 0.45 | 2.23          |
| Total Lineal Distance (%)        | 0.5                             | 0.5  | 0.2  | 2.3  | 0.1  | 0.6  | 0.7           |
| Total Lineal Distance (ft/mi)    | 27                              | 28   | 11   | 120  | 3    | 31   | 38            |
| <b>Wet Soil</b>                  |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 0.65                            | 2.38 | 0.55 | 5.50 | 2.69 | 2.40 | 2.33          |
| Total Lineal Distance (miles)    | 0.23                            | 1.16 | 0.34 | 7.24 | 0.99 | 1.34 | 11.30         |
| Total Lineal Distance (%)        | 0.4                             | 1.7  | 0.7  | 14.6 | 2.3  | 2.6  | 3.5           |
| Total Lineal Distance (ft/mi)    | 23                              | 90   | 35   | 771  | 123  | 136  | 184           |
| <b>Running Water on Trail</b>    |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 0.45                            | 0.58 | 0.29 | 0.85 | 2.49 | 0.68 | 0.78          |
| Total Lineal Distance (miles)    | 0.29                            | 0.39 | 0.11 | 0.67 | 0.70 | 0.45 | 2.60          |
| Total Lineal Distance (%)        | 0.4                             | 0.6  | 0.2  | 1.2  | 4.1  | 0.7  | 1.0           |
| Total Lineal Distance (ft/mi)    | 21                              | 31   | 12   | 65   | 218  | 38   | 54            |
| <b>Multiple Tread</b>            |                                 |      |      |      |      |      |               |
| Occurrences/mile                 | 2.36                            | 1.58 | 0.79 | 1.47 | 0.65 | 1.21 | 1.48          |
| Total Lineal Distance (miles)    | 1.12                            | 2.40 | 0.28 | 1.46 | 0.14 | 0.99 | 6.40          |
| Total Lineal Distance (%)        | 2.3                             | 2.2  | 0.7  | 2.3  | 0.6  | 1.7  | 1.8           |
| Total Lineal Distance (ft/mi)    | 121                             | 115  | 37   | 122  | 29   | 92   | 96            |
| <b>Trail Mileage</b>             | 55                              | 89   | 32   | 60   | 32   | 61   | 328           |
| <b>Number of Trail Segments</b>  | 15                              | 20   | 8    | 11   | 8    | 10   | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, LK = Lake.

density (number per mile) of occurrences for soil erosion exceeding one foot ranged from 3.66 (Oconaluftee) to 0.79 (Cosby). However, occurrences do not account for the lineal distances involved at each location. From the standpoint of minimizing resource degradation, managers should be most concerned with the total lineal distance of eroded trail. The Little River subdistrict contains the largest number of miles of severely eroded trails (5.20 miles). Direct comparisons with other subdistricts are somewhat inappropriate, however, as subdistricts that have a larger proportion of surveyed miles will often have the largest aggregate impact. As a percentage of trail length, the Cataloochee subdistrict trails has the highest percentage of eroded trails (6%). However, percentages can also be misleading because trail lengths vary among subdistricts. The average number of feet per mile of severely eroded trails is perhaps the most appropriate measure for comparison among districts because it standardizes the lineal length of impact on a per mile basis. According to this measure, the Cataloochee subdistrict's trails have, on a per mile basis, the most severely eroded trails (316 feet per mile). In summary, the total lineal distance in miles is the best aggregate measure of impact but the total lineal distance in feet per mile is the best measure for comparing impacts among subdistricts.

Excessive tree root exposure is most prevalent in the Little River subdistrict, which has 1.38 miles of affected trail with an average of 102 feet per mile. Root exposure is also extensive in the Cades Cove (52 feet/mile) and Cosby (58 feet/mile) subdistricts. Problems with excessive trail width are particularly pronounced in the Cataloochee subdistrict, where 1.22 miles of trail and 120 feet per mile have widths exceeding 3 feet greater than normal. The Cataloochee subdistrict also has the most extensive amount of wet soil on trails, 7.24 miles and 771 feet per mile, nearly 6 miles more than any other subdistrict. Occurrences of wet soils average 5.5 per mile and include nearly 15% of the district's trail mileage. Undoubtedly, wet soils are the predominant cause of excessive trail widths for this subdistrict. Running water on trails is somewhat pronounced in the Oconaluftee subdistrict, affecting 4.1% of the district's trail mileage and averaging 218 feet per mile. Finally, multiple treads are most extensive in the Little River subdistrict (2.40 miles, 115 feet/mile) but are also common in the Cataloochee (1.46 miles, 122 feet/mile) and Cades Cove (1.12 miles, 121 feet/mile) subdistricts.

Design and Maintenance Parameters. Graveled treads, which substantially improve the resistance of trails to resource impacts, are most extensive in the Little River subdistrict (11.47 miles) (Table 79c). However, trail grades in excess of 20% are also most prevalent in this subdistrict (1.68 miles), making trails more susceptible to soil erosion in particular. Excessive grades were also common in the Lake Subdistrict (1.34 miles). Trail corduroy, while relatively rare, is most common in the Oconaluftee subdistrict.

The density of drainage dips varies considerably across Ranger subdistricts. For example, drainage dips exceed 20 per mile in the Cosby and Cades Cove subdistricts yet the Oconaluftee and Lake subdistricts average less than 3 per mile. Similar differences are evident for water bars, which range from 25 per mile in Oconaluftee to less than 5 in Cataloochee. Taken together, the Cosby subdistrict has the highest density of drainage features (37 per mile) and the Lake subdistrict has the lowest (11 per mile). According to the drainage dip effectiveness scale ratings the Cosby subdistrict has the highest effectiveness ratings and the Lake subdistrict has the lowest. Similarly, water bar effectiveness is very high in Cades Cove and lowest in the Cosby and Cataloochee subdistricts.

# Results and Discussion

**Table 79c.** Summary of number of occurrences and total lineal distance of design, construction and maintenance parameters by park Ranger subdistrict.

| Design and Maintenance Parameters        | Ranger Subdistrict <sup>1</sup> |       |       |       |       |       | All Districts |
|--|---------------------------------|-------|-------|-------|-------|-------|---------------|
|  | CC                              | LR    | CO    | CA    | OC    | LK    |               |
| <b>Graveled Tread</b>                    |                                 |       |       |       |       |       |               |
| Occurrences/mile                         | 0.03                            | 0.11  | 0.18  | 0.07  | 0.14  | 0.00  | 0.08          |
| Total Lineal Distance (miles)            | 5.47                            | 11.47 | 2.49  | 2.93  | 1.02  | 0.00  | 23.39         |
| Total Lineal Distance (%)                | 8.0                             | 11.8  | 16.1  | 6.4   | 2.9   | 0.0   | 8.0           |
| <b>Excessive Grade: &gt;20%</b>          |                                 |       |       |       |       |       |               |
| Occurrences/mile                         | 0.17                            | 0.46  | 0.35  | 0.21  | 0.23  | 0.69  | 0.35          |
| Total Lineal Distance (miles)            | 0.68                            | 1.68  | 0.23  | 0.79  | 0.19  | 1.34  | 4.91          |
| Total Lineal Distance (%)                | 0.9                             | 1.7   | 0.9   | 1.8   | 0.7   | 2.0   | 1.4           |
| <b>Trail Corduroy</b>                    |                                 |       |       |       |       |       |               |
| Occurrences/mile                         | 0.00                            | 0.02  | 0.00  | 0.05  | 0.24  | 0.02  | 0.04          |
| Total Lineal Distance (miles)            | 0.00                            | 0.01  | 0.00  | 0.01  | 0.10  | <0.00 | 0.11          |
| Total Lineal Distance (%)                | 0.0                             | <0.0  | 0.0   | <0.0  | 0.2   | 0.0   | <0.0          |
|  | ----- Occurrences/mile -----    |       |       |       |       |       |               |
| <b>Drainage Dip: Very Effective</b>      | 5.06                            | 2.07  | 8.31  | 2.58  | 0.88  | 0.07  | 3.05          |
| <b>Drainage Dip: Partially Effective</b> | 10.39                           | 5.42  | 10.63 | 4.68  | 0.88  | 0.16  | 5.68          |
| <b>Drainage Dip: Ineffective</b>         | 8.35                            | 5.38  | 13.26 | 7.23  | 1.08  | 0.39  | 5.99          |
| <b>Water Bar: Very Effective</b>         | 4.55                            | 5.53  | 1.77  | 1.18  | 11.46 | 3.85  | 4.67          |
| <b>Water Bar: Partially Effective</b>    | 0.65                            | 3.52  | 1.30  | 1.13  | 6.78  | 2.42  | 2.52          |
| <b>Water Bar: Ineffective</b>            | 0.19                            | 5.27  | 2.14  | 1.95  | 7.23  | 4.06  | 3.40          |
| <b>Combined Tread Drainage</b>           | 29.18                           | 27.18 | 37.40 | 18.75 | 28.29 | 10.95 | 25.31         |
| <b>Lateral Drain</b>                     | 0.07                            | 0.10  | 0.70  | 0.28  | 0.23  | 0.14  | 0.21          |
| <b>Retaining Wall</b>                    | 0.08                            | 1.09  | 1.31  | 0.44  | 0.86  | 0.07  | 0.64          |
| <b>Culvert</b>                           | 0.67                            | 1.00  | 1.60  | 0.70  | 0.20  | 0.30  | 0.77          |
| <b>Step</b>                              | 0.00                            | 0.20  | 0.05  | 0.18  | 5.64  | 0.52  | 0.79          |
| <b>Drainage Dip Effectiveness Rating</b> | 1.8                             | 1.6   | 1.9   | 1.6   | 1.8   | 1.3   | 1.7           |
| <b>Water Bar Effectiveness Rating</b>    | 2.5                             | 2.0   | 1.8   | 1.7   | 2.1   | 2.0   | 2.0           |
| <b>Trail Mileage</b>                     | 55                              | 89    | 32    | 60    | 32    | 61    | 328           |
| <b>Number of Trail Segments</b>          | 15                              | 20    | 8     | 11    | 8     | 10    | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, LK = Lake.

Lateral drains, retaining walls, and culverts have their highest densities in the Cosby subdistrict. Steps, primarily due to a single segment of the Appalachian Trail, are most common in the Oconaluftee subdistrict.

### Maintenance Subdistrict Results

Inventory Parameters. Table 80a characterizes the Maintenance subdistricts in terms of the number and mileage of trail's sampled and their type of use and tread width. The Cades Cove subdistrict has the largest number and mileage sampled (21 trails, 87 miles) while Twentymile has the least (4 trails, 22 miles). Horse trail mileage is highest in the Cades Cove subdistrict (71 miles) and all but the Cosby subdistrict (with 30 miles) have approximately 18 miles each. Nearly all (99%) of the trails in the Oconaluftee subdistrict are of trail width and do not follow backcountry roads, values for other subdistricts range from 73-90%. Trail mileage on roads range from 17 miles in the Cades Cove subdistrict to half a mile in the Oconaluftee subdistrict.

Resource Condition Parameters. Table 80b characterizes the Maintenance subdistricts in terms of trail resource conditions. See the discussion under Resource Condition Parameters from the Ranger Subdistrict Results section for guidance in interpreting the various measures in Table 80b and discussed below. Trail soil erosion is most extensive on trails in the Little River (4.40 miles, 263 feet/mile) and Oconaluftee (3.52 miles, 383 feet/mile) subdistricts. Erosion is least extensive in the Twentymile (0.25 miles, 52 feet/mile) and Deep Creek (0.50 miles, 122 feet/mile) subdistricts. Excessive root exposure is most prevalent in the Little River subdistrict, including nearly 1 mile of tread with an average of 89 feet per mile. On a per mile basis, the Cosby subdistrict has more root exposure (97 feet/mile) but less total mileage (0.37 miles).

As was shown for the Ranger subdistricts, excessive trail width and wet soil problems are particularly pronounced in the Cataloochee area. The Cataloochee Maintenance subdistrict has 1.17 miles (158 feet/mile) of trail with widths 3 or more feet wider than normal and a highly significant 7.04 miles (1041 feet/mile) of trail with wet soil. In comparison to other subdistricts, wet soils in the Cataloochee subdistrict are 8.5 times more prevalent, on a per mile basis, than any other district. Running water on trails is pronounced on the Oconaluftee subdistrict, including 0.75 miles of trail at an average of 151 feet/mile. Finally, three subdistricts have over 1 mile of multiple treads: Little River (1.9 miles, 116 feet/mile), Cades Cove (1.78 miles, 112 feet/mile), and Cataloochee (1.13 miles, 148 feet/mile).

Design and Maintenance Parameters. The largest mileage of graveled treads are in the Cades Cove (9.78 miles) and Little River (7.16 miles) subdistricts (Table 80c). Miles of trail with grades in excess of 20% range from 2.21 in the Cades Cove subdistrict to 0.17 miles in the Cosby subdistrict. Trail corduroy is quite rare overall but most common in the Oconaluftee subdistrict.

The density of drainage dips varies considerably across Maintenance subdistricts. For example, drainage dips exceed 20 per mile in the Cades Cove and Cosby subdistricts yet the Oconaluftee, Deep Creek, and Twentymile subdistricts average less than 2.1 per mile. Similarly, water bars range from 26 per mile in Oconaluftee to less than 4 in the Deep Creek, Cosby, Twentymile, and Cataloochee subdistricts. Combined, the Cosby subdistrict has the



**Table 80a.** Summary of number of occurrences and total lineal distance of general trail parameters by park Maintenance subdistrict.

| Trail Inventory Parameters         | Maintenance Subdistrict <sup>1</sup> |       |       |       |       |       |       | All Districts |
|------------------------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|---------------|
|                                    | CC                                   | LR    | CO    | CA    | OC    | DC    | TM    |               |
| <b>Use Type: Pedestrian</b>        |                                      |       |       |       |       |       |       |               |
| Total Lineal Distance (mi)         | 15.87                                | 50.11 | 8.45  | 0.00  | 28.87 | 7.76  | 3.75  | 114.8         |
| Total Lineal Distance (%)          | 12.1                                 | 66.0  | 38.6  | 0.0   | 58.3  | 26.8  | 13.6  | 33.5          |
| <b>Use Type: Horse/Pedestrian</b>  |                                      |       |       |       |       |       |       |               |
| Total Lineal Distance (mi)         | 70.88                                | 18.54 | 30.45 | 37.64 | 18.56 | 18.98 | 17.91 | 213.0         |
| Total Lineal Distance (%)          | 87.9                                 | 32.8  | 61.4  | 100.0 | 41.7  | 73.3  | 86.4  | 66.2          |
| <b>Tread Width: Trail 2-6 ft</b>   |                                      |       |       |       |       |       |       |               |
| Total Lineal Distance (mi)         | 69.66                                | 60.98 | 36.30 | 30.05 | 46.87 | 17.39 | 16.37 | 277.6         |
| Total Lineal Distance (%)          | 79.5                                 | 89.7  | 83.8  | 75.3  | 98.9  | 73.0  | 77.0  | 84.3          |
| <b>Width: Trail on Rd 2-6 ft</b>   |                                      |       |       |       |       |       |       |               |
| Total Lineal Distance (mi)         | 9.44                                 | 6.51  | 1.05  | 4.19  | 0.57  | 3.77  | 1.53  | 27.1          |
| Total Lineal Distance (%)          | 10.6                                 | 6.8   | 2.1   | 16.4  | 1.1   | 14.6  | 9.4   | 8.1           |
| <b>Tread Width: Road &gt; 6 ft</b> |                                      |       |       |       |       |       |       |               |
| Total Lineal Distance (mi)         | 7.65                                 | 1.16  | 1.55  | 4.85  | 0.00  | 5.58  | 0.00  | 20.8          |
| Total Lineal Distance (%)          | 9.9                                  | 2.4   | 14.1  | 13.5  | 0.0   | 12.5  | 0.0   | 7.1           |
| <b>Trail Mileage</b>               | 87                                   | 70    | 39    | 38    | 47    | 27    | 22    | 328           |
| <b>Number of Trail Segments</b>    | 21                                   | 15    | 8     | 8     | 12    | 4     | 4     | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, DC = Deep Creek, TM = Twentymile

Table 80b. Summary of number of occurrences and total lineal distance of resource impact parameters by park Maintenance subdistrict.

| Resource Condition Parameters    | Maintenance Subdistrict <sup>1</sup> |      |      |      |      |       |      | All Districts |
|----------------------------------|--------------------------------------|------|------|------|------|-------|------|---------------|
|                                  | CC                                   | LR   | CO   | CA   | OC   | DC    | TM   |               |
| <b>Soil Erosion: &gt;1 ft</b>    |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 1.79                                 | 2.24 | 1.55 | 2.29 | 4.03 | 1.30  | 1.00 | 2.22          |
| Total Lineal Distance (miles)    | 2.95                                 | 4.40 | 1.52 | 1.46 | 3.52 | 0.50  | 0.25 | 14.61         |
| Total Lineal Distance (%)        | 4.0                                  | 5.0  | 4.3  | 4.0  | 7.3  | 2.3   | 1.0  | 4.5           |
| Total Lineal Distance (ft/mi)    | 212                                  | 263  | 227  | 210  | 383  | 122   | 53   | 239           |
| <b>Root Exposure</b>             |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 1.70                                 | 2.36 | 3.08 | 0.30 | 0.98 | 0.02  | 1.03 | 1.58          |
| Total Lineal Distance (miles)    | 0.73                                 | 0.90 | 0.37 | 0.07 | 0.29 | <0.00 | 0.08 | 2.44          |
| Total Lineal Distance (%)        | 1.0                                  | 1.7  | 1.8  | 0.2  | 0.7  | 0.0   | 0.5  | 1.0           |
| Total Lineal Distance (ft/mi)    | 53                                   | 89   | 97   | 12   | 35   | <0    | 26   | 53            |
| <b>Excessive Width: &gt;3 ft</b> |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 0.69                                 | 0.44 | 0.30 | 2.00 | 0.16 | 0.15  | 0.30 | 0.60          |
| Total Lineal Distance (miles)    | 0.71                                 | 0.14 | 0.07 | 1.17 | 0.03 | 0.08  | 0.03 | 2.23          |
| Total Lineal Distance (%)        | 0.8                                  | 0.4  | 0.3  | 3.0  | 0.9  | 0.7   | 0.9  | 0.7           |
| Total Lineal Distance (ft/mi)    | 42                                   | 20   | 17   | 158  | 4    | 9     | 11   | 38            |
| <b>Wet Soil</b>                  |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 1.99                                 | 1.23 | 0.40 | 7.23 | 2.43 | 2.38  | 1.93 | 2.33          |
| Total Lineal Distance (miles)    | 1.16                                 | 0.73 | 0.27 | 7.04 | 1.37 | 0.48  | 0.26 | 11.30         |
| Total Lineal Distance (%)        | 1.5                                  | 1.0  | 0.5  | 19.7 | 2.3  | 2.2   | 1.6  | 3.5           |
| Total Lineal Distance (ft/mi)    | 79                                   | 54   | 26   | 1041 | 121  | 113   | 82   | 184           |
| <b>Running Water on Trail</b>    |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 0.48                                 | 0.53 | 0.50 | 0.90 | 1.70 | 1.35  | 0.35 | 0.78          |
| Total Lineal Distance (miles)    | 0.38                                 | 0.29 | 0.27 | 0.47 | 0.75 | 0.42  | 0.03 | 2.60          |
| Total Lineal Distance (%)        | 0.4                                  | 0.5  | 0.7  | 1.2  | 2.9  | 1.6   | 0.2  | 1.0           |
| Total Lineal Distance (ft/mi)    | 23                                   | 27   | 35   | 63   | 151  | 84    | 10   | 54            |
| <b>Multiple Tread</b>            |                                      |      |      |      |      |       |      |               |
| Occurrences/mile                 | 2.11                                 | 1.28 | 0.99 | 1.60 | 1.25 | 0.90  | 1.00 | 1.48          |
| Total Lineal Distance (miles)    | 1.78                                 | 1.90 | 0.55 | 1.13 | 0.34 | 0.37  | 0.33 | 6.40          |
| Total Lineal Distance (%)        | 2.1                                  | 2.2  | 1.0  | 2.8  | 0.9  | 1.5   | 1.8  | 1.8           |
| Total Lineal Distance (ft/mi)    | 112                                  | 116  | 50   | 148  | 45   | 80    | 93   | 96            |
| <b>Trail Mileage</b>             | 87                                   | 70   | 39   | 38   | 47   | 27    | 22   | 328           |
| <b>Number of Trail Segments</b>  | 21                                   | 15   | 8    | 8    | 12   | 4     | 4    | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, DC = Deep Creek, TM = Twentymile

# Results and Discussion

**Table 80c.** Summary of number of occurrences and total lineal distance of design, construction and maintenance parameters by park Maintenance subdistrict.

| Design and Maintenance Parameters        | Maintenance Subdistrict <sup>1</sup> |       |       |       |       |       |      | All Districts |
|--|--------------------------------------|-------|-------|-------|-------|-------|------|---------------|
|  | CC                                   | LR    | CO    | CA    | OC    | DC    | TM   |               |
| <b>Graveled Tread</b>                    |                                      |       |       |       |       |       |      |               |
| Occurrences/mile                         | 0.08                                 | 0.07  | 0.18  | 0.10  | 0.09  | 0.00  | 0.00 | 0.08          |
| Total Lineal Distance (mi)               | 9.78                                 | 7.16  | 2.49  | 2.93  | 1.02  | 0.00  | 0.00 | 23.39         |
| Total Lineal Distance (%)                | 11.0                                 | 8.4   | 16.1  | 8.8   | 2.0   | 0.0   | 0.0  | 8.03          |
| <b>Excessive Grade: &gt;20%</b>          |                                      |       |       |       |       |       |      |               |
| Occurrences/mile                         | 0.30                                 | 0.43  | 0.28  | 0.29  | 0.22  | 0.50  | 0.90 | 0.35          |
| Total Lineal Distance (mi)               | 2.21                                 | 0.65  | 0.17  | 0.79  | 0.21  | 0.43  | 0.45 | 4.91          |
| Total Lineal Distance (%)                | 1.5                                  | 1.5   | 0.8   | 2.5   | 0.5   | 1.4   | 2.0  | 1.4           |
| <b>Trail Corduroy</b>                    |                                      |       |       |       |       |       |      |               |
| Occurrences/mile                         | 0.00                                 | 0.00  | 0.00  | 0.06  | 0.18  | 0.05  | 0.00 | 0.04          |
| Total Lineal Distance (mi)               | 0.00                                 | 0.00  | 0.00  | 0.01  | 0.10  | <0.00 | 0.00 | 0.11          |
| Total Lineal Distance (%)                | 0.0                                  | 0.0   | 0.0   | <0.0  | 0.1   | <0.0  | 0.0  | <0.0          |
| ----- Occurrences/mile -----             |                                      |       |       |       |       |       |      |               |
| <b>Drainage Dip: Very Effective</b>      | 3.85                                 | 2.67  | 8.59  | 2.76  | 0.65  | 0.08  | 0.02 | 3.05          |
| <b>Drainage Dip: Part. Effective</b>     | 9.85                                 | 4.13  | 11.24 | 5.20  | 0.67  | 0.13  | 0.13 | 5.68          |
| <b>Drainage Dip: Ineffective</b>         | 8.69                                 | 4.38  | 13.01 | 8.50  | 0.80  | 0.10  | 0.20 | 5.99          |
| <b>Water Bar: Very Effective</b>         | 3.99                                 | 6.29  | 0.95  | 1.00  | 10.97 | 1.50  | 1.20 | 4.67          |
| <b>Water Bar: Partially Effective</b>    | 1.06                                 | 3.36  | 0.80  | 1.18  | 7.12  | 0.90  | 0.95 | 2.52          |
| <b>Water Bar: Ineffective</b>            | 1.49                                 | 5.19  | 1.39  | 1.66  | 8.59  | 0.48  | 1.63 | 3.40          |
| <b>Combined Tread Drainage</b>           | 28.93                                | 26.01 | 35.98 | 20.30 | 28.79 | 3.18  | 4.13 | 25.31         |
| <b>Lateral Drain</b>                     | 0.09                                 | 0.08  | 0.71  | 0.38  | 0.17  | 0.25  | 0.05 | 0.21          |
| <b>Retaining Wall</b>                    | 0.20                                 | 0.92  | 0.60  | 0.24  | 1.73  | 0.05  | 0.08 | 0.64          |
| <b>Culvert</b>                           | 0.69                                 | 1.09  | 1.53  | 0.95  | 0.13  | 0.48  | 0.28 | 0.77          |
| <b>Step</b>                              | 0.04                                 | 0.19  | 0.09  | 0.21  | 4.13  | 0.00  | 0.28 | 0.79          |
| <b>Drainage Dip Effectiveness Rating</b> | 1.7                                  | 1.7   | 1.8   | 1.6   | 1.9   | -     | -    | 1.7           |
| <b>Water Bar Effectiveness Rating</b>    | 2.2                                  | 2.0   | 1.7   | 1.8   | 2.1   | 2.3   | 1.6  | 2.0           |
| <b>Trail Mileage</b>                     | 87                                   | 70    | 39    | 38    | 47    | 27    | 22   | 328           |
| <b>Number of Trail Segments</b>          | 21                                   | 15    | 8     | 8     | 12    | 4     | 4    | 72            |

1 - CC = Cades Cove, LR = Little River, CO = Cosby, CA = Cataloochee, OC = Oconaluftee, DC = Deep Creek, TM = Twentymile

highest density of tread drainage features (36 per mile) and the Deep Creek and Twentymile subdistricts has the lowest (3 and 4 per mile, respectively). Drainage dip effectiveness ratings are highest for the Oconaluftee and Cosby subdistricts and lowest for the Cataloochee subdistrict. Similarly, water bar effectiveness is very high in Deep Creek and lowest in the Twentymile subdistrict.

The density of lateral drains is highest in the Cosby subdistrict (0.71/mile). Retaining walls are most prevalent in the Oconaluftee (1.73/mile) and Little River (0.92/mile) subdistricts. The Cosby subdistrict has the highest density of culverts (1.53/mile) and the Oconaluftee subdistrict has the highest density of steps, due to a single segment of the Appalachian Trail.

### Appalachian Trail Results

Table 81 provides a summary of survey findings for the entire 70.97 mile segment of the Appalachian Trail within park boundaries. Survey findings for the 11 individual segments were presented in Tables 5 through 15. An analysis of resource impacts on the Appalachian Trail by type of use (horse/pedestrian vs. pedestrian) is presented in the Relational Analyses section.

Inventory Parameters. Horse use is permitted on 35.17 miles (40.5%) of the 70.97 mile segment of the Appalachian Trail (AT) within the park (Table 81). The majority of the AT is of trail width, only 3.75 miles follows a preexisting narrowed roadbed.

Resource Condition. Soil erosion is the most pervasive impact along the AT and is the only form of impact that exceeds the surveywide averages for feet/mile (compare values, Tables 78 and 81). There are 300 occurrences (4.7/mile) of soil erosion exceeding one foot below the estimated post-construction tread surface. A total of 5.72 miles, 8% of the total mileage, has this degree of soil erosion. Excessive soil erosion may be attributed largely to the extremely high use, for the last several decades, that some portions of the AT receive. Excessive root exposure is less common, with 49 occurrences, affecting a total of 0.35 miles of trail.

Excessive width is also not a significant problem, with 29 occurrences and 0.41 miles of tread with widths exceeding three feet wider than is typical for adjacent treads. Instances of multiple treads are higher than average, with 113 occurrences (1.64 occurrences/mile) and affecting 1.09 miles of trail. Wet soil is also higher than to be expected for a trail following a ridgetop geographic position. Wet soil was found in 146 locations (2.21 occurrences/mile) with a total lineal distance of 1.76 miles. Only 19 occurrences of running water on the trail were noted.

Design and Maintenance. Trail grades in excess of 20% occur in 50 locations, affecting 1.9 miles of trail. Such steep grades may also be a significant contributor to excessive soil erosion noted along the AT. Water bars are more than four times as common as drainage dips along the AT, compare 1,910 to 458 occurrences. Roughly 37% of the drainage dips were rated as ineffective, compared to 33% for water bars. The effectiveness scale ratings, the best measure of effectiveness, reveal that water bars were rated more effective than drainage dips, compare 2.1 to 1.6 on a scale of 1.0 to 3.0. Combined, there are 2,368 tread drainage features, an



**Table 81.** Summary of number of occurrences and total lineal distance of trail attributes for the Appalachian Trail (N=11 segments, 70.97 miles). Dashed line separates lineal feature parameters from point feature parameters.

| Trail Parameter                   | Occurrences |        | Total Lineal Distance <sup>1</sup> |         |         |
|-----------------------------------|-------------|--------|------------------------------------|---------|---------|
|                                   | Number      | No./Mi | Miles                              | Percent | Ft/Mile |
| <b>Inventory</b>                  |             |        |                                    |         |         |
| Use Type: Pedestrian              | 7           | -      | 35.80                              | 59.5    | -       |
| Use Type: Horse/Pedestrian        | 5           | -      | 35.17                              | 40.5    | -       |
| Tread Width: Trail 2-6 ft         | 11          | -      | 67.22                              | 94.7    | -       |
| Tread Width: Trail on Rd 2-6 ft   | 1           | -      | 3.75                               | 5.3     | -       |
| Tread Width: Road > 6 ft          | 0           | -      | 0                                  | 0       | -       |
| <b>Resource Condition</b>         |             |        |                                    |         |         |
| Soil Erosion: 1-1.9 ft            | 274         | 4.26   | 5.39                               | 8.7     | 458     |
| Soil Erosion: 2-2.9 ft            | 23          | 0.37   | 0.31                               | 0.5     | 28      |
| Soil Erosion: >3.0 ft             | 3           | 0.05   | 0.02                               | <0.0    | 2       |
| Root Exposure                     | 49          | 1.08   | 0.35                               | 0.8     | 40      |
| Excessive Width: 3-6 ft           | 25          | 0.35   | 0.36                               | 0.4     | 23      |
| Excessive Width: >6 ft            | 4           | 0.05   | 0.05                               | 0.1     | 3       |
| Multiple Tread                    | 113         | 1.64   | 1.09                               | 1.4     | 75      |
| Wet Soil                          | 146         | 2.21   | 1.76                               | 2.6     | 135     |
| Running Water on Trail            | 19          | 0.21   | 0.20                               | 0.2     | 13      |
| <b>Design and Maintenance</b>     |             |        |                                    |         |         |
| Graveled Tread                    | 0           | 0.00   | 0.00                               | 0       | -       |
| Excessive Grade: >20%             | 50          | 0.63   | 1.90                               | 2.2     | -       |
| Trail Corduroy                    | 13          | 0.16   | 0.10                               | 0.1     | -       |
| Drainage Dip: Very Effective      | 110         | 0.77   |                                    |         |         |
| Drainage Dip: Partially Effective | 179         | 1.17   |                                    |         |         |
| Drainage Dip: Ineffective         | 169         | 1.42   |                                    |         |         |
| Water Bar: Very Effective         | 794         | 11.83  |                                    |         |         |
| Water Bar: Partially Effective    | 485         | 7.54   |                                    |         |         |
| Water Bar: Ineffective            | 631         | 9.39   |                                    |         |         |
| Lateral Drain                     | 16          | 0.19   |                                    |         |         |
| Retaining Wall                    | 122         | 2.00   |                                    |         |         |
| Culvert                           | 10          | 0.11   |                                    |         |         |
| Step                              | 376         | 4.54   |                                    |         |         |

<sup>1</sup> - Miles - Distance in miles, summed across all trails; Percent - Percent of each trail, averaged across all trails;  
Ft/Mile - Number of feet/mile for each trail, averaged across all trails.

average of 32.1 per trail mile. This significantly exceeds the surveywide average of 12.2 per trail mile.

Trail corduroy, lateral drains, and culverts were fairly uncommon, with few occurrences. Retaining walls were surprisingly common, with 122 occurrences. Steps were common only on one segment (Newfound Gap to Clingman's Dome). Of the 376 steps, 122 are located on this segment.

### Relational Analyses

Relational analyses were conducted to identify and determine the relative strength of relationships between the six trail resource condition parameters and various environmental, use-related, or design and maintenance factors. An understanding of these relationships is critical to the professional management of trail resources. Such information, combined with and interpreted by individuals with local trail management and maintenance expertise, can help focus management attention on those factors that will have the greatest potential to correct trail problems. Information on relationships that are quantitatively derived may simply reaffirm first-hand management experience but may also identify important new factors or provide new insights into the relative contributions of recognized factors. Finally, scientific analyses with statistically significant relationships may help to justify management actions that are costly or controversial.

### Factors Affecting Trail Conditions

Trail conditions are influenced by a large variety of factors acting together in complex and dynamic ways. For example, a problem such as wet muddy soil along trails might be influenced by any number of the following:

*Environmental factors:* soil texture, hydrological conditions, aspect, forest type and density, geographic position;

*Use-Related factors:* type and amount of use, user behavior;

*Design and Maintenance factors:* trail design (including trail slope and cross-slope), number and effectiveness of tread drainage features.

Simplistic analyses might seek to evaluate the individual relationship between wet soil and each of these factors. However, such univariate analyses will not reflect the complexity of the interrelationships that exist in nature and may fail to reveal important relationships or the relative strength of the many contributing factors. The relative contribution of one factor can be influenced by another (e.g. dense off-trail vegetation or steep cross-slopes may prohibit trail widening caused by wet soils).

Multivariate analyses attempt to address these problems by simultaneously evaluating the relative contributions of large numbers of potential factors. Such analyses attempt to model the real world through sophisticated statistical procedures that include as many influential and measurable factors as possible. One commonly used type of multivariate analysis is multiple

regression, which analyzes interrelationships between a single dependent variable and many independent variables. Multiple regression was employed to analyze relationships between the six trail condition parameters measured in feet per mile (the dependent variables) and a variety of environmental, use-related, and design and maintenance parameters assessed by the trail survey (the independent variables).

This procedure began with development of a list of independent variables (see Figure 16). The procedure requires that categorical variables have no more than 2 categories, so several variables were transformed and recoded. A new variable, elevation change (ft/mi), was created by counting all contour lines crossed by trails (up and down), multiplying by the contour interval, and dividing by the trail length in miles. The drainage dip and water bar effectiveness scales described earlier were also included, as was a composite scale summing these two measures to obtain tread drainage effectiveness. Other variables in the list have been previously described.

The next step was the selection of appropriate independent variables from this list for analysis with each dependent variable. Only those variables for which some plausible cause-and-effect relationship could be conceived were included in the individual independent variable analysis for each of the six dependent variables. Multiple regression procedures were then run separately for each dependent variable. *For statisticians:* The stepwise elimination method was used with the probability of F-to-enter of 0.10 (PIN) and the probability of F-to-remove of 0.15 (POUT). Two iterations of the equations were run, removing outliers whose absolute values for standardized residuals exceed three.

Stated simply, the multiple regression procedures compute correlations between all possible combinations of variables and then sequentially select independent variables from the list based on their ability to explain variation in the dependent variable (the resource impact). The product of this process is a predictive equation containing the best possible subset of independent variables, those variables that explain the most variation in the dependent variable. This subset of variables, their relative contributions in explaining variation in the dependent variable, and the total amount of variation explained are of particular interest. Use of the equation as a predictive tool is of little utility and those data are not reported.

### Potential Independent Variables

#### Environmental

Tread Width/Type (trail = 0, road = 1)

Geographic Position:

Upper-Slope (1 = upper-slope, 0 = other)

Mid-Slope (1 = mid-slope, 0 = other)

Lower-Slope (1 = lower-slope, 0 = other)

Elevation Change (ft/mi)

Soil Erosion (ft, ft/mi)

Excessive Root Exposure (ft, ft/mi)

Excessive Width (ft, ft/mi)

Wet Soil (ft, ft/mi)

Running Water on Trail (ft, ft/mi)

Multiple Tread (ft, ft/mi)

#### Use-Related

Amount of Use (days/year)

Horse Use (% of total use)

#### Design and Maintenance

Graveled Tread (ft, ft/mi)

Excessive Grade (ft, ft/mi)

Drainage Dips (#, #/mi, effectiveness)

Water Bar (#, #/mi, effectiveness)

Tread Drainage features (drainage dips + water bars) (#, #/mi, effectiveness)

**Figure 16.** Potential independent variables available for multiple regression analyses.

Soil Erosion. Three independent variables were selected by the multiple regression analysis for soil erosion, explaining 29% of the variation in this dependent variable (Table 82). The relative strength and statistical significance of each independent variable can be inferred by examining the absolute value of the T Values (larger values indicate greater significance) or the significance probability values (smaller values indicate greater significance). Interpretations of relationships are suggested but readers are encouraged to formulate and consider their own interpretations.

There is a strong positive correlation between soil erosion and the upper-slope geographic position of trails. More soil erosion occurs on trails that occupy upper-slope or ridgetop positions. One possible explanation is that precipitation is greater at higher elevations. The effects of precipitation may also be greater due to absent or more open tree canopies and reduced root mass from woody vegetation. Soil erosion is also related to the presence of wet soil (ft), increasing with greater lineal feet of wet soil. A simplistic explanation is that wet soils are more easily eroded than dry soils. An alternative explanation is that trails with substantial amounts of wet soils also share some other attribute (e.g. soil texture or reduced tread drainage) that increase their susceptibility to erosion.

The amount of trail use (visitors/day) was the final variable included, indicating that more heavily used trails are more severely eroded. Many of the most severely eroded trails have been popular for many decades and the erosion of soil is a cumulative process.

Interestingly, the number of water bars was initially included in the equation with a strong positive correlation. This was not interpreted as a cause-and-effect relationship, that more erosion occurs on those trail segments with higher numbers of water bars. Rather, we expect that trail maintainers concentrate the placement of water bars on trails with obvious erosion. In instances such as these, the variable exhibiting a "spurious" relationship was manually removed and the analysis was run again. These variables, as well as those automatically excluded from each regression equation, are listed on the right side of Table 82.

Excessive Root Exposure. Only two independent variables were included in the regression equation, explaining 38% of the variation in excessive root exposure (Table 82). The most strongly correlated variable was amount of trail use, most likely for the same reasons described for soil erosion. Inclusion of the *negatively correlated* (see sign of T Value) lower-slope geographic position variable indicates that *less* root exposure occurs on trails occupying drainage-bottom landform positions. Possible explanations are that soil deposition occurs more commonly than erosion in this landform position and/or that soils and their roots are deeper than in upper- or mid-slope positions.

Excessive Width. Four independent variables were selected by the multiple regression analysis for excessive width, explaining nearly two-thirds (65%) of the variation in this dependent variable. Wet soil (ft/mi) is the most significant predictor of excessive width. Field observations indicate that both hikers and horse users often go around the edges of mudholes and mucky soils, thus widening treads. Next in importance was excessive grade (ft/mi), perhaps from individuals picking alternative routes up and down steep and treacherous slopes. Trail widening was also positively correlated with percent horse use, indicating that trail



Table 82. Multiple regression results with trail condition parameters as dependent variables.

| Dependent Variable: Soil Erosion (ft/mi)                         |                          |  |
|--|--------------------------|--|
| Independent Variables Included in Equation                       |                          | Independent Variables Excluded   |
| Position: Upper-Slope  | T Value: 3.43 Sig: .001  | Horse Use (%); Position: Lower-, Mid-Slope; Elevation Change (ft/mi); Road/Trail; Wet Soil (ft/mi); Running Water on Trail (ft, ft/mi); Graveled Tread (ft, ft/mi); Excessive Grade (ft, ft/mi); Drainage Dips (#, #/mi, effect.); Water Bars (#, #/mi, effect.); Tread Drainage (#, #/mi, effect.)    |
| Wet Soil (ft)  | T Value: 2.69 Sig: .010  |  |
| Amt. of Use (visitors/day)                                       | T Value: 1.83 Sig: .074  |  |
| Regression Equation  | F Value: 6.76 Sig: .001  |  |
| Variation in Dependent Variable Explained (R <sup>2</sup> ): 29% |                          |  |
| Dependent Variable: Excessive Root Exposure (ft/mi)              |                          |  |
| Independent Variables Included in Equation                       |                          | Independent Variables Excluded   |
| Amt. of Use (visitors/day)                                       | T Value: 5.33 Sig: .000  | Horse Use (%) Position: Mid-, Upper-Slope; Elevation Change (ft/mi); Road/Trail; Wet Soil (ft, ft/mi); Running Water on Trail (ft, ft/mi); Graveled Tread (ft, ft/mi); Excessive Grade (ft, ft/mi); Drainage Dips (#, #/mi, effect.); Water Bars (#, #/mi, effect.); Tread Drainage (#, #/mi, effect.) |
| Position: Lower-Slope  | T Value: -1.94 Sig: .058 |  |
| Regression Equation  | F Value: 15.05 Sig: .000 |  |
| Variation in Dependent Variable Explained (R <sup>2</sup> ): 38% |                          |  |
| Dependent Variable: Excessive Width (ft/mi)                      |                          |  |
| Independent Variables Included in Equation                       |                          | Independent Variables Excluded   |
| Wet Soil (ft)  | T Value: 9.20 Sig: .000  | Amount of Use (visitors/day); Position: Lower-, Upper-Slope; Elevation Change (ft/mi); Road/Trail; Wet Soil (ft/mi); Running Water on Trail (ft, ft/mi); Graveled Tread (ft, ft/mi); Excessive Grade (ft); Soil Erosion (ft, ft/mi); Root Exposure (ft)  |
| Excessive Grade (ft/mi)  | T Value: 2.99 Sig: .004  |  |
| Horse Use (%)  | T Value: 2.19 Sig: .032  |  |
| Root Exposure (ft/mi)  | T Value: 2.16 Sig: .035  |  |
| Position: Mid-Slope  | T Value: -2.13 Sig: .037 |  |
| Regression Equation  | F Value: 24.33 Sig: .000 |  |
| Variation in Dependent Variable Explained (R <sup>2</sup> ): 65% |                          |  |

-- continued --

Table 82. continued.

| Dependent Variable: Wet Soil (ft/mi)                     |                          |   |
|--|--------------------------|---|
| Independent Variables Included in Equation               |                          | Independent Variables Excluded  |
| Running Water on Trail (ft)                              | T Value: 3.40 Sig: .001  | Amount of Use (visitors/day); Position: Mid-, Upper-Slope; Elevation Change (ft/mi); Road/Trail, Running Water on Trail (ft/mi), Graveled Tread (ft, ft/mi); Soil Erosion (ft/mi); Drainage Dips (#, #/mi, effect.), Water Bars (#, #/mi, effect.), Tread Drainage (#, #/mi, effect.) |
| Horse Use (%)  | T Value: 2.61 Sig: .011  |   |
| Position: Lower-Slope                                    | T Value: 2.58 Sig: .012  |   |
| Soil Erosion (ft)  | T Value: 2.06 Sig: .044  |   |
| Regression Equation                                      | F Value: 8.18 Sig: .000  |   |
| Variation in Dependent Variable Explained ( $R^2$ ): 33% |                          |   |
| Dependent Variable: Multiple Trails (ft/mi)              |                          |   |
| Independent Variables Included in Equation               |                          | Independent Variables Excluded  |
| Wet Soil (ft/mi)   | T Value: 3.35 Sig: .001  | Amount of Use (visitors/day); Position: Mid-, Upper-Slope; Elevation Change (ft/mi); Road/Trail; Wet Soil (ft); Running Water on Trail (ft, ft/mi); Excessive Root Exposure (ft); Graveled Tread (ft, ft/mi); Excessive Grade (ft/mi); Soil Erosion (ft, ft/mi)                       |
| Root Exposure (ft/mi)                                    | T Value: 2.96 Sig: .004  |   |
| Horse Use (%)  | T Value: 2.80 Sig: .007  |   |
| Position: Lower-Slope                                    | T Value: -2.59 Sig: .012 |   |
| Excessive Grade (ft)                                     | T Value: 1.78 Sig: .079  |   |
| Regression Equation                                      | F Value: 6.72 Sig: .000  |   |
| Variation in Dependent Variable Explained ( $R^2$ ): 34% |                          |   |

widening is most extensive on trails predominantly used by horses. The inclusion of the positively correlated excessive root exposure (ft/mi) indicates that trail users trying to circumvent sections with exposed tree roots contribute significantly to trail widening. Negatively correlated mid-slope geographic position was the final variable included. Trails in this position typically have steep sideslopes that inhibit trail widening. In contrast, trails along the ridgetops and streams more often have less steep sideslopes that permit trail widening problems to develop.

**Wet Soil.** Four variables were included in the regression equation for wet soil (ft/mi), explaining 33% of the variation. The most significant variable included, running water on trails (ft), indicates that problems with wet soils are exacerbated when trails intercept water from springs and seeps. Channeling moving water directly across and off of treads should become a higher maintenance priority. Inclusion of the positively correlated percent horse use

variable indicates that wet soils are more prevalent on trails with larger percentages of horse use. Additional discussion on this topic is included in the following section. A probable explanation for inclusion of the lower-slope geographic position variable is that trails in drainage bottom positions generally have poorly drained or organic soils, making them particularly prone to muddiness. It is also difficult to adequately drain treads traversing flatter terrain. Finally, inclusion of the variable soil erosion (ft) indicates that wet soils are more common on highly eroded trails. Water is difficult or impossible to drain from deeply eroded treads and their compacted soils inhibit water infiltration.

Running Water on Trail. Regression analysis did not yield an equation for this dependent variable. This indicates that none of the independent variables were correlated strongly enough to serve as statistically significant predictors of running water on trails.

Multiple Trails. Regression analysis for multiple trails (ft/mi) yielded five significantly correlated variables and explained 34% of the variation in the dependent variable. Wet soil (ft/mi) was the most significant cause of multiple tread development. Individuals often create new treads that circumvent muddy sections of the primary tread. Severe root exposure that makes walking difficult also induces multiple tread creation. Inclusion of the percent horse use variable indicates that horse use is a significant factor in multiple tread development. Horses often pick their way over difficult terrain and may not follow a single primary tread. Many horses, like hikers, will not walk through deep water or mud, thus contributing to multiple trail development. Finally, some riders will ride side-by-side when the terrain and vegetation allow it, for conversational purposes. Inclusion of the negatively-correlated lower slope position variable indicates that there are fewer multiple tread problems on trails within this landform position. One explanation is that tread widening rather than multiple tread creation is the most common response for circumventing main tread problems on flatter terrain. Finally, treads with excessive grades contribute to the formation and use of alternative routes.

In summary, the regression analyses provide additional insight into the factors contributing to various types of trail degradation. These analyses suggest that entirely different sets of factors contribute uniquely to each type of trail impact. Furthermore, by addressing problems such as wet or eroded soils, managers should be able to reduce other forms of impact, including trail widening and multiple treads. For example, wet soils significantly contribute to soil erosion, trail widening, and multiple trail development. A final general conclusion is that trails in lower-slope geographic positions appear to be particularly vulnerable to a number of problems. Trails that closely parallel streams often have poorly drained soils and traverse flatter terrain that makes tread drainage difficult. Wet soils are quickly churned into mud, particularly by heavy horse use. In many cases these problems will be effectively avoided only through trail relocation. The option of relocating particularly troublesome trails to lower valley wall positions should be investigated further. Such positions likely have well-drained soils and the greater cross-slopes would facilitate tread drainage and discourage trail widening and the creation of multiple treads. Reducing trail use, particularly horse use, is another option. Increased tread maintenance for such trails, short of tread gravelling, does not appear to offer an effective solution.



### Evaluation of Trail Use Type

Due to recent interest and concern regarding horse use and its environmental impacts, some additional discussion specific to this issue is included. The regression analyses suggest that trail use type (percentage of pedestrian versus horse use) is an important predictor for wet soil, excessive width, and multiple trails. The percentage of trail horse use was positively correlated with each of these forms of trail impact. Survey results and observation reveal that the most pronounced horse-related problems are associated with the creation of muddy soils. The wet muddy soils characteristic of many of the park's horse trails appear to be a direct result of the horse use, rather than a coincidental occurrence.

Other studies have shown that the tremendous weight of horses and riders, supported by the relatively small surface area of hoofs, tends to punch through damp surface soils and cause significant compaction to the underlying soils. Water infiltration is greatly reduced while the deep hoof-prints tend to collect and retain water long after rains. Furthermore, the loose, uncompacted surface soils more easily form mud than compacted soil. These events explain the formation of the mudholes and extensive muddy quagmires common to many of the park's horse trails. Nearly all hikers and many horses seek to circumvent areas with water or deeper mud, resulting in a cumulative process of trail widening. Trail widening around muddy sections in excess of 12 feet are not uncommon on some trails in the Cataloochee area.

In contrast, foot traffic tends to compact surface soil layers, reducing water infiltration and increasing surface runoff. As a result, trails in drainage bottom locations can often support hiker use with minimal degradation. The Abram's Falls Trail provides perhaps the best model for a drainage bottom trail that lacks problems associated with wet soils. In spite of numerous occurrences of water on the trail, the survey revealed no instances of wet soil. This is likely attributable to its lack of horse use and higher placement above the creek.

Horse use on the Appalachian Trail within the park is somewhat conspicuous as the trail was envisioned by Benton MacKay in 1921 and designated by Congress in 1968 as a "footpath". Portions of the Appalachian Trail through GSMNP are the only sections of this 2,000 mile footpath where horse use is permitted. Data allowing comparison of resource conditions among the Appalachian Trail segments open to horse use (N=5) and restricted from horse use (N=6) are presented in Table 83. The small sample size prohibits statistical testing.

The most severely impacted segment is from Newfound Gap to the Icewater Springs shelter. This segment is restricted to pedestrians but its level of use is over four times higher than any other AT segment. The next two most heavily used segments, False Gap to Icewater Springs and Newfound Gap to Clingman's Dome, are also pedestrian trails. The remaining trails are more comparable as they have similar levels of use. The most highly impacted of these segments is the Spence Field to Doe Knob segment, for which four of the six types of trail impact are relatively high. Horse use is quite high for a portion of this segment, from Spence Field to Russell Field, and moderate from Russell Field to Mollies Ridge. Resource impacts for the entire Spence Field to Doe Knob segment are considerably higher than for the immediately preceding Miry Ridge to Spence Field segment, which is restricted to pedestrians.



Table 83. Comparison of resource conditions for segments of the Appalachian Trail.

| Trail Segment                           | Horse Use (%) | Avg. Use (Persons /Day) | Soil Erosion | Root Exposure | Excessive Width | Wet Soil | Water on Trail | Multiple Treads |
|---|---------------|-------------------------|--------------|---------------|-----------------|----------|----------------|-----------------|
|   |               |                         | ft/mi        |               |                 |          |                |                 |
| <i>Davenport Gap to Tricorner Knob</i>  | 20            | 13.4                    | 211          | 18            | 11              | 45       | 30             | 96              |
| <i>Tricorner Knob to Pecks Corner</i>   | 30            | UK                      | 254          | 15            | 11              | 89       | 15             | 48              |
| <i>Pecks Corner to False Gap</i>        | 0             | 9.3                     | 0            | 0             | 0               | 0        | 0              | 0               |
| <i>False Gap to Icewater Springs</i>    | 0             | 35.2                    | 285          | 58            | 4               | 6        | 71             | 18              |
| <i>Icewater Springs to Newfound Gap</i> | 0             | 156.4                   | 1211         | 319           | 14              | 59       | 0              | 219             |
| <i>Newfound Gap to Clingman's Dome</i>  | 0             | 6.0                     | 626          | 32            | 0               | 444      | 25             | 3               |
| <i>Clingman's Dome to Siler's Bald</i>  | 0             | 30.2                    | 1166         | 0             | 5               | 401      | 0              | 70              |
| <i>Siler's Bald to Miry Ridge</i>       | 10            | UK                      | 429          | 0             | 0               | 183      | 0              | 13              |
| <i>Miry Ridge to Spence Field</i>       | 0             | 14.8                    | 247          | 0             | 13              | 69       | 0              | 144             |
| <i>Spence Field to Doe Knob</i>         | 30            | 17.4                    | 804          | 0             | 227             | 183      | 0              | 158             |
| <i>Doe Knob to Fontana Dam</i>          | 10            | 16.6                    | 128          | 0             | 0               | 4        | 0              | 52              |

### Comparison to Other Studies

Scientific research on trail condition assessment is relatively limited and few standardized methods have been developed or adopted. The most common survey approaches employ a sampling framework whereby trail conditions are characterized by measurements taken only at fixed intervals along a trail's length. This is an efficient approach if the goal is to conduct relational analyses to evaluate the effects of environmental attributes on trail condition. However, such approaches do not provide data on the number, location, or lineal extent of specific trail problems (e.g. severely eroded or muddy segments) or on design and maintenance features (e.g. excessive grades or water bars). Furthermore, unless sampling is intensive, estimates of aggregate change will be inaccurate.

The survey methods developed and applied in this study sought to provide standardized data on trail condition and design and maintenance feature attributes important to park managers while retaining the efficiency typical of sampling approaches. Unfortunately the diversity of methods, including differences in how specific trail problems are defined, limit comparability among studies.

The most extensive trail surveys ever conducted in a U.S. National Park or National Forest were those conducted by Bratton, Hickler, and Graves (1978a 1978b 1978c) within GSMNP. Their survey relied on trail condition measurements taken every 1/3rd mile along all of the park's maintained trails (about 745 miles). The percentage of each 1/3rd mile segment affected by water erosion, mud, rutting, exposed roots, and other attributes was also estimated. These estimates improve comparability with the current study, though definitions differed. For example, their study found that 15% of the total trail mileage had obvious erosion while 9% were rutted more than about four inches. The current survey focused on more severe erosion, finding that 4.5% of the trail surfaces were rutted more than one foot, 0.7% more than two feet, and 0.4% more than three feet. In the Bratton study, exposed roots were estimated at 9% of the trail miles; no definition was provided. The current survey focused on more severe root exposure (tops and sides of tree roots exposed), finding only one percent of the trails exhibiting this degree of tree root exposure. Finally, the Bratton study found five percent of the trails to be muddy while the current study described 3.5% as muddy and 1.0% with running water on the tread.

Comparisons of the relative rankings of trail conditions by geographic areas are more appropriate and indicate some interesting similarities and differences. For example, in 1976, soil erosion was most pronounced on trail segments in the Mount LeConte area and along the Appalachian Trail. In the current survey, eight of the 13 most highly eroded trail segments lie within these areas. The Appalachian Trail and trails in the Cataloochee area were the muddiest in 1976. In 1993, eight of the ten muddiest trail segments lie within these areas, though only two were Appalachian Trail segments. Improved maintenance may explain the apparent reduction in muddiness on the AT, an action that would be far less effective in the Cataloochee area where muddiness is due primarily to poor trail design and heavy horse use. Impacts from horses in 1976 were greatest in the Mount LeConte, Cades Cove, and Cataloochee areas. The park prohibited commercial liveries from overnighting on Mount LeConte in the late 1970's and the Rainbow Falls Trail was restricted to hikers in the late 1980's. However, the Rainbow Falls Trail remains in poor condition, particularly with respect to soil erosion and multiple treads.

In 1984, Renfro (1985) conducted a survey of the Appalachian Trail through the park. Comparisons with this survey are limited; a point sampling approach was used and data were not presented for all AT segments, which were also defined differently. Nevertheless, a limited comparison of the best and worst segments are possible. In 1984, the most impacted AT segment was Newfound Gap to Charlie's Bunyon. A portion of this segment remains the most highly impacted for three of the six condition attributes employed in the current survey (Table 83). However, the least impacted AT segment in 1984 was Buckeye Gap (Miry Ridge) to Silers Bald. In 1993, this segment was intermediate in condition for three of the six condition attributes.

## CONCLUSION AND RECOMMENDATIONS

### Research Products and Potential Management Applications

This research study was initiated in response to growing concerns over the deteriorating conditions of trail resources in GSMNP. An innovative rapid trail survey methodology was developed and applied to 72 trail segments, including 328 miles of backcountry trails. This large sample represents 25% of the park's trail segments and 35% of the park's trail mileage, and is broadly representative of the diversity of trail conditions and the factors affecting those conditions. The study has produced a number of products, including:

- a database printed as an addendum to this report containing 12,733 records of information documenting the condition and existing maintenance features of all surveyed trails (also accessible through menu-driven programming),
- this management report, containing a review of the literature, research methods, presentation of survey results (by trail and for various groupings of trails), analysis of factors contributing to trail degradation, and recommendations.

A doctoral dissertation, providing more comprehensive analysis of the data, and several articles in the scientific literature are planned future products.

These products provide park managers with objective, standardized data describing the condition of park trails and their existing maintenance features. This information has potential applications to three areas of trail management:

Trail planning - Survey information could be used in trail planning activities to describe existing trails and factors contributing to trail resource impacts. A more thorough understanding of trail degradation processes can improve trail maintenance, reroute locations, and the management of amount and type of use.

Trail maintenance - Survey information could be used to identify trail maintenance needs, direct on-the-ground maintenance activities, set priorities or apportion funding and staffing among park districts, and justify budget and staffing initiatives for additional trail management activities.

Trail management decision making - Survey information could be used to guide and justify the selection of alternative trail management decisions. If replicated, survey information could serve a monitoring function to identify trends and evaluate the success of management actions.

## Summary of Principal Findings

### Inventory Parameters

Trails comprised the majority of the sampled trail system mileage (85%, 278 miles), and approximately half of the remaining 48 miles of backcountry roads have effectively narrowed to trail width. Most of the sampled trails (50, 69%) are open to both hikers and horse users, including 291 (67%) of the sampled trail miles.

### Resource Condition Parameters

Soil Erosion - With respect to total lineal feet per mile of trail, soil erosion is the most common form of resource impact. Soil erosion exceeding one foot below the estimated post-construction tread surface averages 239 feet per mile, evident on 14.6 of the 382 sampled miles (4.5%). The most severely eroded trails include the Bote Mountain Jeep Trail (2,201 feet/mile) and the Rainbow Falls Trail (1,955 feet/mile). Trails in the Cataloochee Ranger subdistrict and the Oconaluftee Maintenance subdistrict have the highest soil erosion averages, 316 and 383 feet per mile, respectively. According to regression results, soil erosion can be minimized by improving tread drainage, particularly on trails occupying ridgetop or upper-slope geographic positions. Reducing use or increasing maintenance on the most popular trails may also be effective.

Root Exposure - Excessive root exposure on trail treads averages 53 feet per mile, affecting 2.44 miles of trail and 1% of the surveyed trail miles. Root exposure is greatest for the Albright Grove Loop (345 feet/mile) and the Trillium Gap Trail (324 feet/mile). By subdistrict, root exposure is greatest in the Little River Ranger subdistrict (102 feet/mile) and the Cosby Maintenance subdistrict (97 feet/mile). Regression analyses suggest that root exposure can be minimized by reducing the use of or rerouting trails in drainage bottom positions.

Excessive Width - Tread widths exceeding three feet wider than is typical for adjacent treads were observed on a total of 2.23 miles of trail (0.7%). This is the least common form of resource impact, with an average of only 38 feet per trail mile. Excessive width is greatest for the Mount Sterling Ridge (400 feet/mile) and Long Bunk (369 feet/mile) Trails. Excessive width is also greatest for trails in the Cataloochee Ranger (120 feet/mile) and the Cataloochee Maintenance (158 feet/mile) subdistricts. Regression analyses reveal that this form of impact can be reduced most effectively by improving tread drainage, rerouting segments to avoid excessive grades and severely rutted treads, and reducing horse use. Education of horse riders, encouraging them to avoid trail widening practices, may also be effective. However, it should be recognized that some horses will simply not walk through deep mud or that it may be unsafe to force use of severely rutted treads.

Wet Soil - Wet, muddy soils are the second most common form of resource impact, averaging 184 feet per mile and affecting 11.3 miles (3.5%) of the surveyed mileage. Trails with the muddiest treads include the Long Bunk (3,524 feet/mile) and Little Cataloochee (1,618 feet/mile) Trails. Wet Soil is greatest (and exceptionally high) for trails in the Cataloochee



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## Conclusion and Recommendations

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Ranger (771 feet/mile) and the Cataloochee Ranger (1,041 feet/mile) subdistricts. Based on regression analysis results, wet soil can be reduced by correcting problems with running water (from seeps and streams) on trail treads, reducing or eliminating horse use from trails with wet soils, reducing use on or rerouting trails in drainage bottoms or with severely rutted treads. Seasonal trail use restrictions or closures during wet weather, particularly for horse use, offer another potentially effective management action.

Running Water on Trail - Running water on trails, typically from small springs and seeps, averaged 54 feet per mile on the sampled trails. However, there were 227 occurrences of running water with a cumulative lineal distance total of 2.6 miles. This problem is greatest on the Forney Ridge (1,016 feet/mile) and Little Cataloochee (244 feet/mile) Trails. Similarly, running water is most common in the Oconaluftee Ranger (218 feet/mile) and the Oconaluftee Maintenance (151 feet/mile) subdistricts. Running water on trails can be most effectively reduced by focusing trail maintenance efforts on this problem and, where necessary, rerouting trails from drainage bottom positions.

Multiple Treads - A total of 6.4 miles of multiple or parallel treads were recorded, including 1.8% of the sampled miles for an average of 96 feet per mile. Multiple treads are most common on the Rainbow Falls (1080 feet/mile) and the Lead Cove (448 feet/mile) Trails. With respect to subdistricts, multiple trails are most common on trails in the Cataloochee Ranger (122 feet/mile) and the Cataloochee Maintenance (148 feet/mile) subdistricts. Multiple treads are most effectively addressed by improving tread drainage, rerouting trail segments with severe root exposure or excessive grades, and reducing horse use, according to regression analyses. User education for horse riders, as discussed under excessive width, is another alternative.

### Design and Maintenance Parameters

Eight percent (23.39 miles) of the surveyed trail mileage consists of graveled treads, presumably backcountry roads graveled a long time ago. More significantly, trail grades in excess of 20% exist in 131 locations, including 4.91 miles of trail. Such steep grades reflect poor trail design and are often associated with excessive soil erosion.

Tread drainage is the most critical trail maintenance action, affecting most forms of trail impact. A total of 4,137 drainage dips and 3,804 water bars were observed for a total of 7,941 tread drainage features (25.3/mile). Effectiveness ratings reveal that water bars are more effective than drainage dips, although many factors other than their actual effectiveness influence these data. Both density and effectiveness of tread drainage features vary considerably among park Ranger and Maintenance subdistricts and trails. Tread drainage feature density is highest in the Cosby Ranger subdistrict (37.4/mile) and the Cosby Maintenance subdistrict (36.0/mile). Tread drainage feature effectiveness appears to be highest in the Cades Cove Ranger subdistrict and the Oconaluftee Maintenance subdistrict.

### Appalachian Trail Results

Survey findings summarized for the Appalachian Trail reveal that soil erosion is the most pervasive type of impact. A total of 300 occurrences (4.7/mile) of soil erosion exceeding one foot below the estimated post-construction tread surface were noted, affecting 5.72 miles of trail and 8% of the AT mileage. This degree of soil erosion is the only type of impact exceeding the surveywide averages. However, tread drainage features are fairly numerous on the AT, compare 32.1 per trail mile to the surveywide average of 25.3 per mile. Soil erosion appears to be a result of heavy use over long periods of time, combined with high rainfall on exposed ridgetop positions and a number of excessively steep grades. Horse use also appears to be a contributing factor to impacts in areas receiving the heaviest use.

### Trail Use Type Results

Evaluations of trail use type, pedestrian versus horse/pedestrian trails, reveal statistically significant correlations between the percentage of horse use on trails and the extent of wet soil, excessive tread width, and development of multiple treads. Horse use contributes to the formation of muddy soils on trails by compacting and reducing water infiltration of subsurface soils, and by churning up surface soils which then retain water and form mud. In contrast, the lighter weight of hikers tend to compact surface soils, reducing water infiltration and increasing water runoff at the surface. Consequently, wet soils such as occur in drainage bottoms can often support some degree of foot traffic but horse traffic quickly results in the formation of muddy quagmires. Horses also contribute to the expansion of tread widths and creation of multiple treads because they seek to avoid excessively muddy or rutted treads. Educational efforts for horse riders may help to resolve these problems though horses may simply refuse the urgings of their riders. Additionally, forcing horses to traverse treads with precarious footing raises issues of visitor and horse safety.

## Recommendations

### Trail Planning

Many of the resource problems identified by the trail surveys can be traced to poor original trail placement and design. In particular, significant trail mileage occurs in drainage bottom positions, most of which are open to horse use. Many of these trails closely parallel streams with their associated poorly drained and organic soils. While foot traffic may be sustainable on such trails, horse traffic is problematic. Continued maintenance, at existing or increased levels, will not be a cost effective solution. Where possible, relocations to old graveled roadbeds or sideslopes just above valley bottoms will yield trails that can sustain use with considerably less resource degradation and maintenance. Additionally, many trails have numerous segments with excessively steep slopes, greatly increasing their susceptibility to soil erosion. Continued use of trails with significant resource deficiencies can lead to rapid and unnecessary resource impairment. Over the long term these problems are most effectively addressed through trail reroutes.

Letters to the park and other expressions of public sentiment appear to indicate a growing concern over the impacts of horse use to both the physical resource and the experiences of hikers. Park managers are also concerned with the expense of maintaining a large trail system that reflects a haphazard collection of inherited and often poorly planned routes. A comprehensive analysis of all routes, resource capabilities, intended purposes, and potential linkages for circuit routes is needed.

**Recommendation 1:** Conduct a comprehensive evaluation of the park's trail system that begins with the resource capabilities and deficiencies of trails to support appropriate types and amounts of use. A variety of other factors, including intended purposes, linkages, existing tread conditions, elevation gain/loss, scenic attractions, sensitive natural or historic sites, and others should also be evaluated. The scope of the review should include existing used, unused, and entirely new routes. Public involvement should be sought and integrated with management policies, concerns, and capabilities in the formulation of a revised trail system.

### Trail Maintenance

Survey results revealed some significant problems in trail resource conditions. Specifically, the survey found 734 occurrences of excessive soil erosion totaling nearly 15 miles of trail and 752 occurrences of wet or muddy soil totaling 11 miles of trail. Other resource impacts, such as multiple trails and excessive width, while not common, were nonetheless extensive on some trails. These problems, to varying degrees, both threaten and compromise park management objectives for resource protection, visitor enjoyment, and visitor safety.

A permanent well-funded and well-staffed trail maintenance program is absolutely essential to ensuring the ability of trails to sustain their intended types and amounts of use. The park's trail system provides the only transportation routes in the backcountry, essential to both visitor use and resource protection activities. An ongoing program of maintenance is needed to keep the travel corridors free of vegetation and treefalls, ensuring access throughout the year. An

ongoing program of maintenance is also needed to ensure good tread drainage, removing water from trails as quickly as possible to prevent soil erosion and the formation of muddy soils. Soil erosion is a cumulative process; neglecting trail maintenance when budgets are tight leads to significant short-term impacts, such as stream sedimentation. Long-term impacts, such as badly rutted treads, are unsafe and can lead to additional impacts, such as trail widening and multiple treads.

Trail maintenance is *not* a substitute for good trail positioning and layout, hence the need to address current environmental deficiencies in a comprehensive trail system evaluation. Over the long run it is far more effective and less costly to relocate trails or uses to alternative routes than to continue maintaining trails with significant environmental deficiencies.

Survey data reveal that the degree of trail maintenance, particularly tread drainage features, vary considerably among park Ranger and Maintenance subdistricts and trails. This is not surprising as maintenance efforts should correspond to resource conditions, with more effort expended on trails in poorer condition. However, a review of the individual trail summaries reveal little correlation between the density of tread drainage features and problems such as wet or eroded soils. For example, the Long Bunk Trail, with excessive soil erosion over 12% and wet soil over 67% of its length, has only 10.2 drainage features per mile. Furthermore, survey data for longer and more remote trails reveal a decreasing density of drainage features with increasing distance from access points. The need for at least some seasonal field-based trail maintenance crews is evident.

**Recommendation 2:** Substantially strengthen the existing trail maintenance program with additional permanent, seasonal, and volunteer staff. Review survey data and initiate formal trail maintenance surveys (see Table 2) to provide objective information necessary to direct needed trail work. Establish roving seasonal field-based maintenance crews to address more intensive maintenance needs in remote locations.

### Trail Management Decision Making

Trail resource conditions are the result of inherent resource capabilities, initial trail design and ongoing maintenance, and type and amount of trail use. Park managers have broad influence over numerous individual factors under each of these three general categories. Selecting which factors to influence depends on management policies, objectives, and capabilities, an understanding of the interrelationships between factors affecting trail conditions, and a decision making framework that both guides and supports management decisions. A comprehensive review of NPS and park management policies and objectives is provided in a proposal titled "Justification for Implementing a Backcountry Campsite and Trail Monitoring Program for Great Smoky Mountains National Park" by Marion (1994). This review concludes that existing park policies and objectives emphasize a carrying capacity approach with restrictions on visitation for addressing resource protection concerns. As previously noted, both research and management experience in other areas have shown that a focus on visitor numbers often misdirects management attention from other factors, such as trail relocations and maintenance, that could be more influential.



The past decade has seen significant experimentation with new management frameworks based on objectives, resource and social indicators and standards, routine monitoring, and decision processes that emphasize a diversity of management options. The U.S. Forest Service pioneered the leading framework known as the Limits of Acceptable Change (LAC), while similar frameworks have been developed by the National Parks and Conservation Association (Visitor Impact Management, VIM) and the Denver Service Center (Visitor Experience and Resource Protection, VERP). Over a dozen parks from across the service are beginning to adopt these new frameworks, including a number of large National Parks: Grand Canyon, Grand Teton, Glacier, and Shenandoah.

**Recommendation 3:** Review and consider the adoption of the new LAC management frameworks through incorporation into a revised Backcountry Management Plan. Implement a formal program of trail resource monitoring to provide decision makers with standardized and reliable information on trail conditions.

### Park Organization

Responsibilities for trail planning and management are currently spread across four park divisions: Ranger Activities, Maintenance, Resource Management and Science, and Visitor Services. Coordination has been provided through the Backcountry Use Committee, though the Appalachian Trail Advisory Committee provides input regarding issues associated with the AT. No single individual has responsibility for planning and management of the park's backcountry and proposed wilderness, though such areas account for 93% of park acreage. Furthermore, a recent reorganization within the Ranger Activities Division removed District level Backcountry Ranger positions. GSMNP has one of the largest trail systems of any National Park and its backcountry overnight visitation, at approximately 90,000 visitors annually, is sixth highest within the National Park system. The professional management of the park's backcountry and proposed wilderness, including 930 miles of trail, 105 designated campsites and shelters, heavy day and overnight visitation, and complex visitor, resource, and facility management issues, requires full-time staffing.

**Recommendation 4:** Reorganize/hire park staff to establish one or more full-time permanent backcountry management positions. These staff should have specialized expertise and extensive experience in backcountry and wilderness management. Backcountry staff should have direct or indirect supervisory authority over all other park staff whose jobs relate to the backcountry (e.g. permit writing, trail and campsite maintenance, and visitor contact/law enforcement).

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# APPENDIX 1

## Listing of Surveyed Trails

| Geographic Area and Trail Name                | Trail Code | Type of Use <sup>1</sup> | Length (mi) | Elevation Change (ft) |
|---|------------|--------------------------|-------------|-----------------------|
| <b>Appalachian Trail Corridor</b>             |            |                          |             |                       |
| A.T.: Davenport Gap -> Tricorner Knob Shelter | ATE1       | H/P                      | 16.04       | 10400                 |
| A.T.: Tricorner Knob Shelter -> Pecks Corner  | ATE2       | H/P                      | 5.19        | 3600                  |
| A.T.: Pecks Corner -> False Gap               | ATE3       | P                        | 3.90        | 1300                  |
| A.T.: False Gap -> Icewater Spring Shelter    | ATE4       | P                        | 3.80        | 2500                  |
| A.T.: Icewater Spring Shelter -> Newfound Gap | ATE5       | P                        | 3.06        | 1400                  |
| A.T.: Newfound Gap -> Clingman's Dome         | ATW6       | P                        | 7.87        | 4200                  |
| A.T.: Clingman's Dome -> Siler's Bald         | ATW7       | P                        | 4.42        | 2600                  |
| A.T.: Siler's Bald -> Miry Ridge              | ATW8       | H/P                      | 3.11        | 1400                  |
| A.T.: Miry Ridge -> Spence Field              | ATW9       | P                        | 9.00        | 7300                  |
| A.T.: Spence Field -> Doe Knob                | ATW10      | H/P                      | 7.70        | 4000                  |
| A.T.: Doe Knob -> Fontana Dam                 | ATW11      | H/P                      | 6.87        | 5100                  |
| <b>Big Creek Area</b>                         |            |                          |             |                       |
| Low Gap: Big Creek segment                    | BC53       | H/P                      | 2.74        | 1400                  |
| Swallow Fork                                  | BC57       | H/P                      | 3.98        | 2800                  |
| <b>Cataloochee Area</b>                       |            |                          |             |                       |
| Mount Sterling Ridge                          | CA60       | H/P                      | 5.38        | 2200                  |
| Pretty Hollow Gap                             | CA61       | H/P                      | 5.50        | 2300                  |
| Palmer Creek                                  | CA63       | H/P                      | 3.30        | 2100                  |
| Rough Fork                                    | CA64       | H/P                      | 6.41        | 2300                  |
| Caldwell Fork Trail                           | CA65       | H/P                      | 6.29        | 2500                  |
| Mount Sterling                                | CA171      | H/P                      | 2.35        | 2000                  |
| Long Bunk                                     | CA232      | H/P                      | 3.54        | 2200                  |
| Little Cataloochee                            | CALCT      | H/P                      | 4.89        | 2600                  |
| <b>Cades Cove Area</b>                        |            |                          |             |                       |
| Hatcher Mountain                              | CC2        | H/P                      | 2.80        | 2000                  |
| Gregory Bald                                  | CC3        | H/P                      | 7.45        | 2100                  |
| Abrams Falls                                  | CC6        | P                        | 4.25        | 2200                  |
| Rich Mountain                                 | CC8        | H/P                      | 2.34        | 1700                  |
| Russell Field                                 | CC10       | H/P                      | 3.52        | 2400                  |
| Anthony Creek                                 | CC11       | H/P                      | 3.51        | 2300                  |
| Rabbit Creek                                  | CC101      | H/P                      | 7.75        | 5400                  |
| Indian Grave Gap                              | CC105      | H/P                      | 2.54        | 1800                  |
| Rich Mountain Loop                            | CC205      | H/P                      | 3.34        | 2600                  |
| Crooked Arm Ridge                             | CC242      | H/P                      | 2.16        | 1900                  |

-- table continued --

1 - H/P = Trail open to horses and pedestrians, P = Trail restricted to pedestrians.

2 - Elevation change determined by counting all contour lines crossed by trail segment and multiplying by the contour interval.



**Appendix 1: Listing of Surveyed Trails**

| Geographic Area and Trail Name              | Trail Code | Type of Use <sup>1</sup> | Length (mi) | Elevation Change (ft) <sup>2</sup> |
|---|------------|--------------------------|-------------|------------------------------------|
| <b>Cosby Area</b>                           |            |                          |             |                                    |
| Maddron Bald: Gabes Mtn to Snake Den Ridge  | CO48       | P                        | 6.35        | 3600                               |
| Snake Den Ridge                             | CO49       | H/P                      | 5.24        | 3300                               |
| Maddron Bald: Boundary to Gabes Mountain Tr | CO131      | P                        | 1.20        | 5000                               |
| Low Gap: Cosby Creek segment                | CO132      | H/P                      | 2.68        | 1800                               |
| Albright Grove Loop                         | CO239      | P                        | 0.66        | 800                                |
| <b>Elkmont Area</b>                         |            |                          |             |                                    |
| Sugarland Mountain                          | EL23       | P                        | 11.86       | 6500                               |
| Huskey Gap                                  | EL24       | P                        | 2.13        | 800                                |
| Goshen Prong                                | EL26       | P                        | 4.43        | 3400                               |
| Jakes Creek                                 | EL27       | H/P                      | 3.28        | 2600                               |
| Cucumber Gap                                | EL237      | P                        | 2.35        | 1700                               |
| <b>Forney Creek Area</b>                    |            |                          |             |                                    |
| Forney Ridge                                | FO90       | P                        | 1.07        | 1000                               |
| Forney Creek                                | FO94       | P                        | 6.98        | 4500                               |
| Jonas Creek                                 | FO95       | H/P                      | 4.12        | 2700                               |
| Noland Creek                                | FO139      | H/P                      | 11.20       | 5900                               |
| Forney Creek Horse                          | FOFC       | H/P                      | 4.45        | 1300                               |
| <b>Hazel Creek Area</b>                     |            |                          |             |                                    |
| Lost Cove                                   | HA104      | H/P                      | 4.33        | 2400                               |
| Welch Ridge                                 | HA148      | H/P                      | 6.43        | 3600                               |
| Lakeshore: Pinnacle Creek segment           | HALS       | H/P                      | 4.02        | 2800                               |
| <b>Mount LeConte</b>                        |            |                          |             |                                    |
| Brushy Mountain                             | GR42       | H/P                      | 4.50        | 2800                               |
| Rainbow Falls                               | LE33       | P                        | 6.61        | 5000                               |
| The Boulevard                               | LE33A      | P                        | 6.60        | 3600                               |
| Huskey Gap                                  | LE35       | P                        | 2.01        | 1300                               |
| Alum Cave                                   | LE38       | P                        | 5.97        | 3600                               |
| Trillium Gap                                | LE39       | H/P                      | 5.27        | 3400                               |
| Chimney Tops                                | LE215      | P                        | 1.16        | 1400                               |
| Grapeyard Ridge                             | LE228      | H/P                      | 7.61        | 5500                               |
| Sweat Heifer Creek                          | OC80       | H/P                      | 4.75        | 2500                               |
| <b>Raven Fork Area</b>                      |            |                          |             |                                    |
| Hyatt Ridge                                 | RA68A      | H/P                      | 4.50        | 3600                               |
| Enloe Creek                                 | RA71       | H/P                      | 3.62        | 2200                               |
| Beech Gap: Balsam Mountain segment          | RA241      | H/P                      | 2.38        | 2300                               |
| Beech Gap: Hyatt Ridge segment              | RA241A     | H/P                      | 2.88        | 2200                               |

-- table continued --

1 - H/P = Trail open to horses and pedestrians, P = Trail restricted to pedestrians.

2 - Elevation change determined by counting all contour lines crossed by trail segment and multiplying by the contour interval.

# Appendix 1: Listing of Surveyed Trails

| Geographic Area and Trail Name | Trail Code | Type of Use <sup>1</sup> | Length (mi) | Elevation Change (ft) <sup>2</sup> |
|--------------------------------|------------|--------------------------|-------------|------------------------------------|
| <b>Tremont Area</b>            |            |                          |             |                                    |
| Turkey Pen Ridge               | TR13       | H/P                      | 3.57        | 1100                               |
| Panther Creek                  | TR18       | H/P                      | 2.24        | 2000                               |
| Lynn Camp Prong                | TR20       | H/P                      | 3.65        | 1700                               |
| Miry Ridge                     | TR21       | H/P                      | 4.97        | 2800                               |
| West Prong                     | TR111      | H/P                      | 3.33        | 1800                               |
| Bote Mountain                  | TR113      | H/P                      | 5.19        | 2800                               |
| Bote Mountain Jeep             | TR113A     | H/P                      | 1.70        | 1200                               |
| Middle Prong                   | TR115      | H/P                      | 3.94        | 1900                               |
| Lead Cove                      | TR206      | H/P                      | 1.78        | 1700                               |
| Finley Cane                    | TR207      | H/P                      | 2.74        | 900                                |

1 - H/P = Trail open to horses and pedestrians, P = Trail restricted to pedestrians.

2 - Elevation change determined by counting all contour lines crossed by trail segment and multiplying by the contour interval.

## APPENDIX 2

### Great Smoky Mountains National Park Trail Assessment Manual

This manual describes trail assessment procedures designed to gather three general types of trail information. *Inventory Parameters* are included to provide general descriptive information about trail segments (e.g. tread width and trail use type). *Resource Condition Parameters* are included to provide standardized quantitative information about the type and extent of resource impacts on trails (e.g. soil erosion, wet soil, multiple treads). *Design and Maintenance Parameters* are included to document the number and effectiveness of trail maintenance features (e.g. drainage dips and water bars). An *Attraction Feature Parameter* is included to provide information about significant natural or cultural features. The objective of this manual is to describe a standardized set of procedures for assessing parameters under each of these categories using a rapid survey approach.

The trail survey approach described is designed to provide park managers with standardized, quantitative, and reliable information describing trail segments, their condition, and existing maintenance features. Such information can be used to characterize different trail segments in terms of a variety of attributes, resource condition (impact), and maintenance features. Managers may find this information valuable in preparing and justifying trail management actions and trail maintenance budget and staffing requests. Data on individual trails may also be used to direct trail maintenance activities or to set priorities for needed work. The trail survey information can also be analyzed to describe relevant environmental, managerial, and use-related factors influential to trail conditions. Managers may find this information valuable in trail management decision making, including use in Limits of Acceptable Change frameworks, and in the selection of resistant and resilient locations for new trails or trail re-routes. Finally, trail survey information can be compared to data from future assessments (using the same procedures) for monitoring purposes: identifying trends in trail condition and evaluating the effectiveness of implemented management actions.

Trail survey procedures were designed to be efficient, accurate, and precise. Efficiency refers to the ease of application and amount of staff time necessary. Accuracy refers to how close our measurements are to the "true" values, if we had unlimited time to take more careful or scientific measurements. And precision refers to our ability to get the same results if we had many different crews apply the same measurements to the same trail segment.

Only selected trail segments are assessed (the sample) but observations are made along the entire length of the surveyed trail segments. The rapid survey approach is conducted by two field staff who push a measuring wheel along the trail while observing and recording codes and measurements for all occurrences of the specified set of parameters. This manual provides detailed procedures describing each parameter and how it is to be assessed. Predefined codes are included to make field data recording and computer entry more efficient. A standard Trail Survey Form contains columns for recording parameter codes, cumulative distances from the beginning of the segment, and, where necessary, descriptive comments. Computer programs have been developed to enter, store and analyze the recorded information.

**Materials:** USGS topographic maps (1/24,000)  
Measuring wheel  
Clinometer  
Tape measure, 100 foot (marked in tenths)  
Camera, 35mm SLR, 35mm lens and ASA 1000 color print film (store in freezer until used)  
Clipboard, monitoring manual, field forms, pencils

## Trail Survey Procedures

### General Procedures and Inventory Parameters

Make photocopies of the complete trail segment from the USGS maps. Include some overlap of the segment if more than one copy is necessary. Do not reduce or enlarge the photocopies. Label all trail segments that are assessed with the segment names and codes from the attached trail listing sheets. Carry these photocopies as you assess the trail and verify, and where necessary revise, the segment's mapped alignment.

The following parameters apply to the entire trail segment and must be filled out at the top of each Trail Survey Form. Always begin new trail segments with a new form.

- 1) Trail Code: Record the trail segment code from the attached trail listing sheets.
- 2) Trail Name: Record the trail segment name from the trail listing sheets and trail name from park map if different.
- 3) Page Number: In the space provided record consecutive page numbers for the trail segment beginning with page 1 for each new trail segment.

All other parameters are recorded in the tabular section of the form. For each parameter record the capitalized 2 or 3 letter code in the Code column of the Trail Survey Form. In the Dist1 (Distance 1) column record the cumulative trail distance (nearest 1 foot) from the measuring wheel. Parameters which start with a "B" require "beginning" and "ending" distances; for these you will record the beginning distance under Dist1 and the ending distance under Dist2 (ending distance). Finally, some parameters require you to write additional comments. These should be brief, yet concise and complete. If comments require additional lines leave the first three columns blank. Each code, associated distance(s) and comment(s) must be an independent entry.

Whenever you record a code starting with the letter "B", record a dash (--) adjacent to the code in the left margin. These will serve as a visual aid to remind you to be looking for the "end" of this parameter. When you complete this entry by recording the "ending" distance in Dist2 make the dash into a plus (+). Parameters with beginning distances must have ending distances or the data will be incomplete and unusable in our analyses. Avoiding such missing data will require your undivided attention to this task, particularly to remembering which parameters are currently "incomplete" so that you will spot the locations where they end.

- 4) NEW - New Trail Segment: This parameter must be included beginning on the top line of a new form each time a new trail segment from the attached listing is started (more than one segment may be required to complete a red colored trail on the park map). Record the code "NEW" in the Code column, a "0" in the Dist1 column, and all of the following information in the Comments columns.

Trail Code: xx      Trail Segment Name: xx      Date: xx  
 Inventoried by: xx      Elevation: xx      Begin Wheel: xx

Trail Code and Trail Segment Name: As for Parameters 1 and 2 above.

Date: Month, day, and year the trail segment was evaluated (eg. June 12, 1993 = 06/12/93).

Inventoried by: Identify the field personnel responsible for the trail segment assessment by first initials of first and last names; this is how we will know who is responsible for any mistakes found in the data!

Elevation: Record the elevation (nearest 20 feet) from a USGS map.



Begin Wheel: Select a location near the beginning of the trail segment which is easily identifiable for future reference. Begin the wheel at this location and write a brief description which will allow someone else to relocate precisely where to start the wheel in order to replicate the survey.

- 5) END - End Trail Segment: This parameter must be included to end each trail segment. Record the ending distance and the following information in the comments section.

Soil Moisture: xx      Elevation: xx      End Wheel: xx

Soil Moisture: Record one of the following terms based on the current soil moisture conditions of the entire trail segment: Wet, Intermediate, Dry

Elevation: Record the elevation (nearest 20 feet) from a USGS map.

End Wheel: Select a location near the end of the trail segment which is easily identifiable for future reference. Write a brief description which will allow someone else to relocate precisely where to start their wheel if they replicate the survey in a reverse direction. This distance also reflects total trail segment length.

\* Note: Parameters 6 and 7 must be started now and will always be "incomplete" until the trail segment ends. You may need to record changes in the type of use and trail width over the course of the trail segment. When one of these parameters changes, record an ending distance for the former code and a new code with a begin distance.

- 6) BUP, BUH - Use Type (begin/end): Record the type of use permitted on the trail: Pedestrian (Hiker only) or Horse (hikers are also permitted on horse trails). On the park trail map hiker trails are indicated by dashed lines, horse/hiker trails by solid lines.

BUP - Pedestrian Use Only

BUH - Horse and Pedestrian Use

- 7) BT2, BTR, BT6 - Tread Width (begin/end): Record whether the tread is of trail width, generally 3-6 feet, or if the trail appears to be on an existing or former woods road (even if overgrown), with a width generally > 6 feet. When trail width changes record an ending distance for the former parameter and record a new parameter and begin distance to start the new trail width. Three trail width parameters are defined:

BT2 - Trail:      2-6 feet width and never used as a woods road

BTR - Trail on Road:      2-6 feet width but formerly a wider woods road (now overgrown/unmaintained)

BT6 - Road:      > 6 feet and obviously a woods road

- 8) REF - Reference Point: Record the code and distance for this parameter periodically when you come across a permanent feature which can be used by future workers to compare and/or recalibrate their wheel readings to those you record. As wheels tend to be inaccurate over long distances, try to include a reference point approximately every 1/4 mile (1 mile = 5280 feet, 1/4 mile = 1320 feet or 264 revolutions of a 5 foot wheel [we may experiment with wheels which read in revolutions not feet]). Under Comments describe reference points with sufficient detail that someone else could relocate the precise point and reset their wheel reading to coincide with your own. Also try to select locations which can be identified on maps, for example: stream crossings, trail intersections, and high or low points (remember to describe specific points at these more general locations). As a general rule you should always reference intersections with formal park trails and roads. Examples: stream crossing, waters edge, right bank facing upstream or center of intersection with Parson Trail.

## Resource Condition Parameters

These parameters provide information on the condition of the trail as influenced by human use, environmental, and design/construction/maintenance factors. All parameters are of the begin/end type so be extremely careful to watch for and record beginning and ending distances. Record only those problems which exceed a lineal distance of 10 feet. Do not discontinue a parameter if the gap between two sections exhibiting the problem is less than 10 feet.

- 9) BE1 -> BE? - Soil Erosion (begin/end): The intent of these two parameters is to identify trail sections which have experienced substantial soil erosion following trail construction. Careful attention to the general natural contour of the land in adjacent off-trail areas and to telltale clues regarding the surface of the original tread location and subsequent erosion is necessary. In particular, look for large rocks or boulders and tree roots whose tops were likely at the original trail surface but, through subsequent erosion, have been exposed more fully. Let us know of any suggestions for increasing the precision of this assessment as you gain more experience. Two soil erosion parameters are defined:

BE1 - Soil Erosion 1: 1 - 1.9 feet of soil lost since construction

BE2 - Soil Erosion 2: 2 - 2.9 feet of soil lost since construction

BE3 - Soil Erosion 3: 3 - 3.9 feet of soil lost since construction

... and so on for more highly eroded sections...

\* For each code above, record in the comments section the elevation for Dist1 (nearest 20 feet). Also record the most typical soil texture for the soil that has been eroded (examine the walls of the trench), a slash "/", followed by the texture for the bottom of the trench. Use the codes and descriptions from the list below.

TC: Clayey - Soil high in clay, malleable when damp, sticky with wet, deep cracks appear in ground when dry, color is typically orange or red

TS: Sandy - Loose, coarse soil with high sand content

TI: Silty - Like flour or talcum powder when dry and only slightly plastic and sticky when wet

TL: Loamy - Combinations of the above, typically in roughly equal parts

TO: Organic - Dark organic soil, absorbs/retains water like peat moss and mucky when wet.

TG: Gravel - Record only when its obvious gravel was applied by park management

TR: Rocky - Natural gravel, rock, or bedrock covers at least 60% of the tread

- 10) BRE - Root Exposure (begin/end): Record for trail sections exhibiting severe tree root exposure such that the tops and sides of many roots are exposed.

- 11) BW3, BW6 - Excessive Width (begin/end): Record when the trail exhibits a greater than 3 foot expansion in width that is clearly attributable to recreational uses, such as walking/riding around tree falls, wet or muddy areas, eroded areas, multiple treads, etc. Be alert: this parameter will often be recorded in combination with the other resource problem parameters, i.e. excessive soil erosion, wet soils, and multiple treads often cause an excessive widening of the tread. Trail boundaries, like campsite boundaries, are indicated by pronounced changes in ground vegetation cover, composition, and height, or organic litter. Two expansion widths (actual expansion width, excluding normal trail width) are defined:

BW3: 3 - 6 feet wider than normal

BW6: > 6 feet wider than normal

- 12) BWS - Wet Soil (begin/end): Record for trail sections which exhibit temporary, seasonally, or permanently wet or boggy soils on more than half the width of the tread. Wet soils typically occur in low areas, depressions, or are associated with hillside seeps. Mudholes and other situations with standing water should be assessed with this parameter. If actual overground water flow is present record parameter

**BWT** - Running Water on Trail instead. The objective is to record begin/end distances which reflect normal soil moisture conditions. If little or no rain has fallen in the previous few weeks, look more carefully for signs of seeps and damp soils and use your judgement in recording distances which would reflect more typical soil moisture conditions. The opposite is true if the assessment is conducted soon after rain. Use your judgement to deduce somewhat reduced begin/end distances.

- 13) **BWT - Running Water on Trail (begin/end):** Record whenever water from a large seep or small stream runs on the trail tread, potentially causing soil erosion and tread rutting (disregard water in lateral drains). Some degree of water flow must be present, otherwise record **BWS - Wet Soil**. Use your judgement as described for parameter 12 to record begin/end distances that reflect normal soil moisture conditions.
- 14) **BMT - Multiple Tread (begin/end):** Record the beginning and ending points where multiple treads diverge from a single tread. Record this parameter only when multiple treads are obvious, typically separated by some feature which divides the trail into two or more treads. Also record the maximum number of treads under Comments.

### Design and Maintenance Parameters

These parameters provide information on trail design, construction, and maintenance features. The first three parameters are of the begin/end type (follow previous directions), all other parameters are point features for which only a begin distance is recorded.

- 15) **BMG - Maintained Gravel (begin/end):** Record for trail sections which have been obviously graveled by park staff for either trails, maintained backcountry roads, or former woods roads.
- 16) **BEG - Excessive Grade (begin/end):** Record for trail sections with grades exceeding 20 percent (a 20-foot rise in 100 lineal feet). Using a clinometer, position your partner at the opposite end of the slope in question and sight on a feature of your partner that is the same height above ground as your eyes. Only record this parameter when the slope exceeds 20 percent. Record the soil texture code (see parameter 9) under Comments.
- 17) **BTC - Trail Corduroy (begin/end):** Trail corduroy is defined as any form of wooden or log bridging designed to traverse areas of wet soil (excluding stream bridges).
- 18) **DD"?" - Drainage Dip:** A drainage dip is defined as an obvious human-constructed dip or shallow trench, typically with an earthen berm built across the tread, configured in such a way that water is diverted off the trail. Replace the "?" with a letter code indicating the effectiveness of the drainage dip in diverting water from the trail tread. Effectiveness may be related to the quality of installation or current maintenance.

Use the following codes: V: Very Effective P: Partially Effective I: Ineffective

- 19) **WB"?" - Water Bar:** A water bar is defined as a wooden or rock structure partially buried in the trail tread for the purpose of diverting water off the trail. Replace the "?" with a letter code indicating the effectiveness of the water bar in diverting water from the trail tread. Effectiveness may be related to the quality of installation or current maintenance.

Use the following codes: V: Very Effective P: Partially Effective I: Ineffective

- 20) **LD"?" - Lateral Drain:** A lateral drain or ditch is defined as an obvious human-constructed trench dug along the up-slope side of the trail to collect and carry the water down-slope parallel to the trail until it can be shunted away from the trail at the end of a slope or across the trail at a water bar, drainage dip, or culvert. Record the distance for any point along the trail where the ditch is present. Replace the "?"

with a letter code indicating the effectiveness of the lateral drain in diverting or carrying water from the trail tread. Effectiveness may be related to the quality of installation or current maintenance.

Use the following codes: V: Very Effective P: Partially Effective I: Ineffective

- 21) **RW - Retaining Wall:** A retaining wall is defined as an obvious human-constructed wall or cribbing constructed of rocks and/or logs to retain soil, typically on the downslope sides of trails. Record the distance for any point along the trail where this feature is present.
- 22) **CU - Culvert:** A culvert is defined as a metal, rock, or wooden structure which carries water from one side of the tread to the other; it may be open or enclosed. Be aware that some are buried and may not be easy to see.
- 23) **ST - Step:** A step is defined as an obviously human-placed rock or wooden structure which facilitates travel up a steep slope and/or prevents the erosion of soil or unconsolidated rock/gravel. Also include soil dams, rocks or wood embedded in the trail perpendicular to the tread to retain soil, often to cause eroded sections to fill in. Soil dams are distinct from water bars in that they are not angled and configured to shunt water off the tread.

### Attraction Feature Parameter

- 24) **AF - Attraction Feature:** Outstanding scenic natural or historical features directly or indirectly lead to increased concentrations of use and subsequent impacts. Record these features whenever they are notable or significant enough to attract the attention of visitors. Typically such "popular" features will have well-defined social trails leading to them. These are point features so record a distance under Dist1 for the point along the survey trail which is closest to the feature (do not wheel off the trail to the feature). Briefly describe the feature under comments eg. waterfall, vista, cliff, pond, or stone foundation.

### Comments

At the end of each trail segment please record some of your personal comments. Potential topics include specific problems in applying the trail assessment procedures or suggestions for their improvement, and personal observations regarding the trail segment, including: (1) the original layout, design and construction of the trail, (2) the amount, quality, and effectiveness of maintenance, (3) environmental attributes which make the trail either resistant or susceptible to resource impacts, and (4) the type and amount of use and its effects on the trail. This can be done in the evening when you have more time to comfortably write. Write as many paragraphs or pages as necessary - we need more than codes and distances to appropriately evaluate these trail segments!

### Photos

Please take 1 or 2 representative photos of typical views of the trail as follows: turn camera to take a vertical format photo and compose picture to get a closer view of trail tread in bottom foreground with a more distant view of trail corridor in background. We can also use additional photos of "typical" trail features/conditions that might provide good illustrations for the trail manual and "extreme" examples of trail impacts. Where possible, try to take these latter photos when the sun is behind clouds - the lighting will be much more even. For each photo, record the trail name and a description for labelling purposes in a photo log or on the trail forms.



**Trail Survey Form: Great Smoky Mountains National Park**

**Trail Name**

Trail Code

[illegible]

Page No. \_\_\_\_\_

## Trail Survey Code Sheet

Inventory Parameters

- NEW** - New Trail Segment (4)  
*Record Trail Code, Trail Name, Date, Inventory by, Elevation, and Begin Wheel location description*
- END** - End Trail Segment (5)  
*Record Soil Moisture, Elevation, and End Wheel location description*
- BUP** - Use Type: Pedestrian (6)
- BUH** - Use Type: Horse/Pedestrian (6)
- BT2** - Tread Width: Trail 2-6 ft (7)
- BTR** - Width: Trail on Road 2-6 ft (7)
- BT6** - Width: Road > 6 ft (7)
- REF** - Reference Point (8)  
*Describe to aid in relocation*

Resource Condition Parameters

- BE?** - Soil Erosion: 1 = 1-1.9 ft  
2 = 2-2.9 ft  
3 = 3-3.9 ft  
... and so on ... (9)

*Record Elevation for Dist1, Soil Texture: TC, TS, TI, TL, TO, TG, TR for eroded soil/remaining soil*

- BRE** - Root Exposure (10)
- BW3** - Excessive Width: 3-6 ft (11)
- BW6** - Excessive Width: > 6 ft (11)
- BWS** - Wet Soil (12)  
*Distances to reflect "normal" moisture*
- BWT** - Running Water on Trail (13)  
*Distances to reflect "normal" moisture*
- BMT** - Multiple Tread (14)  
*Record number of treads*

Design and Maintenance Parameters

- BMG** - Maintained Gravel (15)
- BEG** - Excessive Grade: >20% (16)  
*Record Soil Texture: TC, TS, TI, TL, TO, TG, TR*
- BTC** - Trail Corduroy (17)
- DD?** - Drainage Dip, Effectiveness (?):  
V - Very, P - Partially,  
I - Ineffective (18)
- WB?** - Water Bar, Effectiveness (?):  
V - Very, P - Partially,  
I - Ineffective (19)
- LD?** - Lateral Drain, Effectiveness (?):  
V - Very, P - Partially,  
I - Ineffective (20)
- RW** - Retaining Wall (21)
- CU** - Culvert (22)
- ST** - Step (23)

Attraction Feature Parameter

- AF** - Attraction Feature (24)  
*Record type of feature*

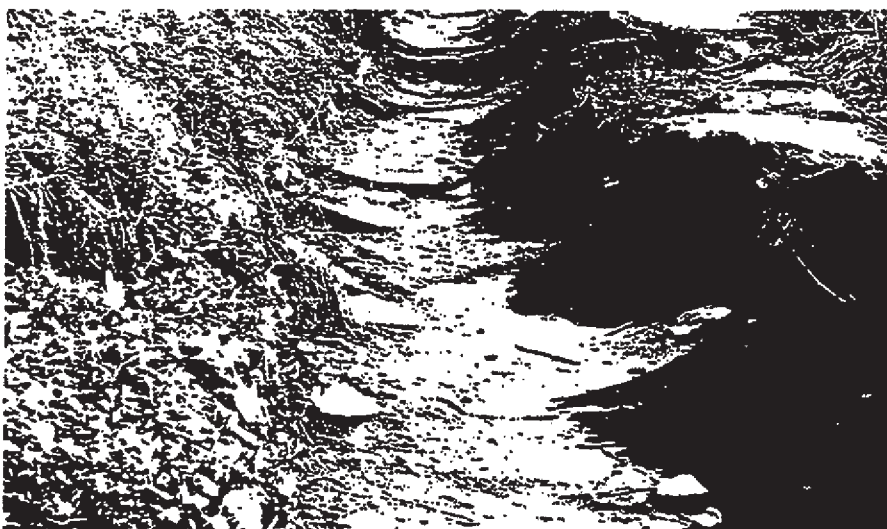


Note: color photos used  
in field manual

Multiple Tread  
(BMT)

Step  
(ST)

Excessive Width  
(BW3)



Soil Erosion  
(BE1) 1 foot



Root Exposure  
(BRE)

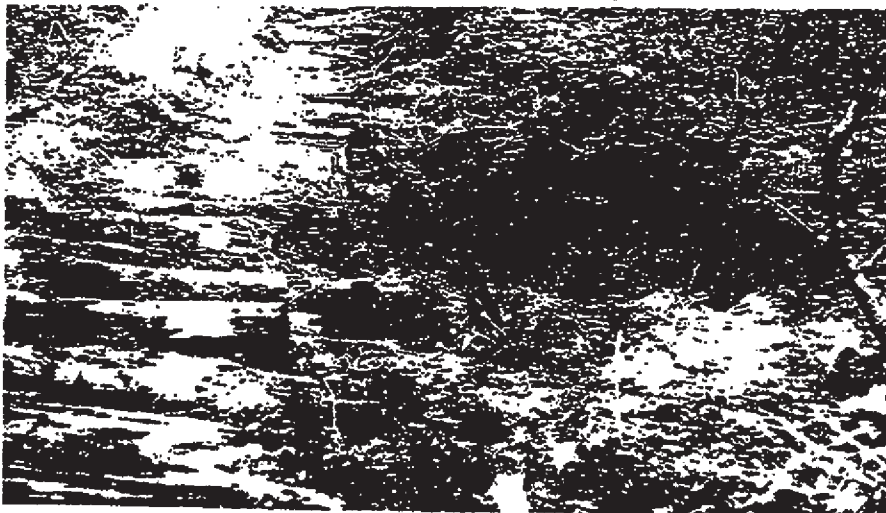
Don't Record:

Multiple Tread  
(BMT)



Note: color photos used  
in field manual

Water on Trail  
(BWT)



Excessive Width  
(BW3)

Wet Soil  
(BWS)

Trail Corduroy  
(BTC)



Wet Soil  
(BWS)

Excessive Width  
(BW6)