

Appendix C

Trail Use Conflict Study



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Trail Use Conflict Study

California State Parks

Road and Trail Change-in-Use Evaluation Process

PREPARED BY:
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June 2012



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List of Acronyms

APBP	Association of Pedestrian and Bicycle and Professionals
BMP	Best Management Practice
CEQA	California Environmental Quality Act
CETLC	California Equestrian Trails and Land Coalition
COSCA	Conejo Open Space Conservation Agency
CSP	California State Parks
EBPRD	East Bay Regional Park District
EIR	Environmental Impact Report
FHWA	Federal Highway Administration
IMBA	International Mountain Bicycling Association
LTBMU	USFS Lake Tahoe Basin Management Unit
NOP	Notice of Preparation
NPS	National Park Service
PEF	Project Evaluation Form
ROMP	Responsible Organized Mountain Peddlers
RTC	Rails-to-Trails Conservancy
USFS	U. S. Forest Service
VCPRD	Vancouver-Clark Parks and Recreation Department

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Glossary

Clear area	Continuous, linear zone around trail free of obstruction to allow for safe, unimpeded travel.
Clearing height	Vertical clearance of obstructions across the width of the trail.
Trail bed or tread width	The width of the relatively level graded area created or utilized for the trail. In many cases the graded edges of the original trail bed slough so that the available width for the trail tread is reduced.
Trail corridor/ right-of-way	The width and boundaries where a trail is following a physical corridor, such as a road right-of-way, utility corridor, or former rail line, and/or a defined access easement corridor.
Trail shoulder	Natural surface, graded area, contiguous and flush to the trail tread, allowing a transition from the tread to natural terrain.
Trail tread	Actual surface portion of a trail upon which users travel excluding the backslope, ditch, and shoulder.
Hillslope, sideslope	The steepness of the slope on which the trail is constructed, or the resulting slope steepness adjacent to the trail after construction.
Front-country	Park areas that are within or close to urban areas. Many users are able to visit.
Back-country	Park areas that are relatively remote, and fewer users will be able to visit because of distance from trailheads and terrain.

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Preface

The Trail Use Conflict Study has been conducted to provide information relevant to issues raised by trail user groups regarding their concern that potential for conflicts between trail users may occur as a result of adding uses to California State Parks (CSP) trails under the proposed Road and Trail Change-in-Use Evaluation Process.

While trail use conflict is an important issue for the management of CSP trails, as a social topic it is not included in the definition of environmental impacts under the California Environmental Quality Act. Nonetheless, because of the importance of the issue, as demonstrated by public input to CSP regarding trail management and scoping comments on the Road and Trail Change-in-Use Evaluation Process Environmental Impact Report (EIR), CSP commissioned the Trail Use Conflict Study to provide an up to date understanding of how trail use conflict is addressed by other agencies with responsibility over recreational trail development and management.

The study is provided as an appendix to the Road and Trail Change-in-Use Evaluation Process Program EIR in recognition of the topic's importance to trail management.

Chapter 1. Introduction and Summary

1.1 Introduction

California's recreational trails provide experiences that attract more users than any other recreational facilities in the state. The ability to exercise and enjoy nature in the outdoors is critical to the physical and mental health of California's population. California State Parks (CSP) considers trails to be primary state park facilities that offer health-enhancing recreational opportunities and access to park resources for interpretation and education and has developed a policy and coordinated set of planning guides to manage state park trails. CSP adopted the policy to provide trails for accessing park features and facilities and to strive to meet the recreational, educational, and interpretation needs of its diverse trail users. The CSP Trails Handbook serves as CSP's primary guideline for trail design, construction, operations, and maintenance (CSP 1994). The *California Recreational Trails Plan* provides a guide to management of an integrated system of trail routes to serve California (CSP 2002).

One of the goals of the *California Recreational Trails Plan* is to promote multi-use trail cooperation, recognizing that efforts to integrate or combine different uses on trails have not all been successful. The goal is to "provide the maximum opportunities for the public use of trails by encouraging the appropriate expansion of multi-use trails." CSP is proposing to implement statewide its Road and Trail Change-in-Use Evaluation Process (Process) to assist District personnel in evaluating which existing trails are appropriate for adding or removing trail uses. In reviewing and refining the Process for statewide application, CSP has been considering the influences of trail use conflicts that can occur when multiple types of trail users are present on a facility. This consideration includes a study of the current state of information and understanding of trail use conflicts and approaches for trails managers to address them.

This Trail Use Conflict Study (Study) reflects review of literature and practice nation-wide for addressing user conflict on natural surface multi-use trails. It is an important contribution to the subject of multi-use trail design and management. This Study is specifically focused on CSP trails. CSP has taken a leadership role in addressing the complex physical and social issues that pertain to accommodating multiple users, such as hikers, equestrians, and mountain bike riders, on the same trails. This leadership is consistent with the overall CSP mission and policy to "encourage hiking, horseback riding, and bicycling as important contributions to the health and welfare of the state's population" (Public Resources Code Section 5070-5077.8), as well as the Trails Policy (Policy Notice 2005-06) and the *California Recreational Trail Plan*, to provide appropriate access to nature-oriented, trail opportunities for all Californians.

This Study provides background information for a Program Environmental Impact Report (Program EIR) for CSP's proposed application of the Road and Trail Change-in-Use Evaluation Process (Process) throughout the State Park System. CSP developed the Process to provide criteria for use in consistently and thoroughly evaluating and responding to proposals for change in designated use on existing road and trail alignments.

Two of the objectives of the Program EIR are to conduct a comprehensive environmental analysis of the Change-in-Use Process and, where applicable, to improve upon the existing Process by providing CSP field staff with additional evaluation tools to assess requests to add or remove uses on existing trails and roads in the State Park System. This research helps refine the set of best management practices used by CSP for implementation of change-in-use actions to support the Program EIR's second objective.

1.1.1 Study Goals

This Trail Use Conflict Study has two primary goals:

- 1) To inform readers of the Program EIR regarding trail use conflict and the nature and extent of the problems as revealed through review and analysis of documents and articles on the subject. The Study provides a summary of the nature of trail use conflict and potential solutions as identified through review of the relevant literature and a survey of trail system managers. The Study draws conclusions regarding the results of the research and their relevance to the CSP trail system and the existing Process.
- 2) To improve the ability of the existing Process to guide decision-making related to trail use conflict through recommended refinements and enhancements to the existing evaluation tool, trail design guidelines, and best management practices. The existing CSP trail design guideline and management measures that help avoid or reduce trail use conflict are reviewed as part of the Study.

This Study provides two sets of recommendations related to the consideration of proposed road and trail changes-in-use. The first recommendations presented are contained in a Checklist for Low-Conflict Multi-Use Trail Design. This clarifies how trails can be designed to comfortably and safely accommodate a mix of hikers, equestrians, and mountain bicyclists, and comply with rules and guidelines for safe, considerate, and low-impact use.

Management of trail use conflicts depends on compliance with the appropriate type of trail use, and rules and guidelines for trail use and behavior, including reasonable speed consistent with trail design and use objectives, yielding to other users per the “yield triangle” (which informs trail users when to yield to other types of users), warning when passing, and having the appropriate knowledge or skill to be on trails shared with other users. The second set of Recommendations is contained in a Checklist for Multi-Use Trail Conflict Management. This contains measures for getting the information to the trail users about appropriate trail use; monitoring trail use, encouraging compliance, and where necessary, responding to situations of non-compliance that can result in conflicts.



1.1.2 California State Parks Trail Policy Setting

Although the research and recommendations presented in this Study are relevant to the CSP trail system, many of the agencies interviewed and documents reviewed for this Study involve non-CSP trail systems with a different mission than CSP. Thus, some of the design and management approaches from these sources, while informative, may not be appropriate for CSP trails.

CSP provides trails to allow people to experience and enjoy nature. This is clearly established in the California Public Resources Code (emphasis added):

5019.53. **State parks** consist of relatively spacious areas of outstanding scenic or natural character, oftentimes also containing significant historical, archaeological, ecological, geological, or other similar values. The purpose of state parks shall be to preserve outstanding natural, scenic, and cultural

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values, indigenous aquatic and terrestrial fauna and flora, and the most significant examples of ecological regions of California . . .

Each state park shall be managed as a composite whole in order to restore, protect, and maintain its native environmental complexes to the extent compatible with the primary purpose for which the park was established.

Improvements undertaken within state parks shall be for the purpose of making the areas available for public enjoyment and education in a manner consistent with the preservation of natural, scenic, cultural, and ecological values for present and future generations. Improvements may be undertaken to provide for recreational activities including, but not limited to, camping, picnicking, sightseeing, nature study, hiking, and horseback riding, so long as those improvements involve no major modification of lands, forests, or waters. Improvements that do not directly enhance the public's enjoyment of the natural, scenic, cultural, or ecological values of the resource, which are attractions in themselves, or which are otherwise available to the public within a reasonable distance outside the park, shall not be undertaken within state parks.

Although Public Resources Code Section 5019.53 mentions only hiking and horseback riding, policies regarding access to mountain bikes on trails have since been added (State Park and Recreation Commission, Policy IV.2, Non-Motorized Bike Use. 2005), and CSP's mission now includes accommodating mountain bikes on trails . The same principles apply: CSP trails are not designed or intended to serve as active recreation facilities where nature appreciation may be secondary to athletic or skill challenge. Mountain bike speed or technical riding, equestrian endurance or poker runs, and group trail runs are examples of activities that are not compatible with CSP trails, shared or otherwise. CSP trails are generally designed to accommodate a passive, nature-oriented type of shared trail use by combining the design requirements for each individual use into a trail on which they can comfortably mix.

1.1.3 Research Scope

The research for this Study includes a review of existing literature pertaining to trail use conflict issues, as well as a survey of U.S. agencies and organizations that manage significant mileage of multi-use trails and may have information or informed opinions about the nature of the problems and potential solutions. The literature review was limited to documents from the U.S. and Canada, but it includes research examples from other countries where they are cited in U.S. or Canadian documents.

This research effort focused on natural surface trails in natural land settings comparable to units of the California State Park System. It focused on multi-use trails with a combination of hikers, equestrians, and/or mountain bikers, and conflicts between these groups. Although conflicts on paved trails were frequently mentioned in the responses, paved trails are not a focus of this Study because the Road and Trail Change-in-Use Evaluation Process does not address paved trails. Also, although conflicts regarding dog access were mentioned in some responses, they are not addressed, because dogs are typically prohibited on CSP trails. This Study also does not address the relative maintenance or environmental impacts of different trail use types, which are subjects of the Program EIR and a separate erosion vulnerability study.

The research sought to identify when, where and why trail use conflict incidents occur on the trail system; which user groups are most often perceived to be in conflict; and what strategies are used to minimize conflict concerns. The research also sought to determine the most prevalent types of conflicts (users involved, specific

reasons, frequency, etc., as measured in complaints); what factors exacerbate or alleviate feelings of conflict; and strategies that managers have found to be successful in addressing conflict.

The research sought data reflecting rigorous study of use conflict and solutions, however, few studies have empirically measured the nature of trail use conflicts or the effectiveness of solutions. The research results highlight the most thorough, objective, and often-cited government or academic research, and planning, design, or management standards or guidelines that address multi-use trails.

1.1.4 Study Notification and Input

The Study team (CSP staff and consultants) developed the initial list of documents to review and agencies to survey based on internet research, including academic and professional sites, and input from CSP staff. The team strove to make the list as inclusive as possible by seeking suggestions of pertinent information or experience from the public, agencies, and organizations.

At research initiation, the people who signed in at the Notice of Preparation (NOP) scoping meetings or who made subsequent comments on the scope of the Program EIR during the scoping period received a notice of the study and solicitation for additional documents, data, and knowledgeable contacts. The notice was also sent to trail-related organizations and posted on major trail-related web sites, as shown in Table 1-1. The research considered all suggestions received through this process; if the Study team found that a document was not directly pertinent to this Study, this was noted, and the document was not included in the annotated bibliography.

Table 1-1. Study Notice Placement

Group	Method
American Trails website	Posted
Association of Pedestrian and Bicycle and Professionals (APBP)	E-mail to list serve
Individuals who signed into the NOP scoping meetings	E-mailed
International Mountain Bicycling Association (IMBA)	E-mailed to staff
Rails-to-Trails Conservancy (RTC)	Sent in April member e-newsletter
Responsible Organized Mountain Peddlers (ROMP)	E-mailed to staff
Sierra Club	E-mailed to staff

Comments and documents provided through these resources are listed in Appendix D.

1.1.5 Organization of the Document

Chapter 1 of this Study introduces the purpose and research scope for this Study. It clarifies the setting and use characteristics considered in the Study, and summarizes the findings derived from the research.

Chapter 2 presents the recommendations related to appropriate trail design as well as management and outreach strategies to address trail use conflict.

Chapter 3 summarizes the overall research results from the review of relevant literature and survey of trail managers regarding conflict issues, appropriate design solutions, and management solutions for addressing user conflicts.

Chapter 1

Chapter 4 provides a bibliography of the literature and agency staff comments cited in Chapters 1 through 3.

A glossary with list of acronyms used in chapters 1 – 3 is provided after the Table of Contents.

These chapters are supported by the following appendices:

- Appendix A provides the recommended design and management measures in summary checklist forms and examples of how the existing CSP documents used for the Change-in-Use Process can be modified to incorporate the measures and related recommendations.
- Appendix B describes the methodology used for the review of the literature and discusses the results by topic. It also includes summaries and critiques of the “key” documents that provided the most pertinent information for this Study.
- Appendix C describes the Agency Survey, including methodology, agencies surveyed, and an analysis of results by topic for the 36 surveys returned. The chapter also provides an overview of the findings from the most pertinent individual surveys received. These were agencies that had environmental settings, trail systems, and/or policies most similar to CSP, and that provided specific data and recommended measures regarding trail use conflict. Appendix D outlines the outreach conducted to user groups for the Program EIR and this Study, as well as the comments and recommendations received.
- Appendix E provides the list of literature considered in the review, as well as a complete annotated bibliography of all literature reviewed that was determined to be relevant to trail user conflicts.
- Appendix F lists all surveys returned.
- Appendix G presents relevant portions of the current CSP *Trail Handbook* and draft unpublished CSP trail design guidelines.

1.2 Summary of Research Findings

Analysis of the data collected shows that the primary management concern on multi-use trails is conflict based on users’ perceptions and behaviors, and that actual accidents involving different user types were rare. The overall findings regarding the nature of trail use conflicts, including potential solutions to these issues, are based on a substantial body of data and informed professional and expert opinion.

1.2.1 Types of Conflict Reports or Events

The research found that evidence of trail use conflict was represented in three basic forms: general comments or complaints, conflict incidents, and as a subset of the incidents, accident events. Clarification of these terms is important to understanding the results:

- “General comments or complaints” are general issues raised that do not include documentation of a specific incident event. These general concerns were often represented in opinion surveys of trail agency managers or trail users that were included in the literature reviewed, or were expressed in the survey of trail agency managers conducted as part of this Study.
- “Incidents” are events that were brought to the attention of trail management staff, typically involving a specific concern or complaint. Incidents can include wildlife encounters and a range of other issues,

but when related to trail use conflict, they tend to involve one user feeling that his/her experience was diminished and/or his/her safety was threatened by another user, and/or a violation of the rules occurred. Incidents include both non-accident and accident events.

- An “accident” event is a type of incident where someone is injured, or falls, but avoided injury. An incident report could include details of an accident. This could be a single user event, or multiple users of the same type, or multiple users of different types. .

1.2.2 Reference Citations

In the following summary findings, where a theme was cited by one or more sources, the reference follows. If several sources supported the finding, the text provides general reference to support without specifically identifying all documents or agencies. These findings and the supporting documentation are presented in more detail in Chapter 3 and 4 and Appendices B and C.

1.2.3 Significant Research Findings

Six significant conclusions were derived from the Literature Review and the Agency Survey results. These findings are listed below, with supporting documentation.

1. Information on trail use conflict is primarily based on opinion; little data about actual user conflicts are available.

The existing literature and the survey responses primarily consist of the opinion of trail system managers and users; even peer-reviewed academic or U. S. Forest Service (USFS) publications primarily rely on manager and user surveys. There is limited detailed report data about actual trail use conflict incidents, such as complaint or incident reports, rigorous analysis regarding the nature and extent of trail use conflict issues, or the results of strategies addressing them.

While there is a wealth of documents and articles on the topic of user conflicts on multi-use trails, the majority of the literature does not provide empirical data regarding the presence, extent, or attributes of user conflict incidents. Although 63 of the 80 Literature Review sources define the problem of trail user conflicts, several of them do so as a presupposition based on previous literature (14 sources), or the author’s experience (13 sources). Several sources present surveys on managers’ perceptions of conflict (9 sources) or users’ perceptions of conflict (22 sources). None of these surveys asked the frequency of actual incidents. However, this notable lack of citations regarding specific incidents, including accidents, implies that they are infrequent.

The Study team requested incident and complaint data from each agency sent an Agency Survey. This request was reiterated when surveys were returned. The survey also asked respondents to provide their professional judgment about the frequency of complaints, which may include formal written complaints or discussions at events, public meetings, or other feedback. Respondents were also asked about the frequency of accidents with injuries due to collisions, non-injury collisions, and ‘close calls’ negatively affecting user experience.

The survey responses showed that agencies rarely maintain detailed data on complaints, incidents, or accidents. Where data are collected, incidents (including accidents) involving multiple user types are often combined with single user or same user types of accidents and separate statistics are not available. Though the research results reflect primarily informed opinion rather than empirical data, there is clear evidence that

accidents are rare compared to the number of incidents, and actual incidents tend to be rare in relation to extent of comments and complaints about conflict between trail user types.

2. Complaints and controversy about other trail users are common.

Several manager and user surveys from the Literature Review indicate the importance of trail use conflict as an issue for trail managers. Over half of the 40 recreational managers from the USFS and U. S. Bureau of Land Management surveyed via telephone reported conflicts between mountain bikers and other user groups (Chavez 1993). A survey of state park Directors of all 50 states found that 77 percent reported trail use conflict as an issue (Schuett 1997). A survey of USFS Managers in the 1990's found that over a third (34 percent) of National Forest managers were concerned about mountain bikers' conflicts with other user groups. This topic was second only to concerns about effects on natural resources (42 percent); (Chavez 1996a).

The Agency Survey found that complaints of conflict are relatively common compared to incidents, based on staff estimates of the frequency with which they receive complaints. Agencies typically receive complaints on a monthly or weekly basis (13 of 25 agencies), and more than two-thirds of the 36 agencies that returned surveys felt that they had significant issues with user conflict on natural surface shared-use trails.

In addition, the extent of literature written on the subject and plethora of studies indicates the contentiousness of the subject of sharing uses on trails.

3. Actual incidents, including those involving accidents, between trail users are relatively rare.

Most agencies group information about all incidents and accidents between users together. However, in some cases it is possible to separate incidents that do not result in injury or a physical altercation.

An Environmental Assessment for the National Park Service (NPS) recorded users on a section of the Cactus Forest Trail in Arizona during a six-month trial period, finding only three minor incidents, including two user complaints and a ranger reminding a mountain bicyclist to yield to equestrians (NPS 2003)

Resources from the Literature Review that consider accidents on trails found there to be a very low frequency of accidents, in general, and few of these involve multiple user types. An early study in the East Bay Regional Park District (EBRPD) found 24 cycling accidents reported from July 1987 to June 1988. Among the accidents, two cases involved two mountain bikers colliding and one involved a cyclist falling to avoid a hiker (Morioka, Steven in Sloan, D. and T. Fletcher, Ed. 1989).

Literature that does not provide data on accidents, but which relies on opinion surveys of trail managers, supports the conclusion that accidents are rare, compared to conflict incidents. The USFS Manager survey found that only 13 percent of managers had "safety concerns" (including wildlife encounters and conflicts with automobiles at trail crossings) related to mountain bikers (Chavez 1996a). A survey of Ohio State Parks and Park Districts about mountain bike management found that 30 percent of the respondents had observed or received reports of user conflict related to mountain biking, while 27 percent reported accidents, and 13 percent reported safety problems of all types (Longsdorf 2006).

In the Agency Survey, the few agencies that record incidents seldom differentiate incidents related to multi-use, but combined incidents are relatively rare in the context of overall trail use levels. Eight of the agencies in

the Agency Survey collect incident data, and four of those had not had any recorded incidents. The majority of agency representatives surveyed responded that, in their professional experience, actual incidents are uncommon; 18 of the 28 agencies responding to the question reported that incidents occur annually or less frequently.

4. Trail use conflict is an important social issue.

There is a strong body of study and informed opinion indicating that trail use conflict is an important social issue, and that the orientation, perception, attitude, and behavior of users are major factors in generating concerns and complaints about trail conflict. Though it tends to be social/perceptual, rather than represented by significant physical evidence, trail use conflict is a very real issue for almost all multi-use trail managing organizations.

Conflicts between trail users are shown to be highly influenced by perception, attitudes, and behavior on both sides of conflicting parties. Conflict has been described in the literature as goal interference, which can be either interpersonal (based on physical presence of other users) or social (based on perception of a group; no contact or sighting has to occur) (Jacob and Schreyer 1980; Moore 1994; Carothers, Vaske, and Donnelly 2001; Cessford 2002; Bradsher 2003; Chiu and Kriwoken 2003). Moore (1994) wrote that “conflict has been found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users.” Watson, a researcher with the USFS, observes that perceptions of conflict are frequently unrelated to measurable incidents of interference in outdoor recreation, but rather reflect an attitude towards wilderness and stereotypes of other user groups (Watson 2001)

USFS Lake Tahoe Basin Management Unit (LTBMU) staff noted that use conflicts are “very subjective and determined by individuals” (LTBMU response to CSP Trail Use Conflict Survey, 2011). Three agencies noted entrenched negative perceptions of other user groups arising from a history of conflict or disagreement; CSP Gold Fields District, the Front Country Trails Multi-Jurisdictional Task Force, and Jefferson County Open Space all cited historic conflicts contributing to an environment where managers had difficulty addressing root causes of conflict perceptions.

Reported conflicts between trail user types tend to reflect perceptions of being unsafe or merely bothered, due to the presence of other types of trail users. Many of the comments received from the Program EIR scoping meetings stated that conflict is related to mountain bikers failing to yield or passing too quickly. Similarly, common concerns related to user conflicts in both the Literature Review and the Agency Survey include mountain bikers’ speeds and lack of warning and/or yielding when passing. Of the 36 surveys completed, the most frequently-noted conflicts were between pedestrians/hikers and bicyclists/mountain bikers (68 percent). The second most frequently-noted concern was conflicts between users with dogs and those without (41 percent), but dog access is not within the scope of this Study, because dog walking is generally not allowed on CSP trails. Only 18 percent of issues cited in the Agency Survey were between equestrians and mountain bikers, despite this being a prevalent concern in the Program EIR scoping comments.

Six percent of the survey respondents noted that the users’ purpose of visiting the trail influenced their behavior; conflicts between recreationalists and families were mentioned. Less-frequent conflicts cited were caused by meet-up groups and running clubs or other users traveling side-by-side and blocking the trail.

Comments at the Program EIR scoping meetings included concerns that mountain bikers' speeds discourage equestrians and hikers from using the trails.

5. Design of trails to accommodate multiple use helps to avoid or reduce conflict.

There are common themes, but there is also significant variation, in trail design principles in the literature and agency practices to address low-conflict, multi-use trail design, or user-specific trail design. Many agencies and organizations incorporate a few of these principles into published trail design standards or guidelines, but few trails have actually been designed and constructed from the outset using these multi-use design principles. Although informed opinion expressed points about the performance of these designs in addressing trail conflict, no data about actual use and frequency of trail conflict incidents were found.

Several documents from the Literature Review support the use of appropriate trail design as critical to managing multiple use. Similarly, in *Trails for the 21st Century*, Flink, Olka, and Searns (1993) stress the importance of designing a trail with the users in mind, stating that, "accommodating a range of users within a single trail depends on trail width, trail surface, and speed of trail users." A recent study conducted by the East Bay Regional Parks District (EBRPD) found that combining use on trails not designed for multiple use has created management challenges for participating agencies (EBRPD 2011).

In addition, several responses from the Agency Survey note the importance of appropriate design. Eight agencies noted that concerns of incidents more frequently occur at turns and corners or other locations with poor visibility. Inappropriate trail width, slope, and designs that allow users to travel at excessive speed are all circumstances that respondents were concerned would exacerbate user conflicts.

Beyond the conclusion that design is important to address trail use conflict, the Study found that conflict-specific design standards in the literature and agency survey responses varied widely, though there were some principles that were commonly mentioned. The design measures had mixed applicability to the CSP setting. The recommendations in this Study incorporate those that have the most applicability and benefit, along with existing CSP trail design measures.

6. User education and outreach are key methods to avoid or reduce conflict.

There was a strong indication in the literature and in agency comments that active efforts to manage and work with users are necessary to address conflict, although elimination of the perception of conflict can be very difficult to achieve. Several trail user surveys indicated that additional education and outreach can reduce conflicts between users. Users who had experience with other trail activities felt less conflict when encountering participants of those activities than respondents who had never performed those activities before (Bradsher 2003).

1.3 Summary of Recommendations

The Study recommendations to reduce trail use conflict are presented in Chapter 2 and feature two checklists of measures to be used as part of the Process, summarized below:

1) Recommendations for low-conflict, multi-use trail design:

The design recommendations include nine interrelated elements that support low-conflict multiuse natural surface trail design:

- **Tread Width and Passing Space.** Provide sufficient width of the trail tread and existing or created space to allow users to pass each other, either as a continuous condition, or as passing spaces at defined intervals. This also includes vertical clearance from overhanging trees and objects.
- **Sight Distance.** Include adequate length of the trail visible ahead to the user. This is particularly important to resolve in conjunction with speed control features, turns, and sinuous layout.
- **Turn Radius.** Create a minimum inside radius of turns to ensure that they can be comfortably negotiated.
- **Sinuosity.** Lay out a trail with many curves and minimal straight sections (however, with sufficient sight distance). This helps limit the speed of mountain bikers and other users.
- **Speed Control Features.** Install pinch points, choke points, trail anchors, technical trail features, 'stiles', and other elements specifically designed to limit users' speeds.
- **Surface Texture.** Design the relative smoothness, evenness, and firmness of the trail tread to moderate travel speed by mountain bicyclists, including the presence of irregularities.
- **Low Trail Structures.** Avoid steps and waterbar structures that constrain access for horses and mountain bikers and can create points of conflict.
- **Gradient.** Apply design limits or variations in the gradient of the trail to allow for multiple uses.
- **Trail Layout and Classification.** When considering trail suitability for multiple uses, factor the level of use of the trail, availability of alternative trails and routes, and the potential for trails to primarily serve one or multiple user types.

2) Recommendations for multi-use trail conflict management:

Management Strategies:

- **Rules.** Adopt enforceable rules, regarding staying on designated trails, right-of-way, warning when overtaking, speed limits, etc.
- **Enforcement.** Establish enforcement strategies, including monitoring, warnings, radar and citations.
- **User Information.** Provide information to users about rules, policies, and advice for trail user respect, right-of-way requirements, courtesy, routes, destinations, and conditions.
- **Data Tracking.** Collect and track data on trail use conflict incidents and design or management response successes.
- **Separate Trails and Specialized Trails.** Alternate use days, provide one-way trails, and designate use-intensive trails.

User Outreach and Coordination Strategies:

- **Education.** Provide user-specific printed materials and web postings, and/or an active, focused public relations campaigns to educate users about trail use rules and appropriate behavior.
- **User Group Relations.** To establish or improve constructive relationships with user groups, arrange and conduct general meetings with user groups about trail safety or conflict-related issues, or

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objectives, such as making improving and maintaining trails and making the trail experience more enjoyable.

- **Volunteer Programs.** Organize, encourage, and /or support establishment of volunteer trail stewardship programs, such as ongoing trail patrol and/or maintenance assistance, specific projects, and help with outreach and education regarding conflict avoidance, safety, and courtesy.
- **Events.** Organize, encourage, and/or support multi-user social, fun, trail construction, or maintenance events (e.g., Trail Clean-up Days).

Checklists that provide more detail about these recommendations are presented in annotated form in Chapter 2 to help explain the background, context and objectives. They are provided in simplified checklist form in Appendix A for ease of use by CSP staff. Chapter 2 describes and Appendix A illustrates how the checklists can be integrated into the existing CSP checklist used to evaluate the feasibility of proposed trail use changes.

Chapter 2. Recommendations for Addressing Trail Use Conflict

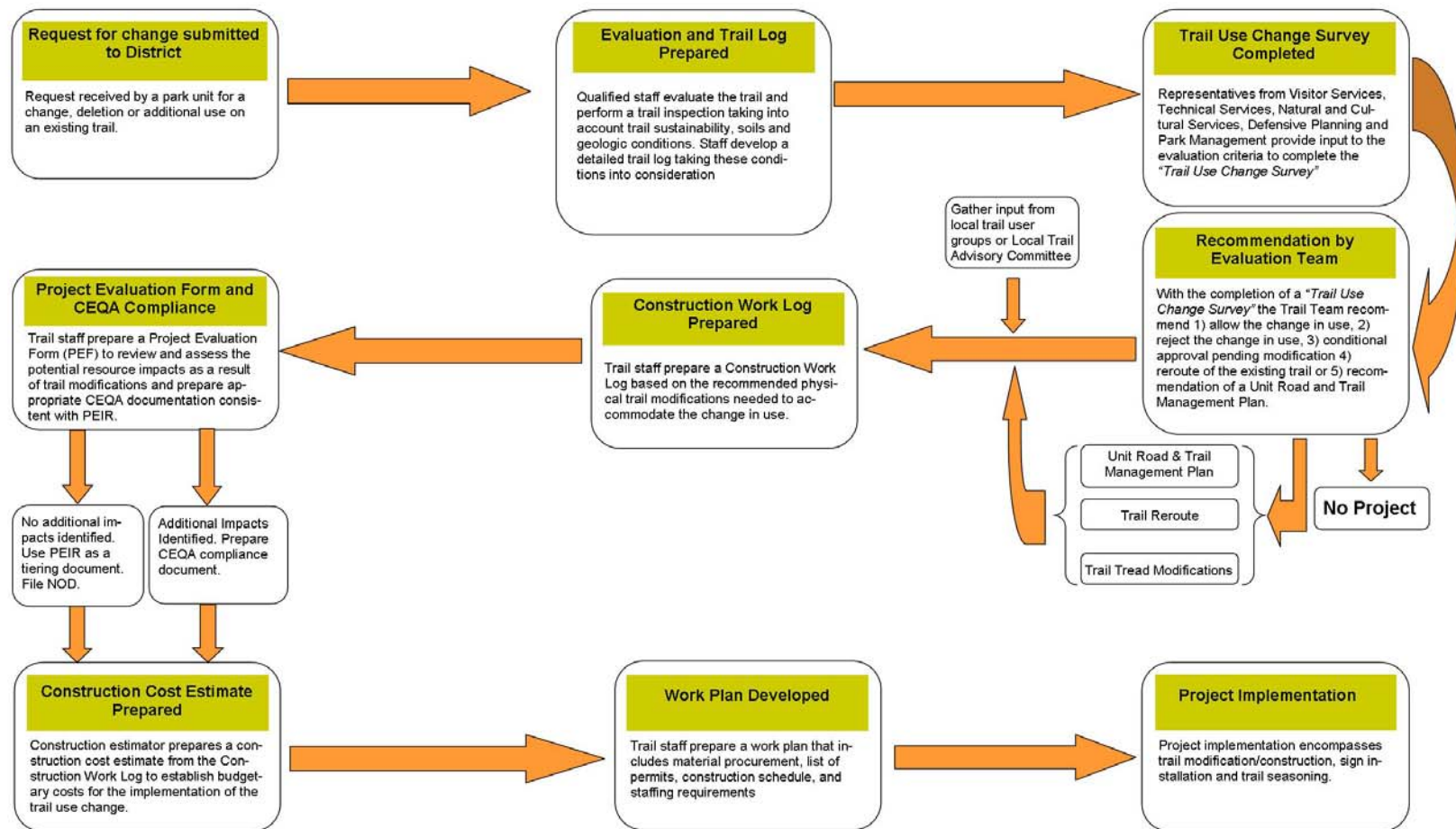
This chapter provides recommendations for refining or augmenting the California State Parks (CSP) Road and Trail Change-in-Use Evaluation Process (Process) to help avoid or reduce trail user conflicts on natural-surface, multi-use trails. The recommendations reflect review of existing CSP trail design guidelines and practices and review of guidelines and standards from other agencies and organizations where they were found to be relevant to CSP trail types and policies. These recommendations are intended to become integral parts of the change-in-use evaluation process.

2.1 Summary of Evaluation Process

The Road and Trail Change-in-Use Evaluation Process facilitates consideration of changes in use of existing State Park roads and trails to best accommodate trail access to natural and/or cultural resources for which a park unit was established and that are appropriate for each road or trail facility. The Process seeks to provide CSP with a systematic evaluation tool to consider proposals to modify roads and trails to add or remove particular uses.

The Process includes steps that lead to recommendations regarding change-in-use proposals, as described and shown graphically in the *Proposed CSP Road and Trail Change-In-Use Evaluation Process Flowchart*. (see Figure 2-1). The CSP decisions regarding proposed changes in use may include: approval, denial, conditional approval pending modifications, rerouting to accommodate the changed uses, modifications to planning documents to implement the proposal, deferral of the decision, or management responses instead of physical changes to the trail.

Draft Trail Use Change Process (PEIR Revision)



May 21, 2012

Figure 2-1. Road and Trail Change-in-Use Evaluation Process Diagram

2.2 Incorporating the Recommendations

The recommendations presented in this chapter take the form of two new checklist documents to support the Process:

- 1) Checklist for Low-Conflict, Multi-Use Trail Design, and
- 2) Checklist for Multi-Use Trail Conflict Management.

The recommended checklists include specific measures to implement appropriate multi-use trail design for the individual user types and their combination, and specific measures that can be taken to encourage appropriate trail use and behavior, and understanding of other trail users' needs and rights. Research for this Study has shown that, applied together, these measures can minimize trail use conflict.

The recommended checklists are intended to be referenced and incorporated into the Road and Trail Change-in-Use Process by supplementing the existing checklist used to evaluate the feasibility of trail use change. Specific recommended changes to the forms are presented in Appendix A of this Study. A general description of the changes to the forms is provided below:

Evaluation and Trail Log

The Evaluation and Trail Log notes the physical conditions and requirements for the proposed use to be added to (or in some cases removed from) the road or trail. The Checklist for Low-Conflict, Multi-Use Trail Design should be applied at this stage.

The evaluation of existing physical conditions and determination of the implications for improvements to add (or remove) the use under consideration should include review of the checklist, with results reflected in the Trail Log.

In some cases the evaluation may find that conditions and feasible modifications for use-appropriate design do not support an existing use. This could potentially result in that use being removed.

Trail Use Change Survey

The Survey form considers the results of the Evaluation and Trail Log and makes a finding regarding overall feasibility.

The Checklist for Trail Use Conflict Management would be completed in parallel with the Trail Use Change Survey, to inform CSP staff about potential trail management needs and opportunities; not as a direct basis for the decision of feasibility of the proposed use change.

Like the physical conditions or changes pertinent to accommodating specific uses and addressing trail use conflict, the Trail Use Conflict Management Checklist evaluation is not a “make or break” factor in the trail use change decision, but it is an important consideration and part of the ultimate Work Plan.

Work Plan

The Work Plan is the comprehensive implementation plan for the change-in-use project. Completing the Trail Use Conflict Management Checklist will generally identify conditions, accomplishments, and needed actions. As part of the Work Plan an action plan should be developed for management, outreach, and coordination tasks, including follow-up monitoring and reporting of conflict issues and response successes.

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Integrating these work elements throughout the Process will help ensure that it is comprehensive and effective.

Monitoring and reporting is already a part of the trail management process. A standardized system of collecting, assessing, and responding to data regarding trail use conflicts, and a centralized database, would help identify “trouble spots” across the state that may deserve special attention in terms of technical support. It could also include requests for local, state or national user group assistance to address the issues identified. If issues can be clearly documented, there is greater potential to provide constructive comments to the parties that may be responsible for inappropriate behavior or lack of understanding of how their use may affect or be perceived by others. Data collection also improves the change-in-use process by measuring the success/failure of specific actions. Designing such a data collection and management system is beyond the scope of the current Study, but it is recommended as an important step in managing multi-use trails.

2.3 Background for Recommendations

Appropriate multi-use trail design and management improves user satisfaction. This can result in users staying on the designated trail alignments and not creating unauthorized or volunteer trails. A higher level of user satisfaction also results in maintaining the use levels of the trail with no significant reduction of trail usage because of user displacement.

The research for this Study entailed review of numerous guidelines, standards, and practices used by local, regional, state, and national agencies and organizations to design and manage multi-use trails. The research sought examples that were related to trail systems in natural settings similar to CSP, with similar allowed uses, and a similar emphasis in trail use policies of providing public access to the resources of a park. The reviewed documents vary widely in terms of consistency with the CSP setting. Even the documents and practices from trail systems that are most comparable typically do not explicitly or thoroughly address ways to minimize conflict through design. Instead they tend to focus on design for low maintenance and environmental impact (together often termed sustainability), and user enjoyment. The goal of the recommended design measures is to identify those design elements that accommodate individual user types (hikers, mountain bikers, and equestrians), as well as combinations of those users in a design that meets each type of user's needs and minimizes the potential for conflicts between them. The most useful new guidance was found in the area of management measures and user outreach, and coordination to reduce trail use conflict. Although CSP documents mention many aspects of these measures, for the most part the recommended management measures are new, while the design measures are built upon existing CSP guidelines.

Natural-surface trail design is difficult to standardize across the country. By comparison, design of the public highway system has been the subject of many decades of intensive study, leading to a shared set of national standards for design and use management. Lack of consistency in multi-use natural-surface trail design standards is due in part to the highly complex and variable settings presented by the wide range of natural and open space landscape types. Also, each managing agency tends to have its own mission, policies, and traditions regarding the appropriate types of use, as well as design.

Through building codes and other standards, common practices have evolved for nearly every type of public facility to ensure they work for the intended use and provide for public safety. Natural-surface, recreational trails are, and logically should be, the “next frontier” in standardization. They are intended to allow people to

experience nature on nature's terms and not to standardize nature for their convenience. However, some level of modification of nature is necessary to provide access, especially for mountain bicyclists and equestrians. Bicycle access to nature and all the benefits of nature-oriented trails is clearly a growing need and desire of the increasingly urbanized U.S. population. Access for horses is an ongoing tradition and continues to be a strong demand. Shared use design standards are needed and are gradually emerging, evolving, and being adapted to local, regional, state and national trail settings.

In some respects, as public, multi-use, recreational transportation systems, multi-use trails can be compared to the national highway system – the most standardized end of the transportation project spectrum. The highway system is carefully designed to maximize safety while accommodating multiple user types, including passenger cars, motorcycles, and freight vehicles. These users may individually resent the presence of the other types of user, but they generally accept their right to use the road, and the rules and design features to avoid conflicts.

The Federal Highway Administration (FHWA) Office of Safety aims to ensure and improve safety on highways using a systematic approach that addresses all “4Es” of safety: engineering, education, enforcement, and emergency medical services. As indicated in this multi-pronged approach, design is a key element of conflict avoidance, but incidents can still occur between users for other reasons. There is no comparison between the size, speed, and volumes of traffic on the street and highway system with multi-use trails, but the principles of design and management for use accommodation and safety are the same.

Good design is a critical component of providing low-conflict, multi-use trails, but it needs to be accompanied by education about proper user behavior and enforcement to encourage users to abide by the rules of the trail to minimize trail use conflicts. On the highway system, accidents can never be completely eliminated. When the number or type of accidents reveals a problem, safety measures are prioritized, including redesign, information campaigns, and increased enforcement. Likewise, trail accidents, including those between different types of users (which are already rare), can never be completely eliminated, but CSP and other trail managers work to minimize the risk of accidents. Appropriate evaluation of whether a trail is a candidate for multi-use should consider trail design, behaviors and perceptions of current and prospective trail users that exacerbate conflict, and possible enforcement requirements. Appropriately addressing these considerations could substantially reduce the actual likelihood of trail conflicts, and greatly reduce the perceived concern about them as well.

2.4 California State Parks Trail Design Guidelines

CSP has prepared updated draft trail design guidelines that expand on and update the current *California State Parks Trail Handbook* (CSP 1994). These newer guidelines include improved standards for sustainable trail design and specific guidelines for design of pedestrian, equestrian, mountain bike, and multi-use trails. The draft guidelines include standard design principles to ensure that trails are suitable to the natural environment and can comfortably accommodate the types of uses that are allowed. These guidelines are in current use by CSP staff and will be incorporated into an update of the *Trail Handbook*, which is expected to be issued within one to two years. Previously unpublished relevant portions of the draft updated CSP trail design guidelines (CSP guidelines) are included in Appendix G of this Study, along with relevant portions of the current *CSP Trail Handbook* (1994).

These CSP *Trail Handbook* and guideline excerpts include:

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- Current trail classifications and related criteria;
- Trail design guidelines for overall suitability and sustainability;
- Guidelines for multi-use trail design, and;
- Guidelines for use-specific trail design, including mountain bike trails, and equestrian trails.

The Study research identified and evaluated design guidelines documents from many other agencies and organizations for their relevance to CSP trail settings and policies. The objective was to identify measures for accommodating different user types and minimizing conflict on multi-use, natural-surface trails. Design principles in the CSP guidelines often parallel the principles contained in other multi-use trail design guidelines or standards. CSP guidelines are listed in the measures, where applicable. In other cases, where CSP guidelines are inconsistent with another agency's approach, the CSP guideline measures are used, while measures from other guidelines are listed for comparison.

Design for Low-Impact, Low-Maintenance, Sustainable Trails

The current Study is focused on addressing trail use conflict, and does not seek to address design for landform, climatic conditions or the direct environmental or resource impacts of use. Sustainability is an important design consideration for trails in general, including for multi-use trails. A sustainable trail is designed, constructed or reconstructed to a standard such that it does not adversely affect natural and cultural resources, can withstand the impacts of the intended users and the natural elements while receiving only routine or periodic maintenance. It meets the needs of the intended users and encourages them not to deviate from the established trail alignment. Conversely, a trail that has become eroded, muddy, or rough due to poor siting, design, or the impacts of use, could increase trail use conflicts.

CSP trail design guidelines thoroughly address these basic trail factors, which are critical to providing trails that are suitable for the setting, environment, and intended use. There are a number of trail design principles that are commonly cited in trail design references to achieve low-impact, low-maintenance, sustainable trails. The literature review contained in Appendix B indicates whether the guidelines reviewed addressed design in the context of environmental suitability/sustainability. The CSP trail design guidelines exemplify these principles. As part of the overall Road and Trail Change-in-Use Evaluation Process Program EIR, a separate study of erosion potential and control has been prepared to support the Process (Pacific Watershed Associates 2011). This erosion study will also be used to support CSP trail design guidelines, and update the *Trail Handbook*.

2.5 User-Specific Design Considerations

Designing successful multi-use trails requires an understanding of the specific needs, tendencies, and limitations of each user type. CSP trail design guidelines and other design references cover this subject thoroughly. The following paragraphs summarize these considerations as context for the conflict avoidance/reduction recommendations that follow.

Hikers

Hikers are the most flexible trail users and allow the broadest trail designs. Traveling by foot allows hikers to adjust to varying trail conditions, travelling over trails that are extremely steep or barely evident. Hiking trails generally traverse all types of environments, land capabilities, grades and surfaces. While hikers can impact

the trail and surrounding resources, upgrading or adding structures to manage impacts of a hiking-designated trail is less problematic than for equestrian or mountain bike trails.

There are baseline design standards for hiking trails in the current CSP Trail Handbook and many other design references. The additional measures to accommodate equestrian and/or mountain bike access are the focus of the Low-Conflict, Multi-Use Trail Design Checklist.

Mountain Bicyclists

CSP design guidelines state that trails open to mountain bikes are intended for the use of the trail to visit unique park resources. Mountain bikers often desire challenging trail experiences including narrow single track, rough or loose surfaces, turns, and relatively steep grades. Aided by ever-advancing technology for light weight, power transfer, traction, and suspension, many mountain bikers are “pushing the envelope” of speed and obstacle negotiation capability. Mountain bikers can attain high rates of speed, particularly on wide trails with good sight lines, flat or downhill grades, and few obstacles. It is not CSP policy to provide trails for fast, highly technical, or adventure rides for mountain bicyclists within the State Park System.

As outlined in the Study findings, mountain bikers’ speeds are the primary reported cause for multi-use trail conflicts. Speed increases the chance that mountain bikers may fall off their bicycle independent of colliding with an object, particularly at turns with loose surface material or steep cross-grades. Speed leads to increased incidents with other users, single-use accidents, and perceptions of user conflicts, particularly if the mountain biker fails to provide adequate warning or passing space, or fails to yield right-of-way to other users. Thus, design of appropriate multi-use trails that include mountain bike access needs to emphasize bike speed control. The CSP trails emphasize speed control in their designs, and this is reflected in the current CSP trail design guidelines.

Mountain bike industry or user group design guidelines and management documents do not always explicitly emphasize speed control, but they often include measures that accomplish this, while placing an emphasis on adding technical challenge over controlling speed. Some of these speed control measures are appropriate in CSP settings, but many technical challenge features suggested by user groups and in some public agency design guidelines are inappropriately artificial and/or inconsistent with CSP policies for trail use in the State Park System. A trail open to mountain bikes in a CSP setting will not approach the challenge level (i.e., steep slopes, obstacles, or sudden turns) that may appear on “technical” or “challenge” trails constructed or allowed by some agencies, or featured in mountain bike parks. CSP trails are designed to place the emphasis on the user access to allow an appreciation of the natural setting and resources, rather than the mode of travel. Trails designed to be more challenging, such as those outlined in mountain bike user group guides and some agency references, may be feasible in California State off-highway vehicle areas, or potentially in California State Recreation Areas (SRAs) that are designated for more developed recreation facilities and uses. Mountain bike parks, such as at ski resorts, are helping to meet the demand for challenge and speed. In any case, design for such specialized use trails is outside the scope of this Study.

Although design to accommodate mountain bikes, including speed control features, is important, to make multi-use trails work, mountain bikers need to be aware of and cooperate with the type of use that CSP trails are intended to accommodate. CSP trail information emphasizes this, and the recommended trail use conflict management measures will help to reinforce this.

Equestrians/Horses

The inherent characteristics of horses are important to understand when considering trail use conflict issues involving equestrians. For instance, horses are herd animals and have the instinct to run when frightened. The U.S. Forest Service (USFS) *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds* states that horses and mules are prey animals, and flight is their primary defense (USFS 2007). They become nervous when escape routes are narrow or blocked and can startle when spooked when something comes by them unexpectedly and/or quickly. Any new element that is unfamiliar to the horse, such as a mountain biker, dog, llama, or even a hiker, can trigger this startle instinct, particularly when they appear suddenly. This can lead to a horse running, jumping, turning quickly, kicking, or biting. Because of the height at which equestrians ride, they can be seriously injured if they fall from a horse.

Given these characteristics of horses, other users using equestrian trails must yield the right-of-way. All equestrian trails should have signs that explain right-of-way protocols. When approaching a horse, other users should make themselves as visible as possible, not approach too rapidly, and speak in a low and friendly voice to ensure recognition. Other users should select a wide spot in the trail or an area with a gentle side slope and step off to the downhill side of the trail. Most equestrians prefer to have the uphill side of the trail during an encounter in case the horse bolts. When the horse approaches, other users should not make any sudden movements and should maintain their conversation. The hiker or biker should not step back on the trail until the horse is a full body length down the trail.

Equestrians also have responsibilities to comply with appropriate multi-use trail behavior. A horse that is inexperienced with encountering other types of trail users, especially in combination with an inexperienced rider, can be a hazard to other trail users, even if other users comply with trail use rules and guidelines.

2.6 Checklist for Low-Conflict, Multi-Use Trail Design

The Checklist for Low-Conflict, Multi-Use Trail Design presented below includes explanations and reference to relevant elements from guidelines and standards identified in the national research, and in some cases incorporates them. Design standards from the CSP guidelines are used in preference to guidelines from other agencies and organizations where there is any conflict.

These recommended measures are specifically tailored to apply to CSP trails. They are presented in an annotated checklist form that explains and lists the key design principles identified in CSP trail design guidelines and, where applicable, other Study research trail design guidelines, as effective for accommodating the individual user types and reducing conflict between users on the CSP natural-surface trails, particularly the nature-oriented trails that CSP facilities are intended to provide. The Checklist identifies the specific design standards for multi-use trails as they relate to mountain bike and equestrian use. .

The streamlined Checklist provided in Appendix A is reduced to a succinct list of recommended measures to allow CSP staff to quickly review it as part of the Road and Trail Change-in-Use Evaluation Process. The annotated Checklist in this chapter provides greater detail for completing the evaluation of conditions and needed actions. Many of the design evaluations are not simple measurements or “yes” or “no” answers; they involve careful study and consideration of multiple factors. The Checklist (either streamlined or annotated) will help to ensure that conflict-reduction objectives are considered in the Process, along with the basics of trail layout, design, and environmental protection.

The design recommendations include nine interrelated elements that support low-conflict multi-use natural surface trail design:

- **Tread Width and Passing Space.** Provide sufficient width of the trail tread and existing or created space to allow users to pass each other, either as a continuous condition, or as passing spaces at defined intervals. This also includes vertical clearance from overhanging trees and objects.
- **Sight Distance.** Include adequate length of the trail visible ahead to the user. This is particularly important to resolve in conjunction with speed control features, turns, and sinuous layout as sight distance increases as speeds are reduced.
- **Turn Radius.** Create a minimum inside radius of turns to ensure that they can be comfortably negotiated.
- **Sinuosity.** Lay out a trail with many curves and minimal straight sections (however, with sufficient sight distance). This helps limit the speed of mountain bikers and other users.
- **Speed Control Features.** Install pinch points, choke points, trail anchors, technical trail features, 'stiles', and other elements specifically designed to limit users' speeds and increase sight distance.
- **Surface Texture.** Design the relative smoothness, evenness, and firmness of the trail tread to moderate travel speed by mountain bicyclists, including the presence of irregularities.
- **Low Trail Structures.** Avoid steps and waterbar structures that constrain access for horses and mountain bikers and can create points of conflict.
- **Gradient.** Apply design limits or variations in the gradient of the trail to allow for multiple uses.
- **Trail Layout and Classification.** Consider suitability for multiple uses, factoring the level of use of the trail, availability of alternative trails and routes, and the potential for trails to primarily serve one or multiple user types.

It is important to emphasize that these elements must be combined carefully to work in concert with each other and with other trail design objectives – too much emphasis on one element could detract from other objectives. Relationships between the design elements are highlighted below.

Generally, when more measures can be checked off, the trail will be more appropriate for multi-use; however, there is no specific passing score or correct combination of measures – each trail project is unique.

2.6.1 Terminology

The CSP trail design guidelines and other standards and guidelines use specific terms to define different parts of trails or the setting for trails. The following definitions include terms used by CSP and other common trail design terms used in the recommended measures.

Clear area	Continuous, linear zone around trail free of obstruction to allow for safe, unimpeded travel.
Clearing height	Vertical clearance of obstructions across the width of the trail.
Trail bed or tread width	The width of the relatively level graded area created or utilized for the trail. In many cases the graded edges of the original trail bed slough so that the available width for the trail tread is reduced.

Trail corridor/ right-of-way	The width and boundaries where a trail is following a physical corridor, such as a road right-of-way, utility corridor, or former rail line, and/or a defined access easement corridor.
Trail shoulder	Natural surface, graded area, contiguous and flush to the trail tread, allowing a transition from the tread to natural terrain.
Trail tread	Actual surface portion of a trail upon which users travel excluding the backslope, ditch, and shoulder.
Hillslope, sideslope	The steepness of the slope on which the trail is constructed, or the resulting slope steepness adjacent to the trail after construction.
Front-country	Park areas that are within or close to urban areas. Many users are able to visit.
Back-country	Park areas that are relatively remote, and fewer users will be able to visit because of distance from trailheads and terrain.
Singletrack	Singletrack is a trail that is only wide enough for one person or mountain biker at a time. Singletrack is the most popular or sought after type of mountain bike trail.

2.6.2 Tread Width and Passing Space

A wider trail makes it easier for users to pass each other easily and safely. However, a wider trail may facilitate higher speeds by mountain bikers. Some agencies tend to restrict mountain bikes to “fire roads” and other road-width trails, because there is more room for passing and because there is generally better sight distance. These conditions may result in fewer complaints from other users, in part because these trails are less popular with mountain bikers and they may experience less use. Many mountain bikers seek “single track” trails for their interest, challenge, and better foreground scenery – the same reasons they are sought by other trail users. There is a trend among some agencies toward accommodating mountain bikes on narrower trails, which addresses demand for single track. Single track trails can also be designed to control bike speed more effectively than wide trails, but it is important that adequate passing space and sight distance are available. Singletrack trails would not be a component of CSP’s multi-use trail system.

The availability of passing space is more important than the continuous width of the trail tread; both trail tread width and trail bed widths affect the users’ ability to safely pass each other.

Measures

Front-country Trails:

1. Where mountain bikes are accommodated, but not equestrians: minimum tread width is 30 inches;
2. Where equestrians are accommodated: minimum tread width is 48 inches;

3. Where hillside slopes are steep, passing spaces are provided at regular intervals (the interval depending on the sight distance available):
 - A minimum of 48 inches wide and 60 inches long where mountain bikes are accommodated, but not equestrians;
 - A minimum of 60 inches wide and 60 inches long where equestrians are accommodated

Back-country Trails:

1. Where mountain bikes are accommodated, but not equestrians: minimum tread width is 18 inches;
2. Where equestrians are accommodated the minimum tread width is 36 inches;
3. Where hillside slopes are steep, passing spaces are provided at regular intervals (the interval depending on the sight distance available):
 - A minimum of 36 inches wide and 60 inches long where mountain bikes are accommodated, but not equestrians;
 - A minimum of 60 inches wide and 60 inches long where equestrians are accommodated

References

Unpublished CSP trail design guidelines (see Appendix G)

Other References:

- To allow hikers, equestrians, and mountain bikers to pass each other on the trail tread, some agencies recommend that the tread should be at least four feet wide (48 inches) (Portland Parks and Recreation, Santa Monica Mountains Area Recreational Trail Coordination Project), (Bondurant, Thompson, et. al. 2009); while others recommend a three-foot minimum (36 inches) (Midpeninsula Regional Open Space District 1993; Minnesota Department of Parks and Recreation; Santa Clara County Parks).
- Narrower trail width is part of a suite of speed control elements that are important for safe shared trails, and also minimize erosion (California Equestrian Trails and Land Coalition 2005). Alternatives to a continuous wide tread include:
 - Build a wide bench that is allowed to overgrow or clear a gentle hillslope (e.g., 20 percent or less) to act as stable shoulder for passing (Santa Clara County Parks; City of Portland Parks and Recreation 2009).
 - Provide passing areas approximately every 1,000 feet (CSP Accessibility Section 2005; Bondurant, Thompson, et. al. 2009). For equestrians, these should be five feet wide by 10 feet long to allow a single trail animal to pull off the tread (USFS 2007).
 - Particularly on trails with treads narrower than three or four feet, maintain good sight distance to make users aware of other trail users in advance.

2.6.3 Sight Distance

Similar to drivers on public roadways, trail users must be able to see ahead a sufficient distance to have time to slow down or stop, or warn and safely pass one another. Effective sight distance is, therefore, a function of

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user speed; where users are traveling relatively quickly, additional sight distance is required. Also, because some horses tend to be easily startled, additional sight distance is warranted where they are present, especially when sharing the trail with mountain bikes. Other animals, as well as hikers, can frighten horses, so the issue does not exclusively pertain to bikes. However, objectives for adequate sight distance are closely related to limitation of bike speed. CSP trails are not intended for challenge or speed-oriented riding, and a 15-mph speed limit applies to CSP trails statewide. This is the assumed design speed for sight distance, and it is a speed limit consistent with the intended use of the trails for access to and appreciation of nature. Riders who exceed this limit are engaging in inappropriate trail behavior, which is the subject of the Trail Use Conflict Management Checklist.

None of the natural-surface trail design guidelines reviewed provided a data-derived basis for their sight distance recommendations, though sight distance was commonly identified as a critical consideration. The closest approximation of science-based sight distance standard is contained in the Caltrans Highway Design Manual section for paved bike routes in Figure 1003.D (Caltrans, 2009). This chart shows the relationship between speed, slope, and coefficient of friction in calculating sight stopping distances. Although the coefficient of friction may be lower on natural-surface trails than on asphalt, mountain bikes with wide knobby tires may actually attain more friction than road bikes with very narrow tires. Given the great variation in natural surfaces, and difficulty of creating and maintaining a surface with a specific standard for coefficient of friction, sight distance standards for natural-surface trails comparable to the paved trail standards may never be practical. Nevertheless, this subject deserves technical study to at least evaluate the range of sight distances that may be appropriate for natural-surface trails.

While adequate sight distance is needed, long straight sections with long, clear sight distances can also facilitate mountain biker speed. This can be an issue particularly on downhill rides, if other measures are not present to control speed.

Measures

Where mountain bikes are accommodated:

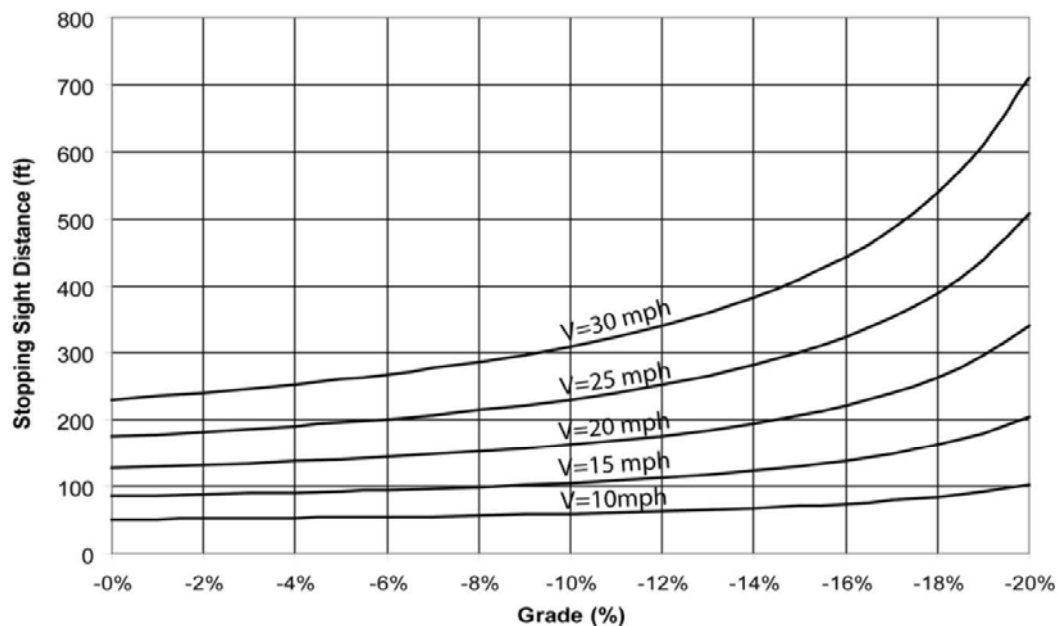
1. Sight distance of between 80 to 200 feet is provided, increasing in proportion to the percent of slope of the trail gradient (0 to 20%+). This assumes that a 15-mph speed limit is posted and generally enforced.
2. Where turns and/or speed control features are in place on a trail segment such that bike speed is controlled below 15-mph, sight distance may be reduced within that segment (but not the portions approaching).

Reference

Caltrans Highway Design Manual – Chapter 1000, Bicycle Facilities (2009)

Other Relevant References:

- Provide a 100-foot average sight distance (USFS 2007; Santa Clara County Parks Department; Flink, Olka, and Searns 1993; Midpeninsula Regional Open Space District 1993).
- Maintain sight lines by regularly thinning overgrowth, especially near curves and speed control elements (Flink, Olka, and Searns 1993; Wade County Parks and Recreation; Front Country Trails Multi-Jurisdictional Task Force).



$$S = \frac{V^2}{30(f - G)} + 3.67V$$

Where : S = Stopping sight distance (ft)

V = Velocity (mph)

f = Coefficient of friction (use 0.25)

G = Grade (ft/ft) rise/run

Figure 2-2. Caltrans Highway Design Manual Figure 1003.D – Stopping Sight Distance – Descending Grade (for paved multi-use paths)

Note: This Stopping Distance/Sight Distance chart applies to paved paths. It illustrates the relationship between factors that need to be considered in combination to determine Stopping Sight Distance on paths or trails in general – particularly the need for increased distance with increased speed and/or grade. Given the great variation in natural surfaces, and difficulty of creating and maintaining a surface with a specific standard for coefficient of friction, such specific sight distance standards for natural-surface trails may never be practical. However, paved paths also have friction and surface variation due to rain, leaves, pavement type and condition, and the above table represents an accepted generalization. This table may provide a template for possible future technical study of Stopping Sight Distance on natural surface trails. A 15 mph design speed may be appropriate, given the prevalence of a 15 mph speed limit/guideline on public multi-purpose trails.

2.6.4 Sinuous Layout

Sinuous trail layout refers to trails with many curves and few, if any, long straight segments. Curves are often necessary to follow the natural topography and geographic features, and to be in concert with the sustainable trail design principle of small trail watersheds. They also can create a more varied and enjoyable trail experience for all users. Curves and turns can be introduced where they are not otherwise required to slow mountain bikes speed.

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The “right” extent of sinuosity in a trail cannot be specified outside of the trail setting; some curves are facilitated by topography, or can be routed around groves of trees, rock outcroppings and other natural features. Introduced curves should blend into the natural landscape, at least when trailside vegetation matures. Trees or shrubs can be planted or logs placed to help reinforce the need for the curve.

While sinuous layout is primarily a speed control measure for bikes in the context of reducing trail use conflict, it also helps limit hiker and equestrian speed (e.g. trail running and galloping). Further, all trail users tend to enjoy a more sinuous trail, because they tend to offer more interesting views and varied experiences, compared to long, straight trail sections.

Sinuosity, curving alignments need to be designed or reviewed to ensure that adequate sight distance is provided around curves.

Measures

Where mountain bikes are accommodated:

1. The trail avoids long, straight segments (particularly on long downhills);
2. The trail follows a curvilinear alignment with numerous turns created by contouring around the landform, around trees and rock outcroppings, and dipping in and out of drainages.

Where equestrians are accommodated, but not mountain bikes, or even on hiking-only trails, sinuosity can be a desirable feature, but is not as high a priority.

Reference

Unpublished CSP trail design guidelines (see Appendix G)

Other Relevant References:

- Follow the natural contour of the land, gaining or losing elevation by crossing contour line obliquely, using trail anchors and pinch points, or by weaving the trail between trees and other features (IMBA 2007; Jefferson County Open Space).
- While sinuosity is recommended, turns should not be sudden or too tight for users to safely negotiate, and adequate sight distances must be provided. To accommodate equestrians, turns should have a minimum radius of five feet, with six to eight feet preferred (USFS 2007).

2.6.5 Turn Radius

Turn radius is the minimum inside radius of a turn in the trail that the average user can comfortably negotiate. Trail layout in hilly or mountainous terrain requires climbing turns (preferable, if the terrain is moderate enough to allow) and if necessary, switchbacks. Minimum turn radius is an important design criterion for trail turns and switchbacks, sinuous trails, and introduced speed control features. Horses are generally the controlling factor in turn radii for multi-use trail design.

Measures

Where mountain bikes are accommodated, but not equestrians:

1. Minimum turn radius is four feet for switchbacks (three feet for climbing turns);
2. Grade of the upper and lower leg of the turn does not exceed 14 percent, unless the material is durable enough to support a steeper grade, but in no case should grade exceed 20 percent.

Where equestrians are accommodated:

1. Minimum turn radius is five feet.
2. If the trail is used by pack stock, the minimum radius is six feet.
3. The grade of the upper and lower leg of the turn should not exceed 14 percent, unless the parent material is durable enough to support a steeper grade.

Reference

Unpublished CSP trail design guidelines (see Appendix G)

Other Relevant References:

- Hiking/mountain biking/equestrian trails: turn radii should be 10 feet minimum (City of Portland Parks and Recreation 2009)
- On trail curves and turns, the minimum comfortable radius is 5 feet. When turns are any tighter, stock may stumble over their own legs. Turns with a radius of 6 to 8 feet are more comfortable for both animal and rider. (USFS 2007)
- The minimum suggested radius for a climbing turn is 20 feet (6.1 meters). Climbing turns work best when built on slopes of 15 percent or less. In steeper areas, switchbacks are a better choice. (USFS 2007)

2.6.6 Speed Control Features

These features have many different terms and design concepts in the literature, but the common theme is slowing user speed; with the focus typically on mountain bikes. If designed in concert with natural topography, trees, shrubs, rocks and other site elements, these features can make the trail more interesting for all users, and avoid an introduced appearance. In the literature and practice, many of these features involve literal “choke points” or “pinch points” where the trail narrows between natural features or relocated natural materials, and users are required to weave through a series of features. Another term for a trail segment with several such tight turns is a “chicane”. Some user group and agency guidelines recommend installing challenging obstacles, such as narrow bridges, log jumps, and ramps to slow user speeds and/or create challenge. In a CSP setting these “challenge” or technical features are inappropriate. Speed control features must be designed to be easy for the average user to negotiate, and should not have the form or function of an artificial obstacle or challenge. Elements should be placed so that they provide more of a visual “pinch point” than a literal narrowing (see Figure 2-3). In other words, the trail width is maintained, but viewed from a distance the trail appears narrowed; users cannot travel in a straight line to negotiate the section of trail.

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Adequate passing space at appropriate intervals, as well as appropriate sight distance, must be provided in conjunction with the speed control measures.

Measures

Where mountain bikes are accommodated:

1. Otherwise straight trail sections are modified by using natural features such as trees or rock outcroppings, or relocated natural materials such as rocks or logs, to create curves and turns such that users must make a series of turns to negotiate the section,
2. The speed control features are substantial enough in volume that users can easily see them and will not accidentally or deliberately run over them (e.g., 3 to 4 feet high and 4 to 6 feet wide). They are constructed of rocks, logs, or root wads, and may include introduced or naturally occurring native vegetation;
3. They may be combined with a soil mound, but do not consist entirely of a soil mound, as this could be used as a jump;
4. They blend into the natural landscape, at least when trail construction and associated vegetation matures.

Where equestrians and mountain bikes are accommodated:

1. As above, plus a horse can easily negotiate the features (turn radius, width, clearance).

Reference

Unpublished CSP trail design guidelines (see Appendix G)

Other Relevant References:

- The trail 'flow' can be adjusted with anchors, turns, choke points, and surface textures to control speeds (IMBA 2004 and 2007). Speed control features include 'Speed chokes' (Wake County), 'Technical trail features' (Lake Tahoe Basin Management Unit), and pinch points (IMBA 2007; CSP Santa Cruz District) or stiles (Goldstein 1987).
- When designing a trail, leave selected large elements, such as trees or large rocks, and weave the trail around these 'anchors' (IMBA 2007; Wake County Lake Tahoe Basin Management Unit).
- Place two large rocks or halves of a fallen tree on either side of the trail with sufficient space for users to pass (IMBA 2007; Goldstein 1987; CSP Santa Cruz District).
- Maintain good sight lines in advance of speed control features to allow users to slow down in anticipation (IMBA 2007).
- Provide passing areas where users can wait if the feature allows only one user to pass at a time (IMBA 2007).

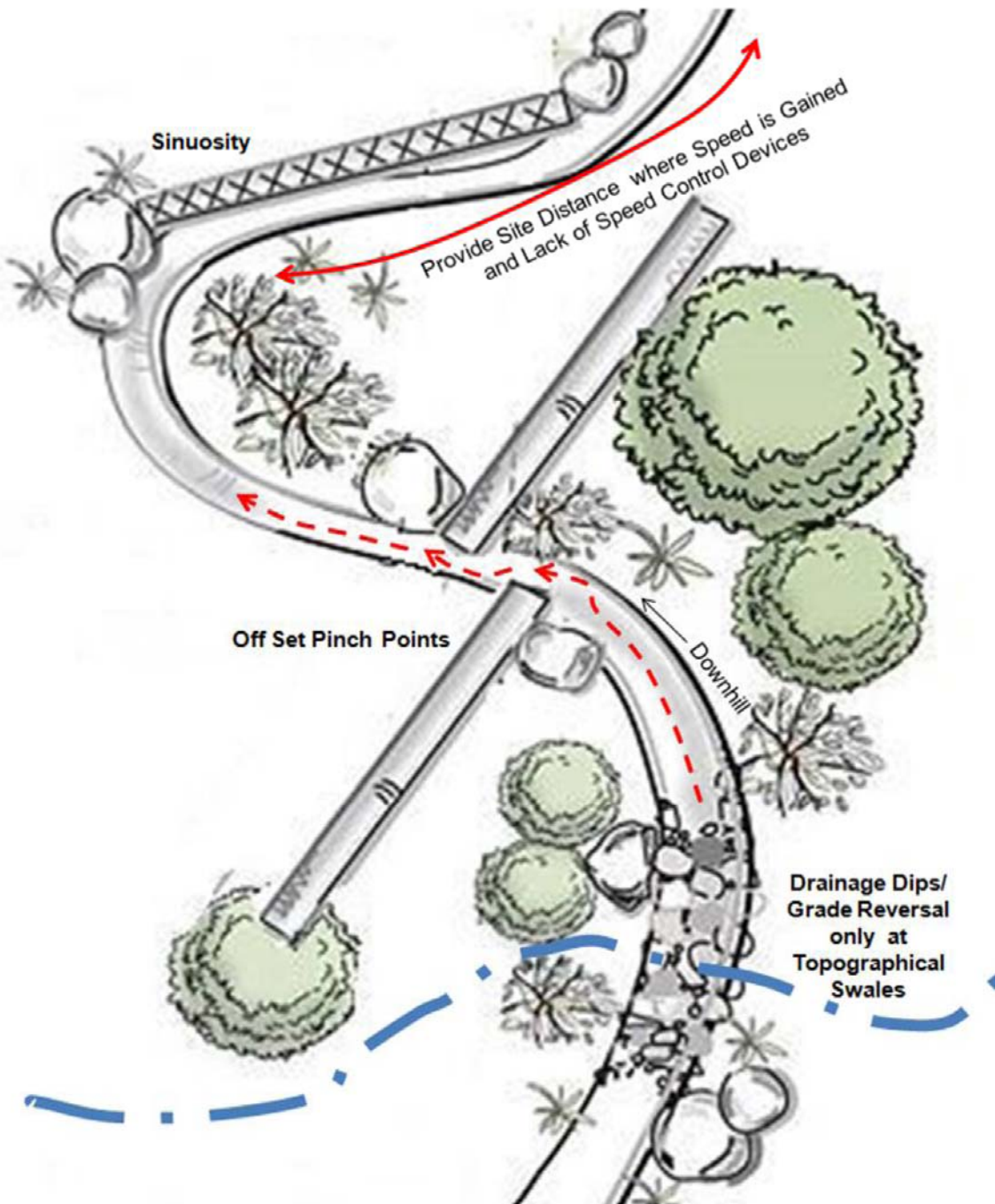


Figure 2-3. CSP Speed Control Measure Concepts

2.6.7 Surface Texture

Surface texture is important for trail safety. There are standards for the relative smoothness, evenness, and firmness of the trail tread and presence of irregularities. CSP and other trail design guidelines pay close attention to soil type, bedrock geology, and drainage to create and maintain a trail that will have a relatively smooth, even tread. However, surface irregularities can be a means of controlling mountain bike speed. Irregular surfaces are, within limits, desirable to many trail users, including hikers, equestrians, and mountain bikers, as part of a more natural trail experience. In some cases, rocky terrain or frequent tree roots dictate that there will be surface irregularities. In other cases, they can be deliberately retained. Retaining such irregular surfaces may be inappropriate, however, on more heavily used front-country trails, because there are a lot more users and more of them tend to be novices.

Measures

On back-country trails where mountain bikes are accommodated:

1. Where native rock is encountered during construction, a portion of that rock can be retained within the tread (textured or roughened surfaces), provided it does not impede overland sheet flow or present a tripping hazard;
2. The surface is fixed and presents a firm, non-slip surface (not loose, slippery or rolling);

Where equestrians are accommodated, the surface does not present sharp edges that may injure horses' hooves.

Reference

- Modify surface texture by placing rocks in the tread or using an uneven but stable material to control mountain bikers' speeds on trails (IMBA 2007).
- Maintain good sight lines and gradually transition to a change in surface texture or obstacle to allow users to slow down in anticipation (IMBA 2007).
- Unpublished CSP trail design guidelines (see Appendix G)

2.6.8 Low Trail Structures

Low trail structures, such as steps and waterbars, should be avoided on mountain bike and equestrian trails. Mountain bikers and horses have a difficult time negotiating these structures (especially mountain bikers riding uphill), and often ride around them, which can damage the trail or resources along the trail. These structures can be areas where conflicts between users occur. In any case, waterbars are not an effective drainage solution and should be a design solution of last resort.

Measures

Where equestrians or mountain bikes are accommodated:

1. Steps and waterbars are avoided, if possible. They should be design solutions of last resort.

Reference

Unpublished CSP trail design guidelines (see Appendix G)

2.6.9 Gradient

CSP trails are designed for users enjoying the natural resources, and grades should be determined by the land capability, climate, season of use, frequency of use, and canopy cover. Abrupt trail gradient changes cause hard braking by mountain bikers and greater hoof pressure by horses, which impacts the trail tread and could cause a loss of control in the case of bikers, a potential conflict-generating issue. Many of the studies and guidelines identified in the research address maximum gradients as a desirable principle for general multi-use trail design and, in some cases, as a means of controlling mountain bike speed. CSP trail design guidelines and practices do not include specific gradient limits, reflecting highly varied topographic and other site conditions that are the setting for CSP trails, and in response to the policy that the trails will conform to the natural landform and provide an experience of the natural setting.

Measures

Where equestrians or mountain bikes are accommodated:

1. Abrupt gradient changes are avoided. There is a gradual transition from steeper to gentler portions.

Reference

Unpublished CSP trail design guidelines (see Appendix G)

Other Relevant References:

- Build a small rise or minimize grade (10 percent maximum for extended lengths) to slow users at intersections and in locations with poor sight lines such as trail junctions or ridges (East Bay Regional Parks District (EBRPD) 2011; Santa Clara County Parks).
- Avoid abrupt changes in grade and fall line trails, which exacerbate erosion (USFS 2007; Hesselbarth, Vachowski, and Davies 2007).
- Grades should generally be 0 to five percent slope, with a maximum of up to 12 percent, as needed. (City of Portland Parks and Recreation 2009).
- Hikers, mountain bikers, and equestrians can comfortably and safely negotiate different maximum grades on a trail. For an accessible trail, the slope perpendicular to the direction of travel, the cross slope, shall be five percent maximum (CSP Accessibility Section 2005). The USFS *Trail Construction and Maintenance Handbook* recommends slopes of 15 percent or less on climbing turns (Hesselbarth, Vachowski and Davies 2007), while *Trail Planning for California Communities* states that ‘wildland trails’ should have a 12.5 percent maximum slope (Bondurant, Thompson, et. al. 2009). IMBA uses a maximum of 7 percent side slope grade for climbing turns and cites the 10 percent average guideline for sustainable trails (IMBA 2004).
- The USFS *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds* (2007) states that equestrian trails can be as steep as 20 percent grade for no more than 200 feet, otherwise switchbacks should be considered to minimize erosion. On running grades steeper than 5 percent, six to 12 inches of extra tread width should be added as a safety margin where possible (USFS 2007).

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- The City of Portland recommends that hiking/mountain biking trails and hiking/equestrian trails should have grades of zero to five percent slope or up to 12 percent, as needed (City of Portland Parks and Recreation 2009). Similarly, California Equestrian Trails and Land Coalition (CETLC) recommends keeping the slope as low as possible (preferably under 12 percent if possible) to allow safe places for passing and visibility (CETLC 2005).
- On running grades steeper than five percent, six to 12 inches of extra tread width should be added as a safety margin where possible (USFS 2007). Also, when trails have outslopes of four to five percent, widening the trail an additional six to 12 inches (152 to 305 millimeters) helps stock stay in the center of the tread (USFS 2007).

2.6.10 Trail Layout and Classification

Trail layout and classification measures do not address trail system layout in detail, a subject that is well covered in the current CSP Trail Handbook and other references. Trail users generally prefer loop trails to “out and back” routes. Bicyclists, and to a lesser extent equestrians, tend to desire longer trail loops than hikers. With equestrians, loop trails are important because a horse can become “barn sour” when retracing a path. When horses know they are heading back to camp or a trailhead, they sometimes get anxious. Knowing that food, water, the company of other horses, and the relief of not carrying riders is close at hand, can cause them to pick up their pace and become difficult to handle, potentially resulting in trail use conflict. This behavior is reduced when riding loop trails.

The context and classification of the trail influences the types and levels of use the trail receives, and these are important considerations for appropriate design and for conflict management. Information on CSP trail classification is provided in Appendix G.

When other public lands and trails connect or are nearby to the CSP unit, the trail’s role in the overall regional trail system also needs to be considered. Trails that are a main connection to destinations or that function as connector trails to a series of loops are likely to experience more use than more remote trails. Trails near trailheads experience the highest level of use and a higher level of design may be needed to accommodate multi-use.

These layout and classification considerations are strongly related to options for managing trail use discussed in the Trail Conflict Management Checklist under Separate Trails and Specialized Trails.

Measures

1. The review of the trail use change proposal considers the trail’s classification and role in the park unit trail system, and where applicable, the regional trail system. This includes the availability of alternative routes to trails that are otherwise open to the use being studied for addition, and the anticipated level of use.

Reference

Unpublished CSP trail design guidelines (see Appendix G)

Other Relevant References:

- Categorize trails according to a classification system such that trails that are anticipated to accommodate more users have a higher level of design, such as width or passing space, frequency of

speed control features, etc. (Forest Service, 2007; Marin Regional Open Space District; East Bay Regional Parks District City of Portland Parks and Recreation and Santa Clara County Parks Department).

- Provide loop trails or an arterial shared-use trail leading to single-use trails (IMBA 2007; Chavez 1996a).

Consider mileage of trails available for each use type when evaluating whether to open or close a trail to a user group. Provide sufficient alternatives to prevent a single trail from becoming overcrowded. [CSP, Karl had previously suggested that this implied a quota system. Let's discuss]

2.7 Measures for Trail Use Conflict Management

The Study found that measures for influencing trail user understanding and behavior through information, enforcement, and particularly pro-active communication with trail user groups and individual users, can be as important as physical trail design to address the overall social issue of trail use conflict. The research identified a set of factors and measures that should be considered, as summarized below and detailed in other Study chapters.

The Literature Review and Agency Survey conducted for this Study found that trail use conflict is heavily based on attitudes and perception. Also, the Study found that trail users who don't follow trail rules, courtesies, or common sense often contribute to conflict perception, incidents, and potentially accidents. Similar to the highways and paved trails that are part of transportation systems, "rules of the road" must be established, understood, and generally followed to create an acceptably low-conflict, trail use environment.

The research shows that trail managing agencies and organizations benefit from taking active steps to work with the users to address trail conflict, although the results and opinions are uneven. Conflict management is much more an adaptive process, and subject to local or regional social conditions and history, compared to multi-use trail design. It also tends to be an ongoing process that is highly dependent on available staff resources at a time when resources are increasingly stretched. Nevertheless, conflict management includes an important set of tools to create and maintain multi-use trails that work for the intended users and that conform to CSP policies for trail use.

Using this Checklist requires consideration of the overall trail and trail use setting and the history, nature and relationships of the types of users involved, including specific key individuals.

The overall management principles are important to consider in this Study; specific application details will vary from project to project. The measures are intended to provide a checklist of strategies that can be undertaken to reduce the potential for conflicts on multi-use trails. The greater number of measures in place and implemented, the more likely that conflict will be minimized; however, each situation is unique.

Management measures for reducing trail use conflict are listed below.

2.7.1 Management Strategies

Direct management strategies seek to regulate behavior through sanctions or fines (enforcement) while indirect strategies provide information and education to users to influence behavior. Techniques can be subtle or obtrusive, positive or appealing to a fear of consequence. Management strategies are discussed in this section under the following six categories:

- Rules– adopted and enforceable rules, regarding staying on designated trails, right-of-way, warning when overtaking, speed limits, etc.;
- Enforcement – monitoring, warnings, radar, and citations;
- User information – information about rules, policies, and advice for trail user respect, right-of-way requirements, and courtesy; routes, destinations and conditions;
- Data tracking - collecting and tracking data on trail use conflict incidents and design or management successes;
- Separate trails and specialized trails - alternate use days, one-way trails, and designated use-intensive trails.

Rules

Typical rules include posted speeds, yielding expectations, and where and when users can be on a trail. Park agencies often have the power to cite, give warnings, or exclude users who break rules. If rules are not adopted and posted, they are not enforceable, and if they are not actively enforced, there may be greater difficulty managing user behavior. Rules should be clear, consistent, and fair with regard to the relative potential issues caused by different types of users. People are more willing to comply with rules when they understand the reasons for them. At a minimum, posted rules should include: stay on trails designated for your user type; yield to other users per the “trail right-of-way triangle;” warn when approaching/passing; and comply with the CSP 15-mph speed limit for trails.

Measures:

1. Rules are adopted and posted (see Public Information) with details of the relevant state codes so that they are clear and enforceable (see Enforcement).

Relevant References:

- A 15-mph speed limit can be posted (Santa Clara County Parks Department; CSP Gold Fields District; Jefferson County; Sacramento County); however, challenges to the use of speed limits include difficulty of enforcement, lack of enforcement staff, and users’ limited knowledge of the speed they are traveling (Bondurant, Thompson, et. al. 2009; IMBA 2007).
- Focus enforcement at parking lots and use radar guns to enforce speed limits (EBPRD 2011).
- Trail offenders can be sentenced to work service on the trail as part (or all) of their penalty (Flink and Searns 1993).
- Enforce rules consistently to assure users that there is no perception of discrimination among different user groups (Flink and Searns 1993).

User Information

Having enforceable rules is a first step, but effectively communicating them and the reason for the rules is critical to achieving compliance. Relevant information should go beyond rules to include trail courtesy and safety guidelines. This includes information about the characteristics and needs of different user types, and how to behave or prepare to minimize the risk of conflicts and accidents. Examples include shared-trail training and experience for horses and riders, bells and call-out techniques for mountain bikers, and information about routes, destinations and conditions to allow users to make informed choices. Many organizations, including CSP units, have already developed public information materials that can be used and adapted. It is important that the rules and guidelines are consistent with adjacent/connecting lands and trail systems, or that the information clarifies inconsistencies.

Measures

1. Information is available regarding trail use rules and reasons for rules, courtesies, behavior and preparation, and trail designation and condition.
2. The information is posted at major trailheads in detail (e.g., on a mapboard) and summarized on signs.
3. The information is included with printed maps and brochures for the unit.
4. Consistent information is posted on the unit website, and where applicable, on local web sites (e.g., partner or volunteer organizations).

Relevant References

- Interpretation messages are as effective as sanction messages and both types are more effective than no message (Duncan and Martin 2002).
- Cite specific policies with enforceable rules and applicable penalties on signs posted at trailheads, in trail brochures, and on maps (Flink and Searns 1993).
- Maximize efficacy by addressing problem behaviors that are characterized by careless, unskilled, or uninformed actions (Manning 2003).
- Distribute information via multiple media, including brochures, personal messages, audiovisual programs, newspapers, magazines, guidebooks, trained volunteers, outfitters, commercial guides, wilderness ranger and volunteer role modeling, and design information for a variety of target audiences (Manning 2003).
- Connect with or modify visitor attitudes, beliefs, or norms and provide information on the impacts, costs, and consequences of problem behaviors (Anderson, Lime, and Wang 1998; Manning 2003).
- Enforce rules in addition to posting signs (CSP Gold Fields District; Tualatin Hills Parks and Recreation District; Mecklenburg County Park and Recreation; and City of Portland Parks and Recreation).

Enforcement

The presence of rangers or other authority figures on the trail can deter violation of rules and encourage users to follow trail etiquette and use guidelines. Ranger patrols can monitor and track issues; inform, warn and cite

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users who violate posted rules; and record and respond to comments or complaints from users. Volunteer patrols (see Volunteer Programs) can support all of these enforcement efforts except citations, and in some cases have been found to be a more acceptable and less threatening form of intervention with trail users because they are at more of a peer-to-peer level. In some cases private non-profits are under contract to provide management assistance that may include this role.

Measures

1. Ranger patrol time is allocated for the trail to monitor, inform and enforce compliance with the rules, and encourage awareness and compliance with courtesy, safety and environmental guidelines;
2. An organized volunteer patrol exists or is being formed that will actively support rangers on monitoring and informing trail users.

Relevant References:

- Where speed limits are posted, have rangers enforce speeds, issue citations, or issue warnings to rule breakers (Tualatin Hills Parks and Recreation Department; City of Durango; City of Portland Parks and Recreation; Sacramento County Parks).
- Off-duty police can assist in enforcement (Mecklenburg County; City of Durango).
- Volunteers can assist with patrolling the trail, discussed in the outreach section. Volunteer patrols act as the 'eyes and ears' of a land manager and can enhance visitor experiences, assist land managers, promote trail stewardship, and respond to incidents (IMBA 2007). Volunteer patrols can also model appropriate behavior.

Public Notification and Input

When a trail use change is being considered, or any other major change in trail system conditions or operation is undertaken, it is important to thoroughly notify and involve the users and other interested parties (e.g. other agencies, adjacent property owners, and related businesses) early in the process. This pertains to the formal, project-specific planning and management process, and also to effective ongoing general coordination with the public, as discussed under Outreach and Coordination.

Measures

1. Notice of the proposal and a means and adequate timeframe (e.g. one month) to comment is posted in sources that are likely to reach the interested parties: trailheads, web site(s), local paper, park and local bulletin boards;
2. Notice of the proposal has been emailed to local and statewide user groups and contacts generated by the unit, local press, and adjacent agency contacts, etc.
3. At least one public meeting regarding the proposal has been held/ is scheduled at a time and place that is accessible to most parties, and notes of comments have been/will be created and made available to attendees and points of notification/contact.

Relevant References

- When an agency changes management practices to mitigate conflicts, public dissatisfaction with the decision-making process can be a barrier to implementing management regulations (Front Country Trails Multi-Jurisdictional Task Force – City and County of Santa Barbara, Town of Pagosa Springs).

Collecting and Tracking Data

Data on complaint or incident reports, particularly involving accidents, is valuable to determine how conflict-reduction measures are working. The data is more valuable if specific details are captured (date, time, location, weather, user types, contributing factors, outcomes). The data's usefulness is further enhanced if there are also counts or at least an estimate of trail use to provide a context about relative frequency of occurrence. Based on the scarcity of hard data in the research results, collecting and tracking such data is beyond the abilities of already strained trail management staff. It may be possible to work with volunteers to collect and manage data, but this may raise the issue of bias, if the volunteers are from one type of user or another. Educational institutions or interns may also be used to collect and analyze data. This information can promote user trust in management, thereby lowering perceptions of conflict. Ideally, data would be collected on an ongoing basis; however, collecting data before and after a major trail use change would be a higher priority.

Measures

1. Trail use and incident/accident data is collected, maintained and analyzed in an organized system, as feasible.
2. Volunteers or partners are assisting with data collection and management
3. The data is being collected and analyzed on a short-term project basis in association with the trail proposal;
4. The data is being collected and analyzed on an ongoing basis.

Relevant References

- To effectively deter noncompliant behavior, gather incident and complaint data, use estimates, and user surveys to address the reason(s) behind the behavior and not just the symptoms (Anderson, Lime, and Wang 1998).

Separate Trails and Specialized Trails

User types can be separated by designating some trails for single-use or primary-use. Some agencies have designated trails that are advertised for a particular use, where other user types are secondary or prohibited. This allows the agency to focus design criteria on accommodating a single or fewer user types, providing more flexibility, and it avoids user conflicts on the specific trail segment(s), at least to the extent that other users comply or are comfortable being secondary.

Alternate days for different user types have been designated on some trail systems, with varying level of success. One-way trails have also been established, although this raises the risks of failure to comply. These solutions are more effective on local or front-country trail systems with a more stable user base, and where agencies have the ability to inform the users in advance of the rules.

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Separate trails can also be designated for different users. A shared-use feeder trail can lead to separate loop trails for different users, although having parallel but separate facilities in the same corridor may result in resource protection challenges.

Measures

This part of the Checklist does not include specific measures, as the options and their potential feasibility are very case-specific.

Relevant References:

- Designate a use-intensive trail or area (Chavez 1996a).
- Develop parallel tread in the same trail corridor if land base and/or resource concerns allow (USFS 2007).
- Use restriction management techniques include alternate use days, one-way trails, and designated use-intensive trails (Flink and Searns 1993).
- Consider implementing alternating day access, in which mountain bikers are allowed on the trail one day and hikers on another (Jellum 2007; National Park Service [NPS] 2003; Flink and Searns 1993; Jefferson County Open Space).
- Consider designating one-way trails on which mountain bikers can only ride in one direction at all times or on certain days (Jefferson County Open Space; Flink and Searns 1993).
- Other natural area management strategies have found that visitors accept use limit policies if they feel the resource requires the protection afforded by the policy (McCool and Christensen in Lime et. al. 1996)
- Restricting or prohibiting activities can be highly obtrusive and “lead to a strong sense of ‘being managed’ on the part of the visitor”, which can result in a climate of conflict (Anderson, Lime, and Wang 1998).

Spatial Separation

- A survey of mountain bikers in National Forests nationwide found that the management strategy of providing separate trails for different users “was not regarded as a plausible solution by any of the participants.”
- A common strategy to separate users who travel at different speeds is to provide parallel tread in the same trail corridor. While this practice is commonly used to separate pedestrians and equestrians from road bicyclists on a paved trail, the strategy is also employed on fully soft-surface facilities. The City of Henderson (NV) and Town of Pagosa Springs (CO) recommend providing separate, parallel equestrian trails.

Temporal Separation

- Different types of use can be allowed on the single tread at different times of day, days of week, season of the year (Flink and Searns 1993)
- A study in Chilkooot Trail National Historic Site, British Columbia found that a management strategy that excludes snowmobilers every third weekend successfully reduced goal interference while increasing skiers’ satisfaction but reducing snowmobilers’ (Jackson, Haider, and Elliot 2004).

- Both hikers and bikers supported an every-other-day exclusion policy in the Snoqualmie National Forest, Washington. Equestrians were not allowed on the system. (Jellum 2007)
- An Environmental Study considered alternating days when mountain bikers and equestrians were allowed on the Cactus Forest Trail in Arizona. The discussion of the alternating days scenario noted that, while the potential for conflict would be reduced, “some recreationists may feel constrained, and others may be displaced” which were considered “adverse, short- to long-term, and of negligible to moderate intensity depending on the individual” (NPS 2003).
- A survey conducted in the Jefferson County Open Space trail system west of Denver, Colorado categorized users who did not observe, but perceived a problem (“social values conflict”) and those who both observed and perceived a problem (“interpersonal conflict”). The study found that more conflicts were reported about mountain bicyclists than hikers. Mountain bicyclists, hikers, and people who participate in both activities all reported more interpersonal, rather than social value conflicts. The study concludes by recommending separation between mountain bicyclists and hikers, stating that, “When the conflict stems from interpersonal conflict, zoning incompatible users into different locations of the resource is an effective strategy” (Carothers, Vaske, and Donnelly 2001)

2.7.2 Outreach and Coordination Strategies

The research has demonstrated that working with trails and user groups, holding public meetings, and educating the public has often been beneficial in reducing conflicts between users and improving safety. Outreach and coordination involve ongoing staff work with user groups, and ideally user groups working with other user groups, to build understanding and cooperative relationships to encourage compliance and minimize conflicts. These measures apply basic trail and trail use information to project-specific and location-specific communications. User group outreach and coordination can include the following strategies:

- Education – user-specific printed materials and web postings, and/or an active, focused public relations campaigns to educate users about trail use rules and appropriate behavior;
- User group relations – general (rather than project specific) meetings with user groups about trail safety or conflict-related issues, or objectives, such as making, improving and maintaining trails and making the trail experience more enjoyable;
- Volunteer programs – ongoing trail patrol and/or maintenance assistance, specific projects, and help with outreach and education regarding conflict avoidance, safety, and courtesy;
- Events –multi-user social, fun, trail construction or maintenance events (e.g. Trail Education Days).

Education

In addition to the basic information discussed under User Information, agencies can reach out to the general user population and to specific types of users to educate existing and prospective trail users about trail use rules (and reasons for the rules), courtesy and safety guidelines, and other information for safe, fun and environmentally compatible trail use. Such education is often combined with project or user group meetings, events and other activities via websites, advertising, outreach to schools, and other activities. Outreach should ideally involve two-way communications – the public can ask questions and get answers, and comments are collected and are reviewed by managers.

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Measures

1. Staff or representatives (volunteers or docents) speak at local events, schools, user group regular meetings or other venues to carry overall CSP or unit messages as well as specific safety and conflict management and environmental compatibility messages.
2. Educational outreach includes collection of comments and consideration by management staff.

Relevant References

- Ranger patrols and/or volunteers should speak directly with trail users about sharing the trail (Lake Norman State Park, Jefferson County Open Space, Turlock Lake, Front Country Trails Multi-Jurisdictional Task Force).
- Target presentations of best practices of trail sharing to user groups (CETLC 2005; Flink and Searns 1993; Santa Barbara).
- Reach out to local schoolchildren through skits and trail events to inform them about appropriate trail etiquette (Conejo Open Space Conservation Agency - COSCA).
- Hold training clinics for equestrians and mountain bikers to teach the horses and riders to meet cyclists in varying situations (CETLC 2005).

User Group Relations

Agencies can work with established user groups to build public support for a trail project or management strategy. Such ongoing contact can build trust and a positive relationship because it goes beyond attendance at an occasional or project-specific meeting where tensions may already be high. These contacts can be venues for venting, initially or even permanently, but this can potentially lead to a better understanding and relationship.

Measures

1. Managers or staff regularly attend user group meetings and/or make informal general contacts on an ongoing basis.
2. Managers or staff regularly attend multi-user trail group meetings such as county trail committees, or have formed their own multi-user group and coordinate with them.
3. Volunteers or docents support staff in this capacity, representing CSP positions and reporting back to staff.

Relevant References

- Collaboration between field staff and the mountain bike and equestrian communities can create a shared sense of resource protection and stewardship between staff and user communities (EBRPD 2011).
- Create a trails committee or stakeholder group of individual trail users to gather input on the project (IMBA 2007; Chavez 1997; Moore 1994; COSCA, Vancouver-Clark Parks and Recreation Department VCPRD, Gold Fields, Bureau of Reclamation Lower Colorado Region, City of Henderson).

- Hold joint trail construction or maintenance projects and skills workshops among different users (Moore 1994).
- Hold public meetings, issues identification workshops, community design workshops, public hearings, citizen advisory committees, surveys, and mass media outreach (Moore 1994).
- Collaborate with trail groups to plan, construct, and manage trail projects (VCPRD, Oregon State Parks and Recreation, Front Country Trails Multi-Jurisdictional Task Force, Town of Crested Butte, Mecklenburg County, City of Durango, and Oregon Parks and Recreation).
- Designate a staff member to attend user group meetings and to work with particular groups on trail work days (CSP Gold Fields District).
- Maintain regular communication with different user groups and bring issues to them as necessary (Mecklenburg County, City of Durango).
- Discuss problems with affected user groups via land manager trail walks (Moore 1994).

Volunteer Programs

Agencies can work with or even form volunteer groups to maintain or patrol trails and to encourage and exhibit proper trail etiquette. This can include volunteer trail patrol to assist with monitoring and informing users about rules, courtesies and desirable practices. Working with and especially forming a volunteer group has significant time requirements. There are complex procedural, legal, and safety/liability concerns that go beyond the scope of this discussion. However, where feasible, and in favorable circumstances, volunteer groups can be tremendous resources for addressing trail safety and conflict, as well as assisting with construction and maintenance. Ideally, volunteer groups include members from all user types. Volunteer groups from a single user type are most effective working with their own peer groups. Concerns about potential bias may arise from other groups

Measures

1. Volunteer group(s) exists that take an active role in working with the CSP unit and their respective user type (indicate user groups represented).
2. A multi-user volunteer group with balanced representation from types of users exists and actively helps CSP staff to work with trail users.
3. A multi-user volunteer trail patrol with balanced representation from types of users exists and actively supports CSP staff and works with trail users.

Relevant References

- Messages from other mountain bikers are more effective in changing mountain bikers' behavior than those coming from a uniformed agency volunteer or a hiker (Hendricks et. al. 2001).
- Organize volunteer patrols or 'Trail Watch' groups to remind users of proper etiquette, model good behavior, and assist trail users with questions (IMBA 2007; CSP Gold Fields District; Jefferson County Open Space; Tualatin Hills Parks and Recreation District; CRD Parks; City of Henderson).
- Have volunteers assist with events such as trail maintenance days and Share the Trail events (Flink and Searns 1993; Bondurant, et. al. 2009).

Trail Events

Agencies can organize or facilitate public events supporting local trails, such as trail construction, repair, or maintenance work days, or events that are simply intended to be fun and social and to allow different user groups to come together in a controlled and cooperative way. These events can improve relationships and consideration between trail user groups and with CSP staff, and are opportunities to convey messages about how to avoid trail use conflict.

Measures

1. The CSP unit participates in trail events and provides information and presentation on appropriate trail use as part of their participation in the events.

Relevant References

- Hold “Trail Education Days” for students (COSCA).
- Organize trail work days that include all types of users (Moore 1994; CSP Gold Fields District).
- Encourage user groups to hold ‘carrot rides’ or ‘Romp N’ Stomp’ events in which mountain bikers feed carrots to equestrians’ horses (CSP Santa Cruz District; Moore 1994; IMBA 2007) or bell give-aways (City of San Luis Obispo).

Chapter 3. Research Results

This chapter presents the combined results of the Literature Review and the Agency Survey regarding the nature of trail use conflict and potential solutions. It summarizes the responses without drawing conclusions as to their applicability to California State Parks (CSP) trails, which is accomplished in the Summary Findings in Chapter 1, and the Recommendations in Chapter 2. More detailed results of the Literature Review are presented in Appendix B, and more detailed results of the Agency Survey are presented in Appendix C.

3.1 Introduction

The existing literature and the information provided in the survey responses primarily consist of the opinion of trail system managers and users. Even peer-reviewed academic or U. S. Forest Service (USFS) publications primarily rely on manager and user surveys. Few sources have used detailed data, such as complaint or incident reports, as a basis for analyzing the nature and extent of trail use conflict issues. While there is a wealth of documents and articles on the topic of user conflicts on multi-use trails, the majority of the literature does not provide empirical data regarding the presence, extent, or attributes of user conflict or incidents. While 63 of the 80 Literature Review sources define the problem of trail user conflicts, several of them do so as a presupposition based on previous literature (14 sources), or the author's experience (13 sources). Several sources present surveys on managers' perceptions of conflict (9 sources) or users' perceptions of conflict (22 sources). None of these surveys asked the frequency of actual trail use conflict-related incidents or accidents. This notable lack of citations regarding specific incidents and accidents implies that they occur infrequently.

Documentation of design challenges and solutions is also primarily based on opinion, and does not reflect empirical study or evaluation of success. However, there is a large body of practical experience and informed opinion represented in the research results, and this reflects the "state-of-the-art" in multi-use trail design and management with respect to trail use conflict.

In the following summary, where a theme was cited by a single source, or multiple agency or document sources, the reference follows. Where jurisdictions are cited without a date, the source is that jurisdiction's Agency Survey. If several sources supported the finding, the text provides general reference to support without specifically identifying all documents or agencies. These findings and the supporting documentation are presented in more detail in the Literature Review and Agency Survey presented in Appendices B and C of this Trail Use Conflict Study.

3.2 The Nature of Trail Use Conflict

The literature reviewed and agencies surveyed strongly supported the idea that conflicts between trail users are highly influenced by perception, attitude, and behavior.

U.S. Forest Service (USFS) Lake Tahoe Basin Management Unit staff noted that use conflicts are "very subjective and determined by individuals." Three agencies noted entrenched negative perceptions of other user groups arising from a history of conflict or disagreement; CSP Gold Fields District, the Front Country

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Trails Multi-Jurisdictional Task Force, and Jefferson County Open Space all cited historic conflicts contributing to an environment where managers had difficulty addressing root causes of conflict perceptions.

Six percent of the survey respondents noted that the users' purpose of visiting the trail influenced their behavior; conflicts between recreationists and families were mentioned. Less frequent conflicts cited were caused by meet-up groups and running clubs or other users traveling side-by-side and blocking the trail. Comments at the Program Environmental Impact Report (EIR) scoping sessions included concerns that mountain bikers' speeds discourage equestrians and hikers from using the trails.

Conflict is commonly defined as "goal interference attributed to another's behavior," stating that users' dissatisfaction (conflicts) from a perception that other users are preventing them from actualizing their recreational goals (Jacob and Schreyer 1980). They note that this goal interference does not necessarily imply goal incompatibility; users may visit the same trail for similar reasons, despite using different modes.

More recently, Moore (1994) advanced this theory of conflict as interpersonal disagreements, writing that "conflict has been found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users" (Moore 1994). Watson, a researcher with the USFS, observes that perceptions of conflict are frequently unrelated to measurable incidents of interference in outdoor recreation, but rather reflect an attitude towards wilderness and stereotypes of other user groups (Watson 2001).

Only 2 percent of users surveyed in Boulder County Parks and Open Space reported experiencing conflict on the day of the survey. One-third reported having experienced a conflict at some point in the past. Nevertheless, users reported several complaints, particularly about mountain bikers' speeds, failure to yield, and not communicating when passing (Bauer 2004). In Ohio, State Park managers and district supervisors surveyed reported concerns about mountain bikers' excessive speeds and potential for conflict with other users (Longsdorf 2006).

A 2001 survey of trail users in the Jefferson County Open Space trail system considered the extent to which conflicts between users are interpersonal (based on physical presence of other users) or social values (no contact has to occur). The survey supported the studies, finding that all types of users reported more interpersonal (physical interactions between users) than social values conflicts (Carothers, Vaske, and Donnelly 2001).

Several surveys of trail users have indicated that conflicts between users were highly influenced by perception and orientation. Research conducted in the Bridger-Teton National Forest found that users who had past experience with other trail activities experienced less conflict when encountering participants of those activities than respondents who had never done those activities before. People who had participated in an activity in the past were also more likely to report increased enjoyment due to encounters with that group than were trail users who had never done the activity before, although the relationship was less statistically significant between mountain biking and horse riding (Bradsher 2003).

A survey conducted for the report, *Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand* (referenced in U.S. literature) indicated that pedestrians who had not encountered any bicyclists had more negative perceptions of bicyclists than those who actually encountered them (Cessford 2002). A survey in Wellington Park, Australia found that users had different goals for use of the park;

mountain bikers visited the park for ‘socializing’ and ‘excitement/risk’, while other users desired ‘relaxation’ (Chiu and Kriwoken 2003).

3.3 Primary Types of Conflict

Conflict issues often relate to users' perception of being unsafe, or just annoyed, due to the presence of other types of trail users. Many of the comments received from the Program EIR scoping session stated that conflict is related to mountain bikers failing to yield or passing too quickly. Similarly, common concerns related to user conflicts in both the Literature Review and the Agency Survey include mountain bikers' speeds and lack of warning and/or yielding when passing. Of the 36 surveys returned, the most frequent conflicts noted were between pedestrians/hikers and bicyclists/mountain bikers (68 percent). The second most frequent concern from the Agency Survey was related to conflicts between users with dogs and those without (41 percent). Only 18 percent cited issues between equestrians and mountain bikers, despite this being a prevalent concern in the Program EIR scoping comments.

Six percent noted that users' purpose of visiting the trail impacted their behaviors; conflicts between recreationalists and families also arose. Less frequent conflicts may be caused by meet-up groups, and running clubs, or other users traveling side-by-side and blocking the trail. Comments at the Program EIR scoping sessions included concerns that mountain bikers' speed differential discourages equestrians and hikers from using the trails.

3.4 User-Appropriate Trail Design Strategies

Design can help to minimize the occurrence of incidents, but not eliminate them. Design strategies are defined as physical trail configuration or alignment treatments intended to create a user-appropriate trail experience for designated user types. Incidents are reduced when user-appropriate designs on multi-use trails are implemented.

Design standards tend to feature general solutions that are not primarily directed at minimizing incidents on multi-use trails. Instead they focus on overall user-appropriate design and sustainability, providing dimensions and specifications for multi-use trails as an aggregate of designs for single-use trails. In this context, adequate sight lines, width and/or passing areas, and elements of design that reduce speeds are frequently mentioned in design guidelines for successful multi-use trails. Among agencies that have comprehensive design guidelines, agency staff often cited design elements that were not documented in the standards, but were based on their professional experience and practice.

In both the Literature Review and the Agency Survey, user-appropriate trail design emerged as being critical to minimizing conflict and user-perceived safety concerns on multi-use trails. In *Trails for the 21st Century*, Flink, Olka, and Searns (1993) stress the importance of designing a trail with the users in mind, stating that, “Accommodating a range of users within a single trail depends on trail width, trail surface, and speed of trail users” (Minnesota Department of Natural Resources 2006).

3.4.1 Agency Design Standards and Guidelines

In addition to their own guidelines, agencies surveyed tend to use select state or national guideline documents. The CSP districts primarily use the CSP's *Trail Handbook* (1991), while the USFS and several other

agencies refer to the USFS *Trail Construction and Maintenance Notebook*, FSH2309.18 (USFS 2007). Several agencies also report using the IMBA manual, *Trail Solutions: IMBA's Guide to Building Sweet Single-Track* (IMBA 2004), as well as *Managing Mountain Biking: IMBA's Guide to Providing Great Riding* (IMBA 2007).

3.4.2 Trail Design Strategies

Few documents or agencies provide specific guidance for design measures to address user conflicts, although many documents and agency staff note the significance of the issue and provide general recommendations for solutions. Although multi-use trail design standards vary widely, five design approaches emerged as common themes from the literature review of design standards and survey responses from agencies and organizations that have focused on trail use conflicts on natural surface trails:

- **Adequate Width and Passing Area**– width of the trail tread and cleared space or trail bench to allow users to pass each other, either as a continuous standard, or as passing spaces at defined intervals.
- **Sight Distance** – the length of the trail visible ahead to the user. This is particularly important to resolve in conjunction with speed control features and curvilinear design.
- **Speed Control Features** – including pinch points, trail anchors, technical trail features, ‘stiles,’ uneven tread surface, and other elements specifically designed to reduce mountain bikers’ speeds.
- **Gradient** – limits or variation in the gradient of the trail. This was often referenced as consideration for controlling mountain bikers’ speeds.
- **Curvilinear /Sinuous Design** – curving layout of the trail that encourages mountain bikers to slow down, and tends to add to the natural quality and sustainability of the trail.

Figure 3-1 shows the frequency which the Literature Review and Agency Surveys referenced each of these solutions.

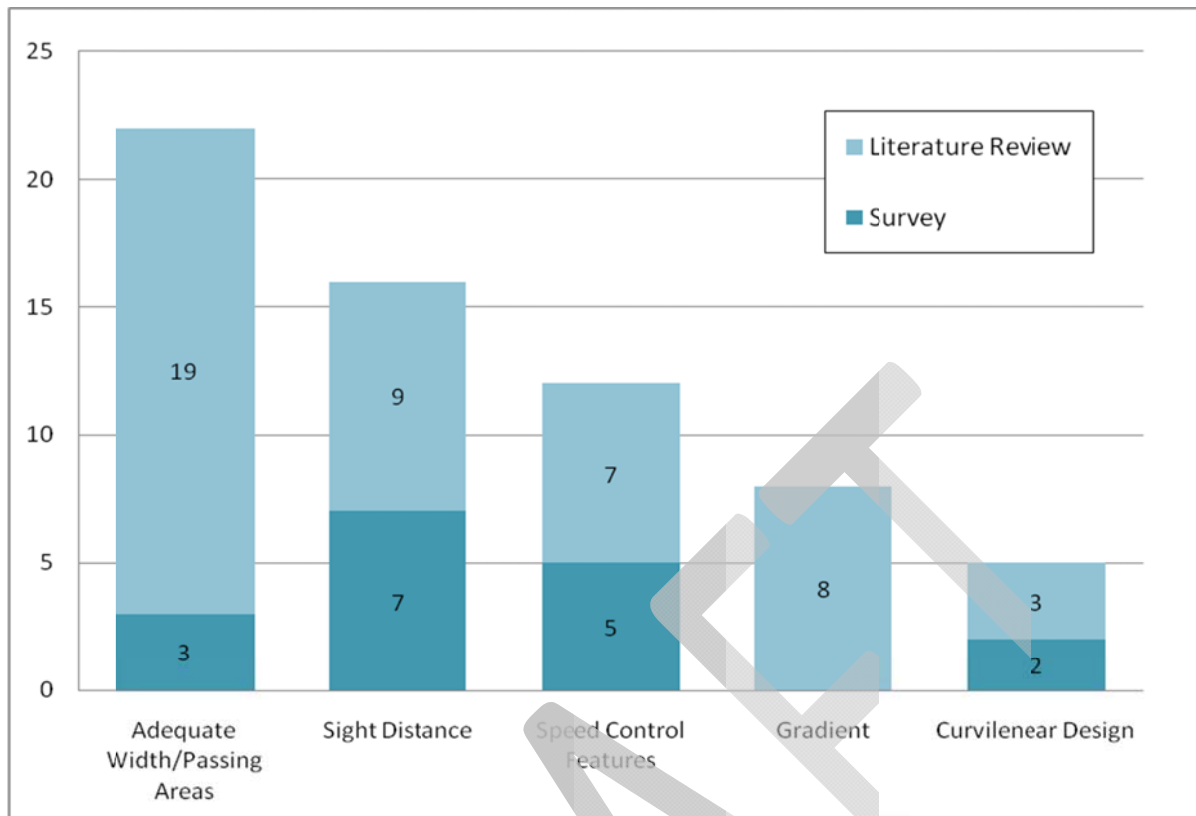


Figure 3-1. Summary of Design Solutions from the Literature Review and Agency Survey

Adequate Width and Passing Space

The width of the trail determines whether users can pass each other easily and safely. It also influences speed; a wide trail may facilitate higher speeds by mountain bikers. Most of the agencies surveyed reported providing sufficient width on trails, without providing specific guidelines.

The *Narrow Natural Surface Trails Study* for the East Bay Regional Parks District (EBPRD 2011) found that, among 15 San Francisco Bay Area parks and open space agencies, the definition of ‘narrow natural surface trails’ varied from 6 inches to 6 feet wide. Some agencies recommend that trails to accommodate hikers, equestrians, and mountain bikers should be at least 4 feet wide (City of Portland Parks and Recreation, Santa Monica Mountains Area Recreational Trail Coordination Project; Bondurant, Thompson, et. al. 2009) while others recommend a 3-foot minimum (Midpeninsula Regional Open Space District 1993; Minnesota Department of Parks and Recreation, Santa Clara County Parks). The USFS states that hiker- and equestrian-only trails can be as narrow as 1.5 feet wide (USFS 2007; Minnesota Department of Natural Resources 2006). Narrower trail width is part of a suite of speed control elements that are important for safe shared trails (Jellum 2007).

In the literature there is often no clear definition or delineation between the trail tread width and the trail bed widths. These dimensions affect the ability to allow safe passage and provide visible trail space versus the

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actual space available (including additional shoulders and refuge areas) to allow users to safely pass each other.

Where trails are too narrow for users to pass each other, clear areas or stable shoulders can act as passing areas to reduce conflicts. A passing area or a stable shoulder can be created from a wide bench that is allowed to overgrow (Santa Clara County Parks; City of Portland Parks and Recreation 2009), and a gentle hillslope condition can also provide a safe shoulder area for passing.

Alternately, where the bench or shoulder cannot continuously provide passing space, passing areas may be provided regularly. The USFS recommends passing spaces for equestrians of 5 feet wide by 10 feet long to allow a single trail animal to pull off the tread (USFS 2007). However, there is little guidance regarding the relationship of topography and frequency of use for placement or variance of placement of passing areas. With the lack of specified direction, it is up to the individual trail manager to implement.

Passing space is closely related to sight distance, i.e., the ability to become aware of other trail users in advance. Passing space is also provided where trails are constructed on relatively gentle side slopes (i.e., 20 percent or less), and dense vegetation is removed or cleared.

Sight Distance

Results from the Literature Review, the Agency Survey, and Program EIR scoping comments frequently noted concerns about poor sight lines and blind corners. Specific standards for sight distance were rarely cited in the research and survey, and tended to vary. One hundred feet is the most-frequently cited. The USFS notes that recommended sight distances for equestrians vary and are most commonly 50 to 100 feet (USFS 2007). A 100-foot average sight distance is recommended on trails by three sources (Santa Clara County Parks Department; Flink, Olka, and Searns 1993; Midpeninsula Regional Open Space District 1993). Several agencies address sight line issues with a policy of regularly thinning overgrowth, especially near curves (Wade County Parks and Recreation; Front Country Trails Multi-Jurisdictional Task Force). Sight distance is strongly related to speed controls; if user speed is reduced, the effectiveness of the sight distance is increased.

Speed Control Features

A number of references and surveys recommended placing or using elements along the trail corridor to create narrowing and turns that encourage users to slow down as they approach. These elements have a wide variety of designs and names including:

- 'Speed chokes' (Wake County Parks, Recreation and Open Space).
- 'Technical trail features' (Lake Tahoe Basin Management Unit).
- Pinch points (CSP Santa Cruz District; IMBA 2007) or stiles (Goldstein 1987).

While agencies commonly use these measures for controlling speed, few design guidelines or manuals provide specific instructions for their use. None of the agencies that discussed speed reduction strategies had specific design guidelines or guidelines that defined minimum width, radii, sight lines, or other factors. Several references and agencies state that, if properly installed and well-maintained, these features can create a lower-conflict and safer trail environment. Several agencies (both those that mentioned using design to reduce speeds and those that did not) cited the IMBA manuals (2004 and 2007), which detail the use of obstacles and choke points.

Goldstein cites a personal interview with a ranger, who recommends that the pinch point be the width of the average set of bicycle cranks, plus 2 or 3 inches (Goldstein 1987). He also recommends avoiding 'stiles,' or offset barriers that users have to negotiate, where wheelchair access is an issue.

In *Managing Mountain Biking*, IMBA recommends adjusting the trail 'flow' with anchors, turns, choke points, and surface textures to control speeds (2007). Sufficient sight distance for users is required to see the obstacle and slow down in advance of the feature, although the document does not recommend specific distances.

Surface Texture

As previously noted, IMBA recommends modifying surface texture to control mountain bikers' speeds on trails. IMBA notes that a variety of textures created with rocks, roots, and other uneven material is a desirable challenge for mountain bikers and requires that they slow down to maneuver through the area. Chiu and Kriwoken (2003) similarly recommend "leaving obstacles and rough surfaces to slow users down." A technique for creating this texture is to place rocks in the trail tread. Sightlines and a gradual transition are keys to using this technique.

In addition, IMBA notes that loose soils are more difficult to brake on, and bicyclists may appear out of control when stopping on a loose surface.

Gradient

Trails can be constructed with a grade change so that users approach a ridge nose (where sightlines are poor) or a trail intersection at a gentle or reduced uphill in either direction, slowing users at potential conflict areas (Santa Clara County Parks; EBRPD 2011).

These techniques can enhance the trail experience for all users by varying sightlines and terrain, and they are a key element of sustainable trails to minimize drainage and erosion (EBRPD 2011; IMBA 2007; Parker 2004). Abrupt changes in grade should be avoided, as should fall line trails, which exacerbate erosion.

Sinuuous Layout

Several references state that multi-use trails should be designed with curves to follow the natural topography, reduce users' speeds and to create a more varied and enjoyable trail experience. Sinuous design refers to trails that emphasize curves and minimize straight segments. The turns help slow users and add interest to the trail in terms of varied route and views. This can be created by following the natural contour of the land and gaining or losing elevation by crossing contour line obliquely, by the use of trail anchors and pinch points, as previously discussed, or by weaving the trail between trees and other features. Jefferson County Open Space uses 'chicane-style traffic calming' to reduce speeds on soft-surface trails. And as discussed above (see 'Speed Control Features'), IMBA recommends adjusting the trail 'flow' with anchors, turns, choke points, and surface textures to control speeds (2007).

Turns should not be sudden or too tight for users to safely negotiate, and adequate sight distances must be provided. The USFS notes that horses can comfortably negotiate a minimum turn radius of 5 feet, with 6 to 8 feet preferred (2007).

3.4.3 Other Design Considerations

The five principles outlined above are the primary aspects of design to address trail use conflict that were mentioned in the research. Other considerations were also mentioned that are pertinent because of their overall relationship to trail design.

Additional measures were often mentioned involving separate trails for different user groups, or designated use-intensive trails.

Trail Context: Trail Use Levels, Classifications, and Route Alternatives

Trail context was another commonly mentioned consideration for addressing trail use conflict. Trails that accommodate higher frequency of use and/or a large mix of uses (e.g., many mountain bikers and equestrians, rather than mostly equestrians with a few mountain bikers) may generate more complaints than less-used trails. Other factors that affect the extent of conflict on a trail include whether the trail is a main connection destination, desirable loop or a remote trail, and whether there are many opportunities for each trail user group, or few. The level of use on the trail, its importance as a connection to other trails, and the availability of alternative routes are important considerations for its design.

Several agencies establish design standards for width and passing areas on paved paths based on anticipated use by using a hierarchical classification system. However, few agencies define varying standards for natural surface trails based on anticipated use, user types, or context (Marin Regional Open Space District, EBPRD, City of Portland Parks and Recreation, and Santa Clara County Parks). CSP defines trails as Class I, II, or III based on accessibility, interpretive opportunities, distance to visitor use facilities, parking, dead end, and safety factors. A separate classification system is provided for mountain bike trails, which considers aggressiveness, scenic value, length, environmental conditions, staff-determined use, and other factors.

The CSP *Trail Handbook* (1991) notes that, “Placing trails into class categories allows a manager to objectively assign standards and work priorities to trails which are consistent with their primary function, environmental sensitivity, relationship to developed facilities and visitor use.”

Some agencies address these contributing factors by classifying trails within the system as major or minor and define differing design standards based on the classification. The implication is that the context of the trail, including the amount and type of existing and likely use(s), access to trailheads, and availability of alternative trails for users, is an important consideration when determining whether it is appropriate to change a designated use.

3.5 Trail Use Conflict Solutions

Common themes and strategies for addressing trail use conflict emerged from the Literature Review and Agency Survey. These include Management Strategies and Outreach and Coordination Strategies. The research indicates that management, outreach and public information is critical to successfully managing conflict, although there is a wide variation in the approach and reported success of these efforts.

3.5.1 Management Strategies

Trail agencies work directly with users or the public to inform users of the rules, encourage them to follow the rules, and cite them if they break the rules. Direct management strategies rely on regulation of behavior through sanctions or fines while indirect strategies provide information and education to users. Techniques can be subtle or obtrusive, positive, or appealing to a fear of consequence. Management strategies have been classified into the following five groups:

- User information – alternate routes and destinations; regulations, guidelines, advice, safety and courtesy.
- Enforcement – radar, warnings and citations.
- Rules and regulations – right-of-way, warning when overtaking, speed limits.
- Public notification – notification of a project or issue, typically with a point of contact and a venting opportunity such as comment cards or a web form.
- Collecting and tracking data on problems and successes.
- Use restrictions – alternate use days, one-way trails, and designated use-intensive trails.

Figure 3-2 shows the frequency that the Literature Review and Agency Survey noted for each of these management strategies.

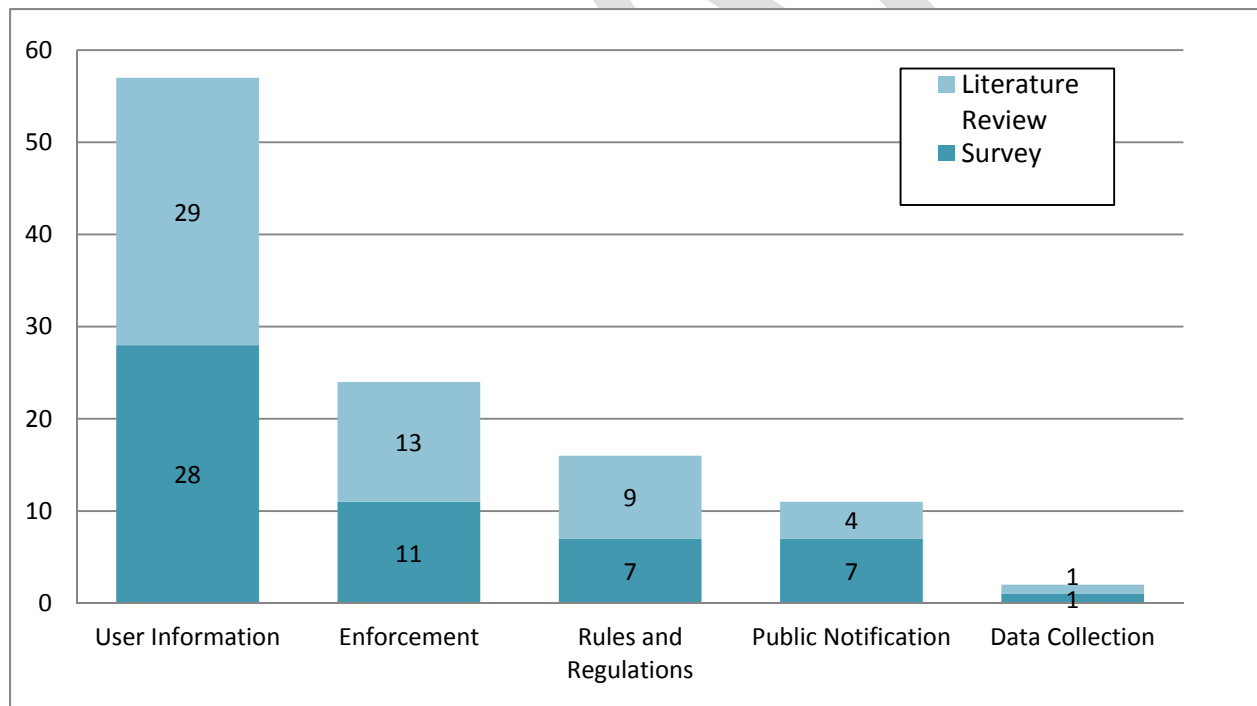


Figure 3-2. Summary of Management Solutions from the Literature Review and Agency Survey

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Several of the agencies reported that they had successfully reduced conflicts by prohibiting certain user types. Few of these jurisdictions have a systematic way of determining where certain user types cannot safely share the trail. Unresolvable health, safety, or natural resource issues often rationalize the decision (Oregon Parks and Recreation), although these are seldom defined. These are not discussed in greater detail in the Assessment, as exclusion is not considered a way of accommodating multiple uses on a trail.

User Information

Most jurisdictions post trail courtesy and rules signage such as the yielding triangle, or trailhead instructions for how to behave around horses or mountain bikes. However, there is significant disagreement about how much of an impact posting trail etiquette has on users' behaviors. Several agencies surveyed responded that signs on their own were insufficient (CSP Gold Fields District; Tualatin Hills Parks and Recreation District; Mecklenburg County Park and Recreation; and City of Portland Parks and Recreation) or that only users who are already law-abiding pay attention to signs (Hill County Conservancy).

To increase their impact, signs should cite specific policies with enforceable regulations, or they may recommend yielding or other good behavior. These regulations, as well as why and how the regulations will be enforced and what the applicable penalties are, can be posted at trailheads and included in trail brochures and on maps (Flink and Searns 1993). This information should be distributed via multiple media, including brochures, personal messages, audiovisual programs, newspapers, magazines, guidebooks, trained volunteers, outfitters, commercial guides, wilderness ranger and volunteer role modeling and should be designed for a variety of target audiences (Manning 2003).

Signs are more effective if they appeal to attitudes and beliefs visitors already hold, instead of trying to instill new beliefs. A collaborative effort to improve the trail system in and surrounding the Santa Monica Mountains National Recreation Area concluded that it is essential to post signs at the appropriate location and directed to the group it is communicating information to (Santa Monica Mountains National Recreation Area 1997). To effectively deter noncompliant behavior, managers must address the reason(s) behind the behavior and not just symptoms (Anderson, Lime, and Wang 1998; Manning 2003). Interpretation messages have been found to be as effective as sanction messages and both types are more effective than no message (Duncan and Martin 2002). Rules

Speed limits rules are important tools for managing the potential for trail use conflicts. While posted speed limits on trails tend to be used on paved multi-use trails, several agencies reported using speed limits on natural surface facilities. Speed limits posted by agencies surveyed are consistently 15 mph (Santa Clara County Parks; CSP Gold Fields District; Jefferson County; Sacramento County).

Challenges to the use of speed limits include difficulty of enforcement, lack of enforcement staff, and users' limited knowledge of the speed they are traveling (Bondurant, Thompson, et. al. 2009; IMBA 2007).

Agencies interviewed in the EBRPD *Narrow Natural Surface Trails Study* generally felt that focusing enforcement at parking lots and using radar guns to enforce speed limits were successful strategies (EBRPD 2011). Park agencies often have the power to cite, give warnings, or exclude users who break rules. Agencies surveyed seldom used this authority (CSP Gold Fields District; Oregon Parks and Recreation; Tualatin Hills Parks and Recreation District; Hill County Conservancy). One way of engaging trail users who break rules is to consider sentencing trail offenders to work service on the trail as part (or all) of their penalty (Flink and Searns 1993).

Rules should be enforced consistently to assure users that there is no perception of discrimination among different user groups (Flink and Searns 1993). Flink and Searns also note that signs are more effective if they address attitudes and beliefs visitors already hold and provide information about the rationale for the regulation.

Enforcement

The presence of rangers or other authority figures on the trail can deter undesired activities and encourage users to employ trail etiquette. Ranger patrols can warn or cite users who violate posted regulations and record and respond to comments or complaints from users. Where speed limits are posted, rangers can enforce speeds or issue citations or warnings to rule breakers (Tualatin Hills Parks and Recreation Department; City of Durango; City of Portland Parks and Recreation; Sacramento County). Off-duty police can assist in enforcement (Mecklenburg County; City of Durango).

Volunteers can also assist with patrolling the trail, discussed in the outreach section. Volunteer patrols act as the ‘eyes and ears’ of a land manager and can enhance visitor experiences, assist land managers, promote trail stewardship, and respond to incidents (IMBA 2007). Volunteer patrols can also model appropriate behavior.

Public Notification

Because user conflict is driven by users’ perceptions, it is crucial for agencies to include public discussion and feedback when they are considering new or modified management to reduce conflicts. Public dissatisfaction with the decision-making process can be a barrier to implementing management regulations (Santa Barbara, Town of Pagosa Springs). While it is likely that most agencies alert the public when making planning or policy decisions, and many sources mentioned working with the public more extensively, they did not provide specific details of public notification practices. General strategies regarding coordination with the public are provided in the section on Outreach and Coordination below.

Collecting and Tracking Data

Data about the frequency or rate of incidents promotes user trust in management and reduces perceptions of conflict. This Assessment has found that relatively few incidents on trails occur, particularly when compared to the amount of trail use.

Few of the agencies surveyed collect or retain incident or complaint data, and only three of the Literature Review sources based their analyses of the nature or significance of conflict between users on incident or complaint data. Jefferson County Open Space is currently tracking public responses to alternate day and one-way management strategies they implemented on a trial basis.

To effectively deter noncompliant behavior, managers must address the reason(s) behind the behavior and not just actions (Anderson, Lime, and Wang 1998). To do this, Anderson, Lime, and Wang recommend gathering and evaluating incident and complaint data, use estimates, and user surveys.

Use Restrictions

Use restriction management techniques were frequently mentioned, including alternate use days, one-way trails, and designated use-intensive trails (Flink and Searns 1993).

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These strategies are likely to be particularly successful in a setting where the majority of users are local residents who return to the trails, such as state parks that are adjacent to metropolitan areas. However, they may be impractical in a setting where the users come from a wide geographic area and cannot be kept informed in advance of the rules.

Alternating Days

Some park agencies instituted alternating day access, in which mountain bikers are allowed on the trail one day and hikers on another day, or one-way trails on which mountain bikers can only ride in one direction at all time or on certain days (Jefferson County Open Space; Flink and Searns 1993). Jefferson County Open Space staff reports that the alternate use was a successful management response, although other jurisdictions have had difficulty managing and enforcing these regulations. Both hikers and bikers supported an every-other-day exclusion policy in Washington State (Jellum 2007), although an Environmental Assessment in Arizona found the displacement associated with an alternating days strategy to be adverse, if only moderately to negligibly so (National Park Service 2003).

One-Way Trails

Jefferson County Open Space also implements directional trails for one-way travel by mountain bikers. One-way trails are also potentially problematic due to the need to inform users in advance, and the higher risk caused by failure to comply when it is expected by other users, and is rather a “no prospect” alternative.

Single-direction trails can alleviate congestion, provide a more predictable experience, and reduce the number of passes between users. Direction restrictions may be combined with user restrictions (such as on a mountain bike-only trail), applied to only one type of user, or applied at certain times or days (IMBA 2004).

3.5.2 Outreach and Coordination Strategies

Several agencies responded that working with trails groups, holding public meetings and educating the public had the greatest effect on reducing conflicts between users. Outreach and coordination are strategies wherein staff works with user groups, and ideally user groups work with other user groups, to build understanding and cooperative relationships to minimize conflicts. Agencies are increasingly using these types of “bridge building management styles” to engage users and build communities (Chavez 1996b). Chavez notes that, “the increasing use of this [bridge building] strategy often accompanies decreasing budget allocations.”

User group outreach and coordination can include the following strategies:

- Education – user-specific printed materials and web postings, and/or an active, focused public relations campaign to educate users about trail use rules and appropriate behavior;
- Meetings with user groups – including general meetings about specific conflict-related issues or objectives.
- Volunteer programs – ongoing trail patrol and/or maintenance assistance, specific projects, outreach and education regarding conflict avoidance, safety, and courtesy;
- User group notification – of a project or issue with a point of contact and venting opportunity such as comment cards or a web form.
- Events –multi-user social, fun, trail construction or maintenance events (e.g. Trail Education Days).

Figure 3-3 shows the frequency of references to outreach and coordination strategies in the Literature Review and the Agency Survey.

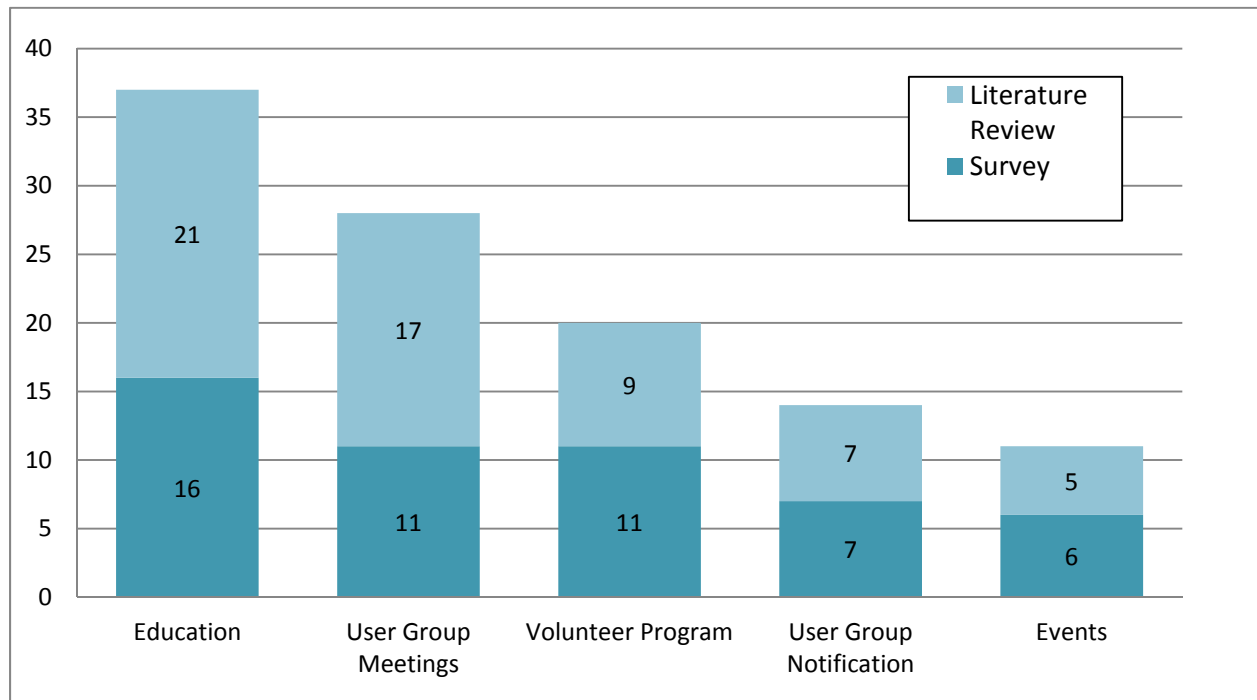


Figure 3-3. Summary of Outreach and Coordination Solutions from the Literature Review and Agency Survey

Education

Many of the agencies who have ranger patrols or who work with volunteers reach out to users through those avenues. Some agencies specifically cited speaking with trail users about sharing the trail as a successful strategy (Lake Norman State Park, Jefferson County Open Space, Turlock Lake, Front Country Trails Multi-Jurisdictional Task Force). Turlock Lake SRA staff noted that education informing users the spirit of trail development and the agency's goal and mission is most effective. In Santa Barbara, staff from the three jurisdictions that are part of Front Country Trails Multi-Jurisdictional Task Force presented best practices of trail sharing, which "helps put the complaints of certain members into perspective."

Conejo Open Space Conservation Agency (COSCA) teaches trail etiquette to local schoolchildren through skits performed at the annual "Trails Education Days." They previously gave out key chains with the yellow etiquette symbol at public events but discontinued that practice due to budget cuts.

Similar to trail user etiquette signs discussed under management strategies, brochures and other outreach methods can be used to inform trail users of expectations and to be aware of other users. Flink and Searns recommend that "if mountain bikers will be using your trail, you should develop an educational campaign on proper trail use for all users" (Flink and Searns 1993).

The California Equestrian Trails and Land Coalition (CETLC) recommends that agencies and user groups educate users about the "startle factor" of horses (CETLC 2005), both for equestrians to be aware of mountain

Chapter 3

bikers potentially spooking the horse and for other users about how to act around horses. They recommend holding training clinics for equestrians to teach the horses and riders to meet cyclists in varying situations.

User Group Meetings

Many of the agencies reported working with established user groups to be a successful or necessary strategy. CSP Gold Fields District designates a staff member to attend user group meetings and to work with particular groups on trail work days. Mecklenburg County and the City of Durango recommend maintaining regular communication with different user groups and bringing issues to them as necessary.

Several agencies collaborate with trail groups to plan, construct, and manage trail projects (Vancouver-Clark Parks and Recreation Department [VCPRD], Town of Crested Butte, Mecklenburg County, City of Durango, and Oregon Parks and Recreation). In some cases, agencies reached out to individual trail users independent of user organizations. This type of collaboration can be formalized through a trails committee (COSCA, VCPRD, CSP Gold Fields District) or via open houses. Several agencies hold stakeholder meetings to discuss solutions to user conflicts (Bureau of Reclamation Lower Colorado Region, Henderson), while others hold multi-user trail meetings when developing plans (Oregon State Parks and Recreation and Front Country Trails Multi-Jurisdictional Task Force). Trail Advisory Groups can help identify and solve user conflicts before they become serious problems (IMBA 2007).

EBPRD found that in some cases, collaboration between field staff and the mountain bike and equestrian communities successfully created a shared sense of resource protection and stewardship between staff and bicyclists enthusiasts (EBRPD 2011).

Volunteer Programs

Several agencies work with volunteers to maintain or patrol trails or to encourage and exhibit proper trail etiquette. Volunteer patrols remind users of proper etiquette, model good behavior, and assist trail users with questions (CSP Gold Fields District; Jefferson County Open Space, Tualatin Hills Parks and Recreation District, CRD Parks, City of Henderson). Trail Watch programs can be successful, as they provide a sense of ownership and provide “eyes on the trail” (City of Henderson).

Volunteers can help with several aspects of trail management. They can reach out to other trail users and educate or appeal to them to yield to other users, and they can assist with events such as trail maintenance days and Share the Trail events (Flink and Searns 1993; Bondurant, et. al. 2009).

IMBA highly recommends such programs, stating that volunteer patrols are a “tangible reminder that mountain bikers are aware of their potential effect on other visitors, are committed to regulating themselves, and are willing to give back to the trails in the form of volunteerism” (IMBA 2007). A study conducted on Marin County’s popular Mt. Tamalpais found that messages from other mountain bikers were more effective than those coming from a uniformed agency volunteer or a hiker (Hendricks et. al. 2001).

User Group Notification

Similarly to meetings with user groups, notifying groups when beginning a planning effort encourages users to be involved and invested in decisions. While several sources mentioned working with users in planning efforts, they did not provide specific information on the topic, but it is assumed to be a standard practice among agencies who work with user groups.

Trail Events

Agencies can organize or facilitate events that allow different user groups to combine in a controlled, cooperative way, such as trail construction, repair, or maintenance work days; competitions such as triathlons and adventure course events that combine kayaking and/or swimming with trail activities, or events that are simply intended to be fun and social.

Agencies and user groups hold a variety of events on trails, including events with specific 'Share the Trail' messages and more general trail clean-up or maintenance days. Events include "Trail Education Days" for 5th graders (COSCA), trail work days that include all types of users (CSP Gold Fields District; Moore 1994), 'carrot rides' or 'Romp N' Stomp' events in which mountain bikers feed carrots to equestrians' horses (CSP Santa Cruz; Moore 1994; IMBA 2007), bell give-aways (City of San Luis Obispo). Specific staff can be assigned to work with various user groups on trail work days (CSP Gold Fields District).

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Chapter 4. Bibliography

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Appendix A. Recommendations Incorporation in Process Documents

This Appendix illustrates how the two checklists recommended to address trail use conflict on multi-use trails could be incorporated into the CSP Trail Use Change Process documents – the existing checklist used to evaluate the feasibility of trail use change and to the associated forms. Specific recommended changes to the forms and process are illustrated below:

Note: Because trail use conflict is primarily a social/perceptual issue, and is rarely evidenced by significant safety issues related to accidents between user types, inability to meet conflict-reducing measures does not mean the trail use change is not feasible or that it has a significant impact under CEQA. Thus completing the trail use conflict checklists are on a side track from the process that directly results in the determination of project feasibility.

The Trail Use Change Survey preparers or CEQA preparers could find that there is a significant case-specific safety issue related to trail use conflict.

Figure A-1 illustrates where the checklists fit into the current process.

Evaluation and Trail Log

The *Trail Log* notes the physical conditions and requirements for the use in question to be added (or in some cases continue) on the road or trail. The checklist for design to address trail use conflict/use-appropriate design (see Table A-1) should be applied at this stage.

The evaluation of existing physical conditions and determination of the implications for improvements to add (or keep) the use under consideration should include review of the checklist, with results reflected in the Trail Log.

The evaluator will need to use judgment about which conflict-reduction design measures are necessary and practical. Overall, there are two conclusions the evaluator could make (presumably in consultation with the person who will complete the Survey):

1. The road or trail is designed or can be modified to meet enough of the conflict-reduction design measures to accommodate the proposed use; the necessary conditions and modifications are reflected in the Trail Log.
OR
2. The road or trail is not designed and/or it is not practical to modify it to meet enough of the conflict-reduction design measures to accommodate the proposed use; the necessary conditions and modifications are reflected in the Trail Log.

In some cases the evaluation may find that conditions and feasible modifications for use-appropriate design do not support an existing use

Trail Use Change Survey

The *Survey* form considers the results of the *Evaluation and Log* in context and makes a finding regarding overall feasibility.

The Survey would be easier to follow if the Evaluation Criteria were referenced numerically to the summary on the first page. This is illustrated in Figure A-2. No other changes to the Survey form are recommended, except that a line has been added under Existing Conditions that notes that the Evaluation and Trail Log has been completed.

The checklist for Trail Use Conflict Management (Table A-2) would be completed in parallel with the Trail Use Change Survey, but it is on a separate track, and is not a direct basis for the decision of feasibility of the use change. It does not relate to the CEQA process but does relate to the existing step prior to the CEQA process to “gather input from local trail user groups or local Trail Advisory Committee”. Completion of the checklist should realistically consider the staff resources available to complete or continue the management actions.

Like the physical conditions or changes specific to accommodating specific uses and addressing trail use conflict, the Trail Use Conflict Management Checklist evaluation is not a “make or break” factor in the trail use change decision – but it is an important consideration and part of the ultimate Work Plan.

Work Plan

The Work Plan is the comprehensive implementation plan for the project. The flow chart “Project Implementation” box in Figure A-1 currently states, “Project implementation includes not only trail modifications but also the future plans for any needed enforcement, patrol development and user education program plans.”

Completing the Trail Use Conflict Management Checklist will generally identify conditions, accomplishments, and needed actions. As part of the Work Plan, a specific action plan for trail use management and user group outreach and coordination should be prepared, to help minimize conflict and make the trail use change successful.

Figure A-1: Recommendations Integrated into Current Process

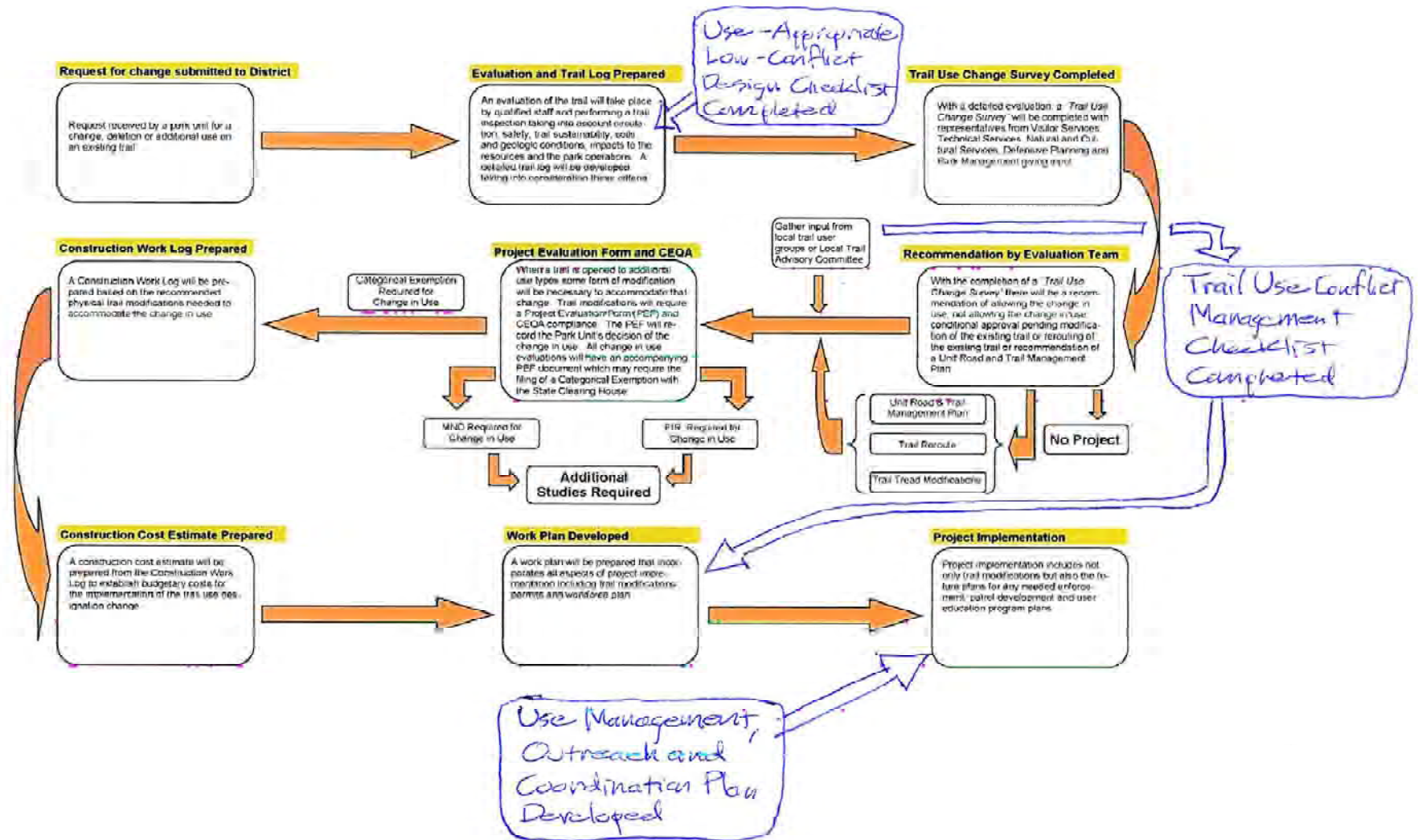



Figure A-2: Recommended Modifications to Trail Use Change Survey

	Park (Including Classification):			
	Trail Name:			
	Location in Unit:			
	Current Use Designation(s):			
	Proposed Use Type Change:			
	Use Change Initiated By:			
(column added)	Evaluation Date:			



Evaluation Criteria Summary		Yes	No	Summary Criteria Evaluation Based on the Synthesis of Data from the Following Pages
1 - Existing Conditions	A Trail evaluation and Log Has Been Completed			
2 - Compatibility	Based on Criteria, is this Use Change Compatible?			
3 - Circulation	Based on Criteria, does this Use Change Enhance Circulation?			
4 - Safety	Based on Criteria, will this Use Change Decrease Trail Safety?			
5 - Sustainability	Based on Criteria, is the Trail Sustainable Under Existing Use Conditions?			
6 - Natural or Cultural Resources	With the Proposed Use Change Will the Trail be Sustainable Based on Criteria, will the Proposed Used Change Create Negative Impacts to the Natural or Cultural Resources?			
7 - Maintenance and Operation	Will the Proposed Use Change and/or Modifications to the Existing Trail Create Significant Facility Maintenance or Operational Work Load?			
8 - Alternatives	Are there other Routes in the Unit or on Nearby Public Lands that Adequately Accommodate the Type of Trail Use Proposed?			
9 - Permits	Would needed modifications trigger outside agency permits?			
Recommendation Based on Evaluation Criteria - Substantiate in Comment Box				
	Recommend that the Park's General Plan or Road and Trail Management Plan be Developed or Amended to Evaluate this Change in Use			
	Recommend that the Proposed Change in Trail Use be Approved			
	Recommend that the Proposed Change in Trail Use be Approved After Design Modifications are Implemented:			
	Recommend that the Major Reroute be Considered to Accommodate Proposed Change in Use			
	Recommend that the Proposed Change in Trail Use be Approved with Management Options such as: Alternating Days of Use, One Way Travel, Seasonal Closures etc.			
	Recommend that the Proposed Change Use be Put on Hold - See Comment Box Below			
Comments:				

Insert Map of Area of Proposed Use Change

Table A-1: Checklist for Low-Conflict Multi-Use Trail Design

Checklist for Use-Appropriate, Low-Conflict Multi-Use Trail Design			
Evaluation Criteria	Yes	No	Comments
Check any existing conditions; note feasibility of modifications to add in comment box:			
1.1 Tread Width and Passing Space - Front-country Trails			
a. Where mountain bikes are accommodated, but not equestrians: minimum tread width is 30 inches			
b. Where equestrians are accommodated: minimum tread width is 48 inches			
c. Where hillside slopes are steep, passing spaces are provided at regular intervals (the interval depending on the sight distance available):			
i. A minimum of 48 inches wide and 60 inches long where mountain bikes are accommodated, but not equestrians			
ii. A minimum of 60 inches wide and 60 inches long where equestrians are accommodated			
1.2 Tread Width and Passing Space - Back-country Trails			
a. Where mountain bikes are accommodated, but not equestrians: minimum tread width is 18 inches			
b. Where equestrians are accommodated the minimum tread width is 36 inches			
c. Where hillside slopes are steep, passing spaces are provided at regular intervals (the interval depending on the sight distance available)			
i. A minimum of 36 inches wide and 60 inches long where mountain bikes are accommodated, but not equestrians			
ii. A minimum of 60 inches wide and 60 inches long where equestrians are accommodated			
1.3 Sight Distance			
Where mountain bikes are accommodated:			
a. Sight distance of between 80 to 200 feet is provided depending on the percent of slope of the trail gradient (0 to 20%+)			
b. Where turns and/or speed control features are in place on a trail segment such that bike speed is controlled below 15 mph, sight distance may be reduced within that segment (but not the portions approaching)			
1.4 Sinuous Layout			
Where mountain bikes are accommodated:			
a. The trail avoids long, straight and uninterrupted sight lines (particularly on downhill runs)			
b. The trail follows a curvilinear alignment with numerous turns created by contouring around the landform, around trees and rock outcroppings, and dipping in and out of			
<i>Where equestrians are accommodated, but not mountain bikes, or even on hiking-only trails, sinuosity can be a desirable feature, but is not as high a priority.</i>			
1.5 Turn Radius			
a. Where mountain bikes are accommodated, but not equestrians:			
i. Minimum turn radius is four feet for switchbacks, (three feet for climbing turns)			
ii. Grade of the upper and lower leg of the turn does not exceed 14 percent, unless the material is durable enough to support a steeper grade, but in no case should grade exceed 20 percent			
b. Where equestrians are accommodated:			
i. Minimum turn radius is five feet			
ii. If the trail is used by pack stock, the minimum radius is six feet			
iii. The grade of the upper and lower leg of the turn should not exceed 14 percent, unless the parent material is durable enough to support a steeper grade			

Table A-1: Checklist for Low-Conflict Multi-Use Trail Design (page 2)

Evaluation Criteria		Yes	No	Comments
1.6 Speed Control Features				
a.	Where mountain bikes are accommodated:			
	i. Otherwise straight trail sections are modified by using natural features such as trees or rock outcroppings, or relocated natural materials such as rocks or logs, to create curves and turns such that users must make a series of turns to negotiate the section			
	ii. The speed control features are substantial enough in volume that users can easily see them and will not accidentally or deliberately run over them (e.g. 3 to 4 feet high and 4 to 6 feet wide). They are constructed of rocks, logs, or root wads, and may include introduced or naturally occurring native vegetation			
	iii. They may be combined with a soil mound, but do not consist entirely of a soil mound, as this could be used as a jump			
	iiii. They blend into the natural landscape, at least when trail construction and associated vegetation matures			
b.	Where equestrians and mountain bikes are accommodated:			
	i. As above, plus a horse can easily negotiate the features (turn radius, width, clearance)			
1.7 Surface Texture				
	On back-country trails where mountain bikes are accommodated:			
a.	Where native rock is encountered during construction, a portion of that rock can be retained within the tread (textured or roughened surfaces) if it does not impede overland sheet flow or present a tripping hazard, provided:			
	i. The rock is fixed and presents a firm, non-slip surface (not loose, slippery or rolling)			
	ii. Where equestrians are accommodated, the rock does not present sharp edges that may injure horses' hooves			
1.8 Structures				
	Where equestrians or mountain bikes are accommodated:			
a.	Steps and waterbars are avoided if possible - they should be design solutions of last resort			
1.9 Gradient				
	Where equestrians or mountain bikes are accommodated:			
a.	Abrupt gradient changes are avoided - there is a gradual transition from steeper to gentler portions			
1.10 Trail Layout and Classification				
a.	The review of the trail use change proposal considers the trail's classification and role in the park unit trail system, and where applicable, regional trail system]			
Recommendation Based on Evaluation Criteria - Substantiate in Comment Box				

Table A-2: Checklist for Trail Use Conflict Management

Checklist for Trail Use Conflict Management			
Check any existing conditions; note feasibility of/commitment to additional measures in comment box:			
Evaluation Criteria	Yes	No	Comments
2.1 Rules and Regulations			
a. Regulations are adopted and posted (see Public Information) with details of the relevant state codes so that they are clear and enforceable (see Enforcement)			
2.2 User Information			
a. Information is available regarding trail use rules and reasons for rules, courtesies, behavior and preparation, and trail designation and condition			
b. The information is posted at major trailheads in detail (e.g. on mapboard) and summarized on signs			
c. The information is included with printed maps and brochures for the unit			
d. Consistent information is posted on the unit website, and where applicable, on local web sites (e.g. partner or volunteer organizations)			
2.3 Enforcement			
a. Ranger patrol time is allocated for the trail to monitor, inform, and enforce compliance with the rules and encourage awareness and compliance with courtesy, safety and environmental guidelines			
b. An organized volunteer patrol exists or is being formed that will actively support rangers on monitoring and informing trail users			
2.4 Public Notification and Input			
a. Notice of the proposal and a means and adequate timeframe (e.g. one month) to comment is posted in sources that are likely to reach the interested parties: trailheads, web site(s), local paper, park and local bulletin boards			
b. Notice of the proposal has been emailed to local to statewide user groups and contacts generated by the unit, local press, adjacent agency contacts, etc.			
c. time and place that is accessible to most parties, and notes of comments have been/will be created and made available to attendees and points of notification/contact			
2.5 Collecting and Tracking Data			
a. Trail use and incident/accident data is collected, maintained and analyzed in an organized system, as feasible			
b. Volunteers or partners are assisting with data collection and management			
c. The data is being collected and analyzed on a short-term project basis in association with the trail proposal			
d. The data is being collected and analyzed as an ongoing effort			
2.6 Education			
a. Staff or representatives (volunteers or docents) speak at local events, schools, user group regular meetings or other venues to carry overall CSP or unit messages as well as specific safety and conflict management and environmental compatibility messages			
b. Educational outreach includes collection of comments and consideration by management staff			
2.7 User Group Relations			
a. Managers or staff regularly attend user group meetings and/or make informal general contacts on an ongoing basis			
b. Managers or staff regularly attend multi-user trail group meetings such as county trail committees, or have formed their own multi-user group and coordinate with them			
c. Volunteers or docents support staff in this capacity, representing CSP positions and reporting back to staff			
Recommendation Based on Evaluation Criteria - Substantiate in Comment Box			

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DRAFT

Trail: _____

Date: 11/1/2007

Segment _____

Park Unit: _____

Feet	Action	Feature	Size/Qty			Units	Comment	Total
			L	H	W			
0		Rail Fence	35			lf		35
0		Sign					Interp.	0
0								0
46		Junction						0
46		Bridge	45			lf		45
46	Remove	Slough and Berm	19629			lf	to allow water drainage	
46	reconstruct	trail at all drainage crossings and ephemeral or topographical swales					construct armored drainage crossings at all ephemeral and topographical drainages that cross the trail - remove existing at grade wooden drainage crossings and replace with rock structures at such crossings	
46		Rail Fence	12			lf		12
444	Const	Pinch Point						0
526		Drainage Crossing						0
526	Recon	Water Bar					replace 4" with 8"	0
526		Retaining Wall Wood	20	2		sq ft		40
590	Const	Pinch Point						0
590	Haul	Material	580			lf		580
766		Bridge	20			lf		20
766	Reconst	Bridge				lf		0
823	Const	Pinch Point						0
1294		Rocky Soil	1294			lf		1,294
1412	Reconst	Drainage Crossing						0
1420		Material					3 or 4 pp	0
1460	Const	Pinch Point						0
1677	Const	Pinch Point						0
1719		Full Soil	425			lf		425
1847	Const	Pinch Point						0
1862		Retaining Wall Wood-W	16	2		sq ft		32
1953	Const	Pinch Point						0
2044		Rocky Soil	325			lf		325
2076		Material						0
2216	Const	Pinch Point						0
2269		Full Soil	225			lf		225
2270		Material					Euc Grove, many pp	0
2432	Const	Pinch Point						0
2500	Const	Pinch Point						0
2545	Const	Pinch Point						0
2694	Const	Drainage Crossing					In Drainage	0
2862		Bridge	20			lf		20
2934		Rocky Soil	665			lf		665
2974	Const	Pinch Point						0
3230	Const	Pinch Point						0
3322	Const	Pinch Point						0
3404		Junction						0
3404		Sign					Directional	0
3414	Remove	Water Bar -Wood						0

Feet	Action	Feature	Size/Qty			Units	Comment	Total
			L	H	W			
3424		Retaining Wall Wood	25	3		If		75
3484		Slide						0
3518	Const	Pinch Point						0
3540		Material					down slope	0
3663	Const	Pinch Point						0
3669		Full Soil	735			If		735
3700		Slide						0
3814	Const	Pinch Point						0
3814		Material					snag upslope 20'	0
3874	Const	Pinch Point						0
3919	Const	Pinch Point						0
3966		Material					snag, 2 pp	0
4235	Recon	Switchback						0
4279	Const	Pinch Point						0
4366		Material						0
4474	Const	Pinch Point						0
4594		Rocky Soil	925			If		925
4660		Material						0
4780	Const	Pinch Point						0
4780		Material						0
4850	Const	Pinch Point						0
4910	Reconst	SW						0
4977	Const	Pinch Point						0
5050		Material						0
5102		Material						0
5270	Const	Pinch Point						0
5375		Material						0
5429	Const	Pinch Point						0
5494		Full Soil profile	900			If		900
5530	Const	Pinch Point						0
5564		Rocky Soil profile	70			If		70
5635		Material					upslope	0
5649	Const	Drainage Crossing					In Crossing	0
5674		Full Soil profile	110			If		110
5700	Const	Pinch Point						0
5792	Const	Pinch Point						0
5960	Reconst	Switchback						0
5989	remove	Limb						0
5989		Material					OH limb	0
6026		Material						0
6115		Material						0
6149	Const	Pinch Point						0
6189	remove	Rootwad						0
6254		Rocky Soil	580			If	Begin	580
6288	Const	Drainage Crossing						0
6354	Const	Pinch Point						0
6435		Material					upslope	0
6508	Const	Pinch Point						0
6571	Const	Pinch Point						0
6650	Const	Pinch Point						0
6721	Const	Pinch Point						0
6771		Material					down slope	0

Appendix B. Literature Review

This appendix presents the methodology and detailed results of the Literature Review conducted for the Trail Use Conflict Study. It reviews the content and quality of the available literature on the subject of trail conflict conditions, issues, impacts, and potential solutions on natural surface multi-use trails. The first section presents the methodology used to identify and critique the studies reviewed. The second section discusses potential solutions identified in the Literature Review, some of which are incorporated into the recommendations presented in Chapter 2 where they are applicable to California State Parks. The appendix closes with a brief review and critique of the key resources identified through the review. An annotated bibliography, including the background of the study, a summary, and a brief critique of each document, can be found in Appendix E.

B.1 Methodology

The Project Team reviewed documents and articles collected from a variety of online sources. In addition, the public recommended 40 documents in comments received during the EIR scoping process and in response to the study notice and other outreach. These 40 documents are listed in Appendix E. Of the 148 documents identified in both the research and public comment, the Project Team was unable to locate 18 documents; these are listed in Appendix E.

B.1.1 Document Relevance

The Project Team initially reviewed the 130 available documents to determine relevance to the trail use safety and conflict subject areas as defined for this Study: information about the frequency and characteristics of incidents and complaints; design of safe shared use trails; the nature of trail use conflict, and management of trail use conflict, all ideally focused on the natural surface trail setting. The review eliminated documents that focused on the issue of dog access or relative environmental impacts of different trail uses. The scope of the Study is defined in more detail in Chapter 1.

The Project Team found 80 of the 130 documents to be relevant; a written summary and critique for these documents is provided in Appendix E. Each summary includes a brief description of the document, including background on the researcher, affiliated organizations, or other available information providing context for the study. All articles in the academic category are peer-reviewed.

Out of the 80 relevant documents, the Project Team identified 16 “key” documents based on the extent to which they address the subject areas of the Study and, in some cases, the frequency with which they were mentioned in the Agency Survey as important references for trail design (most notably the Forest Services’ *Trail Construction and Maintenance Notebook*). These 16 most relevant documents are reviewed and critiqued in more detail in this appendix.

Fifty of the 130 available documents were not found to be relevant to user conflict and safety as defined for this Study; these documents are not included in the written review and critique. The reasons for deeming each of these documents not relevant is detailed in Appendix E. Generally, these sources primarily considered the environmental impacts of trail use or discussed paved trails or other subjects not relevant to the current scope. Some of the documents discussed specific examples or arguments for or against allowing various modes on

trails. Documents with arguments that were not based on quantitative data, informed opinion, or that did not provide concrete recommendations for addressing trail user conflict or safety issues were not included in the written review.

B.1.2 Criteria for Literature Critique

The review of documents and articles seeks to identify documents that provide accurate, complete, and useful information regarding design of safe shared use trails, the nature of trail use conflict, and management of trail use conflict, with a focus on natural surface trails. The critique of the documents was based on criteria that highlight the relevance and usefulness of each. Criteria include objectivity, thoroughness, applicability, useful information, and sustainability. For each factor, the critique assessed whether the document meets (high), partially meets (medium), or does not meet (low) the criterion.

The critique evaluated the extent to which the documents meet the following criteria:

- Objectivity – Is the document’s research methodology rigorous? Is the document based on factual physical or user data, opinion surveys of the subject group, engineering analysis, or peer-reviewed academic research, and does it draw conclusions that specifically follow the data? An objective document is not influenced by personal feelings in representing or considering the facts.
- Thoroughness (breadth and depth of study) – Does the resource thoroughly discuss the context and the specific factors related to multi-use trail safety or conflict and/or provide strategies that consider the full range of factors?
- Applicability – How comparable are the setting, trail facility, and user types to the California State Parks (CSP) trail setting, particularly “soft” or native-surfaced multi-use trails used by hikers, equestrians, and/or mountain bikers?
- Useful Information (detail and specificity) – Within the area of study, does the resource provide specific information regarding the nature of the problem or, in particular, solutions that can be directly used by trail designers and managers to address trail user conflicts and/or safety issues?
- Sustainability – Does the document discuss design for trail safety or reduced conflict in the context of managing or designing for environmental sustainability?

B.1.3 Document Association

Documents are grouped by the author or publisher, and whether either is a government agency or user group, to help identify the impetus for the report. Documents are grouped into the following categories regarding the author’s or publisher’s association with government or other entities, including user groups:

- Federal – Standards and guidelines published by government agencies such as the Forest Service (USFS), Federal Highway Administration (FHWA), or National Parks Service (NPS).
- General – Design guidelines that serve as a general reference, not published by a government agency or user organization (i.e., written by professionals who do not necessarily manage trails themselves).
- State – California-specific guidance and standard documents, including resources published by California State Parks (CSP) and the California Department of Transportation (Caltrans).
- Local – Design guidelines or studies conducted for a specific jurisdiction.
- Academic – Peer-reviewed articles that were published in a journal or by a university.

- User Organization – Resources published by a formal user group such as equestrian or hiking groups.
- Individual User – Unpublished resources or resources posted online by an individual.

User conflicts on trails tend to be controversial issues that complicate management decisions regarding which users are permitted to use which trails. The authors of literature on the subject may have relationships to or personal preferences for certain types of uses. These relationships in and of themselves have no bearing on the quality of the document; the author's objectivity is identified in the critique. However, it is useful to examine the associations inherent to the documents reviewed.

Some of these user group associations are clear from the source, title, and material in the documents. In other cases the impetus for the document and potential orientation of a particular user group's perspective may not be readily apparent. To the extent practicable, the annotated bibliography notes the authors' association or relationship with organizations. The discussion also notes which groups cite the article, and if it is posted or referenced on a user group website. In the Agency Survey, agency representatives reported using several of the User Organization documents. These references are also noted in the review of each document.

To address interactions and connections between user groups, each entry notes if a particular user group cites the source as a rationale for allowing or prohibiting particular trail uses. The objective for identifying these relationships is not to discredit documents that are produced or favored by a user group, but to acknowledge the relationships.

B.2 Summary of Results

This section presents an overview by topic of the key issues identified and discussed in the Literature Review. It discusses definitions of user conflicts identified through surveys of trail managers and users, as well as theoretical or academic assessment of the nature of recreational conflicts. It also summarizes the solutions and strategies identified for appropriate trail design as well as management and outreach to avoid or minimize conflicts. Each subsection includes citations from documents included in the Literature Review. A summary and critique of the documents are available in Appendix E, Annotated Bibliography.

In the following summary findings, where a theme was cited by a single source, or multiple agency or document sources, the reference follows. Where jurisdictions are cited without a date, the source is that jurisdiction's Agency Survey. If several sources supported the finding, the text provides general reference to support without specifically identifying all documents or agencies.

B.2.1 The Nature of Trail Use Conflict

Despite the wealth of information on the topic of user conflicts on multi-use trails, the majority of the literature does not provide concrete data regarding the presence, extent, or attributes of user conflict. While 63 of the 80 sources included in this analysis define the problem of trail user conflicts, several of them do so as a presupposition based on previous literature (14 sources), or the author's experience (13 sources). Several sources present surveys on managers' perceptions of conflict (9 sources) or users' perceptions of conflict (22 sources). None of these surveys asked the frequency of actual incidents. However, this notable lack of citations regarding specific incidents and accidents indicates that they are infrequent.

Relationship of Conflict to Safety Issues

There is a low incidence of accidents or injuries compared to the extent of perceived conflict and complaints about conflict. Four of the 148 sources reviewed based their analyses on actual incident or complaint data to determine the frequency or rate of conflict. They were consistent in finding a low ratio of actual accidents:

- The National Park Service (NPS) conducted an Environmental Assessment considering the impacts of reopening a section of the Cactus Forest Trail to mountain biker use (2003). During the six month trial period, park staff recorded approximately 1,200 bicyclists, representing nearly half of trail users. Three minor and no major incidents occurred during that period, including a complaint that a bicyclist yelled at a hiker; a complaint that three mountain bikers were riding too fast; and a ranger report that a bicyclist was stopped and advised to yield to equestrians. The safety evaluation found that, “Given the past record of incidents on this trail, however, reinstating mountain bike use would not be considered an unsafe use if recreationists continued to abide by the required trail etiquette rules of the trail.”
- In the early 1990’s, the North Carolina Department of Parks and Recreation (NC DPR) opened specific trails to mountain bikers on a trial basis (1993). The study estimated that 4,425 mountain bikers used the study trails annually. Three incidents were recorded during the two-year trial period, all of which were accidents involving only a single mountain biker. NC DPR concluded that good design and adequate staff hours to manage complaints are the primary concerns of allowing multiple use trails.
- An early study in the East Bay Regional Park District (EBRPD) found that four of the 24 cycling accidents reported from July 1987 to June 1988 involved a cyclist and another user; two cases involved two bicyclists colliding, one involved a cyclist falling when avoiding a cow, and the final involved a cyclist falling to avoid a hiker (Morioka, Steven in Sloan, D. and T. Fletcher, Ed., 1989).
- A Bicycle Federation of America publication cited two incidents where a horse was spooked by a mountain biker; one in Santa Rosa where the horse broke its leg and had to be shot, and another on Mt. Tam, where a rider was thrown (Keller, 1990). They did not conduct any counts or estimates to determine a rate or frequency of incidents.

In the 1990’s, the U.S. Forest Service surveyed trail managers to understand the issues and responses to management of the emerging mountain bike sector. Over half of the 40 surveyed recreational managers from the USFS and Bureau of Land Management reported conflicts between mountain bikers and other user groups. Only one interviewee reported an incident that had resulted in injury and litigation, while the majority of complaints were related to “turf,” or users feeling that new users were usurping the trails (Chavez, Winter, and Baas, 1993).

Trail Conflict Perception

Trail use conflict as a social or interpersonal issue is highly influenced by background, orientation, attitude, and other aspects of perception. Numerous surveys of managers and users have identified what parties are in conflict, to what extent they feel bothered by other users, and other facets of conflict. Two themes on user conflict emerged from the results regarding the nature of the problem:

- Trail User Insensitivity - The most common user conflicts concerns expressed include mountain bikers' speeds, lack of warning and/or failure to yield when passing;
- Conflict is a Perception - Concerns about trail conflict are highly subject to perception and orientation – it is a real problem, but it is more a problem of enjoyment and sense of safety than actual risk of incidents on the trail.

Conflict is commonly defined as “goal interference attributed to another’s behavior,” stating that users’ dissatisfaction (conflicts) from a perception that other users are preventing them from actualizing their recreational goals (Jacob and Schreyer, 1980). They note that this goal interference does not necessarily imply goal incompatibility; users may visit the same trail for similar reasons, despite using different modes.

More recently, Moore (1994) advanced this theory of conflict as interpersonal disagreements, writing that “conflict has been found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users” (Moore, 1994). Watson, a researcher with the Forest Service, observes that perceptions of conflict are frequently unrelated to measurable incidents of interference in outdoor recreation, but rather reflect an attitude towards wilderness and stereotypes of other user groups (2001).

Only 2 percent of users surveyed in Boulder County Parks and Open Space reported experiencing conflict on the day of the survey. One-third reported having experienced a conflict at some point in the past. Nevertheless, users reported several complaints, particularly about mountain bikers’ speeds, failure to yield, and not communicating when passing (Bauer, 2004). In Ohio, State Park managers and district supervisors surveyed reported concerns about mountain bikers’ excessive speeds and potential for conflict with other users (Longsdorf, 2006).

A 2001 survey of trail users in the Jefferson County Open Space trail system considered the extent to which conflicts between users are interpersonal (based on physical presence of other users) or social (no contact has to occur). The survey supported the studies, finding that all types of users reported more interpersonal (physical interactions between users) than social values conflicts (Carothers, Vaske, and Donnelly, 2001).

Several surveys of trail users have indicated that conflicts between users were highly influenced by perception and orientation. Research conducted in the Bridger-Teton National Forest found that users who had past experience with other trail activities experienced less conflict when encountering participants of those activities than respondents who had never done those activities before. People who had participated in an activity in the past were also more likely to report increased enjoyment due to encounters with that group than were trail users who had never done the activity before, although the relationship was less statistically significant between mountain biking and horse riding (Bradsher, 2003).

A survey conducted for the report, *Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand* indicated that pedestrians who had not encountered any bicyclists had more negative perceptions of bicyclists than those who actually encountered them (Cessford, 2002). A survey in Wellington Park, Australia found that users had different goals for use of the park; mountain bikers visited the park for ‘socializing’ and ‘excitement/risk’, while other users desired ‘relaxation’ (Chiu and Kriwoken, 2003).

B.2.2 User-Appropriate Trail Design Strategies

There is not a clearly established set of “industry best practices” solutions for appropriate design of multi-use trails documented in the literature. While many sources provided specific trail design parameters, they were primarily general guidelines or standards for trails, rather than design solutions explicitly focused on minimizing incidents between users. Most of the design guideline documents include a brief discussion of designing for shared use, typically without specific design details or specifications to ameliorate these conflicts. Many have general recommendations for adequate widths, sinuosity, or other design elements. The net result is a range of recommendations, and some consensus, regarding the best design measures to address user-appropriate design.

Of the 80 documents included in the Study, 27 contained specific design guidance. This does not include resources that generally stated that good design is important, or that sight lines and width should allow multi-use use, without providing specific dimensions. Figure B-1 shows the frequency of common design solutions cited in all the documents reviewed. For example, the literature that did pertain to design guidelines frequently cited width and passing areas (24 percent), although the dimensions were generally not specific to managing user conflict.

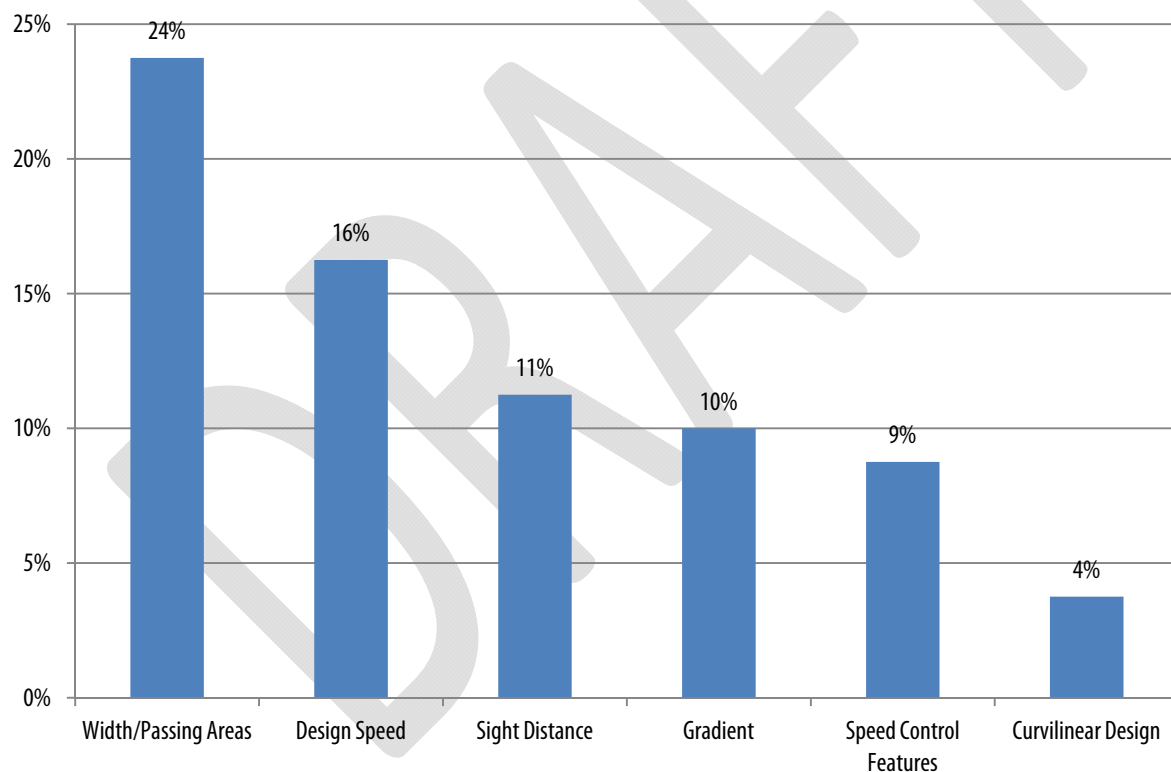


Figure B-1. Common Design Solutions cited in the 80 Literature Sources Reviewed

The following paragraphs highlight the Literature Review results on specific subjects of appropriate trail design for multi-uses.

Trail Width/Passing Areas

Adequate trail bed widths and passing areas were cited as a means to reduce negative conflict perception. Trail width guidance tended to specify widths based on use, type(s), trail context, or trail classification. The width of the trail determines how easily users can pass one another. Elements of width to consider include tread width, bench/clear areas, and passing areas.

Some guidebooks define recommended trail beds or trail clearance widths, which enable trail users to step off the trail and allow another user to pass. Clear area guidance varies from a 2-foot minimum acceptable in low development areas (Forest Service, 2007) to a recommendation of 3 feet clear to either side of the center (Hesselburg, Vachowski, and Davies, 2007).

Passing areas are a sequence of wide points that allow users to let others pass on a narrow trail. The State Parks guidance for accessible trails states that, “where the width of the trail is less than 60 inches, passing spaces measuring 60 inches by 60 inches shall be provided at intervals of 1,000 feet” (99AG-16.2.6; State Parks Accessibility Section, 2005), which is not required on multi-use trails, but is a useful guideline for trails to provide sufficient passing space. Table B-1 shows the variety of guidance related to width and passing. Key width considerations are as follows:

- The Minnesota Department of Natural Resources guide states that, “Trail width must be based on a solid understanding of how a trail will be used since over time it will take the shape users give it” (Minnesota Department of Natural Resources, 2006). The guide recommends 36 inches or more for an easy mountain biker and 72 inches for an ‘easiest’ mountain biker trail.
- The City of Portland states that hiking/mountain biking/equestrian trails should be 4 feet wide at a minimum with 4-foot passing areas. Ten feet is the maximum width (City of Portland Parks & Recreation, 2009).
- The Santa Monica Mountains National Recreation Area uses an 8-foot minimum bench with a tread of 48 to 60 inches, as well as passing areas twice the width of the trail and approximately 16 feet long (1997).

Table B-1. Summary of Width, Bench/Clear Area, and Passing Area Recommendations

Jurisdiction	Tread Width (feet)	Clear Area/ Bench (feet)	Passing Area
<i>Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds</i> (USFS, 2007)	1.5-2 "low development areas" 6-8 "high development areas"	2	5 feet x 10 feet
<i>Trail Planning for California Communities</i> (Bondurant, Thompson, et. al., 2009)	4-6, 2 minimum	N/A	Provide where width < 5 feet, every 1,000 feet
<i>Trail Use Guidelines and Mitigation Measures</i> . (Midpeninsula Regional Open Space District, 1993)	3-4 minimum	N/A	"Passing often requires moving off the trail"
<i>Trail Planning, Design, and Development Guidelines</i> . (Minnesota Department of Natural Resources, 2006)	3-6	N/A	N/A
<i>Trail Design Guidelines for Portland's Park System</i> . (Portland Parks & Recreation, 2009)	4 minimum; 10 maximum	N/A	4

A few of the guidebooks also address issues with trails being too wide:

- IMBA notes that singletrack trails are more attractive for users and "tend to wind around obstacles" (2007), which is key recommendation for reducing speeds.
- The California Equestrian Trails and Land Coalition (CET&LC) organization notes that wide trails should be avoided to minimize erosion, but trails should be wide enough to provide sufficient space for users to pass each other (CET&LC, 2005).
- Narrower trail width is part of a suite of speed control elements that are important for safe shared trails (Jellum, 2007).

The Forest Service *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds* (2007) recommends that when slopes are steeper than 50 percent, consider providing additional horizontal clearance for logs or protruding branches, and widen the trail base along a precipice or other hazardous area (on a 2-foot trail, hazardous segments should be widened to 4 or 5 feet for safety).

Sight Distance

Several sources stated that adequate sight distance should be provided to minimize trail use conflict and maximize safety. Sight distance is the distance that oncoming trail users can see each other. Sight distance recommendations in the literature include:

- The U.S. Forest Service notes that recommended sight distances for equestrians vary and are most commonly 50 to 100 feet (Forest Service, 2007).
- The Midpeninsula Regional Open Space District recommends 100 feet of sight distance on narrow shared trails, with 75 feet acceptable on wider trails (1993).

- Flink, Olka, and Searns recommend a minimum sight distance of 150 feet for bicyclists, 100 feet for equestrians, and 50 feet for pedestrians (1993).
- The City of Portland recommends that sight distance on a hiking/mountain biking trail should be 40 to 100 feet, “depending on speed/flow,” and 50 to 100 feet on a hiking/equestrian trail (2009).
- The California Equestrian Trails and Land Coalition (CET&LC) recommends 50 feet of visual clearance on either side on switchbacks and curves so users can see others (CET&LC, 2005).
- Sight distance standards can also vary based on grade; the Santa Monica Mountains National Recreation Area recommends a minimum of sight line of 85 feet for trail with grades of 5 to 10 percent (1997).

Gradient

There was minimal guidance and no standard in the literature regarding the trail gradients that hikers, mountain bikers, and equestrians can comfortably and safely negotiate. California State Parks employs trail grades that will be sustainable for site conditions and the selected use type. With the exception of Accessible trail guidelines, CSP does not have a standard grade requirement for trails. The CSP *Trail Handbook* states: “The parent soil capability, combined with user type, hydrological site conditions, degree of vegetation cover, percent of side slope, the relationship of the hill side cross slope to the trail running grade and season of use shall dictate the percent of trail grade. User comfort shall be a consideration for determination of trail grade, but after all the other conditions outlined above are met. If soils and parent material geologic capability are not sustainable, overly steep grades will be mitigated with surface hardening techniques. Hardening techniques (such as high quality compacted aggregate or trail structures such as steps or retaining walls) shall keep the surface sustainable, firm and stable”.

The US Forest Service *Trail Construction and Maintenance Handbook* recommends slopes of 15 percent or less on climbing turns (Hesselbarth, Vachowski and Davies, 2007), while *Trail Planning for California Communities* states that ‘wildland trails’ should have a 12.5 percent maximum slope (Bondurant, Thompson, et. al., 2009) and IMBA cites a 10 percent average guideline for sustainable trails (IMBA, 2004).

The Forest Service *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds* (2007) states that equestrian trails can be as steep as 20 percent grade for no more than 200 feet, while the target grade is less than or equal to 12 percent grade for 90 percent of the trail, otherwise switchbacks should be considered to minimize erosion. On running grades steeper than 5 percent, 6 to 12 inches of extra tread width should be added as a safety margin where possible (Forest Service, 2007).

The City of Portland recommends that hiking/mountain biking/equestrian trails should have grades of zero to 5 percent slope or up to 12 percent as needed (City of Portland Parks & Recreation, 2009). Similarly, CET&LC recommends keeping the slope as low as possible preferably under 12 percent if possible) for safe places for passing and visibility (2005).

On running grades steeper than 5 percent, 6 to 12 inches of extra tread width should be added as a safety margin where possible (Forest Service, 2007). Also, when trails have out slopes of 4 to 5 percent, widening the trail an additional 6 to 12 inches helps stock stay in the center of the tread (Forest Service, 2007).

Elements such as grade reversals and rolling grades also enhance drainage and contribute to a sustainable trail. One type of such element, a ‘knick’ is a semicircular depression in the trail, about 5 to 10 feet long and is angled about 15 percent for drainage. The Forest Service supports the use of such elements on trails intended for use by equestrians, stating that “Stock tolerate grade reversals, knicks, and rolling grade dips well” (Forest Service, 2007).

Speed Control Features

Several sources state that trail design can control users’ speeds by providing features that encourage users to slow down, such as obstacles, choke points, pinch points, stiles, traffic calming, chicanes, traffic calming, and surface irregularity. These features are designed to improve appropriate trail design by requiring that users moderate their speeds, and they can keep users on the trail, thereby reducing erosion. Trail anchors or obstacles can include large rocks, logs, trees or other obstacles that act as a visual and physical barrier showing where the trail is and requiring users to slow down to pass. Choke points, pinch points, or stiles can be rocks or a broken tree trunk that acts as a gateway through which trail users must pass. Uneven trail surface features such as rough native bedrock can also provide this function.

In *Managing Mountain Biking*, IMBA recommends using “trail flow” to control speeds (2007). Strategies for modifying the trail flow include corralling the trail with trail anchors, adding turns, using choke points to visually narrow the trail, and adding surface textures. Other related principles include:

- A stile or pinch point can be the width of the average set of bicycle pedals, plus 2 or 3 inches where wheelchair access is an issue (Goldstein, personal interview with George Geer, a Sunset Unit Ranger with the Arroyo Seco Ranger District in Angeles National Forest, 1987).
- *Trail Solutions: IMBA’s Guide to Building Sweet Single-Track* recommends using pinch points to slightly narrow the trail should be install just prior to the area where users should slow down (IMBA, 2004). IMBA recommends providing sufficient sight distance for users to see the obstacle and slow down in advance of the feature.

Surface Texture

In *Managing Mountain Biking*, IMBA recommends adjusting the trail ‘flow’ with anchors, turns, choke points, and surface textures to control speeds (2007). Sufficient sight distance for users is required to see the obstacle and slow down in advance of the feature, although the document does not recommend specific distances. IMBA notes that a variety of textures created with rocks, roots, and other uneven material is a desirable challenge for mountain bikers and requires that they slow down to maneuver through the area. In addition, IMBA notes that loose soils are more difficult to brake on, and bicyclists may appear out of control when stopping on a loose surface.

Chiu, L. and L. Kriwoken (2003) similarly recommend “leaving obstacles and rough surfaces to slow users down.” A technique for creating this texture is to place rocks in the trail tread. Sightlines and a gradual transition are keys to using this technique.

Sinuuous Design

Trails naturally follow curves of topography, which can manage users’ speeds, contribute to an attractive and interesting trail, and manage drainage to reduce erosion.

An unnamed agency responding to the *Narrow Natural: Managing Multiple Use* study conducted for EBRPD recommended avoiding “fall line trails and switchbacks in favor of designing sinuous trails that include rolling, undulating grades (maximum 10 percent for extended lengths) and curves that provide an interesting user experience” (EBRPD, 2011).

Horses can comfortably negotiate a minimum turn radius of 5 feet, with 6 to 8 feet preferred; when turns are tighter, stock may stumble over their own legs (Forest Service, 2007). The City of Portland recommends a 10 – foot minimum turn radius on a hiking/mountain biking trail/equestrian trail (City of Portland Parks & Recreation, 2009). The minimum suggested radius for a climbing turn is 20 feet. Climbing turns work best when built on slopes of 15 percent or less. In steeper areas, switchbacks are a better choice. (Forest Service, 2007).

B.2.3 Conflict Management Strategies

Most of the documents reviewed cite active management and enforcement and working with user groups and individual users as key to minimizing trail use conflict by adjusting users’ perceptions, informing them of appropriate or required behavior, and enforcing the rules of the trail. This section discusses management strategies that were recommended in the literature as a way of reducing user conflicts. The frequency of mention of the various measures by the surveyed agencies is shown in Figure B-2.

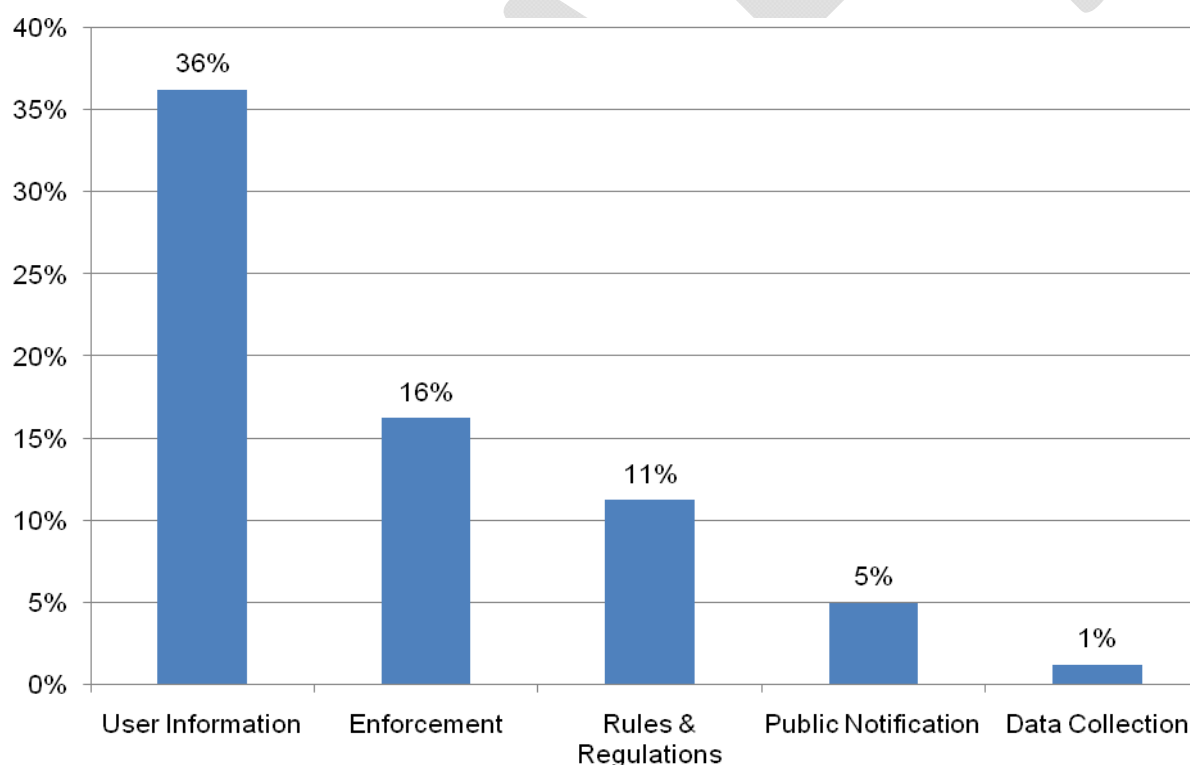


Figure B-2. Common Management Solutions from the 80 Literature Sources Reviewed

A questionnaire given to users of a trail in Wellington Park, Tasmania found that all types of users generally preferred the management strategy of self-regulation. Both mountain bikers and non-mountain bikers desired mountain bike education and information, a code of conduct for mountain bikers, and use of the principle that pedestrians should have right-of-way (Chiu and Kriwoken, 2003).

The North Carolina Department of Parks and Recreation conducted a two-year trial allowing mountain bikers on trails, which found that an average of two staff-hours per week were required to monitor the multi-use trail conditions, while 10 staff-hours were required to respond to complaints resulting from mountain biker use (1993). The study concluded that trails can only be multi-use if adequate staff capacity exists for monitoring.

User Information

Signs tend to be either 'moral appeals' to protect the natural resources and enhance other users' safety or 'fear appeals' that identify consequences for rule breaking (Hendricks, Ramthun and Chavez, 2001). Interpretation messages have been found to be as effective as sanction messages and both types are more effective than no message (Duncan and Martin, 2002).

In situations where hikers do not want to share a trail because of mountain bikers' speeds or fears of being pushed off the trail, agencies have responded by posting signs reinforcing that mountain biking is an allowed use on the trail Chavez (1997).

Signs designating user etiquette may cite specific policies with enforceable regulations, or they may recommend yielding or other good behavior. These regulations, as well as why and how the regulations will be enforced and what the applicable penalties are, should be posted at trailheads and included in trail brochures and on maps (Flink and Searns, 1993). Signs are more effective if they function to activate attitudes and beliefs visitors already hold, instead of trying to instill new beliefs. To effectively deter noncompliant behavior, managers must address the reason(s) behind the behavior and not just symptoms (Anderson, Lime, and Wang, 1998).

IMBA's 'Rules of the Trail' are often posted at trailheads to encourage good behavior. Rules include the following:

- Ride open trails.
- Leave no trace.
- Control your bicycle.
- Yield appropriately.
- Never scare animals.
- Plan ahead.

Manning (2003) provides the following 'emerging principles' for information/education programs:

- Maximize efficacy by addressing problem behaviors that are characterized by careless, unskilled, or uninformed actions.
- Connect with or modify visitor attitudes, beliefs, or norms and provide information on the impacts, costs, and consequences of problem behaviors.
- Deliver messages via multiple media, including brochures, personal messages, audiovisual programs, newspapers, magazines, guidebooks, trained volunteers, outfitters, commercial guides, wilderness ranger and volunteer role modeling.

- Design materials for a variety of target audiences and deliver messages in several locations.

Enforcement

Several of the sources generally recommended enhancing enforcement of trail policies. Most of these recommendations are more specifically for ranger patrols or warnings/citations. In *Managing Mountain Bicycling: IMBA's Guide to Providing Great Riding*, IMBA states that patrols act as the 'eyes and ears' of a land manager and can enhance visitor experiences, assist land managers, promote trail stewardship, and respond to incidents (2007). Ranger patrols can cite users who violate posted regulations and record comments or complaints from users. They can also model appropriate behavior.

The *Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks* in Santa Clara County recommended both staff and volunteer patrols as a key element of managing multi-use trails (1989). In particular, where trails were considered too steep and/or narrow to accommodate multiple uses, the County recommends designating a one-way section and/or having mountain bikers walk, including posting signs and increasing patrols in those locations.

In a study conducted on Mt. Tamalpais, California, both 'moral appeals' to protect the natural resources and enhance other users' safety and 'fear appeals' that identified consequences improved mountain bikers' yielding behavior and had a small impact on reducing speeds over no message. Messages found to come from other mountain bikers were more effective than those coming from a uniformed agency volunteer or a hiker (Hendricks et. al., 2001).

Rules and Regulations

While speed limits are increasingly being used on paved multi-use paths, they are also sometimes used on natural surface trails (Flink and Searns, 1993). However, challenges to the use of speed limits include lack of enforcement staff and users' limited knowledge of the speed they are traveling (Bondurant, Thompson, et. al., 2009).

IMBA discourages the use of speed limits, stating that "speed limits are extremely difficult to enforce, may be unreasonable for trails with constantly changing terrain, probably won't improve real or perceived safety on the trail, and can damage essential respect and trust" (IMBA, 2007).

Flink and Searns recommend enforcing rules and regulations consistently to assure that there is no perception of discrimination among different user groups (1993). They also recommend posting and enforcing regulations from the beginning on new trails to establishing desirable patterns of behavior from the start.

CET&LC feel that law enforcement is a necessary accompaniment to volunteer patrols for enforcing trail rules (2005). Agencies interviewed in the *EBRPD Narrow Natural Surface Trails Study* generally felt that focusing enforcement at parking lots and using radar guns to enforce speed limits were successful strategies (EBRPD, 2011).

One way of engaging trail users who break rules is to consider sentencing trail offenders to work service on the trail as part (or all) of their penalty (Flink and Searns, 1993).

Public Notification

Most agencies alert the public when making planning or policy decisions. However, few of the literature sources cite public notification as a specific strategy used to manage user conflicts. A few sources mentioned working with the public, but did not provide additional details. However, the extensive comments regarding general user group outreach and coordination indicate that formal public notification is occurring as part of the overall process.

Collecting and Tracking Data

A number of the sources noted that managers should begin to track use estimates and complaint/incident data to determine the extent of the problem and to understand root causes. To effectively deter noncompliant behavior, managers must address the reason(s) behind the behavior and not just symptoms (Anderson, Lime, and Wang, 1998). To do this, they recommend gathering incident and complaint data, use estimates, and user surveys.

Use Restrictions

Specific types of use can be allowed on the single tread at different times of day, days of week, and season of the year (Flink and Searns, 1993). Studies are divided on to what extent these management strategies are successful; a survey of mountain bikers in National Forests nationwide found that the management strategy of providing separate trails for different users “was not regarded as a plausible solution by any of the participants” (Hollenhorst, Schuett, and Olson, 1995).

Alternating Days

A study in Chilkoot Trail National Historic Site, British Columbia found that a management strategy that excludes snowmobilers every third weekend successfully reduced goal interference while increasing skiers’ satisfaction but reducing snowmobilers’ (Jackson, Haider and Elliot, 2004). Both hikers and bikers supported an every-other-day exclusion policy in the Snoqualmie National Forest, Washington (Jellum, 2007).

An Environmental Assessment considered implementing a strategy wherein mountain bikers and equestrians would be allowed on the Cactus Forest Trail in Arizona on alternating days. The analysis of the alternating days scenario noted that, while the potential for conflict would be reduced, “some recreationists may feel constrained, and others may be displaced.” The evaluation considered this constraint and displacement to be “adverse, short- to long-term, and of negligible to moderate intensity depending on the individual” (NPS, 2003). This topic was not a focus of the assessment.

One-Way Trails

Single direction trails can alleviate congestion, provide a more predictable experience, and reduce the number of passes between users. Direction restrictions may be combined with user restrictions (such as on a mountain bike only trail), applied to only one type of user, or applied at certain times or days (IMBA, 2004).

The Santa Clara County *Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks* (1989) recommends that, where trails are too steep and/or narrow to accommodate multiple uses, the they can be designated one-way. This treatment requires posting signs and increasing patrols.

B.2.4 Outreach and Coordination Strategies

User group outreach and coordination can include events that bring trail users together, direct interactions with trail users individually via volunteer programs or in user organizations, as well as education and providing users with information. Agencies are increasingly looking to these types of “bridge building management styles” to engage users and build communities (Chavez, 1996b). Chavez notes that, “the increasing use of this [bridge building] strategy often accompanies decreasing budget allocations.”

User group outreach and coordination can include the following strategies:

- Education – user-specific printed materials and web postings, and/or an active, focused public relations campaign.
- Meetings with user groups – including general meetings about specific conflict-related issues or objectives.
- Volunteer programs – ongoing trail patrol and/or maintenance, specific projects, outreach and education – safety and courtesy (e.g. bike bell give-aways): organize, encourage, or support.
- User group notification – of a project or issue with a point of contact and venting opportunity such as comment cards or a web form.
- Events – including multi-user social, fun, trail construction or maintenance events (e.g. Trail Days). Staff could organize, or play a background role to encourage/support user groups who sponsor such events.

Figure B-3 shows the frequency of specific outreach and coordination techniques referenced in the literature.

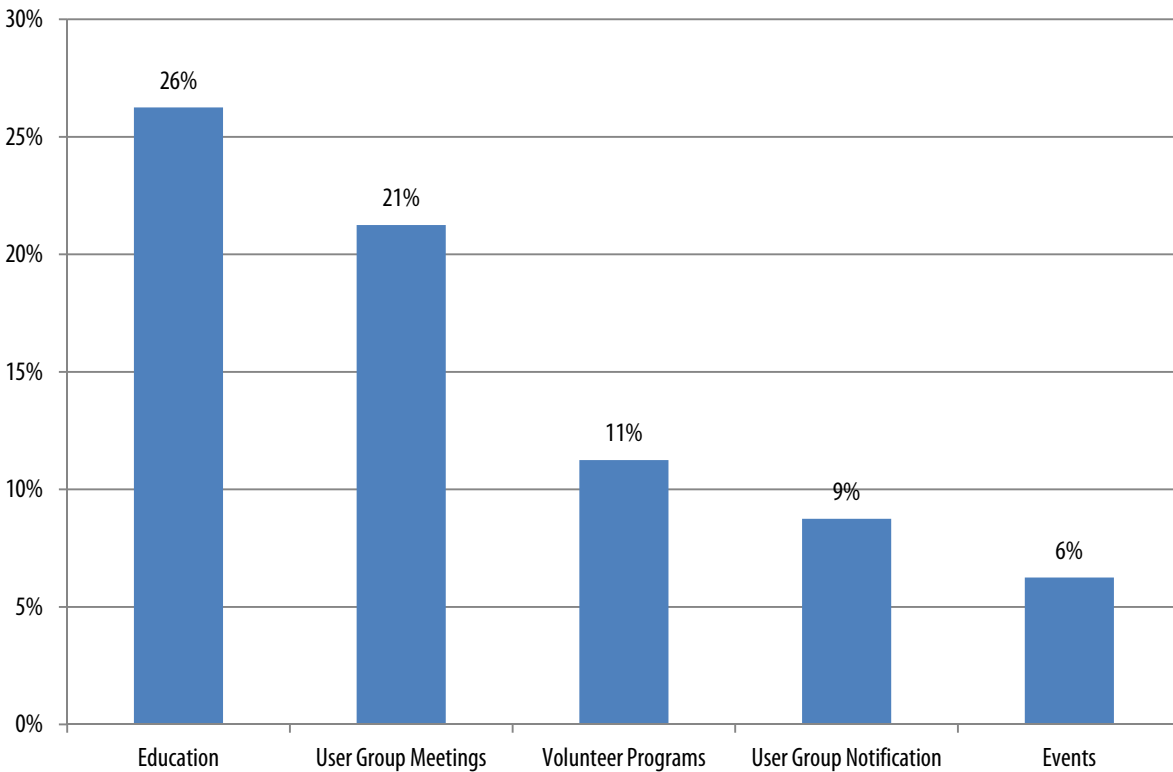


Figure B-3. Common Outreach and Coordination Solutions from the 80 Literature Sources Reviewed

Education

Flink and Searns recommend that “if mountain bikers will be using your trail, you should develop an educational campaign on proper trail use for all users” (1993). Chavez (1997) found that one-on-one education has been used to mitigate a variety of conflict situations, including equestrian complaints about mountain bikes spooking horses, conflict over use of a horse trail by mountain bikers, and hikers not wanting to share trails because of mountain bikers’ speeds.

The California Equestrian Trails and Land Coalition recommends that agencies and user groups educate users about the “startle factor” of horses (CET&LC, 2005), both for equestrians to be aware of mountain bikers potentially spooking the horse and for other users about how to act around horses. They recommend holding training clinics for equestrians to teach the horses and riders to meet cyclists in varying situations.

User Group Meetings

IMBA recommends that agencies form formal partnerships with user organizations by writing specific agreements with user groups to define roles and responsibilities. Agreements should start simple and build as the relationship develops. They also recommend creating a plan for ongoing communication with the group (2007).

The East Bay Regional Parks District found that in some cases, collaboration between field staff and the mountain bike and equestrian communities successfully created a shared sense of resource protection and

stewardship between staff and bicyclists enthusiasts (EBRPD, 2011). Moore (1994) suggests the following techniques to solicit user involvement in trail planning and management:

- Hold public meetings, issues identification workshops, community design workshops, public hearings, citizen advisory committees, surveys, and mass media outreach.
- Convene a trail advisory council composed of representatives of various user groups.
- Hold joint trail construction or maintenance projects and skills workshops among different user groups.
- Discuss problems with affected user groups via land manager trail walks.

Chavez (1997) recommends forming a multi-user trail group to address hikers' concerns about sharing trails with mountain bikers' due to their speeds.

Volunteer Programs

Volunteers can help with several aspects of trail management; they can reach out to other trail users and educate or appeal to them to yield to other users and they can assist with events such as trail maintenance days and Share the Trail events. Flink and Searns note that trail patrols can hand out maps and brochures, provide information to trail users, and record incident and maintenance needs (1993). They can also carry an aid pack containing a tire patch kit, a spare tube, first-aid supplies, extra fluids, a tire patch kit, and a cell phone (Bondurant, et. al., 2009).

IMBA highly recommends such programs, stating that volunteer patrols are a “tangible reminder that mountain bikers are aware of their potential effect on other visitors, are committed to regulating themselves, and are willing to give back to the trails in the form of volunteerism” (IMBA, 2007).

Another method for involving individual users is through the formation of a Trail Advisory Group. IMBA notes that Trail Advisory Groups can help identify and solve user conflicts before they become serious problems (2007).

Mountain Bikes on Public Land: A Manager's Guide to the State of the Practice (Keller, 1990) provides extensive recommendations for forming volunteer trail patrols. Key considerations are to identify eligibility requirements, such as age, commitment to the goals of responsible cycling, first aid knowledge, and training. An agency staff person can work with the club, whose ultimate responsibility is to train, organize, and manage the volunteers. They can work with rangers in the event of an incident or in situations requiring major first aid or emergency medical services.

Similarly to meetings with user groups, notifying groups when beginning a planning effort encourages users to be involved and invested in decisions. While several sources mentioned working with users in planning efforts, they did not provide substantial information on the topic.

Events

Several sources recommended that agencies organize or facilitate events on narrow natural surface trails that allow different user groups to join in a controlled, cooperative way, such as trail construction, repair, or maintenance work days; competitions such as triathlons and adventure course events that combine kayaking and/or swimming with trail activities, or events that are simply intended to be fun and social.

Moore (1994) suggests the following events to engage a variety of user groups:

- "Trail Days" events sponsored jointly by different user groups.
- Joint fundraising or lobbying efforts.
- "Romp and Stomp" events.

In *Managing Mountain Biking: IMBA's Guide to Providing Great Riding*, IMBA recommends holding 'Romp and Stop' events where mountain bikers and equestrians get together and "ride each others' steeds" (2007).

B.3 Review of Most Relevant Literature

The following pages provide a summary of literature that the Project Team found to be most relevant to the subjects of trail safety and trail user conflicts, using the criteria presented in Section B.1.2 on page B-B-2. The summaries include documents that agencies often referenced as guidelines they use to address user conflicts. These documents provide measurable, specific guidance about the nature of the problem and/or solutions to understanding and dealing with the issues.

Information from each document related to trail user conflicts or design guidelines that may address conflicts is provided, along with the evaluation of the document using the criteria established. Other documents that were included in the analysis but were not considered "key" resources are included in Appendix E. Though these documents were not among the most useful references on trail conflict, they contain valuable information, which is cited in the overall Literature Review results in Section B.2.

The key documents are as follows:

- Chavez, D. J. 1996. *Mountain Biking: Issues and Actions for USDA Forest Service Managers*. Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.
- Hesselbarth, W., Vachowski, B., and M Davies. 2007. *Trail Construction and Maintenance Notebook*. FHWA and United States Forest Service.
- Moore, R. L. 1994. *Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice*. FHWA.
- National Park Service, Department of the Interior. 2003. *Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona*. National Park Service. (Public Review Draft)
- United States Department of Agriculture Forest Service. 2007. *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds*. 0723-2816-MTDC
- Flink, C., Olka, K., Searns, R., Rails-to-Trails Conservancy. 1993. *Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails*. Island Press.
- Minnesota Department of Natural Resources. 2006. *Trail Planning, Design, and Development Guidelines*. St. Paul, MN: State of Minnesota.
- North Carolina Division of Parks and Recreation. 1993. *Results of the Two Year Mountain Bicycle Trail Study*. North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources.

- Bondurant, J., L. Thompson et. al. 2009. *Trail Planning for California Communities*. Solano Press Books.
- Anderson, D.H. Lime, D. W., and T.L. Wang. 1998. *Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers*. St. Paul: University of Minnesota Extension Service.
- City of Portland Parks & Recreation. 2009. *Trail Design Guidelines for Portland's Park System*.
- East Bay Regional Parks District. 2011. *Narrow Natural Surface Trails: Managing Multiple Users*.
- Hendricks, W., R. H. Ramthun, and D. J. Chavez. 2001. *The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines*. *Journal of Park and Recreation Administration* 19(3): 38-61.
- Manning, R. 2003. *Emerging Principles for Using Information/Education in Wilderness Management*. *International Journal of Wilderness* 9: 20-27, 12.
- California Equestrian Trails and Land Coalition. 2005. *Safety Considerations for Multi-Use Trails*.
- International Mountain Bike Association. 2004. *Trail Solutions: IMBA's Guide to Building Sweet Single-Track*. Boulder, CO: International Mountain Bicycling Association.
- International Mountain Bike Association. 2007. *Managing Mountain Biking: IMBA's Guide to Providing Great Riding*. Boulder, CO: International Mountain Bicycling Association.

B.3.1 Mountain Biking: Issues and Actions for USDA Forest Service Managers

Chavez, D. J. 1996. Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Background and Context

This article was written by a research social scientist with the Pacific Southwest Research Station's Wildland Recreation and the Urban Culture Research Unit, based in Riverside, California. The study is a continuation of an early 1990s National Park Service study by Tilmant (unpublished) that examined mountain biking on a national scale. The International Mountain Bicycling Association (IMBA) cites this article on their website.

Methodology

The article presents the results of a national survey of U.S. Forest Service (USFS) resource managers from 90 National Forests. The research objectives were to describe the amount of mountain bike riding in National Forests, to determine the level of planning currently used by Forest Service managers to deal with issues related to mountain bike use, and to examine management issues and actions related to mountain bike use in National Forests including resource damage, user conflicts, safety, and accidents.

Findings

The questionnaire results indicate that National Forest managers' primary concerns related to mountain biking include effects on natural resources (42 percent), conflicts with other user groups (34 percent), safety concerns (13 percent), illegal use in designated wilderness (13 percent), and the growth of the sport (12 percent). In addition, 70 percent of managers had received reports of user conflicts and 48 percent noted

specific problems related to incidents. The most significant conflict issues reported were those between mountain bikers and equestrians (41 percent) and mountain bikers and hikers (31 percent). Twenty-one percent reported that the problems were due to the speed of mountain bikers, while 11 percent felt it was generally the other party's behavior.

Managers responded to an open-ended question about the methods they use to reduce user conflicts. The responses were grouped into the following categories:

- Information/education (63 percent) – Safety, brochures, posters, signs, IMBA triangle, etc.
- Cooperation (27 percent) – Personal interactions, volunteer patrols, partnerships, and providing mountain bike shops with rules and regulations.
- Visitor restrictions (17 percent) – Separate user groups, separate trails, alternating use between user groups, redirecting bike use to other trails, law enforcement, and denial of event permits.
- Resource hardening (7 percent) – Changing trail to meet needs, shorter loops for hikers, longer for mountain bikes, and upgrading trails.

The survey asked about safety problems (incidents) and accidents separately from user conflicts. Most managers had observed or reported safety problems (incidents) related to mountain bike use (59 percent), while almost half had observed or received reports of accidents involving mountain bikes (48 percent). Issues included excessive mountain biker speeds, concerns about pack animal groups, mountain bikes that were too quiet (they did not warn other users they were approaching), and mountain bikers being careless around vehicles. Responses to safety issues were categorized in the following ways:

- Information/Education (58 percent) – Safety rules, multiple uses, brochures, maps, trail descriptions, newspaper articles, club newsletters, signs with appropriate use, ethics, etiquette, and low impact use.
- Cooperation (17 percent) – Personal contacts, partnerships, and workshops.
- Visitor Restrictions (12 percent) – Separate trails, enforcement contacts, and non-issuance of special use permits.
- Resource hardening (8 percent) – Wider turnouts and rubber belting on water bars.

Managers also recommended additional research studies on the following: the value of bike patrols and partnerships for alleviating conflict or resource damage; trail construction that can alleviate trail damage; mountain biking interactions with the community; and an evaluation of whether displacement of trail users is an issue.

Chavez concludes that, “trail maintenance is a reasonable way to deal with safety and accident problems, and information and personal interaction are the most reasonable tools for dealing with conflict issues.”

Critique

Objectivity:	High	Chavez's conclusions are direct observations based on an extensive survey of Forest Service trail managers' professional opinions. Her recommendations are limited to identification of additional research needs; they do not exceed the data.
Thoroughness:	High	The article presents a definition of conflict and safety issues, as well as a large range of solutions, including specific information/education, cooperation, visitor restrictions, and resource hardening strategies.
Applicability:	High	The analysis specifically focuses on trail use conflicts and safety issues on soft-surface trails shared with hikers, equestrians, and mountain bikers.
Useful Information:	Medium	While the survey identifies conflict and safety issues as well as strategies to address these issues, the results do not include measureable design guidance or an analysis of the effectiveness of measures.
Sustainability:	Medium	The survey asked about resource damage, but Chavez does not analyze the interactions between the stated survey responses related to safety, user conflict, and resource damage issues.
Keywords:	Problem definition (manager survey), trail layout/availability, user group notification, volunteer programs, events, user group meetings, public notification, user information, alternate use days, enforcement	

Mountain Biking: Issues and Actions for USDA Forest Service Managers Lessons Learned

Design Best Practices

- Provide shorter loops for hikers and longer loops for mountain bikers.

Management Best Practices

- Inform users of etiquette and expectations through brochures, posters, signs, and the yielding triangle.
- Use partnerships, personal interactions, and volunteers to engage visitors.

B.3.2 Trail Construction and Maintenance Notebook

Hesselbarth, W., Vachowski, B., and M Davies. 2007. FHWA and United States Forest Service.

<http://www.fhwa.dot.gov/environment/fspubs/07232806/index.htm>

Background and Context

This online resource is a handbook of Best Management Practices (BMPs) for physical trail construction and maintenance, particularly gravel and dirt trails. It was produced by the Forest Service in cooperation with the Recreational Trails Program (RTP), and several agencies report using it as a design resource in the Agency Survey.

Methodology

The Trail Construction and Maintenance Notebook (Notebook) is based on the professional expertise and experience of the authors. A long list of contributors and reviewers indicates thorough oversight. The

Notebook includes the following: guidance for drainage, erosion, grade, and alignment; tools and methods of trail construction; standards for decommissioning trails; and signs and wayfinding guidance.

Findings

The majority of the recommendations address drainage and other environmental concerns of trails, rather than addressing safety issues or conflicts between users. The Notebook recommends leaving tree stumps in order to minimize downhill trail creep, but it does not mention the possible speed control benefits.

Critique

Objectivity:	High	A FHWA and RTP publication, the recommendations in this document are based on extensive experience and expert review, as well as engineering judgment.
Thoroughness:	Medium	The Notebook discusses specific standards of trail design, but it does not address either trail use conflict in general or specific management or outreach strategies.
Applicability:	Medium	The Notebook discusses soft-surface trail design, but it does not explicitly consider designs for multi-use trails.
Useful Information:	Medium	The standard specifications for sustainable trail design are useful to this Study, but the Notebook does not discuss techniques to design for multi-use.
Sustainability:	Medium	The Handbook provides standard specifications for sustainable trails, but they are not discussed in relation to design for multi-use.
Keywords:	Design guidelines, width/passing area, user information	

Trail Construction and Maintenance Notebook Lessons Learned

Design Best Practices

- Clear a hiking trail corridor for a distance of three feet either side of center.
- Use grade reversals at natural dips in the terrain (10 to 15 feet for the reversed grade) to keep water moving across the trail and minimize maintenance; place every 20 to 50 feet.
- When constructing a trail, leave roots that are perpendicular to the tread, fairly flush, and not a tripping hazard.
- Consider leaving large rocks along the trail to keep the trail from creeping downhill.

B.3.3 Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice

Moore, R. L. 1994. www.americantrails.org/resources/ManageMaintain/MooreConflictMgmt.html

Background and Context

Conflicts on Multiple-Use Trails (1994) is a well-referenced guide to trail user conflicts. The article is a synthesis of existing literature created by the National Trails Training Partnership for the Federal Highway

Administration (FHWA). IMBA cites this article on their website. The article provides guidance for reducing user conflict through information, education, regulations, and enforcement.

Methodology

Moore cites many other peer-reviewed articles, upon which he bases his conclusions. He notes that many trail managers and professional experts were involved in the research for and writing of the report.

Findings

Moore briefly discusses maintaining user safety, citing the following threats to user safety: collisions, reckless and irresponsible behavior, poor user preparation or judgment, unsafe conditions related to trail use (e.g., deep ruts, tracks on snow trail, etc.), unsafe conditions not related to trail use (e.g., obstacles, terrain, weather, river crossings, etc.), poor trail design, construction, maintenance or management, and other hazards (e.g., bears, lightning, cliffs, crime, etc.). His recommendations for maintaining safety on the trail include manager control or influence over the following factors:

- User speed (often has more to do with speed differential than speed itself)
- Mass of user and vehicle (if any)
- Sight distances
- Trail width
- Trail surface
- Congestion (e.g., number of users per mile)
- Users overtaking one another silently/without warning
- Trail difficulty (obstacles, terrain, condition, etc.)
- User skill level and experience
- User expectations and preparedness (e.g., walkers who understand they may see bicycles on a particular trail can better prepare themselves for possible encounters)
- Emergency procedures
- On-site management presence

Moore focuses his analysis on conflicts between users, noting that no actual contact between users is necessary for conflicts to occur. He states that, “conflict has been found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users.” Conflicts arise and are exacerbated by many factors, including an increased demand for trail resources, increased use of existing trails, poor management, under-designed facilities, lack of user etiquette, and disregard for the varying abilities of trail users.

Moore identifies the following 12 principles for minimizing user conflicts on multi-use trails. The principles relevant to this study are listed below:

- Recognize conflict as goal interference.
- Provide adequate trail opportunities.
- Minimize number of contacts in problem areas.
- Involve users as early as possible.
- Understand user needs.
- Identify the actual sources of conflict.
- Work with affected users.
- Promote trail etiquette.

- Encourage positive interaction among different users.
- Favor "light-handed" management.
- Plan and act locally.
- Monitor progress.

Moore lists specific techniques that have been used for reducing user conflicts, separating responses into two categories: physical responses (i.e., design trails in a way that encourages users to behave in more appropriate ways) and management responses. Management responses are divided into "information and education" and "regulations and enforcement."

Critique

Objectivity:	High	Moore based his conclusions on peer-reviewed research. The article was published by the National Trails Training Partnership for FHWA, and many professionals and experts reviewed and contributed to the article.
Thoroughness	High	Moore provides a detailed analysis of previous scholarship on trail conflicts and details a variety of specific management and outreach techniques.
Applicability	High	This article explicitly discusses conflicts between users on multi-use paths.
Useful Information	High	Moore provides specific recommendations for each recommended strategy to address trail user conflict, including physical and management responses.
Sustainability:	Medium	Moore briefly discusses protecting natural resources, as well as how perceptions of some users' impacts can contribute to perceptions of conflict, although it is not the main topic of the article.
Keywords:	Problem definition (theoretical), design guidelines, trail layout/availability, education, user group notification, volunteer programs, events, user group meetings, user information	

Conflicts on Multiple-Use Trails Lessons Learned

Outreach Best Practices

- Hold public meetings, issues identification workshops, community design workshops, public hearings, citizen advisory committees, surveys, and mass media outreach.
- Convene a trail advisory council composed of representatives of various user groups.
- Organize joint trail construction or maintenance projects and skills workshops among different user groups.
- Discuss problems with affected user groups via land manager trail walks.
- Organize events such as "Trail Days" co-sponsored by different user groups, joint fundraising or lobbying efforts, and "ROMP and STOMP" events involving mountain bikers and equestrians.

B.3.4 Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona

National Park Service, Department of the Interior. 2003. National Park Service. (Public Review Draft)

Background and Context

This Environmental Assessment published by the National Park Service considers the impacts of reopening a section of the Cactus Forest Trail to mountain biker use. The trail had allowed mountain bikers but was closed due to “claims by an organization of environmental professionals that the trail was initially opened without proper authorization.” The three alternatives considered included (1) keeping the trail closed to mountain bikers, (2) reopening the trail to mountain bikers, and (3) opening the trail to equestrians and mountain bikers on alternate days.

Methodology

During the six month trial period, the park collected information on the amount of use, total number of complaints and compliments, major and minor incidents, and unauthorized mountain bike use in other areas of the park. The Service’s stated visitor safety goal was to “identify recognizable threats to the safety and health of persons and to the protection of property.” They recorded approximately 1,200 mountain bikers, representing nearly half of trail users. Three minor and no major conflicts occurred during that period: a complaint that a bicyclist yelled at a hiker; a complaint that three mountain bikers were riding too fast; and a ranger report that a bicyclist was stopped and advised to yield to equestrians.

Findings

The analysis found that “Visitor Use, Understanding, and Appreciation” may be increased for bikers and equestrians if mountain bikers were prohibited from the trail, but “given the number of other trails within the park that are closed to mountain bikes the impact to hikers and equestrians would be localized and of negligible to minor intensity.” Impacts to local mountain bikers were seen as “adverse and long-term.” Reopening the trail to mountain biker use would be beneficial for mountain bikers, and impacts to hikers and equestrians were seen as, “adverse, long-term, and minor.” For visitor safety, the Environmental Assessment concludes that the impact of reopening the trail to mountain bikers would be negligible to minor, stating that, “given the past record of incidents on this trail, however, reinstating mountain bike use would not be considered an unsafe use if recreationists continued to abide by the required trail etiquette rules of the trail.”

The discussion of the alternating days scenario noted that, while the potential for conflict would be reduced, “some recreationists may feel constrained, and others may be displaced,” which was considered “adverse, short- to long-term, and of negligible to moderate intensity depending on the individual,” with respect to impact. The safety evaluation found that, “the potential for accidents could vary depending on such factors as the ability of the rider and the number of other cyclists and hikers on the trail. Past incident reports, however, do not indicate that safety was an issue between bicyclists and other trail users.”

The document concludes that the preferred alternative is to reopen the trail to mountain bike use, as not doing so would impact visitor safety and have “adverse, long-term, negligible to minor impacts.”

Critique

Objectivity:	High	This Environmental Assessment was written by the National Park Service and conclusions are based on data collected by the Park staff during a six-month trial period. The document also underwent a thorough public review process.
Thoroughness	High	The document presents a detailed analysis of soils, vegetation, wildlife, archeological resources/historic structures, visitor use, visitor safety, and park operations. It primarily considers management strategies.
Applicability	High	This document is an example of a jurisdiction conducting a process to determine use on a soft-surface trail and is therefore quite relevant to California State Parks' change-in-use process.
Useful Information	High	This Environmental Assessment is one of the three documents reviewed that relied on actual data to determine safety. It provides a detailed critique of management strategies to address safety, user conflict, and environmental consequences.
Sustainability:	Medium	The Environmental Assessment considers the environmental consequences of opening the trail to mountain bikers, but does not present design criteria for both sustainability and multi-use.
Keywords:	Problem definition (count/incident data), alternate use days	

Cactus Forest Trail Environmental Assessment Lessons Learned

Management Best Practices

- Opening the trail to mountain bike use, in this case, was not considered a safety issue.
- Consider trail availability for users within the system when determining use on a specific trail.

B.3.5 Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds

United States Department of Agriculture Forest Service. 2007. 0723-2816-MTDC

<http://www.fhwa.dot.gov/environment/fspubs/07232816/pdf07232816dpi72all.pdf>

Background and Context

This guidebook was published by the U.S. Forest Service, in cooperation with FHWA and funded by RTP. The document provides practical guidance for designing trails and other facilities for use by equestrians. It summarizes considerations for planning with horses in mind, including a 4-foot estimated width of the horse with a rider.

Methodology

The planning trail systems chapter provides a list of questions for determining whether a trail is suitable for equestrian use. Questions pertinent to this Study include:

- Is the trail corridor wide enough to accommodate many trail users, including stock and their riders? Is the anticipated trail appropriate for equestrian use?

- Is the trail corridor free of hazards or potential safety problems that would affect riders? Do trail conditions, such as separate treads for different non-motorized users, promote a sense of safety?

While these questions show how trail design can influence user safety, the second bullet implies that physical design can influence perceptions of safety. The report refers to Moore (1994) for additional information on interactions between trail users.

Findings

The document quotes IMBA's trail etiquette, which includes, "Give animals extra room and time to adjust to you. When passing horses, always use special care and follow directions from the horseback riders (ask if uncertain). Running cattle and disturbing wildlife is a serious offense. Leave gates as you found them, or as marked."

Specific guidelines for designing trails to accommodate equestrians include the consideration that stock tend to travel about 18 inches from the edge of the tread surface, and have an approximately 2-foot shy distance from obstacles. The guide recommends a 5- to 6-foot tread with 'adequate clearance.'

A call-out box discussing 'Mixing Bicycle and Horse Use' states that equestrians' and bicyclists' ability to share a trail may reflect the local cycling style and local circumstances or customs. The guide explains the prevalence of separating users as being because the sudden appearance of bicyclists can unnerve stock, as well as equestrians' desire to ride on a natural surface. It provides guidelines for multiple tracked trails, including treads separated by distance. Additional guidelines pertain to recommended sight distance, tread and clearing widths, turn radii and switchbacks, and design of crossing features.

Critique

Objectivity:	High	The Guidebook was published by USFS and FHWA, and many professionals and experts contributed to the recommendations.
Thoroughness:	High	The Guidebook addresses many trail design issues, as well as recommending strategies to minimize conflicts and potential incidents with mountain bikers.
Applicability:	Medium	The majority of the recommendations in the Guidebook are intended for trails where riding is the primary purpose, or for a shared hiker/equestrian trail, rather than trails that accommodate mountain bikers as well.
Useful Information:	Medium	Specific design recommendations for trails that also accommodate mountain bikers as well as equestrians and hikers are minimal.
Sustainability:	Medium	The Guidebook discusses sustainable trail design such as grade reversals and gradient, but does not provide design guidance for sustainability and multi-use.
Keywords:	Problem definition (general), design guidance, width/passing area, gradient design speed, sight lines, trail layout/availability	

Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds Lessons Learned

Design Best Practices

- Provide a space 5 by 10 feet to allow a single trail animal to pull off the tread.
- Equestrian trails can be as steep as 20 percent grade for less than 90 percent of the trail, otherwise switchbacks should be considered to minimize erosion. On running grades steeper than 5 percent, add 6 to 12 inches of extra tread width as a safety margin where possible.
- When slopes are steeper than 50 percent, consider providing additional horizontal clearance for logs or protruding branches widen the trail base along a precipice or other hazardous area (on a 2-foot trail, hazardous segments should be widened to 4 or 5 feet for safety).
- Recommended sight distances for equestrians vary, and are most commonly 50 to 100 feet.
- Use a minimum radius of 5 feet (6 to 8 feet preferred) on trail curves and turns; stock may stumble where turns are tighter. For a climbing turn, use a minimum radius of 20 feet, with a slope of 15 percent or less. Consider switchbacks in steeper areas.

B.3.6 Trails for the Twenty-First Century

Flink, C., Olka, K., Searns, R., and Rails-to-Trails Conservancy. 1993. Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails. Island Press.

Background and Context

Trails for the Twenty-First Century was authored by Flink, Olka, and Searns, who are trail planning and designing professionals, along with the Rails-to-Trails Conservancy and the National Center for Recreation and Conservation Division of the National Park Service. The second edition was sponsored by the Federal Highway Administration (FHWA).

Methodology

The book “was written to help those who are planning, designing, building, and managing multi-use trails” and presents a thorough discussion of considerations for both paved and soft-surface trails, as well as designing trails to accommodate multi-use.

Findings

Flink, Olka, and Searns advocate for designing trails with specific users in mind to avoid conflict and unsafe trail conditions. *Trails for the Twenty-First Century* states that speed issues are better addressed through design, as speed limits require consistent, ongoing enforcement and may not improve real or perceived safety on the trail. Where speed limits are created, strategies to increase compliance can include informing users of the regulations, communicating the reasons for regulations to the users affected, and considering sentencing trail offenders to work service on the trail as part (or all) of their penalty.

They propose six alternative layouts for land-based trails, varying single or multiple treads, and responding to the number of user types. Users can also be separated via time of use, zoning, and skill levels or preferences.

The book presents a case study on ‘Resolving Conflicts between Cyclists and Equestrians’ that highlights ROMP n’ STOMP events where equestrians and mountain bikers use trails together to build partnerships and mutual understanding. The recommended response to conflict issues is therefore to improve perceptions of other users.

Critique

Objectivity:	High	This manual was written in association with the Rails to Trails Conservancy, and is disseminated under the sponsorship of FHWA. The authors are trail design professionals and the book cites many other professionals and experts on the subject.
Thoroughness:	High	This manual provides detailed design guidelines for developing a variety of types of trails, as well as general information about defining conflict and conflict strategies.
Applicability:	Medium	The manual provides guidance on the design of all types of trails, including ones not pertinent to this Study. The manual briefly discusses soft-surface multi-use trails, but they are not the main focus of the manual.
Useful Information:	Medium	The primary useful information for this Study is management and outreach strategies for engaging users, although they are not explicitly related to user conflict.
Sustainability:	Medium	The manual discusses sustainable trail design, but does not integrate with design for multi-use.
Keywords:	Problem definition (general), design guidance, width/passing areas, design speed, sight lines, trail layout/availability, education, rules and regulations, enforcement	

Trails for the Twenty-First Century Lessons Learned

Design Best Practices

- Avoid use of speed limits, but use a 15 mph design speed for natural surface paths.

Management Best Practices

- Post and enforce regulations from the very beginning on newly opened trails. Establishing desirable patterns of behavior from the start is far easier than trying to change bad user habits later on.
- Enforce rules and regulations consistently to assure that there is no perception of discrimination among different user groups.
- Employ a variety of on-site enforcement personnel if possible and appropriate, including: peer policing programs (e.g., peer pressure); volunteer trail patrols, and uniformed enforcement officers.
- Consider sentencing trail offenders to work service on the trail as part (or all) of their penalty.

Outreach Best Practices

- Develop an educational campaign on proper trail use for all users if mountain bikers will be using the trail.
- Have trail patrols hand out maps and provide information to trail users, and record incident and maintenance needs.
- Post regulations at trailheads and include them in trail brochures and maps.

- Communicate why and how the regulations will be enforced and what the applicable penalties are.
- Form cooperative agreements with local law enforcement and fire protection agencies.

B.3.7 Results of the Two Year Mountain Bicycle Trail Study

North Carolina Division of Parks and Recreation. 1993. North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources.

Background and Context

This study was conducted by the North Carolina Division of Parks and Recreation (NC CSP) in response to the department's recognition that its "lack of mountain bicycle trail management experience would make it difficult to reach or defend any decision to permit or deny mountain bicycling use within units of the state park system." It was developed by a Quality Action Team comprised of:

- Walt Gravley, Superintendent, South Mountains State Park.
- Ob Davies, Chief Ranger, William B. Umstead State Park.
- Marshall Ellis, Natural Resource Management Section.
- Darrell McBane, State Trails Coordinator.
- Tom Potter, Regional Trails Specialist.
- Dwayne Stutzman, Regional Trails Specialist.

IMBA cites this article on their website.

Methodology

NC CSP initially surveyed other state parks systems to gather information on how to manage mountain bikers. However, the information was inconclusive, and a two-year study was commissioned. Mountain bikers were allowed on designated multi-use trails in William B. Umstead State Park and South Mountains State Park, and significant data was collected to support the conclusions.

One of the surfaces tested in the experiment was an 8-foot wide roadbed with a compacted soil surface; other trails were paved or wider. Criteria selected to study the effects of mountain bikers included natural resource protection, visitor safety, operational impacts, and user satisfaction. Visitor safety was measured by case incident reports filed and user comments.

Findings

Three incidents occurred during the study period; all were accidents that did not involve other users. Staff did receive several verbal comments, predominantly from equestrians who questioned mountain bikers' presence on the trails, in particular on the first half-mile of trails from the parking lot. Complaints included mountain bikers weaving in and out of traffic and passing too closely to hikers at high speeds and without warning.

NC CSP also found that an average of two staff-hours per week were required to monitor the multi-use trail conditions, while 10 staff-hours were required to respond to complaints resulting from mountain biker use. In

addition, mountain bikers noted that the wide road was a less-desirable trail than a narrower 18- to 24-inch singletrack. The report recommends having mountain bikers walk near the trailhead, where more users are present.

Critique

Objectivity:	High	This report is the results of a two-year study of the impacts of allowing mountain bikers, and the conclusions are closely related to the study findings. The report makes recommendations
Thoroughness:	High	The report analyzes a wide range of impacts, including natural resource protection, visitor safety, operational impacts, and user satisfaction.
Applicability:	Medium	The trails studied in this report are 8 feet or wider, and therefore do not replicate the trails under consideration by CSP. Nevertheless, this report represents one of the few data-driven analyses on multi-use soft-surface trails available.
Useful Information:	Medium	While the report makes clear conclusions and recommendations for the specific condition being studied, the information has moderate specificity a limited applicability outside of the NC CSP situation.
Sustainability:	High	The report considers resource preservation and integrates the design and management recommendations with the recommendations for multi-use.
Keywords:	Problem definition (count data), design guidelines, width/passing areas, user information	

Results of the Two Year Mountain Bicycle Trail Study Lessons Learned

- No incidents involving user conflict were recorded during the two-year study period.

Design Best Practices

- Minimum use criteria for allowing mountain bike use:
 - Average width of 8 feet.
 - Minimum standard for trail surface is compacted soil.
 - Minimum length of 10 miles.
 - Average slope of 10 percent with 25 percent maximum.

Outreach Best Practices

- Only allow multiple use where sufficient staff capacity exists to monitor trail conditions and maintain the trail.

B.3.8 Trail Planning for California Communities

Bondurant, J., L. Thompson et. al.. 2009. Solano Press Books

Background and Context

This 400-page book is a comprehensive guide for recreational trail planning. The primary authors are (Bondurant) a Senior Park Planner with EBRPD and (Thompson) the manager of the San Francisco Bay Trail Project. Many other “contributing partners” also assisted with the development of the guide.

Methodology

The guide presents detailed recommendations about policy and regulation, community involvement in trail building, legal responsibilities, trail design, permitting, funding, and maintenance. It describes and proposes designs that separate users or serve particular groups of users, and references existing, successful trail designs and planning measures.

Trails particularly relevant to this Study are fire roads and wildland trails, although the guide does not provide specific instructions for selecting width or mitigating user conflicts on a single-track.

Findings

Bondurant presents a wide range of design, planning, and management considerations and specifications. Those that are pertinent to this Study are included in the findings and recommendations in the Study.

Critique

Objectivity:	High	The book is authored by two main authors, nine contributing authors, and 25 direct contributors, who range from trail management agency staff to planning and design professionals. The recommendations are based on this significant expert and professional experience.
Thoroughness:	High	Bondurant et. al. discuss a great breadth and depth of information related to trail design and management. They also discuss multi-use issues and considerations.
Applicability:	High	The book discusses planning, design, and management considerations by trail classification. Where considerations pertain to wildland trails, the information is specifically related to the topic of this Study.
Useful Information:	Medium	This book contributes a information to the appropriate design of multi-use trails, as included in Section B.2., although it does not specifically discuss measurable designs for multi-use wildland trails.
Sustainability:	Medium	The authors discuss design for trail sustainability, albeit separately from managing multiple uses in a sustainable way.
Keywords:	Problem definition (general), design guidelines, width/passing areas, gradient, design speed, sight lines, trail layout/availability, user information	

Trail Planning for California Communities Lessons Learned

Design Best Practices

- Build trail 4 to 6 feet wide, widths as narrow as 2 feet are acceptable in natural surface conditions.
- Provide clear passage along the full width of the trail and an average sight line of 100 feet.
- Grade for wildland trails: 12.5 percent maximum.

Management Best Practices

- Post trail regulations and rules on signs in prominent locations.
- Develop enforcement policies.
- Maintain a uniformed presence on the trail.
- Provide adequate trail mileage and disperse users among several access points, oriented to different user groups.

Outreach Best Practices

- Provide brochures and newsletters with basic safety information.
- Distribute maps that clearly delineate where various uses are acceptable.
- Institute safety program days and presentations given by trail staff to schools, recreation, civic groups, etc.
- Develop a consensus-building process.

B.3.9 Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers

Anderson, D.H., Lime, D. W., and T.L. Wang. 1998. St. Paul: University of Minnesota Extension Service.
http://cpsp.cfans.umn.edu/publications/revtactics_handbook.pdf

Background and Context

This handbook provides resource managers with a step-by-step, easy-to-use process for identifying and defining unacceptable impacts to biological and cultural resources and to visitor experiences, and identifies strategies and tactics to address unacceptable impacts to resources and experiences. The handbook was commissioned by the National Park Service (Denver Service Center) as a complement to the Visitor

Experience and Resource Protection (VERP) framework.

The handbook was field-tested in 1997 in four National Park Service units (Arches, Mesa Verde, Grand Teton, and Yellowstone national parks) and is built on the publications by Cole, Petersen, and Lucas (1987), *Managing wilderness recreation use: Common problems and potential solutions*; and Cole (1989b), *Low-impact recreational practices for wilderness and backcountry*.

Methodology

The handbook defines a decision process of five stages: (1) problem awareness, (2) problem specification, (3) strategy and tactic selection, (4) plan implementation, and (5) monitoring. Problems are defined as unacceptable visitor-caused impacts to biophysical resources and visitor experiences.

Findings

Problems related to visitor experiences include:

- Visitor conflicts due to incompatible uses, encounters with large groups or parties dissimilar to one's own, or rowdiness by itself or in combination with excessive consumption of alcohol and visitor displacement (spatial, temporal, or total).
- Inadequate or inappropriate levels of access to facilities, natural areas, or cultural resources; facility design that fails to accommodate the needs of the broadest possible spectrum of people, including persons with disabilities.
- Threats to visitor safety, behavior that jeopardizes the safety of the individual or of other visitors, failure to maintain a safe environment through facility design, maintenance, or other means.

The handbook provides three worksheets associated with the decision process, which are used for problem specification, to define what the acceptable resource condition would be and what the existing impact is, and finally the possible causes of any impacts that are determined to be unacceptable or approaching unacceptable levels. If indicators or standards are not prescribed for a given impact, the manager determined what is acceptable or how much impact can be tolerated before management intervention is required.

Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers recommends the following selection criteria for management tactics:

- Does the tactic adequately address the root cause of the visitor use problem?
- Is the tactic direct or indirect in terms of how it operates on visitor behavior?
- Is the tactic subtle or obtrusive in terms of visitor awareness of being managed?
- Does the tactic preserve visitor freedom of choice?
- Does the tactic affect visitors offsite during the planning stages of their trip? Or does the tactic affect visitors onsite while they are engaged in their recreational experience?
- Does the tactic affect a large or small number of visitors? Are those affected primarily visitors who are generally not responsible for the impact(s) in question?
- Does the tactic affect an activity to which some visitors attach a great deal of importance?
- Are visitors likely to resist the management action?
- What are the costs to managers in terms of tactic implementation and administration, including facility construction, operation, and maintenance, staff workload, and communication and enforcement costs? Are any of these limiting factors?
- How effective is the tactic likely to be at solving the visitor use problem in question?
- Is the tactic likely to lead to the creation of a new problem?

(Anderson, Lime, and Wang, 1998)

The handbook outlines five general management strategies to address unacceptable impacts:

- “Modify the character of visitor use by controlling where use occurs, when use occurs, what type of use occurs, and how visitors behave.
- Modify the resource base by increasing resource durability or maintaining/rehabilitating the resource.
- Increase the supply of recreation opportunities.
- Reduce use in the entire area, or in problem areas only.
- Modify visitor attitudes and expectations.”

Strategies included in the workbook include: site management, rationing and allocation, regulation, deterrence and enforcement, and visitor education.

The second half of the handbook describes specific treatments. The section on site management primarily addresses environmental impacts with recommendations for facility design to maximize compatibility with adjacent uses and other aesthetic qualities, as well as reducing conflicts between users, but it does not provide specific guidelines such as minimum widths or sight lines. Non-regulatory recommendations to reduce user conflicts include site management, rationing and allocation, deterrence and enforcement, and visitor education.

Site management strategies aim to “direct and channel use” and primarily address environmental concerns through resource hardening, increasing/decreasing the number of facilities, improving/not improving facilities, and closing areas. The authors state that curvilinear design “may be used to eliminate unacceptable impacts to visitor experience.” One specific recommendation related to mitigating conflict issues is to use a rope or fence barrier to separate pedestrians travelling in different directions. Another is to provide additional trails to reduce congestion on popular trails.

Rationing strategies address localized visitor use problems and include limiting access via reservations, queuing (first-come first-serve) system, lotteries, merit/eligibility system, and charging fees. The majority of these refer to public versus private uses or reservation/permitting systems, which are less appropriate at for single-day use due to the work involved with issuance and enforcement. The authors note that sanctions can be effective, but at high cost to management. The authors also state that the management problem is often the distribution of recreationists, rather than the total number, so these strategies should be coupled with other management techniques.

Deterrence and enforcement strategies include providing signs, sanctioning visitors who engage in noncompliant behavior, and providing personnel and law enforcement. The authors recognize that, while signs are an important accompaniment to policies and education, success relies on user attention. They conclude that personnel and law enforcement can serve as an effective reminder of regulations.

The chapter on visitor education defines key conditions for visitor education to be effective: visitors must regard the behavior advocated by park managers as personally desirable and important messages must be communicated so they facilitate visitor acceptance. Education is more effective in combination with other tactics, and the authors state that, “educating visitors about appropriate behavior will be more effective when visitors: (1) are highly motivated to change their behavior to protect the biophysical environment, (2) are

motivated to adjust their behavior so it better reflects values toward natural and cultural areas they already hold, and (3) understand the reason for the management action.”

The section addressing regulation discourages managers from using regulation where effective non-regulatory alternatives exist. Regulatory strategies that can address user conflicts include the following:

- Restrict access to specific locations (zoning) – ensure that only regulations necessary to realize management goals are implemented.
- Restrict/prohibit activities – a highly obtrusive regulation that can “lead to a strong sense of ‘being managed’ on the part of the visitor which can lead to a climate of conflict.

Critique

Objectivity:	High	The Handbook was developed using extensive prior research by experts and professionals, and was field-tested for accuracy.
Thoroughness:	High	The Handbook covers a wide range of management practices, including site management, rationing and allocation, regulations, deterrence and enforcement, and visitor education.
Applicability:	High	The information presented in the Handbook is directly related to the CSP trail conditions and discusses management techniques on multi-use soft-surface trails.
Useful Information:	High	As outlined above, the information is quite helpful for developing recommendations regarding multi-use. A significant amount of this information was included in the findings.
Sustainability:	High	While the Handbook does not discuss design specifically, it notes key sustainability considerations in the site management section.
Keywords:	Problem definition (theoretical), trail layout/availability, education, user information, alternate use days, speed limits/citations	

Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers **Lessons Learned**

Design Best Practices

- Consider using a rope or fence barrier to separate users travelling in different directions on an natural surface path.
- Use curvilinear design to minimize visitor impacts.

Management Best Practices

- Avoid restricting or prohibiting activities, as they are highly obtrusive regulations that can “lead to a strong sense of ‘being managed’ on the part of the visitor which can lead to a climate of conflict.”
- Remind users of personnel and regulations with law enforcement.

Outreach Best Practices

- Communicate important messages so that visitors “(1) are highly motivated to change their behavior to protect the biophysical environment, (2) are motivated to adjust their behavior so it better reflects

values toward natural and cultural areas they already hold, and (3) understand the reason for the management action.”

- Target the message to the specific behavior that is the source of the unacceptable impacts, making clear what is or is not allowed, why the behavior is or is not allowed, and what, if any, the consequences are for noncompliance.

B.3.10 Trail Design Guidelines for Portland’s Park System

City of Portland Parks & Recreation. 2009. atfiles.org/files/pdf/DesignGuidelinesPortland09.pdf

Background and Context

Design guidelines for Portland’s trail system were developed by Portland Parks & Recreation (PP&R) in 2009 after the City’s Parks 2020 Vision identified a lack of trail standards to be an issue.

Methodology

The guidelines are developed from PP&R’s experience with the trail system in Portland, and included a list of contributors and reviewers.

Findings

The first issue considered in the guidelines’ design philosophy is safety. While the discussion primarily addresses user separation from motor vehicles, it also notes that different trail users may travel at differing speeds. Accessibility is another design philosophy, which highlights PP&R’s desire to provide trails at a range of challenge levels. The guidelines recommend public process and review by the Portland Citizens’ Disability Advisory Committee (PDAC) to determine what level of accessibility a given trail should provide.

The guidelines provide design and use standards for all types of single use trails, as well as multi-use trails. The trail type pertinent to this Study is Type J: hiking/mountain biking trails (equestrian use is allowed). The guidelines clarify the equestrians and dog walkers are minor uses on hiking/mountain biking trails, while mountain bikers are not allowed on hiking/equestrian trails. Mountain bikers, equestrians, and hikers are also allowed on fire roads or wider gravel trails.

Hiking/mountain biking trails/equestrian trails should be 4 feet wide with passing areas at a minimum, 10 feet maximum width. The easement width should be 10 feet in addition to the tread width. Native herbaceous plants can be allowed to revegetate all but the trail bed. The discussion noted that these widths allow side-by-side hiking or riding, or room for on-coming or overtaking trail users. Grades should be 0 to 5 percent slope or up to 12 percent as needed, but the trail does not have the obstacles desired by expert riders. These trails should be ADA-accessible, although the surface is not reliably firm and slip resistant. Sight distance should be 40 to 100 feet, “depending on speed/flow,” and turn radii should be 10 feet minimum. The guidance also recommends retaining large stable round rocks at the surface of the trailhead, while removing pointed or loose stones.

Hiking and equestrian trails are designed for single-file walking, running, and horse riding. Dogs must be on leash. Trail width should be 4 to 10 feet with an additional 10 feet for the easement. Standard grades are 0-12 percent slope (5 percent maximum preferred). Sight distance is 50 to 100 feet and turning radius guidance is

to “avoid sharp turns.” In addition, the guidance states that, “Bicycles are specifically not allowed in order to not startle more nervous horses.”

Critique

Objectivity:	High	The book is a detailed design guide for Portland, developed by staff with contributions from several other agencies.
Thoroughness:	High	PP&R has the most nuanced trail classification system included in this Literature Review, and discusses appropriate design and considerations for each type.
Applicability:	High	The Type J: Hiking/mountain biking trails where equestrians are allowed include all users and the conditions addressed in this Study.
Useful Information:	High	The Guidelines present specific, measurable standards for multi-use trails, which inform the findings and recommendations of this Study.
Sustainability:	High	PP&R includes a section discussing design for sustainability, and includes these considerations in the appropriate design for each trail type.
Keywords:	Design guidelines, width/passing areas, gradient, design speed, trail layout/availability, sight lines	

Trail Design Guidelines for Portland’s Park System Lessons Learned

Design Best Practices

- Hiking/mountain biking trails (equestrians permitted) should be 4 feet wide with passing areas at a minimum, 10 feet maximum width. Hiking/equestrian trails (mountain bikers prohibited) should be 4 to 10 feet wide with an additional 10 feet for the easement.
- Provide 10 feet easement width in addition to the tread width and allow native herbaceous plants to revegetate all but the trail bed.
- Sight distance on a hiking / mountain biking trail should be 40 to 100 feet, “depending on speed/flow,” and on a hiking/equestrian trail is 50 to 100 feet.
- Hiking/MTB Grades should be 0-5 percent slope or up to 12 percent as needed, but the trail does not have the obstacles desired by expert riders. Hiking/equestrian Standard grades are 0-12 percent slope (5 percent maximum preferred).
- Turn radii on a hiking/mountain biking trail should be 10 feet minimum and on a hiking/equestrian trail should “avoid sharp turns.”
- Hiking/mountain biking trails should be ADA-accessible, although the surface is not reliably firm and slip resistant. Hiking/equestrian trails are not accessible.

B.3.11 Narrow Natural Surface Trails: Managing Multiple Users

East Bay Regional Parks District. 2011.

[http://www.ebparks.org/files/ebprd Narrow Trail Study FINAL 03 24 2011.pdf](http://www.ebparks.org/files/ebprd%20Narrow%20Trail%20Study%20FINAL%2003%2024%202011.pdf)

Background and Context

This 2011 study from the East Bay Regional Parks District (EBPRD) identifies and discusses specific management approaches for narrow natural surface trails in the San Francisco Bay Area.

Methodology

The study includes a survey of 15 park and open space management agencies requesting information on their agency's trail use practices, planning policies, environmental review, maintenance activities and enforcement practices.

Findings

The executive summary states the following general consensus findings:

- “Trails designed with multiple use in mind are more successful in accommodating multiple uses, such as hiking, equestrians and bicycling than trying to adapt existing trails for multiple use.
- Designating allowable uses when a trail is initially constructed and opened is more successful in gaining public acceptance that initiating use changes over time, especially in popular parks where existing use patterns are well established.
- Providing regulatory information simultaneously multiple ways through park signage, a web site and staff and volunteer presence serve as the most effective way to reach out and inform trail users.
- Fewer regulations consistently applied and enforced yields greatest compliance.”

The survey was an in-depth analysis of park and open space managers' experience with managing multiple uses on narrow natural surface trails. The 15 agencies surveyed by EBRPD have differing standards for narrow natural surface trails, shown in Table B-2.

Table B-2. Agency Definition of Narrow Multi-Use Trails

From *Narrow Natural Surface Trails: Managing Multiple Users* (EBRPD, 2011)

Agency	Agency Definition of Narrow Trails
Marin County Open Space District	3 to 3.5 feet wide with 8 feet of lateral clearance
Midpeninsula Regional Open Space District	6 to 10 feet wide (Class A, widest) 4 to 6 feet wide (Class B, intermediate) 2 to 4 feet wide (Class C, narrowest classification)
Santa Clara County Parks and Recreation Department	4 to 6 foot wide (narrow trails limited to mountain areas)
California State Parks	Less than 60 inches wide (Roads are defined as greater than 60 inches)
East Bay Regional Park District	Less than 8 feet wide

Agencies employ a variety of techniques to manage users on narrow natural surface trails. Key findings are summarized in Table B-3. In addition to these, the survey found that, “Participating managers surveyed noted that some of the strategies being used, especially those intended to control speed (e.g., pinch points, uneven surfaces), may render the trail less accessible to those with mobility impairments.” Agencies must balance providing facilities that are suitable for all users.

Table B-3. Findings –Summary of Managers’ Survey Findings, Narrow Natural Surface Trails: Managing Multiple Users (EBRPD, 2011)

Tool	Strategies that have been successful with participating agencies	Strategies that have created management challenges for participating agencies
Design	Moderate grades Good sightlines Bench width Grade reversals Features to minimize conflict	Combining use on trails not designed for multiple use Design that benefits one user can be an obstacle to another Encouraging speed differential with sustained steep grades
Use Distinctions	Multi-use from day one Plan out uses before opening Design for multi-use intent Construct and restore the land before opening Create opportunity for cooperative use Separate users: Separate by park Separate at trailheads Separate by trail	Combining uses on crowded trails More challenging to safely manage many different uses where use is high Every potential conflict is magnified High use areas require user limitations
Signage	Regulatory/wayfinding signage that clearly communicates What is an official trail and what is not? What people need to know in order to comply What people need to know to recreate at a comfortable skill, mobility level	Lack of signage Leads to confusion Lack of information on conditions can create poor or dangerous trail experiences Add to misuse of existing trails, use of bootleg trails
Enforcement	Consistent enforcement Regulatory compliance on trails requires consistent enforcement This does not come for free Communicate/educate through enforcement	Complex regulations Uphill only One way loop Alternate day Inconsistent Enforcement Low commitment equals limited effectiveness People will do what they think they can get away with People are angry with inconsistency Self Regulation Dependent on a small and local user group Ownership is key, fee and membership base Generally not effective in publicly-managed park lands

The study also addresses outreach and education techniques, noting the difficulty with assessment of these strategies; “The success of outreach and educational programs in promoting compliance with trail use policies varies considerably across the region with no obvious factors determining the difference between success and failure.” Nevertheless, several agencies cited education and outreach techniques that they had found to have a positive impact. Examples include the Marin County Open Space District’s sponsorship of mountain biking races and running and mountain biking user groups’ use of EBRPD’s trails for training.

While the survey only briefly addresses environmental impacts of mountain bikes, it does include consideration of management strategies directed at minimizing those impacts.

Critique

Objectivity:	High	The conclusions in this report directly based on findings from a survey of parks districts.
Thoroughness:	Medium	This study presents the results of the survey, including management strategies for multi-use. It does not discuss specific, measurable designs.
Applicability:	High	The study focuses on trail agencies that manage narrow natural surface trails that accommodate a variety of users, similar to the situation considered in this Study.
Useful Information:	High	While the study provides limited design for multi-use, it presents management and outreach best practices that inform this Study.
Sustainability:	Medium	The study discusses resource considerations for allowing multiple uses, but does not link sustainability with appropriate multi-use trail design.
Keywords:	Problem definition (general), design guidelines, width/passing areas, speed treatments, education, events, user group meetings, user information, enforcement	

Narrow Natural Surface Trails Lessons Learned

Design Best Practices

- Provide moderate grades, good sightlines, a wide bench, grade reversals, and features to minimize conflicts.

Management Best Practices

- When possible, plan for multiple uses when trail is being developed and planned.
- Separate users by park, trail, or trailhead.
- Use regulatory and wayfinding signs that communication regulations and skill level expectations.
- Consistently enforce trail rules; educate users through enforcement.

Outreach Best Practices

- Monitor blogs and e-mail list serves.
- Actively connect with trail users through organized activities and leagues.
- Coordinate with other agencies, non-profit organizations, schools and volunteers.
- Partner with youth-oriented organizations to reach out to younger trail users.

B.3.12 The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines

Hendricks, W., R. H. Ramthun, and D. J. Chavez. 2001. Journal of Park and Recreation Administration 19(3): 38-61.

Background and Context

This study was co-authored by a professor with the Recreation Administration Program, Natural Resources Management Department at California Polytechnic State University (Hendricks), a professor with Tourism

Industry Management at Concord College (Ramthun), and a research social scientist with the USDA Forest Service (Chavez).

Methodology

The study was conducted in the Marin Municipal Water District (MMWD), on fire roads on Mt. Tamalpais where bicycling is allowed. At the time of the study, MMWD enforced a 15 mph speed limit on all trails and a 5 mph speed limit when passing others and on blind curves. The fine for speeding was \$200, while the fine for riding on single-track where mountain biking is prohibited was \$125.

The study tested three main factors: mountain bikers' behaviors, message content, and message source as shown in Table B-4.

Table B-4. Matrix of Variables Tested, Hendricks et. al., 2001

Behaviors Tested ⁱ	Message Content Tested	Message Sources Tested
<ul style="list-style-type: none"> Bicyclists' yielding behavior when approaching hikers Bikers' speeds Bikers' actions when approaching an area where biking was prohibited Bikers' behavior at stream crossings 	<ul style="list-style-type: none"> 'Moral appeals' to protect the natural resources and enhance other users' safety 'Fear appeals' that identified consequences. 	<ul style="list-style-type: none"> Uniformed agency volunteer Hiker Biker

ⁱ Yielding was rated on a 10-point scale by trained researchers, while speed was tested with a hidden radar gun and behaviors categorized into 'compliance' and 'non-compliance.'

Findings

For yielding behavior, the study found that the source of the appeal (uniformed agency volunteer, hiker or biker) did not make a difference, but the fear appeal resulted in stronger yielding behavior than the moral appeal or the control. On the other hand, neither message source nor content had a significant impact on mountain bikers' speeds. Mountain bikers given an appeal message from a volunteer hiker were found to be more likely to dismount when approaching an area where mountain biking was prohibited (although compliance remained below 40 percent in all cases), while the fear appeal was more likely to result in bikers dismounting to cross the stream. In all four behaviors, the uniformed volunteer was less effective in gaining compliance than the volunteer mountain biker or hiker.

The authors conclude that any type of message is better than no message at all. In addition, they postulate that, because mountain bikers were not aware their speeds were being measured, they had less incentive to comply with regulations given a threat of the consequences. The authors conclude that, "volunteer mountain bike patrols, such as those organized and trained by IMBA's National Mountain Bike Patrol, have the potential to be an effective mechanism for influencing behavior of bicyclists."

Critique

Objectivity:	High	This article uses data collected by MMWD and was authored by professors and peer-reviewed.
Thoroughness:	High	While the article discusses a single specific topic (trail signage), it goes into significant detail regarding analysis and recommendations.
Applicability:	High	The study considers mountain bikers' compliance with signage on multi-use trails, which is directly relevant to the subject of this Study.
Useful Information:	High	The study's conclusions are highly pertinent to this Study, and relevant information is included in the findings and the recommendations.
Sustainability:	Low	The article does not address sustainability.
Keywords:	Problem definition (general), education, volunteer programs, user information	

The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines Lessons Learned

Management Best Practices

- Use volunteer hikers or mountain bikers to encourage good behaviors on trails.
- When using a threat of enforcement message, enforce with visible presence of rangers or volunteer patrols.

B.3.13 Emerging Principles for Using Information/Education in Wilderness Management

Manning, R. 2003. *International Journal of Wilderness* 9: 20-27, 12. <http://ijw.org/wp-content/uploads/2003/12/Vol-09.No-1.Apr-03small.pdf>

Background and Context

Manning is a professor of Natural Resources and Director of the Park Studies Lab at the University of Vermont. He worked with the Park Service and has authored several publications on the subject of trail use, including *Parks and Carrying Capacity: Commons without Tragedy*. Published in the *International Journal of Wilderness*, this is peer-reviewed article.

Methodology

This article is a conceptual review of literature that suggests the potential effectiveness of information and education on five types of problem behaviors of wilderness visitors (illegal, careless, unskilled, uninformed, and unavoidable actions).

Findings

Manning found that information and education has limited effectiveness in deterring deliberately illegal or unavoidable problem behaviors, while it can be effective at reducing careless, unskilled, or uninformed

actions. This conclusion supports this Study's recommendation to address user conflict through a variety of avenues, including information, enforcement, and outreach.

The article defines several empirical studies that have analyzed the effectiveness of information and education programs. Studies that have focused on enhancing visitor knowledge to reduce ecological and social impacts have not found trailhead signs and brochures to be very effective, while workshops and special programs can enhance knowledge levels. Studies focusing on visitor attitudes toward management policies have found that information/education "can be effective in modifying visitor attitudes so they are more supportive of wilderness and related land management policies." Finally, studies focused on depreciative behavior (such as littering or vandalism) have found that education (a brochure and a personal contact) can be a successful deterrent to littering. While not directly related to user conflict, this finding supports the use of signs to encourage good user behaviors in a variety of contexts.

Manning concludes with a series of 'emerging principles' for information and education programs, as paraphrased in the table below.

Critique

Objectivity:	High	This article cites other empirical studies and was authored by professors and peer-reviewed.
Thoroughness:	High	Manning considers a range of studies that considered the use of information in a variety of backcountry settings.
Applicability:	High	This article addresses how visitors respond to user information and education of similar types being considered in this Study.
Useful Information:	Med	Some of the information presented in the article is not directly pertinent to user conflicts on soft-surface trails, although it informs the types of management outreach strategies used to modify user behavior.
Sustainability:	Low	The article does not address sustainability.
Keywords:	User information	

Emerging Principles for Using Information/Education in Wilderness Management Lessons Learned

Outreach Best Practices

- Maximize efficacy by addressing problem behaviors that are characterized by careless, unskilled, or uninformed actions.
- Connect with or modify visitor attitudes, beliefs, or norms and provide information on the impacts, costs, and consequences of problem behaviors.
- Deliver messages via multiple media, including brochures, personal messages, audiovisual programs, newspapers, magazines, guidebooks, trained volunteers, outfitters, commercial guides, wilderness ranger and volunteer role modeling.
- Design materials for a variety of target audiences and deliver messages in several locations.

B.3.14 Safety Considerations for Multi-Use Trails

California Equestrian Trails and Land Coalition. 2005.

<http://www.calequestriancoalition.com/FinalVerCETLCSafetyGuides.htm>

Background and Context

This 2005 publication by the California Equestrian Trails and Land Coalition (CET&LC) recommends design standards and safety guidelines to safely accommodate bicyclists, equestrians, and hikers on the same trail.

Methodology

The CET&LC recommends specific trail standards that provide visibility, width, slope, and separation to accommodate a variety of user types. The report does not state what data the conclusions are based on.

Findings

CET&LC states that mountain bicycling use has become a safety issue for equestrians, particularly due to the speed differential with other users; most users travel at 4 to 5 mph while mountain bicyclists frequently travel at faster speeds.

They do not make specific recommendations about trail widths, but note that wide trails can create maintenance and drainage problems. CET&LC states that, “Forest Service believes bikers and equestrians will often ride side by side if the trail is too wide, while many equestrians consider a 6-foot wide trail as a minimum in order to safely pass cyclists” while travelling in opposite directions.

If the trail cannot be built to these standards, they recommend it not be opened to multiple user types. They also recommend education of trail users, including training equestrians to minimize their horses’ ‘startle factor,’ as well as etiquette signage and enforcing trail rules.

Critique

Objectivity:	Med	The authors do not cite what the recommendations are based on, aside from user experience on multi-use trails.
Thoroughness:	Med	CET&LC makes recommendations regarding guidelines for appropriate trail use, management, and outreach strategies, but do not provide background for the recommendations.
Applicability:	High	The recommendations are directly targeted to reducing conflicts on multi-use trails.
Useful Information:	High	The information is a good resource for appropriate trail design.
Sustainability:	Med	CET&LC mention sustainability concerns, but do not link them to appropriate trail design.
Keywords:	Problem definition (general), design guidelines, width/passing areas, design speed, education, user information, enforcement	

Safety Considerations for Multi-Use Trails Lessons Learned

Design Best Practices

- Switchbacks and curves need 50 feet of visual clearance on either side so users can see others.
- Avoid wide trails to minimize erosion, but provide sufficient space for users to pass each other.
- Keep slope as low as possible (less than 12 percent if possible) for safe places for passing and visibility.
- Where terrain is steep, visibility is limited, and there is insufficient space for users to pass each other, consider having separate parallel trails for different user types.

Management Best Practices

- Use the triangle yield sign at trailheads of all multi-use trails.
- Enforce trail rules via law enforcement as well as volunteer patrols.

Outreach Best Practices

- Educate users about the “startle factor” of horses.
- Hold training clinics for equestrians to teach the horses and riders to meet cyclists in varying situations.

B.3.15 Trail Solutions: IMBA's Guide to Building Sweet Single-Track

International Mountain Bike Association. 2004. Boulder, CO: International Mountain Bicycling Association.

Background and Context

The International Mountain Bicycling Association (IMBA) is a worldwide group of individuals, clubs, and organizations focused on advancing and supporting opportunities for mountain biking to grow. The book was edited by IMBA's director of special projects, Pete Webber, who also edited *Trail Solutions: IMBA's Guide to Building Sweet Single-Track*. Several agencies surveyed reported that they use this book as a guidance document for developing single-track trails, including North Carolina Division of Parks and Recreation; Wake County, NC; and Durango, CO.

Methodology

This book is a guide to establishing single-track trails and includes topics on building partnerships, writing proposals, management strategies, and trail design guidelines. The book presents two methods to develop multi-use trails: user etiquette and trail design. The recommendations come from expert and professional opinion of trail builders, as well as case studies.

Findings

One of IMBA's "Rules of the Trail" is the precept to 'Always Yield the Trail'. From the rules: "Let your fellow trail users know you're coming. A friendly greeting or bell is considerate and works well. Anticipate other trail users around corners or in blind spots. Show your respect when passing others on the trail by slowing to a walking pace or even stopping. Yielding means slowing down, establishing communication, and being prepared to stop if necessary in order to pass safely." The book explains that user conflicts can be mitigated by following basic trail etiquette.

The book includes discussion of multi-use trails and single-use trails from a perspective of managing user conflict. The authors disagree with the notion that separating users is the best strategy to manage conflict and contend that responsible bike use is compatible with most other types of trail use. The book advocates against single-use trails from the belief that they concentrate users and increase the negative impacts of crowding, as well as the negative environmental issues of providing sufficient trail mileage for all user types. The authors do acknowledge that single-use trails can be useful for reducing user conflict in certain situations including very crowded trails, high-speed trails, challenge parks, and secluded nature trails.

Single direction trails are another strategy for reducing user conflict mentioned by the authors. They state that single direction trails can manage conflict through alleviating congestion, providing a more predictable experience, and reducing the number of passes between users. Direction restrictions may be combined with user group restrictions, such as day/time restrictions, or applied to one user group. For instance, a trail network may require mountain bikers to use trails, during allowed hours, in one direction while hikers may be allowed to travel in either direction."

IMBA frames single-track trails as a tool for speed management of mountain bikers and implies that wider trail widths increase mountain bike speeds and have the potential to increase user-conflicts. Narrow and rough trails are said to encourage focused and slower speeds of travel, and promote safe sharing of the trail space. The guide generally recommends that pinch points to slightly narrow the trail be installed just prior to areas where users should slow down. In addition, anchors in the form of large rocks or objects, can be staggered on the sides of the trail to slow users. The simple suggestions and guidelines presented here are based on extensive experience, although limited in scope to single-track trails.

Critique

Objectivity:	Med	The IMBA guide was developed with input from numerous individuals that professionally manage and build trails. However, being authored by a mountain biking organization, the authors are interested in promoting mountain bicycling.
Thoroughness:	Med	This book primarily focuses on the planning and design of single track trails, but does include guidance for using design and separate trails to minimize trail user conflicts and safety issues.
Applicability:	High	The IMBA guidance is highly applicable to the CSP setting, as mountain bikes are one of the primary additional uses being considered. The guide does, however, focus on a specific type of soft-surfaced trail: singletrack.
Useful Information:	High	This resource provides very specific guidance for planning and designing mountain bike trails, including design elements for minimizing conflict and safety issues.

Sustainability:	Med	The IMBA guide includes an entire section dedicated to 'The Principles of Sustainable Trails.' The guidance primarily focuses on the aspect of sustainability related to minimizing trail erosion.
Keywords:	Problem definition (general, design guidance, , width/passing areas, gradient, design treatments, trail layout/availability, education, user group notification, volunteer programs, events, user group meetings, public notification, ranger patrol, user information, speed limit/citations, enforcement	

Trail Solutions: IMBA's Guide to Building Sweet Single-Track Lessons Learned

Design Best Practices

- Use single-track trails over wider trails to reduce mountain bike speeds.
- Pinch points to slightly narrow the trail should be installed just prior to the area where users should slow down.
- Anchors, in the form of large rocks or objects, can be staggered on the sides of the trail to slow users.

B.3.16 Managing Mountain Biking: IMBA's Guide to Providing Great Riding

International Mountain Bike Association. 2007. Boulder, CO: International Mountain Bicycling Association.

Background and Context

IMBA's guidebook on managing trails was produced in cooperation with the Recreational Trails Program of the Federal Highway Administration. It was edited by Pete Webber, IMBA's Director of Special Projects and includes contributions from FHWA's Recreational Trails Program, Pennsylvania Department of Conservation and Natural Resources, Tennessee Department of Environment and Conservation, Minnesota Department of Natural Resources, Trails and Waterways Division, and the U.S. National Park Service Rivers, Trails, and Conservation Assistance Program. Several agencies contacted in the survey for the current study noted they have used this resource to design trails and manage user conflict including California State Parks Santa Cruz District; the Hill Country Conservancy, TX; Mecklenburg County, NC; Wake County, NC; Lake Norman State Park, NC.; and City of Durango, CO.

Methodology

Similarly to *Trail Solutions: IMBA's Guide to Building Sweet Single-Track*, this resource uses information from case studies and from the long list of contributors. The recommendations are not tied directly to the source of the information.

Findings

The guide begins with the preface that, "When trails are well-designed and visitors observe basic trail etiquette, most people, whatever their means of conveyance, will have a satisfying experience on shared trails." Nevertheless, IMBA lists situations where separating users may be advised:

- Crowded trails – to avoid congestion.

- Crowded trailheads – to provide dedicated parking facilities.
- Extraordinary mountain biking trails – trails designed exclusively for mountain biking.
- High-speed trails – trails designated for race-training or use by expert-level users.
- Bike parks – trails for riders to hone mountain biking skills.
- Nature trails – trails that provide seclusion for hikers or that are ADA-accessible.

The section entitled, “Should an existing trail be open to Mountain Bikers?” lists questions designed to assist managers in determining allowable uses. Questions that pertain to conflict issues include the following:

- Will the pre-existing uses mesh with mountain biking?
- Does the trail have a sustainable alignment?
- Could the trail be altered to have a more sustainable alignment?
- Will the trail meet local needs?
- What kind of trails do local cyclists seek?
- Would mountain bikers like to ride the trail?
- Are resources available to meet maintenance needs that may arise with increased use?
- Is there a local bike club available and willing to support the trail?

The guide also recommends ways of managing conflict and safety issues on shared trails including trail design, information and education, regulations, and user involvement and partnerships. Information and education include share the trail signs, as well as paid staff patrols, volunteer patrols, peer education, clinics, and handouts. The guide notes that volunteer patrols are a “tangible reminder that mountain bikers are aware of their potential effect on other visitors, are committed to regulating themselves, and are willing to give back to the trails in the form of volunteerism.” IMBA discourages the use of speed limits, stating that “speed limits are extremely difficult to enforce, may be unreasonable for trails with constantly changing terrain, probably won’t improve real or perceived safety on the trail, and can damage essential respect and trust.”

The authors recommend that designing a trail to reduce conflict and safety issues and be sustainable requires consideration of the trail flow, or the rhythm of the trail as “determined by the landscape and sequence of terrain.” Trail anchors can include large rocks, logs, trees or other obstacles that act as a visual and physical barrier showing where the trail is and requiring users to slow down to pass. Choke points are rocks or a broken tree trunk that acts as a gateway through which trail users must pass. IMBA recommends providing sufficient sight distance for users to see the obstacle and slow down in advance of the feature. Uneven surfacing can also encourage users to slow down and trail hardening is recommended for sustainability in difficult locations. Bermed turns and consistent flow are recommended to minimize soil disruption. However, part of the benefit of these elements is that they allow mountain bikers to turn without slowing down.

The chapter about partnerships highlights the importance of soliciting input from proposed user groups. Recommendations include writing specific agreements to define roles and responsibilities, starting simple and building as the relationship develops, and creating a plan for ongoing communication with the group. Some of the guidance is directed at trail managers, while other guidance is intended for use by advocates and trail user

groups. For example, the chapter on managing volunteers is directed at a new club or organization. IMBA also recommends forming a Trail Advisory Group to mitigate conflict. Additional partnership solutions include forming user group coalitions, holding volunteer trail work days, and organizing multi-use events.

Critique

Objectivity:	Med	While the book was published through five public agencies, it does not provide information about the contributors' backgrounds. The guidelines are based on a series of case studies and professional experience of the authors.
Thoroughness:	Med	This book focuses primarily on management and outreach, as well as designs to address conflicts, although it does not provide measurable guidelines for the appropriate design of multi-use paths.
Applicability:	High	The topics discussed in this book directly discuss management strategies for user conflict and are therefore highly applicable.
Useful Information:	High	This resource has significant information informing the Study, which is included and cited in the findings and the recommendations.
Sustainability:	Med	The chapter, "Mountain Biking and the Environment" discusses mountain bikers' impacts to the trail surface
Keywords:	Problem definition (general), design guidelines, speed treatments, trail layout/availability, user information, designated use-intensive	

Managing Mountain Biking Lessons Learned

Design Best Practices

- Use trail anchors as visual barriers showing where the trail is and requiring users to slow down to pass.
- Create choke points through which trail users must pass.
- Provide sufficient sight distance for users to see the obstacle and slow down in advance of the feature.
- Use uneven surfacing to encourage users to slow down and for sustainability.
- Use stacked loops that require mountain bikers to travel further to access more technical riding areas while hikers and families have trails near parking.
- Place trail crossings at the top of a small rise or place rocks to encourage users to slow down in advance of an intersection.

Management Best Practices

- Use management strategies, including share the trail signs, paid staff patrols, volunteer patrols, peer education, clinics, and handouts.
- Provide adequate trail opportunities and diverse trail experiences.
- Designate one-way loops to reduce passing events.

Outreach Best Practices

- Write specific agreements with user groups to define roles and responsibilities; start simple and build as the relationship develops; and create a plan for ongoing communication with the group.
- Form a Trail Advisory Group to identify and solve user conflicts before they become serious problems.
- Hold 'Romp and Stop' events where mountain bikers and equestrians get together and "ride each others' steeds."

Table B-5. Summary of Key Literature Review Resources

Author	Title	Year	Journal/ Citation	Agency/ Affiliation	Problem Definition					Design					Management					Outreach					Critique				
					General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
Chavez, D. J.	<i>Mountain Biking: Issues and Actions for USDA Forest Service Managers</i>	1996a	Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.	US Forest Service			x									x	x				x	x	x	x	High	High	High	Med	Low
Hesselbarth, W., B. Vachowski, M. Davies	<i>Trail Construction and Maintenance Notebook</i>	2007	FHWA and United States Forest Service, FSH2309.18	US Forest Service						x					x										High	Low	Low	Low	Low
Moore, R. L.	<i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>	1994		FHWA		x									x					x	x	x	x	x	High	High	High	High	Low
National Park Service, Department of the Interior	<i>Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona</i>	2003		National Park Service					x																High	High	High	High	Low
United States Department of Agriculture Forest Service	<i>Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds</i>	2007	0723-2816-MTDC	In cooperation with FHWA	x					x	x														High	High	High	High	Low
Flink, C., Olka, K., Searns, R., Rails-to-Trails Conservancy	<i>Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails</i>	1993	Washington, D.C.: Island Press.	Island Press	x					x	x					x	x			x					High	High	Low	Low	Low
MN Dept of Natural Resources	<i>Trail Planning, Design, and Development Guidelines</i>	2006	St. Paul, MN: State of Minnesota.	MN Dept of Natural Resources	x					x		x			x										High	High	High	High	High
North Carolina Division of Parks and Recreation	<i>Results of the Two Year Mountain Bicycle Trail Study</i>	1993	North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources						x	x					x										High	High	Med	Low	High
Bondurant, J., L.Thompson et. al.	<i>Trail Planning for California Communities</i>	2009	Solano Press Books		x					x	x	x			x										High	High	High	Med	Med

Author	Title	Year	Journal/ Citation	Agency/ Affiliation	Problem Definition					Design					Management					Outreach					Critique				
					General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
Anderson, D.H., Lime, D. W., and T.L. Wang	Maintaining the Quality of Park Resources and Visitor Experiences	1998	St. Paul: University of Minnesota Extension Service.	University of Minnesota		x									x	x	x			x					High	High	High	High	High
City of Portland Parks & Recreation	Trail Design Guidelines for Portland's Park System	2009		City of Portland, OR						x	x	x													High	High	High	High	High
East Bay Regional Parks District (EBPRD)	Narrow Natural Surface Trails Managing Multiple Use	2011			x					x				x	x	x				x	x			x	High	Med	High	High	Low
Hendricks, W., R. H. Ramthun, and D. J. Chavez	The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines	2001	Journal of Park and Recreation Administration 19(3): 38-61	California Polytechnic State University, Concord College , USDA Forest Service				x							x					x		x			High	High	High	High	Low
Manning, R. E.	Emerging Principles for Using Information/Education in Wilderness Management	2003	International Journal of Wilderness 9: 20-27, 12.												x										High	High	Med	High	Low
California Equestrian Trails & Lands Coalition	Safety Considerations for Multi-use Trails	2005	NOP Comment Letter O-5, p. 82	California Equestrian Trails & Lands Coalition	x					x					x	x				x					Low	Low	High	High	Low
IMBA	Trail Solutions: IMBA's Guide to Building Sweet Single-track	2004	Boulder, CO: International Mountain Bicycling Association.	International Mountain Bike Association	x								x	x	x										Med	Med	High	High	Med
IMBA	Managing mountain biking: IMBA's guide to providing great riding	2007	Boulder, CO: International Mountain Bicycling Association.	International Mountain Bike Association	x					x		x	x	x	x	x	x	x		x	x	x	x		Med	Med	High	High	Med

Appendix C. Agency Survey

This chapter presents the results of the Agency Survey (survey). The goal of the survey was to collect information on the practices, standards (if available), and opinions of agency staff and in a few cases organization representatives, with significant experience managing unpaved shared-use trails in the U.S. and Canada. The survey was conducted in March, April and May of 2011. The goal of the survey was to determine trail managers' informed opinions and experiences of user conflict and what actions they have taken to address these issues. This information supports the Literature Review by identifying issues and solutions that may not be captured in written documents or that may be the result of experience in the field.

The first section of this appendix presents the survey methodology and agency selection process. The second section presents a “lessons learned” review of the key findings collected from this survey. The appendix closes with a summary of the information collected from key agencies.

C.1 Methodology

The survey instrument asked questions about the nature of trail user conflicts, including which groups are involved in conflicts, what common complaints are heard, how frequently incidents or complaints occur, and what other characteristics or features exist in locations where conflicts occur. Managers were also asked about solutions they had employed, including design and management strategies to address these issues. The survey also requested any available incident or complaint data, as well as any design guidelines or policies used by the agency.

To gather the best information related to user conflicts on trails in a short timeframe, the survey form was updated based on feedback from early participants. An initial survey form was developed and sent to a preliminary set of agencies, then reviewed and revised based on the feedback about the clarity of the questions. The final survey form is provided in Appendix F.

Prior to e-mailing the survey, Alta staff filled in basic information about the agencies, recording the size of the agency and identifying available design or management documents. As surveys were returned, staff followed up with each agency to collect relevant data or reports, if available, or to determine that that information was not available from the agency. The objective was to collect data and documents to back up opinions and clarify practices.

C.1.1 Agencies Surveyed

The agency contact list was initially developed based on State Parks staff suggestions and included several agencies known to have dealt with trail user conflicts. The survey was also sent to all State Parks districts. In addition, a user group study notice was developed to solicit additional contacts and resources for the Literature Review. The notice is provided in Appendix D and was shared with trail user groups.

Surveys were sent to 52 agencies and State Parks Districts. Thirty-six surveys were returned. The breakdown of the agencies who returned surveys is shown in Table C-1.

Appendix C.

Table C-1. Agencies Surveyed

Agency	Type	State	Park Acreage	Trail Mileage
Bureau of Reclamation, Lower Colorado Region	Federal	CO	120,000	120
U.S. Forest Service, Lake Tahoe Basin Management Unit	Federal	CA/NV	160,000	415
Calaveras Sector, State Parks	CA State Park	CA	252	0.5
Columbia State Historic Park	CA State Park	CA	6,500	15
Colorado Desert District, State Parks	CA State Park	CA	700,000+	200
Four Rivers Sector, State Parks	CA State Park	CA	37,000	45
Gavilan Sector, State Parks	CA State Park	CA	87,000	363
Gold Fields District, State Parks	CA State Park	CA	46,000	218
San Joaquin Sector, State Parks	CA State Park	CA	12,520	16
Santa Cruz District, State Parks	CA State Park	CA	N/A	262
Topanga Sector, State Parks	CA State Park	CA	11,000	36
Turlock Lake SRA/Caswell Memorial SP/Bethany Reservoir	CA State Park	CA	533	3
North Carolina Division of Parks and Recreation - Lake Norman State Park	State Park	NC	N/A	25
Oregon Parks and Recreation	State Park	OR	102,500	960
Capital Regional District Parks	Regional	BC	28,400	50
Conejo Open Space Trails Conservation Agency	Regional	CA	11,300	140
Front Country Trails Multi-Jurisdictional Task Force	Regional	CA	N/A	30
Hill Country Conservancy	Regional	TX	N/A	100+
Tualatin Hills Park and Recreation District	Regional	OR	1,300	60
Vancouver-Clark Parks and Recreation	Regional	WA	7,000	44
Jefferson County Open Space	County	CO	39,000	204
Mecklenburg County Park and Recreation	County	NC	18,800	113
Sacramento County Regional Parks, Recreation & Open Space	County	CA	15,000	23
San Luis Obispo County	County	CA	15,000	52
Santa Clara County Parks and Recreation	County	CA	45,000	300
Wake County Parks, Recreation and Open Space	County	NC	250	14
Town of Crested Butte	City	CO	N/A	20
City of Durango	City	CO	2,531	95
City of Henderson	City	NV	N/A	N/A
Town of Pagosa Springs	City	CO	200	6
City of Palo Alto Open Space & Parks	City	CA	4500	45
Portland Parks and Recreation	City	OR	11,000	220

Agency	Type	State	Park Acreage	Trail Mileage
San Luis Obispo	City	CA	4,000	41
City of Las Vegas	City	NV	N/A	51
Forest Park Conservancy	Non-profit	OR	5,100	80+
Pacific Crest Trails Association	Non-profit	CA, OR, WA	N/A	2650

In addition to the agencies listed above, the Monterey, Asilomar, Big Sur, and Refugio Sectors of California State Parks reported that they receive too few complaints to justify completing the survey.

C.2 Summary of Key Survey Findings

Several key themes and successful strategies emerged from the Agency Survey. This section summarizes the information received by topic, first discussing the problem definition, then solutions that were proposed by agency representatives, including safe trail design, and management/outreach solutions. The survey questions were open-ended, to encourage agency representatives to provide feedback without leading them toward specific responses. However, this technique resulted in many different responses. The Planning Team categorized these responses to the extent possible, but a certain amount of interpretation was required.

In addition, some of the data does not directly pertain to this Study. In particular, surveys frequently cited issues with bicyclist speeds on paved trails, issues with dogs, and concerns about managing other power driven mobility devices (OPDMDs). These concerns are noted in the appropriate sections below, but the Project Team did not follow up on these issues, and the lessons learned focuses on information relevant to the Change-In-Use Process.

In the following summary findings, where a theme was cited by a single source or multiple agency or document sources, the reference follows. Where jurisdictions are cited without a date, the source is that jurisdiction's Agency Survey. If several sources supported the finding, the text provides general reference to support without specifically identifying all documents or agencies.

C.2.1 Problem Definition

Agencies selected for the survey had generally dealt with trail user conflicts and had utilized a variety of creative and successful solutions. When contacted for the survey, several agencies stated that trail user conflicts are a significant issue for their trail management, and that they are interested in other jurisdictions' best practices.

However, several other agencies indicated that trail user conflicts are not an issue in their jurisdiction. The State Parks Monterey Sector, Asilomar Sector, and Big Sur Sectors reported that complaints are so low that they did not complete the survey. Other agencies or State Parks districts completed the survey but stated that they did not feel conflicts between user groups on unpaved trails were an issue in their jurisdiction. These include: State Parks Calaveras Sector, Colorado Desert District, Four Rivers District, San Joaquin District, Turlock Lake SRA/Caswell Memorial SP/Bethany Reservoir, Channel Coast District, Memorial SP/Bethany

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Reservoir, Conejo Open Space Trails Conservation Agency (COSCA), Hill Country Conservancy, and San Luis Obispo County.

The USFS Lake Tahoe Basin Management Unit staff highlighted the difference between incidents and complaints as indicators of user conflict, noting that use conflicts are “very subjective and determined by individuals.”

Data Availability

The Project Team requested incident and complaint data from each agency sent a survey. This request was reiterated when surveys were returned. The survey also asked respondents to provide their professional judgment about the frequency of complaints, which may include formal written complaints or discussions at events, public meetings, or other feedback. Respondents were also asked about the frequency of incidents (actionable events), including injuries due to collisions, non-injury collisions, and ‘close calls negatively affecting user experience.’

Complaint Data

None of the agencies surveyed provided complaint data. However, the majority receive complaints in some form, whether at the trailhead, in public meetings, or via an online complaint form such as State Parks Gold Fields District and the Tualatin Hills Park and Recreation District (THPRD)’s ‘Park Watch’ website. State Parks Gold Fields District responded that complaints sometimes come in the form of an e-mail or phone call and may be shared with Parks staff to address the problem, although the District does not retain information.

Agency representatives typically estimated that they receive complaints about perceived conflicts on a monthly or weekly basis. By contrast, incidents are estimated to occur yearly or less frequently.

Incident Data

While few of the agencies surveyed provided incident data, the majority of representatives responded that in their professional experience, actual incidents are uncommon. As shown in Table C-2, only eight of the agencies surveyed maintain incident data, and four of those reported no incidents. Santa Clara County Parks and Recreation provided data which indicate that eight to twelve incidents involving multiple uses occurred during 2008-2010 (four of the equestrian-related injuries did not provide information about what spooked the horse).

Capital Regional District (CRD Parks) BC stated that, “we have over 80 kms of Regional Trails in our region with over 2 million users per year. Based on that, the ratio of complaints we receive is very low.”

The one serious incident cited in the survey responses was in Santa Barbara (under the Front Country Trails Multi-Jurisdictional Task Force’s jurisdiction). In 2006, a mountain biker and an equestrian were passing on a narrow trail without shoulders, and the horse fell off the trail, with ultimately fatal results to the horse. The incident prompted design and outreach responses from the management agency.

Table C-2. Incident and Complaint Data Frequency and Data Availability

Agency	Incident Dataⁱ	Incident Estimateⁱⁱ	Complaint Dataⁱⁱⁱ	Complaint Estimate^{iv}
Bureau of Reclamation, Lower Colorado Region	No	Monthly	No	Weekly
Forest Service, Lake Tahoe Basin Management Unit	Yes, 0	N/A	No	Monthly
Calaveras Big Trees State Park	No	<1/year	No	Monthly
Columbia State Historic Park	No	<1/year	No	Monthly
Colorado Desert District, State Parks	Yes, 0	<1/yr	Yes, N/A	0
Four Rivers Sector, State Parks	No	<1/yr	No	<1/yr
Gavilan Sector, State Parks	No	<1/yr	No	2-3/yr
Gold Fields District, State Parks	No	Monthly	No	Weekly
San Joaquin Sector, State Parks	No	<1/yr	No	<1/yr
Santa Cruz District, State Parks	No	<1/yr	No	Annually
Topanga Sector, State Parks	Yes, N/A	Monthly	Yes, N/A	Annually
Turlock Lake State Recreation Area/ Caswell Memorial SP/ Bethany Reservoir	Yes,, N/A	<1/yr	No	<1/yr
North Carolina Division of Parks and Recreation - Lake Norman State Park	No	Yearly	No	Yearly
Oregon Parks and Recreation	No	Monthly	No	Weekly
Capital Regional District Parks (CRD)	No	N/A	No	N/A
Conejo Open Space Trails Conservation Agency (COSTCA)	Yes, 0	0	No	4 times/year
Front Country Trails Multi-Jurisdictional Task Force (Front Country)	No	Few	No	N/A
Hill Country Conservancy	No	N/A	No	N/A
Tualatin Hills Park and Recreation District (THPRD)	No	Yearly	No	Monthly
Vancouver-Clark Parks and Recreation Department (VCPRD)	No	N/A	No	N/A
Jefferson County Open Space(JCOS)	No	Yearly	No	Weekly
Mecklenburg County Park and Recreation	No	Monthly	No	Monthly
Sacramento County Regional Parks, Recreation & Open Space	Yes, N/A	Yearly	Yes, N/A	Monthly
San Luis Obispo County	No	2 per year	No	N/A
Santa Clara County Parks and Recreation	Yes, 8-12/ 2 years	N/A	No	N/A
Wake County Parks, Recreation and Open Space	Yes, N/A	Yearly	No	N/A
Town of Crested Butte	No	N/A	No	N/A
City of Durango	No	Yearly	No	Monthly

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Agency	Incident Data ⁱ	Incident Estimate ⁱⁱ	Complaint Data ⁱⁱⁱ	Complaint Estimate ^{iv}
City of Henderson	Yes, N/A	Monthly	Yes, N/A	More than once per week
Town of Pagosa Springs	Yes, 0 in 5 years	Monthly	No	Monthly
City of Palo Alto Open Space & Parks	Yes, 0	N/A	Yes, 0	N/A
Portland Parks and Recreation (PP&R)	No	N/A	No	N/A
San Luis Obispo	No	Once per year	No	Once per year
City of Las Vegas	No	0	No	None
Forest Park Conservancy	No	Weekly	No	Annually
Pacific Crest Trails Association	No	Monthly	No	Weekly

ⁱ 'Incident data' indicates whether the agency collects specific data related to incidents between users on the trails. Agencies that note that they do collect incident data but have N/A did not provide data.

ⁱⁱ 'Incident estimate' is the agency representative's professional opinion of how frequently incidents occur.

ⁱⁱⁱ 'Complaint data' indicates whether the agency retains a list of complaints received from users.

^{iv} 'Complaint estimate' is the agency representative's professional opinion of how frequently complaints are received.

Prevalent Concerns

By a large margin, agency representatives most frequently cited concerns about speed differential between users on the trail (62 percent), as shown in Figure C-1. The Lake Tahoe Basin Management Unit specifically noted that "speed differentials of more than about 12 mph causes an increase in use conflicts."

Other frequently-cited issues included sight lines (44 percent), narrow trails (32 percent), congestion (24 percent), illegal trail use (e.g. users traveling on a trail via a prohibited mode; 24 percent), user perceptions (18 percent), and failure to yield (18 percent). Several of the concerns are interrelated; sight lines are related to user speeds, while user perceptions of other users could be related to getting passed quickly, without warning.

Several respondents cited a lack of alternative trails for users as a reason for user conflict. Portland Parks and Recreation (PP&R) noted that, "the lack of accessible single track mountain bike trails in the Portland metro area has caused bikers to ride on many of the pedestrian only trails in Forest Park." Similarly, the Folsom Lake Trails Advisory Group and the Santa Cruz District identified a lack of trails relative to mountain biking demand as a cause of user conflict.

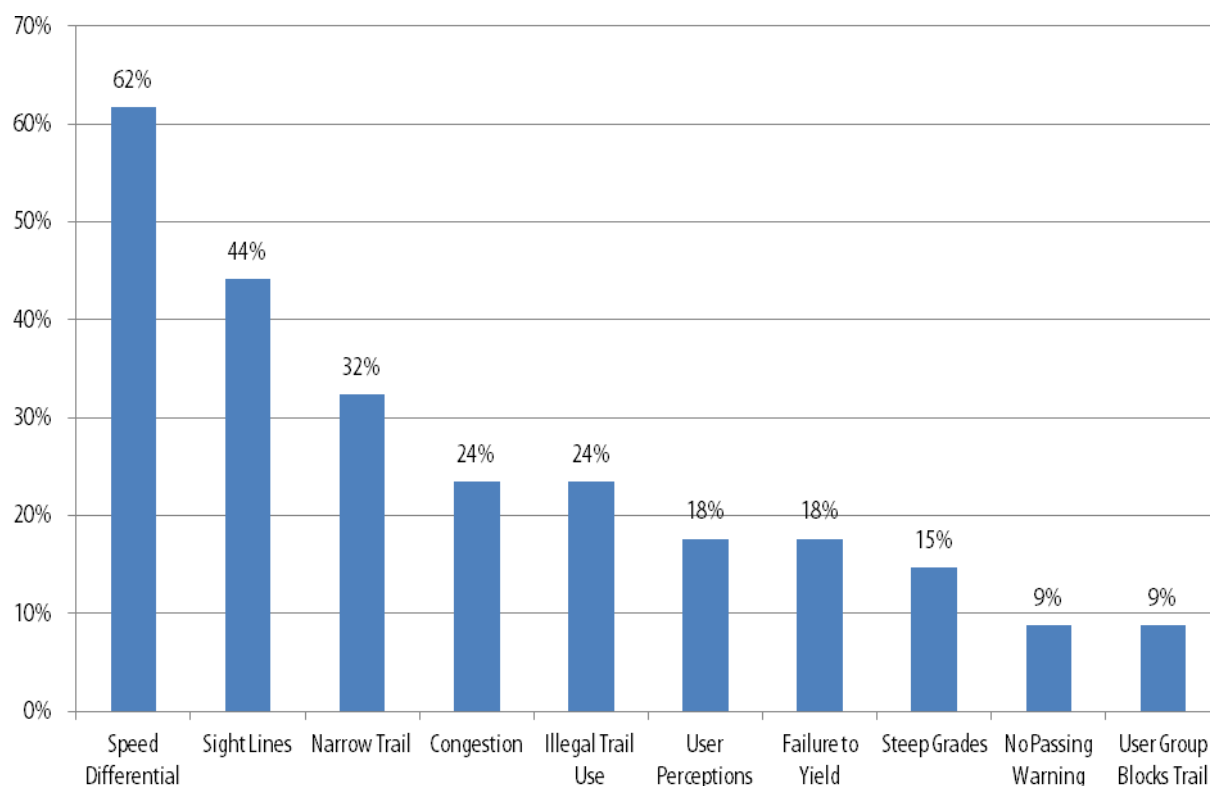


Figure C-1. Factors Contributing to User Conflicts from 34 Agencies Surveyed

Three agencies noted entrenched negative perceptions of other user groups arising from a history of conflict or disagreement; State Parks Gold Fields District, the Front Country Trails Multi-Jurisdictional Task Force (Front Country), and Jefferson County Open Space (JCOS) all cited historic conflicts contributing to an environment where managers had difficulty addressing root causes of conflict perceptions. Oregon Parks and Recreation and the Conejo Open Space Trails Conservation Agency (COSCA) noted that the introduction of a relatively new user group to historic types and levels is a problem. Front Country stated that, because long-time hikers or equestrians do not expect mountain bikers, their unexpected presence exacerbates perceptions of user conflicts.

User Groups in Conflict

Of the 36 surveys returned, the most frequent conflicts cited were between pedestrians/hikers and road bicyclists/mountain bikers (71 percent). The second most frequent concern was related to users with dogs and those without (41 percent). Only 18 percent cited issues between equestrians and mountain bikers. The State Parks Four Rivers Sector noted that Pacheco State Park has heard from equestrians that their horses were spooked during large special events, but “These are just anecdotal and occur infrequently.” Similarly, the State Parks Gavilan Sector responded that they have received comments from equestrians about mountain bikers, but complaints are rare and most users share fire trails with sufficient space.

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Other conflicting groups mentioned included bicyclists and other bicyclists (9 percent), off-highway vehicles (OHVs; 6 percent), runners and walkers (6 percent), and recreationalists and families (6 percent).

The Bureau of Reclamation, Lower Colorado Region noted that meet-up groups and running clubs sometimes conflict with local residents on the trails. Both CRD Parks and JCOS noted conflicting goals between people using the trails 'as a gym' or for exercise, versus use by families or enjoying nature. State Parks Topanga Sector, Oregon Parks and Recreation, and the Hill Country Conservancy have all received complaints about hikers walking side-by-side and blocking the trail.

The USFS Lake Tahoe Basin Management Unit felt that conflicts arise more from perceptions of other groups than from incidents. The Unit defines a user conflict as being between two individuals, while "the Forest Service manages for use conflicts that reflect a trend of conflict between use groups as a result of uses that are not compatible as a result of trail design, use types, or lack of management."

Where agency representatives commented on which users originated the offending behavior, they generally stated that mountain bikers were responsible for speeding, failure to yield, and not giving a passing warning. Other behaviors that agency representatives felt contributed to user conflicts include all user types wearing headphones (Topanga Sector) and mountain bikers shuttling to the top of a trail system and riding down at high speeds (Front Country).

Locations of Concern

Several agencies noted that concerns of incidents more frequently occur at turns and corners or other locations with poor visibility (Bureau of Reclamation Lower Colorado Region, State Parks Santa Cruz District, State Parks Topanga Sector, COSCA, THPRD, JCOS, Santa Clara Parks and Recreation, and Wake County). State Parks Galvilan Sector noted that user issues occur primarily on single track trails rather than on fire roads, where they feel there is space for all users. State Parks Gold Fields District, Front Country, and Oregon Parks and Recreation reported that issues occur in areas with steep slopes.

Agencies cited concerns both with narrow trails (Front Country, JCOS, and PP&R) and straight-aways where mountain bikers can gain high speeds (State Parks Santa Cruz, THPRD, and JCOS). State Parks Gold Fields and the Santa Cruz Districts cited illegal mountain bike use on hiker/equestrian trails as leading to problems.

C.2.2 Appropriate Trail Design Strategies

The Project Team requested references or copies of design guidelines used by agencies, in particular those agencies that cited design solutions to trail user issues. The State Parks districts and other California agencies primarily refer to the California State Parks' *Trail Handbook* (1991), while the USFS Lake Tahoe Basin Management Unit, COSCA, and the Town of Crested Butte use the Forest Service *Trail Construction and Maintenance Notebook* (FSH 2309.18; 2007).

Several agencies use the International Mountain Bicycling Association (IMBA) manual, *Trail Solutions: IMBA's Guide to Building Sweet Single-Track* (IMBA, 2004) as well as *Managing Mountain Biking: IMBA's Guide to Providing Great Riding* (IMBA, 2007) including State Parks Santa Cruz District, the Hill Country Conservancy, Mecklenburg County, Wake County, Lake Norman State Park, and City of Durango. Design guidelines

developed for a specific agency are included in the Literature Review, and pertinent details are included in the appropriate section below.

Design strategies used by multiple agencies include providing separate tread via trail layout (33 percent); maintaining sightlines (19 percent); controlling speeds with pinch points or obstacles (14 percent); providing adequate widths (15 percent); and using curvilinear design (6 percent) shown in Figure C-2. Each of these strategies is discussed in greater detail in the following pages.

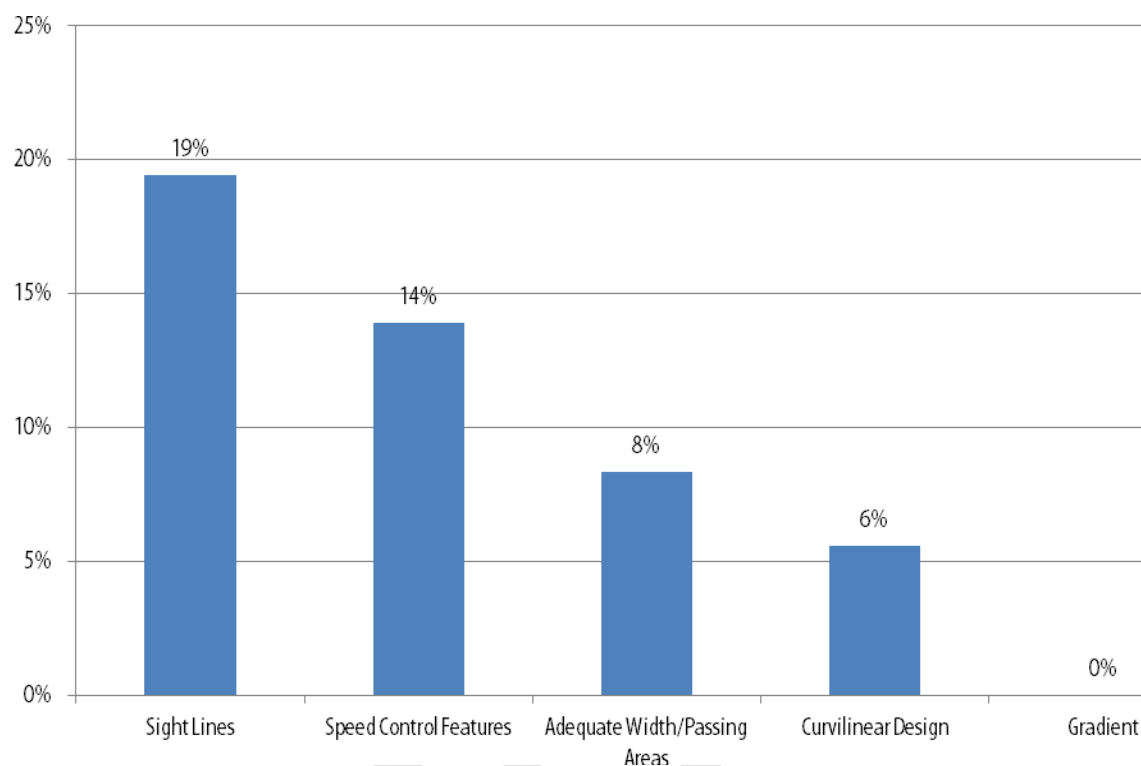


Figure C-2. Design Technique Results from 36 Agencies Surveyed

Sight Lines

Sightlines are a frequently-cited concern about mixing users on trails. Front Country, Santa Clara County Parks, THPRD, PP&R, City of Durango CO and the Town of Crested Butte CO all generally stated that they reduce conflicts by designing and maintain good sight lines (but did not define what that would be). The Town of Pagosa Springs CO noted a policy of thinning overgrowth, especially near curves.

The Santa Clara County Parks Department's design guidance contains specific instructions related to designing and maintaining good sight lines; the clearing width and trail curvature should assure a 100-foot average sight distance where possible. If sight distances are less than 100-feet, the guidance recommends considering posting safety signs and reducing speed limits (Santa Clara County Interjurisdictional Trails Committee, 1999). In addition, the County recommends designing grade rises on approaches to trail junctions and in locations with poor sight lines.

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The PP&R guidance for sight distance on a hiking/mountain biking/equestrian trail is 40 to 100 feet, “depending on speed/flow” (2009). Front Country has used community organizations and volunteer assistance to maintain good sightlines on trails by cutting back vegetation that was encroaching on the trail.

Speed Control Measures

Seven of the surveyed agencies intentionally slow mountain bikers’ speed through trail design using pinch points or trail anchors. Wake County Parks, Recreation and Open Space designs ‘speed chokes’ in the trails. Similarly, JCOS uses what they describe as chicane-style traffic calming to reduce mountain bikers’ speeds. The Lake Tahoe Basin Management Unit noted the use of ‘technical trail features’ (TTF’s) to slow users and to “meet their needs on certain trails.” State Parks Santa Cruz District has used pinch points to decrease speeds, but they reported that user groups sometimes remove these features.

None of the agencies that discussed speed reduction strategies had specific design guidelines or guidelines for use. Several of the agencies (both those that mentioned using design to reduce speeds and those that did not) cited the IMBA manuals, which detail the use of rolling contour trails, obstacles, choke points, turns, and other strategies for reducing speeds.

Adequate Width and Passing Area

Five of the agencies noted standards for width that have helped reduce user conflicts. THPRD PP&R, and Mecklenburg County all responded generally that they seek to provide sufficient width on trails. Several agencies’ design guidelines specify different widths depending on the expected amount or type of use, including CRD, THPRD, and Santa Clara County Parks. Most of these systems designate Regional, Community, and Local paved trails, without specifying divisions or optimal widths for different types of soft-surface trails. Santa Clara County Parks’ *Uniform Interjurisdictional Trail Design, Use, and Management Guidelines* recommends providing sufficient width based on level of trail, specifying that 6 feet is the minimum width to allow two wheelchairs to pass each other (Santa Clara County Interjurisdictional Trails Committee, 1999).

PP&R’s design guidelines designate a 4-foot minimum width on hiking/mountain biking trails (equestrians are allowed), noting that passing areas should be provided (2009). Oregon Parks and Recreation also noted that designing trails for shared-use from their development is more successful than retrofitting trails to accommodate multiple users.

Santa Clara County Parks also constructs single-track trails with a 5- to 6-foot bench that they allow to revegetate to 3 to 4 feet of width, providing a safe place for users to step off the trail to allow others to pass.

Many guidelines recommend providing wider turn-out/passing areas at regular intervals where trails are narrower than 8 feet. Wake County NC recommends building triangular intersections at key locations to regulate the flow of users and to minimize collisions. PP&R requires passing areas on hiking/mountain biking/equestrian trails 4 feet or narrower (2009). None of these guidelines provide information about how large the passing area should be, or how frequently located.

Sinuuous Design

Strategies included curving, sinuous and undulating trails; also designing a trail so users arrive at an intersection or conflict area traveling uphill. Santa Clara County Parks’ *Uniform Interjurisdictional Trail Design*,

Use, and Management Guidelines recommend undulating trails to reduce speeds, control water flow, and enhance user experience (Santa Clara County Interjurisdictional Trails Committee, 1999).

Santa Clara County Parks reported design practices not contained in their design guidelines, but found to be very effective by trail managers, including constructing a trail with a grade change so that users approach a ridge nose (where sightlines are poor) or a trail intersection at an uphill in either direction. In general, County Parks constructs undulations in the trail to enhance user experience, control water flow, and moderate speeds. County Parks has found that trails with undulations and sinuosity slow trail users.

Gradient

It is relevant to note that, while 15 percent of agencies cited steep trails or other grade-related issues as causing user conflicts, none of the surveys provided guidance for designing grades to address conflict.

C.2.3 Management Strategies

Most of the agencies surveyed (78 percent) reported that they use signs or other user information to remind users to share the path. (While it is expected that all agencies post signs, more than three-quarters noted it as a conflict management strategy). However, agency representatives varied on whether they felt signs had any impact on user behavior. Other key management strategies include enforcement (31 percent), through rules and regulations such as posting speed limits (19 percent), or through public notification of planning or management decisions (19 percent). Only 3 percent of agencies noted data collection as an element of their conflict reduction or management strategy.

Policies to manage trails include exclusionary policies, which may prohibit motorized or specific user types, as well as policies that define trail behavior and etiquette such as a speed limit or yielding to other users. These policies and other etiquette guidelines are often posted on signs at trailheads and enforced by park rangers or another authority. Some agencies have the ability to issue citations or exclude specific users who break the rules.

In addition, COSCA mentioned policies related to other power driven motorized devices (OPDMDs) and CRD Parks has a policy about use of motorized bicycles on paved trails.

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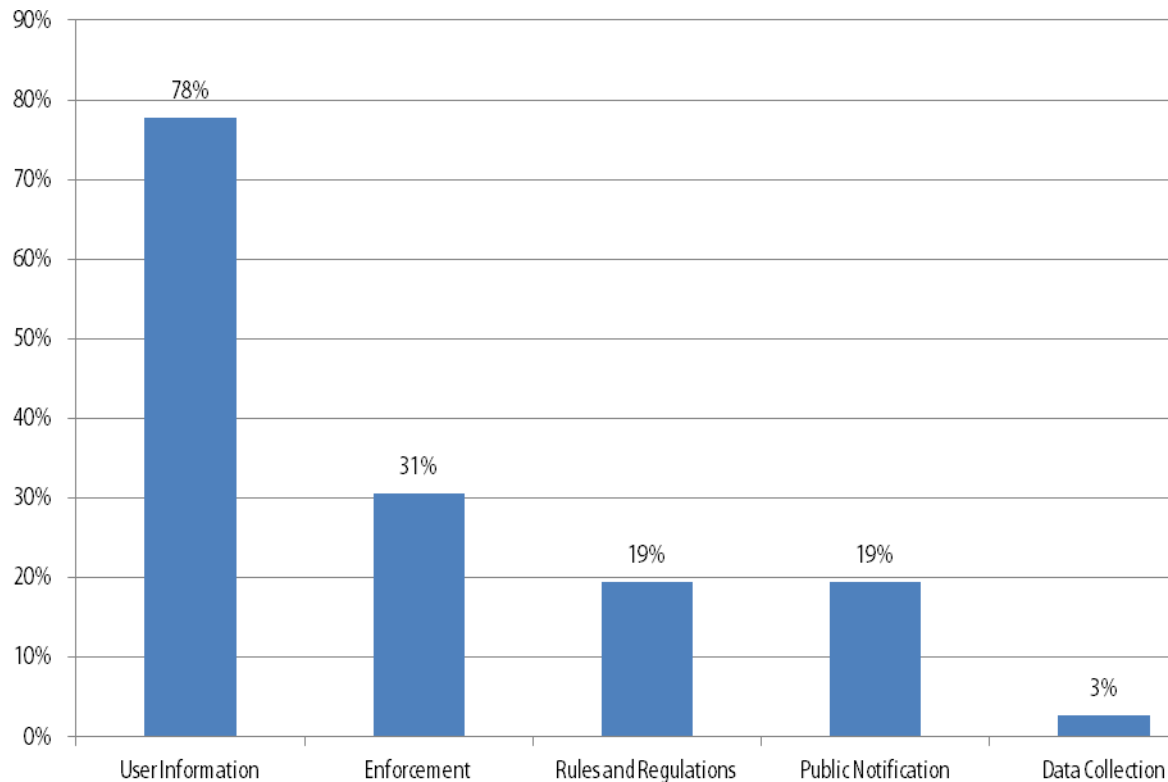


Figure C-3. Management Technique Results from 36 Agencies Surveyed

Alternate Use Days and Times

JCOS has designated alternate use days (i.e., mountain bikers on one day and hikers on another) as well as directional travel (mountain bikers can only ride in one direction on certain days). JCOS staff reports that the alternate use was a successful management response, as were the separate trails. User groups were resistant at first but were eventually satisfied with the management strategy.

In Santa Barbara, the Forest Service initially recommended alternate use, but the process did not include public involvement or multi-agency coordination, resulting in significant public resistance to the strategy. The Town of Pagosa Springs also reports that efforts to institute alternative use days were unsuccessful.

Separate and Specialized Trails

It is a common strategy to separate users who travel at different speeds with parallel treads in the same trail corridor. Similarly, some agencies note that they provide specialized trails for mountain bikers, where they can ride quickly and not expect to encounter other users. In some cases, dedicated mountain bike trails can be provided to encourage users to travel more slowly on shared trails. COSCA and the City of Henderson both mentioned this strategy.

User Information

Most jurisdictions reported posting trail courtesy and rules signage. State Parks Gavilan Sector noted that the majority of users are well-informed by posted trail etiquette signs, while the Town of Crested Butte CO reported that signs are primarily useful for out-of-town visitors.

However, several agencies felt that signs did not address problems with users. State Parks Gold Fields District, THPRD, Mecklenburg County Park and Recreation, and PP&R felt that signs on their own were insufficient. The Hill County Conservancy feels that only users who are already law-abiding pay attention to signs. State Parks Santa Cruz District noted that signs tend to be vandalized by excluded user groups. The City of Palo Alto also provides user information about trail conditions via social media (Facebook and Twitter).

Enforcement

The presence of rangers or other authority figures on the trail can deter undesired activities and encourage users to employ trail etiquette. Where speed limits are posted, rangers can enforce speeds or issue citations or warnings to rule breakers. In Mecklenburg County and the City of Durango, off-duty police work sections of the trails. In other locations, rangers patrol the trail system (THPRD, City of Durango, and PP&R). In Portland, a ranger position was created to enforce proper passing and speeds on trails.

At State Parks Gold Fields District, equestrian groups have felt that spot enforcement was successful in reducing behavior that leads to conflicts, although the agency noted that actual success of the program is uncertain.

Rules and Regulations

While speed limits tend to be posted on paved shared-use trails, several agencies reported using speed limits on unpaved facilities. Santa Clara County Parks, State Parks Gold Fields District, Jefferson County, and Sacramento County all have posted 15 mph speed limits. Jefferson County is considering 'zoning,' whereby users are expected to dismount or reduce speeds in certain areas, although zones have not been implemented.

Several of the agencies have the ability to cite, give warnings, or exclude users who break rules. Oregon Parks and Recreation and State Parks Gold Fields District have citation authority but rarely use it; in the Gold Fields District, a peace officer has to catch the violation as it occurs. THPRD and the Hill County Conservancy can exclude users who violate trail rules. While the Bureau of Reclamation Lower Colorado Region does not directly manage trails, the agency encourages their management partners to issue citations to offending users.

Collecting and Tracking Data

Few agencies take the time to record and track data regarding trail use conflict. JCOS is monitoring incidents and complaints to gauge the efficacy of their strategies. While the report is not complete, it will provide an important resource.

C.2.4 Outreach and Coordination Strategies

Several agencies responded that working with trails groups, holding public meetings and educating the public had the greatest effect on reducing conflicts between users. The most common outreach category was education (44 percent), followed by volunteer programs (31 percent), user group meetings (31 percent), user group notification (19 percent) and holding events (17 percent), as shown in Figure C-4.

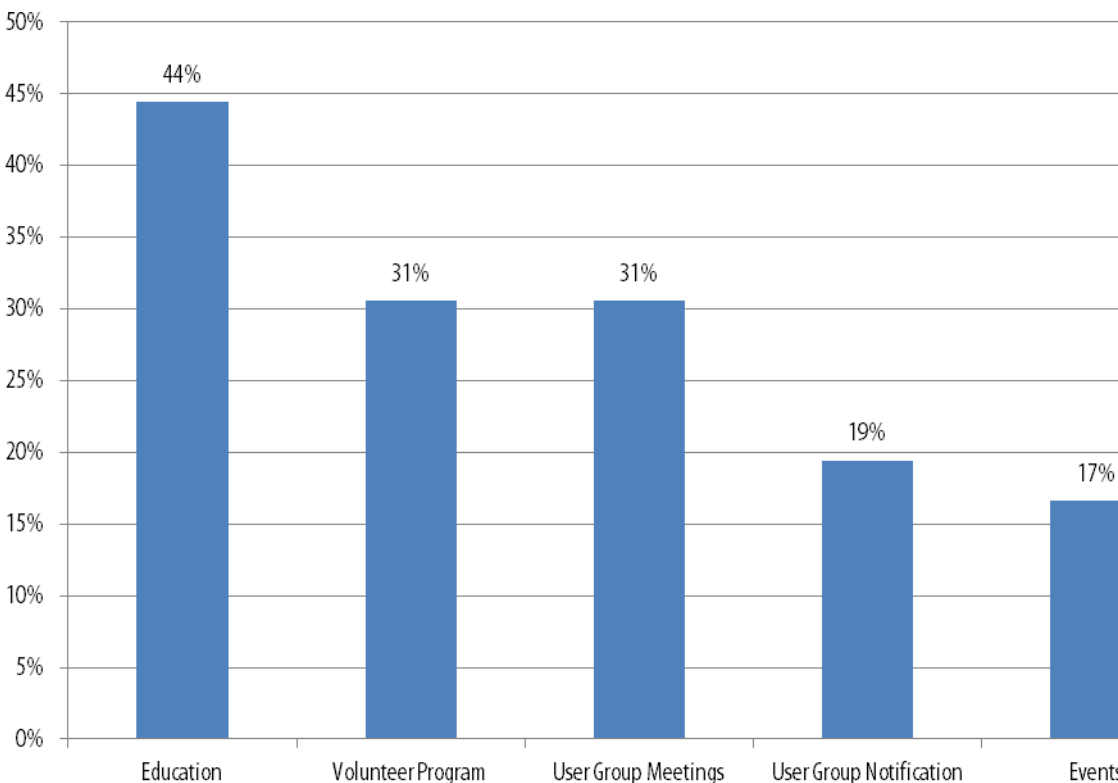


Figure C-4. Outreach Technique Results from 36 Agencies Surveyed

Education

Many of the agencies who have ranger patrols or who work with volunteers reach out to users through those avenues. Some agencies specifically cited speaking with trail users about sharing the trail as a successful strategy (Lake Norman State Park, Turlock Lake State Recreation Area, JCOS, Front Country). Turlock Lake State Recreation Area staff noted that education that informs users the spirit of trail development and the agency's goal and mission is most effective. In Santa Barbara, staff from the three jurisdictions that are part of Front Country presented best practices of trail sharing to the public in order to increase compliance.

COSCA teaches trail etiquette to local schoolchildren through skits performed at the annual Trails Education Days. They previously gave out key chains with the yellow etiquette symbol at public events but discontinued that practice due to budget cuts.

Volunteer Programs

Several agencies work with volunteers to maintain or patrol trails or to encourage and exhibit proper trail etiquette. State Parks Gold Fields District, JCOS, THPRD, and CRD Parks all have active volunteer patrols.

The City of Henderson has a volunteer Trail Watch program, in which volunteers monitor trail use and model appropriate trail use by providing information and assistance to all trail users. The volunteers document incidents that require the City's attention. The City reports that the Trail Watch program is very successful, as it provides a sense of ownership.

User Group Meetings

Many of the agencies reported working with established user groups to be a successful or necessary strategy. State Parks Gold Fields District designates a staff member to attend user group meetings and to work with particular groups on trail work days. Mecklenburg County and the City of Durango recommend maintaining regular communication with different user groups and bringing issues to them as necessary.

In some cases, agencies reached out to individual trail users independent of user organizations. This type of collaboration can be formalized through a trails committee (State Parks Gold Fields District, COSCA, VCPRD) or via open houses. Several agencies hold stakeholder meetings to discuss solutions to user conflicts (Bureau of Reclamation Lower Colorado Region, City of Henderson), while others hold multi-user trail meetings when developing plans (Oregon State Parks and Recreation and Front Country).

Trail Events

Agencies and user groups hold a variety of events on trails, including events with specific 'Share the Trail' messages and more general trail clean-up or maintenance days. COSCA holds "Trails Education Days" annually for 5th graders. State Parks Gold Fields District has assigned specific staff to work with various user groups on trail work days, which sometimes include both mountain bikers and equestrians.

The Mountain Bikers of Santa Cruz hold a carrot ride at Wilder Ranch State Park, wherein mountain bikers hand carrots out to horses to make a positive connection with the horse, to reduce horses' likelihood of being spooked when mountain bikers approach. In partnership with the City of San Luis Obispo, the local mountain bike user group holds bell give-aways, which have had a positive impact on mountain bikers' use of bells when passing other trail users.

Several agencies collaborate with trail groups to plan, construct, and manage trail projects (VCRD, Town of Crested Butte, Mecklenburg County, City of Durango, and Oregon Parks and Recreation).

Table 10 provides a summary of the design solutions and management and outreach strategies indicated by the 36 survey respondents.

Appendix C.

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Table C-3. Matrix of Agency Survey Responses to Trail User Conflict Solutions

ID	Agency	Design Solutions						Outreach					Management							
		Trail Layout/Availability	Sight Lines	Speed Control Features	Adequate Width/Passing Areas	Curvilinear Design	Gradient	Education	Volunteer Program	User Group Meetings	User Group Notification	Events	User Information	Enforcement	Ranger Patrol	Speed Limit/Citations	Public Notification	Designated Use-Intensive	Data Collection	Alternate Use Days
1	Bureau of Reclamation, Lower Colorado Region			x				x	x	x			x	x		x	x			
2	U.S. Forest Service, Lake Tahoe Basin Management Unit			x																
3	Calaveras Sector, State Parks	x						x							x					
4	Columbia State Historic Park												x	x	x					
5	Colorado Desert District, State Parks																			
6	Four Rivers Sector, State Parks																			
7	Gavilan Sector, State Parks												x							
8	Gold Fields District, State Parks	x							x	x	x	x	x	x		x				
9	San Joaquin Sector, State Parks												x							
10	Santa Cruz District, State Parks			x								x	x							
11	Topanga Sector, State Parks							x			x						x			
12	Turlock Lake SRA/Caswell Memorial SP/Bethany Reservoir							x					x	x						
13	North Carolina Division of Parks and Recreation - Lake Norman State Park							x					x							
14	Oregon Parks and Recreation	x								x			x							
15	Capital Regional District Parks							x	x				x				x			
16	Conejo Open Space Trails Conservation Agency							x	x	x		x	x					x		
17	Front Country Trails Multi-Jurisdictional Task Force		x					x	x	x		x	x							
19	Hill Country Conservancy	x													x					
20	Tualatin Hills Park and Recreation District		x										x	x	x					
21	Vancouver-Clark Parks and Recreation	x								x	x		x				x			
22	Jefferson County Open Space	x	x	x				x	x	x	x	x	x			x	x			x
23	Mecklenburg County Park and Recreation	x			x								x	x	x					
24	Sacramento County Regional Parks, Recreation and Open Space	x											x			x				
25	San Luis Obispo County							x					x						x	
26	Santa Clara County Parks and Recreation		x		x	x		x			x			x	x	x				

ID	Agency	Design Solutions						Outreach					Management							
		Trail Layout/Availability	Sight Lines	Speed Control Features	Adequate Width/Passing Areas	Curvilinear Design	Gradient	Education	Volunteer Program	User Group Meetings	User Group Notification	Events	User Information	Enforcement	Ranger Patrol	Speed Limit/Citations	Public Notification	Designated Use-Intensive	Data Collection	Alternate Use Days
27	Wake County Parks, Recreation and Open Space			x									x							
28	Town of Crested Butte	x							x	x			x							
29	City of Durango		x					x	x	x	x		x	x	x					
30	City of Henderson	x						x	x	x		x	x	x			x	x		
31	Town of Pagosa Springs	x	x										x							
29	City of Palo Alto Open Space & Parks		x		x	x				x	x		x			x	x			
32	Portland Parks and Recreation	x						x					x	x	x	x				
33	San Luis Obispo								x											
34	City of Las Vegas												x							
35	Forest Park Conservancy							x	x				x							
36	Pacific Crest Trails Association							x					x	x						

C.3 Review of Key Surveys

Of the 36 surveys returned, 11 stood out as examples that provide specific guidance for managing trail incidents and user conflicts. These agencies manage a significant number of unpaved shared-use trails and provided substantial information, including design guidelines, management policies, and other documentation to expand on the strategies used. Agencies that responded that they have few issues with conflicts between users, or who focused their responses on issues on paved paths or with dogs or vehicles, are not included in the ‘key’ surveys.

C.3.1 U.S. Forest Service, Lake Tahoe Basin Management Unit

The Lake Tahoe Basin Management Unit oversees all Forest Service roads and trails around Lake Tahoe. They manage 160,000 acres of land and 415 miles of trails, both paved and unpaved. Most user types are accommodated, including off-highway vehicles (OHVs), motorcycles, hikers, equestrians, dog walkers (on leash), and bicyclists (road and mountain bike).

Nature of the Problem

The Management Unit records incidents, but no incident has been recorded where an injury was involved. Reported incidents occur less than once per year, while congestion occurs in July and August on about 10 different trails.

The Management Unit draws the distinction of ‘user conflicts’ between two or a group of users, and ‘use conflicts,’ which are a trend of conflict between use groups “as a result of uses that are not compatible as a result of trail design, use types, or lack of management.”

Most complaints received by the Management Unit are specific to local areas; in one location users complain about the presence of dog feces, while at others users may complain about equestrian or mountain bike use. Several complaints about incidents involving mountain bikers had been reported on the Lake Valley Trail, which the Management Unit rerouted and reconstructed as a response.

Solutions

Staff feel that trail design or layout can contribute to or resolve user incident issues, particularly short sight lines, confined areas, and over-steep grades. Other factors include differing user goals and knowledge, speed differential, and other site-specific factors. Perceptions of user conflict arise primarily from attitudes about sharing the trail and repeat offenders who are looking for a conflict. The Management Unit also views signage informing users of trail rules as an important avenue for educating users about trail sharing etiquette.

The Management Unit mitigates trail user conflicts by focusing on embracing shared-use management. Staff feel that “over use of exclusion is harmful for all trail users and we avoid it unless there are safety issues.”

The primary design document is the Forest Services’ *Trail Construction and Maintenance Notebook* (FSH 2309.18). They have also used technical trail features (TTFs) to reduce mountain bikers’ speeds and to design interesting trails, although they recognize that the approach is not appropriate on all trails.

Appendix C.

Management policies refer to the Multiple-Use Sustained-Yield Act of 1960.¹ In addition, the Management Unit attempts to identify perceived conflicts versus actual conflicts, minimizing exclusion of groups unnecessarily.

Bureau of U.S. Forest Service, Lake Tahoe Basin Management Unit Lessons Learned

Design Best Practices

- Use the Forest Services' *Trail Construction and Maintenance Notebook* (FSH 2309.18).
- Maintain good sightlines.
- Reduce mountain bikers' speeds where appropriate with use of technical trail features (TTFs).

Management Best Practices

- Post signs educating users about etiquette and yielding expectations.

C.3.2 California State Parks, Gold Fields District

The Gold Fields District is located in Folsom and includes the Folsom Lake State Recreation Area (SRA) and Auburn SRA. Folsom Lake SRA is 20,000 acres with about 100 miles of trails, while Auburn SRA is 26,000 acres with 118 miles of trails. The majority of trails in the District are designated hiker/equestrian, with few trails that also allow mountain biking. The District is working on revising its posted order to better document the current use designations.

Nature of the Problem

Gold Fields District staff report that most of the conflicts and incidents on unpaved trails are between equestrians and mountain bikers or pedestrians and mountain bikers. Folsom Lake SRA occasionally has problems between pedestrians and road bicyclists on the paved trails. Staff report that most incidents occur on trails where mountain bikers are prohibited and are riding illegally. Areas with high use, intersections with shared-use trails, and areas with blind corners or poor sight lines are also problem areas.

State Park peace officers write an incident report when it results in an injury or if there is criminal activity. Complaints are not systematically recorded or retained by State Parks, although they may be shared with other Parks staff to address a particular problem. In addition, equestrian user groups at Folsom Lake SRA have developed a "Park Watch" website where users can record incidents and complaints. Staff members estimate that they receive informal complaints approximately weekly, and reported incidents (to which staff responds) monthly. Injuries due to collisions occur approximately quarterly.

The Folsom Lake Trails Advisory Group identified the lack of trails relative to demand, particularly for mountain bikers, as a factor that led to user conflict. Poor etiquette by all trail users also leads to situations where mountain bikers' speeds can lead to an incident. Staff writes, "The long history of user conflicts at Folsom Lake SRA has led to entrenched negative perceptions by both equestrians and mountain bikes or the

¹<http://www.fs.fed.us/emc/nfma/includes/musya60.pdf>

other user group. Neither of these groups is homogenous in their use of trail etiquette, but the negative actions and rhetoric of some users have affected the wider perceptions of many users on either side of this conflict.

Solutions

The District uses State Parks' *Trails Handbook* (1991), which provides guidelines for the development, construction and maintenance of trails. However, most trails predate the Handbook, and the staff feel that they are poorly aligned and inadequately maintained.

The District has posted speed limit signs, caution signs, and trail use etiquette signs on some trails, but is in the process of updating the signs. Staff considers signing not to be generally successful in preventing illegal use of trails or compliance with speed limits. Spot enforcement has been seen positively by equestrian groups, but the actual success is uncertain. The District can issue violation notices for illegal trail use if violators are caught in the act by a peace officer. Folsom Lake SRA has a volunteer Mounted Assistance Patrol.

The District set up the Folsom Lake Trails Advisory Group (FTAG) in 2000 to address user conflicts between equestrians and mountain bikes at Folsom Lake SRA. Facilitated by State Parks staff, the group included representatives from equestrian, mountain bike, runner, hiker and youth user groups. FTAG worked on changing a limited use trail to shared-use. However, the planning process was held up and members left the process dissatisfied.

The District has assigned staff to work with user groups, including the volunteer patrols, equestrian user groups and mountain bike user groups. Staff attends the meetings of these groups and work with user groups on trail work days, which sometimes include mountain bikers and equestrians.

District staff believes that the long term solutions to issues associated with user incidents in Folsom Lake SRA include developing more trail opportunities for all users, particularly mountain bikers and improving design through repairs, re-routes, and improved maintenance.

California State Parks, Gold Fields District Lessons Learned

Design Best Practices

- Use the State Parks *Trails Handbook* (1991) to retrofit trails for multiple uses.

Management Best Practices

- Provide sufficient trail opportunities for all user types.
- Enforce appropriate use of trails.

Outreach Best Practices

- Involve stakeholders in an advisory committee.

C.3.3 Front Country Trails Multi-Jurisdictional Task Force, California

As a partnership of the City and County of Santa Barbara and the Los Padres National Forest, the Front Country Trails Multi-Jurisdictional Task Force (Front Country) was formed to create and implement trail management objectives and programs. Consisting of staff representatives of all three governmental agencies, the group manages 30 miles of trail most of which are narrow natural surface trails that accommodate hiking, horse riding, bicycling, and trail running.

Nature of the Problem

Although not recorded, trail use conflicts and incidents in the Front Country trail system have occurred for 30 years. User complaints are received at Front Country meetings and public education events.

The speed of downhill bicyclists, near misses between bikers and other users, and equestrians who are nervous about encountering bikers on the trails contribute to incidents and conflicts. Concerns are also related to the trails being too narrow to allow different user groups to safely pass in different directions. In 2006 a mountain biker and an equestrian were passing each other on a trail and the horse fell over the side and died. Equestrians have reported avoiding the shared-use trails because they do not feel safe sharing the trail with mountain bikers. Individual equestrians have lobbied for prohibiting bikes on the trails so that they will be safe for equestrian use.

In particular, the Sierra Club is active in the region and is vocal about issues with bikers. Based on public comment, most concerns seem to occur where line of sight is impaired and where a steep grade leads to higher bike speeds. At public education events, complaints are primarily associated with issues between hikers, walking dogs, and other hikers.

Perceptions based on historical expectations likely contribute to user conflicts, as the trails predate mountain biking, although the last 20 to 30 years have set a precedent for shared-use. Physical characteristics that contribute to incidents include: average grades of 12 percent with some areas as steep as 26 percent and steep drop-offs, which create high speeds for downhill bikes, and areas that have little space for users to pass each other safely. Brush growth in the summer inhibits lines of sight, leading to users being surprised by approaching bikers. In addition, since the majority of the road accesses are at the top of the trail, the system has become popular with downhill mountain bikers who shuttle to the top and ride down at high speeds, exacerbating concerns and conflicts among other users.

Solutions

Initially, the Task Force focused education on standardized trail etiquette and information signs at trailheads. Signs help clarify expected behavior and set the expectation of shared-use, which has particularly reached users from outside the local community. A Forest Service community forum worked for several years to resolve user conflict issues and established a plan for a pilot project of odd/even day alternating uses on one trail. However, when the public became aware, there was a backlash from individuals not involved in the process, which led to the plan being abandoned. The current Task Force structure assures a completely open process that is accessible at city and county levels as well involving Forest Service personnel. The task force also tried to empower a single community group made up of members from all user groups to serve as an

umbrella group which would take on trail stewardship and bring user groups together. However, staff report that the political climate in the community has made these efforts fruitless.

Enhanced volunteer engagement in trail maintenance has allowed for better brush clearing and repair of eroded areas of trail, which has led to better lines of sight and fewer narrow, loose areas of trail. Standardized trail rehabilitation guidelines have allowed community organizations to assist with rehabilitating specific trails for safer equestrian, and therefore shared-use, access. Better trail maintenance and rehabilitation is expected to lower the number of actual incidents on the trail, though staff estimate that few actual incidents occurred before or after the enhanced trail maintenance (Front Country does not have a formal reporting system).

Creation of a multi-agency task force with regular public meetings has been vital to provide the public a legitimate place to express their concerns about other trail users. This partnership has decreased overall hostility and served as a catalyst for problem solving. Staff from the City and County of Santa Barbara and the Los Padres National Forest have gathered and presented best practices in trail management and user conflict. The task force serves as the major educational outreach to help set user expectations for Front Country's shared-use trails.

The Santa Barbara Mountain Bike Trail Volunteers, an IMBA group, has led the mountain biking community in educating users about proper etiquette and in encouraging use of bike bells. Other users have noticed the local bike community's courtesy and helped to diminish conflict and shift the conversation from 'bikes are bad; how do we eliminate them?' to 'how do we change the behavior of certain bicyclists?' However, entrenched conflict among long-time users remains.

The Task Force continues struggling with issues of entrenched perceptions of conflict, seeking to build trust between groups and to manage user expectation. Open and respectful communication at all levels is considered critical.

Front Country Trails Multi-Jurisdictional Task Force Lessons Learned

Design Best Practices

- Organize volunteer trail days to provide a higher level of maintenance than otherwise possible.
- Use standardized trail rehabilitation guidelines.

Management Best Practices

- Use standardized signs.
- Present information about proper etiquette.

Outreach Best Practices

- Engage volunteers in trail maintenance activities.
- Create a formal Task Force to manage the multi-jurisdictional area.
- Hold regular public meetings to discuss issues.
- Maintain open communications and collaborate on management solutions.

C.3.4 Oregon Parks and Recreation Department

Oregon Parks and Recreation Department (OPRD) manages nearly 102,500 acres of natural, recreational, and historic resources throughout the State of Oregon. OPRD's parks, trails, recreation, and natural areas consistently rank among the top ten most-visited parks systems in the nation. Approximately 960 miles of recreational trails and 220 non-vehicle bridges make up the OPRD trails system. Most trails are natural surface or compacted gravel with the exception of the bridges and boardwalks and accommodate hikers, cyclists, and equestrians.

Nature of the Problem

Most complaints have to do with other trail users not sharing the trail or following trail etiquette protocols to allow passing (pedestrians) or maintaining safe speed (bikers). OPRD also receives complaints about horse manure on trails. Many complaints are related to specific uses that cause erosion and widened wet areas, which make the trail unusable for parts of the year.

All user groups have complaints about other groups. Staff report that mountain bikers tend to complain less than other groups, but OPRD maintains fewer miles of trails that allow mountain bikes than other miles of trail open to equestrians and hikers. Most of the complaints come during summer months and peak weekend times when more people are using the trails. User conflicts are attributed to increasing levels of use by a user group that was not historically as frequent and perceptions of other trail users.

Solutions

OPRD recommends providing separate tread for different users where space allows. If health, incident occurrences, or natural resource issues prove unworkable, OPRD will separate user groups to different trails. Once trails are closed to a group of trail users, OPRD has the option of issuing citations to violators, but that action is rarely taken.

OPRD engages in shared-user trail meetings to develop trail plans to meet all users' needs. The biggest success has come when users work together to develop a solution. This reduces the tendency for users to have a negative perception of an entire group based on one bad experience and allows relationships to be built.

From experience, OPRD has learned that poor trail design has the biggest impact on user conflict and incident occurrence. However, trails that are designed sustainably and with multiple user groups in mind have few conflicts. Several of the areas that receive the most complaints are areas where the trails are old logging roads that are now managed as part of the trail system and open to all trail users.

Oregon Parks and Recreation Lessons Learned

Design Best Practices

- Design for shared-use from the beginning.
- Provide separate designated-use trails when space allows or other alternatives are not effective.

Management Best Practices

- Allowed-use and etiquette signs posted.

Outreach Best Practices

- Engage multiple user groups to develop trail solutions.

C.3.5 Jefferson County Open Space, Colorado

Jefferson County Open Space (JCOS) has jurisdiction over almost 39,000 acres of land, with over 200 miles of trails. Trail surfaces vary and all types of users are allowed on the system, with restrictions for specific trails.

Nature of the Problem

JCOS staff estimate that they receive a complaint approximately each week. Reported incidents occur approximately on an annual basis. Staff acknowledge that not all collisions (injury or non-injury) may be reported.

The majority of complaints JCOS receives are related to off-leash dogs. In addition, users complain about the speed differential between hikers and bikers, particularly mountain bikers on a downhill trail segments. Conflicts more frequently occur during periods of heavy use, in particular weekday late afternoons and weekends. The majority of conflicts involve mountain bikers and hikers, as well as hikers with off-leash dogs and those without dogs. Complaints with regards of off-leash dogs occur throughout the system.

Design issues identified include narrow unpaved trails in the foothills that have bends with limited visibility due to heavy vegetation or trees. Narrow trails may have poor lines of sight that cause users to not see one another, and lack of space for passing contributes to perceptions of conflicts. On the other hand, staff note that wide trails allow mountain bikers to travel at fast speeds, increasing concern among users.

Complaints also arise due to the variety of user types and difference in capabilities and user expectations. Users on JCOS' trails vary from expert riders who are exercising, to families with children on a leisurely stroll or riding to enjoy nature. In addition, the agency reports that some individuals have existing negative perceptions of particular user groups, which contributes to complaints about those user groups on the trail.

Solutions

JCOS staff have been dealing with conflict issues for a significant time on established parks and has had the opportunity to plan new parks and trails anticipating shared use. Design elements used to reduce conflicts include: establishing a chicane-style traffic calming structure of rock and fencing, creating segregated access trails at trailheads, and managing vegetation to maintain sight lines. In addition, JCOS posts etiquette signs at trailheads and other strategic locations throughout the trail system.

Educational efforts have included the Bike Right and Share the Trail programs and using volunteer patrollers to monitor users on the trail. Staff had tried mitigating conflict with educational special events and by increasing patrols. However, they did not find that these outreach efforts resulted in changing the behavior of some of the faster users. As a response, staff began engaging user groups and developing management options in collaboration with users.

JCOS has provided some separate trails for hiking uses only, as well as a park used exclusively for hiking. Additional management responses have included alternate use days (i.e. bikers on one day and hikers on another), directional travel (mountain bikers one direction on certain days), and speed limits at one urban park and on concrete bikeways. JCOS staff reports that the alternate use was a successful management response, as were the separate trails. JCOS also developed a new regulation regarding the manner in which users are required to pass one another on trails. While resistance from user groups was evident at first, satisfaction with the overall management was high with both management actions.

Appendix C.

JCOS documented the increase in incident reports at an established park and responded by engaging park users in developing alternatives. Through this collaboration, the County decided to implement an alternating day directional restriction to mountain bikers. Visitors now can select trails in anticipation of where faster users might be present. No user types are prohibited from accessing the park at any time. JCOS is in the second year of monitoring compliance and user satisfaction with treatments to decrease the number of incidents among visitors at this park. The program will continue specific outreach and enforcement activities to sustain initial improvements. The initial responses from user groups have been favorable.

During the planning and public input phase of a new park, JCOS initiated alternating weekend day use by hikers and mountain bikers. The park website provides alternatives for hikers or mountain bikers who arrive at the park on the wrong day. Equestrians are allowed on the trails at any time.

JCOS also constructed an additional mile of mountain bike trail to provide a complete experience to all users despite any directional restriction. JCOS is also considering “zoning”, whereby bicyclists would be required to dismount or reduce speeds.

Jefferson County Open Space, Colorado

Design Best Practices

- Avoid wide trails where users can build speeds.
- Address sight lines and provide passing space on narrow trails where there is potential user conflict while passing.
- Establish chicane-style traffic calming structures of rock and fencing.
- Create separate trails for hikers and mountain bikers at trailheads.
- Manage vegetation to maintain sight distances.

Management Best Practices

- Post etiquette signs at trailheads and other strategic locations throughout the trail system.
- Alternate day or weekend use without barring any user types.

Outreach Best Practices

- Engage user groups in development and management of trails.

C.3.6 Santa Clara County Parks and Recreation Department, California

The Santa Clara County Parks and Recreation Department manages 45,000 acres of parks, including 300 miles of paved and unpaved trails. Pedestrians/hikers, equestrians, bicyclists, and dogs (on leash) are allowed on the trails. Walking/running is the most frequent recreation activity (51 percent), followed by hiking (20 percent) and bicycling (14 percent). Only 1 percent ride horses.

The Department’s 2003 *Strategic Plan* reconceptualizes the well-established trail system to accommodate the growing numbers of users. The Plan visualizes trails “whose inner rings generally serve more intensive group

activities, while outer rings provide for more dispersed recreation opportunities and solitary recreation experiences.” The Plan also considers a trail to be of countywide significance if it accommodates the needs of multiple user types from throughout the County and established design standards for trails of countywide significance.

Nature of the Problem

From 2008 to 2010, Santa Clara County Parks recorded 19 injuries on the trail system. Of these, 11 occurred on paved paths. Seven injuries were unrelated to user conflicts (spooked horses, users not paying attention, etc.). Four of the equestrian-related injuries do not provide information about what spooked the horse. Two equestrians were injured by horses spooked while passing other users. Five incidents occurred between two bicyclists, and one incident each involved a bicyclist interacting with a roller blader, jogger, scooter, and a pedestrian, respectively.

County Parks has received several complaints about trail user conflicts. Complaints are generally submitted via comment cards, and do not always contain specificity as to the location or circumstances of the incident. Santa Clara County Parks have seasonal use, and the majority of complaints are received in the spring and summer, particularly on weekends.

The majority of the complaints have been conflicts between equestrians and mountain bikers, originating from the equestrian community. Conflicts between mountain bicyclists and hikers also occur, but less frequently. The majority of the complaints are related to mountain bikers traveling too quickly and not warning other users that they are passing. Design issues identified by the park manager include trail design and grade contributing to high mountain bike speeds and poor visibility.

Solutions

The Santa Clara County Interjurisdictional Trails Committee developed *Uniform Interjurisdictional Trail Design, Use, and Management Guidelines* (1999) to coordinate efforts between the County, the 15 cities, and the other special districts and agencies within the County. The document defines trails in terms of the users’ experience, using the following distinctions:

- Level 1. Low Volume/ Remote Experience
- Level 2. Moderate Volume / Rural Area or Natural Experience
- Level 3. High Volume/ Incorporated Urban Experience

The County’s design guidelines utilize these levels, designing recommended tread width and surface, shoulder width, striping, signing, and management approaches.

Design guidance related to accommodating multiple user types includes standards for width, accessibility, sight lines, design speed, centerline striping, signage, and traffic calming. One guideline states, “Trail uses should be consolidated where safe within the same trailway, depending on the steepness, available right-of-way, user frequencies, and other conditions. Where it is appropriate and/or necessary to limit use on one trail bed, limited-use and single-use trails should be kept separate and clearly signed” (UM - 1.2). However, the guidelines do not provide specific metrics for these factors.

Appendix C.

Other techniques Santa Clara County Parks has implemented are designed to reduce mountain bikers' speeds, including constructing a trail with a grade change so that users approach a ridge nose (where sightlines are poor) or a trail intersection at a gentle uphill in either direction. In general, County Parks constructs undulations in the trail to enhance user experience, control water flow, and moderate speeds. County Parks has found that trails with undulations and sinuosity reduce trail users' speeds.

Santa Clara County Parks also constructs single-track trails with a SWECO trail dozer that builds the trail tread at 5 to 6 feet width on a full bench (all cut cross-section). The trail is then seeded and allowed to re-vegetate to a 3 to 4 feet of width through use (as most users only occupy 3 to 4 feet of the trail tread). However, the 5- to 6-foot bench remains present, providing users a place to stand off the trail to allow other users to pass safely. The 5- to 6-foot bench additionally allows safe passage with dogs on leash (dogs can be held on the far side of the trail while other users pass on the other side).

County Parks has also conducted outreach and education, as well as posting speed limits. Park rangers enforce the speed limit with radar, focusing on areas identified in complaint cards. Regulations are posted that clarify yielding expectations, as well as etiquette for bicyclists and dog walkers.

County Parks reports that their responses have been successful in reducing user conflicts, although it is difficult to track the success of reducing perception of conflicts.

Santa Clara County Parks Lessons Learned

Design Best Practices

- Design and maintain good sight lines – clearing width and trail curvature should assure a 100-foot average sight distance where possible. If sight distances are less than 100 feet, consider safety signs and reduced speed limits.
- Design a grade rise on both directions at trail junctions and in locations with poor sight lines.
- Build undulating trails to reduce speeds, control water flow, and enhance user experience.
- Provide sufficient width based on level of trail – 6 feet is the minimum width to allow two wheelchairs to pass each other.
- Build a wide tread for passing –where narrower than 8 feet, provide wider turn-out/passing areas at regular intervals or grade a wide bench and allow the shoulders to revegetate, leaving a stable passing area.
- Stripe centerlines on paved paths.

Management Best Practices

- Provide signs at regional trail entrances that state applicable use and management regulations with references to appropriate governing ordinances.
- Place use restrictions on trail entrance bollards.
- Sign and enforce a 15 mph speed limit.

C.3.7 Wake County Parks, Recreation and Open Space, North Carolina

Wake County Parks, Recreation and Open Space Department manages 250 acres and 14 miles of shared-use trails open for hiking, mountain biking, and running. Trail surfaces are mineral surface with some aggregate base stone armoring and wood bridges. The agency acts as a steward of trail resources, guiding maintenance and trail renovation efforts conducted by the Triangle Off Road Cyclists (TORC), which is a volunteer user group who builds and maintains the trails. According to the agreement between Wake County Parks, Recreation and Open Space and TORC, the trails are may not be used by horses and riders, automotive vehicles, all-terrain vehicles, trucks, skateboards, rollerblades, or other types of motorized and non-motorized means of personal transport, except by County approval.

Nature of the Problem

Complaints regarding trail use conflicts can occur between hikers and bikers, mainly due to the volume of mountain biking trips on the trail system (over 100,000 per year). The next most common complaint is between two mountain bikers, mostly resulting from perceived right-of-way and speed issues. Hikers often think the mountain bikers are travelling too fast, but most seem to understand that biking is dominant sector represented on Wake County trails. Incidents are most likely to occur on long hills, but there are conflicts on blind turns and intersections as well.

Trails are designed by the local mountain biking community and some of the existing design flaws are being rectified as the IMBA guidelines used for trail renovations. Improvements relate to both improving the sustainability of the trails and to mitigating user conflicts.

Congestion and overcrowding are weekly phenomena on Wake County trails. Complaints regarding natural resources damage and close calls occur approximately monthly, while incidents and non-injury collisions occur on an annual, less-frequent basis.

Solutions

Wake County Parks, Recreation and Open Space has been designing speed chokes in the trails to manage mountain bikers' speeds. Several key trail intersections are triangular to ease flow in and out and to minimize collisions; flares or Y-shaped intersections create more space when two mountain bikers meet. The specific design tends to be unique to each intersection and is impacted by the geography at the intersection, the orientation of the intersecting trails, and other factors. In addition to wider intersections, grassy medians or berms in the middle of the intersection help channel each mountain bike into a particular direction to avoid the other mountain bike. Other trail design improvements, such as improved site lines, chokes, etc., tend to be implemented during re-routes where the existing trail is closed and re-planted with vegetation. The agency typically looks to IMBA guidelines for many of these designs.

Wake County also posts signs indicating standard right-of-way: "cyclists yield to hikers," "downhill yields to uphill," etc. In light of the volume of mountain biking trips, these tactics seem to be having a positive effect.

To maintain sustainable trails, the department closes trails due to wet conditions. The volume of users dictates that they do this to preserve the trail surface even if designed to optimal standards. One section of trail is in a flat, flood-prone area and has been closed to mountain biking.

Appendix C.

Several rogue trails in the area were built by the freeride, dirt jumping sector of the sport. The park now has a pump track and jump lines to meet the need in a public park as opposed to on private land without the owner's permission.

Wake County Parks, Recreation and Open Space Lessons Learned

Design Best Practices

- Abide by IMBA trail construction standards for all new work completed.
- Design speed chokes in the trails.
- Build triangular intersections at key locations to ease flow in/ out and minimize collisions.

Management Best Practices

- Post signs indicating standard right of way: “cyclists yield to hikers”, “downhill yields to uphill”, etc.
- Built a pump track and jump lines in the public park to provide mountain bikers an alternative to building rogue trails.

C.3.8 City of Durango, Colorado

The City of Durango Department of Parks and Recreation manages 2,245 acres of open space and 286 acres of parks. Their jurisdiction includes an estimated 95 miles of trails, including 83 miles of natural surface and 12 miles of concrete and asphalt hard surface trails. Trails are open to non-motorized uses, including mountain and road bicyclists, walkers, hikers, joggers, roller bladders, and skate boarders.

Nature of the Problem

Trail user conflicts are primarily between pedestrians and mountain bikers. Conflicts tend to be associated with high use of the trails system, and are exacerbated by areas of reduced sight distance and a poor trail etiquette. Hikers have expressed concern about mountain bikers' speed, mountain bikers startling hikers when passing them, and mountain bikers not yielding to hikers on the trail. Most conflicts occur on the hard surface primary trail system (Animas River Trail) due to high utilization. Issues on natural surface trails typically occur on a narrow section of trail that has reduced sight distance.

Congestion on the trails is a regular occurrence, with damage to natural resources from users moving off the trail to allow others to pass occurring weekly. Close calls and complaints occur monthly, and accidents only occur approximately once a year. Another challenge has been free ride bikers, who go out into open space and build wooden ramps or jumps, for free ride trails. They are not satisfied with regular mountain bike trails and are looking for more excitement.

Solutions

The Durango Department of Parks and Recreation has responded to trail user incidents by redesigning and reconstructing hard surface trails to correct poor sight distance and known hazards. Trails are designed in accordance with city standards in addition to applicable state and federal standards (AASHTO and IMBA).

The Department also uses the Colorado State Parks handbook *Planning Trails with Wildlife in Mind* (1998). The Department reports successful outcomes from the reconstruction of hazardous areas on the hard surface trails. For example, they have straightened out curves in the trail, using AASHTO standards resulting in fewer issues.

The primary policy and management campaigns focus on share the trail etiquette and leave no trace principles. The Department has also increased public education and outreach of trail etiquette, in partnership with the local trail advocacy group (Trails 2000). Park Rangers and police officers carry out enforcement activities. They travel on foot on the soft surface trails and are strategically deployed due to a tight budget. The Department utilizes seasonal part-time employees during the warmer months and they tend to deploy rangers to the soft surface trails in response to a specific complaint, such as a homeless camp, an illegally built jump, etc. Education and enforcement is ongoing and has had some success. However, education focusing on bikers yielding to pedestrians on the trail has not had much success.

The Department works closely with the local Trails 2000 group to plan, design, construct and manage trails to reduce user conflicts. Trails 2000 also maintains a current database of volunteers for education about trail use and etiquette. Trails 2000 organizes volunteers to construct and maintain the natural surface trail system. The city has a lot of dialogue with this citizen group on anything trail-related. The Department reports that this joint effort has been extremely beneficial to the community.

In response to free ride bikers building illegal trails, the Department and Trails 2000 has met with group representatives to work on a solution to provide them with more exciting riding opportunities. The Department would like to build them a ramp park on sanctioned area, which the free ride bikers have indicated an interest in

City of Durango Lessons Learned

Design Best Practices

- Reconstruct hard surface trails to correct poor sight distance and known hazards.
- Provide alternative stimulating mountain bike trails to discourage illegal trails and improper riding behavior on shared trails,

Management Best Practices

- Carry out enforcement activities by Park Rangers and Police officers.

Outreach Best Practices

- Partner with local volunteer agency to construct and maintain the trail system and perform outreach about trail use and etiquette.

C.3.9 City of Portland Parks and Recreation, Oregon

Portland Parks and Recreation (PP&R) is the steward of 11,000 acres of land at more than 250 locations including a multitude of community and neighborhood parks, natural areas, recreational facilities, gardens, and trails. The Portland region has an estimated 220 miles of regional trails, though not all are managed by PP&R. PP&R manages both single and shared-use trails, which range from soft surface to paved. Shared-use

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trails include hiking/mountain biking/equestrian, hiking/equestrian, walking/biking, and hiking/mountain biking/equestrian on fire and maintenance roads. Guiding documents include the *Trail Guidelines for Portland's Park System* (2009)² and the *Recreational Trail Strategy* (2006).

Nature of the Problem

PP&R reports that most conflicts relate to high speed users such as bike commuters or road bikers conflicting with walkers and others going a slower pace, mountain bikers conflicting with hikers, and off-leash dogs conflicting with runners. Less-frequently conflicts relate to dogs being off leash in general (conflicts with multiple users), dog owners leaving bags of waste on trails, and mountain bikers using walking and hiking trails.

Trail conflicts occur on all days during all daylight hours, but do tend to occur on trails that are too narrow for all the allowed uses. The factors contributing to incidents include off-trail use (by dog walkers, hikers, mountain bikers), dogs being off leash, and trails being too narrow for the allowed uses and number of people using them. Complaints typically come from pedestrians, hikers, and families.

Solutions

Physical responses to trail user conflicts have included posting various types of signage, including trail etiquette, slow down, and designating allowed uses on the trail. These strategies have met with marginal success. PP&R's *Trail Guidelines for Portland's Park System* (2009) provides design and use standards for all types of single use trails, as well as shared-use trails. The trail type pertinent to this study is Type J: hiking/mountain biking/equestrian trails. The guidelines indicate the equestrians and dog walkers are minor uses on hiking/mountain biking trails, while mountain bikers are not allowed on hiking/equestrian trails. Mountain bikers, equestrians, and hikers are also allowed on fire roads or wider gravel trails.

Type J trails should be 4 feet wide with passing areas at a minimum, 10 feet maximum width. The easement width should be 10 feet in addition to the tread width. The discussion noted that these widths allow side-by-side hiking or riding, or room for on-coming or overtaking trail users. Grades should be 0-5 percent slope or up to 12 percent as needed, but the trail does not have the obstacles desired by expert riders. These trails should be ADA-accessible, although the surface is not reliably firm and slip resistant. Sight distance should be 40 to 100 feet, "depending on speed/flow," and turn radii should be 10 feet minimum.

PP&R recently created a new Ranger position for Forest Park (a 5,000 acre natural area). The Ranger can hold education events and write citations. PP&R is currently developing a volunteer program to educate users about appropriate trail use and etiquette. Overall, staff report not having many enforcement tools because of limited staff and budget.

² Portland Parks & Recreation. 2009. *Trail Guidelines for Portland's Park System*. [atfiles.org/files/pdf/DesignGuidelinesPortland09.pdf](https://files.portlandoregon.gov/documents/2009/01/20090120_PP&R_Trail_Guidelines.pdf)

Portland Parks and Recreation Lessons Learned

Design Best Practices

- Hiking/mountain biking/equestrian trails should be 4 feet wide with passing areas at a minimum, 10 feet maximum width, with 10 feet in addition to the tread for the easement.
- Sight distance on a hiking/mountain biking/equestrian trail should be 40 to 100 feet, “depending on speed/flow,” and on a hiking/equestrian trail is 50 to 100 feet.
- Turn radii on a hiking/mountain biking/equestrian trail should be 10 feet minimum.
- Separate users where possible.

Management Best Practices

- Seek additional resources for enforcement.

C.3.10 City of San Luis Obispo, California

The City of San Luis Obispo (SLO) manages approximately 4,000 acres of land, with over 41 miles of trails. Trails are both natural surface and asphalt, and accommodate walking/hiking, dog walking, bicycling, and horse riding. The Ranger Supervisor estimates that the trail system is used by over 500 people per day, with well over 1,000 users on the weekends.

Nature of the Problem

SLO reports receiving few complaints related to user conflicts, approximately one per year. Complaints submitted tend to be related to conflicts between all types of trail users; people walking their dog off-leash, as well as between hikers and bicyclists, particularly due to speed issues. Conflicts most often occur after work or on the weekend, at areas with poor line of sight or locations where bicyclists can build speed.

The Ranger Supervisor estimates that one reported incident occurs each year, although injuries are less frequent.

Solutions

The City has had success with encouraging bicyclists to utilize bells to inform other users of their presence on trails that allow hiking, horse riding, and mountain biking. SLO teamed with the local Central Coast Concerned Mountain Bikers (CCCMB) club, other local advocacy groups, and local bike shops to provide free bells at trailheads. Starting in Spring 2010, the partnership funded the placement of bell boxes at trailheads with simple language reminding bicyclists to use their bells when passing other trail users. The approximate cost was \$850 for five bell boxes, with the first bell purchase of 250 bells with logos at \$510, which was split with bike shop sponsors. In approximately one year, the program has purchased 3,000 bells. They have received positive response within the bicycling community and from equestrian clubs.

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Members of the partnership feel that, while a culture of cooperation between hikers, equestrians, and mountain bikers preceded the program, it continues to foster positive interactions. In particular, the bells and bell boxes create an opportunity for ongoing dialogue in the trails community.

City of San Luis Obispo Lessons Learned

Outreach Best Practices

- Hold bike bell give-aways.
- Partner with local bicycle clubs, advocacy organizations, and bike shops.

DRAFT

Appendix D. User Group Comments

This appendix outlines the outreach conducted to user groups for this Study. Public comments were submitted during the Notice of Preparation (NOP) of the Road and Trail Change-In-Use Evaluation Process (PEIR). Comments related to user conflicts and safety issues on trails or potential solutions are summarized in the first section of this appendix. This Trail User Conflict Study (Study) also sent a notice of the study to a variety of user groups and professional organizations. The notice is provided in the second part of this appendix, followed by a list of resources and agency references recommended by groups and individuals who responded to the notice.

D.1 NOP Scoping Comments

This section provides a summary of the comments received through the PEIR NOP process, followed by a list of the resources provided by people who made comments, which were included in the Literature Review.

D.1.1 Summary of Comments Related to User Conflicts on Trails

Comments from the PEIR NOP process have been categorized into relevant themes which emerged during the review of the comments, including standards for change in use, desire for public involvement, potential techniques to address these issues, concerns about mountain bikers, concerns about enforcement, and general considerations for multiple uses.

D.1.2 Standards for Change in Use

Several comments ask or state a need for a clear set of criteria to establish when it is appropriate for different users to have access to a given trail (Letter O-5, page 2). Others caution against rigid standards that would not be able to consider the variations in conditions on different trails and at different parks.

Need for Standards

- Unclear of the standards that will be used to evaluate a proposed change.
- Need for criteria/standards determining when a trail is suitable for use by specific groups and for shared-use, including trail width, surface treatments, shoulders, grade, sight lines, bicycle design speed, and steepness of adjacent terrain.
- When analyzing existing trail conditions and possibilities to upgrade specific trail segments, wide variations in local conditions impede the development of rigid parameters for trail width, slope, rise, tread, etc.
- Develop specific standards, but address each change of use on a site by site basis.
- Desire for formalized reporting or recordkeeping on incidents.

Factors to Consider

- Concern that the Change in Use process will only result in more allowable uses. Desire for Change in Use to result in downgrading a trail to fewer user types, or not making any changes.

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- Hiker/horse trails should not become shared-use if any portion of it is unsafe for shared-use, unless such portions are improved to address this problem.
- Preferred alternative should balance user demands, environmental protection, mitigation and allocation of resources. Consider ratio of miles to size of user group. Inventory trail system so parks can make optimal decisions.
- Assure that the environment, user safety and the quality of the nature experience are all protected.
- Consider the impact of change of use on biological resources; what mitigation will be put in place? Can these be achieved in light of current state budgetary problems?

D.1.3 Public Involvement

- Give public advance notice on specific changes of use.
- Requests better publicizing of meetings, including local newspapers.
- All trail users, including major trail organizations, should be notified of prospective trail changes. Meetings should be arranged at times when people can attend.
- Supports the change in use concept to more effectively manage user conflicts. Concerned about a lack of a mechanism to notify public of proposed changes in use. Will decision-making process and analysis become part of public record? Some way for parties to check the decision-making process.

D.1.4 Potential Techniques to Address Conflict and/or Safety

People offer specific ideas for mitigating safety issues and user conflicts. Examples include the following:

- Signage
- Education
- Speed enforcement
- User etiquette
- Trail management to separate users
- Parallel option to accommodate different user types¹
- Place traffic calming devices in the trail
- Alternating use days
- One-way trails
- Designating uphill-only routes
- Encourage connections with the community through trail stewardship, collaboration and volunteerism
- Consider social and economic indicators² as well as public safety when measuring impacts
- User input via surveys is important to reducing conflicts

¹ As separate from the provision for “major realignment” noted in the checklist

² Social and economic effects can be indicators of significant impacts that might otherwise go unaddressed in an EIR, as recognized in the CEQA guidelines at section 15131.

D.1.5 Concerns about Mountain Bikes

Several people commend this effort to consider allowing mountain bikes on additional trails, though many people who provided comments expressed their concern that mountain bikes on trails harms the natural environment, the experience of other users and drives some users off of the trails all together.

One commenter recognizes that there are many reasons for unauthorized trail use by mountain bikers, including cyclists being arbitrarily excluded from trails, failure to provide desired trails, or the need for more legitimate trail access. In most cases, unauthorized trail use will not be diminished unless the root causes are identified and dealt with in a constructive manner (Letter O-9, page 3).

Commends the change in use effort

- Supports the change in use program. Mountain biking is positive for the community, involves youth in the outdoors. Mountain bikers also want to see the nature in the forests and mountains preserved in their natural state.
- Consider potential benefits of the change of use, such as: reducing vehicle trips if, by opening a trail for additional uses, more visitors have direct park access without the need for a vehicle; reducing the number of interactions between trail users on any individual route by distributing park visitors over a broader area; increasing the pool of volunteers available for trail maintenance, monitoring and restoration.
- To the extent possible, impacts of additional users should be based on available scientific data. Consider per capita impact of mountain bikes vs. other users. Also opening a trail to mountain bikes may cause mountain bike use of other trails in the park to decrease.

Incompatibility with other users

- Speed differential of mountain bicyclists discourages trail use by equestrians and hikers, high speeds lead to inability to stop for other users and spooks horses.
- Mountain bikes are driving off horses, hikers and elderly trail users.
- Extremely concerned that historical users who travel by foot will be displaced if non-motorized vehicles are allowed on foot paths.
- Proposed change in use document appears biased in favor of mountain bikers as compared to the traditional trail user public.

Types of trails

- Fire roads are appropriate for mountain biker use due to adequate width.
- Mountain bikes should only be allowed on wide trails intended for their use. Good lines of site are essential.
- Minimum requirements of well designed shared-use trails should be at least a 72 inch width, good visibility and no blind corners to accommodate room for all users.
- Should continue to share vehicular width roads with bikes, but keep them off other trails.

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- Provide a diversity of trail experience for mountain bicyclists; Mountain bikes should not be limited to flat, smooth, obstacle-free trails; Changes should consider equity, diversity of trail experience and connectivity.

D.1.6 Enforcement

Many people point out that there is a danger of new rules being ineffective if there is not budget to enforce them.

- Consider the need for enforcement and the likelihood of it taking place before implementing new rules.
- Concerns about mountain bicyclists not adhering to alternate day or signed exclusions without clear means of enforcement.
- Consider making it a criminal offense with significant penalties to discourage destructive bike riders from continued use of public parks, if there were funds for patrolling and enforcement.
- Desire for an enforceable way of managing the large volume of users on trails.
- Solutions should consider the reality of local budgets, and that there is little money available for maintenance and enforcement. Therefore, consider building separate trails for mountain bikes.

D.1.7 General Considerations of Different Users

Several comments request the consideration of differences in how different groups use trails (i.e., distance traveled, seasonal users, etc.) when developing solutions. Furthermore, different users have different ideas of what they would like their trail experience to be (i.e., hikers wanting a quiet natural experience free of motorized or mountain bikes).

- Draw a distinction between urban and remote parks – considering the distance different user types penetrate a trail system in a given amount of time.
- Recognize seasonal use and off-season use of trails (e.g., hunters in the fall, ski trails in the winter, etc.).
- Address impact of changes of use on user experience by different user types and site conditions (desired aesthetic experiences).

D.1.8 References and Attachments Provided in NOP Comment Letters

The following is a list of references recommended and provided in comment letters. These resources are included in the Literature Review discussed in Appendix B.

- Impact of Mountain Biking - Palos Verdes Nature Preserve, compiled by Lynn Brown.
- Article “Trail Wars at Annadel State Park” dated July 6, 2010
- Summary of personal reports of incidents involving bikers, compiled from Park Watch.org
- CET&LC Safety Considerations for Multi-use Trails.
- Motion to Intervene, Lake Oroville Relicensing, Federal Energy Regulatory Commission, March 31, 2006
- Hoger & Chavez (1998). Conflict and management tactics on the trail. *Parks & Recreation*, 33(9), 41-49.
- Moore, (1994). Conflicts on Multiple-Use Trails: Synthesis of Literature and State of Practice. Washington, D.C.: Federal Highway Administration.
- Ramthum (1995). Factors in user group conflict between hikers and mountain bikers. *Leisure Sciences*, 17(3), 159-170
- Schneider (2000). Revisiting and revising recreation conflict research. *Journal of Leisure Research*, 32(1), 129-132.
- Vaske, Donnelly, Karin & Laidlaw (1995). Interpersonal versus social-values conflict. *Leisure Sciences*, 17(3), 205-222
- Marion & Wimpey, (2007). Environmental Impacts of Mountain Biking: Science Review and Best Practices. Originally published in *Managing Mountain Biking: IMBA's Guide to Providing Great Riding* (2007).
- Bjorkman, Alan. 1996. Off Road Bicycle and Hiking Trail User Interactions: A Report to the Wisconsin Natural Resources Board. Wisconsin Department of Natural Resources: Bureau of Research.
- Chiu, Luke and Kriwoken, Lorne. Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia. *Annals of Leisure Research*, (in press).
- Crockett, Christopher S. 1986. Survey of Ecological Impact Considerations Related to Mountain Bicycle Use on the Edwards Field Trail at Joseph D. Grant County Park. Santa Clara County (CA) Parks Department.
- Gander, Hans and Ingold, Paul. 1996. Reactions of Male Alpine Chamois *Rupicapra r. rupicapra* to Hikers, Joggers and Mountain Bikers. *Biological Conservation* 79:107 - 109.
- Goeft, Ute and Alder, Jackie. 2001. Sustainable Mountain Biking: A Case Study from the Southwest of Western Australia. *Journal of Sustainable Tourism* 9(3): 193 - 211.

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- Herrero, Jake and Herrero, Stephen. 2000. Management Options for the Moraine Lake Highline Trail: Grizzly Bears and Cyclists.
- Papouchis, Christopher M. and Singer, Francis J. and Sloan, William. 2001. Responses of Desert Bighorn Sheep to Increased Human Recreation. *Journal of Wildlife Management* 65(3): 573 - 582.
- Spahr, Robin. 1990. Factors Affecting the Distribution of Bald Eagles and Effects of Human Activity on Bald Eagles Wintering Along the Boise River. Boise State University.
- Taylor, Audrey R. and Knight, Richard L. 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications* 13(4): 951 - 963.
- Thurston, Eden and Reader, Richard J. 2001. Impacts of Experimentally Applied Mountain Biking and Hiking on Vegetation and Soil of a Deciduous Forest. *Environmental Management* 27(3): 397 - 409.
- Weesner, Meg. 2003. Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona, National Park Service.
- Wilson, John P. and Seney, Joseph. 1994. Erosional Impacts of Hikers, Horses, Motorcycles and Off-Road Bicycles on Mountain Trails in Montana. *Mountain Research and Development* 47(1): 77 - 88.
- Environmental Impacts of Mountain Biking: Science Review and Best Practices. <http://www.imba.com/resources/research/trail-science/environmental-impacts-mountain-biking-science-review-and-best-practices>. By Jeff Marion and Jeremy Wimpey. 2007.
- <http://www.imba.com/resources/research/environmental-impacts>
- <http://www.imba.com/resources/research/trail-science/environmental-impacts-mountain-biking-science-review-and-best-practices>
- www.americantrails.org

D.1.9 Study Notice

A notice of the study and solicitation for additional objective documents and data on the subject was sent to the people who signed in at the PEIR scoping sessions as well as the groups noted in Table D-1. The notice is provided, as well as a list of resources and agency references recommended by respondents.

Table D-1. Solicitation Notice Outreach

Group	Method
American Trails website	Posted
Association of Pedestrian and Bicycle and Professionals (APBP)	E-mail to list serve
Individuals who signed into the NOP scoping workshops	E-mailed
International Mountain Bicycling Association (IMBA)	E-mailed to staff
Rails-to-Trails Conservancy (RTC)	Sent in member April e-newsletter
Responsible Organized Mountain Peddlers (ROMP)	E-mailed to staff
Sierra Club	E-mailed to staff

Notice

The study notice is provided on the following pages.

• NOTICE •




California Department of Parks and Recreation Seeks Trail Conflict/Safety Data and Documents




The Department is conducting a Statewide Roads and Trails Change-in-Use Program Programmatic Environmental Impact Report (PEIR). We are conducting background research regarding trail use conflict and safety issues and solutions.

We are seeking hard data and documented practices, including success stories and failures. **THIS IS NOT A TRAIL USER OPINION SURVEY**; rather it is an attempt to find the most complete and objective documentation of the issues, and the best practices for addressing them. **The goal is to complete the research collection and document review by April 30, 2011.**

We have already received several references and resources on this topic from those who commented on the scope for the PEIR (listed in Attachment A). Attachment B presents our initial working list of reference documents and data (it may duplicate some resources in Attachment A). We would like any other study, strategy, contact, or other source of information on techniques for managing multiple user types on trails and shared-use paths.

Additional data, documents, or suggestions, or questions about the research should be directed to Hannah Kapell, Research Coordinator: hannahkapell@altaplanning.com or (510) 540-5008 x111.

Attachment A: References and Attachments Provided in NOP Comment Letters

NOP Comment Letter O-5 Attachments:

- D. Impact of Mountain Biking - Palos Verdes Nature Preserve, compiled by Lynn Brown.
- E. Article "Trail Wars at Annadel State Park" dated July 6, 2010
- F. Summary of personal reports of incidents involving bikers, compiled from Park Watch.org
- G. CET&LC Safety Considerations for Multi-use Trails.
- H. Motion to Intervene, Lake Oroville Relicensing, Federal Energy Regulatory Commission, March 31, 2006

NOP Comment Letter O-9:

For additional consideration of trail conflict and the research conducted on its causes and solutions, please refer to the following sampling of studies:

- Hoyer & Chavez (1998). Conflict and management tactics on the trail. *Parks & Recreation*, 33(9), 41-49.
- Moore, (1994). Conflicts on Multiple-Use Trails: Synthesis of Literature and State of Practice. Washington, D.C.: Federal Highway Administration.
- Ramthun (1995). Factors in user group conflict between hikers and mountain bikers. *Leisure Sciences*, 17(3), 159-170
- Schneider (2000). Revisiting and revising recreation conflict research. *Journal of Leisure Research*, 32(1), 129-132.
- Vaske, Donnelly, Karin & Laidlaw (1995). Interpersonal versus social-values conflict. *Leisure Sciences*, 17(3), 205-222

Some examples of research conducted that compare the effects of bicyclists with other trail users:

- Marion & Wimpey, (2007). Environmental Impacts of Mountain Biking. Science Review and Best Practices. Originally published in Managing Mountain Biking: IMBA's Guide to Providing Great Riding (2007).
- Bjorkman, Alan. 1996. Off Road Bicycle and Hiking Trail User Interactions: A Report to the Wisconsin Natural Resources Board. Wisconsin Department of Natural Resources: Bureau of Research
- Chiu, Luke and Kriwoken, Lorne. Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia. *Annals of Leisure Research*, (in press).
- Crockett, Christopher S. 1986. Survey of Ecological Impact Considerations Related to Mountain Bicycle Use on the Edwards Field Trail at Joseph D. Grant County Park. Santa Clara County (CA) Parks Department.

- Gander, Hans and Ingold, Paul. 1996. Reactions of Male Alpine Chamois *Rupicapra r. rupicapra* to Hikers, Joggers and Mountainbikers. *Biological Conservation* 79:107 - 109.
- Goeft, Ute and Alder, Jackie. 2001. Sustainable Mountain Biking: A Case Study from the Southwest of Western Australia. *Journal of Sustainable Tourism* 9(3): 193 - 211.
- Herrero, Jake and Herrero, Stephen. 2000. Management Options for the Moraine Lake Highline Trail: Grizzly Bears and Cyclists.
- Papouchis, Christopher M. and Singer, Francis J. and Sloan, William. 2001. Responses of Desert Bighorn Sheep To Increased Human Recreation. *Journal of Wildlife Management* 65(3): 573 - 582.
- Spahr, Robin. 1990. Factors Affecting The Distribution Of Bald Eagles And Effects Of Human Activity On Bald Eagles Wintering Along The Boise River. Boise State University.
- Taylor, Audrey R. and Knight, Richard T. 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications* 13(4): 951 - 963.
- Thurston, Eden and Reader, Richard J. 2001. Impacts of Experimentally Applied Mountain Biking and Hiking on Vegetation and Soil of a Deciduous Forest. *Environmental Management* 27(3): 397 - 409.
- Weesner, Meg. 2003. Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona, National Park Service.
- Wilson, John P. and Seney, Joseph. 1994. Erosional Impacts of Hikers, Horses, Motorcycles and Off-Road Bicycles on Mountain Trails in Montana. *Mountain Research and Development* 47(1): 77 - 88.

NOP Comment Letter O-11 attachments/links:

- Environmental Impacts of Mountain Biking: Science Review and Best Practices. <http://www.imba.com/resources/research/trail-science/environmental-impacts-mountain-biking-science-review-and-best-practices>. By Jeff Marion and Jeremy Wimpey. 2007.
- <http://www.imba.com/resources/research/environmental-impacts>
- <http://www.imba.com/resources/research/trail-science/environmental-impacts-mountain-biking-science-review-and-best-practices>

NOP Comment Letter I-14:

- www.americantrails.org (provides information on environmental impacts caused by various user groups)

Attachment B: Resources Collected to Date

Author	Org/Agency	Title
AASHTO	AASHTO	Guide for the Development of Bicycle Facilities
Alta Planning & Design	East Bay Regional Park District	DRAFT Narrow Natural Surface Trails Managing Multiple Use
Bjorkman, Alan	Wisconsin Bureau of Natural Resources; Bureau of Research	Off Road Bicycle and Hiking Trail User Interactions: A Report to the Wisconsin Natural Resources Board
Bondurant, J., L.Thompson et. Al.	N/A	Trail Planning for California Communities
Brown, Lynn	?	Impact of Mountain Biking – Palos Verdes Nature Preserve
CA State Parks	CA State Parks	Park Watch Reports for Folsom Lake Pioneer Express Trail
CA State Parks	CA State Parks	California Recreational Trails Plan
CA State Parks	CA State Parks	Best Management Practices For Road Rehabilitation: Road to Trail Conversion
CA State Parks	CA State Parks	State Parks Policy on Roads and Trails Change in Use
CA State Parks	CA State Parks	Trail Manager's Toolbox
California Equestrian Trails & Lands Coalition	California Equestrian Trails & Lands Coalition	Safety Considerations for Multi-use Trails
Caltrans	Caltrans	Bikeway Planning and Design
Caltrans	Caltrans	Manual on Uniform Traffic Control Devices
Caltrans	Caltrans	Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedure
Carothers, P., J. Vaske, & M. P. Donnelly		Social values versus interpersonal conflict among hikers and mountain bikers
Cesford, G.R.	International Mountain Bike Association	Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand
Chiu, Luke and Kriwoken, Lorne		Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia
Coalition for the Capitol Crescent Trail	Coalition for the Capitol Crescent Trail	Capitol Crescent Trail User Survey
Cole, David H.	Aldo Leopold Wilderness Research Institute	Visitor and Recreation Impact Monitoring: Is it Lost in the Gulf Between Science and Monitoring?
Crockett, Christopher S.	Santa Clara County (CA) Parks Dept.	Survey of Ecological Impact Considerations Related to Mountain Bicycle Use on the Edwards Field Trail at Joseph S. Grant County Park
FERC	FERC	Notice of Motion, Motion to Intervene, Protest and Comments...
FHWA	FHWA	BIKESAFE Website
FHWA	FHWA	Evaluation of Safety, Design and Operation of Shared Use Paths: Final Report
Gander, Hans and Ingold, Paul		Reactions of Male Alpine Chamois (<i>Rupicapra rupicapra</i>) to Hikers, Joggers and Mountain Bikers
General Manager of Engineering Services	City of Vancouver, BC	Speed Limits on Recreational Bicycle Paths
Goedt, Ute and Alder, Jackie		Sustainable Mountain Biking: A Case Study from the Southwest of Western Australia
Hoger & Chavez		Conflict and management tactics on the trail
Jackson, S. A., Haider, W., & Elliot, T.		Chilkoot Trail National Historic Site, British Columbia
Jellum, C. M.	Central Washington University	Managing Mountain Bike Recreation and User Conflicts: A Case Study on Mt. Baker-Snoqualmie National Forest, Washington State
Johnson, Julie		Trail users at Annapolis State Park
Litman, Tod	bicyclinginfo.org	Share the Trail: Minimizing User Conflicts on Non-Motorized Facilities
MN Dept of Natural Resources	MN Dept of Natural Resources	Trail Planning, Design, and Development Guidelines
Moore, B. I.	Federal Highway Administration	Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice
Papouchis, Christopher M. and Singer, Francis J. and Sloan, William		Responses of Desert Bighorn Sheep To Increased Human Recreation
Ramthun		Factors in user group conflict between hikers and mountain bikers
Reynolds, C., M. Harris, K. Teschke, P. Cription, and M. Winters.	N/A	The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: A Review of the Literature
Rodgers, G.B.		Factors Associated with the Crash Risk of Adult Bicyclists
Ryan, K.L. (Ed)	N/A	Trails for the Twenty-First Century
Schneider		Revisiting and redesign recreation conflict research

Appendix D.

Author	Org/Agency	Title
Spahr, Robin	Boise State University	<i>Factors Affecting The Distribution Of Bald Eagles And Effects Of Human Activity On Bald Eagles Wintering Along The Boise River</i>
Stearns, R., B. Woodcock & J. Pflaum	National Trails Training Partnership	<i>Trail Maintenance and Management: We Built It and They Came</i>
Taylor, Audrey R. and Knight, Richard L.		<i>Wildlife Responses to Recreation and Associated Visitor Perceptions</i>
Thurston, Eden and Reader, Richard J.		<i>Impacts of Experimentally Applied Mountain Biking and Hiking on Vegetation and Soil of a Sensitive Forest</i>
Tinsworth, D., S. Cassidy, C. Polen		<i>Bicycle-related injuries: Injury, hazard, and risk patterns</i>
Transportation Research Board	Transportation Research Board	<i>Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedures</i>
Transportation Alternatives	Transportation Alternatives	<i>The 15-Mile-Per-Hour Cycling Speed Limit</i>
USDA USFS	USDA USFS	<i>Trail Construction and Maintenance Notebook</i>
Vaske, Donnelly, Karin & Laidlaw		<i>Interpersonal versus social-values conflict</i>
Webber, P. (Ed)	International Mountain Bike Association	<i>Managing mountain biking: IMA's guide to providing great riding</i>
Weesner, Meg	National Park Service	<i>Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona</i>
Wilson, John P. and Seney, Joseph		<i>Erosional Impacts of Hikers, Horses, Motorcycles and Off-Road Bicycles on Mountain Trails in Montana</i>
International Mountain Bike Association	International Mountain Bike Association	<i>Trail Solutions: IMA's Guide to Building Sweet Singletrack</i>
Sprung, Gary	International Mountain Bike Association	<i>Natural Resource Impacts of Mountain Biking: A summary of scientific studies that compare mountain biking to other forms of trail travel</i>
Marion, Jeff & Jeremy Wimpey	International Mountain Bike Association	<i>Environmental Impacts of Mountain Biking: Science Review and Best Practices</i>
Wimpey, Jeremy	International Mountain Bike Association	<i>Environmental Impacts of Mountain Biking: Science Review and Best Practices</i>

D.2 Comments Received

Table D-2 lists the agencies and trails that user groups or individuals recommended for inclusion in the Agency Survey. Table D-3 following lists the literature sources recommended.

Table D-2. Agencies Recommended by User Groups and Individuals

Source	Affiliation	Agency
Macdonald, Stewart	American Trails Magazine	Jefferson County, CO
Macdonald, Stewart	American Trails Magazine	ROMP www.romp.org
Macdonald, Stewart	American Trails Magazine	Griffith Park, Los Angeles, CA
Macdonald, Stewart	American Trails Magazine	East Bay Municipal Utility District
Macdonald, Stewart	American Trails Magazine	East Bay Regional Parks District
Cohen, Laura	Rails-to-Trails Conservancy	Rivers, Trails & Conservation Assistance Program, National Park Service, Barbara Rice
Cohen, Laura	Rails-to-Trails Conservancy	East Bay Area Trails Council
Cohen, Laura	Rails-to-Trails Conservancy	East Bay Regional Park District, Jim Townsend
Sullivan, Jim	Responsible Organized Mountain Pedalers (ROMP)	City of Palo Alto Lester Hodges,, Supervising Ranger Lester.Hodgins@cityofpaloalto.org
Sullivan, Jim	Responsible Organized Mountain Pedalers (ROMP)	Golden Gate National Recreation Area, National Park Service, George Durgerian, Park Ranger, Public Affairs & Special Events
Sullivan, Jim	Responsible Organized Mountain Pedalers (ROMP)	Enid Pearson Arastradero Preserve, Palo Alto
Bernhardt, Chris	International Mountain Bicycling Association (IMBA)	Garrett Villanueva, Lake Tahoe Basin Management Unit
Bernhardt, Chris	International Mountain Bicycling Association (IMBA)	Rob Perrin, BLM
Bernhardt, Chris	International Mountain Bicycling Association (IMBA)	Jeremy Wimpey, PhD, Applied Trails Research
Bernhardt, Chris	International Mountain Bicycling Association (IMBA)	Jim Schmid, USFS
Bernhardt, Chris	International Mountain Bicycling Association (IMBA)	Woody Keen, Trail Dynamics

Table D-3. Literature Recommended by User Groups and Individuals

Source	Affiliation	Resource/Publication
Macdonald, Stewart	American Trails Magazine	Moore, R. L. 1994. <i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>
Vandeman, Michael		Vandeman, Michael 2004. <i>The Impacts of Mountain Biking on Wildlife and People -- A Review of the Literature.</i>
Vandeman, Michael		City of St. Louis Board of Public Service. 2008. <i>Forest Park - Access, Circulation, and Parking Study</i>
Vandeman, Michael		Vandeman, Mike. No Date. <i>Letter to author of the paper, "Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreation Area"</i>
Vandeman, Michael		Vandeman, Mike. 2006. <i>A Critique of "A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S." (White et al 2006).</i>
Brown, Lynn	Equestrian Trails Inc.	Mountain Bike Task Force for the City of Los Angeles. 2000. <i>Majority Report.</i>
Beyaert, Bruce	Trails for Richmond Action Committee (TRAC)	California Public Resources Code, <i>Section 5850(e)</i>
Beyaert, Bruce	Trails for Richmond Action Committee (TRAC)	Zero Motorcycles, http://www.zeromotorcycles.com/
Zerger, Cindy	Center for Changing Landscapes	Center for Changing Landscapes and the Department of Forests. 2011. <i>Minnesota's Network of Parks & Trails.</i>
Zerger, Cindy	Center for Changing Landscapes	Associate Dean Greg Lindsey of the Humphrey School http://www.hhh.umn.edu/people/glindsey/index.html
Zsutty Yves	Trail Manager, City of San Jose, Department of Parks, Recreation & Neighborhood Services	City of San Jose. 2011. <i>Council Agenda 03-29-11: Trail Safety Enhancements.</i>
Zsutty Yves,	Trail Manager, City of San Jose, Department of Parks, Recreation & Neighborhood Services	City of San Jose Trail Program. 2010. <i>Trail Signage Guidelines</i>
Bible, Sue		American Competitive Trail Horse Assoc site -- www.actha.us
Bible, Sue		www.perfecthorse.com
Villwock-Witte, Natalie	Research Scientist, Western Transportation Institute	Moore, R. L. 1994. <i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>
Koontz, Clif	Program Director, Ride with Respect	Moore, R. L. 1994. <i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>
Koontz, Clif	Program Director, Ride with Respect	Koontz, C. R. 2005. <i>Recreational Trail Conflict: Achieving Equity Through Diversity</i>
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Weir, Donald. . <i>A Guide to the Impacts of Non Motorized Trail Use.</i> Don Weir and Associates- Edmonton Alberta Canada.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Lanz, Michael. 2001. <i>Trail Shock.</i> AMC Outdoors Magazine, April 2001.

Source	Affiliation	Resource/Publication
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Colorado State Parks. 1997. <i>Trails and Wildlife Bibliography</i> . Colorado State Parks, Trails Program.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Goldstein, S. S. 1987. <i>Mountain Bikes and the Parks: Mitigation of Safety and User Conflict Problems</i> . Unpublished undergraduate paper.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Santa Clara County. 1989. <i>Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks</i> .
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Sloan, D. and T. Fletcher (editors). 1989. <i>Environmental Management for the East Bay</i> . Report of the Environmental Sciences Senior Seminar.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Ford, R. 1989. <i>Mountain Bike Survey Update</i> . Unpublished Report, Santa Barbara Ranger District, Los Padres National Forest.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Keller, K.D. 1990. <i>Mountain bikes on public land: A manager's guide to the state of the practice</i> . Washington DC: Bicycle Federation of America.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Pearce, Brian. 1990. <i>Mountain Biking on the Niagara Escarpment</i> . University of Waterloo Faculty of Environmental Studies, School of Urban and Regional Planning.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Watson, A.E., D.R. Williams and J. J. Daigle. 1991. <i>Sources of Conflict Between Hikers and Mountain Bike Riders in the Rattlesnake NRA</i> . Journal of Park and Recreation Administration 9: 59-71.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Kulla, Andy. 1991. <i>A New Perspectives Approach in National Forest Recreation and its Application to Mountain Bike Management</i> .
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	North Carolina Division of Parks and Recreation. 1993. <i>Results of the Two Year Mountain Bicycle Trail Study</i> . North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Hollenhorst, S. J., Schuett, M. A., Olson, D. & Chavez, D. 1995. <i>An Examination of the Characteristics, Preferences, and Attitudes of Mountain Bike Users of the National Forests</i> . Journal of Park and Recreation Administration, 13(3): 41-51.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Hollenhorst, Schuett and Olsen. 1995. <i>A National Study of Mountain Biking Opinion Leaders: Characteristics, Preferences, Attitudes and Opinions</i> .
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Cessford, G.R. 1995. <i>Off-Road Impacts of Mountain Bikes: A Review and Discussion</i> . Science and Research Series no. 92.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Chavez, D. J. 1996. <i>Mountain Biking: Issues and Actions for USDA Forest Service Managers</i> . Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	<i>Trends</i> US Department of Interior, NPS, National Recreation and Park Association, Special Issue on Mountain Biking Management and Research, 34(3), 1997
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Symmonds, M. C., W.E. Hammit and V. L. Quisenberry. 2000. <i>Managing Recreational Trail Environments for Mountain Bike User Preferences</i> . Environmental Management 25(5): 549-571.

Appendix D.

Source	Affiliation	Resource/Publication
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Hendricks, Ramthum and Chavez. 2000. <i>Mountain Bicyclists' Behavior in Social Trail Etiquette Situations</i> . Kyle, Gerard, comp., ed. 2000. Proceedings of the 1999 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 194-198.
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Rothman. 2001. <i>The War of the Future</i> . The George Wright Forum 18(1).
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Locke, Justin. No Date. <i>Access to our Public Lands: Mountain Bikes, the Concept of Public Ownership, and the Fatal Flaw in Bicycle Trails Council of Marin v. Babbitt</i> .
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	Cessford, G.R. 2002. <i>Monitoring and Management of Visitor Flows in Recreational and Protected Areas</i> . .
Jim Hasenauer	International Mountain Bicycling Association (IMBA)	J. L. Marion. 2006. <i>Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreational Area</i> . NPS. USGS Patuxent Wildlife Research Center, Cooperative Park Studies Unit, Virginia Tech Dept. of Forestry.

Appendix E. **Annotated Bibliography**

This appendix summarizes literature relevant to the subject of trail user conflicts or safety issues. Each summary includes a brief description of the study, including background on the researcher, affiliated organizations, or other available impetus or context for the study. The discussion also notes which groups tend to cite the article, whether it is posted or referenced from a user group website. All articles in the academic category are peer-reviewed. Key information from each document is provided, as well as the critique of the document, as described below.

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Table E-1. Summary of Sources Included in Literature Review

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
Federal								
1	AASHTO	<i>Guide for the Development of Bicycle Facilities</i>	1999		AASHTO			
2	Bowker, J. M., and D. B. English	<i>Mountain Biking at Tsali: An Assessment of Users, Preferences, Conflicts, and Management Alternatives</i>	2002	U.S. Department of Agriculture Forest Service, Southern Research Station. General Technical Report SRS-59	US Forest Service	http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs059.pdf		
3	Chavez, D. J.	<i>Mountain Biking: Issues and Actions for USDA Forest Service Managers</i>	1996a	Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.	US Forest Service	http://www.fs.fed.us/psw/publications/documents/psw_rp226/p_sw_rp226.pdf	User rec	IMBA
4	FHWA	<i>Evaluation of Safety, Design and Operation of Shared Use Paths: Final Report</i>	2006		FHWA	http://www.fhwa.dot.gov/publications/research/safety/pedbike/05137/		
5	FHWA	<i>BIKESAFE Website</i>	No Date		FHWA	http://www.bicyclinginfo.org/bikesafe/		
6	Hendricks, Ramthum and Chavez	<i>Mountain Bicyclists' Behavior in Social Trail Etiquette Situations</i>	2000	Proceedings of the 1999 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.	Wildland Recreation and Urban Cultures Research Unit of the Pacific Southwest Research Station	Hard copy provided by user	User rec	IMBA
7	Hesselbarth, W., B. Vachowski, M. Davies	<i>Trail Construction and Maintenance Notebook</i>	2007	FHWA and United States Forest Service, FSH2309.18	US Forest Service	http://www.fhwa.dot.gov/environment/fspubs/07232806/toc.htm		

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ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
8	Hollenhorst, S. J., Schuett, M. A., Olson, D. & Chavez, D.	<i>An Examination of the Characteristics, Preferences, and Attitudes of Mountain Bike Users of the National Forests</i>	1993	Journal of Park and Recreation Administration, 13(3): 41-51			User rec	IMBA
9	Kulla, A.	<i>A New Perspectives Approach in National Forest Recreation and its Application to Mountain Bike Management</i>	1991	Ohio State University's Professional Development for Outdoor Recreation Managers/Planners Shortcourse	Lolo National Forest	Hard copy provided by user	User rec	IMBA
10	Moore, R. L.	<i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>	1994		FHWA	www.americantrails.org/resources/ManageMaintain/MooreConflictMgmt.html	User rec	IMBA
11	National Park Service, Department of the Interior	<i>Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona</i>	2003		National Park Service			
12	Rouphail, N. J. Hummer, J. Milazzo II, P. Allen.	<i>Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedure</i>	1998		FHWA	http://katana.hsrc.unc.edu/cms/downloads/CapacityAnal_PedBike_SignalizedIntersections.pdf		
13	Sprinkle Consulting	<i>Characteristics of Emerging Road and Trail Users and Their Safety.</i>	2004		FHWA-HRT-04-103, Federal Highway Administration, McLean, VA, October 2004.	http://www.fhwa.dot.gov/publications/research/safety/04104/roadstechbrief.pdf		
14	Tuler, S., Golding, D., Krueger, R.J.	<i>A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System</i>	2002	George Perkins Marsh Institute, Clark University, MA	National Park Service	http://www.californiatrills.org/documents/NationalParkServiceSafety.pdf		

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
15	USFS	<i>Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds</i>	2007	0723-2816-MTDC	In cooperation with FHWA	http://www.fhwa.dot.gov/environment/fspubs/07232816/pdf/07232816dpi72all.pdf		
General								
16	Birkny, R. C.	<i>Lightly on the Land: The SCA Trail-Building and Maintenance Manual</i>	1996			-		
17	Flink, C. A., and R. M. Searns	<i>Greenways: A Guide to Planning, Design and Development</i>	1993	Washington, D.C.: Island Press.				
18	Flink, C., Olka, K., Searns, R., Rails-to-Trails Conservancy	<i>Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails</i>	1993	Washington, D.C.: Island Press.	Island Press			
19	MN Dept of Natural Resources	<i>Trail Planning, Design, and Development Guidelines</i>	2006	St. Paul, MN: State of Minnesota.	MN Dept of Natural Resources			
20	North Carolina Division of Parks and Recreation	<i>Results of the Two Year Mountain Bicycle Trail Study</i>	1993	North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources		Hard copy provided by user	User rec	IMBA
21	Parker, T. S.	<i>Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails</i>	2004	Boulder, CO: Natureshape.				

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
State								
22	Bondurant, J., L.Thompson et. al.	<i>Trail Planning for California Communities</i>	2009	Solano Press Books				
23	CA State Parks	<i>California State Parks Accessibility Guidelines</i>	2005					
24	Caltrans	<i>Highway Design Manual Chapter 1000: Bikeway Planning and Design</i>	2009	California Highway Design Manual (2009): 1000	Caltrans	http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm		
25	Caltrans	<i>Manual on Uniform Traffic Control Devices</i>	2011		Caltrans	http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd2011_draftrevisions.htm		
Local								
26	Anderson, D.H., Lime, D. W., and T.L. Wang	<i>Maintaining the Quality of Park Resources and Visitor Experiences</i>	1998	St. Paul: University of Minnesota Extension Service.	University of Minnesota	http://cpsp.cfans.umn.edu/publications/revtactics_handbook.pdf		
27	Bauer, M.	<i>Recreation Conflict at Six Boulder County Parks and Open Space Properties: a Baseline Study</i>	2004		Boulder County Parks and Open Space	http://www.californiatrills.org/documents/ConflOutdoorRec2.pdf		
28	Chiu, Luke and L. Kriwoken	<i>Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia</i>	2003	Annals of Leisure Research. 6:4, 339-361	University of Tasmania, Australia	http://eprints.utas.edu.au/2948/1/Managing Recreational Mountain Bike.pdf		IMBA
29	City of Portland Parks & Recreation	<i>Trail Design Guidelines for Portland's Park System</i>	2009		City of Portland, OR	atfiles.org/files/pdf/DesignGuidelinesPortland09.pdf		

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
30	City of San Jose	<i>Council Agenda 03-29-11: Trail Safety Enhancements</i>	2011			http://www.sanjoseca.gov/clerk/Agenda/20110329/20110329_0501.pdf	User rec	
31	City of San Jose Trail Program	<i>Trail Signage Guidelines</i>	2010			http://www.sjparks.org/Trails/Reports/TrailSignageGuidelines_low-res.pdf	User rec	
32	City of St. Louis Board of Public Service	<i>Forest Park - Access, Circulation, and Parking Study</i>	2008		City of St. Louis Board of Public Service	http://stlouis.missouri.org/citygov/parks/forestpark/ParkingReport.pdf	User rec	
33	City of Vancouver, B.C. General Manager of Engineering Services	<i>Speed Limits on Recreational Bicycle Paths</i>	1995		City of Vancouver, BC	http://vancouver.ca/ctyclerk/ccleark/951207/vtc1.htm		
34	East Bay Regional Parks District (EBPRD)	<i>Narrow Natural Surface Trails Managing Multiple Use</i>	2011			http://www.ebparks.org/files/ebpdpd/Narrow_Trail_Study_FINAL_03_24_2011.pdf		
35	Midpeninsula Regional Open Space District	<i>Trail Use Guidelines and Mitigation Measures</i>	1993			-		
36	Mosedale, J.	<i>Mountain Biking in the Canadian Rocky Mountains: A situational analysis</i>	2002	The Canadian Environmental Network		-		
37	Santa Clara County	<i>Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks</i>	1989			Hard copy provided by user	User rec	IMBA

Appendix E.

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
38	Searns, R., B. Woodcock & J. Pflaum	<i>Trail Maintenance and Management: We Built It and They Came</i>	2007		National Trails Training Partnership	www.americantrails.org/resources/ManageMaintain/ManageMCSearns.html		
39	Santa Monica Mountains National Recreation Area	<i>Santa Monica Mountains Area Recreational Trail Coordination Project</i>	1997			http://www.nps.gov/samo/parkmgmt/upload/SmmartTOExecSumProjOV.pdf		
Academic								
40	Bradsher, D.J.	<i>The Relationship Between Past Experience and Multiple Use Trail Conflict</i>	2003	Masters' Thesis	North Carolina State University	http://www.californiatrills.org/documents/RelationshipBetwConflict.pdf		
41	Carothers, P., J. Vaske, & M. P. Donnelly	<i>Social values versus interpersonal conflict among hikers and mountain bikers</i>	2001	Leisure Sciences 23(1): 47-61.		http://bolt.lakeheadu.ca/~bpaynewwww/3812/carothers.pdf		IMBA
42	Cessford, G.R.	<i>Off-Road Impacts of Mountain Bikes: A Review and Discussion</i>	1995b	Science and Research Series no. 92	New Zealand Department of Conservation		User rec	IMBA
44	Cessford, G.R.	<i>Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand</i>	2002	in Proceedings from conference at Bodenkultur University, Vienna Austria 2002. Also to be printed in Journal of Nature Conservation, Germany	International Mountain Bike Association	http://www.imba.com/resources/research/trail-science/perception-and-reality-conflict-walkers-and-mountain-bikes-queen-charlotte	User rec	IMBA
45	Chavez, D. J.	<i>Mountain Biking: Direct, Indirect and Bridge-Building Management Styles</i>	1996b	Journal of Park and Recreation Administration 14: 21-35				IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
46	Chavez, D. J.	<i>Mountain Biking Management: Resource Protection and Social Conflict</i>	1997	Trends, 34(3): 36-40		Hard copy provided by user	User rec	IMBA
47	Chavez, D.J., P.L. Winter, and J. M. Bass	<i>Recreational Mountain Biking: A Management Perspective</i>	1993	Journal of Park and Recreation Administration 11(3): 29-36				IMBA
48	Duncan, G., and S. Martin	<i>Comparing the Effectiveness of Interpretive and Sanction Messages for Influencing Wilderness Visitors' Intended Behavior</i>	2002	International Journal of Wilderness 8: 20-25		http://ijw.org/wp-content/uploads/2002/08/Vol-08.No-2.Aug-02small.pdf		
49	Goldstein, S. S.	<i>Mountain Bikes and the Parks: Mitigation of Safety and User Conflict Problems</i>	1987	Unpublished undergraduate paper	UC Santa Cruz	Hard copy provided by user	User rec	IMBA
50	Hendricks, W., R. H. Ramthun, and D. J. Chavez	<i>The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines</i>	2001	Journal of Park and Recreation Administration 19(3): 38-61	California Polytechnic State University, Concord College , USDA Forest Service		User rec	IMBA
51	Hoger, J. L. and D. J. Chavez	<i>Conflict and management tactics on the trail</i>	1998	Parks & Recreation, 33(9), 41-49.		http://admin.ibt.org.il/files/94644644798.pdf		
52	Hollenhorst, S. J., Schuett, M. A., Olson, D.	<i>Conflicts and Issues Related to Mountain Biking in the National Forests: A Multimethodological Approach</i>	1995	USDA Forest Service Gen. Tech. Rep. PSW-156.	USFS	http://www.fs.fed.us/psw/publications/documents/psw_gtr156/psw_gtr156_1_hollenhorst.pdf		IMBA
53	Jackson, S. A., Haider, W., & Elliot, T.	<i>Resolving inter-group conflict in winter recreation: Chillkoot Trail National Historic Site, British Columbia</i>	2004	Journal for Nature Conservation, 11(4): 317-323	University of Victoria	http://www.collectionscanada.gc.ca/obj/s4/f2/dsk3/ftp04/MQ61568.pdf		

Appendix E.

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
54	Jacob, G. R. and R. Schreyer	<i>Conflict in Outdoor Recreation: A Theoretical Perspective</i>	1980	Journal of Leisure Research 4: 368-379	Utah State University			
55	Jellum, C. M.	<i>Managing Mountain Bike Recreation and User Conflicts: A Case Study on Mt. Baker-Snoqualmie National Forest, Washington State</i>	2007		Central Washington University	http://www.cwu.edu/~geograph/faculty/lillquist_files/pubs/Jellum_Thesis.pdf		
56	Koontz, C. R.	<i>Recreational Trail Conflict: Achieving Equity Through Diversity</i>	2005	Masters' Thesis, Master of Science in Recreation Management	University of Montana	Hard copy provided by user	User rec	
57	Lime, D. (editor)	<i>Congestion and Crowding in the National Park System: Guidelines for Management and Research</i>	1996	St. Paul: University of Minnesota Agriculture Experiment Station Publication 86-1996				
58	Lime, D., D. Anderson, and J. Thompson.	<i>Identifying and Monitoring Indicators of Visitor Experience and Resource Quality: A Handbook for Recreation Resource Managers</i>	2004	St. Paul: University of Minnesota Department of Forest Resources	University of Minnesota	cspcfans.umn.edu/publications/Indicators_Standards_Handbook.pdf		
59	Longsdorf, E. L.	<i>Mountain Bikes and Metropolitan Park Districts: Issues and Trends Identified by State Parks and State Park Districts in Ohio</i>	2006	Proceedings of the 2006 Northeastern Recreation Research Symposium, GTR-NRS-P-14	American Trails	http://www.americantrails.org/resources/ManageMaintain/OhioMtnbike.html		
60	Manning, R. E	<i>Parks and Carrying Capacity: Commons Without Tragedy</i>	2007	Washington, DC: Island Press.				

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
61	Manning, R. E.	<i>Emerging Principles for Using Information/ Education in Wilderness Management</i>	2003	International Journal of Wilderness 9: 20-27, 12.		http://ijw.org/wp-content/uploads/2003/12/Vol-09.No-1.Apr-03small.pdf		
62	Moore, R. L., D. Scott and A. R. Graefe.	<i>The effect of activity differences on recreation experiences along a suburban greenway trail</i>	1998	Journal of Park and Recreation Administration 16(2), 35-53				
63	Morey, E. R., T. Buchanan and D. M. Waldman	<i>Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: choice experiments and benefits transfer</i>	2002	Journal of Environmental Management (2002) 64, 411–422	University of Colorado, Boulder			
64	Morioka, Steven in Sloan, D. and T. Fletcher, Ed	<i>Off the Road: The Issues Surrounding Mountain Bicycling in Environmental Management for the East Bay</i>	1989	Report of the Environmental Sciences Senior Seminar	U. C. Berkeley		User rec	IMBA
65	Owens, P. L.	<i>Conflict as a Social Interaction Process in Environment and Behavior Research: The Example of Leisure and Recreation Research</i>	1985	Journal of Environmental Psychology 5: 243-259	University of Sheffield			
66	Pearce, B.	<i>Mountain Biking on the Niagara Escarpment</i>	1990	University of Waterloo Faculty of Environmental Studies, School of Urban and Regional Planning			User rec	IMBA
67	Schuett, M. A.	<i>State Park Directors' Perceptions of Mountain Biking</i>	1997	Environmental Management 21(2): 239-246				IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
68	Watson, A. E.	<i>Goal Interference and Social Value Differences: Understanding Wilderness Conflicts and Implications for Managing Social Density</i>	2001	USDA Forest Service Proceedings RMRSP-20: 62-67.	Forest Service			
69	Watson, A. E., M. J. Niccolucci and D. R. Williams	<i>The nature of conflict between hikers and recreational stock users in the John Muir Wilderness.</i>	1994	Journal of Leisure Research (26): 372-385	Forest Service			
70	Watson, A.E., C. Asp, J. Walsh, and A. Kulla	<i>The Contribution of Research to Managing Conflict Among National Forest Users</i>	1997	Trends 34(3): 29-35		http://www.fs.fed.us/psw/programs/recreation/publications.shtm		IMBA
71	Watson, A.E., D.R. Williams and J. J. Daigle	<i>Sources of Conflict Between Hikers and Mountain Bike Riders in the Rattlesnake NRA</i>	1991	Journal of Park and Recreation Administration 9: 59-71			User rec	IMBA
User Organization								
72	California Equestrian Trails & Lands Coalition	<i>Safety Considerations for Multi-use Trails</i>	2005	NOP Comment Letter O-5, p. 82	California Equestrian Trails & Lands Coalition	http://www.calequestriancoalition.com/FinalVerCETLCSafetyGuides.htm		
73	IMBA	<i>Trail Solutions: IMBA's Guide to Building Sweet Single-track</i>	2004	Boulder, CO: International Mountain Bicycling Association.	International Mountain Bike Association			
74	IMBA, Webber, P. Ed.	<i>Managing mountain biking: IMBA's guide to providing great riding</i>	2007	Boulder, CO: International Mountain Bicycling Association.	International Mountain Bike Association			

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Citation
75	Keller, K.D.	<i>Mountain Bikes on Public Land: A Manager's Guide to the State of the Practice</i>	1990	Washington DC: Bicycle Federation of America.	Bicycle Federation of America	Hard copy provided by user	User rec	IMBA
76	Backcountry Horsemen of California	<i>A Common Sense Guide for High Country Manners</i>	2008		Backcountry Horsemen of California	http://www.bchcalifornia.org/		
77	Bicycle Trails Council of Marin, Access4Bikes	Share the Trail Campaign	No Date		Share the Trail	www.Sharethetrail.org		
78	Brown, L.	<i>Impact of Mountain Biking – Palos Verdes Nature Preserve</i>	No Date	NOP Comment Letter O-5, p. 30				
Individual User								
79	Ford, R.	<i>Mountain Bike Survey Update</i>	1989	Unpublished Report, Santa Barbara Ranger District, Los Padres National Forest	USFS	Hard copy provided by user	User rec	IMBA
80	Lucke, J.	<i>Access to our Public Lands: Mountain Bikes, the Concept of Public Ownership, and the Fatal Flaw in Bicycle Trails Council of Marin v. Babbitt</i>	No Date	No publishing information.		Hard copy provided by user	User rec	IMBA

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
Federal																												
1	AASHTO	Guide for the Development of Bicycle Facilities	1999							X												●	◐	●	◐	○		
2	Bowker, J. M., and D. B. English	Mountain Biking at Tsali: An Assessment of Users, Preferences, Conflicts, and Management Alternatives	2002				X															●	◐	●	◐	○		
3	Chavez, D. J.	Mountain Biking: Issues and Actions for USDA Forest Service Managers	1996a			X							X	X				X	X	X	X	●	●	●	◐	◐		
4	FHWA	Evaluation of Safety, Design and Operation of Shared Use Paths: Final Report	2006																			●	●	◐	◐	○		
5	FHWA	BIKESAFE Website	No Date		X								X									◐	◐	◐	◐	○		
6	Hendricks, Ramthun and Chavez	Mountain Bicyclists' Behavior in Social Trail Etiquette Situations	2000	X																		●	◐	●	●	○		

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
7	Hesselbarth, W., B. Vachowski, M. Davies	<i>Trail Construction and Maintenance Notebook</i>	2007						X					X										●	●	●	●	●
8	Hollenhorst, S. J., Schuett, M. A., Olson, D. & Chavez, D.	<i>An Examination of the Characteristics, Preferences, and Attitudes of Mountain Bike Users of the National Forests</i>	1993				X												X					●	●	●	○	○
9	Kulla, A.	<i>A New Perspectives Approach in National Forest Recreation and its Application to Mountain Bike Management</i>	1991											X	X				X	X		X		●	●	●	●	○
10	Moore, R. L.	<i>Conflicts On Multiple-Use Trails: Synthesis of the Literature and State of the Practice</i>	1994	X										X					X	X	X	X	X	●	●	●	●	●

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
11	National Park Service, Department of the Interior	Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona	2003					X																●	●	●	●	●
12	Rouphail, N. J. Hummer, J. Milazzo II, P. Allen.	Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedure	1998	X																				●	●	●	●	○
13	Sprinkle Consulting	Characteristics of Emerging Road and Trail Users and Their Safety.	2004						X															●	●	●	●	○
14	Tuler, S., Golding, D., Krueger, R.J.	A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System	2002		X																			●	●	●	●	○
15	USDA Forest Service	Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds	2007	X					X	X														●	●	●	●	●

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
General																												
16	Birkny, R. C.	Lightly on the Land: The SCA Trail-Building and Maintenance Manual	1996						X	X																		
17	Flink, C. A., and R. M. Searns	Greenways: A Guide to Planning, Design and Development	1993	X					X					X	X													
18	Flink, C., Olka, K., Searns, R., Rails-to-Trails Conservancy	Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails	1993	X					X	X					X	X		X										
19	MN Dept of Natural Resources	Trail Planning, Design, and Development Guidelines	2006	X					X		X			X														
20	North Carolina DPR	Results of the Two Year Mountain Bicycle Trail Study	1993				X		X					X														

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				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
21	Parker, T. S.	<i>Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails</i>	2004																					●	●	●	○	●
State																												
22	Bondurant, J., L.Thompson et. al.	<i>Trail Planning for California Communities</i>	2009	x					x	x	x			x										●	●	●	●	●
23	CA State Parks	<i>California State Parks Accessibility Guidelines</i>	2005						x		x													●	●	●	●	○
24	Caltrans	<i>Highway Design Manual Chapter 1000: Bikeway Planning and Design</i>	2009						x															●	●	●	●	○
25	Caltrans	<i>Manual on Uniform Traffic Control Devices</i>	2011											x										●	●	●	●	○

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				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability			
Local																															
26	Anderson, D.H., Lime, D. W., and T.L. Wang	Maintaining the Quality of Park Resources and Visitor Experiences	1998		X										X	X	X			X							●	●	●	●	●
27	Bauer, M.	Recreation Conflict at Six Boulder County Parks and Open Space Properties: a Baseline Study	2004					X																			●	◐	●	◐	◐
28	Chiu, Luke and L. Kriwoken	Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia	2003					X		X	X			X					X								◐	◐	●	◐	◐
29	City of Portland Parks & Recreation	Trail Design Guidelines for Portland's Park System	2009							X	X	X															●	●	●	●	●
30	City of San Jose	Council Agenda 03-29-11: Trail Safety Enhancements	2011					X						X													◐	●	○	○	◐

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
31	City of San Jose Trail Program	<i>Trail Signage Guidelines</i>	2010											X										●	●	●	●	○
32	City of St. Louis Board of Public Service	<i>Forest Park - Access, Circulation, and Parking Study</i>	2008				X																	●	●	●	●	○
33	City of Vancouver, B.C. General Manager of Engineering Services	<i>Speed Limits on Recreational Bicycle Paths</i>	1995											X										●	●	●	●	○
34	East Bay Regional Parks District (EBPRD)	<i>Narrow Natural Surface Trails Managing Multiple Use</i>	2011	X					X				X	X	X				X	X			X	●	●	●	●	●

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
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35	Midpeninsula Regional Open Space District	<i>Trail Use Guidelines and Mitigation Measures</i>	1993						X	X	X													●	●	●	●	○
36	Mosedale, J.	<i>Mountain Biking in the Canadian Rocky Mountains: A situational analysis</i>	2002			X	X							X					X	X	X			●	○	●	●	○
37	Santa Clara County	<i>Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks</i>	1989				X							X	X	X			X		X			●	●	○	●	●
38	Searns, R., B. Woodcock & J. Pflaum	<i>Trail Maintenance and Management: We Built It and They Came</i>	2007									X				X								●	○	●	●	○

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique					
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability	
39	Santa Monica Mountains National Recreation Area	Santa Monica Mountains Area Recreational Trail Coordination Project	1997			X			X	X	X			X	X	X			X						●	●	●	●	●
Academic																													
40	Bradsher, D.J.	The Relationship Between Past Experience and Multiple Use Trail Conflict	2003				X											X	X					●	●	●	●	●	
41	Carothers, P., J. Vaske, & M. P. Donnelly	Social values versus interpersonal conflict among hikers and mountain bikers	2001				X							X										●	●	●	●	●	
42	Cessford, G.R.	Off-Road Impacts of Mountain Bikes: A Review and Discussion	1995b				X					X												●	●	●	●	●	

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
44	Cessford, G.R.	<i>Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand</i>	2002				X																	●	●	●	●	○
45	Chavez, D. J.	<i>Mountain Biking: Direct, Indirect and Bridge-Building Management Styles</i>	1996b			X												X	X					●	●	●	●	○
46	Chavez, D. J.	<i>Mountain Biking Management: Resource Protection and Social Conflict</i>	1997			X																		●	●	●	●	●
47	Chavez, D.J., P.L. Winter, and J. M. Bass	<i>Recreational Mountain Biking: A Management Perspective</i>	1993		X																			●	●	●	●	●
48	Duncan, G., and S. Martin	<i>Comparing the Effectiveness of Interpretive and Sanction Messages for Influencing Wilderness Visitors' Intended Behavior</i>	2002											X										●	●	●	●	○

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
49	Goldstein, S. S.	<i>Mountain Bikes and the Parks: Mitigation of Safety and User Conflict Problems</i>	1987		X					X		X			X				X	X	X		X	●	●	●	●	○
50	Hendricks, W., R. H. Ramthun, and D. J. Chavez	<i>The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines</i>	2001				X							X				X			X			●	●	●	●	○
51	Hoger, J. L. and D. J. Chavez	<i>Conflict and management tactics on the trail</i>	1998		X									X				X						●	●	●	○	●
52	Hollenhorst, S. J., Schuett, M. A., Olson, D.	<i>Conflicts and Issues Related to Mountain Biking in the National Forests: A Multimethodological Approach</i>	1995				X																	●	●	●	●	○
53	Jackson, S. A., Haider, W., & Elliot, T.	<i>Resolving inter-group conflict in winter recreation: Chilkooot Trail National Historic Site, British Columbia</i>	2004				X																	●	●	●	●	○

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
54	Jacob, G. R. and R. Schreyer	Conflict in Outdoor Recreation: A Theoretical Perspective	1980	X																		●	◐	◐	◐	◐		
55	Jellum, C. M.	Managing Mountain Bike Recreation and User Conflicts: A Case Study on Mt. Baker-Snoqualmie National Forest, Washington State	2007				X		X	X	X	X				X	X					●	●	●	●	◐		
56	Koontz, C. R.	Recreational Trail Conflict: Achieving Equity Through Diversity	2005	X										X			X		X			◐	◐	◐	◐	◐		
57	Lime, D. (editor)	Congestion and Crowding in the National Park System: Guidelines for Management and Research.	1996	X			X							X		X						◐	◐	◐	◐	◐		
58	Lime, D., D. Anderson, and J. Thompson.	Identifying and Monitoring Indicators of Visitor Experience and Resource Quality: A Handbook for Recreation Resource Managers	2004	X																		●	◐	●	◐	◐		

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
59	Longsdorf, E. L.	<i>Mountain Bikes and Metropolitan Park Districts: Issues and Trends Identified by State Parks and State Park Districts in Ohio</i>	2006			X																		●	●	●	●	○
60	Manning, R. E.	<i>Parks and Carrying Capacity: Commons Without Tragedy</i>	2007											X										●	●	●	●	○
61	Manning, R. E.	<i>Emerging Principles for Using Information/Education in Wilderness Management</i>	2003				X							X					X					●	●	●	●	○
62	Moore, R. L., D. Scott and A. R. Graefe.	<i>The effect of activity differences on recreation experiences along a suburban greenway trail</i>	1998				X																	●	●	●	○	○
63	Morey, E. R., T. Buchanan and D. M. Waldman	<i>Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: choice experiments and benefits transfer</i>	2002				X																	●	●	●	●	○

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
64	Morioka, Steven in Sloan, D. and T. Fletcher, Ed	<i>Off the Road: The Issues Surrounding Mountain Bicycling in Environmental Management for the East Bay</i>	1989					X																○	●	●	○	●
65	Owens, P. L.	<i>Conflict as a Social Interaction Process in Environment and Behavior Research: The Example of Leisure and Recreation Research</i>	1985		X																			●	●	●	●	○
66	Pearce, B.	<i>Mountain Biking on the Niagara Escarpment</i>	1990			X																		●	●	●	○	●
67	Schuett, M. A.	<i>State Park Directors' Perceptions of Mountain Biking</i>	1997			X											X			X		X		●	●	●	●	○
68	Watson, A. E.	<i>Goal Interference and Social Value Differences: Understanding Wilderness Conflicts and Implications for Managing Social Density</i>	2001		X																			●	●	●	○	
69	Watson, A. E., M. J. Niccoluc	<i>The nature of conflict between hikers and recreational stock users in</i>	1994		X																			●	●	●	●	○

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
	ci and D. R. Williams	<i>the John Muir Wilderness.</i>																										
70	Watson, A.E., C. Asp, J. Walsh, and A. Kulla	<i>The Contribution of Research to Managing Conflict Among National Forest Users</i>	1997				X								X			X	X	X				●	●	●	●	○
71	Watson, A.E., D.R. Williams and J. J. Daigle	<i>Sources of Conflict Between Hikers and Mountain Bike Riders in the Rattlesnake NRA</i>	1991				X							X				X						●	●	●	●	○
User Organizations																												
72	California Equestrian Trails & Lands Coalition	<i>Safety Considerations for Multi-use Trails</i>	2005	X					X					X	X			X						●	●	●	●	●
73	IMBA	<i>Trail Solutions: IMBA's Guide to Building Sweet Single-track</i>	2004	X								X	X	X										●	●	●	●	●
74	IMBA, Webber,	<i>Managing mountain biking: IMBA's guide to</i>	2007	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X		●	●	●	●	●

ID	Author	Title	Year	Problem Definition					Design					Management					Outreach					Critique				
				General	Theoretical	Manager Survey	User Survey	Incident/Complaint Data	Width/Passing Areas	Sight Distance	Gradient	Speed Control Features	Curvilinear Design	User Information	Enforcement	Rules & Regulations	Public Notification	Data Collection	Education	User Group Meetings	Volunteer Programs	User Group Notification	Events	Objectivity	Thoroughness	Applicability	Useful Info	Sustainability
	P. Ed.	<i>providing great riding</i>																										
75	Keller, K.D.	<i>Mountain Bikes on Public Land: A Manager's Guide to the State of the Practice</i>	1990		x		x								x	x	x		x	x	x	x	x	●	●	●	●	●
76	Backcountry Horsemen of California	<i>A Common Sense Guide for High Country Manners</i>	2008															x						●	●	●	○	○
77	Bicycle Trails Council of Marin, Access4Bikes	Share the Trail Campaign	No Date															x						○	○	●	●	○
78	Brown, L.	<i>Impact of Mountain Biking –Palos Verdes Nature Preserve</i>	No Date	x																				○	●	○	○	●
Individual User																												
79	Ford, R.	<i>Mountain Bike Survey Update</i>	1989				x																	●	●	●	●	○
80	Lucke, J.	<i>Access to our Public Lands: Mountain Bikes,</i>	No Date	x																				○	○	●	●	●

ID	Author	Title	Year	<u>Problem Definition</u>					<u>Design</u>					<u>Management</u>					<u>Outreach</u>					<u>Critique</u>				
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		<i>the Concept of Public Ownership, and the Fatal Flaw in Bicycle Trails Council of Marin v. Babbitt</i>																										

Table E-2. Documents Reviewed Not Pertaining to Trail User Conflicts

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
Federal									
1	Chavez, D. J.	<i>Visitor Perceptions of Crowding and Discrimination at Two National Forests in Southern California</i>	1993	Res. Paper PSW-RP-216. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.	US Forest Service, Utah State University	http://www.fs.fed.us/psw/publications/documents/psw_rp216/psw_rp216.pdf		Discusses visitor perceptions of crowding and discrimination to determine the potential of visitor displacement from recreational sites in two National Forests in 1990.	IMBA
2	FHWA	<i>US Department of Transportation FHWA Recreational Trails Program</i>	1998		FHWA	http://www.fhwa.dot.gov/environment/recreational/publications.htm		Aggregation of other sources; relevant ones included individually.	
3	Marion, J. L.	<i>Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreation Area</i>	2006	NPS. USGS Patuxent Wildlife Research Center, Cooperative Park Studies Unit, Virginia Tech Dept. of Forestry			User rec	Environmental	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
4	Trails and Wildlife Task Force, Colorado State Parks, Hellmuth Associates	<i>Planning Trails with Wildlife in Mind: A Handbook for Trail Planners</i>	1998			http://www.fs.fed.us/outdoors/naturewatch/start/planning/Trails-for-Wildlife-Handbk.pdf		Environmental; does not relate to user conflicts	
General									
5	Fruin, J.J.	<i>Pedestrian Planning and Design</i>	1971	New York, NY, 1971. 25	Metropolitan Association of Urban Designers and Environmental Planners			Discusses urban pedestrian characteristics	
State									
6	CA State Parks	<i>California Recreational Trails Plan Phase I</i>	2002		CA State Parks	http://www.parks.ca.gov/pages/1324/files/ca%20rec%20trails%20plan.pdf		Goals and policies; does not relate to user conflicts	
7	CA State Parks	<i>Best Management Practices For Road Rehabilitation: Road to Trail Conversion</i>	2003		CA State Parks	http://www.parks.ca.gov/pages/23071/files/road%20to%20trail.pdf		Technical reference	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
8	CA State Parks	<i>Trail Manager's Toolbox</i>			CA State Parks	http://www.parks.ca.gov/?page_id=23419#multi-use%20trail%20management		Aggregation of other sources; relevant ones included	
9	California Public Resources Code	<i>Section 5850(e)</i>				http://law.onecle.com/california/public-resources/5850.html	User rec	Does not provide background on the problem or strategies	
Local									
10	Center for Changing Landscapes and the Department of Forests	<i>Minnesota's Network of Parks & Trails</i>	2011		College of Food, Agricultural, and Natural Resource Sciences and College of Design at the University of Minnesota	http://ccl.design.umn.edu/documents/MNPaTFrameworkJanuary2011_001.pdf	User rec	Document refers to general need to address conflict; no relevant data.	
11	Crockett, Christopher S	<i>Survey of Ecological Impact Considerations Related to Mountain Bicycle Use on the Edwards Field Trail at Joseph D. Grant County Park</i>	1986		Santa Clara County (CA) Parks Dept.			Environmental	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
Academic									
12	Alder, J.	<i>Costs and Effectiveness of Education and Enforcement, Cairns Section of the Great Barrier Reef Marine Park</i>	1996	Environmental Management 20: 541-51				Evaluation of efficacy of educating users about a marine park conservation zone, attitudes towards management; not directly related.	
13	Bacon, J., R. Manning, D. Johnson, and M. Vande Kamp	<i>Norm Stability: A Longitudinal Analysis of Crowding and Related Norms in the Wilderness of Denali National Park and Preserve</i>	2001	The George Wright Forum 18(3): 62-71		http://www.georgewright.org/backlist_forum.html		This study compares the results of a 1978 and a 2000 user survey evaluating perceptions of crowding; not directly relevant.	
14	Botma, H.	<i>Method to Determine level of service for bicycle paths and pedestrian-bicycle paths</i>	1995	Transportation Research Record 1502: 38-44	Transportation Research Board			Pertains to paved paths	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
15	Botma, H., and H. Papendrecht	<i>Traffic Operations of Bicycle Traffic</i>	1991	Transportation Research Record 1320, Washington, DC, pp. 65–72, 1991.	Transportation Research Board			Pertains to paved paths	
16	Brown, L.	<i>Griffith Park provides equestrian trails in the heart of the city</i>	2007	American Trails Magazine	Equestrian Trails, Inc	http://www.americantrails.org/trailtracks/07spring/griffithhorse.html	User rec	Environmental	
17	Cessford, G.R.	<i>Off Road Mountain Biking: A Profile of Participants and their Recreation Setting and Experience Preferences</i>	1995a	Science and Research Series no. 93	Science and Research Division, Department of Conservation		User rec	Discusses the experiential desires of mountain bikers; does not address conflicts.	IMBA
18	Cole, David N.	<i>Visitor and Recreation Impact Monitoring: Is it Lost in the Gulf Between Science and Monitoring?</i>	2006	The George Wright Forum 23.2 (2006): 11-16	Aldo Leopold Wilderness Research Institute	http://leopold.wilderness.net/pubs/581.pdf		Discusses the need for additional data; not related to user conflicts.	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
19	Gander, H. and P. Ingold	<i>Reactions of Male Alpine Chamois <i>Rupicapra r. rupicapra</i> to Hikers, Joggers and Mountain Bikers</i>	1996	Biological Conservation 79:107 - 109.				Environmental	IMBA
20	Goeft, Ute and Alder, Jackie	<i>Sustainable Mountain Biking: A Case Study from the Southwest of Western Australia</i>	2001	Journal of Sustainable Tourism 9(3): 193 - 211.				Environmental	IMBA
21	Hendricks, W.	<i>Mountain Bike Management and Research: An Introduction</i>	1997	Trends 34(3): 2-4		Hard copy provided by user	User rec	Introduction to the Trends magazine issue that addresses conflicts on trails; individual articles included separately.	
22	Homburger, W.S.	<i>Capacity of Bus Routes, and of Pedestrian and Bicycle Facilities.</i>	1976	Institute of Transportation Studies, University of California, Berkeley.				On-street facilities	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
23	Landis, B.W., V.R. Vattikuti, and M.T. Brannick	<i>Real-Time Human Perceptions: Toward a Bicycle Level of Service</i>	1997	Transportation Research Record 1578, Washington, DC, 1997.				Paved trails	
24	Lawson, S., and R. Manning	<i>Crossing Experiential Boundaries: Visitor Preferences Regarding Tradeoffs Among Social, Resource and Managerial Attributes of the Denali Wilderness</i>	2001	The George Wright Forum 18(3): 10-27		http://www.georgewright.org/183laws/on.pdf		Document focuses on management of backcountry hiking; not other uses	
25	Papouchi s, C. M., F. J. Singer and S. William	<i>Responses of Desert Bighorn Sheep To Increased Human Recreation</i>	2001	Journal of Wildlife Management 65(3): 573 - 582.				Environmental	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
26	Reynolds, C., M. Harris, K. Teschke, P. Cription, and M. Winters.	<i>The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: A Review of the Literature</i>	2009	Environmental Health Journal 8.47 (2009).	University of British Columbia	http://www.ehjournal.net/content/pdf/1476-069x-8-47.pdf		Pertains to paved paths and automobile traffic safety	
27	Rodgers, G.B.	<i>Factors Associated with the Crash Risk of Adult Bicyclists</i>	1997	Journal of Safety Research 28: 233-241.				Compares relative risk of types of bicycle facilities; not related to other users	
28	Rothman	<i>The War for the Future: Mountain Bikes and the Golden Gate Recreation Area</i>	2001	The George Wright Forum 18(1)		Hard copy provided by user	User rec	Describes the history of mountain bike access issues in the San Francisco area.	IMBA
29	Schneider, I. E.	<i>Revisiting and revising recreation conflict research</i>	2000	Journal of Leisure Research 32(1): 129-132.				General conceptual argument for conflicts; not directly related	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
30	Spahr, R.	<i>Factors Affecting The Distribution Of Bald Eagles And Effects Of Human Activity On Bald Eagles Wintering Along The Boise River</i>	1990		Boise State University			Environmental	IMBA
31	Symmonds, M. C., W.E. Hammit and V. L. Quisenberry	<i>Managing Recreationa l Trail Environmen ts for Mountain Bike User Preferences</i>	2000	Environmental Management 25(5): 549-571				Identifies social characteristics and experiential needs of mountain bikers to accommodate their needs.	IMBA
32	Taylor, A. R. and R. L. Knight	<i>Wildlife Responses to Recreation and Associated Visitor Perceptions</i>	2003	Ecological Applications 13(4): 951 - 963.				Environmental	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
33	Thurston, E. and R. J. Reader	<i>Impacts of Experimentally Applied Mountain Biking and Hiking on Vegetation and Soil of a Deciduous Forest</i>	2001	Environmental Management 27(3): 397 - 409.				Environmental	IMBA
34	Tinsworth, D., S. Cassidy, C. Polen	<i>Bicycle-related injuries: Injury, hazard, and risk patterns</i>	1994	International Journal of Injury Control and Safety Promotion, 1(4):207-220				Pertains to paved paths and automobile traffic safety	
35	Vaske, J. J., M. P. Donnelly et al.	<i>Establishing Management Standards: Selected Examples of the Normative Approach</i>	1993	Environmental Management 17(5): 629-643				Establishes experiential standards to be used in qualitative evaluations of visitor park experiences; does not address conflicts.	IMBA
36	Weir, D.	<i>A Guide to the Impacts of Non Motorized Trail Use</i>	2000	Don Weir and Associates-Edmonton Alberta Canada		Hard copy provided by user	User rec	Environmental; user conflicts cite Jacob and Schreyer (1980), Moore (1996) and Kulla (1991).	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
37	Wilson, J. P. and J. Seney	<i>Erosional Impacts of Hikers, Horses, Motorcycles and Off-Road Bicycles on Mountain Trails in Montana</i>	1994	Mountain Research and Development 14(1): 77 - 88.					IMBA
User Organization									
38	Concerned Off Road Bicyclists Association	<i>Rules of the Trail</i>	No Date	Concerned Off Road Bicyclists Association		http://www.corbamt.com/Resources/RulesoftheTrail.shtml			
39	Dice, Jenn	<i>Saguaro</i>	2003	AmericanTrails.org	International Mountain Bike Association	http://www.americantrails.org/resources/ManageMaintain/CactusTrailBike.html		Environmental	IMBA
40	Lanza, M.	<i>Trail Shock</i>	2001	Appalachian Mountain Club Outdoors Magazine.		Hard copy provided by user	User rec	Environmental	IMBA
41	Marion, J. and J. Wimpey	<i>Environmental Impacts of Mountain Biking: Science Review and Best Practices</i>	2007	International Mountain Bike Association		http://www.imba.com/resources/research/trail-science/environmental-impacts-mountain-biking-science-review-and-best-practices		Environmental	IMBA

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ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
42	Sprung, G.	<i>Natural Resource Impacts of Mountain Biking: A summary of scientific studies that compare mountain biking to other forms of trail travel</i>	2007	International Mountain Association Bike		http://www.imba.com/		Environmental	
43	Action Coalition of Equestrians, et. al.	<i>Motion to Intervene, Comments & Protest</i>	2006	NOP Comment Letter O-5 p. 88; Docket No. P-2100, P-2100-052. March 31, 2006	Federal Regulatory Commission	Hard copy provided by user	User rec	Motion to reconsider allowing mountain bikes on a trail in Oroville, CA. Contains user arguments and criticisms of the incomplete analysis; no data or analysis.	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
44	Action Coalition of Equestrians, et. al.	<i>Motion to Intervene, Comments, & Protest Re: Project 2100-119 Oroville (Feather River Dam) – California Department of Water Resources' Application for Amendment of License</i>	2003		Mountain Bike Task Force for the City of Los Angeles	Hard copy provided by user	User rec	Discusses mountain bikers' goals and environmental impact; includes letters of support. No information on user conflict or specific strateies.	
45	Park Watch	<i>Park Watch Reports for Folsom Lake Pioneer Express Trail</i>	2010	NOP Comment Letter O-5, p. 65; Park Watch.org		Hard copy provided by user	User rec	Incident reports collected by user group - may be incomplete, no recommendations	
46	Ride with Respect	<i>Trail Sharing: from concept to application</i>	No Date			Hard copy provided by user	User rec	Presentation of sharing the trail; cites several documents included.	
47	Johnson, J.	<i>Trail wars at Annadel State Park</i>	2010	NOP Comment Letter O-5, p. 61; The Press Democrat, July 6 2010		Hard copy provided by user		Discusses impacts of illegal trails.	

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Link	Source	Notes	Citations
Individual User									
48	Vandeman, Mike	<i>The Impacts of Mountain Biking on Wildlife and People - A Review of the Literature</i>	2004			http://home.pacbell.net/mjvande/scb7	User rec	Environmental	
49	Vandeman, Mike	<i>A Critique of "A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S." (White et al 2006)</i>	2006			http://home.pacbell.net/mjvande/white	User rec	Environmental	
50	Vandeman, Mike	<i>Letter to author of the paper, "Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreation Area"</i>	No Date			http://home.pacbell.net/mjvande/marion	User rec	Environmental	

Table E-3. Documents Not Found

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Citation
Federal						
1	Doucette, J. E., and D. N. Cole.	<i>Wilderness visitor education: Information about alternative techniques</i>	1993	General Technical Report INT-295. Ogden, UT: USDA Forest Service, Intermountain Research Station.	US Forest Service	
Academic						
2	Horn, C.	<i>Conflict in Recreation: the Case of Mountain-Bikers and Trampers</i>	1994	Unpublished masters' thesis, Department of Parks, Recreation and Tourism, Lincoln University		IMBA
State						
3	Colorado State Parks	<i>Trails and Wildlife Bibliography</i>	1997	Colorado State Parks, Trails Program	Colorado State Parks Trails Program	User recommendation
Local						
4	Bjorkman, A.	<i>Off Road Bicycle and Hiking Trail User Interactions: A Report to the Wisconsin Natural Resources Board</i>	1996		Wisconsin Bureau of Natural Resources: Bureau of Research	IMBA
5	Pettit, B., and P. Pointes	<i>"Kepner-Trego analysis": Mountain bicycle situation on Santa Barbara front trails managed by the U.S. Forest Service</i>	1987	Unpublished report, Santa Barbara Ranger District, Los Padres National Forest	USFS	IMBA

ID	Author	Title	Year	Journal/Citation	Agency/ Affiliation	Citation
Academic						
6	Devall, W. and Harry J.	<i>Who Hates Whom in the Great Outdoors: The Impact of Recreational Specialization on Technologies of Play.</i>	1981	Leisure Sciences 4(4): 399-418		IMBA
7	Grost, R.	<i>Managing the Mountain Bike</i>	1989	American Forests 95: 50-53, 75-77		IMBA
8	Hall, T. and B. Shelby	<i>Who Cares About Encounters? Differences Between Those With and Without Norms</i>	1996	Leisure Sciences 18: 7-22		
9	Hammit, W. E. and D. N. Cole	<i>Wildland Recreation: Ecology and Management</i>	1998	New York: John Wiley and Sons, Inc.		IMBA
10	Hendricks, W.	<i>A resurgence in recreation conflict research: Introduction to the special issue</i>	1995	Leisure Sciences 17(3):157-159		
11	Jacoby, J.	<i>Mountain Bikes: A New Dilemma for Wildland Recreation Managers?</i>	1990	Western Wildlands 16(1): 25-28		IMBA
12	Manning, Robert E	<i>Studies in Outdoor Recreation</i>	1999		Oregon State University	
13	Navin, F.P.D.	<i>Bicycle Traffic Flow Characteristics: Experimental Results and Comparisons.</i>	1994	ITE Journal, Vol. 64, No. 3, March 1994.		
14	Phillely, M. and S. McCool	<i>Law Enforcement in the National Park System: Perceptions and Practices</i>	1981	Leisure Sciences 4: 355-71		
15	Ramthum	<i>Factors in User Group Conflict Between Hikers and Mountain Bikers</i>	1995	Leisure Sciences 17(3): 159-170		IMBA
16	Schneider, I.E., and W.E. Hammitt	<i>Visitor Response to Outdoor Recreation Conflict: A Conceptual Approach</i>	1995	Leisure Sciences 17(3):223-234		
17	Vaske, Donnelly, Karin & Laidlaw	<i>Interpersonal versus social-values conflict</i>	1995	Leisure Sciences 17(3): 205-222		
18	Watson, A. E.	<i>An analysis of recent progress in recreation conflict research and perceptions of future challenges and opportunities</i>	1995	Leisure Sciences 17(3): 235-238		

E.1 Federal Guidelines and Studies

E.1.1 Guide for the Development of Bicycle Facilities

American Association of Highway Transportation Officials (AASHTO). 1999.

The Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* provides national standard for bikeways. According to the AASHTO Guide, shared-use paths should be 12 to 14 feet wide, with 2-foot shoulders on either side. The minimum allowed for a two-way shared-use path is 10 feet, which is only recommended for low traffic situations. Clearance to overhead obstructions should be a minimum of 8 feet. The Guide does not provide assistance for selecting the appropriate width.

The Guide recommends a minimum design speed on a shared-use path of 20 mph, or 30 mph where a downgrade exceeds 4 percent or where strong prevailing tailwinds exist. The Guide recommends using design and traffic controls to control ‘excessive speeds’ over the 30 mph, but cautions that, “Lower design speeds should not be selected to artificially lower user speeds.”

The manual also provides design guidance for maximum grade, sightlines, turning radii and intersections of off-street facilities based on desired speed of bicyclists. It does not discuss alternative actions for reducing speed on a facility. For shared facilities over structures (i.e. bridges), the Guide recommends that the minimum clear width should be the same as the approach paved shared-use path, in addition to the minimum 2-foot wide clear areas.

Keywords: Design guidelines, width, design speed
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ○ Useful Information: ●

E.1.2 Mountain Biking at Tsali: An Assessment of Users, Preferences, Conflicts, and Management Alternatives

Bowker, J. M., and D. B. English. 2002. U.S. Department of Agriculture Forest Service, Southern Research Station. General Technical Report SRS-59.

This study was written by social scientists at the Forest Service Southern Research Station in Athens, Georgia. The study was conducted at the Tsali Recreation Area, part of the Cheoah Ranger District of the Nantahala National Forest, near the Great Smoky Mountains. Other affiliates include the Nantahala Outdoor Center, Graham County, the Department of Agricultural and Applied Economics and the Department of Recreation and Leisure Studies at the University of Georgia, and the Forest Resources department at the Clemson University. The Recreation Area has a four-loop trail system just under 38 miles in length, and accommodates hikers, mountain bikers, and equestrians. Tsali is a fee demonstration site, and the park alternates between allowing mountain bikers and equestrians.

An on-site survey of visitors examined the demographics, behavior, current trip profile, and attitudes toward user fees, current management policies, and future management alternatives. The survey found that trail surface and congestion were the most important site attributes to visitors (43.9 percent and 40.0 percent, respectively), while horse/bike rotation was the third most important attribute (37.8 percent). The survey also

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found that the majority of users do not object to the idea of user fees. Most (89.4 percent) felt that the \$2 per day or \$15 per year fee was appropriate.

Respondents were also asked to report their feelings about a variety of scenarios of increased user fees for expanded amenities and trails. Most respondents desired changes involving moderate cost increases. The primary desired improvement was to increase trail miles. Most visitors (95 percent) agreed that fees are a “good tool to manage public recreation areas,” in general and at Tsali. Visitors overwhelmingly supported future management alternatives that proposed more trail miles, even when these were combined with fee increases.

Keywords: Problem definition (user survey), trail layout/availability
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ●

E.1.3 Mountain Biking: Issues and Actions for USDA Forest Service Managers

Chavez, D. J. 1996a. Res. Paper PSW-RP-226-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

This article was written by a research social scientist with the Pacific Southwest Research Station’s Wildland Recreation and the Urban Culture Research Unit, based in Riverside, California. The study is a continuation of an early 1990s National Park Service study by Tilmant (unpublished) that examined mountain biking on a national scale. The International Mountain Bicycling Association (IMBA) cites this article on their website.

The article presents the results of a national survey of U.S. Forest Service (USFS) resource managers from 90 National Forests. The research objectives were to describe the amount of mountain bike riding in National Forests, to determine the level of planning currently used by Forest Service managers to deal with issues related to mountain bike use, and to examine management issues and actions related to mountain bike use in National Forests including resource damage, user conflicts, safety, and accidents.

The questionnaire results indicate that National Forest managers’ primary concerns related to mountain biking include effects on natural resources (42 percent), conflicts with other user groups (34 percent), safety concerns (13 percent), illegal use in designated wilderness (13 percent), and the growth of the sport (12 percent). In addition, 70 percent of managers had received reports of user conflicts and 48 percent noted specific problems related to incidents. The most significant conflict issues reported were those between mountain bikers and equestrians (41 percent) and mountain bikers and hikers (31 percent). Twenty-one percent reported that the problems were due to the speed of mountain bikers, while 11 percent felt it was generally the other party’s behavior.

Managers responded to an open-ended question about the methods they use to reduce user conflicts. The responses were grouped into the following categories:

- Information/education (63 percent) – Safety, brochures, posters, signs, IMBA triangle, etc.
- Cooperation (27 percent) – Personal interactions, volunteer patrols, partnerships, and providing mountain bike shops with rules and regulations.

- Visitor restrictions (17 percent) – Separate user groups, separate trails, alternating use between user groups, redirecting bike use to other trails, law enforcement, and denial of event permits.
- Resource hardening (7 percent) – Changing trail to meet needs, shorter loops for hikers, longer for mountain bikes, and upgrading trails.

The survey asked about safety problems (incidents) and accidents separately from user conflicts. Most managers had observed or reported safety problems (incidents) related to mountain bike use (59 percent), while almost half had observed or received reports of accidents involving mountain bikes (48 percent). Issues included excessive mountain biker speeds, concerns about pack animal groups, mountain bikes that were too quiet (they did not warn other users they were approaching), and mountain bikers being careless around vehicles. Responses to safety issues were categorized in the following ways:

- Information/Education (58 percent) – Safety rules, multiple uses, brochures, maps, trail descriptions, newspaper articles, club newsletters, signs with appropriate use, ethics, etiquette, and low impact use.
- Cooperation (17 percent) – Personal contacts, partnerships, and workshops.
- Visitor Restrictions (12 percent) – Separate trails, enforcement contacts, and non-issuance of special use permits.
- Resource hardening (8 percent) – Wider turnouts and rubber belting on water bars.

Managers also recommended additional research studies on the following: the value of bike patrols and partnerships for alleviating conflict or resource damage; trail construction that can alleviate trail damage; mountain biking interactions with the community; and an evaluation of whether displacement of trail users is an issue.

Chavez concludes that, “trail maintenance is a reasonable way to deal with safety and accident problems, and information and personal interaction are the most reasonable tools for dealing with conflict issues.”

Keywords: Problem definition (manager survey), trail layout/availability, user group notification, volunteer programs, events, user group meetings, public notification, user information, alternate use days, rules & regulations, enforcement

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.1.4 Evaluation of Safety, Design, and Operation of Shared-Use Paths

Hummer, J.E., Roupail, J.L., Toole, J.L., Patten, R.S., Schneider, R.J., Green, J.S., Hughes, R.G., and Fain, S.J. 2006. FHWA-HRT-05-137 <http://www.fhwa.dot.gov/publications/research/safety/pedbike/05137/>

This 2006 study for FHWA analyzes operational data from 15 paved paths in 10 cities, as well as surveys from over 100 trail users. The evaluation provides a tool to evaluate the operational effectiveness of a shared-use path, given a traffic forecast or observation at an existing path along with some geometric parameters. The project team used a video camera mounted on a moving bicycle to collect data, as well as surveying users “to quantify the effect of selected operational trail parameters on bicyclist and pedestrian judgments of the perceived adequacy of the trail facility.”

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The study considers both passive passing, in which the test bicyclist is passed by a faster path user and delayed passing, when the test bicyclist would arrive behind a slower path user and not be able to pass because of the lack of an adequate-sized gap in the next lane to the left (oncoming or same direction).

The methodology involved gathering substantial data related to average speed, number of meetings, passing space, and other data about how bicyclists, pedestrians, inline skaters, runners, and child bicyclists interact. It includes a review of international literature about mode space needs, speeds, and operating characteristics. The analysis builds on the *Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedures* research for the 2000 HCM (see below), and provides a model of path LOS that incorporates the user types listed above.

The analysis is highly objective, although space requirements and other operational characteristics are taken from other studies and do not include user perceptions of conflicts or conflicting goals. Capacity analysis is useful for this analysis, particularly on paved shared-use pathways.

Keywords: Design guidelines

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.1.5 BIKESAFE Bicycle Countermeasure Selection System Website

FHWA. No Date. www.bicyclinginfo.org/bikesafe/countermeasure.cfm?CM_NUM=34

The Federal Highway Administration (FHWA) operates the BIKESAFE website, which recommends countermeasures to alleviate a variety of bicycle-related issues and safety concerns. The website's 'Share the Path Treatments' page highlights the importance of good path design, policies, education, and enforcement. The website generally recommends involving various user groups in planning and share-the-path type programs, then provides specific guidance in the case study of Victoria, British Columbia.

Case Study #36 - Share the Trail: Minimizing User Conflicts on Non-Motorized Facilities

Todd Litman of the Victoria Transport Policy Institute contributed BIKESAFE Case Study #36 based on experience in Victoria, British Columbia. Litman argues that a reliance on separating user types can prohibit some forms of transport. He recommends focusing on users' behavior rather than mode and presents a generalized comparison of speed, size, and maneuverability of a variety of modes found on the Galloping Goose Regional Trail.

Litman recommends clarifying trail rules by publicizing them in signage, brochures, and through a website. He argues against imposing traffic citations on non-motorized vehicles due to perception and difficulty of processing a citation.

The website provides general recommendations for countermeasures that improve the bicycling environment, supporting the recommendations with case studies of jurisdictions that have dealt with the specific issues. In the case of trail user conflicts, Litman's analysis is more general than most case studies, and the recommendations are not directly supported by data or evaluation. However, recommendations related to etiquette signage are relevant to this study.

Keywords: Problem definition (theoretical), trail layout/availability, user information
 Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ●

E.1.6 Mountain Bicyclists' Behavior in Social Trail Etiquette Situations

Hendricks, Ramthum and Chavez. 2000. *Proceedings of the 1999 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 194-198.*

William Hendricks is an Associate Professor of Recreation Administration at California Polytechnic State University. He has published previous papers pertaining to mountain biker behavior and management practices, including *Mountain Bike Management and Research: an Introduction* (1997) and *Mountain Bike Trail Etiquette: A Comparison of Guidelines and Behavior* (1995, with Ruddell). Roy Ramthum is an Assistant Professor of Travel Industry Management at Concord College. He has published previous papers on the study of trail etiquette such as *Analysis of the Role of Physical and Situational Factors in Trail Etiquette* (1992, with Ruddell). Deborah Chavez is a Research Social Scientist with the USDA forest service who has published several other articles included in this Literature Review, including *Recreational Mountain Biking: A Management Perspective* (1993, with Winter and Bass), *Mountain Biking: Issues and Actions for USDA Forest Service Managers* (1996), and *Mountain Biking: Direct, Indirect, and Bridge-building Management Styles* (1996). IMBA cites this article on their website.

This article analyzes data collected from the Mt. Tamalpais recreation area in Marin County, California with the purpose of gaining insight into the factors that affect etiquette behavior of mountain bikers when they encounter hikers on a trail. The study specifically looks at yielding behavior and traveling speed of mountain bikers as they approach hikers on a trail. The study surveyed 188 mountain bikers on random days at random times during the summer of 1998. The researches collected data on yielding behavior, approach speed, estimated age, gender, and equipment indicators (e.g. clipless pedals, hydration pack, gloves) for each biker who passed. The results showed that the majority of bikers yielded only slightly to the oncoming hikers and that 60 percent of mountain bikers surveyed were travelling over the recommended maximum safe speed (15 mph). They also showed that generally mountain bikers who were younger, male, and with more accessory equipment yield less to hikers and travel at unsafe speeds more frequently than other user groups.

As a result of the study, it is concluded that management issues persist in Tamalpais even after a 20-year history of simultaneous trail use by mountain bikers and hikers. These issues continue in spite of continued management practices such as informational signage on trail etiquette, informational publications on etiquette produced by local interest groups, and fines up to \$200 for violating trail speed limits (checked by patrols equipped with radar guns). However, management techniques have not been as stringent in recent years as in the past, and this may have an effect on the tendency of younger users to yield to hikers less and speed more. The authors recommend reconsidering and reutilizing these management techniques to reduce the occurrence of poor trail etiquette by mountain bikers.

The study suggests that the majority of mountain bikers in Tamalpais are not exercising safe and courteous practices for shared-use trails. The authors suggest the greater utilization of direct and indirect management tools such as informational signage on trail etiquette, informational publications on etiquette produced by local interest groups, and fines for violating speed limits to help alleviate this problem. However, the

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effectiveness of these techniques in Tamalpais seems uncertain. A more effective solution may be better trail design and programming. Effective trail design solutions (e.g. trail width narrowing in limited visibility areas to slow riders) and programming solutions (e.g. one-way trails, alternating use trails, locating difficult/expert trails at greater distances from trailheads) in conjunction with the management tools mentioned by the authors may provide greater effectiveness in reducing trail user conflicts, although the authors did not study the effectiveness of these techniques.

Keywords: Problem definition (general)

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ○ Useful Information: ●

E.1.7 Trail Construction and Maintenance Notebook

Hesselbarth, W., Vachowski, B., and M Davies. 2007. FHWA and United States Forest Service. <http://www.fhwa.dot.gov/environment/fspubs/07232806/index.htm>

This online resource is a handbook of Best Management Practices (BMPs) for physical trail construction and maintenance, particularly gravel and dirt trails. It was produced by the Forest Service in cooperation with the Recreational Trails Program (RTP), and several agencies report using it as a design resource in the Agency Survey.

The Trail Construction and Maintenance Notebook (Notebook) is based on the professional expertise and experience of the authors. A long list of contributors and reviewers indicates thorough oversight. The Notebook includes the following: guidance for drainage, erosion, grade, and alignment; tools and methods of trail construction; standards for decommissioning trails; and signs and wayfinding guidance.

The majority of the recommendations address drainage and other environmental concerns of trails, rather than addressing safety issues or conflicts between users. The Notebook recommends leaving tree stumps in order to minimize downhill trail creep, but it does not mention the possible speed control benefits.

Keywords: Design guidelines, width/passing area, user information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ○ Useful Information: ●

E.1.8 An Examination of the Characteristics, Preferences, and Attitudes of Mountain Bike Users of the National Forests

Hollenhorst, S. J., Schuett, M. A., Olson, D. & Chavez, D. 1993. Journal of Park and Recreation Administration, 13(3): 41-51. Report #PSW-920019CA

This report was conducted by a professor (Hollenhorst) and a master's student (Olson) in the Division of Forestry at West Virginia University and a professor in the Department of Health, Physical Education, and Recreation at Southwest Texas State University (Schuett), in cooperation with Deborah Chavez, of the USFS Pacific Southwest Experiment Station. This information is also presented in the shorter summary, *Conflicts and Issues to Mountain Biking in the National Forests: A Multimethodological Approach* (Hollenhorst, Schuett, Olson, & Chavez, 1995). IMBA cites this article on their website.

The study's objectives are to describe the demographic characteristics of mountain bikers and patterns of participation (participation rates, opportunity preferences, and patterns). The authors collected on-site questionnaires from 750 mountain bikers from May to September 1992. Locations included Monogahela National Forest in West Virginia; the Cleveland, Inyo, and San Bernadino National Forests in California; and the Sam Houston and Davy Crockett National Forests in Texas. The authors also conducted focus group interviews.

The authors found that mountain bikers are concerned with conflict with other users but are generally tolerant of other users. Mountain bikers also generally felt that other users should "change their outlook and maintain a less 'possessive' attitude about the trails and become more understanding of increases in trail usage by mountain bikers." The authors also asked why participants mountain bike, why mountain biking has become popular in national forests, and to identify important issues and problems facing mountain biking in national forests. They categorized these open-ended questions and concluded that, "A cooperative effort between mountain bicyclists, other user groups and the land managing agencies appears to be the most effective approach thus far." However, it is unclear how this conclusion was derived from the open-ended opinion data collected from users.

Keywords: Problem definition (user survey), user group meeting
 Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ○

E.1.9 A New Perspectives Approach in National Forest Recreation and its Application to Mountain Bike Management

Kulla, A. 1991. Ohio State University's Professional Development for Outdoor Recreation Managers/Planners Shortcourse.

Andy Kulla is a Recreation Specialist at Lolo National Forest in Missoula, Montana. This paper was written for the Utah State University's Professional Development for Outdoor Recreation Managers/Planners Shortcourse. IMBA cites this article on their website.

The paper recommends ways of adapting recreation management for limited budgets and increased workloads through increased user involvement and ownership. The intent is to "fully empower recreation user groups to promote care for the land and the development of coalitions that emphasize positive relationships between different types of recreationists." In particular, the goal is to empower user groups to care for the land, develop positive relationships with other recreationists, build coalitions with other groups, and do so in prior to the conflict stage.

Kulla argues the need for soft programs, such as working with groups on issues before they arise, rather than merely the hard programs of maintenance, trail improvement, etc. He recommends the following formula for involvement:

1. Identify whether the conflict is an emerging issue.
2. Determine who is interested in, or involved with, the issue.
3. Describe the situation, including public input.
4. Develop objectives for the manager and the users involved in the issue.

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5. Work with interested and affected people, groups, agencies, and companies.

Kulla applies this formula to mountain bikers in Missoula, Montana. He works with the group, Low Impact Mountain Bicyclists of Missoula (LIMB), which is a MOU between a mountain bike user group and the Lolo National Forest. The group formed five committees: an advisory group, a media group, a project opportunities group, an ambassadors group, and a membership group.

In the appendix, Kulla presents “A Hierarchy of Solutions to Mountain Bike Impact Emphasizing User Participation.” Solutions (generally presented in ranked order of least to greatest impact) include: signing, peer pressure, education, use roads (wider than trails), training programs, design, barriers, walk your bike, one-way only, post speed limits, patrolling, restrict cyclists by time, restrict cyclists by day, separate sections, construct separate routes, zoning, and close trail to cyclists. Interestingly, most of the last solutions (considered the most successful) involve restricting mountain bikers.

Keywords: Design guidelines, trail layout/availability, education, user group notification, user group meetings, user information, alternate use days, enforcement

Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ●

E.1.10 Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice

Moore, R. L. 1994. www.americantrails.org/resources/ManageMaintain/MooreConflictMgmt.html

Conflicts on Multiple-Use Trails (1994) is a well-referenced guide to trail user conflicts. The article is a synthesis of existing literature created by the National Trails Training Partnership for the Federal Highway Administration (FHWA). IMBA cites this article on their website. The article provides guidance for reducing user conflict through information, education, regulations, and enforcement.

Moore cites many other peer-reviewed articles, upon which he bases his conclusions. He notes that many trail managers and professional experts were involved in the research for and writing of the report.

Moore briefly discusses maintaining user safety, citing the following threats to user safety: collisions, reckless and irresponsible behavior, poor user preparation or judgment, unsafe conditions related to trail use (e.g., deep ruts, tracks on snow trail, etc.), unsafe conditions not related to trail use (e.g., obstacles, terrain, weather, river crossings, etc.), poor trail design, construction, maintenance or management, and other hazards (e.g., bears, lightning, cliffs, crime, etc.). His recommendations for maintaining safety on the trail include manager control or influence over the following factors:

- User speed (often has more to do with speed differential than speed itself)
- Mass of user and vehicle (if any)
- Sight distances
- Trail width
- Trail surface
- Congestion (e.g., number of users per mile)
- Users overtaking one another silently/without warning
- Trail difficulty (obstacles, terrain, condition, etc.)
- User skill level and experience
- User expectations and preparedness (e.g., walkers who understand they may see bicycles on a particular trail can better

prepare themselves for possible encounters)

- Emergency procedures
- On-site management presence

Moore focuses his analysis on conflicts between users, noting that no actual contact between users is necessary for conflicts to occur. He states that, “conflict has been found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users.” Conflicts arise and are exacerbated by many factors, including an increased demand for trail resources, increased use of existing trails, poor management, under-designed facilities, lack of user etiquette, and disregard for the varying abilities of trail users.

Moore identifies the following 12 principles for minimizing user conflicts on multi-use trails. The principles relevant to this study are listed below:

- Recognize conflict as goal interference.
- Provide adequate trail opportunities.
- Minimize number of contacts in problem areas.
- Involve users as early as possible.
- Understand user needs.
- Identify the actual sources of conflict.
- Work with affected users.
- Promote trail etiquette.
- Encourage positive interaction among different users.
- Favor "light-handed" management.
- Plan and act locally.
- Monitor progress.

Moore lists specific techniques that have been used for reducing user conflicts, separating responses into two categories: physical responses (i.e., design trails in a way that encourages users to behave in more appropriate ways) and management responses. Management responses are divided into “information and education” and “regulations and enforcement.”

Keywords: Problem definition (theoretical), design guidelines, trail layout/availability, education, user group notification, volunteer programs, events, user group meetings, user information

Objectivity: ● Applicability: ● Sustainability: ●

Thoroughness: ● Useful Information: ●

E.1.11 Cactus Forest Trail Environmental Assessment, Saguaro National Park, Arizona

National Park Service, Department of the Interior. 2003. National Park Service. (Public Review Draft)

This Environmental Assessment published by the National Park Service considers the impacts of reopening a section of the Cactus Forest Trail to mountain biker use. The trail had allowed mountain bikers but was closed due to “claims by an organization of environmental professionals that the trail was initially opened without proper authorization.” The three alternatives considered included (1) keeping the trail closed to

mountain bikers, (2) reopening the trail to mountain bikers, and (3) opening the trail to equestrians and mountain bikers on alternate days.

During the six month trial period, the park collected information on the amount of use, total number of complaints and compliments, major and minor incidents, and unauthorized mountain bike use in other areas of the park. The Service's stated visitor safety goal was to "identify recognizable threats to the safety and health of persons and to the protection of property." They recorded approximately 1,200 mountain bikers, representing nearly half of trail users. Three minor and no major conflicts occurred during that period: a complaint that a bicyclist yelled at a hiker; a complaint that three mountain bikers were riding too fast; and a ranger report that a bicyclist was stopped and advised to yield to equestrians.

The analysis found that "Visitor Use, Understanding, and Appreciation" may be increased for bikers and equestrians if mountain bikers were prohibited from the trail, but "given the number of other trails within the park that are closed to mountain bikes the impact to hikers and equestrians would be localized and of negligible to minor intensity." Impacts to local mountain bikers were seen as "adverse and long-term." Reopening the trail to mountain biker use would be beneficial for mountain bikers, and impacts to hikers and equestrians were seen as, "adverse, long-term, and minor." For visitor safety, the Environmental Assessment concludes that the impact of reopening the trail to mountain bikers would be negligible to minor, stating that, "given the past record of incidents on this trail, however, reinstating mountain bike use would not be considered an unsafe use if recreationists continued to abide by the required trail etiquette rules of the trail."

The discussion of the alternating days scenario noted that, while the potential for conflict would be reduced, "some recreationists may feel constrained, and others may be displaced," which was considered "adverse, short- to long-term, and of negligible to moderate intensity depending on the individual," with respect to impact. The safety evaluation found that, "the potential for accidents could vary depending on such factors as the ability of the rider and the number of other cyclists and hikers on the trail. Past incident reports, however, do not indicate that safety was an issue between bicyclists and other trail users."

The document concludes that the preferred alternative is to reopen the trail to mountain bike use, as not doing so would impact visitor safety and have "adverse, long-term, negligible to minor impacts."

Keywords:	Problem definition (count/incident data), alternate use days		
Objectivity:	●	Applicability	●
Thoroughness	●	Useful Information	●
		Sustainability:	●

E.1.12 Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedures

Rouphail N., J. Hummer, J. Milazzo II, P. Allen. 1998. FHWA.

Developed for the Highway Capacity Manual (HCM) for the 2000 update, this report presents a level of service (LOS) methodology for shared-use trails based on traffic-flow theory. LOS is the measure-of-effectiveness used to determine the flow of users on transportation infrastructure, based on passing and overtaking movements. The HCM recommendations are based on assumptions regarding the average speeds and speed distributions of bicycles and pedestrians and do not provide capacity or appropriate speeds for facilities.

The FHWA report, *Evaluation of Safety, Design, and Operation of Shared-Use Paths* (2006) notes several issues with the methodology used in this report:

- The LOS models are based in part on field data from The Netherlands, but have not been compared to U.S. data, on paths that are typically wider and with different bicycle types and skill levels.
- The procedure does not account for “passive passings” wherein the test bicyclist is passed by a faster user.
- The procedure assumes adequate room for passings, rather than “delayed overtakings” when users queue in order to pass.
- The procedure was developed with mopeds and tandem bicycles, but the presented model accounts for only bicyclists and pedestrians.
- The analysis assumes a single average speed for pedestrians and bicyclists.
- The analysis provides guidance for two-lane paths (8-foot wide) and three-lane paths (10-foot wide) exclusively.

Keywords: Problem definition (general), design guidelines

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.1.13 Characteristics of Emerging Road and Trail Users and Their Safety

Sprinkle Consulting. 2004. FHWA-HRT-04-104.

<http://www.fhwa.dot.gov/publications/research/safety/04104/roadstechbrief.pdf>

Prepared as part of the Pedestrian and Bicycle Safety Research Program, this FHWA report presents design features of ‘emerging’ nonmotorized road and trail users, including inline skaters, recumbent bicycles, and Segways for road and trail design standards. Data were collected to better understand the physical dimensions and operational characteristics at 21 data collection stations at three shared-use paths across the U.S. “Rides for Science” were publicized at the San Lorenzo River Trail in California, the Pinellas Trail in Florida, and the Paint Branch Trail in Maryland to encourage participation by targeted user groups.

Data collected include the following:

- Physical dimensions, including length, width, height, eye height, wheelbase, wheel spacing, wheel diameter, tire/wheel width, and tire type.
- Space required for a three-point turn.
- Lateral operating space (sweep width).
- Turning radii.
- Acceleration capabilities.
- Speed.
- Stopping sight distance and time (perception/reaction and braking distances).

The article provides 85th percentile performance values for design speed, stopping sight distance and horizontal alignment and compares the needs of these emerging user groups with existing AASHTO standards for bicycle and pedestrian facilities. The document provides specific, researched design needs of users on paved paths, although it does not address users on unpaved paths or equestrians.

Keywords: Width/passing areas, design speed

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.1.14 A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System

Tuler, S., Golding, D., Krueger, R.J. 2002.

<http://www.californiatrails.org/documents/NationalParkServiceSafety.pdf>

This article reviews literature about hazards, accidents and risks, especially those that may apply to visitors to National Parks. This article broadly covers the circumstances, behaviors and physical/psychological factors that contribute to hazardous situations, including natural disasters, weather, communication, preparedness, infrastructure, user characteristics, etc. The authors evaluate crowding and user conflict as contributors to stress that may induce risky behavior and physical harm. Several referenced studies examine bicycle-hiker conflict, which are included individually in this analysis.

Keywords: Problem definition (theoretical)

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.1.15 Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds

United States Department of Agriculture Forest Service. 2007. 0723-2816-MTDC

<http://www.fhwa.dot.gov/environment/fspubs/07232816/pdf07232816dpi72all.pdf>

This guidebook was published by the U.S. Forest Service, in cooperation with FHWA and funded by RTP. The document provides practical guidance for designing trails and other facilities for use by equestrians. It summarizes considerations for planning with horses in mind, including a 4-foot estimated width of the horse with a rider.

The planning trail systems chapter provides a list of questions for determining whether a trail is suitable for equestrian use. Questions pertinent to this Study include:

- Is the trail corridor wide enough to accommodate many trail users, including stock and their riders? Is the anticipated trail appropriate for equestrian use?
- Is the trail corridor free of hazards or potential safety problems that would affect riders? Do trail conditions, such as separate treads for different non-motorized users, promote a sense of safety?

While these questions show how trail design can influence user safety, the second bullet implies that physical design can influence perceptions of safety. The report refers to Moore (1994) for additional information on interactions between trail users.

The document quotes IMBA's trail etiquette, which includes, "Give animals extra room and time to adjust to you. When passing horses, always use special care and follow directions from the horseback riders (ask if uncertain). Running cattle and disturbing wildlife is a serious offense. Leave gates as you found them, or as marked."

Specific guidelines for designing trails to accommodate equestrians include the consideration that stock tend to travel about 18 inches from the edge of the tread surface, and have an approximately 2-foot shy distance from obstacles. The guide recommends a 5- to 6-foot tread with 'adequate clearance.'

A call-out box discussing 'Mixing Bicycle and Horse Use' states that equestrians' and bicyclists' ability to share a trail may reflect the local cycling style and local circumstances or customs. The guide explains the prevalence of separating users as being because the sudden appearance of bicyclists can unnerve stock, as well as equestrians' desire to ride on an natural surface surface. It provides guidelines for multiple tracked trails, including treads separated by distance. Additional guidelines pertain to recommended sight distance, tread and clearing widths, turn radii and switchbacks, and design of crossing features.

Keywords: Problem definition (general), design guidance, width/passing area, gradient design speed, sight lines, trail layout/availability

Objectivity: ● **Applicability:** ● **Sustainability:** ●

Thoroughness: ● **Useful Information:** ●

E.2 General Guidelines and Studies

E.2.1 Lightly on the Land: The SCA Trail-Building and Maintenance Manual

Robert C. Birkny and The Student Conservation Association, 2008

The Student Conservation Association (SCA) is a service organization dedicated to conservation and stewardship of wilderness, parks and nature sanctuaries. Their recommendations for design are developed from years of in the field experience building and maintaining trails through sensitive environmental areas.

This book is a comprehensive manual for natural surface trail construction and maintenance, covering topics of tools, design, drainage and working with various construction materials. Introduced into the second edition is a discussion of relationship building between land managers and volunteers, as well as an emphasis on sustainable trails to require a minimum level of maintenance.

This book does not discuss strategies to address trail user conflicts. The authors do discuss managing user behavior to prevent trespassing into sensitive environmental areas, with Birkney suggesting the use of physical barriers with control points on each end to prevent unwanted access. Beyond physical diversion, removal of tracks and/or planting vegetation can provide the sense that an area is being actively maintained, discouraging off-trail access.

Keywords:	Design guidance, width/passing areas, design speed, sight lines, trail layout/availability				
Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	○		

E.2.2 Greenways: A Guide to Planning, Design and Development

Flink, C. A., and R. M. Searns. 1993. Washington, D.C.: Island Press.

The authors are professional designers and planners who provide recommendations based on professional experience. This guide presents guidance for trail visioning, planning, design and construction process. Thorough descriptions of processes and step-by-step guidance walk the reader through designing a trail.

The book stresses the importance of designing greenways with specific users in mind to address safety concerns. Decisions about which user groups to accommodate should be based on an evaluation of the needs and desires of the community. Trail users can be grouped into two main categories: motorized and nonmotorized. Within this categorization, subcategories include: pedestrian, nonmotorized vehicular, nonmotorized water, pack and saddle animal users, motorized, and motorized water trail users.

Flink and Searns define a design-based framework for managing potential safety issues by classifying and designing trails as single/multiple use and single/multiple tread. Multiple-tread, multiple use trails can resolve safety issues through user segregation. Single-tread, multiple use trails can have usage-control features, such as signs or striping to separate trail users. Time of use restrictions may also be used to manage single use trail conflicts by limiting trail use to a single user group at different times, days, or months.

Establishing a trail user ordinance can resolve user conflict by requiring users to restrict speeds and manage passing, overtaking, behaviors at crossings, and other locations with a higher potential for incidents. While ordinances alone do not resolve these issues, they do provide a framework for enforcing uniform trail use regulations.

This book provides a practical framework for understanding users and trail typologies to establish the appropriate safety and user conflict strategies available.

Keywords:	Problem definition (general), design guidance, width/passing areas, design speed, user information, alternate use days, enforcement				
Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.2.3 Trails for the Twenty-First Century

Flink, C., Olka, K., Searns, R., Rails-to-Trails Conservancy. 1993. Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails. Island Press.

Trails for the Twenty-First Century was authored by Flink, Olka, and Searns, who are trail planning and designing professionals, along with the Rails-to-Trails Conservancy and the National Center for Recreation and Conservation Division of the National Park Service. The second edition was sponsored by the Federal Highway Administration (FHWA).

The book “was written to help those who are planning, designing, building, and managing multi-use trails” and presents a thorough discussion of considerations for both paved and soft-surface trails, as well as designing trails to accommodate multi-use.

Flink, Olka, and Searns advocate for designing trails with specific users in mind to avoid conflict and unsafe trail conditions. *Trails for the Twenty-First Century* states that speed issues are better addressed through design, as speed limits require consistent, ongoing enforcement and may not improve real or perceived safety on the trail. Where speed limits are created, strategies to increase compliance can include informing users of the regulations, communicating the reasons for regulations to the users affected, and considering sentencing trail offenders to work service on the trail as part (or all) of their penalty.

They propose six alternative layouts for land-based trails, varying single or multiple treads, and responding to the number of user types. Users can also be separated via time of use, zoning, and skill levels or preferences.

The book presents a case study on ‘Resolving Conflicts between Cyclists and Equestrians’ that highlights ROMP n’ STOMP events where equestrians and mountain bikers use trails together to build partnerships and mutual understanding. The recommended response to conflict issues is therefore to improve perceptions of other users.

Keywords: Problem definition (general), design guidance, width/passing areas, design speed, sight lines, trail layout/availability, education, alter nature use days, rules & regulation, enforcement

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.2.4 Trail Planning, Design, and Development Guidelines

MN Dept of Natural Resources. 2006. St. Paul, MN: State of Minnesota.

This guidebook seeks to establish a consistent set of guidelines for motorized and non-motorized trails, developed through practices common to Minnesota. The guide covers planning, design, materials, and special considerations for winter-use trails. The book promotes proper trail design to manage speed, increase safety, and reduce conflict.

The guide provides typical design dimensions to accommodate different types of users for travel and maneuvering. Failing to accommodate the expected types and volume of users could lead to increased levels of conflict and increased propensity for accidents.

Varying travel speeds can be managed through the use of different design patterns. Introducing a curved path or other visual cues can slow users to appropriate speeds where necessary. In some cases, design speeds cannot be easily artificially lowered, and the trail should be designed to accommodate higher speeds. Other considerations to promote safety include appropriate curve radii, gradients, clearance zones, and sight distances. On paved trails, the authors recommend use of pavement markings and white/yellow lines to establish expectations for users of shared-use paths.

This guide is comprehensive in its approach to trail design and maintenance, and offers a strong basis for understanding the operating space needs of different users. The guide focuses on design approaches as the foundation for managing safety issues and user conflict.

Keywords:	Problem definition (general), design guidelines, width/passing areas, gradient, design speed, trail layout/availability, user information				
Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.2.5 Results of the Two Year Mountain Bicycle Trail Study

North Carolina Division of Parks and Recreation. 1993. North Carolina Division of Parks and Recreation, Department of Environment, Health and Natural Resources.

This study was conducted by the North Carolina Division of Parks and Recreation (NC CSP) in response to the department's recognition that its "lack of mountain bicycle trail management experience would make it difficult to reach or defend any decision to permit or deny mountain bicycling use within units of the state park system." It was developed by a Quality Action Team comprised of:

- Walt Gravley, Superintendent, South Mountains State Park.
- Ob Davies, Chief Ranger, William B. Umstead State Park.
- Marshall Ellis, Natural Resource Management Section.
- Darrell McBane, State Trails Coordinator.
- Tom Potter, Regional Trails Specialist.
- Dwayne Stutzman, Regional Trails Specialist.

IMBA cites this article on their website.

NC CSP initially surveyed other state parks systems to gather information on how to manage mountain bikers. However, the information was inconclusive, and a two-year study was commissioned. Mountain bikers were allowed on designated multi-use trails in William B. Umstead State Park and South Mountains State Park, and significant data was collected to support the conclusions.

One of the surfaces tested in the experiment was an 8-foot wide roadbed with a compacted soil surface; other trails were paved or wider. Criteria selected to study the effects of mountain bikers included natural resource protection, visitor safety, operational impacts, and user satisfaction. Visitor safety was measured by case incident reports filed and user comments.

Three incidents occurred during the study period; all were accidents that did not involve other users. Staff did receive several verbal comments, predominantly from equestrians who questioned mountain bikers' presence on the trails, in particular on the first half-mile of trails from the parking lot. Complaints included mountain bikers weaving in and out of traffic and passing too closely to hikers at high speeds and without warning.

NC CSP also found that an average of two staff-hours per week were required to monitor the multi-use trail conditions, while 10 staff-hours were required to respond to complaints resulting from mountain biker use. In addition, mountain bikers noted that the wide road was a less-desirable trail than a narrower 18- to 24-inch singletrack. The report recommends having mountain bikers walk near the trailhead, where more users are present.

Keywords: Problem definition (count data), design guidelines, width/passing areas, user information

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.2.6 Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails

Parker, T. S. 2004. Boulder, CO: Natureshape.

This book covers the philosophy and design behind natural surface trail development. Common problems are identified and solutions are discussed. User conflicts are not covered in this book.

Keywords: Design guidelines

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	○		

E.3 State Guidelines and Studies

E.3.1 Trail Planning for California Communities

Bondurant, J., L.Thompson et. al... 2009. Solano Press Books

This 400-page book is a comprehensive guide for recreational trail planning. The primary authors are (Bondurant) a Senior Park Planner with EBRPD and (Thompson) the manager of the San Francisco Bay Trail Project. Many other “contributing partners” also assisted with the development of the guide.

The guide presents detailed recommendations about policy and regulation, community involvement in trail building, legal responsibilities, trail design, permitting, funding, and maintenance. It describes and proposes designs that separate users or serve particular groups of users, and references existing, successful trail designs and planning measures.

Trails particularly relevant to this Study are fire roads and wildland trails, although the guide does not provide specific instructions for selecting width or mitigating user conflicts on a single-track.

Bondurant presents a wide range of design, planning, and management considerations and specifications. Those that are pertinent to this Study are included in the findings and recommendations in the Study.

Keywords: Problem definition (general), design guidelines, width/passing areas, gradient, design speed, sight lines, trail layout/availability, user information

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.3.2 California State Parks Accessibility Guidelines

California State Parks. 2005.

The Accessibility Guidelines provide general information related to laws and regulations for Parks and Recreation staff. Section 40 addresses issues for trails. The guidelines state that “trails provide the means for the activity of hiking.” The guide recommends installing and maintaining accessible trails wherever hiking is

considered one of the primary activities or where there is a large concentration of trails. Specific guidelines are provided for running and cross-slopes, resting spaces, obstacles, and other design features.

Keywords: Design guidelines, width/passing areas, gradient

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.3.3 California Highway Design Manual Chapter 1000

Caltrans. 2009. <http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm>

The California Highway Design Manual (HDM) defines a Class I Bikeway or Bike Path as “a completely separated right of way for the exclusive use of bicycles and pedestrians with crossflow by motorists minimized.” When defining Class I bikeways, the HDM states that, “experience has shown that if significant pedestrian use is anticipated, separate facilities for pedestrians are necessary to minimize conflicts. Dual use by pedestrians and bicycles is undesirable, and the two should be separated wherever possible.” The guidance is primarily related to on-street bikeways and paved shared-use paths.

The guidance establishes the minimum design speed for a bike path as 25 miles per hour, except where mopeds are permitted or where located on a long downgrade, where design speed should be 30 mph. The HDM clearly discourages the use of bicycle traffic calming on shared-use paths, stating that, “Installation of ‘speed bumps’ or other similar surface obstructions, intended to cause bicyclists to slow down in advance of intersections or other geometric constraints, shall not be used. These devices cannot compensate for improper design.” The HDM recommends barrier posts exclusively to discourage motorized vehicle use of the path and not for slowing bicyclists.

The HDM encourages separation between bicyclists and pedestrians, as well as alternative treatments to reduce safety issues, including additional width, signing and pavement markings.

Keywords: Design guidance, width/passing areas, design speed

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.3.4 California Manual on Uniform Traffic Control Devices

Caltrans. Draft 2011.

http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd2011_draftrevisions.htm

The California *Manual on Uniform Traffic Control Devices* (CAMUTCD) provides guidance for the use of signs and pavement markings on roadways and bikeways in California. The CAMUTCD discusses use of the ‘Shared-Use Path Restriction’ sign (R9-7; Section 9B.11).

Chapter 9C provides guidance for the use of pavement markings on shared-use paths. The CAMUTCD offers the option of marking patterns and colors on shared-use paths, stating that, “Where shared-use paths are of sufficient width to designate two minimum width lanes, a solid yellow line may be used to separate the two directions of travel where passing is not permitted, and a broken yellow line may be used where passing is permitted (Section 9C.03).

The CAMUTCD recommends the use of centerline markings, particularly in the following circumstances:

- Where there is heavy use;
- On curves with restricted sight distance; and,
- Where the path is unlighted and nighttime riding is expected.

Keywords: Design guidelines, user information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.4 Local Jurisdiction Guidelines and Studies

E.4.1 Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers

Anderson, D.H., Lime, D. W., and T.L. Wang. 1998. St. Paul: University of Minnesota Extension Service.

http://cpsp.cfans.umn.edu/publications/revtactics_handbook.pdf

Background and Context

This handbook provides resource managers with a step-by-step, easy-to-use process for identifying and defining unacceptable impacts to biological and cultural resources and to visitor experiences, and identifies strategies and tactics to address unacceptable impacts to resources and experiences. The handbook was commissioned by the National Park Service (Denver Service Center) as a complement to the Visitor

Experience and Resource Protection (VERP) framework.

The handbook was field-tested in 1997 in four National Park Service units (Arches, Mesa Verde, Grand Teton, and Yellowstone national parks) and is built on the publications by Cole, Petersen, and Lucas (1987), *Managing wilderness recreation use: Common problems and potential solutions*; and Cole (1989b), *Low-impact recreational practices for wilderness and backcountry*.

Methodology

The handbook defines a decision process of five stages: (1) problem awareness, (2) problem specification, (3) strategy and tactic selection, (4) plan implementation, and (5) monitoring. Problems are defined as unacceptable visitor-caused impacts to biophysical resources and visitor experiences.

Findings

Problems related to visitor experiences include:

- Visitor conflicts due to incompatible uses, encounters with large groups or parties dissimilar to one's own, or rowdiness by itself or in combination with excessive consumption of alcohol and visitor displacement (spatial, temporal, or total).

- Inadequate or inappropriate levels of access to facilities, natural areas, or cultural resources; facility design that fails to accommodate the needs of the broadest possible spectrum of people, including persons with disabilities.
- Threats to visitor safety, behavior that jeopardizes the safety of the individual or of other visitors, failure to maintain a safe environment through facility design, maintenance, or other means.

The handbook provides three worksheets associated with the decision process, which are used for problem specification, to define what the acceptable resource condition would be and what the existing impact is, and finally the possible causes of any impacts that are determined to be unacceptable or approaching unacceptable levels. If indicators or standards are not prescribed for a given impact, the manager determined what is acceptable or how much impact can be tolerated before management intervention is required.

The handbook outlines five general management strategies to address unacceptable impacts:

- “Modify the character of visitor use by controlling where use occurs, when use occurs, what type of use occurs, and how visitors behave.
- Modify the resource base by increasing resource durability or maintaining/rehabilitating the resource.
- Increase the supply of recreation opportunities.
- Reduce use in the entire area, or in problem areas only.
- Modify visitor attitudes and expectations.”

Strategies included in the workbook include: site management, rationing and allocation, regulation, deterrence and enforcement, and visitor education.

The second half of the handbook describes specific treatments. The section on site management primarily addresses environmental impacts with recommendations for facility design to maximize compatibility with adjacent uses and other aesthetic qualities, as well as reducing conflicts between users, but it does not provide specific guidelines such as minimum widths or sight lines. Non-regulatory recommendations to reduce user conflicts include site management, rationing and allocation, deterrence and enforcement, and visitor education.

Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers recommends the following selection criteria for management tactics:

- Does the tactic adequately address the root cause of the visitor use problem?
- Is the tactic direct or indirect in terms of how it operates on visitor behavior?
- Is the tactic subtle or obtrusive in terms of visitor awareness of being managed?
- Does the tactic preserve visitor freedom of choice?
- Does the tactic affect visitors offsite during the planning stages of their trip? Or does the tactic affect visitors onsite while they are engaged in their recreational experience?
- Does the tactic affect a large or small number of visitors? Are those affected primarily visitors who are generally not responsible for the impact(s) in question?
- Does the tactic affect an activity to which some visitors attach a great deal of importance?
- Are visitors likely to resist the management action?
- What are the costs to managers in terms of tactic implementation and administration, including facility construction, operation, and maintenance, staff workload, and communication and enforcement costs? Are any of these limiting factors?
- How effective is the tactic likely to be at solving the visitor use problem in question?
- Is the tactic likely to lead to the creation of a new problem?

(Anderson, Lime, and Wang, 1998)

Site management strategies aim to “direct and channel use” and primarily address environmental concerns through resource hardening, increasing/decreasing the number of facilities, improving/not improving facilities, and closing areas. The authors state that curvilinear design “may be used to eliminate unacceptable impacts to visitor experience.” One specific recommendation related to mitigating conflict issues is to use a rope or fence barrier to separate pedestrians travelling in different directions. Another is to provide additional trails to reduce congestion on popular trails.

Rationing strategies address localized visitor use problems and include limiting access via reservations, queuing (first-come first-serve) system, lotteries, merit/eligibility system, and charging fees. The majority of these refer to public versus private uses or reservation/permitting systems, which are less appropriate at for single-day use due to the work involved with issuance and enforcement. The authors note that sanctions can be effective, but at high cost to management. The authors also state that the management problem is often the distribution of recreationists, rather than the total number, so these strategies should be coupled with other management techniques.

Deterrence and enforcement strategies include providing signs, sanctioning visitors who engage in noncompliant behavior, and providing personnel and law enforcement. The authors recognize that, while signs are an important accompaniment to policies and education, success relies on user attention. They conclude that personnel and law enforcement can serve as an effective reminder of regulations.

The chapter on visitor education defines key conditions for visitor education to be effective: visitors must regard the behavior advocated by park managers as personally desirable and important messages must be communicated so they facilitate visitor acceptance. Education is more effective in combination with other tactics, and the authors state that, “educating visitors about appropriate behavior will be more effective when visitors: (1) are highly motivated to change their behavior to protect the biophysical environment, (2) are motivated to adjust their behavior so it better reflects values toward natural and cultural areas they already hold, and (3) understand the reason for the management action.”

The section addressing regulation discourages managers from using regulation where effective non-regulatory alternatives exist. Regulatory strategies that can address user conflicts include the following:

- Restrict access to specific locations (zoning) – ensure that only regulations necessary to realize management goals are implemented.

Restrict/prohibit activities – a highly obtrusive regulation that can “lead to a strong sense of ‘being managed’ on the part of the visitor which can lead to a climate of conflict.

Keywords: Problem definition (theoretical), trail layout/availability, education, user information, alternate use days, rules and regulations

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.4.2 Recreation Conflict at Six Boulder County Parks and Open Space Properties: a Baseline Study

Bauer, M. 2004. <http://www.californiatrails.org/documents/ConflOutdoorRec2.pdf>

This report on a user survey conducted in Colorado provides baseline data on perceived user conflicts in six county parks, informing management decisions and future surveys. It was prepared by an interpretive specialist at Boulder County Parks and Open Space and reviewed by an independent leisure studies consultant, Marcella Wells, Ph.D.

The study directly asked respondents if and how others interfered with their goals or enjoyment of the trail, considering hikers, bikers, pedestrians, and dog walkers. The study found that the majority of users never experienced conflict and only two percent experienced conflict on the day of the survey. Overall, a third of respondents reported that they had even experienced conflicts with other users on the trails. Pedestrians are more likely than mountain bikers to perceive conflict associated with speed, yielding and communication on behalf of bikers, whereas bikers reported little conflict with pedestrians. Other concerns included dogs being off-leash and the presence of horse feces.

The survey did not ask about the nature of the conflict; whether users had to stand aside to let another user pass, felt physically unsafe, or if the presence or actions of other users detracted from their experience. The prevalence of reported complaints and infrequency of incidents is commensurate with other reports.

Keywords: Problem definition (user survey)

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ① Useful Information: ①

E.4.3 Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia

*Chiu, L. and L. Kriwoken. 2003. *Annals of Leisure Research*. 6:4, 339-361*

Written at the University of Tasmania, Australia, this article examines management strategies for recreational mountain biking for the Wellington Park Management Trust. Study methods include a questionnaire survey of mountain bikers and other park users, as well as an environmental impact study of mountain biking. The study was conducted in Wellington Park, Tasmania, an 18,250 hectare park that has about 250,000 visitors a year. A separate survey form was developed for mountain bikers and for other users, asking reasons for visiting the park, recreational setting and track preferences, perceived user-group conflicts, and preferences for different management options. IMBA cites this article on their website.

The survey found that conflicts between mountain bikers and other recreational users were uncommon and users were generally tolerant of mixing uses. Mountain bikers and other users tended to visit the park for the same reasons ('exercise' and 'appreciation of nature/scenery'), although mountain bikers also came for 'socializing' and 'excitement/risk', while other users also responded 'relaxation.' Non-bikers' concerns are primarily related to bikers travelling at excessive speeds and not giving a warning on approach. All users' preferred management strategy was self-regulation, while non-mountain bikers were more likely to desire a code of conduct and right-of-way principles.

The study recommends informing other users of mountain bikers' legitimate right to a trail, encouraging other users to be prepared for an encounter. Design solutions to managing safety issues include "leaving obstacles and rough surfaces to slow users down; re-routing tracks on low slope angles across hills rather than straight up them; and avoiding sharp corners on steep descents." The authors also recommend user education, particularly about the needs of other users and appropriate behavior, as well as maintenance to minimize safety concerns and environmental damage. The questionnaire inquired about users' perceptions of each management technique, and did not determine their efficacy.

Keywords: Problem definition (user survey), speed control features, sight lines, education, user information

Objectivity: ☒ Applicability: ☒ Sustainability: ☐

Thoroughness: ☒ Useful Information: ☒

E.4.4 Trail Design Guidelines for Portland's Park System

City of Portland Parks & Recreation. 2009. [atfiles.org/files/pdf/DesignGuidelinesPortland09.pdf](https://files.org/files/pdf/DesignGuidelinesPortland09.pdf)

Design guidelines for Portland's trail system were developed by Portland Parks & Recreation (PP&R) in 2009 after the City's Parks 2020 Vision identified a lack of trail standards to be an issue.

The guidelines are developed from PP&R's experience with the trail system in Portland, and included a list of contributors and reviewers.

The first issue considered in the guidelines' design philosophy is safety. While the discussion primarily addresses user separation from motor vehicles, it also notes that different trail users may travel at differing speeds. Accessibility is another design philosophy, which highlights PP&R's desire to provide trails at a range of challenge levels. The guidelines recommend public process and review by the Portland Citizens' Disability Advisory Committee (PDAC) to determine what level of accessibility a given trail should provide.

The guidelines provide design and use standards for all types of single use trails, as well as multi-use trails. The trail type pertinent to this Study is Type J: hiking/mountain biking trails (equestrian use is allowed). The guidelines clarify the equestrians and dog walkers are minor uses on hiking/mountain biking trails, while mountain bikers are not allowed on hiking/equestrian trails. Mountain bikers, equestrians, and hikers are also allowed on fire roads or wider gravel trails.

Hiking/mountain biking trails/equestrian trails should be 4 feet wide with passing areas at a minimum, 10 feet maximum width. The easement width should be 10 feet in addition to the tread width. Native herbaceous plants can be allowed to revegetate all but the trail bed. The discussion noted that these widths allow side-by-side hiking or riding, or room for on-coming or overtaking trail users. Grades should be 0 to 5 percent slope or up to 12 percent as needed, but the trail does not have the obstacles desired by expert riders. These trails should be ADA-accessible, although the surface is not reliably firm and slip resistant. Sight distance should be 40 to 100 feet, "depending on speed/flow," and turn radii should be 10 feet minimum. The guidance also recommends retaining large stable round rocks at the surface of the trailhead, while removing pointed or loose stones.

Hiking and equestrian trails are designed for single-file walking, running, and horse riding. Dogs must be on leash. Trail width should be 4 to 10 feet with an additional 10 feet for the easement. Standard grades are 0-12 percent slope (5 percent maximum preferred). Sight distance is 50 to 100 feet and turning radius guidance is

to “avoid sharp turns.” In addition, the guidance states that, “Bicycles are specifically not allowed in order to not startle more nervous horses.”

Keywords: Design guidelines, width/passing areas, gradient, design speed, trail layout/availability, sight lines

Objectivity: ● Applicability: ● Sustainability: ●

Thoroughness: ● Useful Information: ●

E.4.5 City of San Jose Council Agenda 03-29-11: Trail Safety Enhancements

City of San Jose. 2011. http://www.sanjoseca.gov/clerk/Agenda/20110329/20110329_0501.pdf

This memorandum on trail safety enhancements was produced by Albert Balagso, Director of Parks, Recreation and Neighborhood Services and David Sykes, Acting Director of Public Works. The memorandum recommends that San Jose’s Mayor and City Council accept the staff report and work plan to install new signage, striping, and mileage markers along City trails. The report is the result of an accident on the Los Alamitos Creek Trail, wherein a woman died in September 2009. The report explains the rationale for not pursuing a prohibition on bicycle riding with leashed dogs. This memorandum refers to user conflicts on paved trails and is therefore not included in this analysis.

Keywords: Problem definition (incident data), user information

Objectivity: ● Applicability: ○ Sustainability: ○

Thoroughness: ● Useful Information: ○

E.4.6 Trail Signage Guidelines

City of San Jose Trail Program. 2010.

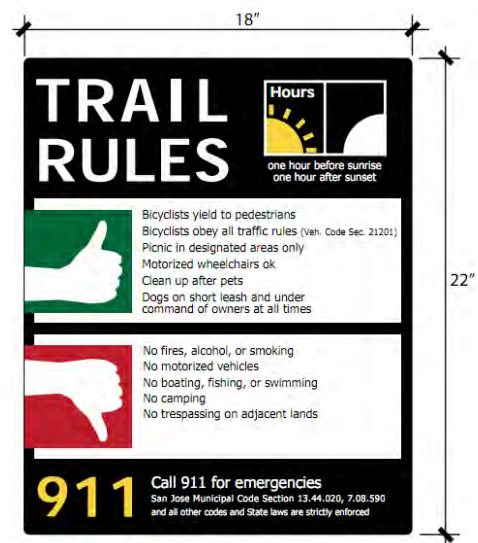
http://www.sjparks.org/Trails/Reports/TrailSignageGuidelines_low-res.pdf

This recent planning study for the City of San Jose presents comprehensive guidelines for the development of signs on trails in the City of San Jose. The guidelines include an etiquette sign, which reminds bicyclists to yield to pedestrians and to obey traffic rules. The signs are intended for paved paths, rather than unpaved facilities, and are not relevant to this study.

Keywords: User information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●



E.4.7 Forest Park - Access, Circulation, and Parking Study

City of St. Louis Board of Public Service. 2008.

<http://stlouis.missouri.org/citygov/parks/forestpark/ParkingReport.pdf>

The *Forest Park - Access, Circulation, and Parking Study* was prepared for the City of St. Louis Board of Public Service in 2008 by Crawford, Bunte, Brammeier Traffic and Transportation Engineers. At 1,731 acres, Forest Park is one of the largest urban parks in the United States. Forest Park has a Dual Path System made up of hard surface ('wheels') and soft surface ('heels'), which are paired in a loop along the perimeter of the park. Sidewalks and dirt trails provide connections through the interior of the park.

The study collected more than 50 traffic counts, as well as extensive parking surveys, a thorough walkability/bikeability audit, transit studies, reviews of several previous studies, an in-park user survey, and demographic reviews.

The study indicates that because portions of the dual system are not complete, many pedestrians use the hard surface path. Conflicts arise between bicyclists, skaters, walkers and joggers due to speed differentials. Users report being frustrated when walkers and joggers do not return to the 'heels' path when it resumes. Because pedestrians walk on the hard-surface trails, some bicyclists use the park roads instead of the paths.

The top four park-wide recommendations are for the completion of the dual system so that pedestrians can travel exclusively on the soft-surface trails designated for their use. Another related recommendation is to develop a comprehensive wayfinding signage plan. Opportunities are identified for making the park's roadways friendlier for bicyclists. Another recommendation is to construct the soft-surface (heels) portion of the dual path nearest to the road, as it was observed that pedestrians often have a 'sidewalk instinct' that leads them to use the first path they cross when walking from the road or parking lot. "Share the Road" concepts are also recommended, along with increased lighting and enhanced pedestrian facilities.

Keywords: Problem definition (user survey), trail layout/availability

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.4.8 Speed Limits on Recreational Bicycle Paths

City of Vancouver, B.C. General Manager of Engineering Services. 1995.

<http://vancouver.ca/ctyclerk/cclerk/951207/vtc1.htm>

This policy report to the Vancouver Traffic Commission was produced by the General Manager of Engineering Services in Vancouver, British Columbia. In 1994, Vancouver implemented a 15 km/h (9 mph) speed limit for bicyclists on the Seaside Bicycle Route and Stanley Park Seawall for a trial period. This report was written the following year, when the Vancouver Traffic Commission considered whether to retain this speed limit.

Engineering Services recommended retaining the 15 km/h posted speed limit on shared path portions of the Seaside Bicycle Route. Speed checks taken before and after use of the speed limit signs are inconclusive, but show few cyclists exceeding 10 km/h over the limit (6 mph), with average speeds between 17 and 18 km/h (10 to 11 mph). The policy report states that the Bicycle Advisory Committee supports the retention of the speed

limit. No money for enforcement was available, and the report concludes that no negative impacts were identified. The 15 km/h signs are still posted as of 2011.

Keywords: Design speed, user information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.4.9 Narrow Natural Surface Trails: Managing Multiple Users

East Bay Regional Parks District. 2011.

http://www.ebparks.org/files/ebrpd_Narrow_Trail_Study_FINAL_03_24_2011.pdf

This 2011 study from the East Bay Regional Parks District (EBPRD) identifies and discusses specific management approaches for narrow natural surface trails in the San Francisco Bay Area.

Methodology

The study includes a survey of 15 park and open space management agencies requesting information on their agency's trail use practices, planning policies, environmental review, maintenance activities and enforcement practices.

Findings

The executive summary states the following general consensus findings:

- “Trails designed with multiple use in mind are more successful in accommodating multiple uses, such as hiking, equestrians and bicycling than trying to adapt existing trails for multiple use.
- Designating allowable uses when a trail is initially constructed and opened is more successful in gaining public acceptance that initiating use changes over time, especially in popular parks where existing use patterns are well established.
- Providing regulatory information simultaneously multiple ways through park signage, a web site and staff and volunteer presence serve as the most effective way to reach out and inform trail users.
- Fewer regulations consistently applied and enforced yields greatest compliance.”

The survey was an in-depth analysis of park and open space managers' experience with managing multiple uses on narrow natural surface trails. The 15 agencies surveyed by EBRPD have differing standards for narrow natural surface trails, shown in Table E-4.

Table E-4. Agency Definition of Narrow Multi-Use TrailsFrom *Narrow Natural Surface Trails: Managing Multiple Users* (EBRPD, 2011)

Agency	Agency Definition of Narrow Trails
Marin County Open Space District	3 to 3.5 feet wide with 8 feet of lateral clearance
Midpeninsula Regional Open Space District	6 to 10 feet wide (Class A, widest) 4 to 6 feet wide (Class B, intermediate) 2 to 4 feet wide (Class C, narrowest classification)
Santa Clara County Parks and Recreation Department	4 to 6 foot wide (narrow trails limited to mountain areas)
California State Parks	Less than 60 inches wide (Roads are defined as greater than 60 inches)
East Bay Regional Park District	Less than 8 feet wide

Agencies employ a variety of techniques to manage users on narrow natural surface trails. Key findings are summarized in Table E-5. In addition to these, the survey found that, “Participating managers surveyed noted that some of the strategies being used, especially those intended to control speed (e.g., pinch points, uneven surfaces), may render the trail less accessible to those with mobility impairments.” Agencies must balance providing facilities that are suitable for all users.

Table E-5. Findings –Summary of Managers’ Survey Findings, *Narrow Natural Surface Trails: Managing Multiple Users* (EBRPD, 2011)

Tool	Strategies that have been successful with participating agencies	Strategies that have created management challenges for participating agencies
Design	Moderate grades Good sightlines Bench width Grade reversals Features to minimize conflict	Combining use on trails not designed for multiple use Design that benefits one user can be an obstacle to another Encouraging speed differential with sustained steep grades
Use Distinctions	Multi-use from day one Plan out uses before opening Design for multi-use intent Construct and restore the land before opening Create opportunity for cooperative use Separate users: Separate by park Separate at trailheads Separate by trail	Combining uses on crowded trails More challenging to safely manage many different uses where use is high Every potential conflict is magnified High use areas require user limitations
Signage	Regulatory/wayfinding signage that clearly communicates What is an official trail and what is not? What people need to know in order to comply What people need to know to recreate at a comfortable skill, mobility level	Lack of signage Leads to confusion Lack of information on conditions can create poor or dangerous trail experiences Add to misuse of existing trails, use of bootleg trails
Enforcement	Consistent enforcement Regulatory compliance on trails requires consistent enforcement This does not come for free Communicate/educate through enforcement	Complex regulations Uphill only One way loop Alternate day Inconsistent Enforcement Low commitment equals limited effectiveness People will do what they think they can get away with People are angry with inconsistency Self Regulation Dependent on a small and local user group Ownership is key, fee and membership base Generally not effective in publicly-managed park lands

The study also addresses outreach and education techniques, noting the difficulty with assessment of these strategies; “The success of outreach and educational programs in promoting compliance with trail use policies varies considerably across the region with no obvious factors determining the difference between success and failure.” Nevertheless, several agencies cited education and outreach techniques that they had found to have a positive impact. Examples include the Marin County Open Space District’s sponsorship of mountain biking races and running and mountain biking user groups’ use of EBPRD’s trails for training.

While the survey only briefly addresses environmental impacts of mountain bikes, it does include consideration of management strategies directed at minimizing those impacts.

Keywords: Problem definition (general), design guidelines, width/passing areas, speed control treatments, curvilinear design, education, events, user group meetings, user information, enforcement

Objectivity: ● **Applicability:** ● **Sustainability:** ○

Thoroughness: ○ **Useful Information:** ●

E.4.10 Trail Use Guidelines and Mitigation Measures

Midpeninsula Regional Open Space District. 1993.

Adopted by the Board of Directors in January 1993, this document “represents a comprehensive strategy for implementing the Midpeninsula Regional Open Space District Trail Use Policies.” It includes trail use guidelines, including the definition of three trail classifications to designate suitable trail uses. Designations are shown in **Table E-6**.

Table E-6. Trail Designations, Trail Use Guidelines and Mitigation Measures (Midpeninsula Regional Open Space District, 1993)

	Use	Width (feet)	Grade	Side Slope	Line of Sight
Class A	Hiking, running, equestrian, bicycling	6 to 10	Varying	Varying	>75 feet
Class B	Hiking, running, equestrian, bicycling	4 to 6	<15%	<30%	>100 feet
Class C	Hiking, running	2 to 4	Varying	>30%	>50 feet

Keywords: Design guidelines, width/passing areas, gradient, sight line

Objectivity: ● **Applicability:** ● **Sustainability:** ○

Thoroughness: ● **Useful Information:** ●

E.4.11 Mountain Biking in the Canadian Rocky Mountains: A situational analysis

Mosedale, J. 2002. The Canadian Environmental Network.

This article was published through the Canadian Environmental Network and is a survey of mountain bike management strategies at parks from Fernie, British Columbia, to Edson, Alberta. Respondents included

protecting and land use agencies, as well as mountain bikers. Mosedale presents finding of issues by location, which are a description of partnerships and driving forces behind mountain biker management. The article cites some studies that indicate mountain bikes do not cause environmental stress, but acknowledges that the study did not conduct a Literature Review on that subject.

Management strategies employed to minimize user conflict include: closures and other restrictions, user group separation, education and information, trail use designation, communication, and volunteer patrols. Mosedale also notes that Parks Canada has changed its management strategy as a result of closing a trail to mountain biking without involving local mountain biking groups. He concludes by recommending regional collaboration for management of mountain biking, as use shifts regionally as a result of management decisions.

Keywords: Problem definition (manager and user survey), trail layout/availability, education, volunteer programs, user group meetings, user information

Objectivity:	●	Applicability	●	Sustainability:	○
Thoroughness	○	Useful Information	●		

E.4.12 Adoption of Negative Declaration and Policy Related to New Off Road Bicycle Trail in County Parks

Santa Clara County. 1989.

This proposed Negative Declaration for CEQA finds that the Santa Clara County Parks and Recreation Department Off-Road Bike Policy will not have a significant impact on the environment, based on studies conducted by the County. Published by the Public Services Agency of the Santa Clara County Parks and Recreation Department, the trail policy permits off-road bicycle uses in seven Santa Clara Parks. IMBA cites this article on their website.

The accompanying report enumerates the fiscal implications of the project, which include trail improvements and ongoing maintenance and operational costs. In addition, it cites two studies undertaken for the application. A survey of County park visitors identified user conflicts, while the other study considered the extent of erosion caused by mountain bikers. Proposed policy modifications include educating the public at each affected park, posting trail yield instruction signs at trailheads, increasing the trail patrol, advocating the use of volunteer trail patrols, citing violators of trail policy, designating trail closure when trail conditions present safety and/or environmental concerns, and ensuring that all designated trails conform to policy facility standards.

Where trails were considered too steep and/or narrow to accommodate multiple uses, the County recommends designating a one-way section and/or having mountain bikers walk, including posting signs and increasing patrols.

Keywords: Problem definition (user survey), education, volunteer programs, user information, rules and regulations, enforcement

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.4.13 Trail Maintenance and Management: We Built it And They Came

Searns, R., B. Woodcock & J. Pflaum. 2007. National Trails Training Partnership.

www.americantrails.org/resources/ManageMaintain/ManageMCSearns.html

This short case study posted on the National Trails Training Partnership discusses physical measures undertaken to calm bicycle traffic and reduce safety issues and conflict between bicyclists and pedestrians on a popular regional trail south of Denver. It was co-authored by the Chair of American Trails (Searns), a civic engineer who designed side trail and roundabout (Pflaum), and the Manager of Planning and Development with the South Suburban Park and Recreation District in Littleton, Colorado (Woodcock).

The treatments discussed include a 15 miles per hour speed limit enforced with harsh penalties, centerline striping, a parallel pedestrian path, and bicycle roundabouts. At the time of the writings, the traffic calming impacts of the roundabouts was not clear.

Keywords: Speed control features, rules and regulations

Objectivity: ☒ Applicability: ☒ Sustainability: ☐

Thoroughness: ☐ Useful Information: ☒

E.4.14 Santa Monica Mountains Area Recreational Trail Coordination Project

Santa Monica Mountains National Recreation Area. 1997.

<http://www.nps.gov/samo/parkmgmt/smmartreportsept1997.htm>

A cooperative effort of the Santa Monica Mountains Area Recreation Trails Coordination Project, this project was facilitated by the Rivers, Trails and Conservation Assistance Program of the National Park Service. The report is a summary of a collaborative effort to improve the trail system in and surrounding the Santa Monica Mountains National Recreation Area near Las Angeles, California. The report includes park and local officials as well as representatives from different park user groups. The purpose of the study is to collaboratively develop recommendations for issues confronting the Santa Monica Mountains area trails system including: developing standards for shared-use trails, improving signage throughout the area, and building support for the trails system through involvement with various local interest groups. Not only did this study make several positive recommendations for the trails, but it also built bridges between different user groups by assessing their desires and having them work together to achieve mutually beneficial goals and management strategies.

Some of the notable suggestions produced for trail guidelines were posting the maximum speed limits for bikers on shared-use trails and having regulations and trail etiquette well marked at trailheads. Also, the group determined that it is essential to have signs at the appropriate location and level for the group it is communicating information to. It was felt that the most signage and the widest, least vision-restricting trail design was needed at trailheads, as these areas had the greatest potential to experience safety issues. Safety issues are less likely further into the trail system, therefore reducing the need for safety precaution through design.

Shared-use trail guidelines for new trails were collectively developed by all participating user groups. One of the possible regulations for application to existing trails is that if an existing single-use trail meets 75 percent

of the shared-use trail guidelines, it should be open to shared use. It is the intent that over time, any shared-use trail not complying with all the guidelines will be modified until it is brought up to 100 percent compliance.

This is a useful resource for both support and guidance of shared-use trail systems. It shows how a collaborative initiative can help address the needs of several user groups.

Keywords: Problem definition (manager survey), design guidelines, width/passing areas, design speed, sight lines, gradient, trail layout/availability, user group meetings, user information, enforcement, rules and regulations

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.5 Academic Studies

E.5.1 The Relationship Between Past Experience and Multiple Use Trail Conflict

Bradsher, D.J. 2003. North Carolina State University Masters' Thesis.

<http://www.californiatrills.org/documents/RelationshipBetwConflict.pdf>

Conducted under the direction of R.L. Moore (*Conflicts on Multiple-Use Trails*, 1994), this Master's Thesis tested the relationship between experience and conflict on shared-use natural surface trails. The research was conducted in the Greater Snow King Area of the Bridger-Teton National Forest near Jackson, Wyoming in 2002. Participants were asked to rate their increased or decreased enjoyment due to encounters with other user groups. Past experience was judged based on participants having participated in other activities on the trail.

The analysis found that users with past experience with running, mountain biking, horseback riding, and walking dogs experienced less conflict when encountering participants of those activities than respondents who had never done those activities before. People who had participated in an activity in the past were also more likely to report increased enjoyment due to encounters with that group than were trail users who had never done the activity before, although the relationship was not statistically significant between mountain biking and horse riding.

Bradsher notes that, conflict is not "an objective state, rather it is an individual's interpretation and evaluation of past and future social contacts." While the majority of trail users did not feel that encountering other user types affected their enjoyment, the study found some "reduced enjoyment" with runners, pedestrians/hikers, mountain bikers, and equestrians encountering another activity group. The greatest negative effect on enjoyment was attributed to equestrians (less than one-fifth of users feeling this way). In addition, all user groups indicated that encounters increased their enjoyment, in particular encounters with pedestrians/hikers and with dog walkers. Common reasons for increased enjoyment provided include "seeing other users' enjoyment" (runners, walkers/hikers, mountain bikers) and "pleasant/friendly encounters" (walkers/hikers). While on average, respondents felt that mountain bikers had a positive impact on enjoyment, almost half of comments indicated conflicts, particularly excessive speeding.

This research provides background into the causes of trail user conflicts and indicates that building partnerships and encouraging interactions between different users can minimize perceptions of conflicts.

Keywords: Problem definition (user survey), volunteer programs, user group meetings

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.5.2 Social values versus interpersonal conflict among hikers and mountain bikers

Carothers, P., Vaske, J. J., and Donnelly, M. P. 2001. Leisure Sciences, 23(1), 47-61

<http://bolt.lakeheadu.ca/~bpaynewwww/3812/carothers.pdf>

This article from *Leisure Sciences* evaluated hikers' and mountain bikers' normative beliefs about unacceptable social values as indicators of recreation conflict. IMBA cites this article on their website. Users were surveyed in the Jefferson County Open Space trail system west of Denver, Colorado.

The report draws a distinction between interpersonal conflicts (wherein one individual directly impacts another) and social value conflicts (independent of actual contact between the individuals). Survey responses were categorized into users who did not perceive or observe a problem; those who did not observe but perceived a problem ("social values conflict") and those who both observed and perceived a problem ("interpersonal conflict").

The study found that more conflicts were reported for mountain bicyclists than hikers. Most of the conflicts involving hikers were reported by mountain bicyclists. Mountain bicyclists, hikers, and people who participate in both activities all reported more interpersonal, rather than social value conflicts. The study concludes by recommending separation between mountain bicyclists and hikers, stating that, "When the conflict stems from interpersonal conflict, zoning incompatible users into different locations of the resource is an effective strategy." It also notes that increased law enforcement, expanded education programs, and the posting of signs could improve behavior, although the study does not discuss how or why these treatments might reduce user conflicts.

The study is a thorough analysis of user perceptions based on data collected. However, it does not provide substantial guidance for agencies seeking to minimize conflicts without space for user separation.

Keywords: Problem definition (user survey), trail layout/availability, education, user information, alternate use days

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.5.3 Off-Road Impacts of Mountain Bikes: A Review and Discussion

Cessford, G.R. 1995b. Science and Research Series #92, New Zealand Department of Conservation.

Gordon Cessford is a Senior Social Scientist for the New Zealand Department of Conservation. His focus is research and information coordination in the recreation, tourism, and public relations sector of the

department. He has a master's degree from Lincoln University in Resource Management and Outdoor Recreation Research. IMBA cites this article on their website.

This study summarizes and builds upon the information of the social and environmental impacts of mountain biking. The objectives are to provide a profile of mountain bike rider characteristics, to describe their preferences for recreation settings and experiences, to determine their attitudes toward key management issues, and to make recommendations for management options and future research needs. Cessford discusses the environmental impacts of various users on trails, which are not analyzed for the purposes of this Assessment.

Active mountain bikers were surveyed at two major mountain bike races in the Wellington Area of New Zealand. The top features respondents cited for mountain biking were speed/excitement/risk (43 percent), exercise/fitness workout (42 percent), and appreciating views/scenery (38 percent). Almost three-quarters prefer routes in native forestland over routes in forestry areas or in open farmland.

Cessford concludes that although conflict is possible in cases of irresponsible riding, experience and research shows that accidents are not common, based primarily on mountain bikers' perceptions that safety concerns are over-estimated. Negative perception of mountain biking from other users can stem from a general difference in values, desires, appearance, and age between mountain bikers and other trail users. Trail users not familiar with mountain biking may also perceive that mountain bikers should be confined to just a few trails or primitive roads, whereas in reality many mountain bikers seek out and enjoy the same trail variety and intimacy that hikers enjoy.

Cessford concludes by making several management suggestions based on the research. He states that on trails where speed is a legitimate safety issue, the addition of trail design elements such as steps, rocks, culverts, logs, water bars, can be used to slow or deter riders. He also suggests using programming techniques to restrict mountain biker access to trails where the potential for safety issues or user conflict with children, families, and elderly user groups is greater. Research also suggests that perceived conflict may decrease over time as different user groups become more familiar with one another.

Keywords: Problem definition (user survey), speed control features

Objectivity: ● Applicability: ● Sustainability: ●

Thoroughness: ● Useful Information: ●

E.5.4 Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand

Cessford, G.R. 2002. IMBA. <http://www.imba.com/resources/research/trail-science/perception-and-reality-conflict-walkers-and-mountain-bikes-queen-charlotte>

This 2002 article by Gordon Cessford was presented at the Monitoring and Management of Visitor Flows in Recreational and Protected Areas Conference in Vienna, Austria. IMBA cites this article on their website. The paper considers the social and physical impacts attributed to mountain biking. Cessford analyzed surveys from pedestrians on a soft-surface trail where biking was allowed on a trial basis.

Cessford discusses the three major categories of concerns with mountain biking: environmental impacts, perceptions of safety hazards, and perceptions of social impacts. He finds few reported incidents involving a

bicyclist hitting a hiker, and concludes that actual safety hazards are likely over-estimated by walkers. The primary focus of the research is to determine if walking and biking have different experience preferences, ensuring that the activities would always be in conflict.

The survey found that the majority of walkers who encountered bikes on the track did not report themselves to be dissatisfied because of the experience. In fact, walkers who had not encountered any bicyclists had the most negative perceptions of bicyclists, followed by those who saw bicyclists but did not expect them to be present. Walkers over 40 were more likely to have negative perceptions of bicyclists. Cessford concludes that perceptions and realities of conflicts are different, and that increasing awareness and experience of sharing a track can reduce perceptions of problems.

The analysis of walkers' perceptions on the Queen Charlotte Track follows a user survey. However, Cessford's conclusion that mountain bikes do not cause safety hazards is founded on incident reports, which may not count all bicycle/pedestrian crashes if no hospitalization or property damage results. In addition, Cessford does not offer user conflict strategies other than increased exposure.

Keywords: Problem definition (user survey),
Objectivity: ☒ Applicability: ☒ Sustainability: ☐
Thoroughness: ☒ Useful Information: ☒

E.5.5 Mountain Biking: Direct, Indirect and Bridge-Building Management Styles

Chavez, D. J. 1996b. *Journal of Park and Recreation Administration* 14: 21-35.

Deborah Chavez is a Research Social Scientist with the USDA forest service, who has published several other articles included in this Literature Review, including *Recreational Mountain Biking: A Management Perspective* (1993, with Winter and Bass), *Mountain Biking: Issues and Actions for USDA Forest Service Managers* (1996), *Mountain Biking Management: Resource Protection and Social Conflict* (1997), and *Mountain Bicyclists' Behavior in Social Trail Etiquette Situations* (2000, with Hendricks and Ramthum). IMBA cites this article on their website.

This article revisits the results of the 1991 national survey of USDA Forest Service Regional Foresters (Tilmant, 1991 not published) with an updated survey in 1993. Survey questions included management issues and actions related to mountain bike use of National Forests, including whether mountain bikers are a management concerns, the frequency of accidents, resource damage, user conflict, or safety problems, and how these were addressed.

The results from the second set of surveys indicated that managers are increasingly looking to 'bridge building' activities to address or mitigate conflicts. These strategies are different from the direct, indirect, or resource hardening classifications that emerged in the previous survey. Chavez describes bridge building techniques as involving "two-way or multi-way communication, cooperation, and resource sharing between individuals or groups and agencies." Examples of techniques include personal contacts with users and partnering with different groups.

Seventy percent of forest managers reported that they had observed or received reports of user conflict. The most frequently reported conflict was between mountain bikers and hikers (37 percent), followed by mountain bikers and equestrians (34 percent). The majority of techniques used to reduce user conflicts were

indirect, including posters/signs, brochures, and etiquette). The majority of forest managers (59 percent) reported that they had observed or received safety problems related to mountain bike use. These included excessive speeding, lack of noise, careless mountain bikers, and pack animal safety concerns. Solutions included indirect strategies similar to those used to address user conflicts. Almost half of forest managers (48 percent) had observed mountain bike accidents. Most of the solutions were indirect, as well as direct management (including separating uses), and bridge building.

Keywords: Problem definition (manager survey), education, user group meeting

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.5.6 Recreational Mountain Biking: A Management Perspective

Chavez, D. J., P.L. Winter, and J.M. Baas. 1993. Journal of Park and Recreational Administration. 11:3. 29-36.

Two of the researchers for this project are research social scientists for the Wildland Recreation and Urban Culture Project, USDA Forest Service, Pacific Southwest Research Station (Chavez and Winter), while the third is a human dimensions in wildlife management specialist with the Colorado Division of Wildlife and is a professor at Colorado State University (Baas). IMBA cites this article on their website. The study involved telephone surveys of 40 recreational managers from the USDA Forest Service and USDI Bureau of Land Management regarding management practiced for mountain biking. Researchers asked four yes or no questions about mountain bike use and perceived issues.

The jurisdictions interviewed characterized biking in their region as moderate to extensive. Over half of interviewees reported conflicts between bikers and other user groups. Conflicts included equestrians, hikers, ORV/ATV, and wilderness trespass. Only one interviewee reported an incident that had resulted in injury and litigation, while the majority of complaints were related to “turf,” or users feeling that new users were usurping the trails. Some of the managers reported success in encouraging councils or user groups to resolve the issues together. “Categories of concern” included managers desiring a way of handling multiple use, need for signs, maps, and brochures, and ways of encouraging user group cooperation.

Keywords: Problem definition (manager survey)

Objectivity: ● Applicability: ● Sustainability: ●

Thoroughness: ● Useful Information: ●

E.5.7 Comparing the Effectiveness of Interpretive and Sanction Messages for Influencing Wilderness Visitors' Intended Behavior

Duncan, G., and S. Martin. 2002. International Journal of Wilderness 8: 20-25. <http://ijw.org/wp-content/uploads/2002/08/Vol-08.No-2.Aug-02small.pdf>

For this research, trail users viewed either sanction, interpretation, or no (control group) signs, and then were asked to indicate the likelihood they would perform certain behaviors in given scenarios. Behaviors included firewood collection, human waste disposal, cultural artifacts, and food scraps disposal. The laboratory

experiment indicated that the interpretation message was as effective as the sanction in three of the four scenarios, and both types were more effective than no message.

The background provides information about many studies that have indicated how providing the reason for a regulation is usually more effective than stating the rule, for a variety of park management scenarios. However, there is a concern that threatening users with sanctions diminishes the wilderness experience. The study found that for one of the undesired behaviors (wood gathering), interpretation signs were more effective than sanctions, and they were at least as effective for all scenarios. The study evaluated reported resource management behavior, which may deviate from actual behaviors. It is unclear to what extent this study would translate to yielding behavior on trails, but it does indicate that users respond to signs.

Keywords: User information

Objectivity: ☒ Applicability: ☒ Sustainability: ☐

Thoroughness: ☒ Useful Information: ☒

E.5.8 Mountain Bikes and the Parks: Mitigation of Safety and User Conflict Problems

Goldstein, S. S. 1987. Unpublished undergraduate paper, UC Santa Cruz.

This thesis was submitted for a Bachelor of Arts in Environmental Studies at the University of California, Santa Cruz. Goldstein interned for the Santa Cruz Mountains District of State Parks and discusses the Nisene Marks State Park. He investigates the safety concerns and social conflicts involving mountain bikers and specifically does not consider physical impacts of mountain bikes. IMBA cites this article on their website.

Goldstein presents a brief Literature Review, followed by a discussion of methods for reducing user conflicts and safety concerns. He recommends “a comprehensive and well-designed outreach campaign by the parks, in conjunction with cycling manufacturers, retailers and clubs.” He also recommends that willing and interested trail users educate users and encourage proper behavior. A “Wilderness Area Hosts” or cycling assistance program could involve hikers or mountain bikers in education, enforcement, and rescue activities.

Design measures include improving line-of-sight, upgrading for impact resistance, and other treatments. The recommendation for using water balls as speed bumps does not provide specific dimensions. Stiles can be used to force cyclists to slow down. Goldstein cites a personal interview with George Geer, a Sunset Unit Rangers with the Arroyo Seco Ranger District in Angeles National Forest, who recommends that the notch to be the width of the average set of bicycle cranks, plus 2 or 3 inches. Stiles cannot be used where wheelchair access is an issue. Several of these mitigation measures do not include specific dimensions or guidance, and others do not contain any references.

Keywords: Problem definition (theoretical), design guidelines, speed control measures, sight lines, education, volunteer programs, events, user group meetings, enforcement

Objectivity: ☒ Applicability: ☒ Sustainability: ☐

Thoroughness: ☒ Useful Information: ☒

E.5.9 The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines

Hendricks, W., R. H. Ramthun, and D. J. Chavez. 2001. Journal of Park and Recreation Administration 19(3): 38-61.

This study was co-authored by a professor with the Recreation Administration Program, Natural Resources Management Department at California Polytechnic State University (Hendricks), a profession with Tourism Industry Management at Concord College (Ramthun), and a research social scientist with the USDA Forest Service (Chavez). IMBA cites this article on their website.

The study was conducted in the Marin Municipal Water District (MMWD), on fire roads on Mt. Tamalpais where bicycling is allowed. At the time of the study, MMWD enforced a 15 mph speed limit on all trails and a 5 mph speed limit when passing others and on blind curves. The fine for speeding was \$200, while the fine for riding on single-track where bicycling is prohibited was \$125. The study tested three main factors: bicyclists' behaviors, message content, and message source as shown in Table E-7.

Table E-7. Matrix of Variables Tested, Hendricks et. al., 2001

Behaviors Tested ⁱ	Message Content Tested	Message Sources
<ul style="list-style-type: none"> Bicyclists' yielding behavior when approaching hikers Bikers' speeds Bikers' actions when approaching an area where biking was prohibited Bikers' behavior at stream crossings 	<ul style="list-style-type: none"> 'Moral appeals' to protect the natural resources and enhance other users' safety 'Fear appeals' that identified consequences. 	<ul style="list-style-type: none"> Uniformed agency volunteer Hiker Biker

ⁱ*Yielding was rated on a 10-point scale by trained researchers, speed was tested with a hidden radar gun, and behaviors categorized into 'compliance' and 'non-compliance'*

For yielding behavior, the study found that the appeal source did not make a difference, but the fear appeal resulted in stronger yielding behavior than the moral appeal or the control. On the other hand, neither message source nor content had a significant impact on bicyclists' speeds. Bikers given an appeal message from a volunteer hiker were found to be more likely to dismount when approaching an area where bicycling was prohibited (although compliance remained below 40 percent in all cases), while the fear appeal was more likely to result in bikers dismounting to cross the stream. In all four behaviors, the uniformed volunteer was less effective in gaining compliance than the volunteer biker or hiker.

The authors make the conclusions that any type of message is better than no message at all. In addition, they postulate that, because bikers were not aware their speeds were being measured, they had less incentive to comply with regulations given a threat of the consequences. The authors conclude that, "volunteer mountain bike patrols, such as those organized and trained by IMBA's National Mountain Bike Patrol, have the potential to be an effective mechanism for influencing behavior of bicyclists."

Keywords: Problem definition (user survey), education, volunteer programs, user information

Objectivity:	●	Applicability	●	Sustainability:	○
Thoroughness	●	Useful Information	●		

E.5.10 Conflict and Management Tactics on the Trail

Hoger, J. L. and Deborah J. C. 1998. Parks & Recreation, 33(9), 41-49.

<http://admin.ibt.org.il/files/94644644798.pdf>

This article is a Literature Review summarizing common concerns about mountain biking on shared trails, including environmental impact, trail degradation, trail safety, and social differences. The document presents a brief history of mountain biking, as well as previously-identified sources of conflict. In particular, the article focuses on the perception of conflict among mountain bikers, hikers and equestrians. It also summarizes different management techniques, including indirect and direct management, education, and outreach. The authors cite several studies in their evaluation of the conflict and the available tools for managers.

Keywords: Problem definition (theoretical), education, user information

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	○	Useful Information	○		

E.5.11 Conflicts and Issues Related to Mountain Biking in the National Forests: A Multimethodological Approach

Hollenhorst, S. J., Schuett, M. A., Olson, D. 1995. USDA Forest Service Gen. Tech. Rep. PSW-156.

http://www.fs.fed.us/psw/publications/documents/psw_gtr156/psw_gtr156_1_hollenhorst.pdf

This article was written for the U.S. Forest Service by a professor of Wildlands Recreation, Division of Forestry at West Virginia University (Hollenhorst), a professor of Recreation Administration, Department of Health, Physical Education and Recreation at Southwest Texas State University (Schuett), and a Recreation Research Technician in the Division of Forestry at West Virginia University (Olson). The study was conducted to understand issues and management solutions to high participation rates of mountain bikers on National Forest land. This is a shorter analysis of the same data analyzed in *An Examination of the Characteristics, Preferences, and Attitudes of Mountain Bike Users of the National Forests* (Hollenhorst, Schuett, Olson, & Chavez, 1993). IMBA cites this article on their website.

Mountain bikers were surveyed in four locations in National Forests nationwide. Three focus groups were also held in Houston and Austin Texas and in Morgantown, West Virginia. The survey results indicate that mountain bikers are concerned with conflict and the impact increasing mountain biking may have on their future access to trails. The mountain bikers surveyed also indicated a perception that equestrians and pedestrians are too “possessive” of trails and intolerant of mountain bikers, though mountain bikers are relatively tolerant of other users.

The authors state that, while the management strategy of providing separate trails for different users was discussed, it “was not regarded as a plausible solution by any of the participants.” Participants were supportive of informational signs and suggested that mountain bike manufacturers and retailers could take a part in educating users.

Keywords: Problem definition (user survey), trail layout/availability
 Objectivity: ● Applicability: ● Sustainability: ●
 Thoroughness: ● Useful Information: ●

E.5.12 Resolving inter-group conflict in winter recreation: Chilkoot Trail National Historic Site, British Columbia

Jackson, S. A., Haider, W., & Elliot, T 2004. Journal for Nature Conservation, 11(4): 317-323.

<http://www.collectionscanada.gc.ca/obj/s4/f2/dsk3/ftp04/MQ61568.pdf>

This study conducted through the University of Victoria evaluates the effectiveness of separating snowmobilers and skiers in reducing user conflict. The research surveyed users to gauge satisfaction with a management strategy that excludes snowmobilers every third weekend. Surveys were conducted in 1993 and 1998 to compare perceptions of recreation conflict.

The survey asked about visitor motivations for visiting the area, and results indicate that snowmobilers and skiers exhibit different perceptions of conflicts with other users, motivations to use the trail, and values in outdoor recreation. The survey then asked users about their perceptions of whether their goals had been achieved.

It also shows that an exclusionary management strategy can effectively increase the skiers' satisfaction and reduce snowmobilers' satisfaction. It demonstrates the possible results of using direct management strategies to separate trail users. While the article does not specifically address trail user types relevant to most California State Parks' experience, the study outlines how management strategies can successfully negotiate and reduce user conflicts.

Keywords: Problem definition (user survey), alternate use days
 Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ●

E.5.13 Conflict in Outdoor Recreation: A Theoretical Perspective

Jacob, G.R. and R. Schreyer. 1980. Journal of Leisure Research 4: 368-379.

This article was co-authored by a consultant (Jacob) and a professor in the Department of Forestry and Outdoor Recreation at Utah State University (Schreyer). One of the first academic studies of conflicts in outdoor recreation, the study defines conflict as goal interference as a result of others' behaviors and discusses the phenomenon of scapegoating, wherein feelings of frustration are attributed to a different source.

The authors propose four factors which contribute to this conflict:

- "Activity style – the various personal meanings assigned to an activity
- Resource specificity – the significance attached to using a specific recreation resource for a given recreational experience
- Mode of experience – the varying expectations of how the natural environment will be perceived
- Lifestyle tolerance – the tendency to accept or reject lifestyles different from ones' own"

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These four factors do not necessitate actual conflict; rather, “the degree to which these factors are present represents the extent to which the *potential* for conflict exists.”

While the theoretical framework proposed in this article has been superseded by more recent academic work, this article is one of the first to attempt to define a theory about conflict in outdoor recreation.

Keywords: Problem definition (theoretical)

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.5.14 Managing Mountain Bike Recreation and User Conflicts: A Case Study on Mt. Baker-Snoqualmie National Forest, Washington State

Jellum, C. M. Research thesis, Central Washington University. 2007.

This research thesis was presented to Central Washington University for a Master of Science in Resource Management degree. It evaluates the effectiveness of biker/hiker policy for the Middle Fork Trail in the Snoqualmie National Forest on Mt. Baker in Washington State. To mitigate hiker/biker conflicts, trail managers adopted a temporal separation policy, allowing bike access every other day. An on-site exist questionnaire was presented to users to gauge perceptions.

Users were asked about perceptions of trail conditions and facilities, including width and information, and observed user-induced trail conditions (mud, manure, tire ruts, etc.). About half of hikers surveyed had positive perceptions of trail width on days mountain bikers were prohibited, which dropped to one-third on days that bikers are present, although overall the majority of hikers had positive responses.

For perceptions of user conflict, over 90 percent of bikers and hikers reported enjoyment and positive interactions with other users. Concerns included biker etiquette and speed. The majority of hikers (56 percent) and mountain bikers (83 percent) indicated liking the every-other-day policy. This highly positive response from mountain bikers may be attributed in part to the following question, which asks whether the trail should be closed to mountain bikes. About a quarter of hikers desired closing the trails to mountain bikers entirely, while over half felt they should not be closed (58 percent). By contrast, less than an eighth of hikers felt the trails should always be open to mountain bikers (11 percent), while slightly more than half of mountain bikers agreed (53 percent).

The study concludes with a recommendation to keep the current access policy. Additional restrictions for conflict reduction considered include closing the trail to cyclists after the first six miles. Physical recommendations for safety include hardening trail surfaces, increasing the width of the trail corridor (minimum of 24 inches), reducing the width of the trail to reduce speeds, strategically introducing user friendly barriers to reduce speed, and the realignment of trails/introduction of switchbacks at excessively steep slopes (other specific guidelines are not provided). Annual maintenance to reduce erosion, mud and other unpleasant trail conditions is also recommended as a measure to reduce conflict. Finally, the research recommends outreach to reduce user conflict and promote trail etiquette, such as signs and posters that detail restrictions /proper etiquette, patrolling, and partnership with local hiking and biking groups.

Keywords: Problem definition (user survey), design guidelines, width/passing areas, speed control measures, gradient, education, user group meetings, user information

Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ●

E.5.15 **Recreational Trail Conflict: Achieving Equity Through Diversity**

Koontz, C. R. 2005. Masters' Thesis, Master of Science in Recreation Management, University of Montana.

This masters' thesis discusses the nature of conflicts on shared-use trails based on mode of travel and mode of experience. Koontz also promotes public involvement as critical for managing conflict, and discusses how managers can communicate plans and their rationales to visitors to increase efficacy. Koontz discusses the Recreation Opportunity Spectrum (ROS) framework that can be used to determine allocation of trails, although he is critical of it, stating that it favors the status quo.

The second chapter of the thesis makes a case for public involvement in trail planning. Koontz primarily cites other studies, and concludes the chapter with a case study of public involvement in Grant County, Utah. The majority of this research is theoretical in nature and does not provide specific guidelines or recommendations beyond public involvement.

Keywords: Problem definition (theoretical), user group notification, user group meetings, public notification

Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ●

E.5.16 **Congestion and Crowding in the National Park System: Guidelines for Management and Research**

Lime, D. (editor). 1996. St. Paul: University of Minnesota Agriculture Experiment Station Publication 86-1996.

This book was developed as a result of a 1993 workshop attended by National Park Service (NPS) employees and research cooperative and is an extension of research by University of Minnesota's Cooperative Park Studies Unit. The book contains a series of articles about congestion and crowding, addressing concerns about NPS's role in environmental education, visitor education, managing conflicts (particularly with 'incompatible uses' such as ATV's and snowmobiles as well as generally), and addressing inappropriate behaviors within parks. Much of the research is associated with the NPS's Visitor Experience and Resource Protection (VERP) process (see Manning, 2007). The relevant articles are summarized below.

Congestion and Crowding at Parks and Related Areas: Narrowing the Gap Between What Is and is Not Known. Lime, D.

Lime defines congestion as "the physical conditions that occur during periods of high density use when infrastructures and services are seriously stressed" as compared to crowding, which is "a concept in which the number or type of people encountered exceeds an individuals' normative standards for a preferred experience." While these studies primarily pertain to backcountry camping management, the acceptance and efficacy of management strategies indicates strategies that may be successful for managing user conflicts on trails. For example, Lime found that park and recreation visitors have limited willingness to shift activity

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patterns to off-peak times to avoid congestion and crowding. In addition, locations that have few or no substitutes (e.g., Niagara Falls, the Grand Canyon, etc.) become particularly congested with few alternatives.

Strategies employed to manage congestion and crowding include reservations, limitation of entry, fees, visitor education/information, and visitor demonstration of skills/ knowledge. Lime stresses the importance of public involvement in determining the appropriate strategy for a particular park.

Crowding and Carrying Capacity in the National Park System: Toward a Social Science Research Agenda Manning, R.E., and Lime, D.

Manning and Lime discuss the difficulty of evaluating crowding, noting that “in most empirical studies, little or no statistical relationship was found between the level of visitor use and overall trip satisfaction.” Crowding is a subjective measure of personal characteristics of visitors, characteristics of other visitors encountered, and situational variables (including level of development of the surrounding environment and perceived environmental quality of the park). They also define ‘social carrying capacity’ that deals with crowding and social impacts of visitor use, based on user perception studies.

Alleviating Congestion in Parks and Recreation Areas Through Direct Management of Visitor Behavior McCool, S.F. and Christensen, N.A.

This study compares direct and indirect management styles for managing congestion in National Parks. Direct management styles rely on regulation of behavior through sanctions or fines, while indirect styles include information and education. The authors note that, “by retaining the locus of control within the visitor, indirect measures provide a context within which the visitor retains the sense of freedom important to recreation experiences.” In addition, most user studies show a preference for indirect management.

The authors provide research to date on specific management strategies, including seasonal/temporal limit on use level, group type restrictions, and area closures, among others. They found that visitors accept use limit policies if they feel that the resource requires the protection afforded by the policy. They note that use restrictions on bicycling can be controversial.

The authors conclude that:

- Visitor support for direct management is highest when the rationale is understood and the benefits of such techniques can be easily understood.
- Visitor support for direct management is highest in settings with a tradition of direct management, and techniques with which they are familiar.
- Preferences and acceptability of direct management are influenced by visitor motivations for visiting the setting.

Keywords: Problem definition (theoretical, user surveys), education, alternate use days,, rules and regulations,

Objectivity: ● Applicability ● Sustainability: ●

Thoroughness ● Useful Information ●

E.5.17 **Identifying and Monitoring Indicators of Visitor Experience and Resource Quality: A Handbook for Recreation Resource Managers**

Lime, D., D. Anderson, and J. Thompson. 2004. St. Paul: University of Minnesota Department of Forest Resources. cspc.cfans.umn.edu/publications/Indicators_Standards_Handbook.pdf

Prepared by the University of Minnesota Department of Forest Resources and funded by the Minnesota Department of Natural Resources' Division of Parks and Recreation, this handbook is designed to assist managers in identifying and mitigating problems in Minnesota parks. It is intended to accompany the previous guide: *Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers* (Anderson et al., 1998), which addresses impacts of biophysical resources and visitor experiences. This guide presents indicators of quality and the monitoring of indicator variables and focuses on preventing impacts from reaching unacceptable levels or exceeding carrying capacity.

The guide defines carrying capacity as, "The amount and type of use that can be accommodated in a particular area over time while sustaining desired biophysical resources and opportunities for quality visitor experiences." Carrying capacity is measured by minimally acceptable conditions (MACs) or standards of quality, which "are increasingly explicit statements of management objectives and reflect the quantitative and measurable conditions of indicator variables." Indicator variables are selected for a particular park, and should be: specific, objective and measurable, reliable and repeatable, sensitive, related to visitor use, efficient and effective to measure, and significant. In addition, a quantifiable measure of the indicators must be determined, with a threshold to determine when action is required.

The guide addresses how to evaluate concerns about impacts to resources (e.g., vegetation) and social conflicts (e.g., carrying capacity as measured by persons at one time [PAOT] and number of users encountered). However, no specific indicators of user safety or conflicts between different user groups on trails are defined. Methods for data collection include roadway level of service on access roads, visitor surveys.

Keywords: Problem definition (theoretical)

Objectivity: ● Applicability ● Sustainability: ○

Thoroughness ① Useful Information ①

Mountain Bikes and Metropolitan Park Districts: Issues and Trends Identified by State Parks and State Park Districts in Ohio

Longsdorf, E. L. 2006. Proceedings of the 2006 Northeastern Recreation Research Symposium, GTR-NRS-P-14. <http://www.americantrails.org/resources/ManageMaintain/OhioMtnbike.html>

This study publishes the result of a survey sent to Ohio State Parks and Park Districts about mountain biking and mountain bike management. The survey results indicate that the increase in mountain bike use of trails in State Parks poses new challenges for resource management, and that State Park managers are concerned about the social and ecological impacts related to recreational use of mountain bike, including environmental damage, user conflicts, accidents and safety.

The study suggests that park managers have several strategies available to manage mountain bikers, including behavior modification (both direct and indirect), resource hardening, and building bridges between user groups. This survey indicates that Ohio State Parks are employing mostly indirect behavior modification and

bridge-building. This article does not address the attitude or preferences of mountain bikers, or their perception of management efforts. Though it does not discuss conflicts between user groups at length, it does report incidents of conflict (shown in Table E-8), and addresses issues on shared trails and exclusion of cyclists from certain trails.

Table E-8. Reported Trends in Mountain Bike Management in Ohio State Parks and State Park Districts (Longsdorf, 2006)

Table 5.—Reported Trends in Mountain Bike Management in Ohio State Parks

Management Indicator	Yes	Percentage	No	Percentage
Observed Evidence or Resource Damage From Mountain Biking	6	33	12	67
Observed/Received Reports of Mountain Biking Accidents	7	39	11	61
Observed/Received Reports of User Conflict from Mountain Biking	7	39	11	61
Observed/Received Reports of MTB Safety Problems	4	22	14	78

N=18

Table 6.—Reported Trends in Mountain Bike Management in Ohio State Park Districts

Management Indicator	Yes	Percentage	No	Percentage
Observed Evidence or Resource Damage From Mountain Biking	3	38	5	62
Observed/Received Reports of Mountain Biking Accidents	1	13	7	87
Observed/Received Reports of User Conflict from Mountain Biking	2	25	6	75
Observed/Received Reports of MTB Safety Problems	0	0	8	100

N=8

This data demonstrates how resource damage, accidents, and user conflict are greater management concerns than safety issues due to conflicts with mountain bikers.

Keywords: Problem definition (manager survey)

Objectivity: ☒ Applicability: ☒ Sustainability: ☐

Thoroughness: ☒ Useful Information: ☒

E.5.18 Emerging Principles for Using Information/Education in Wilderness Management

Manning, R. 2003. *International Journal of Wilderness* 9: 20-27, 12. <http://ijw.org/wp-content/uploads/2003/12/Vol-09.No-1.Apr-03small.pdf>

Manning is a professor of Natural Resources and Director of the Park Studies Lab at the University of Vermont. He worked with the Park Service and has authored several publications on the subject of trail use, including *Parks and Carrying Capacity: Commons without Tragedy*. Published in the *International Journal of Wilderness*, this is peer-reviewed article.

This article is a conceptual review of literature that suggests the potential effectiveness of information and education on five types of problem behaviors of wilderness visitors (illegal, careless, unskilled, uninformed, and unavoidable actions).

Manning found that information and education has limited effectiveness in deterring deliberately illegal or unavoidable problem behaviors, while it can be effective at reducing careless, unskilled, or uninformed actions. This conclusion supports this Study's recommendation to address user conflict through a variety of avenues, including information, enforcement, and outreach.

The article defines several empirical studies that have analyzed the effectiveness of information and education programs. Studies that have focused on enhancing visitor knowledge to reduce ecological and social impacts have not found trailhead signs and brochures to be very effective, while workshops and special programs can enhance knowledge levels. Studies focusing on visitor attitudes toward management policies have found that information/education "can be effective in modifying visitor attitudes so they are more supportive of wilderness and related land management policies." Finally, studies focused on depreciative behavior (such as littering or vandalism) have found that education (a brochure and a personal contact) can be a successful deterrent to littering. While not directly related to user conflict, this finding supports the use of signs to encourage good user behaviors in a variety of contexts.

- Manning concludes with a series of 'emerging principles' for information and education programs, as paraphrased in the table below

Keywords: User information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.5.19 Parks and Carrying Capacity: Commons Without Tragedy

Manning, R. E. 2007. Washington, DC: Island Press.

In this book, Manning presents the development and methodology for developing the *Visitor Experience and Resource Protection* (VERP) program for the National Park Service. Also discussed in Anderson, Lime, and Wang (1998), VERP uses visitor perceptions to define indicators of carrying capacity for parks.

Indicators can include normative standards of how acceptable certain conditions are, and Manning provides a methodology to determine a social norm curve for a group, based on surveys or preference tests. The majority of indicators discussed are related to persons-at-a-time at key locations within a park setting, as well as trash or environmental indicators of use, rather than physical incidents or conflicts.

While VERP is primarily intended to guide management decisions about number of hikers or campers in a wilderness setting, some of the guidance could be used for trail user conflicts. For example, Manning recognizes the encounters with a specific type of user may have a greater impact on perceived crowding than another user.

One relevant case study is that of crowding on carriage roads in at Arcadia National Park, Maine. One of the indicators that emerged from the study addressed "problem behaviors" such as bicyclists passing without warning, excessive bicycle speed, people obstructing the road by walking abreast, and off-leash dogs. The study found that most visitors supported a mix of users, indicating a management strategy of establishing zones. However, the empirical methodology used a crowding measure of persons-per-viewpoint (PPV) based on a visual measurement approach.

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Manning's recommendations for management strategies include education, including workshops and brochures (including key recommendations from Manning, 2003) and use-rationing, in which he recommends implementing use quotas and controlling access.

Manning does not explore actual incidence of density, crowding or conflict experienced by park users, but their preference for different photographic representations. The study also does not differentiate between distinct, conflicting user groups, such as cyclists and pedestrians.

Keywords: Problem definition,(user survey), user group meetings, alternate use days, user information
Objectivity: ● Applicability: ● Sustainability: ●
Thoroughness: ● Useful Information: ●

E.5.20 The Effects of Activity Differences on Recreation Experiences Along a Suburban Greenway Trail

Moore, R. L., D. Scott and A. R. Graefe. 1998. Journal of Park and Recreation Administration 16(2), 35-53.

This article was co-authored by a professor in the Department of Parks, Recreation, and Tourism Management at North Carolina State University (Moore), a professor in the Department of Parks, Recreation, and Tourism Sciences at Texas A & M University (Scott), and a professor in the Leisure Studies Program at Pennsylvania State University (Grafe).

The authors sampled 438 walkers, runners, in-line skaters, and bicyclists on a paved trail in North Chagrin Reservation near Cleveland, Ohio to “explore the effects of each activity upon the experiences of those engaged in the others.” They suggest that Jacob and Schreyer’s (1980) theory about four classes of factors that influence user conflict (activity style, resource specificity, mode of experience, and tolerance for lifestyle diversity) are more useful for predicting predispositions toward conflict than actual goal interference.

While this study focused on experiences between users on paved trails, the findings are nonetheless relevant to interactions on soft-surface trails. While most of the problems and concerns users have are minor, a small minority of users expressed significant issues with other users. In general, users reported feeling more positive about sharing the trail with other users engaged in the same activity. Frequent problems included walkers and runners traveling two or more abreast and not moving aside for others to pass. Complaints about bikers and in-line skaters were that they were traveling too fast and failing to provide a warning when passing other users. The authors conclude that “conflict does not appear to be a major problem overall,” but a sizable minority may experience major problems.

Keywords: Problem definition (user survey)
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ○

E.5.21 Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: choice experiments and benefits transfer

Morey, E. R., T. Buchanan and D. M. Waldman. 2002. Journal of Environmental Management (2002) 64, 411–422.

Written by professors in the Department of Economics at the University of Colorado, Boulder, this study looks at costs of different management strategies for mountain bikers. The study includes a brief background of management strategies in use and being considered, including limiting mountain bikers to fire roads and implementing access fees. The analysis uses a discrete choice random utility model of mountain bike site choice. Interviews and focus groups were conducted to evaluate which factors would cause mountain bikers to change sites.

The model indicated that the presence of hikers and equestrians had a significantly negative impact on site choice. Attractive features included presence of single-track and rolling hills (of a sufficient height). While increased access fee had a generally negative impact on site choice, depending on income, the results suggest that “significant numbers of bikers would be willing to pay an access fee for improved conditions,” depending on number of substitute sites and trail characteristics.

Keywords: Problem definition (user survey), trail layout/availability
 Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ● Useful Information: ●

E.5.22 Off the Road: The Issues Surrounding Mountain Bicycling

Morioka, Steven in Sloan, D. and T. Fletcher, Ed. 1989. In Environmental Management for the East Bay. Report of the Environmental Sciences Senior Seminar, University of California, Berkeley.

This document was written by an Environmental Studies class in the College of Letters and Sciences at UC Berkeley. The editors, Doris Sloan and Tod Fletcher, were the Senior Seminar instructors. IMBA cites this article on their website. The chapter on mountain biking discusses issues identified by park users in Charles Tilden Regional Park. Environmental impacts were assessed through a Literature Review. Research on safety issues and conflicts included informal interviews, attendance at trail user meetings, and attending hearings held by the California Recreational Trails Committee.

The article notes that four of the 24 cycling accidents reported at the East Bay Regional Park District (EBRPD) from July 1987 to June 1988 involved a cyclist and another user; two cases involved two bicyclists colliding, one involved a cyclist falling when avoiding a cow, and the final involved a cyclist falling to avoid a hiker. The specific recommendations for managing safety and user conflict (educational efforts, stricter regulations, design improvements) do not directly follow the data collected.

Keywords: Problem definition (incident data)
 Objectivity: ○ Applicability: ● Sustainability: ●
 Thoroughness: ● Useful Information: ○

E.5.23 Conflict as a Social Interaction Process in Environment and Behavior Research: The Example of Leisure and Recreation Research

Owens, P.L. 1985. Journal of Environmental Psychology 5: 243-259

This article was published by a professor in the Department of Geography in the University of Sheffield, England. Owens presents a theory to distinguish between density, crowding and conflict in recreation. While *density* is a neutral descriptor, he describes *crowding* as a negative, subjective perception that results in a coping response to “eliminate discrepancies between achieved and desired states.” *Conflict*, the author posits, arises when feelings of crowding “metamorphose and eventually crystallize into conflict.” While crowding describes a transient state, feelings of conflict are cumulative and persistent. The author suggests implications of this theory for future management and empirical research. This concept of users vying for a limited resource is a precursor to the commonly-accepted concept that conflict is a result of goal interference.

Keywords: Problem definition (theoretical)
Objectivity: ☒ Applicability: ☒ Sustainability: ☐
Thoroughness: ☒ Useful Information: ☒

E.5.24 Mountain Biking on the Niagara Escarpment

Pearce, B.1990. University of Waterloo Faculty of Environmental Studies School of Urban and Regional Planning.

This study discusses a survey of land managers and public-interest groups in the Niagara Escarpment area. It considers natural resource management and user conflicts. IMBA cites this article on their website. The section addressing user conflicts includes a brief synopsis of the problem. It contains no citations and makes several statements that conflate all hikers in having particular opinions and experiences with regard to mountain bikers. Presumably, these conclusions are based on the author’s personal experience.

The policies of the Escarpment Natural Area allow mountain biking as a “non-intensive” use. Managers responding to the survey concluded that mountain biking has not become an important planning issue, while public-interest groups are more divided. Few policies address mountain bikes in the area.

Recommendations for managing mountain biking include promoting ‘soft cycling’ or riding at lower speeds to reduce environmental impacts (based on IMBA’s *Rules of the Trail*). In addition, user groups can assist with trail maintenance and patrolling the park. This resource does not provide additional specific information about strategies to address user conflict.

Keywords: Problem definition (manager survey)
Objectivity: ☒ Applicability: ☒ Sustainability: ☒
Thoroughness: ☒ Useful Information: ☐

E.5.25 State Park Directors' Perceptions of Mountain Biking

Schuett, M. A. 1997. Environmental Management 21(2): 239-246.

Michael Schuett is an Assistant Professor at Southwest Texas State University in the department of Health, Physical Education, and Recreation. He has produced several studies focusing on many different areas of recreation and resource management. IMBA cites this article on their website.

This study summarizes and draws conclusions from a survey of the State Park Directors of all 50 states on the issue of mountain bike use within their respective state parks. While 89 percent of managers indicated that mountain biking was allowed in some areas of their state park system, 80 percent indicated that there is currently no management plan in place for mountain biking in their state. On average, only 40 percent of trails are open to mountain bikers. Approximately half the states reported minimal mountain bike trail use while the other half reported moderate use. Sixty-seven percent of park managers reported degradation problems due to mountain bike activity, but only 12 percent had conducted studies on degradation of trails in their respective parks. Seventy-seven percent of the states reported user conflict, the majority (80 percent) being between bikers and equestrians as opposed to hikers and bikers.

Schuett draws several conclusions and recommendations from the data. He suggests that states reporting moderate mountain bike use should consider a mountain bike management plan, while states reporting minimum use should consistently monitor trail use by mountain bikers to ensure that they are meeting the needs of all trail users. States with management plans in place have historically had little collaboration with local and regional bike groups on management strategies. Schuett suggests that these states should consider more involvement of mountain bike groups on management plans in the future. Lastly, Schuett recommends an internet database for park manager collaboration on management issues pertaining to mountain biking.

While the data presented in this case has some interesting implications, the recommendations are not directly drawn from the data presented. The main purpose of the paper is to establish possible areas of further study. It does indicate the need for more mountain bike management plans in the state parks and the possible misconception of the high environmental impact of mountain biking.

Keywords: Problem definition (manager survey), user group notification, user group meeting, public notification
 Objectivity: ☒ Applicability: ☒ Sustainability: ☐
 Thoroughness: ☒ Useful Information: ☒

E.5.26 Goal Interference and Social Value Differences: Understanding Wilderness Conflicts and Implications for Managing Social Density

Watson, A. E. 2001. USDA Forest Service Proceedings RMRSP-20: 62-67.

Watson is a Research Social Scientist with the Aldo Leopold Wilderness Research Institute of the USDA. In this article, he reviews theories about conflict between user groups, observing that perceptions of conflict are frequently unrelated to measurable incidents of interference in outdoor recreation, but rather reflect an attitude towards wilderness and stereotypes of other user groups. Watson notes that an interpersonal recreation conflict model proposed in the late 1970's set the tone for most wilderness conflict research in the U.S. While this methodology "may contribute to an understanding of how social densities influence

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perceptions of conflict,” Watson argues that, “understanding of the causes for differences in attitudes toward wilderness and the meanings various subpopulations attribute to wilderness resources will be critical to developing solutions for conflict management and managing the social mix among all demands in the future.”

Watson criticizes modern conflict literature for discounting the interaction between the number of people, their behaviors, and their modes. He notes Jacob and Schreyer’s 1980 hypothesis that users more focused on the environment are less tolerant of others’ behaviors that change these aspects. Watson argues that understanding the root of attitudes towards wilderness and the meanings different groups attribute towards wilderness resources is critical to effectively managing different user groups in wilderness areas. He states that, “An appropriate approach to conflict management may be a proactive one that brings all interests together in order to understand conflicting values and work through compromise or recognition of decision criteria.”

Keywords: Problem definition (theoretical)
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ○

E.5.27 The nature of conflict between hikers and recreational stock users in the John Muir Wilderness

Watson, A. E., M. J. Niccolucci and D. R. Williams. 1994. Journal of Leisure Research 26:4, 372-385.

Co-authored by Watson of the Aldo Leopold Wilderness Research Institute and Niccolucci with the Intermountain Research Station (both of the USDA Forest Service), and Williams in the Department of Leisure Sciences of the University of Illinois, this article reviews previous academic research/writing on the nature of conflict between user groups. The authors observe that past research has focused on theory, and not proposed methods of effective conflict measurement.

The study measures conflict between mountain bikers and hikers in the John Muir Wilderness in California, based on responses to a mailed survey. Surveys were sent to a group of stock users and hikers randomly sampled from those who secured wilderness permits over the course of six months in 1990. The authors evaluated subjective dislike, undesirability, and goal interference as measures of conflict between these user groups.

Study found that hikers perceived conflict with and expressed undesirability of stock users more frequently than vice versa; however, there was not a significant difference between perceptions of cumulative goal interference. The article concludes that perception of conflict indicates a predisposition towards conflict in general, and does not reflect actual conflict encountered on trails, and may reveal more about group norms than safety incidents.

Keywords: Problem definition (theoretical)
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ●

E.5.28 **The Contribution of Research to Managing Conflict Among National Forest Users**

Watson, A.E., C. Asp, J. Walsh, and A. Kulla. 1997. Trends 34(3): 29-35.

This article in the *Trends* magazine was written by Watson with the Aldo Leopold Wilderness Research Institute of the USDA, Asp, a doctoral candidate at the University of Montana, and Kulla, a manager at the Lolo National Forest. It discusses a consortium of students at the University of Montana, Adventure Cycling (a user group), and the National Forest System managers in the Missoula, Montana area to study conflict at the Rattlesnake National Recreation Area. This article is related to *Sources of Conflict Between Hikers and Mountain Bike Riders in the Rattlesnake NRA* (Watson, Williams, and Daigle, 1991). IMBA cites this article on their website.

The article presents the results of manager interviews as well as a 1989 study that was replicated in 1994, which asked community members about the desirability of management alternatives. Respondents were asked how pervasive the problem is, as measured by letter, phone calls, and other complaint formats. A mail-back questionnaire found 30 percent of hikers that in 1989 and 21 percent of hikers in 1994 who encountered mountain bikers during their visit disliked these encounters, while only 3 percent of mountain bikers who encountered hikers felt similarly each year. The authors conclude that management strategies had successfully reduced conflicts, at least partially.

Staff at the Rattlesnake NRA implemented an awareness campaign to educate mountain bikers how to behave when encountering hikers. A local mountain biking group was also formed, and managers provided information and brochures to the group where appropriate. A laboratory experiment was performed to determine the effectiveness of alternative management strategies, as well as the obtrusiveness, or “magnitude of negative emotional response” to strategies. Conversely than some direct/indirect management schemas, some of the direct techniques such as one-way only traffic and patrolling, were found to be less obtrusive than trail widening, speed control barriers, and speed limits.

The authors conclude that managers should be able to describe the level of conflict, who is involved and how factors have changed. They should address the concerns of hikers who never mountain bike separately from the concerns of hikers who also mountain bike, to avoid creating an “us” versus “them” mentality.

Keywords: Problem definition,(user survey), education, user group meeting, alternate use days, rules and regulations, data collection

Objectivity: ● Applicability ● Sustainability: ○

Thoroughness ● Useful Information ●

E.5.29 **Sources of Conflict Between Hikers and Mountain Bike Riders in the Rattlesnake NRA**

Watson, A.E., D.R. Williams and J. J. Daigle. 1991. Journal of Park and Recreation Administration 9: 59-71

This article was written by a research social scientist in wilderness management research at the Intermountain Research Station, USDA (Watson), a professor at the School of Forestry and Wildlife Resources, Virginia Polytechnic Institute and State University (Williams), and an outdoor recreation planner in wilderness management research at the Intermountain Research Station, USDA (Daigle).

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The authors studies mountain bikers and hikers in the Rattlesnake National Recreation Area (NRA) outside of Missoula, Montana. They investigated the similarities and difference in how mountain bikers and hikers relate to the recreational resource. A random sampling technique was used to select visitors at the trailhead, who were then mailed a survey that asked about the length, purpose, and mode of their visit, as well as group characteristics. Each visitor was asked to respond with their positive, negative, or neutral feelings about other users; whether the behavior of other users affected their enjoyment; and their attachment to the wilderness.

Only one mountain biker had had a negative experience encountering a hiker, while 32 percent of hikers had disliked meeting mountain bikers. A key finding was that the wilderness bikers felt that they had similar attachment to the wilderness as hikers, while hikers were least likely to agree that the groups were similar. In addition, mountain bikers who did not enter the wilderness area reported less focus on the trail setting than hikers or mountain bikers who entered the wilderness area, although the groups exhibit few real differences.

One of the key implications is that, “Many of those who had not reported disliking meeting the conflicting group on the trails still felt the opposing group was a problem.” Similarly, only 20 percent of the hikers could specify the mountain bikers’ activity or behavior that was a detractor. The authors conclude that the study favors a “light-handed” technique, to raise mountain bikers’ awareness that their behavior is negatively impacting hikers. Similarly, they recommend educating hikers about what to do when they encounter a mountain biker and correcting some misperceptions about how the groups differ.

Keywords: Problem definition (user survey), education, user information

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.6 User Organization Resources

E.6.1 Safety Considerations for Multi-Use Trails

California Equestrian Trails and Land Coalition. 2005.

<http://www.calequestriancoalition.com/FinalVerCETLCSafetyGuides.htm>

This 2005 publication by the California Equestrian Trails and Land Coalition (CET&LC) recommends design standards and safety guidelines to safely accommodate bicyclists, equestrians, and hikers on the same trail. The CET&LC notes that mountain bicycling use has become a safety issue for equestrians, particularly due to the speed differential with other users; most users travel at 4 to 5 mph while mountain bicyclists frequently travel at faster speeds.

The CET&LC recommends specific trail standards that provide visibility, width, slope, and separation to accommodate a variety of user types. If the trail cannot be built to these standards, they recommend it not be opened to multiple user types. They also recommend education of trail users, including training equestrians to minimize their horses’ ‘startle factor,’ as well as etiquette signage and enforcing trail rules. The report does not state what data the conclusions are based on.

Keywords: Problem definition (general), design guidelines, width/passing areas, design speed, education, user information, enforcement

Objectivity: ● Applicability: ● Sustainability: ●

Thoroughness ①

Useful Information ●

E.6.2 Managing Mountain Biking: IMBA's Guide to Providing Great Riding

International Mountain Bike Association. Webber, P., Ed. 2007. Boulder, CO: International Mountain Bicycling Association.

IMBA's guidebook on managing trails was produced in cooperation with the Recreational Trails Program of the Federal Highway Administration. It was edited by Pete Webber, IMBA's director of special projects and includes contributions from FHWA's Recreational Trails Program Pennsylvania Department of Conservation and Natural Resources, Tennessee Department of Environment and Conservation, Minnesota Department of Natural Resources, Trails and Waterways Division, and the U.S. National Park Service Rivers, Trails, and Conservation Assistance Program. Agencies that noted in the survey that have used this resource to design safe trails and manage user conflict include: State Parks Santa Cruz District, the Hill Country Conservancy (TX), Mecklenburg County (NC), Wake County (NC), Lake Norman State Park (NC) and City of Durango (CO).

The guide begins with the preface that, "When trails are well designed and visitors observe basic trail etiquette, most people, whatever their means of conveyance, will have a satisfying experience on shared trails." Nevertheless, IMBA lists situations where separating users may be advised:

- Crowded trails – to avoid congestion.
- Crowded trailheads – to provide dedicated parking facilities.
- Extraordinary mountain biking trails – trails designed exclusively for mountain biking.
- High-speed trails – trails designated for race-training or use by expert-level users.
- Bike parks – trails for riders to hone mountain biking skills.
- Nature trails – trails that provide seclusion for hikers or that are ADA-accessible.

The section entitled, "Should an existing trail be open to Mountain Bikers?" lists questions designed to assist managers in determining allowable uses. Questions that pertain to conflict issues include the following:

- Will the pre-existing uses mesh with mountain biking?
- Does the trail have a sustainable alignment?
- Could the trail be altered to have a more sustainable alignment?
- Will the trail meet local needs?
- What kind of trails do local cyclists seek?
- Would mountain bikers like to ride the trail?
- Are resources available to meet maintenance needs that may arise with increased use?
Is there a local bike club available and willing to support the trail?

The guide also recommends ways of managing safety concerns and user conflicts on shared trails, including trail design, information and education, regulations, and user involvement and partnerships. Information and

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education include share the trail signs, as well as paid staff patrols, volunteer patrols, peer education, clinics, and handouts. The guide notes that volunteer patrols are a “tangible reminder that mountain bikers are aware of their potential effect on other visitors, are committed to regulating themselves, and are willing to give back to the trails in the form of volunteerism.” IMBA discourages the use of speed limits, stating that “speed limits are extremely difficult to enforce, may be un-reasonable for trails with constantly changing terrain, probably won’t improve real or perceived safety on the trail, and can damage essential respect and trust.”

Designing a trail to reduce safety issues and be sustainable requires thought to the trail flow, or the rhythm of the trail as “determined by the landscape and sequence of terrain.” Trail anchors can include large rocks, logs, trees or other obstacles that act as a visual and physical barrier showing where the trail is and requiring users to slow down to pass. Choke points are rocks or a broken tree trunk that acts as a gateway through which trail users must pass. IMBA recommends providing sufficient sight distance for users to see the obstacle and slow down in advance of the feature. Uneven surfacing can also encourage users to slow down and trail hardening is recommended for sustainability in difficult locations. IMBA also recommends bermed turns and consistent flow to minimize soil disruption, although part of the benefit of these elements is that they allow mountain bikers to turn without slowing down.

The chapter about partnerships highlights the importance of soliciting input from user groups. Recommendations include writing specific agreements to define roles and responsibilities; starting simple and building as the relationship develops; and creating a plan for ongoing communication with the group. Some of the guidance is directed at trail managers, while other guidance is intended for use by advocates and trail user groups. For example, the chapter on managing volunteers is directed at a new club or organization. IMBA also recommends forming a Trail Advisory Group to mitigate conflict. Additional partnership solutions include forming user group coalitions, holding volunteer trail work days, and organizing shared-use events.

Keywords: Problem definition (general), design guidelines, speed control measures, trail layout/availability, user information

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.6.3 Trail Solutions: IMBA's Guide to Building Sweet Single-Track

International Mountain Bike Association. 2004. Boulder, CO: International Mountain Bicycling Association.

IMBA is a worldwide group of individuals, clubs, and organizations focused on advancing and supporting opportunities for mountain biking to grow in recognition and respect as a contributing user of trails. This book is a guide to establishing single-track trails and includes topics on building partnerships, writing proposals, management strategies, and trail design guidelines. The book presents safe trail design and etiquette to manage user conflict: user etiquette and trail design. Several agencies surveyed reported that they use this book as a guidance document for developing single-track trails, including North Carolina Division of Parks and Recreation; Wake County, NC; and Durango, CO.

One of IMBA’s “Rules of the Trail” is the precept to ‘Always Yield the Trail’. From the rules: “Let your fellow trail users know you’re coming. A friendly greeting or bell is considerate and works well. Anticipate other rail users around corners or in blind spots. Show your respect when passing others on the trail by slowing to a

walking pace or even stopping. Yielding means slowing down, establishing communication, and being prepared to stop if necessary in order to pass safely.” The book explains that user conflicts can be mitigated by following basic trail etiquette.

The book includes discussion of shared-use trails and single-use trails from a perspective of managing user conflict. The authors disagree with the notion that separating users is the best strategy to manage conflict and contents that responsible bike use is compatible with most other types of trail use. The book advocates against single-use trails from the belief that they concentrate users and increase the negative impacts of crowding. The do acknowledge that single-use trails can be useful for reducing safety issues in certain situations, including very crowded trails, high-speed trails, challenge parks, and secluded nature trails.

Another strategy for reducing safety issues is with single direction trails. Single direction trails can alleviate congestion, provide a more predictable experience, and reduce the number of passes between users. Direction restrictions may be combined with user restrictions (such as on a mountain bike only trail,) applied to only one type of user, or applied at certain times or days.

Single-track trails are framed as a tool for speed management of mountain bikers than compared to wider trail widths. Narrow, rough trails encourage focused, slower speed travel, and promote safe sharing of the trail space. The guide generally recommends pinch points to slightly narrow the trail, installed just prior to the area where users should slow down. In addition, anchors in the form of large rocks or objects, can be staggered on the sides of the trail to slow users. The simple suggestions and guidelines presented here are based on extensive experience, although limited in scope to single-track trails.

Keywords: Problem definition (general), design guidance, , width/passing areas, gradient, speed control features, trail layout/availability, education, user group notification, volunteer programs, events, user group meetings, public notification, ranger patrol, user information, enforcement, rules and regulations

Objectivity:	●	Applicability	●	Sustainability:	●
Thoroughness	●	Useful Information	●		

E.6.4 Mountain Bikes on Public Land: A Manager's Guide to the State of the Practice

Keller, K. 1990. *Bicycle Federation of America*.

This resource provides guidance to trail managers considering how to manage mountain bikers on trails. IMBA cites this article on their website. Chapter 3 discusses Public Safety Considerations and notes that legal liability is frequently waived by state law. Possible actions recommended for managing multiple uses include use designation signs, safety/etiquette signs, identify potential safety hazards with representatives of all trail user groups, work in partnership with local bike shops or clubs to develop and pay for brochures, maps, and signs, emphasize trail preparedness (e.g. the Tread Lightly Program), educate users through interpretive rides, establish a mountain bike trail patrol, issue citations for violations, and encourage local judges to impose work service in the park for trail violation citations. The chapter provides specific recommendations, including size, content, and purchasing details of signs. The section on speed limits notes the challenge for users, as most do not have speedometers, while most managers do not have radar guns to adequately enforce the limit.

Appendix E.

Chapter 5 addresses user conflicts, and notes the values and expectations that can lead to or exacerbate conflicts. Perceptions that mountain bikers are not concerned with the environment because they wear brightly-colored clothing or that they are not in control of their bikes when passing lead to negative feelings. A significant concern is whether horses are inherently incompatible with mountain bikes; while some equestrians believe this to be true, others feel it is a matter of proper training. The authors cite two incidents where a horse was spooked by a mountain biker; one in Santa Rosa where the horse broke its leg and had to be shot, and another on Mt. Tam, where a rider was thrown. Major recommendations include signs, user education, ROMP and STOMP events, dispersing uses, encouraging user involvement in advisory councils, maintenance efforts, building projects, volunteer patrols, and as 'Backcountry Hosts.' Design guidelines follow the USFS *Trail Construction and Maintenance Notebook* (Hesselbarth, Vachowski, and Davies, 2007).

With many citations and specific examples, this resource is quite useful, if somewhat dated. Chapter 4 discusses environmental impacts.

Keywords: Problem definition (theoretical, incident data), trail layout/availability, education, user group notification, volunteer programs, events, user group meetings, public notification, rules and regulation, enforcement

Objectivity: ● Applicability: ● Sustainability: ●
Thoroughness: ● Useful Information: ●

E.6.5 A Common Sense Guide for High Country Manners

Backcountry Horsemen of California, No Date

This one-page flyer is a list of behavior guidelines directed to stock users of the backcountry describing means to minimize both environmental damage caused by stock animals as well as conflict between user groups, specifically hikers. It describes proper trail etiquette, as well as suggesting means of communicating with hikers to lessen the likelihood of conflict.

Keywords: Education
Objectivity: ● Applicability: ● Sustainability: ○
Thoroughness: ● Useful Information: ●

E.6.6 Marin Share the Trail Campaign

Bicycle Trails Council of Marin, Access4Bikes. No Date. www.Sharethetrail.org

The Share the Trail campaign was launched by the Bicycle Trails Council of Marin and Access4Bikes to encourage mountain bikers, equestrians and hikers to share the trail. This effort will soon have a new name and mission. The current effort focuses on educating mountain bikers, with an emphasis on changing habits so that mountain bikes will be more accepted on public lands. The Share the Trail website lists the same six rules developed by IMBA (see above), five of which relate to trail user conflicts and are included below. The description of each rule is slightly different than those of IMBA, though the message is the same. The rules encourage mountain bikers to stay off trails closed to bikes, stay off trails after heavy rains, control speeds, yield the trail and take measures to avoid scaring animals.

Keywords: Education

Objectivity: ● Applicability: ● Sustainability: ○
 Thoroughness: ○ Useful Information: ●

E.7 User Studies

E.7.1 Mountain Bike Survey Update: Results of Spring 1989 Survey

Ford R. 1989. *Kepner-Trego Analysis Mountain Bike Situation on Santa Barbara Front Trails Managed by the US Forest Service.*

Ray Ford is the manager of Los Padres Forest Association trail volunteer program. He is also the Trail Chair for the Santa Barbara Trails Council. He has been involved in trail management related issues and has written several books on Santa Barbara area trails.¹ IMBA cites this article on their website.

This study of user-groups' trail experiences with mountain bikers was initiated in response to seven written complaints (four by the same individual) to the park service staff in Los Padres National Forest. The study consists of two parts. The first section is a two-part survey to evaluate hikers', equestrians', and Sierra Club members' experiences with mountain bikers they encounter on the trail, and also to see what percentage of trail use each group amounted to. This survey was first conducted in 1987 and then again two years later (1989) to assess if conditions had changed. In both surveys, around 70 percent of respondents responded that mountain biking had never posed a safety concern and had never distracted them from their enjoyment. In the two years between the two surveys, mountain biking increased from 7 to 24 percent of total trail use.

In the second part of the report, the forest service gathered together representatives from each major trail user group in order to come up with an agreed upon strategy for mountain bike use on the trails. Several different options were discussed and five were picked from the list as the most substantial/discussed possibilities. These were: "Current Management with an Emphasis on Safety and Education, Selected Trails Where Bicycle Use is Permitted, Close All Front Country Trails to Bicycles, Regulate Day/Time of Bicycle Use on Trails, and Regulate Direction of Bicycle Travel on Trails." Using a threat analysis matrix to determine the probability and severity of several environmental, experiential, monetary, and safety costs, the group determined that the park should continue the Current Management with an Emphasis on Safety and Education scenario so long as mountain biking use continues at its current intensity.

This is a well-backed report on the management of mountain biking in the Santa Barbara area. It shows that the majority of users were not negatively affected by mountain bike use in Los Alamos National Forest, even as mountain bike use on trails was intensifying. Most users that were surveyed felt that safety was only a concern with a limited number of rouge, extreme mountain bikers. It seems that the initial concern that sparked this report was primarily voiced by a few passionate individuals. Consequently, when a large, representative group was gathered to deal with the issue of mountain biking, they concluded that the best possible course of action was to let it continue while maintaining bike management, enforcement, and education in the park.

¹ Source: <http://www.independent.com/staff/ray-ford/>

Appendix E.

The results of the report seem well founded and representative; over 500 users were included in the surveys. However, the report is 15 years old—trail user group attitudes, trail user group characteristics, and mountain bike trends may have changed significantly since that time.

Keywords: Problem definition (user survey)

Objectivity: ● Applicability: ● Sustainability: ○

Thoroughness: ● Useful Information: ●

E.7.2 Access to our Public Lands: Mountain Bikes, the Concept of Public Ownership, and the Fatal Flaw in *Bicycle Trails Council of Marin v. Babbitt*

Lucke, J. No Date. No publishing information.

This article is a review of court decisions related to allowing or prohibiting mountain bikers on trails. For each decision, Lucke argues why management decisions were based on preconceived notions and biases that lead to restrictions of mountain bikers. The article was unpublished, and no information provided about the author. IMBA cites this article on their website.

Lucke posits that “conflicts inevitably arise on these [public lands] because there are simply too many people.” He discusses the roots of perceptions about access to public lands, arguing that restricting mountain bikers from trails is misplacing the problem and relying on incomplete, biased, or incorrect assumptions. He also states that the NPS and BLM’s approach to managing mountain bikers has led to negative perceptions from other users, leading to an unpleasant experience for all users.

This analysis is not based on counts or incident reports but on an individuals’ review of court decisions. While most of the paper is strictly opinion, the author makes some valid arguments for the acceptance of mountain bikes on trails previously only used by hikers and equestrians. The first argument is that mountain bikers were excluded from trails based on insufficient evidence that they were causing unacceptable damage to trails.

Keywords: Problem definition (general)

Objectivity: ○ Applicability: ● Sustainability: ●

Thoroughness: ○ Useful Information: ●

Appendix F. Agency Surveys Returned

F.1 Federal Agencies

F.1.1 Bureau of Reclamation

Agency contact information

Name of agency:	Bureau of Reclamation
Street address:	jkirby@lc.usbr.gov
Name/position of contact:	Jason Kirby / Realty Specialist
Phone/e-mail:	(702) 293-3171
Responsibility for trail use policy/management:	The Bureau of Reclamation in our Lower Colorado Region does not directly manage trails. We have recreational leases in places on our lands with third party land managers. These entities typically include municipalities and other Federal lands management agencies.

Agency and Trail System Information

Type(s):	Multi-use trails including hiking, biking, & equestrian trails
Size (acres managed):	120,000 acres
Trail system miles managed:	120
Trail surface types:	Multi-use including asphalt, compacted gravel, native material, soil cement
Trail user types accommodated:	Equestrian, walkers, bicyclists

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Most complaints usually revolve around different user groups. Predominantly complaints on Reclamation land are related to Off Road Vehicle (ORV) use and other users.

Occasionally there are conflicts with walkers and bicyclists. Additional conflicts are competing special events with everyday local users.

From which group(s) do these complaints usually come?

Local residents. Walkers and hikers. Occasionally we hear complaints from bicyclists.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

During our busy seasons which are spring & fall on weekends

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

At turns and corners but most involving ORV use are in high traffic areas where roads cross the multi-use trail system.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

Walkers and ORV users on the land. Sometimes bicyclists and ORV users.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Meet up groups and biking and running clubs have conflicts with local residents. The groups can be large, should be permitted for special events and overtake a section of trail.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	x			
Reported Incident		x		
Injury due to collisions			x	
Non-injury collision			x	
Damage to natural resources	x			
Close calls negatively affect user experience		x		
Congestion or overcrowding on trails		x		
Other (Please Specify)	x			ORV use in the trail corridor with other users

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Design issues for the competing uses of walking and/or biking. For example bikes flying around corners.

The perception that ORV users are always at fault is an issue as well.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

The managing partners respond, Trail watch volunteers follow up. We have held stakeholder meetings and trail surveys inviting all users.

How successful were the physical response(s)?

Positive. When we have been able to break the issues down and bring everyone together it is a good experience.

What has been your agency's management response?

(i.e., speed limits, citations, exclusion of particular user groups, etc.)

Encouraging our managing partner to issue citations, physical barriers, signage and education

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

Management policies in place with each partner. This policy outlines acceptable maintenance and uses.

An active partnership of stakeholders that have agreed upon policy and enforcement of local City code on specific violations.

How well did you find the management response(s) work?

A response to forums, meetings, and a combination of enforcement has been positive.

What other responses did your agency try that did not work?

N/A

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

A handful of chance onsite meetings with ORV users and educating them on the proper uses and areas.

DRAFT

F.1.2 Lake Tahoe Basin Management Unit

Agency contact information

Name of agency:	Lake Tahoe Basin Management Unit
Street address:	35 College Drive / South Lake Tahoe, CA96150
Name/position of contact:	Garrett Villanueva, Assistant Forest Engineer
Phone/e-mail:	530.543.2762 / gvillanueva@fs.fed.us
Responsibility for trail use policy/management:	Oversee all NFS roads and trails at Lake Tahoe.

Agency and Trail System Information

Type(s):	US Forest Service
Size (acres managed):	160,000 acres
Trail system miles managed:	415 miles
Trail surface types:	Paved and unpaved
Trail user types accommodated:	OHV, Motorcycle, Hiking, equestrian, dog walking (on leash), bicycling (road and MTB)
Additional resources:	\$ 261.55 Motor Vehicle Use, FSH 2309.18 Trail Management Handbook.

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts? (From which groups, related to which other users, etc.)

As a provider of many public trails we don't recognize user conflicts, we recognize use conflicts. A user conflict is between two individuals, the Forest Service manages for use conflicts that reflect a trend of conflict between use groups as a result of uses that are not compatible as a result of trail design, use types, or lack of management.

It is difficult to identify the nature of most complaints because complaints are localized and specific to certain areas: Lam Watah Trail is dog poop, Camp Richardson is equestrian use of trails. Mountain bike conflicts were predominate on the Lake Valley Trail (Xmas Valley), however, the trail has been rerouted and reconstructed and use conflicts between bikers and hikers are no longer a common issue.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Use conflicts occur for a variety of reasons. Federal Highways completed a study on the reasons use conflicts occur. Clearly trail design/layout may contribute or resolve use conflicts, however, signage, setting, differing user goals, differing user technology, speed differential between users and other site specific factors affect use conflict.

Does your agency collect or record incidents or complaints? (If yes, would you be willing to provide us with that information?)

We record incidences, however, we have no recorded incidents where an injury was involved. There is nothing to provide.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			x		
Reported Incident					x
Injury due to collisions					x
Non-injury collision					Don't know
Damage to natural resources			As a result of use conflict?		
Close calls negatively affect user experience		As a result of the 5%er's (WAG)			
Congestion or overcrowding on trails	July-August on around 10 different trails				
Other (Please Specify)					

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

The primary cause for perceived use conflicts is attitude. Those with a trail sharing attitude can get along with anyone.

Speed Differential between use groups. Speed differentials of more than about 12 mph causes an increase in use conflicts.

Lack of management – signage to set user expectations such as allowed uses is very important. Without this users will take management upon themselves and may contribute to use conflicts by looking for a conflict. Management may also help users understand trail sharing etiquette so that they may have a positive trail experience.

Trail design. Short sight lines, confined areas, over steep grades, may all contribute to use conflicts.

The bottom line is that use conflicts as a trail issue is very subjective and determined by individuals. The repeat complainers or offenders are looking for a conflict.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

We have used all the above examples, however, we embrace shared use management. Over use of exclusion is harmful for all trail users and we avoid it unless there are safety issues.

We have used TTFs to slow down mountain bikers and meet their needs on certain trails. This approach is not appropriate on all trails.

How successful were the response(s)?

Very.

What design guidelines documents does your agency use?(please provide a link if available online)

FSH2309.18 and everything else we can find.

What trail policies or management techniques does your agency use? (please provide a link if available online)

Shared Use – Shared Use Sustainable Yield Act

What other responses did your agency try that did not work?

It is important to identify what is a perceived conflict vs. an actual conflict. Reaction to perceived conflicts causes confusion and may result in exclusion for certain use groups.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

They are smattered amongst the responses above.

F.2 California State Park Agencies

F.2.1 Calaveras Big Trees

Agency contact information

Name of agency:	California Dept of Parks and Recreation, Calaveras Big Trees
Street address:	1170 E. Highway 4
Name/position of contact:	Gary Olson, Park Superintendent
Phone/e-mail:	209-795-8904 golson@parks.ca.gov
Responsibility for trail use policy/management:	yes
	yes

Agency and Trail System Information

Size (acres managed):	6500
Trail system miles managed:	15
Trail user types accommodated:	Foot on trails, bicycles allowed on fire roads
Additional resources:	

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

Bicycles being used on foot trails

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

No particular place

Does your agency collect or record incidents or complaints?

Depends on the severity of the incident

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint		X		
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources			X	
Close calls negatively affect user experience		X		

	Weekly	Monthly	Annually	Less than once a year
Congestion or overcrowding on trails				X
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Illegal use of bicycles on foot trails

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

Signage, increased enforcement and patrols

How successful were the response(s)?

Somewhat

What design guidelines documents does your agency use?(please provide a link if available online)

State Parks Trails Handbook

What trail policies or management techniques does your agency use? (please provide a link if available online)

State Parks Operations Manual

What other responses did your agency try that did not work?

N/A

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

Education, increased patrols, and providing alternatives

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

N/A

F.2.2 Columbia State Park

Agency contact information

Name of agency:	California Dept of Parks and Recreation, Columbia State Park
Street address:	11255 Jackson St, Columbia, CA 95310
Name/position of contact:	Vince Sereno, Sector Superintendent
Phone/e-mail:	209-536-2916 vsere@parks.ca.gov
Responsibility for trail use policy/management:	yes
	yes

Agency and Trail System Information

Size (acres managed):	252 acres
Trail system miles managed:	One half mile
Trail user types accommodated:	foot
Additional resources:	

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

Motorcycles being operated on the trails

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

No particular place

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

Depends on the severity of the incident

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint		X		
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources			X	
Close calls negatively affect user experience		X		

	Weekly	Monthly	Annually	Less than once a year
Congestion or overcrowding on trails				X
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Motorcycles are not permitted, so illegal use is the problem

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

Signage, increased enforcement and patrols

How successful were the response(s)?

Somewhate

What design guidelines documents does your agency use?(please provide a link if available online)

State Parks Trails Handbook

What trail policies or management techniques does your agency use? (please provide a link if available online)

State Parks Operations Manual

What other responses did your agency try that did not work?

N/A

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

Short trail, low use, isolated area of park

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

N/A

F.2.3 Colorado Desert District

Agency contact information

Name of agency:	Calif. State Parks, Colorado Desert District
Street address:	200 Palm Canyon Drive, Borrego Springs, Ca. 92004
Name/position of contact:	Jim Dascoulias District Trails Coordinator
Phone/e-mail:	760-765-0604 jdascoulias@parks.ca.gov

Agency and Trail System Information

Size (acres managed):	700,000 +
Trail system miles managed:	200
Trail user types accommodated:	Hikers, bikers, equestrian, accessible
Additional resources:	

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

None

Does your agency collect or record incidents or complaints?

Yes

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				
Reported Incident				x
Injury due to collisions				x
Non-injury collision				x
Damage to natural resources		x		
Close calls negatively affect user experience				x
Congestion or overcrowding on trails			x	
Other (Please Specify)				

No further information provided.

Four Rivers Sector

Agency contact information

Name of agency:	California Department of Parks and Recreation, Four Rivers Sector
Street address:	31426 Gonzaga Road, Gustine, CA 95322
Name/position of contact:	Greg Martin, Sector Superintendent
Phone/e-mail:	209-826-1197, gmart@parks.ca.gov
Responsibility for trail use policy/management:	Policy: Greg Martin, Sector Superintendent Management: Mike Stanley, Sector Maintenance Chief

Agency and Trail System Information

Size (acres managed):	Total Acres within the Four Rivers Sector: approximately 37,000
Trail system miles managed:	Total Miles of Trails within the Four Rivers Sector: approximately 45
Trail user types accommodated:	Multi –use trails: pedestrian, equestrian, bicycles
Additional resources:	NA

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails? (From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

No formal reports of trail conflicts have been reported within the Four Rivers Sector to the best of my knowledge. Occasionally, Pacheco State Park has heard from equestrian riders that their horses were spooked by people on multi-use trails during large special events. These are just anecdotal and occur infrequently.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

No reports of conflicts have been reported to the best of my knowledge.

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

No, we do not have records of trail conflicts.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				x
Reported Incident				x
Injury due to collisions				x
Non-injury collision				x
Damage to natural resources				x

	Weekly	Monthly	Annually	Less than once a year
Close calls negatively affect user experience				x
Congestion or overcrowding on trails				x
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

No, we do not have records of trail conflicts.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

No, we do not have records of trail conflicts.

How successful were the response(s)?

No, we do not have records of trail conflicts.

What design guidelines documents does your agency use?(please provide a link if available online)

No, we do not have records of trail conflicts.

What trail policies or management techniques does your agency use? (please provide a link if available online)

No, we do not have records of trail conflicts.

What other responses did your agency try that did not work?

No, we do not have records of trail conflicts.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

No, we do not have records of trail conflicts.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

No, we do not have records of trail conflicts.

F.2.4 Gavilan Sector

1. Agency contact information

Name of agency: GAVILAN SECTOR
 Street address: 19 FRANKLIN ST/PO BOX 787 SJV, CA 950
 Name/position of contact: EDDIE GUARACHA
 Phone/e-mail: 831-623-4526
 Responsibility for trail use policy/management: _____

2. Agency and Trail System Information

Size (acres managed): 87,000 ACRES
 Trail system miles managed: 363 MILES (FIREROADS + TRAILS)
 Trail user types accommodated: HIKERS, BIKERS, EQUESTRIANS
 Additional resources: _____

3. Documenting the Problem

- a. What is the nature of most of the complaints you receive related to user conflicts on soft surface trails? (From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

Very rarely, complaints from equestrians about mountain bikers. Typically, if equestrians and mountain bikers are on the same trail, it is a fire road with plenty of room for all user groups

- b. Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

Single track trails

- c. Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

No.

- d. How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			2-3	
Reported Incident				X
Injury due to collisions			0	
Non-injury collision			0	
Damage to natural resources			2-3	
Close calls negatively affect user experience			0	
Congestion or overcrowding on trails			0	
Other (Please Specify)				

- e. What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Mtbr's riding too fast on single track when they encounter equestrians

4. Responses to Trail User Conflicts

- a. What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

posting trail etiquette. 99.9% of users are well informed

- b. How successful were the response(s)?

N/A

- c. What design guidelines documents does your agency use? (please provide a link if available online)

Dept. Trails Manual

- d. What trail policies or management techniques does your agency use? (please provide a link if available online)

See above

e. What other responses did your agency try that did not work?

None

f. If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

*The amount of trails we have: 200+ miles single track,
200+ miles of fire roads*

g. Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

No

5. Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:

N/A

Agency contact (if available):

Phone/e-mail:

a. In particular, what solution or strategy has the above agency used?

Thank you for your time!

F.2.5 Gold Fields District

Agency contact information

Name of agency:	California State parks, Gold Fields District
Street address:	7806 Folsom Auburn Road, Folsom, CA 95630
Name/position of contact:	Jim Micheaels, Senior Park & Recreation Specialist
	Rich Preston, Public Safety Superintendent
Phone/e-mail:	(916) 988-0513, jmiche@parks.ca.gov
Responsibility for trail use policy/management:	JM - District Trail coordinator, Trail planning (both projects and management plans). RP – public safety and law enforcement.

Agency and Trail System Information

Size (acres managed):	Folsom Lake SRA – 20,000 acres (land and water), Auburn SRA - 26,000 acres.
Trail system miles managed:	Folsom Lake SRA – approx. 100 miles, Auburn SRA - 118 miles of trail.
Trail user types accommodated:	Hikers/runners/pedestrians, equestrians, mountain bikes, road bikes (paved trails), accessible trails.

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

Most of the user group conflicts on dirt trails are between equestrians and mountain bikes and mountain bikes or pedestrians and mountain bikes. Folsom Lake SRA does have paved trails and we occasionally have conflicts between pedestrians and road bicyclists on the paved trails.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

Areas where user conflicts most frequently occur are illegal use of trails designated equestrian/pedestrians by mountain bikes.

These conflicts most often occur in areas where trails are intensively used by both equestrians and mountain bikes and where limited use trails either are in close proximity or intersect with multi-use trails. The specific location in Folsom Lake SRA where user conflicts most often occur is the Granite Bay area which has intensive trail use in this area and several places where equestrian/ pedestrian and multi-use trails intersect. Other locations where user conflicts occur are on steep sections of trail or blind corners. Auburn SRA has fewer trail user conflicts than Folsom Lake SRA.

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

If an incident results in injury or criminal activity an Incident Report is completed by a State Park peace officer. Violation notices can be issued for illegal trail use if violators are caught in the act by a peace officer. Complaints are not systematically recorded or retained by State Parks. Sometimes complaints are in the form of an e-mail or phone call to various State Park staff and may be shared with other Parks staff to address a particular problem, but this information is not retained in any comprehensive or systematic manner.

Equestrian user groups who primarily use Folsom Lake SRA have developed a "Park Watch" internet site where complaints and incidents can be recorded by trail users. Occasionally these reports are passed onto State Parks staff. This is not a State Park system, but a user group developed and operated system.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint – informal complaint*	X			
Reported Incident - these are incidents to which we respond.		X		
Injury due to collisions		More like quarterly – not as frequent as monthly, but more than annually.		
Non-injury collision – this type of incident is likely not reported, so frequency is uncertain.		X?		
Damage to natural resources – damage to resources isn't usually a result of user conflicts. More often is it s result of the intensity of use or illegal activity such as building bike jumps or other illegal trails.				
Close calls negatively affect user experience – mostly unreported, but may occur weekly. Again most of this is the result of illegal use of limited use trails.	X			
Congestion or overcrowding on trails – this doesn't seem like a consequence of user conflict – but one of the causes.	X			
Other (Please Specify)				

*State Parks comments on each category of complaint are in bold.

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Back in 2000, when user conflicts between equestrians and mountain bikes started to increase at Folsom Lake SRA, the District set up a "Folsom Lake Trails Advisory Group" (FTAG) to address some of these user conflict issues. The group had representatives from equestrian, mountain bike, runner, hiker and youth user groups. The group was facilitated by State Parks staff. The group met roughly monthly over a couple of years. The group's goal was to find ways to reduce user conflicts. One of the causes of user conflicts the group identified was the lack of trails (relative to demand) for many users, but in particular mountain bikes. The group undertook a project to determine if an existing limited use trail could be successfully changed into a multi-use trail. Trail condition surveys were done, necessary modifications and re-routes of the trail were identified and specific ideas for management of the trail were identified. Public meetings were held to discuss the proposal. A tenuous and somewhat grudging consensus by the FTAG was developed to present the proposal to change the limited use trail to multi-use to the District Superintendent. At the time, the Department had just initiated a process to revise the General Plan for the park unit. The District Superintendent believed the GP would address the trail system in its entirety and that it was more appropriate to defer to the GP on any changes in trail use designations. This decision, the length of time it took to complete the GP, and the fact that GP's are not really designed to make specific trail use designation decisions took much of the energy out of the FTAG – which dissolved shortly thereafter with members leaving the process dissatisfied. The GP was completed, but it did not make specific trail use designation decisions. Those decisions will be made in a unit Road and Trail Plan which has been initiated this year.

The District did designate uses of trails back in the 1990's at a time when mountain biking was gaining popularity, but prior to the most intense user conflicts. Many trail segments were designated equestrian/pedestrian use only. The District has posted use designations on many trails, but the posting is not perfect. The District has undertaken to revise its "posted order" – a form of park specific regulation – regarding trail use designations. This posted order will not make use designation changes, but just better document the current use designations. Any changes in use designations would occur in the unit Road and Trail Management Plan.

The District has posted speed limit signs, caution signs and trail use etiquette signs on some trails.

The District has initiated spot enforcement of trail use designations to address illegal trail use.

The District has looked at a couple of re-alignments of trails to separate trails with different use designations, but has not implemented these yet.

Most user conflicts result from the illegal use of equestrian pedestrian only trails by mountain bikes. The underlying causes of these conflicts include: the sheer volume and intensity of use in certain areas, particularly by mountain bikes; the limited number of trails (relative to amount of use) available to mountain bikes; the close proximity and intersection of limited use trails and multi-use trails in some areas; the poor alignment, design or condition of existing trails; the speed of mountain bikes on trails; instances of poor etiquette by all trail users. The long history of user conflicts at Folsom Lake SRA has led to entrenched negative perceptions by both equestrians and mountain bikes of the other user group. Neither of these groups is homogenous in their use of trail etiquette, but the negative actions and rhetoric of some users have affected the wider perceptions of many users on either side of this conflict.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

How successful were the response(s)?

Signing has not generally been successful in preventing illegal use of trails or compliance with speed limits. Spot enforcement has been seen positively by equestrian groups, but the actual success is uncertain. Too early to tell. Overall, the District's efforts to reduce user conflicts at Folsom Lake SRA have not been particularly successful.

What design guidelines documents does your agency use?(please provide a link if available online)

The Department has a Trails Handbook which provides guidelines for the development, construction and maintenance of trails. Karl Knapp can provide a copy of the Handbook.

The Trails Handbook was developed initially in 1991. Most of the trails at Folsom Lake SRA predate the Handbook guidelines and many trails are poorly aligned and not adequately maintained. Re-aligning and re-constructing these trails is very expensive. The District has done several re-routes of trail segments as opportunities for funding (grants) have been available.

What trail policies or management techniques does your agency use? (please provide a link if available online)

See 4a above. The District has designated the allowed uses on trails. Some are limited use, some a multi-use.

The District does have volunteer patrol groups including the Mounted Assistance Patrol at Folsom Lake SRA and a volunteer patrol groups at Auburn SRA (both equestrian and mountain bike)?

The District has specific staff assigned to work with various user groups, including the volunteer patrols, equestrian user groups and mountain bike user groups. State Parks staff attends the meetings of these groups and work with various user groups on trail work days. One of these work days recently included both mountain bikes and equestrians.

What other responses did your agency try that did not work?

The District is uncertain of the degree of success of any of our responses in effectively reduction trail user conflicts. Some responses may have a short term positive effect, but it does not seem like this reduction in conflict is sustained.

For Folsom Lake SRA, the District believe part of the long term solutions include developing more trail opportunities for all users – but particularly mountain bikes - either through development of new trails or changes in use; and addressing the design and conditions inadequacies of the current trail system through repairs, re-routes and improved maintenance. Given the current intensity of use and the seemingly endless latent demand for trail use – it could be that some limitations on use, such as further reduction in special events involving trails may be needed to help reduce use conflicts. Perhaps our trails are exceeding their carrying capacity – both physically and socially.

DRAFT

F.2.6 Refugio SB

Agency Contact Information

Name of agency:	State Parks
Street address:	10 Refugio Beach Rd Goleta, CA 93117
Name/position of contact:	Scott Anderson/Ranger
Phone/e-mail:	805-968-3852 / sanderson@parks.ca.gov

Agency and Trail System Information

Size (acres managed):	Roughly 9K acres
Trail system miles managed:	Roughly 20mi
Trail user types accommodated:	Bikers, hikers, walkers

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?

We don't receive any complaints

- **Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)**

N/A

Does your agency collect or record incidents or complaints?

If we had any complaints or incidents, we would generate a report number if necessary and write a report on the incident.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				X
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources				X
Close calls negatively affect user experience				X
Congestion or overcrowding on trails				X
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

N/A

Responses to Trail User Conflicts

What has been your agency's response?

N/A

How successful were the response(s)?

N/A

What design guidelines documents does your agency use?(please provide a link if available online)

N/A

What trail policies or management techniques does your agency use?

We have our trails signed and patrol them regularly

What other responses did your agency try that did not work?

N/A

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

I feel that we have a knowledgeable and respectful group of hikers, walkers and bikers who frequent our trails.

F.2.7 San Joaquin Sector

Agency contact information

Name of agency:	Department of Parks and Recreation
Street address:	5290 Millerton Rd. Friant, CA 93626
Name/position of contact:	Kent Gresham, Acting San Joaquin Sector Superintendent
Phone/e-mail:	559-822-2332, kgresham@parks.ca.gov
Responsibility for trail use policy/management:	Kent Gresham

Agency and Trail System Information

Size (acres managed):	12,520 acres
Trail system miles managed:	16 miles
Trail user types accommodated:	Multi-use and pedestrian/equestrian only
Additional resources:	

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

No significant complaints.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

N/A

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

No.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				X
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources				X

	Weekly	Monthly	Annually	Less than once a year
Close calls negatively affect user experience				X
Congestion or overcrowding on trails				X
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

Signs to regulate types of trail users.

How successful were the response(s)?

Successful.

What design guidelines documents does your agency use?(please provide a link if available online)

Department policy.

What trail policies or management techniques does your agency use? (please provide a link if available online)

Trail management plan.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

Trail groups work together.

F.2.8 Santa Cruz District

Agency Contact Information

Name of agency:	California Dept of Parks & Recreation
Street address:	Santa Cruz District 303 Big Trees Park Road. Felton, Ca. 95018
Name/position of contact:	Chris Pereira – Trails Supervisor
Phone/e-mail:	(831) 335-6321 / cpereira@parks.ca.gov

Agency and Trail System Information

Size (acres managed):	
Trail system miles managed:	262
Trail user types accommodated:	Hike, Bike, Equestrian
Additional resources:	

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails? (From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs' on- or off-leash.)

Most complaints come from hikers & equestrians about bikes riding too fast on open and closed to bikes. I have personally been forced off the trail by speeding mountain bikers while performing trail maintenance, 3 times in the last 10 years. Twice in Fall Creek State Park and once in the Forest of Nisene Marks State Park.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

Sometimes at blind corners, but also at long straight away, where bikes can pick up a lot of speed.

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

Yes, when they receive a formal complaint, but most often just inform staff that an incident has occurred. It is rarely documented. Our Public Safety Officer queried back two years and found no formal written complaints or incidents.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			X	
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources			X	
Close calls negatively affect user experience		X		
Congestion or overcrowding on trails		X		
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Probably design issues, mountain bikes riding on closed trails, lack of trails for just mountain bikers to ride on.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

- excluding certain user groups
 - constructing pinch points to reduce bike speeds
 - posting signage
-

How successful were the response(s)?

Excluding bikes from certain areas has not deterred the user group from using the trail. Pinch points have worked at reducing speeds, but sometimes they have been removed by the user group. Sign gets vandalized or removed at trails that are closed to bikes or horses.

What design guidelines documents does your agency use?(please provide a link if available online)

-State Park Trail Guidelines and have used IMBA trail book "managing mountain biking" for some bike specific trail projects.

What trail policies or management techniques does your agency use? (please provide a link if available online)

- posting trail signage
 - certain policies excluding certain user groups have been around a long time and are still in affect
-

What other responses did your agency try that did not work?

Continually posting signs then having them removed.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

We don't get many formal complaints but I do here about trail user concerns over bike speed, when I'm on the trail working. I also here from hikers about horse manure and the damage to trails caused by horses and bikes.

I don't believe you can remove conflicts on trails, certainly not in parks that have high volume of users like our State Parks here in the Santa Cruz District.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Not sure if it is a success story, but Mountain Bikers of Santa Cruz put on a carrot ride at Wilder Ranch State Park. Bikers hand out carrots to horses to help make a positive connection with the horse, in hopes that the horse and rider do not get spooked when bikes approach. I have not heard either way how successful it was.

F.2.9 Topanga Sector

1. Agency contact information (to be completed by Alta)

Name of agency:

Street address:

Name/position of contact:

Phone/e-mail:

Responsibility for trail use
policy/management:

California State Parks
1501 Will Rogers S. P. and Pacific Palisades CA 90271
Lynette Brody - Topanga Sector Superint.
LBrody @ Parks . CA . Gov

2. Agency and Trail System Information (to be completed by Alta)

Type(s):

Size (acres managed):

Trail system miles managed:

Trail surface types:

Trail user types accommodated:

Additional resources:

3. Documenting the Problem

- a. What is the nature of most of the complaints you receive related to user conflicts? (From which groups, related to which other users, etc.)

Perception of Mountain Bikes being unsafe;
Speeding, Element of Surprise, Horses
mess up trails after rain.

- b. Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Older trails now open to all user
groups. Trails w/o step off access,
Sight distance, Blind curves.

- c. Does your agency collect or record incidents or complaints? (If yes, would you be willing to provide us with that information?)

Yes, we can give you statistics,
but not Confidential reports.

- d. How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			X		
Reported Incident				X	
Injury due to collisions				X	
Non-injury collision				unknown	
Damage to natural resources		X			
Close calls negatively affect user experience		X	Not Reported		
Congestion or overcrowding on trails					
Other (Please Specify)					

- e. What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Trail design, inappropriate use, -
Mountain bike - Speed
Horses - Speed
Hikers - Hiking 3-4 Abnast, Not allow for
other users to pass
All users wearing iPods - Don't Hear

Do you have data supporting this information? If you are willing to share your data with us, please send to
hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111

4. Responses to Trail User Conflicts

- a. What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

2008 trail Policy
Trail use Change Policy

- b. How successful were the response(s)?

Educational, public meetings
letting all users group know
about our process.

- c. What design guidelines documents does your agency use? (please provide a link if available online)

Our state guidelines

- d. What trail policies or management techniques does your agency use? (please provide a link if available online)

trail Policy
Dept Notice 2008
Ca. Code of Resources - Enforcement
Codes

e. What other responses did your agency try that did not work?

Not being responsive

f. Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Our Dept should educate All field employees of the "Change in Use" process, Stick to policy.

5. Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:

Agency contact (if available):

Phone/e-mail:

Conito open space, Thousand Oaks
National Parks - SMT's
MRCA - Walt Young
* info on internet.

a. In particular, what solution or strategy has the above agency used?

?

Thank you for your time!

F.2.10 Turlock Lake SRA/Caswell Memorial SP/Bethany Reservoir

Agency contact information

Name of agency:	CA State Parks
Street address:	22600 Lake Road, La Grange, CA 95329
Name/position of contact:	Bill Lutton / Park Superintendent
Phone/e-mail:	wlutt@parks.ca.gov

Agency and Trail System Information

Size (acres managed):	228 Acres Turlock Lake SRA / 258 Acres Caswell Memorial SP/ 47 Acres Bethany Reservoir
Trail system miles managed:	3 Miles
Trail user types accommodated:	Hikers, Disabled

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails?(From which groups, related to which other users, etc. We are interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

I have experienced no complaints other than dogs off leash.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

N/A

Does your agency collect or record incidents or complaints? (If you are willing to share your data with us, please send to hannahkapell@altaplanning.com or contact us at (510) 540-5008 x111)

In the event of complaints, we resolve the issue through interpretation, education or enforcement. Recording of the complaint would only occur in the enforcement arena.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				X
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources			X	
Close calls negatively affect user experience				X
Congestion or overcrowding on trails				X
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

The trails are well defined and utilized for foot traffic and ADA accessibility. Inclement weather has not been a factor for usage.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

We utilize signage / posting, interpretation and enforcement techniques.

How successful were the response(s)?

I would gauge our successes high as we have little to no reported conflicts of trail usage.

What design guidelines documents does your agency use?(please provide a link if available online)

ADA guidelines if the trail is accessible. Departmental guidelines for width, designed usage, number of projected users, community input etc

What trail policies or management techniques does your agency use? (please provide a link if available online)

Departmental policies.

What other responses did your agency try that did not work?

N/A

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

Clear signage, proactive interpretation and education and enforcement.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

I would submit public education is the most effective tool. If the users understand the spirit of the trail development. If they understand the goal of the agency and its mission.

F.3 State Parks Agencies

F.3.1 North Carolina Division of Parks and Recreation - Lake Norman State Park

Agency contact information

Name of agency:	North Carolina Division of Parks and Recreation – Lake Norman State Park
Street address:	159 Inland Sea Lane, Troutman, NC 28166
Name/position of contact:	Casey Rhinehart / Park Superintendant
Phone/e-mail:	707 528 6350 / Casey.rhinehart@ncdenr.gov

Agency and Trail System Information

Type (s):	Hiking and Mountain Biking/Hiking
Size (acres managed):	Hiking = 7 miles and Mtn Biking/Hiking = 18
Trail system miles managed:	About 25
Trail surface types:	Earth
Trail user types accommodated:	Hiking and Mtn Biking

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Mtn bikers and hikers complaining about each other

Where do trail user conflicts most frequently occur?

Everywhere

Does your agency collect or record incidents or complaints?

Only if the visitor requests to document it

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint				x	
Reported Incident					x
Injury due to collisions					x
Non-injury collision					x
Damage to natural resources					
Close calls negatively affect user experience				x	
Congestion or overcrowding on trails				x	
Other (Please Specify)					

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Perceptions of user groups

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

Post trail etiquette at trailhead and speak with users about sharing trail

How successful were the response(s)?

Unknown

What design guidelines documents does your agency use?(please provide a link if available online)

For all trails, we have trail design guidelines. Use a lot of IMBA guidelines on MTB trails

What trail policies or management techniques does your agency use? (please provide a link if available online)

Agency trail guidelines

What other responses did your agency try that did not work?

None

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

No

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: NCDPR

Agency contact (if available): Tim Johnson

Phone/e-mail: tim.johnson@ncdenr.gov

In particular, what solution or strategy has the above agency used?

Not sure

F.3.2 Oregon Parks and Recreation

Agency Contact Information

Name of agency:	Oregon Parks and Recreation Department
Street address:	725 Summer St NE, Suite C, Salem, OR 97301
Name/position of contact:	Rocky Houston, State Trails Coordinator
Phone/e-mail:	(503) 986-0750 / rocky.houston@state.or.us

Agency and Trail System Information

Documenting the Problem

Type(s):	State agency
Size (acres managed):	OPRD properties include almost 102,500 acres of natural, recreational and historic resources in every part of Oregon
Trail system miles managed:	Approx. 960 miles of recreational trails and 220 non-vehicle bridges
Trail surface types:	Natural, compacted gravel, pavement, boardwalks, etc.
Trail user types accommodated:	Hiker, Cyclist, Mountain Biking, Equestrian,

What is the nature of most of the complaints you receive related to user conflicts?

Not sharing the trail, ie not following the trail etiquette protocols to allow passing, etc.; speed of cyclists; horse manure on trail; specific users impacting the trail, which makes it unusable part of the year (erosion, widened wet areas, etc.)

From which group(s) do these complaints usually come?

All user groups have complaints. Mountain bikers seem to have less complaints about other users, but we have the fewest user miles available to them.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

More during summer months and weekend, ie peak use times.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

Road cyclists and equestrians, mountain bikers and hikers

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Hiker – Hiker; Runner – Walker;

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	X			
Reported Incident		X		
Injury due to collisions			X	
Non-injury collision			X	
Damage to natural resources	X			
Close calls negatively affect user experience		X		
Congestion or overcrowding on trails		X		
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Design. Introduction of higher level of one user group that wasn't historically as high. Perception of other user groups, which influence interactions.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Post closures by user-type. Have trail etiquette signs on major trails in system.

How successful were the physical response(s)?

It keeps most people on the trails that they are allowed on.

What has been your agency's management response? (i.e., speed limits, citations, exclusion of particular user groups, etc.)

Separation of use, when space allows. Exclusion of use if health, safety or natural resource issue irresolvable. Citation authority available, but used rarely. Engage in multi-user trail meetings to develop plans to meet all users needs.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

OAR 736-010-0020, 8; 736-010-0026, 2; 736-010-0030, 8

How well did you find the management response(s) work?

Biggest success is when we can get users to work together on the solution. This reduces lumping one bad experience with the entire user group, allows relationships to be built and shared successes to be experienced.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Trail design (too steep, poor flow, etc.) appear to create the biggest impact on conflict. When trails are designed sustainably and with multi-users in mind, the conflicts are reduced. Most of our complaints can be linked back to design (using old logging roads for example) which magnify any conflict.

F.4 Regional Agencies

F.4.1 Capital Regional District Parks

Agency contact information

Name of agency:	Capital Regional District Parks
Street address:	490 Atkins Avenue/ Victoria, British Columbia / Canada V9B 2Z8
Name/position of trail manager:	Jeff Ward, Manager of Planning, Resource Management and Development
Phone/e-mail:	250.360.3370 / jward@crd.bc.ca
Responsibility for trail use policy/management:	Responsible for designing, building, and maintaining 30 Regional Parks and three Regional Trails (including Lochside, Galloping Goose, E & N Rail Trail

Agency and Trail System Information

Type(s):	Regional
Size (acres managed):	11,500 hectares of 30 Regional Parks, 3 Regional Trails
Trail system length managed:	Approx. 80 km
Trail surface types:	
Trail user types accommodated:	pedestrians, wheelchair users, cyclists, dogs (on & off leash),
Additional resources:	BIKESAFE #36

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

- 1) Dog management
- 2) People riding bikes too fast on the regional trails
- 3) Trail width – not enough room

From which group(s) do these complaints usually come?

- 1) Non-dog owners. Walkers typically. Complaint is sometimes between two dog owners
- 2) Pedestrians
- 3) Cyclists

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Dogs: Any time. No trends noticed

Cycling: Mostly during peak commuting periods (7-9am, 4-6pm)

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Dogs: No trends noticed

Cycling: Urban sections of trail as they are more heavily used

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

1) dog-walker – non dog-walker

2) cyclist – pedestrian

3) vehicle – trail user (at road crossings)

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Horseback riders – dog-walkers

Horseback riders – cyclists

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

Not enough data to answer this question.

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Dogs – lack of leash regulations

Community traffic vs. recreational traffic: trail etiquette issues (i.e. cyclists biking two abreast, walkers with headphones, trail users not yielding to other users, etc.)

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Trail etiquette signage is posted at most entrances to the trail. Have painted centerline on trail. Intersection design.

How successful were the physical response(s)?

Moderate – hard to judge as we have no benchmark data with which to measure from.

What has been your agency's management response?

(i.e., speed limits, citations, exclusion of particular user groups, etc.)

Park bylaws and regulations; bylaw enforcement; volunteer trail ambassador program aimed at promoting good trail etiquette; volunteer warden program; seasonal regulations for dogs (on beaches in particular); some exclusion of user groups (i.e. no motorized access, no cyclists in places); information on website (i.e. trail etiquette, etc.) and other media outreach

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

Regional Park Regulation Bylaw, Trail Etiquette document; pedal-assist bicycle FAQ, Pets in Parks webpage, Cycling in Regional Parks and Trails webpage

How well did you find the management response(s) work?

Moderate – hard to judge due to lack of benchmark data with which to measure from.

What other responses did your agency try that did not work?

Tried to put leash regulations in park but due to public input, the regulation was lifted.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

We have over 80 kms of Regional Trails in our region with over 2 million users per year. Based on that, the ratio of complaints we receive is very low.

In 2010, we rolled out our Volunteer Trail Ambassador Program – public response for this program has so far been very good.

DRAFT

F.4.2 Conejo Open Space Trails Conservation Agency

Agency contact information

Name of agency:	Conejo Open Space Trails Conservation Agency (COSCA)
Street address:	City Hall/Civic Arts Plaza / 2100 Thousand Oaks Boulevard / Thousand Oaks, CA 91362
Name/position of contact:	Kristin Foord, Manager
Phone/e-mail:	kfoord@toaks.org or (805) 449-2505.
Responsibility for trail use policy/management:	Preserving, protecting and managing open space resources

Agency and Trail System Information

Size (acres managed):	Over 11,300 acres
Trail system miles managed:	Over 140 miles
Trail user types accommodated:	Hikers, equestrians, mountain bikers
Additional resources:	COSCA Ordinance NO 01 2009

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?(From which groups, related to which other users, etc. We are primarily interested in conflicts between user groups, rather than those involving dogs on- or off-leash.)

The complaints, which are relatively rare overall, are generally from equestrians (most frequently) or hikers (less frequently) complaining that mountain bikers are speeding down the trail and don't yield to them.

The equestrians in particular bemoan the lack of etiquette amongst the young, male mountain bikers; these same people generally do admit that non-"lone male" mountain bikers are often well behaved and do follow trail etiquette.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

On single-track sections, and the concern from equestrians in particular is that mountain bikers speeding around a corner will either hit them on their horse (because they don't have time to move) or that it will scare their horse and will injure either the rider (if thrown), the mountain biker (if kicked), or both.

Does your agency collect or record incidents or complaints?

We do not collect data, as we rarely get complaints. We are very fortunate to have a long history of shared use on our trails (all of our 140 miles of trails except ~1 mile) may be used by hikers, mountain bikers, and equestrians, and a very low rate of conflicts (and to my knowledge, no actual accidents because of these conflicts to date). Most of our trail user complaints (by all groups) are about dogs off leash.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint		x 4x/yr		
Reported Incident			x	
Injury due to collisions				x
Non-injury collision				x unknown
Damage to natural resources		x		
Close calls negatively affect user experience			x	
Congestion or overcrowding on trails				x
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Many of our equestrians are older females who would prefer not to share the trail with mountain bikers because of the speed of the bikes and their perception that mountain bikers don't respect the trails or follow etiquette.

I've heard that they express their displeasure aloud when encountering a non-yielding mountain biker, which perhaps helps the mountain bikers to become more aware of the rules, and results in a self-correcting system

Some hikers have complained that mountain bikes aren't keeping on the trails on a few of the flatter areas, instead creating "more challenging" (illegal) trails alongside the main trail, causing resource damage. We do have many challenging trails available, so we try to put up "revegetation area" signs to stop this use and our Rangers will direct riders to the more challenging areas where they will have less desire to create their own side-trails.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

We do not post speed limit signs, but the trail etiquette symbol is on all of our trail entrance signs. We try to teach trail etiquette to local schoolchildren through skits performed at our "Trails Education Days" annually for 1,500+ 5th graders. We used to give out keychains with the yellow etiquette symbol at public events (no longer, due to budget cuts). We only exclude horses/bikes on a few short trail segments where the trail includes stairs.

How successful were the response(s)?

We have never really had any serious problems, and continue to be very lucky in that regard. We do have a Trails Advisory Committee, composed of three equestrians, three hikers/runners and three mountain bikers, which meets monthly to discuss trail issues. User conflicts are not often a topic of discussion, but the forum does help to build relationships and understanding between the user groups. The Committee members primarily just alert staff about general maintenance issues and all help to manage our volunteer programs. One of those programs is a volunteer Trail Patrol with hiking, mountain biking, and equestrian members.

What design guidelines documents does your agency use?(please provide a link if available online)

We generally USFS or CA State Parks trail standards (for our new/rerouted trails). Some of our older trails are former ranch roads which we are trying to reroute to bring up to standards over time.

What trail policies or management techniques does your agency use?

<http://www.conejo-openspace.org/COSCA%20Ordinance%20No.%2001-2009.pdf>

What other responses did your agency try that did not work?

We haven't had to try anything since we've been lucky to have so few problems (knock on wood).

In one incident several years ago, one equestrian apparently decided to slow down mountain bikes by digging a hole in the trail just below a downhill switchback as a booby trap for bikers. Her equestrian friends apparently soon convinced her to repair the intentional trail damage and remove the trap. This problem thankfully resolved itself as a result of community peer pressure to share the trail.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

We have seen fewer and fewer equestrians and more and more mountain bikers over the past ~15 years.

Our trails are very popular with mountain bikers and because we have so many of them now, and fewer equestrians, the equestrians have had to adapt and would not be successful in keeping the mtn. bikers out. It's also possible that because many of our trail users are local residents, there is a sense that they may see the other trail users at the grocery store or will see them again on the trail, so it's a disincentive to misbehave. There may be a better sense of shared community here than in larger trail systems.

Does your agency have a policy or approach to managing "Other Power Driven Mobility Devices" (OPDMD)'s, based on the new Department of Justice ADA Ruling that power-driven vehicles must be permitted on trails unless a safety assessment is completed (35.137)?

Yes, see <http://www.conejo-openspace.org/COSCA%20Policy%20on%20OPDMDs%203.11.pdf>.

We will be watching for rulings, guidance from the Access Board, or other new interpretations and plan to revise our policy as necessary in the future based on that new information.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Basically all of our trails have been multi-use (hiking/mtn biking/horseback riding) from the time of the agency's founding in 1977. Segregation has not been considered, nor has it been requested by our users in the past. On our Trails Advisory Committee, all three user groups sit around the table together, and at our popular volunteer trail work days, all three user groups work side by side to maintain our trails. The primary local mountain bike shop sells (and encourages customers to buy) bells to tie to the back of mountain bikes to alert other users that the rider is coming down the trail. We have heard that when these bells are used by mtn bikers, the equestrians and hikers are appreciative and thank the bikers.

F.4.3 Front Country Trails Multi-Jurisdictional Task Force

Agency Contact Information

Name of agency:	Front Country Trails Multi-Jurisdictional Task Force
Street address:	187 Paradise Rd, Santa Barbara, CA 93102-1990
Name/position of contact:	Rebecca Mordini, Front Country Trails Coordinator
Phone/e-mail:	805.698.5455 / sbfct1@gmail.com
Responsibility for trail use policy/management:	Coordinate with Park Staff from City and County and Los Padres National Forest on creating and implementing trail management objectives and programs.

Agency and Trail System Information

Type(s):	Regional (City & County of Santa Barbara, the Los Padres National Forest)
Size (acres managed):	
Trail system miles managed:	30 miles of trail
Trail surface types:	narrow, natural surface trails
Trail user types accommodated:	hiker, equestrian, bicyclists, trail runners

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Historical conflict dating back 30 years between bicyclists and the other user groups, hikers and equestrians.

Complaints of speed of downhill bicyclists, near misses between bikes and other users, and horses in fear of encountering bikes on the trail. Fear that the trails are too narrow to allow for safe passing of different user groups in different directions.

Five years ago a bike and a horse were passing each other on a trail and the horse fell over the side and died.

From which group(s) do these complaints usually come?

The Sierra Club has leadership that is vocal about problems with bikes. Individual equestrians also lobby for removing bikes from the trails so that they will be safe for equestrian use.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

There is no formal reporting system for conflict, so we do not have that data.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Based on public comment on this issue, it seems that most conflict occurs where line of sight is impaired and where a steep grade leads to higher bike speeds.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

While we do not have data on actual conflict, most complaints at Task Force meetings are received from hikers about the speed of mountain bikes. However, during public education events, we hear mostly about the problems associated with dogs and hikers.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Conflict between equestrians and mountain bikes is also a complaint. Aside from the incident five years ago, we do not have any reported incidents. However, equestrians state they have stopped using the multi-use trails as they do not feel safe knowing that mountain bikes could be approaching. Horses are easily startled by anything unexpected on the trail and this can be a real danger.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

I am sorry we do not have this data.

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.)

Please be specific as to the user groups involved.

Historical Expectations: the trails predate mountain biking, so having bikes on the trails is not the expectation of long-time users. However, bikes have never been banned from the trails, so there is 20 to 30 years of bike use that is also an expectation of the community.

Physical Characteristics: narrow, natural surface trails with average grades of 12% with some areas as steep as 26% and steep drop offs. This creates high speeds for downhill bikes, with some areas that have little space for users to pass each other safely. Brush growth in the summer inhibits line of sight, leading to being surprised by an approaching bike.

Road access at top of the trail: with most of our trails having access to the trailhead from a road at the top of the trail, the trails have become popular with downhill mountain bikes who shuttle to the top and ride down at high speeds. This particular type of riding has exacerbated conflict between bikes and other groups.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Initial education focused on standardized trail etiquette and information signs at trailheads.

Enhanced volunteer engagement in trail maintenance has allowed for better brush clearing and repair of eroded areas of trail. This has led to better lines of sight and fewer narrow, loose areas of trail.

Standardized trail rehabilitation guidelines have allowed community organizations to take on rehabilitating specific trails for safer equestrian and therefore multi-use access.

How successful were the physical response(s)?

Signs help clarify expected behavior and set the expectation of multi-use, which has been very helpful, especially in reaching those from outside the local community.

Better trail maintenance and rehabilitation is expected to lower the number of actual incidents on the trail. There is no formal reporting system but the feel is that "none to few" actual incidents occurred before and that continues to be the case after our enhanced trail maintenance. This does not impact user expectation.

What has been your agency's management response? (i.e., speed limits, citations, exclusion of particular user groups, etc.)

Creation of a multi-agency Task Force with regular public meetings has been key in giving the public a legitimate place to express their concerns about other trail users. This has lowered overall hostility and served as a catalyst for problem solving. Staff from all three agencies has been able to gather and present best practices in all areas of trail management and user conflict, which helps to put the complaints of certain members into perspective. The Task Force serves as the major educational outreach to help set user expectations for our multi-use trails.

The bike community, lead by Santa Barbara Mountain bike Trial Volunteers, an IMBA group, has taken the lead in educating bike users on etiquette and in encouraging use of bike bells. The courtesy of our local bike community has been noticed and helped greatly to diminish conflict. This has helped to shift the conversation from "bikes are bad; how do we eliminate them?" to "how do we change the behavior of certain bicyclists?"

Entrenched conflict among long-time users is less affected by these changes than other types of conflict.

How well did you find the management response(s) work?

Anything that addresses user expectation and improves trail courtesy has a positive impact.

What other responses did your agency try that did not work?

A single agency (USFS) community forum worked for several years to resolve these issues and agreed on an odd/even arrangement on one trail as a pilot project. When this arrangement became public knowledge, a backlash from individuals not involved in the process led to the plan being abandoned. The current Task Force structure assures a completely open process that is accessible at City and County levels as well involving Forest Service personnel.

The agencies have tried to empower a single community group made up of members from all user groups to serve as an umbrella group. The hope would be that the umbrella group would take on trail stewardship and bring user groups together. The political climate in the community has made these efforts fruitless.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

We are still struggling with issues of entrenched conflict, while make progress one conversation at a time. I feel that our biggest challenge is to build trust between groups and to manage user expectations. There is no magic bullet or ideal trail design that resolves these issues, simply an ongoing commitment to our goals of Safety, Sustainability and Satisfaction, with open and respectful communication at all levels.

In particular, what solution or strategy has the above agency used?

My conversations with the Parks and Recreation Trail Management team in Boulder Colorado was very useful. They are building single track for multi-use with a well-structured community process. They are well-funded and use tools to measure their results.

F.4.4 Hill Country Conservancy

Agency Contact Information

Name of agency:	Hill Country Conservancy
Street address:	221 W. 6 th St., Austin, Tx. 78701
Name/position of contact:	Butch Smith
Phone/e-mail:	512/328-2481 / butch@hillcountryconservancy.or
Responsibility for trail use policy/management:	planning
	Project manager

Agency and Trail System Information

Type(s):	Regional trails
Size (acres managed):	
Trail system miles managed:	100 or more miles regionally
Trail surface types:	various
Trail user types accommodated:	All but motorized

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts? (From which groups, related to which other users, etc.)

Overcrowded trails bring complaints about bikes and dog walkers.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Most occur in highly urbanized trails, especially around activity areas (non-trail related) where large numbers of park and trail users mix.

Does your agency collect or record incidents or complaints? (If yes, would you be willing to provide us with that information?)

Not that I know about.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

No information provided.

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Bike riders go too fast. Dog walkers have trip wire leashes. Social walking groups of 3 or more use the entire trail.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

On the Barton Creek Trail, hikers and bikers are separated in areas of scenic interest so that hikers can relax and look at the setting without having to constantly watch out for bikes. More on-street bike lanes are being developed to take some bike use away from trails.

How successful were the response(s)?

The Barton Creek trails separation has been appreciated. The Lance Armstrong Bikeway, an off-street and on-street path, has been successful.

What design guidelines documents does your agency use?(please provide a link if available online)

Various depending on the type of trail, ranging from ASSHTO to IMBA.

What trail policies or management techniques does your agency use? (please provide a link if available online)

A Trail Ranger Corps is being implemented by the Austin Parks and Recreation Dept.

What other responses did your agency try that did not work?

On the most used trail around Lady Bird Lake in Austin (1.5 million visits per year), there was an attempt to create a parallel trail for bikes only. This did not work out due to land pattern limitations. Basically there was not enough room in a highly developed urban area.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Partnerships between local governmental agencies, user groups and non-profit organizations has improved communication greatly. Each entity does what it can within its realm of influence to improve trail conditions and etiquette.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:	Nadia Barrera
Agency contact (if available):	Bike / Ped program with the City of Austin
Phone/e-mail:	Nadia.barrera@ci.austin.tx.us

In particular, what solution or strategy has the above agency used?

We are observing and learning from everyone.

F.4.5 Tualatin Hills Park and Recreation District

Agency Contact Information

Name of agency:	Tualatin Hills Park and Recreation District
Street address:	15707 SW Walker Road Beaverton, OR 97006
Name/position of contact:	Brad Hauschild / Park Planner
Phone/e-mail:	503 629 6305 x2931 / bhaus@thprd.org

Agency and Trail System Information

Type(s):	City
Size (acres managed):	1,300 acres of natural areas
Trail system miles managed:	60 miles of trails
Trail surface types:	45 paved, 15 unpaved
Trail user types accommodated:	Walkers, runners, bicycles, wheelchairs, etc. No ATV or other motorized used. Minimal mountain bike usage.

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Users going too fast- mostly bicyclists on paved trails. Occasionally similar complaints about runners. Some complaints about blind corners, being cut off by a bike rider or no announcement that they're coming.

From which group(s) do these complaints usually come?

Walkers seem to complain the most.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Highest complaint load is during the summer, but we get them at all times of the year. The greatest number of users on our trails is during the weekends with peaks in the spring and early fall.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Bends for sure, or anyplace that has poor visibility. On the other hand some conflicts occur on straightaways because bikers go too fast.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

Road bikers and walkers.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Walker with dogs and those without dogs.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint		X		
Reported Incident			X	
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources			X	
Close calls negatively affect user experience			X	
Congestion or overcrowding on trails			X	
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

The biggest issue is design- no matter how wide the trail is, there tend to be too many different types of users at peak times and a conflict (perceived or real ensues). I think older trail users tend to be more uncomfortable with faster moving users and see that as a threat- so they complain about it even when the usage isn't likely to lead to an accident.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

We gave posetted etiquette signs in some places but they don't tend to work- only law abiding users tend to read them! We have done some pruning of trails to improve visibility. Some of our paved trails are striped like a road. We also have rangers out on trails- they are a reassuring presence and talk to folks when they encounter a situation, which is not often.

How successful were the physical response(s)?

Design changes that influence behavior like stripes or wider trails seem to be the most effective. Signs are useless.

What has been your agency's management response?

We don't give citations, but can exclude certain users for violating rules. We've used this rarely but it can work.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

We can only exclude someone from a trail if they violated a rule in our rule book
(www.thprd.org/about/risk/safety/rulesregs.cfm)

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:

Portland Parks, Portland OR They have a lot more trails and users than we do.

F.4.6 Vancouver-Clark Parks and Recreation

Agency Contact Information

Name of agency:	Vancouver-Clark Parks and Recreation
Name/position of contact:	Lisa Goorjian / Regional Trail Planner
Phone/e-mail:	(360) 619-1134 / lisa.goorjian@ci.vancouver.wa.us

Agency and Trail System Information

Type(s):	City and County (merged park management responsibilities)
Size (acres managed):	Manages nearly 7,000 acres of parkland
Trail system miles managed:	Over 44 miles of trails. Paved path, Unpaved path, Bicycle Path, Equestrian Trail, Mountain Biking, Hiking
Trail surface types:	Paved, gravel and soft-surface
Trail user types accommodated:	Walkers, bicyclists, equestrians, roller-bladers

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

The nature of most complaints we receive related to user conflicts is regarding pet owners and off-leash dogs.

We also receive limited complaints from walkers and bicyclists saying that the trail width is too narrow.

From which group(s) do these complaints usually come?

Most of the complaints come from pet owners (who keep their pets on leash).

We also receive limited complaints from walkers and bicyclists.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

User conflicts often occur after work in the evenings and in the spring when the majority of trail users return.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Trail user conflicts most frequently occur at trail junctions and narrow sections.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

Pet owners on the trail are most commonly involved in conflicts with each other.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Less frequently walkers and bicyclists may sometimes be in conflict with one another.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			X	
Reported Incident				X
Injury due to collisions				X
Non-injury collision			X	
Damage to natural resources			X	
Close calls negatively affect user experience				X
Congestion or overcrowding on trails			X	
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Design issues include: poor drainage, steep slopes, narrow width, hard to see bollards and curbs

Wet weather conditions on old trail bridges that become very slippery contribute to conflicts and user safety.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Our agency has designated and built some soft surface trails adjacent to paved trails to accommodate, but not for exclusive use by equestrians. We have also installed trail courtesy signs- share the trail triangle and we have proposed installing reflective tape around all bollards within the trail.

How successful were the physical response(s)?

The separated trails and courtesy signage have been successful in addressing some user conflicts. We have not yet implemented reflective tape on all the bollards.

What has been your agency's management response? (i.e., speed limits, citations, exclusion of particular user groups, etc.)

Our agency's management response to user conflicts is to work closely with trail user groups (equestrian groups, hiking groups, etc), citizens and business owners to have them inform and guide their constituents on strategies to minimize user conflicts.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

We do not currently have any trail policy statements, regulations or guidelines to document our management response to user conflict issues (but we'll probably use this memo as a start.)

How well did you find the management response(s) work?

Our agency has found working with trail user groups and interested citizens to assist with reducing trail user conflicts to work well.

What other responses did your agency try that did not work?

Trying to close or regulate sections of trail that had user conflicts did not work and increased trail management issues.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Our agency has been most successful in reducing trail user conflicts by working with the trail groups that use the facility to provide a positive message, role model, expectations, etc. Additionally our agency recognizes that working with trail groups and citizens on trail projects from the planning- through construction and management instills ownership, and mutual respect for all the user groups.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:	Washington Department of Natural Resources- facilitates TAG
Agency contact (if available):	Trail Advisory Group for Yacolt Burn Forest
Phone/e-mail:	Jessica Kimmick
	jessica.kimmick@dnr.wa.gov Office number: 360-666-9400

In particular, what solution or strategy has the above agency used?

The best solution and strategy we have employed to address trail user conflicts is to work with trail user groups, citizens, and volunteers

F.5 County Agencies

F.5.1 Jefferson County Open Space

Agency Contact Information

Name of agency:	Jefferson County Open Space, Colorado
Street address:	700 Jefferson County Parkway / Golden, CO 80401
Name/position of contact:	Colleen Gadd, Visitor and Resource Protection Supervisor
Phone/e-mail:	cgadd@jeffco.us / 303-271-5995
Responsibility for trail use policy/management:	Construction, maintenance and management of park and recreation facilities.

Agency and Trail System Information

Type(s):	County
Size (acres managed):	38,761 acres
Trail system miles managed:	204 miles
Trail surface types:	Natural surface, gravel, concrete
Trail user types accommodated:	dogs (leashed), non-motorized, pedestrian, equestrian, bicycling
Additional resources:	Yielding order & passing regulations; American Trails article

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Dogs off leash.

Speed differential usually resulting from mountain bicycle use on downhill trail segments.

From which group(s) do these complaints usually come?

Hikers, equestrians and other bicyclists

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Conflicts occur at heavy use periods, particularly weekday late afternoons (after work) and weekends.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section of an unpaved trail, etc.)

Unpaved trails in our foothill terrain that include trail bends that are heavy with vegetation or tree lined, narrow trails with limited visibility or wide trails that allow for fast speeds. Dogs off leash complaints occur throughout our parks system.

Which combination of trail users is most commonly involved in conflicts with each other? (i.e., mountain bikers and equestrians, road bicyclists and inline skaters)

Mountain bikers with hikers.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Hikers without dogs and hikers with dogs not on leash

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	X			
Reported Incident			x	
Injury due to collisions				Unknown – some may not be reported to our agency
Non-injury collision				Unknown – some may not be reported to our agency
Damage to natural resources			x	
Close calls negatively affect user experience	X			
Congestion or overcrowding on trails	X			
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Design sometimes contributes to conflict. Narrow trails and wide trails each have their own challenges. Narrow trails with poor line of sight can cause users to not see one another when approaching at a fast speed and sometimes there is not a lot of room for passing. Wide trails sometimes lend to higher rates of speed which may increase safety concerns as well.

Variety of users types, difference in capabilities and user expectations. From expert riders who want to get a work out to kids and families just on a stroll or leisurely ride. Using the trails as a gym vs using them to enjoy nature.

Perceptions of user groups...a few bad apples have spoiled opinions related to all within the user groups, most particularly toward mountain bicyclists, but other user groups have also had negative perceptions due to the actions of a few.

Responses to Trail User Conflicts***What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?***

Jefferson County Open Space, CO has provided some separate trails for hiking only, as well as a hiking only park. We post trail user etiquette, stage special educational events at parks, and in 2009 did extensive user outreach and implemented new management techniques at a high conflict park (Apex Park).

Apex design considerations for trail development and maintenance to reduce speed (and minimize conflict) include: establishing chicane style traffic calming structure of both rock and fencing; creating segregated access trails at trailheads; being thoughtful of vegetation management as it relates to sight distances; and post etiquette signs at both trail heads and strategic locations throughout the trail system.

Additional responses throughout our system have been alternate use days (i.e. bikers on one day and hikers on another), directional travel (mtn. bikes one way on certain days), speed limits at one urban park and on concrete bikeways, educational efforts including our Bike Right and Share the Trail programs and use of volunteer patrollers.

How successful were the physical response(s)?

The alternate use proved to be a successful management response, as did the separate trails. While resistance from user groups was evident at first, satisfaction with the overall management was high with both management actions

At Apex Park, Jefferson County Open Space is in the second year of monitoring compliance and satisfaction of objectives to increase safety for visitors. The program will continue to have specific outreach and enforcement activities at this park to sustain initial improvements. However, initial responses from user groups thus far are showing favorable.

What has been your agency's management response?

To reduce speeds on some trail sections, JCOS implemented an alternating day (odd-days) directional restriction to mountain bicycling over three trail segments as well as constructed additional trail mileage (approx 1 mile) at Apex Park to provide a complete Park experience to all users despite any directional restriction. We are considering "zoning", whereby there may be zones for dismount or posted reduced speeds, although we have not implemented zones at this time. We also developed a new regulation regarding the manner in which users are required to pass one another on trails.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

JCOS documented the rise in safety/incident reports at Apex Park, and responded to the situation by engaging the park users in developing alternatives and management made the decision to implement the alternating day directional restriction to bicyclists at Apex Park. The visitor thus had the opportunity to select trails and anticipate from where a faster user might come on the odd days. The management technique did not prohibit any user type from accessing the park at any time.

How well did you find the management response(s) work?

For Apex Park, Jefferson County Open Space is in the second year of monitoring compliance and satisfaction of objectives to increase safety for visitors. The program will continue to have specific outreach and enforcement activities at this park to sustain initial improvements.

Other favorable outcomes of different management actions are noted in b. and other areas.

What other responses did your agency try that did not work?

Before engaging user groups and developing management options, staff had used educational special events and increased patrol to help with conflict issues. These outreach efforts didn't result in the behavioral changes necessary to address safety by some of the faster users.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Before implementing alternating day, directional restrictions for mountain bicyclists at Apex Park, Jefferson County Open Space experienced reduced user conflict at one of the newer parks in the system, Centennial Cone Park. During the planning and public input phase at Centennial Cone Park, the option of alternating weekend day use by hikers and mountain bikers was a new concept for the program that had largely been a multiple non-motorized use system. Initiated in 2006, alternating weekend days by hikers and mountain bikers has been adopted as a viable technique for user management.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: Jefferson County Open Space, Golden, CO

In particular, what solution or strategy has the above agency used?

Alternating Weekend Day access at Centennial Cone Park in Jefferson County, CO.

F.5.2 Mecklenburg County Park and Recreation

Agency Contact Information

Name of agency:	Mecklenburg County Park and Recreation
Street address:	5841 Brookshire Blvd., Charlotte NC 28216
Name/position of contact:	Michael Kirschman / Division Director, Nature Preserves & Natural Resources (natural surface trails), Jeff Robinson/Division Director, Park Operations & Athletic Services (paved greenway trail maintenance), Gwen Cook, Greenway Planner (greenway planning & design)
Phone/e-mail:	(704) 336-3854 Michael.Kirschman@MecklenburgCountyNC.gov
Responsibility for trail use policy/management:	Planning, design, some construction (most bid to outside contractors, although some built in-house), maintenance and management
	Policies associated w/ the various trails are contained in the Mecklenburg County Park & Recreation Facilities Ordinance and the approved Nature Preserves Master Plan

Agency and Trail System Information

Type(s):	Parklands designated by usage/type. Designations include Neighborhood Parks, Community Parks, Regional Parks, Greenways, Nature Preserves, and Special Facilities (ex: golf courses, aquatic center, stadium, etc.). Greenways are linear parks typically following streams/floodplains with paved trails. Over 33 miles built to date. Nature Preserves contain 35 miles of natural surface trails through woodlands and prairies. In the active Regional/Community Parks, there are 7 mt. biking trails totaling 44.75 miles.
Size (acres managed):	The Mecklenburg County Park & Recreation Department is home to 210 parks and facilities located on more than 18,800 acres of parkland throughout Mecklenburg County.
Trail system miles managed:	There are 33 miles of developed paved Greenway trails in Mecklenburg County (147 miles planned). There are 35 miles of natural surface trail in the established parks designated as Nature Preserves. There are nearly 45 miles of separate natural surface single track mt. biking trails.
Trail surface types:	Paved asphalt, some crushed gravel greenway trails, boardwalks, and natural surface/dirt trails in the preserves and at the mt. biking trails.
Trail user types accommodated:	Greenways – permit all users except motorized vehicles and horses. This includes hikers/walkers, runners, bikers, rollerblades, etc. (no equestrian use, no segways, no golf carts or other vehicles permitted) Natural Surface Trails – walking/hiking/running only. No bikes permitted. No vehicles permitted. Equestrian trails (shared with hikers) at one preserve – Latta Plantation Nature Preserve. Mt Bike Trails – bikers only.

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Regarding paved greenway trails, trail users not using good judgment and/or breaking rules (ex: going too fast on bikes, dogs off leash, etc.)

For the natural surface nature preserve trails, horse droppings on trail (at Latta Plantation Nature Preserve, the only preserve that permits equestrian use) and dogs off leash (similar to greenway trails).

Again for Latta, horse riders riding too fast and/or horse on non-horse/hiking only trails.

From which group(s) do these complaints usually come?

Mostly from park visitors walking the greenways, or from trail hikers and trail runners using the natural surface nature preserve trails.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

All time, but more often weekends, and more often from March thru October (our "peak" season in terms of visitation and usage). Greenway trails experience more conflicts after 5pm and on the weekends (high usage times).

Where do trail user conflicts most frequently occur?

Regardless of trail section or design, conflicts occur throughout the system and mainly on the most heavily used and crowded sections/segments of trail.

Which combination of trail users is most commonly involved in conflicts with each other?

On paved greenways, bicyclists and walkers, or bicyclists and runners.

On natural surface nature preserve trails, equestrian riders and hikers (at Latta only), dog walkers and hikers, dog walkers and other dog walkers.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Horse rider to horse rider (Latta only)

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

Unable to provide accurate information – these are "best guesses"

	Weekly	Monthly	Annually	Less than once a year
Complaint		X		
Reported Incident		X		
Injury due to collisions			X	
Non-injury collision	X			
Damage to natural resources			X	
Close calls negatively affect user experience		X		
Congestion or overcrowding on trails		X		

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Main condition is too many users/heavy trail use at one time. Other conditions mainly related to safety are due to weather conditions such as rains that bring creek levels above trail surface, depositing mud, sediment and debris along the trails.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Separate trails for separate users has worked well, and is likely responsible for the low amount of issues we experience. As stated, no biking on natural surface nature trails. There are separate mt. biking trails. Also, no equestrian trails throughout the system, except at one location where it was grandfathered (the only place we have equestrian conflicts). The entire department master plan, which contains the nature preserve master plan (which outlines permitted uses) can be found at <http://charmeck.org/mecklenburg/county/ParkandRec/InsideTheDepartment/Divisions/ParkPlanning/Pages/10YrPlan.aspx>

If trail design was/is an issue, typically those are addressed as possible/practical. For problems related to improper trail use, additional rule/regulation signage is posted (mixed results on effectiveness, but necessary), and patrols and monitoring is sometimes increased. In some cases, off-duty police are scheduled to work sections of greenway trails where problems are more frequent.

Due to popularity of greenway trails, trail widths increased (standard width is now 10 feet, whereas some of the original paved trails were smaller)

How successful were the physical response(s)?

Moderately successful

What has been your agency's management response?

(i.e., speed limits, citations, exclusion of particular user groups, etc.)

Increase monitoring, enforcement of rules/regulations, increased communication with user groups

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

The department has a Park Ordinance document that addresses all rules and regulations for use in the parks, on the trails, and on any county property.

How well did you find the management response(s) work?

Moderate

What other responses did your agency try that did not work?

All worked to some degree. Definitely the best practice has been to segregate users/trails, and try to stay away from mixed use trails.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: Forest Preserve Districts in Illinois (ex: Kane County, DuPage County, Will County, Cook County)

In particular, what solution or strategy has the above agency used?

I'm aware that at least one district (Kane County I believe) opened up entire forest preserves as "off leash" preserves. Meaning at those preserves individuals can let their dogs run off leash through the entire property, and anyone visiting the preserve should simply expect to have contact w/ off leash dogs. A unique way to provide "off leash areas" as opposed to fenced dog parks or requiring pets to be leashed. Unsure how successful this has been. It has been 5 years since I lived in IL.

F.5.3 Sacramento County Regional Parks, Recreation & Open Space

Agency Contact Information

Name of agency:	Sacramento County Regional Parks
Street address:	700 H Street, Room 7650 / Sacramento, CA 95814
Name/position of contact:	Kathleen Utley, Chief Ranger
Phone/e-mail:	916.876.3030 / utleyk@saccounty.net

Agency and Trail System Information

Type(s):	County
Size (acres managed):	15,000 acres
Trail system miles managed:	23 miles (American River Parkway)
Trail surface types:	Paved, unpaved
Trail user types accommodated:	Hikers, pedestrians, MTBs, equestrians, dogs (on leash)
Additional resources:	American River Parkway Plan; Bike Trail Rules & Regulations; Sacramento County Parks Ordinance (2008)

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Our most frequent complaint is speeding groups of bicyclists that yell at slower more family oriented groups.

Several of our user groups use the trail for endurance training. They usually want to go faster than the posted speed limit of 15 mph.

Where do trail user conflicts most frequently occur?

These conflicts occur most frequently on weekends and in the section of trail that goes from Watt Ave. to Hazel Access. It is generally not associated with any particular bend or narrowing.

Does your agency collect or record incidents or complaints?

We keep accident reports which would have to be released by our Risk Management Office.

We are dispatched thru the Sheriff's Department. They would have a record of every call, but I am not familiar with their policy for releasing those stats.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			x		
Reported Incident				x	
Injury due to collisions				x	
Non-injury collision			x		
Damage to natural resources			x		
Close calls negatively affect user experience			x		
Congestion or overcrowding on trails		x			
Other (Please Specify)					

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

We have reached our carrying capacity on our trail on weekends. As stated before we have two types of user, the recreation/family users and those that are using the trail for physical training and endurance.

Responses to Trail User Conflicts

What have been your agency's responses?

15 mph speed limit; posted trail rules (Policy 5.14 & 8.25); exclusion of uses (Policy 5.14 & 5.16); separated pedestrian, equestrian/hiker, and bicyclist trails run the length of the American River Parkway (Policy 5.3 & 8.10);

How successful were the response(s)?

We still have some conflicts when users ignore the rules and regulations governing the trail.

Does your agency use other design guidelines documents in addition to the American River Parkway Plan (2008)?(please provide a link if available online)

Sacramento County Codes starting in section 9.36.066 (<http://qcode.us/codes/sacramentocounty/>)

Do you enforce the 15 mph speed limit? If so, how and how successful has that been?

Prior to the 2009 Budget Cuts we were able to use Rangers on motorcycles to enforce the limit. We have not been able to do any regular enforcement since those cuts.

What other responses did your agency try that did not work?

Placing a radar unit along the trail. This just served to encourage bicyclist to see how fast they could go.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

This is an ongoing issue.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: Sacramento County Department of Regional Parks, Park Ranger Unit

In particular, what solution or strategy has the above agency used?

The use of the motorcycles was very effective. They could pace the large group and talk to them with little impact to other users.

F.5.4 San Luis Obispo County

Agency Contact Information

Name of agency:	San Luis Obispo County Parks
Street address:	1087 Santa Rosa Street / San Luis Obispo, CA 93408
Name/position of contact:	Ernie Del Rio, Parks Superintendent
Phone/e-mail:	805.781.5930 / edelrio@co.slo.ca.us

Agency and Trail System Information

Type(s):	County
Size (acres managed):	15,000 acres
Trail system miles managed:	52
Trail surface types:	7 Paved & 45 unpaved
Trail user types accommodated:	Hikers, bicyclists (road & MTB), equestrians, dogs

Documenting the Problem

What is the nature of most of the complaints you have received related to user conflicts?

Trespass issues., dogs off leash , dog feces on trails

From which group(s) do these complaints usually come?

Private property owners for trespass issues and hikers complain about equestrians who let their dogs run free

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

All year round, but increases during peak season April through September

Where do trail user conflicts most frequently occur?

Mid trail

Which combination of trail users is most commonly involved in conflicts with each other?

Hikers verses equestrians

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Bicycles verses hikers on the paved trails.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint				
Reported Incident				
Injury due to collisions			2	
Non-injury collision				
Damage to natural resources			3	
Close calls negatively affect user experience				
Congestion or overcrowding on trails				
Other (Please Specify)			4	Conflicts with wildlife

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Congestion and open space

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Inform and educate.

How successful were the physical response(s)?

Limited, honest people respond. Others don't

What has been your agency's management response?

Inform and educate. Has been positive.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

Incident reports and supervisors investigation reports

How well did you find the management response(s) work?

Limited success

What other responses did your agency try that did not work?

Tried to get law enforcement involved with limited response. Offense must be committed in their presence.

In particular, what solution or strategy has the above agency used?

Mutt mitts, signs with ordinances listed.

Santa Clara County Parks and Recreation

Agency Contact Information

Name of agency:	Santa Clara County Parks
Street address:	298 Garden Hill Drive / Los Gatos, CA 95032
Name/position of contact:	Donald Rocha, Natural Resource Program Supervisor
Phone/e-mail:	408.846.5892 / don.rocha@prk.sccgov.org

Agency and Trail System Information

Type(s):	County
Size (acres managed):	45,000 acres
Trail system miles managed:	300 miles
Trail surface types:	Paved & unpaved
Trail user types accommodated:	Hikers, pedestrians, equestrians, bicycles/MTBs, dogs (on leash)

Documenting the Problem

What is the nature of most of the complaints you have received related to user conflicts?

Equestrian and mountain bike use. Although complaints are perceived conflicts with very few reported incidents or actual conflicts.

From which group(s) do these complaints usually come?

Equestrian community.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Complaints are spring/summer, day use hours on weekends, when parks are more frequently used.

Where do trail user conflicts most frequently occur?

Complaints typically come to Parks from park user comment cards and during planning efforts/public meetings.

The complaints are more general with little detail as to the circumstances.

Which combination of trail users is most commonly involved in conflicts with each other?

Mountain bikes are equestrian and road bikes with walkers/strollers on paved trails.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Road bikes and walker/strollers, mountain bikers and hikers (less frequent conflict, but we do receive reports of mountain bikers traveling too fast and little warning to hikers.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			X	
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources		Seasonal		
Close calls negatively affect user experience			X	
Congestion or overcrowding on trails			X	
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Mainly related to design and trail grades contributing to speed and visibility.

Responses to Trail User Conflicts

What has been your agency's physical response? (i.e., separate trails for different users, posting of trail etiquette, tight turns, etc.) Do you have any documentation you can provide?

Investigation, enforcement and education. Additionally, we may perform maintenance to improve sight lines and visibility (at times, these are due to deferred maintenance due to staffing and resources). During implementation of a trail construction project we design trails to accommodate multi-use (sight lines, control speeds with grade changes, etc.).

How successful were the physical response(s)?

Outreach and education by Operations staff is well received, although our main conflicts are perceptions and not substantiated by reports or incidents.

What has been your agency's management response?

Outreach and education, as well as enforcement. We have posted speed limits and park rangers enforce those with radar (typically targeted areas from complaints).

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

County wide trails master plan and multi jurisdictional guidelines document (found on County Parks website: www.parkhere.org)

How well did you find the management response(s) work?

Design and construction responses work real well. Response to perception of a conflict is political and hard to track success

What other responses did your agency try that did not work?

N/A

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

The best solutions are design and layout. We have constructed trails with grade changes whereby you reach a ridge nose as an uphill at either direction (as the ridge nose is poor sight line feature). This also works for trail intersections.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:	Santa Clara County Parks
Agency contact (if available):	Greg Bringelson, Senior Park Maintenance-Trail Crew
Phone/e-mail:	408-629-9347 / greg.bringelson@prk.sccgov.org

F.5.5 Wake County Parks, Recreation and Open Space

Agency Contact Information

Name of agency:	Wake County Parks, Recreation and Open Space
Street address:	1400 Aviation Pkwy. Morrisville, NC 27560
Name/position of contact:	Drew Cade / Manager Lake Crabtree County Park
Phone/e-mail:	919 460 3396 / Drew.Cade@wakegov.com
Responsibility for trail use policy/management:	Act as steward for trail resources, guide maintenance and trail renovation efforts of supporting club- Triangle Off Road Cyclists (TORC).

Agency and Trail System Information

Type(s):	Multi- use- hiking , mountain biking, running
Size (acres managed):	250
Trail system miles managed:	14
Trail surface types:	Mineral surface with some ABC stone armoring and wood bridges
Trail user types accommodated:	hiking , mountain biking, running
Additional resources:	Park also has 520 flood control/ recreational lake attached

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Some hiker/ biking conflicts- mainly due to the volume of mountain biking. Next would be biking to biking conflicts- mostly right of way, speed issues

Where do trail user conflicts most frequently occur?

Most are on long hills, but there is some on blind turns and intersections as well.

Does your agency collect or record incidents or complaints?

We do not collect and collate complaints only incidents involving injuries, most of these are not the result of user conflicts

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			x		
Reported Incident				x	
Injury due to collisions					x
Non-injury collision				x	
Damage to natural resources			x		
Close calls negatively affect user experience			x		
Congestion or overcrowding on trails		x			

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Again volume drives most of these issues and the fact that the trails are designed by the mountain biking community. There are some design flaws which are being rectified as the IMBA guidelines are implemented in trail renovations. Hikers certainly think the mountain bikers are travelling too fast, but most seem to understand that biking is dominant sector represented on our trails.

Responses to Trail User Conflicts

What has been your agency's response?

We now try and design speed chokes in the trails and several key intersections are triangular to ease flow in/ out and minimize collisions. We also post signs indicating standard right of way- "cyclists yield to hikers", etc... "downhill yields to uphill".

How successful were the response(s)?

Given the volume of mountain biking trips- over 100,000 per yr, I would say the response has been positive for the most part.

What design guidelines documents does your agency use?(please provide a link if available online)

We do have a park use agreement with TORC- it is not online, but I can send with survey.

What trail policies or management techniques does your agency use?

The main management tool is closing trails due to wet conditions- again volume dictates that we do this to preserve the trail surface even if designed to optimal standards. The other tool is certainly abiding by the IMBA trail construction standards for all new work completed

What other responses did your agency try that did not work?

Some of our lake trail is in flat, flood prone areas. We have closed this section to mountain biking.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Several rogue trails in the area were built by the freeride, dirt jumping sector of the sport. The park now has a pump track and jump lines so the need is now met in a public park as opposed to on private land without the owner's permission.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: NC State Parks –Lake Norman St. Park

In particular, what solution or strategy has the above agency used?

Not positive how the park funnels/ filters users, but it is one of the only State Parks to permit mountain biking in North Carolina. Definitely worth checking into.

F.6 Local Agencies

F.6.1 Town of Crested Butte

Agency Contact Information

Name of agency:	Town of Crested Butte, Colorado
Street address:	507 Maroon Ave CB, CO 81224
Name/position of contact:	Jake Jones
Phone/e-mail:	970-349-5338
Responsibility for trail use policy/management:	Trails within jurisdiction and on conservation easements held by Town

Agency and Trail System Information

Type(s):	Range from natural surface single track to paved multi use
Trail system miles managed:	20+
Trail surface types:	Range from natural surface single track to paved multi use
Trail user types accommodated:	All non-motorized including hiker, horse, mtb and hand cycles

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

User conflicts are actually pretty rare. Most conflicts arise around the desire for "hiker only" trails close to town. Crested Butte is a mountain bike mecca and zero trails on our system restrict mountain bikes outside of Wilderness. Hikers would like a non-Wilderness hiker only trail. A couple areas do not allow dogs. Big problem for many people. No strict leash laws outside of Wilderness. Where there are leash requirements on trails, they get ignored. This is a problem for some land owners and non dog lovers.

Where do trail user conflicts most frequently occur?

No place in particular given the nature of conflicts that we have.

Does your agency collect or record incidents or complaints?

No we don't. We monitor open space and deal with violations of Conservation Easements, but we don't exactly record complaints. We have very active mountain bike and hiking clubs that do a lot of self-policing.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint					X
Reported Incident					X
Injury due to collisions					X
Non-injury collision					X
Damage to natural resources			X		

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Close calls negatively affect user experience					X
Congestion or overcrowding on trails		X			
Other (Please Specify)					

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Our biggest problem is lots of use/overuse of some trails. We need better signage for out of town visitors and maintenance is mostly done through stewardship orgs such as the mtb club or the local land trust.

Responses to Trail User Conflicts

What has been your agency's response?

Signage and trail design mostly.

How successful were the response(s)?

Very successful.

What design guidelines documents does your agency use?(please provide a link if available online)

We have trail design guidelines created by Greenways Inc as a part of a recently completed Parks and Recreation Master Plan. The plan is available online and attached to this email.

What trail policies or management techniques does your agency use?

We work in partnership with the local land trust and land owners on the trail system. Each parcel of land and easement language is different, so there is not one single policy or management tool that is applied to all. We have requirements for developers to provide trails in our subdivision regulations.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

I think the major assets to our trail systems is that 1) mountain bikes rule, 2) hikers and horses have lots of places to go to avoid bikes. We are a small town surrounded by public land including a couple Wilderness Areas, so everyone has plenty of room to move. Unlike a smaller park or urban area, we don't have a lot of user conflicts. The Crested Butte community is crazy about trails and no one wants to jeopardize access. Our trail work days can attract 150+ people for a community of around 4000 (if it is a mountain bike trail).

City of Durango

Agency Contact Information

Name of agency:	City of Durango
Street address:	949 E. Second Avenue
Name/position of contact:	Cathy Metz, Parks and Recreation Director
Phone/e-mail:	(970) 375-7329 metzcl@ci.durango.co.us
Responsibility for trail use policy/management:	Oversight of special event permits for trail use; maintenance of trail system Establish policy and management

Agency and Trail System Information

Size (acres managed):	2245 acres of open space; 286 acres of parks
Trail system miles managed:	Estimated 95 miles total (83 miles natural surface, 12 miles hard surface)
Trail surface types:	Dirt trails; concrete and asphalt hard surface trails
Trail user types accommodated:	Mountain and road bicyclists, walkers, hikers, joggers, roller bladders, skate boarders (non-motorized uses)

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Primary complaints relates to pedestrians and bicyclists, with pedestrians expressing concern about the speed of travel of the bicyclist and startling the pedestrian when passing.

Complaint from pedestrians that bicyclists do not yield to their use on the trail.

Where do trail user conflicts most frequently occur?

Most conflicts occur on the hard surface primary trail system (Animas River Trail) due to the high utilization. Conflicts tend to occur where there is a reduced site distance.

Natural surface trail conflicts typically occur on a narrow section of trail with reduced site distance.

Does your agency collect or record incidents or complaints? (If yes, would you be willing to provide us with that information?)

No permanent record is kept by the City on trail user conflicts.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			X		
Reported Incident				X	
Injury due to collisions					X
Non-injury collision					X

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Damage to natural resources		X			
Close calls negatively affect user experience			X		
Congestion / overcrowding	X				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

High use of the trail system by bicyclists and pedestrians; lack of understanding by some trail users of appropriate trail etiquette.

Responses to Trail User Conflicts

What has been your agency's response?

Redesign and reconstruct hard surface trails with poor site distance and known hazards.

Public education and outreach on trail etiquette, with local trail advocacy group (Trails 2000).

Enforcement by Park Rangers and Police officers.

How successful were the response(s)?

Successful on the reconstruction of hazardous area on the hard surface trail. Education and enforcement is ongoing, with some success.

What design guidelines documents does your agency use?(please provide a link if available online)

City standards in addition to applicable state and federal standards. (AASHTO and IMBA)

What trail policies or management techniques does your agency use?

Share the trail etiquette and leave no trace.

What other responses did your agency try that did not work?

Education on bikers yielding to pedestrians on the trail.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

The City works closely with the local Trails 2000 group on planning, design, construction and management of trail user conflicts. This joint effort has been extremely beneficial to the community.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name: Trails 2000

Agency contact (if available): Mary Monroe, Executive Director

Phone/e-mail: (970) 259-4682 mary@trails2000.org

In particular, what solution or strategy has the above agency used?

Organizes volunteers to construct and maintain the natural surface trail system. Maintains a current database of volunteers for education about trail use and etiquette.

F.6.2 City of Henderson

Agency Contact Information

Name of agency:	City of Henderson
Street address:	240 Water Street, Henderson Nevada
Name/position of contact:	Patricia Ayala Park Project Manager
Phone/e-mail:	patricia.ayala@cityofhenderson.com
Responsibility for trail use policy/management:	Planning and Design

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Unleashed dogs, dog waste in trail areas, lights out urban areas, graffiti, debris on trails (rocks, leaves), user conflicts because leashed dogs are taking up entire trail, Cyclist and dog walkers, cyclists riding too fast on multi-use trails, bollards hinder cyclists.

Where do trail user conflicts most frequently occur?

Bike riders going too fast – Under crossings and on grades.

Busy areas near parks, trailhead, recreation centers and neighborhood access areas have conflicts due to high use and multiple user groups

Does your agency collect or record incidents or complaints?

Trail Watch Volunteer program, Tracked only for the purpose of resolution only. These are not published therefore not available.

Formal concerns, requests or complaints are also entered (staff or citizen access) through a Contact Henderson.

This information is not available. .

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint	X				
Reported Incident			X		
Injury due to collisions					X
Non-injury collision				X	
Damage to natural resources				X	
Close calls negatively affect user experience			X		
Congestion or overcrowding on trails		?	X		

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

High use conditions create conflicts between many user groups. Interactions between dog owners and other users. Cycling groups taking over full trail conflict with recreation users. (speed, area,)

Responses to Trail User Conflicts

What has been your agency's response?

Trail and park rules are posted at all major access areas, exclusion of equestrian or separate, parallel equestrian trails, design for exclusion of user groups (rugged hiking trails, mountain biking trails) design to exclude vehicular/ATV groups. Enforcement include the volunteer Trail Watch Group, Henderson Police Public Outreach with ATV groups. Trail Days for educational purposes, public outreach with community groups (HOA's, Community meetings, etc)

How successful were the response(s)?

HPD outreach successful to reduce illegal ATV. Increased uses reduced many conflicts.

What design guidelines documents does your agency use?(please provide a link if available online)

ADA where applicable, and Federal Standards for accessibility, AASHTO design Standards.

What trail policies or management techniques does your agency use?

Trail rules are posted, Trail Watch volunteers monitor trail use (Volunteer Hours exceed 2500)

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Trail Watch program is very successful, provides a sense of ownership, keeps the "good" users with "eyes" or casual observation (a CPTED concept) at a high level.

Volunteers are provided training, and have been known to provide further casual education to other trail users.

F.6.3 Town of Pagosa Springs

Agency Contact Information

Name of agency:	Town of Pagosa Springs
Street address:	551 Hot Springs Boulevard
Name/position of contact:	Tom Carosello/Parks and Recreation Director
Phone/e-mail:	(970) 264-4151 Ext. 232 tcarosello@centurytel.net
Responsibility for trail use policy/management:	Policy development and implementation, trail maintenance and monitoring.

Agency and Trail System Information

Type(s):	Hiking footpath, unpaved multi-use, paved multi-use
Size (acres managed):	Approximately 200
Trail system miles managed:	6 miles of "ground trail" plus 1 mile of river "trail" (paddlers, rafters, etc.) through downtown
Trail surface types:	Earthen path, asphalt and concrete walkways, river
Trail user types accommodated:	Pedestrian, bicycle/mountain bike and equestrian, rollerbladers

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Nearly all of the complaints we have received involved either pedestrian vs. equestrian conflicts or pedestrian vs. bicycle conflicts, and these have all been on the unpaved, multi-use portions of our trails. On rare occasions, we get a pedestrian vs. equestrian conflict, but less than twice per year. We have received very few complaints resulting from conflict on our paved or concrete trails, and these have always been pedestrian vs. bicycle conflicts or pedestrian vs. unauthorized motor vehicles (scooters, ATV's, etc.).

Where do trail user conflicts most frequently occur?

Our conflicts occur most frequently on "blind" or "short-sighted" curves on our unpaved, multi-use trails, primarily on Reservoir Hill, a 90-acre primitive park within town limits which experiences heavy pedestrian, equestrian and mountain bike use from late spring through early fall. Since the park is heavily forested, nearly every tight bend includes some sight obstructions, and collisions are most apt to occur at these locations.

Does your agency collect or record incidents or complaints?

We only log incidents involve injuries and have not recorded any within the last five years.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Complaint			X		
Reported Incident			X		
Injury due to collisions					X
Non-injury collision				X	

	More than once per week	One per week	Once per month	Once per year	Less than once per year
Damage to natural resources				X	
Close calls negatively affect user experience			X		
Congestion or overcrowding on trails				X	
Other (Please Specify) Unauthorized motor travel			X		

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Most conflicts on our paved or concrete paths involve ignorance of the trail rules. For example, our town is heavily tourist-oriented, and some visitors assume the trails are suitable for scooters, ATV's or, rarely, even cars and trucks. For the most part, however, our conflicts stem from the use of our heavily-wooded, earthen trail system. During the summer, these trails are so thick with foliage that clear lines of sight exist only on long straight-aways, so there is the occasional collision or near collision on bends and switchbacks. Also, until recently, most of the trails in this area were not professionally designed/planned, so as user groups grow, there is inevitably the "discovery" that what was once considered an acceptable trail route or design does not meet current needs or standards with regard to use and safety.

Responses to Trail User Conflicts

What has been your agency's response?

We have posted "warning signs" indicating that the unpaved trails are subject to use by pedestrians, equestrians and mountain bikers, and we have also recently begun to thin some of the dense undergrowth which limits sight distance on some of the "curvier" trails. In addition, we are also currently examining the possibility of designating some of the trails "equestrian only" and "pedestrian only" to limit conflicts. With regard to our paved surfaces, there are postings at each access point indicating trail rules, permissions, etc. For example, all trailheads are marked with "Yield To Pedestrians" signs. In addition, all new trails are planned with the assistance of professionals who specialize in this area.

How successful were the response(s)?

In most instances, the signage and thinning of overgrowth has been sufficient on unpaved trails; conflicts involving injuries have dropped to less than one per year over the past five years.

What design guidelines documents does your agency use?(please provide a link if available online)

In general, we use the recommendations from the National Trails Training Partnership, with some local "tweaking" to accommodate our town codes, trails plan, etc.

What trail policies or management techniques does your agency use?

Same as above, please refer to the link below: www.americantrails.org/resources/trailbuilding/index.html

What other responses did your agency try that did not work?

A few years ago, at the suggestion of a trails-study committee, we tried to limit uses of the unpaved trails, especially equestrian use and mountain bike use, to certain hours of the day. This was a miserable failure.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Recently, we have learned that constructing "parallel" trails for pedestrians and equestrians works quite well where feasible. Even a small buffer zone between the two trails almost entirely prevents conflict, provided each user group is aware of their respective trail guidelines and rules.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:	Pagosa Area Trails Council
Agency contact (if available):	John Applegate, if he is still involved.
Phone/e-mail:	(970) 731-9325

In particular, what solution or strategy has the above agency used?

I'm not exactly sure of the particulars, but the Pagosa Area Trails Council has been heavily involved in trail construction, maintenance and planning. In fact, the council is more experienced with trails, especially earthen trails, than my department due to the fact that the council services a significantly larger usage area.

DRAFT

F.6.4 City of Palo Alto Open Space & Parks

Agency Contact Information

Name of agency:	City of Palo Alto Open Space & Parks
Street address:	1305 Middlefield Road / Palo Alto CA 94301
Name/position of contact:	Lester Hodgins, Supervising Ranger
Phone/e-mail:	Lester.Hodgins@cityofpaloalto.org

Agency and Trail System Information

Size (acres managed):	4500
Trail system miles managed:	45+ miles
Trail user types accommodated:	Hiking, biking, and horseback riding
Additional resources:	Two small lakes, camping, fishing.

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails ?

Very few complaints, of those we receive it usually bicyclists vs. hikers in relation to speed differential or line of sight.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

Narrow sections of trails.

Does your agency collect or record incidents or complaints?

Have so few we do not track data.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			x	
Reported Incident				x
Injury due to collisions				x
Non-injury collision				x
Damage to natural resources			x	
Close calls negatively affect user experience				x
Congestion or overcrowding on trails				x
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Design issues, where trails are narrow or sight line is poor and or vegetation growth narrows trails or visibility. These conflicts are typically between bikes and hikers.

Responses to Trail User Conflicts

What has been your agency's response?

We do post trail etiquette and speed / passing limits. Use social media to alert user groups to trail conditions, hazards, and safety concerns. Have also modified trails over time to improve safety e.g. widen for visibility, change grade and surface for speed control.

How successful were the response(s)?

Typically well received. Social media effective for regular /frequent user groups (e.g. biking clubs)

What design guidelines documents does your agency use?(please provide a link if available online)

Trail Master Plan (2001) developed for the Pearson-Arastradero Preserve and the Foothills Park Trails Maintenance Plan (2002) (Sorry, neither are on line)

Both Plans were prepared with Amphion Environmental, Inc and Thomas Reid Associates.

What trail policies or management techniques does your agency use?

Policies and ordinances established by City council (Park Regulations link attached)

Guidelines and techniques also developed in the above mentioned Master / Maintenance Plans

What other responses did your agency try that did not work?

So far no problems.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

In the development of the Pearson-Arastradero Preserve's Trail Master Plan user groups participated in development of preserves multi use trails in facilitated meetings and trail visits. We maintain contacts and communications with local user groups and use social media to keep user groups informed of any issues.

Does your agency have a policy or approach to managing "Other Power Driven Mobility Devices" (OPDMD)'s, based on the new Department of Justice ADA Ruling that power-driven vehicles must be permitted on trails unless a safety assessment is completed (35.137)?

No not yet!

F.6.5 Portland Parks and Recreation

Agency Contact Information

Name of agency:	Portland Parks and Recreation
Street address:	1120 SW 5 th Ave, Portland, OR 97204
Name/position of contact:	Emily Roth / Planner
Phone/e-mail:	(503) 823-9225 / emily.roth@portlandoregon.gov
Responsibility for trail use policy/management:	Planning and policy for natural area trails and some regional, paved trails

Agency and Trail System Information

Type(s):	City
Size (acres managed):	Portland Parks & Recreation is the steward of 11,000 acres of land at more than 250 locations including a multitude of community and neighborhood parks, natural areas, recreational facilities, gardens, and trails
Trail system miles managed:	Single and multi-use trails. Portland has a projected 220 miles of regional trails.
Trail surface types:	Range from soft surface to paved.
Trail user types accommodated:	Single use trails include hiking, walking, exercise/fitness, biking, mountain biking. Multi-use include hiking and mountain biking, hiking and equestrian, walking and biking, walking, biking and equestrian, fire and maintenance
Additional resources:	PP&R Trail Guidelines (2009) & Recreational Trail Strategy (2006)

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Dogs off leash and bags of waste bags left on trails; bikes on walking and hiking trails; high speed users/bike commuters with walkers and others going a slower pace

From which group(s) do these complaints usually come?

Walker/hikers/families

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

All days, all daylight hours

Where do trail user conflicts most frequently occur?

Trails that are too narrow for all the allowed uses

Which combination of trail users is most commonly involved in conflicts with each other?

Road bicyclists that are commuting or training and walkers; runners and dog walkers (dog off leash) on soft surface trails, mountain bikers and hikers

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Dog off leash users with everyone.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	X			
Reported Incident	X			
Injury due to collisions				X
Non-injury collision			X	
Damage to natural resources	X			
Close calls negatively affect user experience	X			
Congestion or overcrowding on trails	X			
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Off trail use by dog walkers, hikers, mountain bikers

Off leash dogs and runners;

Trails too narrow for the allowed uses and number of people using them

Responses to Trail User Conflicts

What has been your agency's physical response?

Post Trail etiquette; post slow down signs; Ranger in Forest Park (new position); post allowed uses on the trail

How successful were the physical response(s)?

Marginal

What has been your agency's management response?

Created a new Ranger Position for Forest Park (5000 acre natural area) that can do education and write citations.

Currently developing a volunteer program to educate users about safety and etiquette.

We do not have many enforcement tools because of limited staff and dollars

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

City Code

How well did you find the management response(s) work?

Very limited resources to enforce.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Ensure trails are wide enough for use; separate uses where possible.

F.6.6 City of San Luis Obispo Parks

Agency Contact Information

Name of agency: City of San Luis Obispo Parks

Agency and Trail System Information

Type(s): single and multi use City of SLO

Size (acres managed): Around 4,000

Trail system miles managed: 41 plus

Trail surface types: Natural and asphalt

Trail user types accommodated: Foot, bicycle, horse

Additional resources: Great volunteers

Documenting the Problem

What is the nature of most of the complaints you have received related to user conflicts?

Knock on wood but we don't really have many. Occasionally hiker biker and speed issues but over all they coexist well.

From which group(s) do these complaints usually come?

Hikers

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Heavy traffic times like after work or weekends

Where do trail user conflicts most frequently occur?

Areas with little line of sight or area with high speed possibilities

Which combination of trail users is most commonly involved in conflicts with each other?

Hiker vs Biker

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Just the one...

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint			X	
Reported Incident			X	
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources		X		
Close calls negatively affect user experience			X	
Congestion or overcrowding on trails			X	

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Typically it is hikers upset about bikers speeds and not seeing them. Bells have really helped ton with this

Responses to Trail User Conflicts

What has been your agency's physical response?

They usually just want to be heard and then they are okay with it. Again the bells have been a nice addition

Never have there been any suggestions for policy changes

How successful were the physical response(s)?

GOOD

What has been your agency's management response?

(i.e., speed limits, citations, exclusion of particular user groups, etc.)

Nothing has been needed....

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

None

How well did you find the management response(s) work?

NA

What other responses did your agency try that did not work?

none

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

We are lucky and id like to keep it that way ☺

In particular, what solution or strategy has the above agency used?

This is just a side note but... I guess the biggest trail user conflicts we have are Dogs off leash people verses everyone else. I get way more calls about that then a user group VS another...

Not sure if that helps at all????

F.6.7 City of Las Vegas

Agency Contact Information

Name of agency:	City of Las Vegas / Public Works / Engineering Planning
Street address:	333 N. Rancho Drive, Las Vegas, NV 89106
Name/position of contact:	Connie Diso
Phone/e-mail:	CDiso@LasVegasNevada.GOV
Responsibility for trail use policy/management:	Planning and funding of the City of Las Vegas Trails Master Plan

Agency and Trail System Information

Trail system miles managed:	Ultimate Master Plan of 239-miles of which approximately 51-miles are constructed to date
Trail user types accommodated:	Shared-use and equestrian trails

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts on soft surface trails?

All of our pedestrian trails are hard surfaced. The equestrian trails are primarily a soft decomposed granite surface.

User conflict complaints are rare on these trails. In fact, only one complaint I've encountered was when parents complained of their children walking to and from school had stepped on horse manure on these trails. They claimed that rarely would horses be present, and therefore, the equestrian trails should be turned into sidewalks.

Where do trail user conflicts most frequently occur? (i.e., at a bend on the trail, at a narrow section, etc.)

We have no trail user conflicts on file other than what is stated above.

Does your agency collect or record incidents or complaints?

The types of trail conflicts we have collected are not user conflicts, but are more related to access issues. The trail planning and development challenges the City of Las Vegas faces is due to it being a built-out urban jurisdiction. A challenge with lack of available right-of-way is accomplishing trail connectivity. Until that improves, usage will continue to be minimal and therefore, user conflicts are basically non-existent.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Basically non-existent
Complaint				X
Reported Incident				X
Injury due to collisions				X
Non-injury collision				X
Damage to natural resources				X
Close calls negatively affect user experience				X
Congestion or overcrowding on trails				X
Other (Please Specify)				X

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions? (e.g., weather, design issues, previous interactions/perceptions of user groups, etc.) Please be specific as to the user groups involved.

Not applicable to the City of Las Vegas based on the above answered questions.

Responses to Trail User Conflicts

What has been your agency's response? (i.e., posting/enforcing trail etiquette, designing tight turns to reduce speeds, excluding certain types of users, etc.)

The City of Las Vegas while not faced necessarily with trail user conflicts at this time, does adhere to trail design standards that are based on American Association of State Highway and Transportation Officials (AASHTO) and American Disability Association (ADA) standards.

In addition, trails located near unpaved, open space areas have signage and barriers prohibiting off road vehicles. The comfort and quality of the trails reflect the use of these standards and may be part of the reason conflicts are virtually non-existent.

How successful were the response(s)?

See above.

What design guidelines documents does your agency use?(please provide a link if available online)

<http://www.fhwa.dot.gov/environment/recreails/manuals.htm>

<http://www.rtcsonthernnevada.com/mpo/streets/>

http://www.ada.gov/2010ADAstandards_index.htm

What trail policies or management techniques does your agency use?

The City of Las Vegas does not currently have trail policies or management techniques in place.

If your agency has not experienced many conflicts or complaints, what factors do you believe contribute to removing sources of conflicts?

The City, in general, makes a concerted effort to address citizen complaints in a timely, purposeful and respectful manner. Trail access complaints are noted and being pursued as funding becomes available.

Does your agency have a policy or approach to managing "Other Power Driven Mobility Devices" (OPDMD)'s, based on the new Department of Justice ADA Ruling that power-driven vehicles must be permitted on trails unless a safety assessment is completed (35.137)?

The new DOJ ADA ruling regarding "Other Power Driven Mobility Devices" is being evaluated by our Public Works Department and City Attorney at this time.

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Trail user conflicts are virtually non-existent other than the one listed in question #3A. That particular equestrian/pedestrian conflict was addressed by explaining the intent of the City's Master Plan, and as development progressing and/or funding becomes available safer school routes will be installed. It seemed to placate the complainants.

F.7 Non-Profit Agencies

F.7.1 Forest Park Conservancy

Agency Contact Information

Name of agency:	Forest Park Conservancy
Street address:	1505 NW 23 rd Ave, Portland, OR 97210
Name/position of contact:	Matt Wagoner, Trail & Restoration Manager
Phone/e-mail:	matt@forestparkconservancy.org
Responsibility for trail use policy/management:	FPC's field crew is the primary caretaker of the trails in Forest Park. FPC does not make policy but is the "eyes" for Portland Parks and advisor on management decisions in Forest Park.

Agency and Trail System Information

Type(s):	Non-profit
Size (acres managed):	5,100
Trail system miles managed:	80+ miles of trails and fire roads managed as trails
Trail surface types:	Asphalt, aggregate, native soil
Trail user types accommodated:	Hikers, bikers, equestrians
Additional resources:	www.forestparkconservancy.org

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

The FPC field crew works on trails throughout the year and interacts with users on a daily basis. When users identify crew members as a park authority they report conflicts and concerns. Reports also come from the FPC member base which is composed of park users and supporters from the Portland community. Complaints are received by phone, email, and in person. Users typically have concerns about other people not following the regulations of the park. The two most common complaints are that other trail users let their dogs run off leash and that mountain bikers are using pedestrian only trails. It is not common to hear about an actual collision or conflict besides the occasional second hand anecdote.

From which group(s) do these complaints usually come?

Primarily from trail users encountered in the process of maintaining trails and FPC's members/donors. By user group, pedestrian users without dogs usually have the most to say about what other people are doing. Trail users commonly identify themselves as residents of the area as they are filing a complaint. It seems to be a safe assumption that nearby residents are more common users and have a greater sense of ownership in areas of the park.

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

When trail use spikes: weekends and evenings in the summer.

Where do trail user conflicts most frequently occur?

Areas where trail use is most concentrated. The places in the park where it is easily accessed from the city and adjacent neighborhoods.

Which combination of trail users is most commonly involved in conflicts with each other?

Trails users with dogs and trail users without dogs. Mountain bikers and pedestrians is another common conflict.

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Runners and pedestrians, trail users and illegal campers, dogs and other dogs, rogue trail users and non-users

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	x			
Reported Incident			x	
Injury due to collisions				x
Non-injury collision			x	
Damage to natural resources	x			
Close calls negatively affect user experience	x			
Congestion or overcrowding on trails	x			
Other (Please Specify)				

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

In the conflict between pet owners and non pet owners there are conditions that make the park unique and also cause conflict: Forest Park is a large natural area and also a city park in a dense urban area. The park is used by the many dog owners in Portland who most likely have restricted space for their pet. The opportunity to give their dog unrestricted access to such a large area is likely difficult to resist. Also, the size of the park contributes to limited enforcement capability. There is a single permanent ranger in forest park and more than 80 miles of trails, making the chances of getting a ticket slim and ineffective as a deterrent. Another factor is Forest Park's status as a natural area managed for wildlife as well as recreation. The sensitive nature of the park is fiercely protected by users who place higher priority on the conservation side of management. Some users are also not comfortable around dogs and poorly behaved ones especially can be a source of conflict.

In the case of mountain bikers and pedestrians a lengthy dissertation could be written on the history of user conflicts and the fairly recent public process attempting to resolve some of the issues. To grossly oversimplify: The lack of accessible single track mountain bike trails in the Portland metro area has caused bikers to ride on many of the pedestrian only trails in Forest Park. Many miles of forest road is open to bikes but provide an unsatisfactory experience for many mountain bikers. Pedestrian users commonly confront bikers as they are seen as dangerous in their disregard for the park regulations. The influence of design should not be discounted as trails accessible to both groups intertwine and it may be desirable for bikers to make connections between trails on pedestrian only routes. The existing pedestrian trails have also not been optimized for safety when users of different speeds interact, perhaps causing more close calls and surprises than would occur otherwise.

Responses to Trail User Conflicts

What has been your agency's physical response?

In mitigating dog user conflict, one strategy that is a side effect of restoration efforts has been to make damage impossible, hopefully removing the conflict that results. Particularly sensitive areas have been protected from both human and pet damage by fencing. Riparian areas near high traffic trails have been blocked to both human and pet access. Three foot tall split rail cedar fencing is used for its natural appearance and a section of welded wire fencing is used on the bottom third to prevent dogs from ducking under the bottom fence rail. These sensitive areas are also signed to indicate that dogs should be kept on leash. Signage has been a large part of the physical response. "Dogs and the Environment" interpretive signs and "doggy bag" stations at trailheads have also been implemented. The signs offer some educational details about the impact of dogs on wildlife in natural areas and how to prevent damage.

In some lower traffic areas dogs are discouraged from entering waterways by creating steep drops off of the trail with retaining walls and installing plant material that blocks the line of sight to the stream.

For the mountain bike issue there has yet to be a concerted response to the conflict. Signs have been used for years to indicate which trails do not allow bikes. These signs are constantly vandalized or stolen and it is a continuing effort to develop more permanent markers. Plans are in motion to retrofit existing forest roads for a more enjoyable mountain biking experience and increase the miles of single track for bikers. A trail etiquette education program with signage has been proposed and any new multi-user trail would be designed to limit the speed disparity between bikers and pedestrians while maximizing sight distance and safety. Unfortunately, the conflict has gone beyond the confines of the park so what we can do physically is limited.

How successful were the physical response(s)?

Physical exclusion of dogs has been successful in localized areas by removing the cause for at least one user group's conflict-sparking concerns. Success of interpretive signage is harder to quantify as a comprehensive study of behavior before and after installation was not done. Signs most likely need to be continually updated and improved in conjunction with a focused program of user education and outreach. The existing signs may be too few and the design too wordy to reach many people. Anecdotally, it is apparent that dog owners readily utilize "doggy bags" but it has created another source of conflict when bags are disposed of improperly. More education and improved disposal facilities may be necessary.

What has been your agency's management response?

Along with interpretive signage, education has been a main focus of managing both of these user conflicts. As the primary representatives of FPC in the park and in the public eye, the field crew takes every opportunity to educate dog owners and trail users on trail etiquette and park regulations. Our status as a partner organization prevents us from having any enforcement authority but allows us to interface with the public in a non-threatening manner. Outreach has also been used especially when a group has an established organization. Mountain bikers are a good example of a user group with established clubs that can be engaged in volunteer activities and education. While not a response to the conflict, FPC has had a written agreement to manage the local mountain bike organization's volunteer efforts in the park for years. This type of arrangement can keep communication open and provide opportunities to educate user groups.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

As more of a "soft" response our unofficial policy involves suggestions and guidelines for field crew interactions with the public. When encountering an off-leash dog, the field crew can mention concerns for the safety of the trail workers and pets alike if animals are allowed to wander unrestrained among heavy tool use. It can be as easy as asking politely to leash the dog or notifying the pet owner of city leash laws. If the trail user engages in conversation the crew member can explain the environmental impacts caused by dogs in riparian areas, and as invasive plant seed vectors. Education goes both ways in the conflict, however, and when trail users or volunteers become overzealous in their pursuit of infringers, it can be helpful to explain that well behaved dogs that stay on the trail and obey commands may not pose a threat to anyone regardless of whether they are leashed or not.

When encountered by mountain bikers on pedestrian trails their response is usually to turn around as soon as they identify a crew member. If they are caught unaware then they are notified of the trail's no bike regulation and encouraged to walk their bike to the nearest multi-use trail.

How well did you find the management response(s) work?

When dealing with dog owner conflicts, our efforts have not been very systematic. We respond to the problem when we see it but have not developed a plan to initiate or document change. We are continually working closely with the newly appointed Forest Park ranger, who has the authority to enforce regulations, to build data and develop strategies that address this conflict. With mountain bikers and pedestrians the overall strategy has been to separate them. The debate over the issue was, at times, less than friendly and the big decisions are more or less out of our hands. We continue to maintain communication with the local mountain bike organization and provide our assistance in implementing the physical solutions to the conflict.

What other responses did your agency try that did not work?

Probably the least successful has been the effort to develop a strong volunteer program from the mountain bike community. During the public debate between representatives from many user groups around Forest Park trail usage, attendance to work parties organized for mountain bikers dropped noticeably. It is something that should be pursued again as we move forward with new responses.

Is there anyone else that we should contact who has successfully implemented measures to deal with trail user conflicts?

Agency name:	Portland Parks and Recreation
Agency contact (if available):	Bob McCoy, Forest Park Ranger
Phone/e-mail:	robert.mccoy@portlandoregon.gov

In particular, what solution or strategy has the above agency used?

Bob McCoy has been working since he was hired several months ago to develop educational programs and gather data on Forest Park infractions. His information is probably in the early stages but could hold some good insight.

F.7.2 Pacific Crest Trails Association

Agency Contact Information

Name of agency:	Pacific Crest Trail Association
Street address:	20130 87 th Ave SW, Vashon, WA 98070
Name/position of contact:	Mike Dawson, Trail Operations Director
Phone/e-mail:	206.463.9087/mdawson@pcta.org
Responsibility for trail use policy/management:	I am the lead for these issues for PCTA

Agency and Trail System Information

Type(s):	Non-profit
Size (acres managed):	Trail corridor is well defined in some places, not so much across large agency holdings, hundreds of thousands of acres would be conservative
Trail system miles managed:	2,650 mile long National Scenic Trail running from Mexico to Canada through California, Oregon, and Washington
Trail surface types:	Native surface on 99.9% of trail
Trail user types accommodated:	Hikers, equestrians
Additional resources:	PCTA has 5 regional offices covering 400-700 miles of trail each and a volunteer network of over 1700 trail work volunteers, USFS has full time PCT manager, and one assistant, plus personnel trail wide, also NPS, BLM and CA State Park personnel responsible for sections of PCT

Documenting the Problem

What is the nature of most of the complaints you receive related to user conflicts?

Most conflict results from uses that are not legal on the PCT resulting in trail damage, degraded experiences for intended users, and unsafe conditions for intended users

From which group(s) do these complaints usually come?

Hikers and equestrians

When do trail user conflicts typically occur? (i.e., time of year, time of day, weekend vs. weekday)

Complaints are greater during times of increased use due to increased numbers of encounters: snow free season, weekends, holiday weekends, good weather

Where do trail user conflicts most frequently occur?

Higher use areas mean more complaints, but the seriousness of the complaints increase in wilderness remote back country, etc. because the experiential expectations and investment are greater, so the experiential impact are higher.

Which combination of trail users is most commonly involved in conflicts with each other?

Motorized users and mountain bikers create conflicts with intended users: hikers and equestrians. Safety situation is worse with motorized users (usually dirt bikes) and is worse with equestrian interaction, especially users with a pack string

Which other trail users tend to be in conflict with each other (i.e., less-frequent conflicts)?

Sometimes get contacts from hikers who don't want horses on the trail. Usually urban hikers who don't like horse droppings, or yielding the right of way on narrow trails.

How often do the following consequences of trail user conflicts occur? (Mark with an 'X')

	Weekly	Monthly	Annually	Less than once a year
Complaint	X			
Reported Incident		X		
Injury due to collisions				X
Non-injury collision			X	
Damage to natural resources		X		
Close calls negatively affect user experience	X			
Congestion or overcrowding on trails			X	
Other (Please Specify) Experience degradation	X			

What conditions contribute to conflicts or safety issues between the user groups identified in the previous questions?

Trail is designed for hikers and stock only, by law. Fast, silent approach of mountain bikes on narrow trails with little sight distance. Hikers and equestrians often use the PCT to avoid these illegal uses.

Responses to Trail User Conflicts***What has been your agency's physical response?***

Trail is closed to these conflicting uses. Sporadic law enforcement efforts, trailhead signing and other information dispersal.

How successful were the physical response(s)?

Successful with a large percentage of potential illegal users who are law abiding. Not successful with the minority who are not.

What has been your agency's management response?

Exclusion is long standing and in the establishing legislation. Law enforcement usually occurs at particular trouble spots, and in large sting operations.

What trail policy statements, regulations, guidelines, etc. do you have to document the response?

Too Much to list: CFR regulations, Closure orders, planning documents and decisions, comprehensive plan...

How well did you find the management response(s) work?

Not particularly well in various limited locations

What other responses did your agency try that did not work?

Physical barriers

Are there any other success stories or lessons learned with regard to trail user conflicts in your jurisdiction that you would like to share?

Providing high quality alternative opportunities for excluded uses in nearby locations seem to reduce illegal use and conflicts.

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Appendix G. Excerpts – CSP Trail Handbook and Draft Trail Design Guidelines

This appendix provides relevant excerpts from the current *CSP Trail Handbook* and from previously unpublished draft chapters of *CSP Trail Design Guidelines* that are intended to be incorporated into an updated *Trail Handbook*.

G.1 Excerpts from CSP Trail Handbook (1994)

G.1.1 CSP Trail Classifications

While several individual parks districts have developed regulations and design guidelines, the overarching policies regarding CSP trails are contained in the following:

- The California Recreational Trails Act
- California Recreational Trails Plan - Progress Report (2009)
- California Department of Recreation Trails Policy (No. 2005-06)

The CSP 1994 *Trail Handbook* categorizes trails based on the following factors:

CSP Trail Classifications

- Handicapped accessible
- Interpretive
- Within visitor use facility
- Equestrian and bike
- Adjacent to visitor use facility
- Connection of visitor use facilities
- Parking access
- Destination oriented
- Connection with other agency trail
- Special use or access
- Dead end trail
- Loop or connecting trail
- Fragile environment (protected by lessening use or by upgrading)
- Safety factors
- Staff determined use patterns

Definition of California Department of Parks and Recreation (DPR) Trail Rating Criteria:

1. Trails meeting the Regulatory Negotiation (REGNEG) and DPR accessible trail design and construction guidelines.
2. Trails with a series of interpretive signs or self-guiding pamphlets.
3. Trails that originate and stay within a visitor use facility.
4. Trails used for horse travel or bicycle riding.
5. Trails that start at a visitor use facility or within a radius (mileage listed) of a visitor use facility.
6. Trails that connect two visitor use facilities.
7. Developed or non-developed parking at either end or in the middle of a trail route.
8. Trails with a unique scenic, historical, or recreational feature. (Visitors seek out these trails and point values are given in relation to distance from trail beginning to destination).
9. Any part of a longer regional trail system that connects to another agency trail. (Higher point value assigned to importance and visitor usage of connection).
10. Trails that provide access to memorial or honor groves.
11. "0" points if trail is destination oriented, -3 points if dead end with no sought out destination.
12. Trails that are part of a loop hike or connect to another trail. Higher point value is assigned to the completeness of the loop or importance of the connection.

13. Fragile environment is defined as an area the trail passes through that is sensitive due to wildlife habitat, endangered plant or animal species, geologically unstable, etc. (Negative values are applied to protect by limiting development, positive values for trails needing upgrading to mitigate damage).
14. Safety factors to consider include structures, steep terrain, or precipitous drops. (Positive values are assigned to trails used often and need more maintenance attention. "0" values are assigned for no additional safety concern, higher values for areas needing maintenance to keep trail safe).
15. Staff determination of trail use to offset factors of visitor use patterns not assigned a value.

Mountain bike trails are evaluated on the following criteria:

- Aggressiveness
- Scenic value
- Lake view
- Length
- Parking access
- Part of regional trail
- Special use/access
- Loop or connecting trail
- Dead end trail
- Environmental conditions
- Staff determined use

These criteria result in Class I – IV trails, defined below.

- Class I – Trail bed: 36" minimum, 48" a preferred width.
- Class II – Trail bed will be a minimum of 24" wide.
- Class III – The trail bed will be a minimum of 18" wide.
- Class IV – special use and access trails

In practice, trail classifications used at individual districts vary. In most districts, a variety of combinations of users are allowed on trails, including pedestrians (walkers, runners, hikers, dog walkers, and pedestrians with mobility impairments), bicyclists (road and mountain), equestrians, and other modes.

Table G-1. California State Parks Trail Classification Guidelines

Class	Uses	Surface Type	Bed Width	Tread Width	Clearing Limits*	Brushing Limits**	Structures
Class I	Interpretive and hiking	Aggregate surfacing	40" min, 48" preferred	36" to 48"	8' high, 8' wide	8' high, 6' wide	48" tread, 40" min tread between handrails and posts
	Accessible equestrian	Aggregate surfacing	40" min, 48" preferred	36" to 48"	10' high, 8' wide	10' high, 6' wide	48" tread, 52" min tread between handrails and posts
Class II	Hiking trails providing access into regions away from developed visitor use facilities	Natural surfacing	24" min	18" to 24"	8' high, 8' wide	8' high, 6' wide	48" tread, 40" min tread between handrails and posts
Class III	Lightly used hiking trails	Natural surfacing	18" min	12" to 18"	8' high, 6' wide	8' high, 4' wide	Avoid or follow Class I trail guideline
Class IV	Special use and access trails	Natural surfacing	12" min	10" to 12"	minimal	minimal	Avoid

* Downed logs and tree limbs.

** Woody brush and herbaceous plant species

G.2 Excerpts from Draft CSP Trail Design Guidelines

G.2.1 Trail Design Standards for Sustainability

Designing or modifying a trail to be sustainable requires a thorough understanding of the landform that the trail is or will be traversing. It also requires an understanding of the user groups the trail is intended to serve and the needs and design standards that are specific to each user group. In addition, the highest quality and most appropriate standards need to be applied to the building and maintenance of trails in order for them to withstand the physical forces of rainfall, runoff, and use. Only by combining this information can the sustainability threshold for each individual trail be determined and achieved.

There are a number of trail design principles that are commonly cited in trail design references to achieve low-impact, low-maintenance, sustainable trails. California State Parks trail design guidelines exemplify these principles.

Sustainable Trail Grade - Trail Grades will be sustainable for the selected use type:

1. With the exception of Accessible trail guidelines, the Department does not have a standard grade requirement for trails. The parent soil capability, combined with user type, frequency of use, hydrological site conditions, degree of vegetation cover, percent of side slope, the relationship of the hill side cross slope to the trail running grade and season of use should all be considered when dictating the percent of trail grade.
2. User comfort should be a consideration for determination of trail grade, but after all the other conditions outlined above are met.
3. If soils and parent material geologic capability are not sustainable, overly steep grades will be mitigated with surface hardening techniques. Hardening techniques (such as high quality compacted aggregate or trail structures such as steps or retaining walls) will keep the surface sustainable, firm and stable.
4. Poorly designed trails and trails traversing low capability geology are often sited in locations where there are no alternate alignments possible for relocation. In these cases the only reconstruction option is to install appropriately designed trail structures. Trail structures are placed to provide comfortable user passage and protection of natural and cultural resources, while providing the best long term maintenance solution.

Maximum Sustainable Grade – Maximum sustainable linear grade is a linear trail grade which, when combined with proper layout and construction, will result in a trail bed that requires only routine maintenance and will not threaten resources, even when subjected to severe weather conditions or heavy use. All trails require some level of maintenance. However, a sustainable trail is expected to perform with only the most basic, routine trail maintenance. In addition, a sustainable trail should not be subject to catastrophic failures during storm events.

Trail user types and the level of use affect the mechanical wear of the trail tread and the trail's sustainability. There are different rates of wear associated with different user groups. The rate of mechanical wear must be considered when identifying the maximum sustainable grade. The amount of use a trail receives also affects the rate of wear; the higher the use, the greater the amount of wear that occurs. This factor must also be considered when determining the maximum sustainable grade.

1. **Outslope** – Trail tread construction should incorporate out-slope design with no berm to impede natural hydrologic sheet flow from crossing the constructed trail surface. Trail tread out-slope should provide for maximum sheet drainage. Unless designated as a Recreational Accessible Trail (California State Parks Accessibility Guidelines, 2009 Ed.), trail tread out-slope will have a minimum cross slope to facilitate sheet drainage.
2. Parent soil capability, combined with user type, hydrological site conditions, degree of vegetation cover, percent of side slope and season of use will dictate the percent of out-slope required to provide sheet flow.
3. Where running grades exceed the trail tread out-slope or trail cross slope, the trail out-slope percentage should be greater than running slope grade.
4. Where there is insufficient difference between the running grade and out-slope, hardening techniques (such as high quality compacted aggregate) will be incorporated to keep the surface sustainable, firm and stable and provide sheet drainage from the trail surface to native undisturbed areas.

Drainage Crossings – All natural topographic drainage features (ephemeral, seasonal or permanent) crossed by the trail should receive some type of drainage dip or swale (hardened or not hardened) to minimize capture and conveyance of natural hydrology onto, or down trail alignments.

G.2.2 CSP Multi-Use Trail Policies and Design Guidelines

- Trails are for access to unique natural, cultural and historic resources protected by State Park Classifications. The trails provide access to enjoy, learn and meditate on the park resources. This is the primary reasons for providing the trail. This type of trail use places the emphasis of the user experience on the “setting” rather than the mode of travel. The use of the trail for a challenging ride and/or exercise is a consumptive use and is not why the trail was established. This type of trail use places the emphasis of the user experience on the mode of travel or locomotion. When the ride or mode of travel across the trail becomes as important, or more important, than the experience of being in the “setting”, the trail use is inconsistent with the mission, policies and restrictions of the park classification.
- For a trail to be considered multi-use it must have been designated use for mountain bikers, equestrians and pedestrians. Since trails that are specifically designated for mountain bike and/or equestrian/horse usage also allow pedestrians as a secondary use, these combinations of mountain bike/pedestrian or horse/pedestrian are not considered multi-use.
- When multiple user groups are sharing the same trail, some of the design needs and user expectations of these different user groups cannot be met. Multi-use trail design and construction therefore represents a compromise of the design needs and user expectations for these different groups. This compromise often results in less user satisfaction and greater difficulty in designing and constructing a sustainable trail.
- The most significant conflict arising in multi-use trails is between mountain bikers and equestrians. This conflict is centered on the reaction of horses to the movement of mountain bikers along the trail. The physical and behavioral characteristics of horses make them susceptible to flight when mountain bikers approach them unexpectedly or quickly from the front or rear. The size, shape, sound and

speed of the bike and rider can startle a horse. This can lead to the horse rearing up, kicking or bolting. This situation can be partially mitigated by designing multiuse trails to slow the speed of the mountain biker therefore giving the horse more time to recognize the rider and adjust appropriately. Another design technique is make multi-use trails wider, straighter, with longer sight distances and broader turning radiuses. These design characteristics allow trail users to see and hear other users sooner, gives them more time to stop and get off of the trail and gives them more passing room.

- Multi-use trails generally have more trail structures and less sinuosity which can result in a less intimate experience of the surrounding environment.
- When designing multi-use trails the design standards generally default to the highest standards identified for the respective user groups. Generally, equestrian trails have the highest design and construction standards so those would be the minimum standards for any multi-use trails.
- New multi-use trails and trails for consideration of addition of horses and/or mountain bikes should have a similar variety of trail lengths and connecting loops. Trail lengths, connecting loops and circulation patterns pertain whether the entire trail system is designed as a multi-use trail or just the main connecting arteries.
- Multi-use trails should have a minimum tread width that is consistent with equestrian trail standards. In locations where the hillslopes are steep and hikers and mountain bikers may have difficulty stepping off the trail, passing spaces should be provided. Passing areas should be a minimum of 60 inches wide and 60 inches long. The frequency of these passing areas shall be dictated by local site conditions including sight distances, percent of hillslope, and the stability of the parent soils and the general roughness of the terrain.
- The general layout and design of multi-use trails should follow typical design and layout principles. In addition, multi-use trail layout should avoid low gradient hillslopes (< 15%) and flat ground. If flat ground cannot be avoided, the trail tread must be elevated by constructing a turnpike or causeway. On hillslopes, multi-use trails should always be constructed to have a full bench. Since horses and mountain bikes have a tendency to use the outside portion of the trail tread, a full bench will provide more durability and greater sustainability.
- When laying out and constructing multi-use trails, it is important that sudden increases in linear grade are avoided. This will help avoid the additional mechanical tread wear associated with horses, mountain bikes and hikers when they encounter sudden grade pitches.
- Because low trail structures such as steps and waterbars are problematic for horses and mountain bikes they should not be used in multi-use trails. The elimination of steps and waterbars will also reduce the barriers to hikers that may have mobility challenges.
- When designing switchbacks and climbing turns, the design and construction standards should default to equestrian trails which require the highest standards
- When laying out and designing multi-use trails, dry crossings are generally preferred over wet crossings. Culverts, puncheon and bridges on multiple-use trails should be designed to equestrian trail standards. All approaches to drainage crossing structures should be constructed at trail grade.

G.2.3 CSP User-Specific Trail Design Guidelines

G.2.3.1 CSP Mountain Bike Trail Design Guidelines

User Categories

California State Parks trail design guidelines categorize mountain bike users as follows;

Beginning or casual riders

These riders seek easy to moderately challenging trails. They prefer single-track trails that are a little wider, have smooth surfaces, and a gentle meander as they contour around the landform. Typically, these trails are short to moderate in length. These riders enjoy a combination of being outdoors, the beauty of the natural setting, getting exercise, and developing their riding skills. This type of trail is mostly located in front country¹ areas on public lands.

Intermediate riders

These experienced bikers seek moderate to difficult trails. They prefer narrow single-track trails that have tighter turns and rougher surfaces. Typically, the trails are moderate to long in length. These riders enjoy being outdoors, having a more rustic trail experience, maintaining their physical condition, and testing their biking skills. These trails are in front-country and back-country areas on public lands.

Advanced technical riders

These technical trail mountain bikers seek challenging courses with drop-offs, precipitous ledges, logs and rocks to ride (jump) over, elevated bridges, boardwalks, ramps, jumps, and seesaws. They prefer courses designed to challenge even the most experienced mountain biker and their advanced equipment. These riders enjoy being outdoors, testing their riding skills, and the satisfaction of overcoming obstacles. These trails are at ski resorts and mountain biking clubs on public lands. Some federal agencies, such as the Bureau of Land Management (BLM), offer these types of trail courses. The Off Highway Vehicle Division of California State Parks manages lands that may be suitable locations for these trails.

Trail Length and Circulation

The largest numbers of mountain bikers in the US are found in urban areas. They ride their bikes after work and on weekends. To accommodate this user group, trail designers in front-country settings strive to provide trails of varying lengths. Trails of three to ten miles in length provide the distances desired by most mountain bikers for afternoon or evening rides. Longer trail opportunities are provided for riders that have more time and for weekend activities (if the land base is large enough to support this). Back-country trails receive most of their use on weekends, when mountain bikers have time to ride longer distances. Like equestrian trails, interconnected loop trails that progressively get longer will provide options to mountain bikers for their various riding needs.

¹ "Front-country" refers to park areas that are within or close to urban areas. "Back-country" refers to park areas that are relatively remote.

Tread Width

Front-country single-track trails have a minimum tread width of 30 inches. Although the primary user is the mountain biker, hikers are frequently encountered. In locations where the hillslopes are steep and hikers have difficulty stepping off the trail, passing spaces should be provided. Passing spaces are a minimum of 48 inches wide and 60 inches long. On back-country trails with a minimum tread width of 18 inches, passing areas are a minimum of 36 inches wide and 60 inches long.

Trail Layout and Tread Construction

The general layout, design, and construction of mountain bike trails will follow the standard principles. In addition, an important element in mountain bike trail design is reducing biker speed. High rates of speed lead to increased user conflicts (even with other mountain bikers), safety issues, resource degradation, and trail sustainability issues. One method of speed reduction is to avoid laying out trail segments that have long, straight, and uninterrupted sight lines. If the biker can see a clear route ahead (particularly on downhill runs) that has no turns or natural features to maneuver around, they will accelerate through that segment. When they come to the end of that segment and encounter a curve in the trail, a natural feature to maneuver around, or another trail user, they will apply their brakes hard. This braking action causes the bike to go into a skid. The tires dig into the soil across the trail tread and push the soil toward the outside edge. When this action is repeated over a period of time, an entrenched trail tread develops, with a berm on the outside edge. The trail can no longer effectively sheet overland runoff and becomes a ditch that collects and diverts water, making the trail a liability to the resources and unsustainable. This type of use also increases the potential for user conflicts and accidents.

By following a curvilinear alignment, the trail can achieve a fair amount of turns by contouring around the landform, avoiding trees and rock outcroppings, and dipping in and out of drainage crossings (including micro-drainages such as swales and crenulations). With mountain bike trails, additional turns are necessary to reduce user speed. This is achieved by using natural features such as trees, brush, rocks, and down logs that the trail must go over or under. However, the trail designer must be careful not to create trail grades exceeding the maximum sustainable grade or create sudden pitches that cause the mountain biker to brake hard going downhill or stand on their pedals when going uphill. Keeping linear grades below the maximum sustainable grade and selecting natural objects to weave over or under without rapid elevation change is critical to successful mountain bike trail design. The frequency of natural features encountered on this type of trail can be adjusted to provide higher or lower levels of challenge to the biker. These variables, along with adjusting the tread width, allow the designer to create a sustainable trail alignment tailored to beginning or casual riders and intermediate riders.

If the landform lacks natural features, rocks and logs can be placed adjacent to the trail as artificial choke or pinch points. These objects can be placed above and below the trail bench where the trail curves or turns. The objects are offset, with one being further up or down the trail from the other, and placed outside of the designed width of the trail tread. When placed in this way, these objects will appear to the rider as adjacent with only a narrow opening between them. The mountain biker will slow down to negotiate between the two objects. Since the opening is wider than the designed tread width, the location does not present an increased safety risk to the user.

A weaving or sinuous trail design makes the mountain biker slow down. This eliminates the need for hard braking, and the trail tread receives less wear, the impact on resources is reduced, sustainability is achieved,

and user conflicts are avoided. This type of alignment also produces a more challenging ride for the mountain biker and increases user satisfaction, and helps curb illegal trail riding and unauthorized trail construction that are prevalent on State Park and other public lands.

Mountain bike trail layout also should avoid low gradient hillslopes (less than 15 percent) and flat ground. If flat ground cannot be avoided, elevate the trail tread by constructing a turnpike or causeway. On hillslopes, mountain bike trails should always have a full bench for more durability and greater sustainability. Mountain bikers have a tendency to ride in the same track regardless of the trail's location on the hillslope. A "grooving" of the trail usually occurs on the outer third of the trail tread. If this portion is comprised of fill material, the trail bench rapidly breaks down.

Trail tread needs to be uniformly firm and smooth to allow overland sheet flow. However, on back-country mountain bike trails where native rock is encountered during construction, a portion of that rock can be retained within the tread (textured or roughened surfaces) if it does not impede overland sheet flow or present a tripping hazard. Leaving rock projecting into the trail tread further reduces the speed of mountain bikers and provides a more challenging ride.

If parent or native soils are not suitable for long-term sustainability, trail tread can be strengthened by adding crushed rock aggregate.

Low Trail Structures

Low trail structures, such as steps and waterbars, should be avoided on mountain bike trails. Mountain bikers have a difficult time negotiating these structures, especially riding uphill, and often ride around them, which can damage the trail and cause resource impacts. Steps, when encountered by bikers, make them dismount and walk up or down, or ride around (on the downhill side of the steps). This leads to erosion of the hillslope and undermines the step structure, leading to resource degradation and trail maintenance/sustainability problems. When designing and laying out new mountain bike trails, steps are never used. If existing mountain bike trails have steps, the trail should be reconstructed or rerouted to eliminate them. If this is not possible, they should be constructed to appropriate step design as prescribed in the CSP revised Trails Handbook.

Switchbacks and Climbing Turns

When designing switchbacks and climbing turns, the radius must be wide enough for mountain bikers to negotiate. A turning radius that is too tight will cause bikers to cut across the inside corner when going downhill. At the turn, the grade between the upper and lower legs is steeper, and mountain bikers can erode the trail tread. Bikers riding uphill dismount if they cannot sustain enough momentum to make it around the tight turn. A minimum turning diameter of eight feet is required for switchbacks (six feet for climbing turns) on bike trails. The grade of the upper and lower leg of the turn should not exceed 14 percent, unless the material is durable enough to support a steeper grade. Grades should not exceed 20 percent, due to the difficulty of climbing such a steep turn on a bike.

Drainage Crossings

Wet crossings should not be considered for mountain bike trails unless flows are shallow and have low velocities. All wet crossings, even those across swales, should be armored to protect soils and stream gravels, reduce erosion and sediment delivery, and be sustainable.

Dry crossing designs are preferable for mountain bike trails. Culverts, puncheon, and bridges on mountain bike trails should be designed to pedestrian trail standards. All approaches to drainage crossings should be constructed at trail grade.

G.2.3.2 CSP Equestrian Trail Design Guidelines

Trail Length and Circulation

Although many equestrians ride their horses for long distances in remote back-country settings, most are not trained or in condition for this type of riding. The largest population of equestrians in the United States is in urban areas. Trail design principles in front-country settings should provide trails of varying lengths, typically three to eight miles in length.

Loop trails are preferable for all user groups. Retracing a path is not as stimulating as traversing over new ground. With equestrians, loop trails are important because a horse can become “barn sour” when retracing a path. When a horse knows they are heading back to camp or a trailhead, they sometimes get anxious. Knowing that food, water, the company of other horses, and the relief of not carrying their rider is close at hand can cause them to pick up their pace and become difficult to handle. This behavior is reduced when riding loop trails.

Water

Horses require between 12 and 20 gallons of water per day, depending on the weather, amount of exercise, physical size, and food consumed. Trail distances greater than seven miles require watering stations. Water troughs should be properly located and of appropriate design for longer trails. Horses should not be allowed to drink from streams, ponds, and springs due to the impact associated with their ingress and egress, or from urinating and defecating in sensitive areas.

Tread Width

Front-country equestrian trails should have a minimum tread width of 48 inches; back-country trails should have a minimum tread width of 36 inches. Although the primary users are equestrians, hikers will be encountered frequently on these trails. When the hillslopes are steep and hikers will have difficulty stepping off the trail, passing spaces should be a minimum of 60 inches wide and 60 inches long.

Trail Layout and Tread Construction

Equestrian trail layout should avoid low gradient hillslopes (less than 15 percent) and flat ground. When flat ground cannot be avoided, elevate the trail tread by constructing a turnpike or causeway. On hillslopes, equestrian trails always have a full bench for durability and greater sustainability. Horses tend to walk on the outside edge on trails that are constructed on hillslopes. This may be related to their limited binocular vision and prey instincts. Staying on the outside edge of the trail provides them with a better view of the uphill side of the trail, where potential predators would likely approach. Their tendency to walk on this portion of the trail makes full bench construction imperative.

If native soils are not suitable for long-term sustainability, trail tread can be strengthened by adding crushed rock aggregate. Hardened and smooth trail surfaces such concrete, soil cement, asphalt, and non-permeable

soil stabilizers should not be applied to trails designated for equestrian uses. These surfaces are slippery and cause horses to lose their traction and fall. They also can injure the bottom of the hoof.

Grade Uniformity

Sudden increases in linear grade are to be avoided when laying out and constructing equestrian trails. When linear trail grades are relatively constant, horses have a steady gait. When those grades suddenly increase (such as going from a five percent to a ten percent grade in ten linear feet), horses will adjust their stride to compensate. Horses will push off harder with their back legs when going uphill. This transfers more weight to the hind legs and applies more force to the hooves. When going downhill, the horse will sit back on its rear legs and break its descent with its hooves. This also transfers more weight to the hind legs and applies more force to the hooves. These actions result in the hooves penetrating deeper into the trail tread and displacing more soil. Over a period of time, these sections of trail can become entrenched and develop drainage problems.

Trail Structures

Due to the blind spot directly in front of the horse's feet, low trail structures such as steps and waterbars should be avoided on equestrian trails. Horses have a difficult time recognizing these structures and will trip over them or walk around them. Waterbars are generally not an effective drainage solution and should be avoided. Steps on horse trails are also problematic. When designing and laying out new equestrian trails, steps should never be utilized. If existing trails have steps, the trail should be re-routed to eliminate them. If elimination is impossible, steps should be constructed according to DPR equestrian specifications.

Switchbacks and Climbing Turns

The radius of the turn must be wide enough to accommodate horses. If the turning radius is too narrow, horses will cut across the inside corner of the turn. At the turn, the grade between the upper and lower legs is steeper. Horses will erode the trail tread as described above. A minimum turning diameter of 10 feet is required for equestrian trails. If the trail is used by pack stock, the diameter should increase to 12 feet. The grade of the upper and lower leg of the turn should not exceed 14 percent, unless the parent material is durable enough to support a steeper grade.

Drainage Crossings

For equestrian trails, wet crossings or fords are preferred over bridges. All wet crossings, even those across permanent streams need to be armored to protect soils and stream gravels.

Some horses become nervous walking across a bridge. This is related to their depth perception, sensitivity to vibrations through their hooves, and reduced traction on unnatural surfaces. Horses are also more confined while crossing bridges and their options for flight are severely limited. However, crossing limitations and environmental concerns will often necessitate a bridge. Bridges on equestrian trails should be designed to accommodate the size, weight, and traction needs of horses. The bridge should be wide enough and/or the handrails high enough that the horse and equestrian feel unconfined, but also protected at the edge of the bridge.