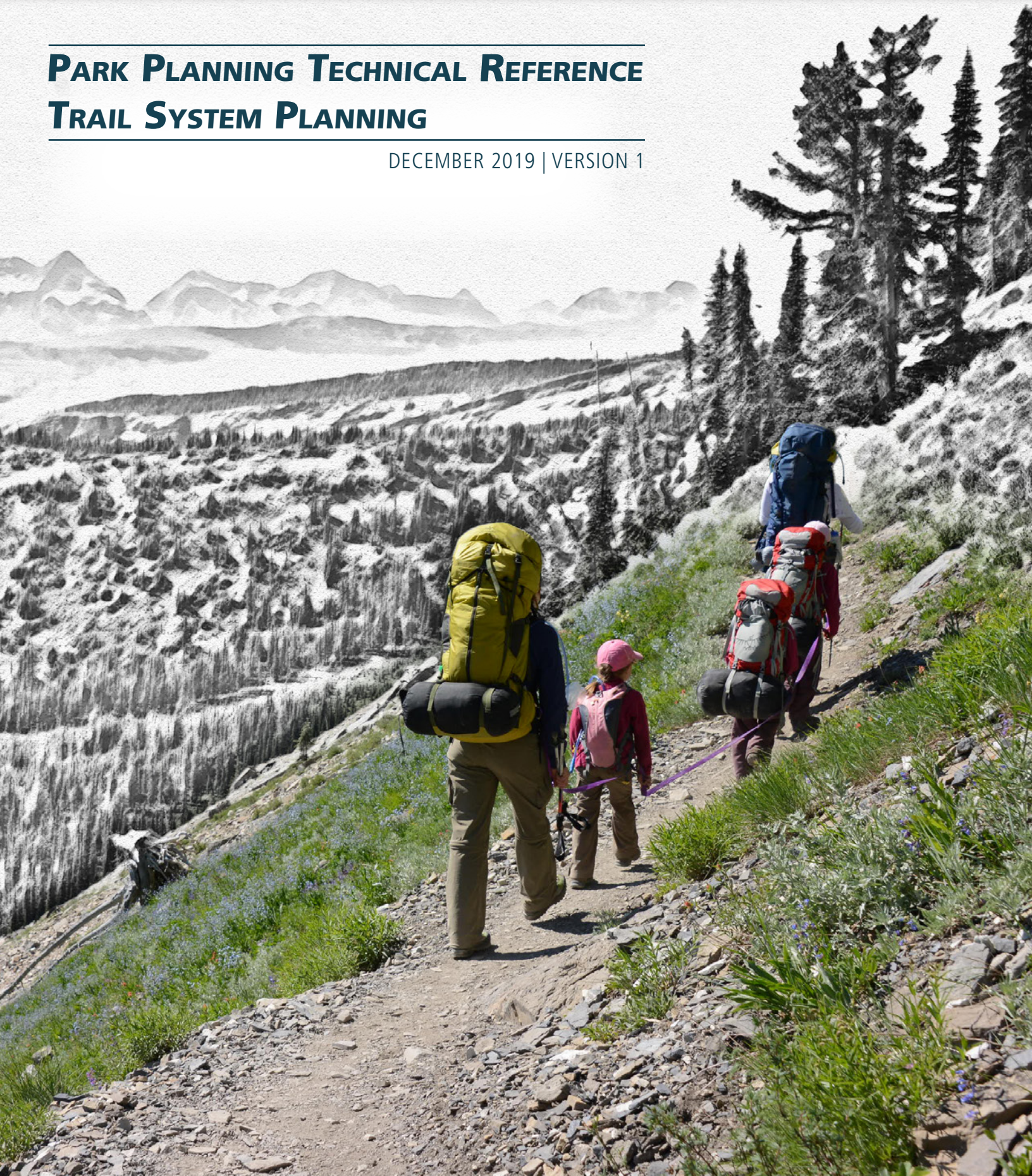
National Park Service
U.S. Department of the Interior

Park Planning Technical Reference
Trail System Planning

DECEMBER 2019 | VERSION 1



Planning in the National Park Service guides informed and insightful decisions that provide relevant and timely direction to park management, and informs future decision-making for each national park system unit in accord with its stated mission.

Contents

Acronyms and Abbreviations

ABAAS	Architectural Barriers Act Accessibility Standards
CESS	Cost Estimating Software System
cm	centimeter
ft^2	square feet
GIS	geographic information system
GPS	global positioning system
IVUMC	Interagency Visitor Use Management Council
NEPA	National Environmental Policy Act
NPS	National Park Service
O&M	Operations and Maintenance
TCFO	Total Cost of Facility Ownership
TRAC	Trail Assessment and Condition Survey
USFS	US Forest Service

Introduction

Purpose of Trail Planning

There are several common drivers of trail system plans. The first (and perhaps most-common) driver is increasing visitor use of a park trail system. Expanding the park's trail system is a good way to ease perceived congestion, disperse visitors, and offer visitors new opportunities.

In other cases, changing visitor preferences and activities necessitates the need for a trail plan. For instance, there may be a growing mountain biking community in the area around a park. The mountain bikers may be interested in holding special events (e.g., races on the park's trail system) and in constructing single-track trails for their bikes inside the park.

Another common driver of a trail plan is an aging trail system—one with many trails in poor condition. Commonly, maintenance budgets have not grown to keep pace with trail system deterioration.

The key point for any planning team is: *the issues driving the plan influence the solutions proposed*. For instance, if the park is seeing issues associated with a new type of activity, the plan will need to address this activity and where the use is appropriate, if anywhere.

Intent of this Guidebook

Many technical references focus on construction and maintenance of individual trails. This guidebook focuses on system planning for a medium to large park, a recreation area, or another unit managed by the National Park Service (NPS). The emphasis is on big-picture thinking for a comprehensive network of trails. The guidebook discusses fundamentals of trail system design and management, the trails planning process, and on-the-ground facilitation and implementation techniques. The guidebook is not agency policy, but rather represents recommendations developed for consistent best practices based on the current state of knowledge.

This document was drafted in response to a need for additional guidance for comprehensive trail planning and is focused on planning within the context of the National Park Service. Information here could be useful for other land managers but in its original form it was written for park managers, planners, trail supervisors, and staff involved in trail management. This guidebook is not a construction manual for trail crews, nor is it a one-stop guide for all the subtopics that intersect with trail planning such as landscape architecture, civic engagement, visitor use management, and natural resource management. However, this guidebook does provide information on trail accessibility and sustainable trail design. Please note that the guidebook is a dynamic document and there may be future editions as lessons learned are collected from continued implementation.

Helpful resources that can be used in conjunction with this guidebook are provided in the bibliography at the end of this document. This guidebook and the references therein are not intended to be a comprehensive representation of the literature on this topic.

Process Overview

A great trail system was not created by happenstance. Land managers and stakeholders create great trail systems through sound planning. The following process overview lays out the planning process for developing a trails system plan (see figure 1):

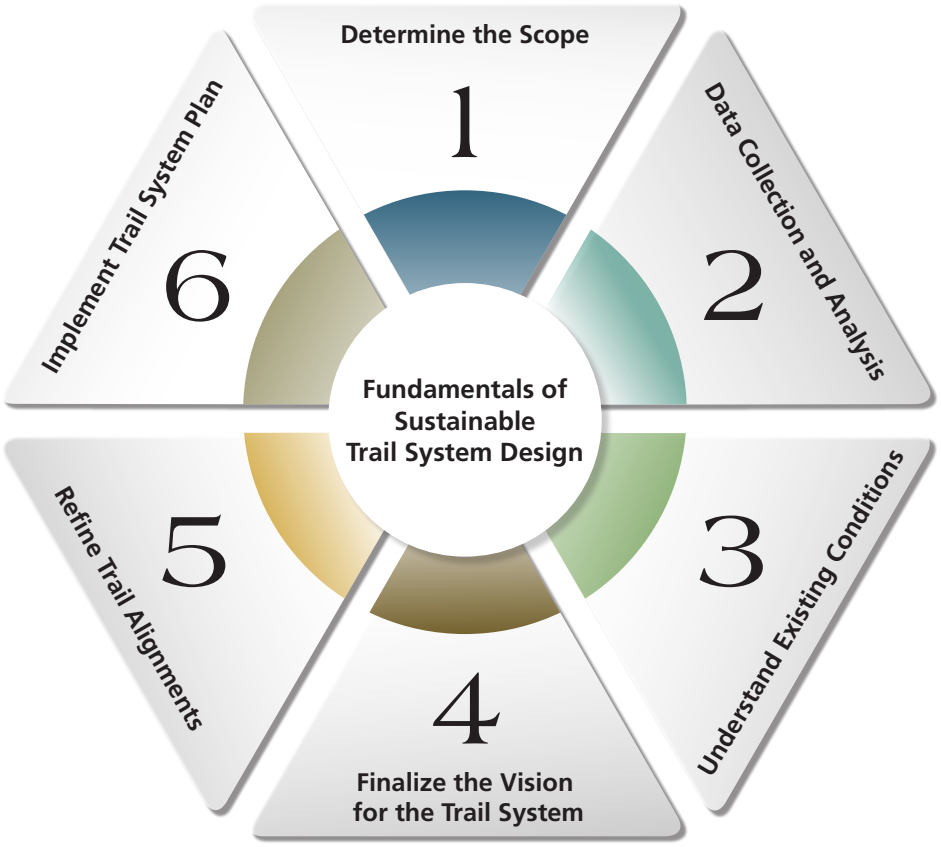


Figure 1. Trail Planning Process Diagram

Note: Small versions of figure 1 appear throughout this guidebook to indicate which phase of the trail planning process the section is in.

It is essential to the trail system planning process to understand and embed the fundamentals of sustainable trail system design, which are introduced and covered throughout the guidebook. In addition, the trail system planning process can be facilitated through a series of trail planning workshops, as outlined through the subsequent sections.

Parks vary considerably with regard to the trail experiences they provide for visitors. Smaller parks may have limited or no trail system but, through general circulation, provide access to various walks and outdoor recreational opportunities in and beyond the park boundaries. Some parks provide universal access through formalized trails throughout the park as a complement to other resources and opportunities, while others derive a large part of their primary visitor experience from a substantial recreational trail system. It is important to keep in mind the needs of your park and understand that the planning process covered in this guidebook can be applicable to a variety of trail system needs.

Fundamentals of Sustainable Trail System Design

Understanding basic trail planning principles gives managers, planners, and field staff the same knowledge framework to allow them to have productive conversations about trail system planning. Key terms and concepts follow, as well as an overview for trail accessibility requirements and assessments essential to sustainable trail system design.

Key Definitions

This section includes definitions of key trail system terms and concepts used in sustainable trail system design, including trail purpose, class, difficulty, length, geometry, connectivity, use, and accessibility.

Sustainable Trail System

Sustainable trail systems are primarily made up of well-designed trails that lie lightly on the land, last a long time, and require little maintenance. These trails require minimal engineering improvements and have grades of one-quarter to one-third of the prevailing cross slope (see figure 2). Trails with grades that exceed one-third of cross slope generally require more-significant engineering improvements (e.g., drainage control, rock work) that in turn leads to more frequent and costly maintenance, and more impacts on the landscape.

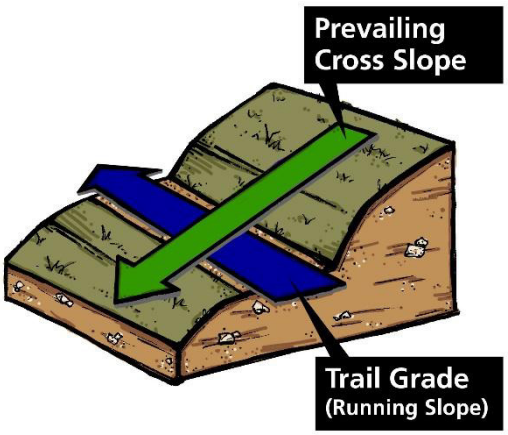


Figure 2. Image of Prevailing Cross Slope and Trail Grade

Sustainable trail systems also reflect the fiscal realities of operating and maintaining a trail system. Whether considering building a new trail system or taking a fresh look at an existing system, trail managers need to understand the staffing and financial capacity to maintain trails, provide for routine monitoring, and (if necessary) provide law enforcement. Examine opportunities to work with local or regional trail advocacy groups and assess their volunteer capabilities. Unmaintained or under-maintained trails can often lead to resource damage and a poor visitor experience. Therefore, trail managers should only build sustainable, highly durable trails that they, often with the help of partners, can commit to maintaining over time.

Trail Purpose

Each trail in a trail system should have a purpose. Individual trails can have several purposes. Generally, the more purposes addressed by one trail, the better. Common examples of trail purpose include

- providing access to a destination, point(s) of interest, or geographic area
- providing opportunities for interpretation, immersion in a landscape, or personal challenge
- providing an alternative mode of transportation in an area
- dispersing visitors and/or protecting resources

Trail Class

Trail classes prescribe the scale of development for a trail, representing its intended design (which may or may not reflect the current condition of the trail). The most accepted trail class designation derives from the US Forest Service (USFS) 2008 Trails Management Handbook. These trail classes vary by type of use and range from least developed (trail class 1) to most developed (trail class 5) (USFS 2008).

- Trail Class 1: Minimally Developed
- Trail Class 2: Moderately Developed
- Trail Class 3: Developed
- Trail Class 4: Highly Developed
- Trail Class 5: Fully Developed

In comprehensive planning documents, such as a general management plan or backcountry management plan, management zones are typically delineated within a park unit. Management zones correspond to a description of the desired resource and visitor experience conditions for each area of the park. Management zones describe the kind of appropriate uses and facilities necessary to support these desired conditions. For example, highly sensitive natural areas might tolerate little, if any, visitor use, while other areas might accommodate much higher levels of use (Management Policies 2006). The assignment of trail classes in a trail plan should be consistent with prescribed management zones and desired conditions. For instance, class 4 and 5 trails are typically most appropriate in frontcountry zones, while class 1 and 2 trails are most appropriate in backcountry zones (see figure 3).

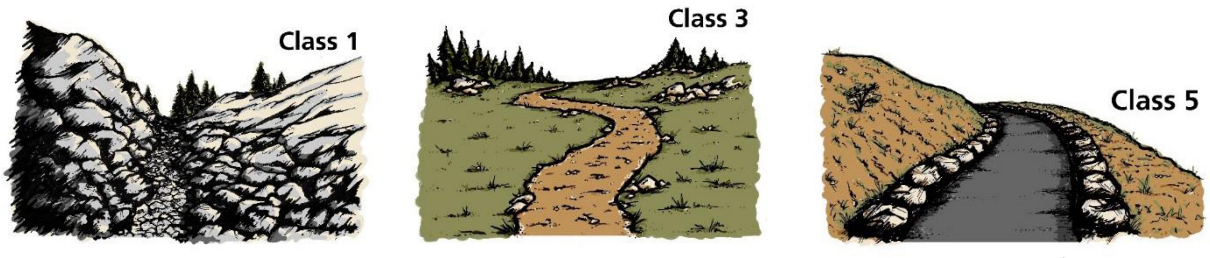


Figure 3. Examples of Different Trail Classes

Trail Difficulty

A park trail system should have a variety of difficulty levels for visitors of all ages and abilities. The goal in considering trail difficulty is to provide diverse opportunities to accommodate all visitor needs, abilities, and interests. Difficulty ratings are based on trail condition, steepness/total elevation change, and the amount and types of natural barriers that must be traversed. Difficulty ratings are generally categorized as easy, moderate, and strenuous. Difficulty ratings are linked to trail class designation, which derives from the USFS 2008 Trails Management Handbook.

Trail Length

Trail length typically corresponds with trail difficulty. Providing a variety of trail lengths ensures all visitors have opportunities for rewarding and enjoyable experiences. When deciding on trail length, consider the purpose of the trail, trail geometry, and visitor motivations. Generally, trails less than 2 miles round-trip are considered short, easy trails; trails from 2 to 10 miles round-trip are considered day hikes; and trails over 10 miles round-trip are considered overnight hikes.

Trail Geometry

Individual trails can take many different forms when viewed from above (on a map or satellite image). Some examples of trail geometry include (also see figure 4)

- loop trail
- horseshoe trail
- lasso trail
- through trail
- out-and-back trail
- spur trail
- connector trail

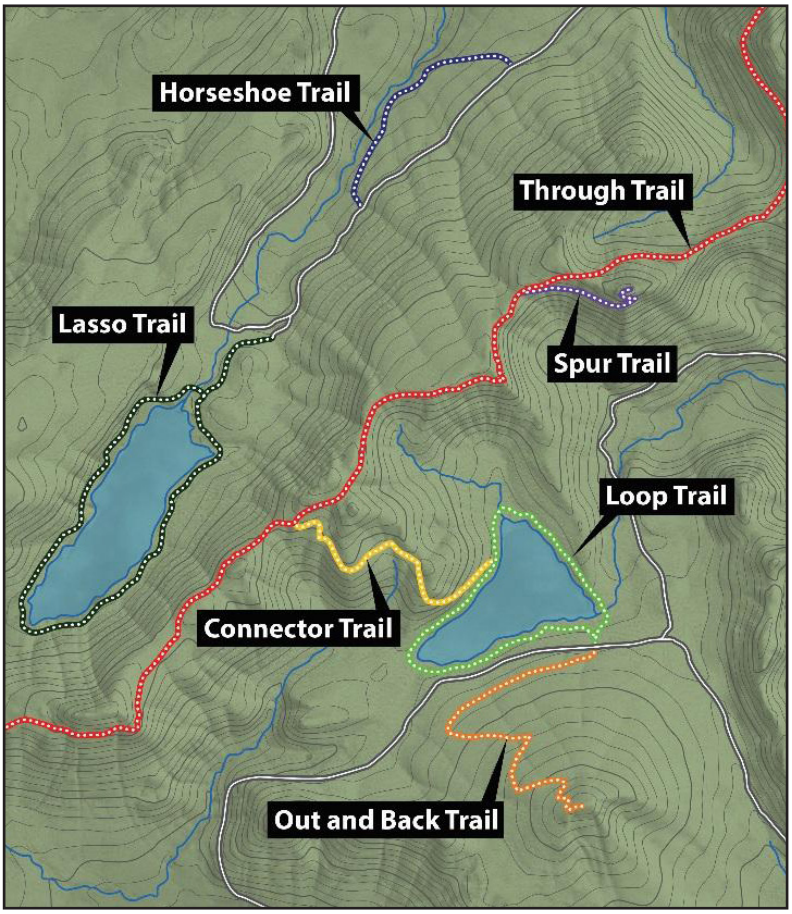


Figure 4. Map of Different Trail Geometries

Connectivity

Well-designed trail systems improve visitor circulation between areas of interest and throughout a park. Improving trail connectivity can also provide an alternative to vehicular circulation in a park, which helps alleviate parking, safety, and congestion issues. Trail managers should also seek partnerships with neighboring public land managers to provide greater connectivity between adjacent trail networks, unless there are specific reasons for not doing so. In other words, a good trail system should be cross-boundary and not isolated to one management agency.

Trail Use

Designing a trail for a specific use, such as bicycling or horseback riding, often requires demanding design, construction, and maintenance parameters. Each trail and trail segment should take into consideration the types of use that will be appropriate. Generally, equestrian trails have the most demanding design specifications, followed by mountain biking, and then hiking. Think about this concept in terms of obstacles—for example, most equestrians would not want to ride up a rock slab, so an alternate route would be necessary for equestrians. This same rock slab might be appropriate to include in a hiking trail route.

Beyond the intended trail-use design, some trails may have allowed uses that extend the functionality of the trail. Allowed uses are those permitted on a trail, but for which the trail was not explicitly designed. For instance, a trail may have been originally designed in 1935 as a hiking trail but may now be suitable as a mountain bike trail without any design improvements. In this case, the designed use could still be considered hiking, but mountain biking could be an allowed use while trail conditions remain suitable. In this instance, the trail manager is providing for more allowed uses but is not committing to maintain the trail to a more exacting standard. There are exceptions to the designed and allowed use concepts and not all managers use them.

Each trail, and the trail system as a whole, should minimize conflict among different user groups and avoid creating unsafe conditions. Large numbers of trail users and a wide variety of allowed user groups, especially if their speeds vary greatly, are two factors that increase the potential for conflict and safety issues. Tools to minimize conflict and increase safety generally fall into three categories.

- Engineering techniques include lengthening sight lines, installing features to slow speed, building turnouts for passing, and widening the trail tread and trail corridor.
- Education techniques include installing signs that reinforce good trail etiquette and communicate which users should yield to others (see figure 5).
- Enforcement techniques include implementing rules and regulations to separate uses by trail, day, and/or time; managing the amounts or types of trail access; and prohibiting undesirable activities or types of use. Enforcement techniques often require additional law enforcement ranger or volunteer presence (for example, trail advocates or ambassadors).

Figure 5. Image of Educating Trail Users with Signage

Trail Accessibility Requirements

Section 504 of the Rehabilitation Act of 1973 states that no otherwise qualified individual with a disability in the United States be excluded from participating in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance or under any program or activity conducted by any executive agency.

Trails in national parks and other outdoor areas developed by the federal government are subject to the requirements outlined in the Architectural Barriers Act Accessibility Standards (ABAAS). These standards provide technical requirements for accessibility to sites, facilities, buildings, and elements on federal sites when newly built or altered.

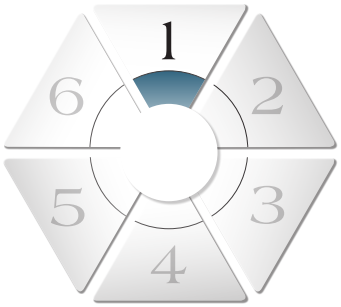
Accessibility should be considered in the design of all hiking trails. Exceptions are provided for portions of trail where conditions such as terrain, construction practices, resource protection, and other factors make full compliance impracticable. All other appropriate design options should be considered before applying an exception.

Trails should not be designated as accessible and should not be given labels such as "handicap-accessible," "ADA/ABA," or "barrier-free." Instead, information about the conditions of the trails—including length, surface type, typical and minimum tread width, typical and maximum running slope, and typical and maximum cross slope—should be presented to visitors on trailhead signage, brochures, and websites so visitors can decide for themselves what conditions will best meet their interests and needs (figure 6).

Chapter 10 of the Architectural Barriers Act Accessibility Standards contains technical standards for the design of recreation facilities, including accessible trails and related features, and conditions for exceptions related to trail development. Additional requirements will apply to adjoining facilities (e.g., parking, restrooms) and can be found in preceding chapters of the Architectural Barriers Act Accessibility Standards.

Figure 6. Accessible Trailhead Signage

Trail Planning Process

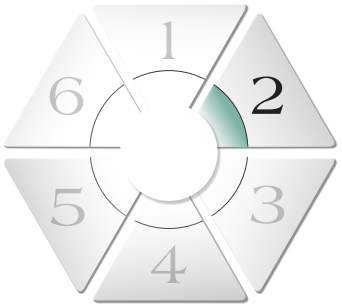


1. Determine the Scope

In general, a trail management plan should focus on developing, maintaining, and managing use of a trail system for a long period of time, typically 20 to 30 years. Because trails provide access to a broad range of park resources, visitor experiences, and facilities, it is critical to clearly define the scope of a comprehensive trail plan at the outset. In the scoping phase, planning teams and project managers determine what decisions will and will not be made through the plan. For example, scoping conversations may reveal that decisions about trails will have intended or unintended consequences for backcountry or wilderness zones.

Planning teams should discuss whether comprehensive planning for a trail system can be completed without tackling related management issues, such as backcountry camping. A tight scope generally results in a shorter planning schedule and lower costs for plan development. That said, a broader scope is not necessarily a bad thing. In some cases, there are clear and obvious reasons for addressing trails and related management issues, such as camping, in the same planning process. Combining comprehensive trail planning with related management challenges ensures a holistic approach, as opposed to a series of isolated decisions. However, as the scope grows, so do the cost and time to complete the plan.

The Visitor Use Management Framework, A Guide to Providing Sustainable Outdoor Recreation (the framework) provides a process for determining long-term strategies to provide access, connect visitors to key visitor experiences, protect resources, and manage visitor use. See the framework for a consistent approach to visitor use management on federally managed lands and waters (IVUMC 2016a).



2. Data Collection and Analysis

After defining scope, the planning team should consolidate geospatial data and other data forms related to trails, visitors, resources, and terrain. This information will help with decision-making and environmental impact analysis. Some parks will have volumes of such information, while others may have very little or only "coarse" data. Remember that datasets should inform decision-making in a clear and direct way.

Four categories of data that could be useful to inform trail systems planning include general geographic information, trail conditions, visitor use data, and sensitive resources. Note, the following list includes types of data, but the list is not exhaustive.

- General geographic information
  - Soil types – generally, soil types will need to be converted into three categories: soils highly suitable, moderately suitable, and unsuitable for trails
  - Topography/slope
  - Existing roads and recreation facilities, such as campgrounds
  - Ground cover/vegetation
  - Hazard areas, such as avalanche or rock-slide zones
  - Park zoning
  - Land ownership
  - Hydrology

- Trail condition data
  - Condition of existing trails/maintenance needs (USFS 2008)
  - Location of informal trails

- Visitor use data
  - Trail counts
  - Traffic counts
  - Parking lot counts
  - Types of visitor activities
  - Overnight trips/backcountry permits
  - Overall visitation to a park or area
  - Average length of stay for visitors

- Sensitive resource data
  - Archeological sites
  - American Indian ceremonial sites
  - Locations for special status species
  - Wetlands
  - Critical habitat

Avoidance Layer

Ideally, geospatial information on sensitive resources (e.g., endangered species, archeological sites, wetlands) and unsuitable soils should be mapped and consolidated into one "avoidance area" map. This avoidance layer will help the planning team understand trail planning constraints on a large scale.

Developing an avoidance layer begins by reaching out to the park's geographic information system (GIS) specialist and resource managers to determine the appropriate datasets for inclusion in the layer. For example, during comprehensive trail planning at Crater Lake National Park, staff identified unsuitable soils, occurrences of white bark pine, spotted owl nests and habitat, bull trout habitat, archeology sites, long-term monitoring areas, research natural areas, and areas of sensitive vegetation. Park staff were tasked to identify a spatial buffer around each of these resources to ensure limited impact. The buffered areas were merged into a single layer to minimize bias during the trail-planning exercises.

Using GIS, the final avoidance layer was overlaid onto aerial imagery or a topographic base map (figure 7). The avoidance layer should be symbolized boldly on the map and act as a visual cue for areas not suitable for new trail development. It is also important to add the park's existing trail system, infrastructure, and points of interest to the base map. This allows the trail planning team to visualize how new trail development integrates with the park's current assets.

Information on visitor use and trail conditions can also be incorporated into geospatial files and then categorized and displayed using color coding. For example, some teams map and color-code trails according to popularity (trail counts); the most visited trails might be one color, with the least-visited trails in another color. This technique helps create a simple visual aid of visitor patterns for meetings, workshops, and public events. This technique is most useful when there is a large trail network and complex information needs to be conveyed. When the trail network is relatively small and there is limited information for the team and public to digest, such a visual aid may not be as useful.

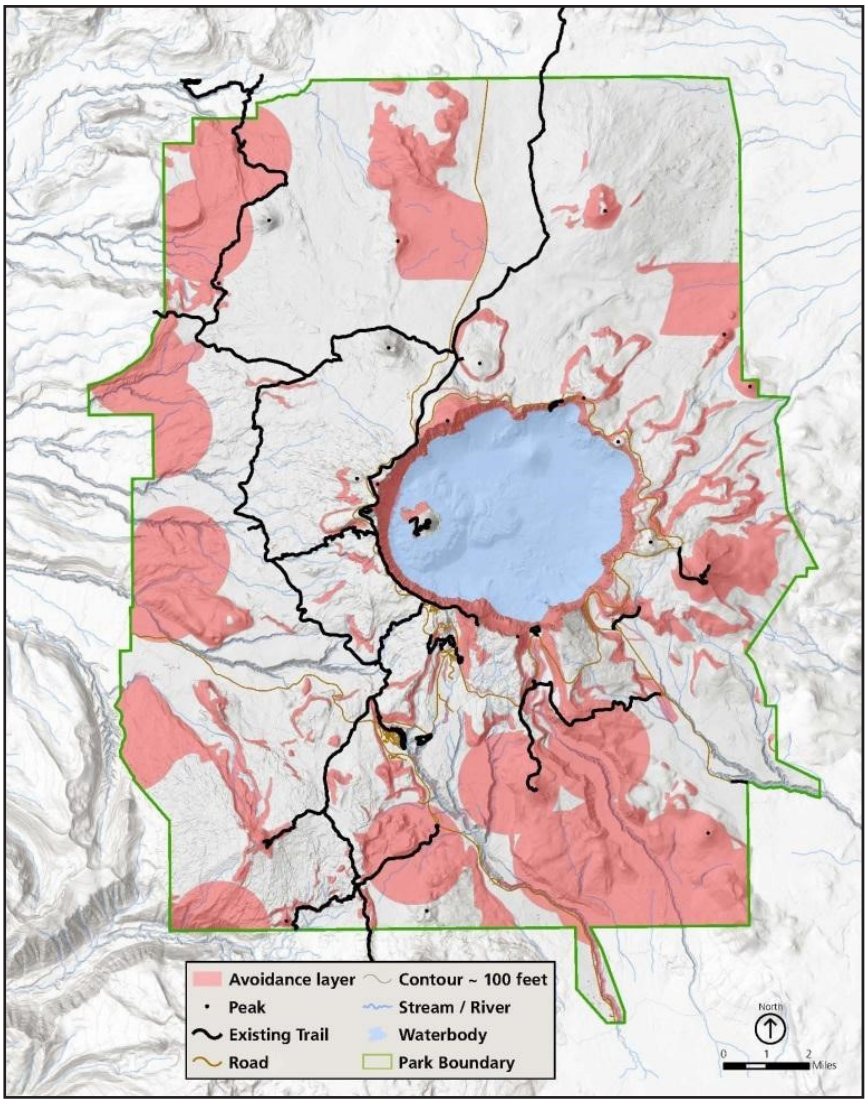
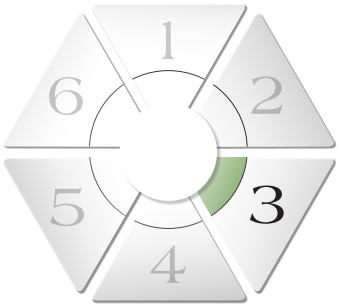


Figure 7. Avoidance of Sensitive Resources



3. Understand Existing Conditions

The next step in the planning process is to understand the existing conditions of the trail system. There is a variety of things that can be done to get an accurate picture of existing conditions. One option is to use the USFS Trail Assessment and Condition Surveys (TRACs) methodology. This ensures that trail managers have a current working knowledge of their trail system (USFS 2011). Please see the "Evaluating the Current Trail System" section in this guidebook for more information.

Another option to get an accurate picture of existing conditions is to use workshops with park staff and public engagement. This will result in a myriad of ideas for the trail system, which will need to be weighed, sorted, and trimmed before continuing forward. Public engagement will give the unit more insight into what visitors would like to see done with the trail system. They may share ideas that are insightful and well thought out. Refer to the "Public Participation in Trail Planning" section of this guidebook for more information on how to engage the public.

From a resource-protection standpoint, a trail system is a tool for protecting sensitive resources and directing visitors to more resilient areas. During discussions about visitor access and resource protection, planning groups often find themselves debating whether a trail will have an adverse impact on the natural environment, specifically wildlife and habitat. There are no definitive answers to these questions because the balance varies significantly depending on the context. Consider the following topics on the likelihood and scale of potential environmental impacts as a reference for guiding these discussions in the most productive way possible.

Difficult Ground and Environmental Hazards

Most people tend to follow trails rather than move cross-country, especially in areas with dense ground-level vegetation, forest cover, challenging terrain, and dangerous flora and fauna (who wants to bushwhack through thick brush, traipse through poison ivy, or get bitten by a rattlesnake?). Such factors make off-trail movement more dangerous and difficult, thus reducing the number of visitors traveling off trail.

In areas with thick ground cover and environmental hazards, a trail is very effective at concentrating visitor use. If a trail is designed and constructed in a sustainable manner, then negative environmental impacts are generally limited to the trail corridor. Further, techniques such as hardening trail surfaces and armoring can be used to ensure the trail tread lasts a long time and encourages visitors to remain on the trail, thus preventing common issues like braiding, rutting, trenching, and creation of informal trails.

Conversely, areas with limited ground cover and few environmental hazards are more likely to see off-trail use because cross-country movement and navigation are easier and less hazardous, and sometimes the designated trail can be challenging to identify.

Existing Visitor Use Levels versus Anticipated Visitor Use Levels

A second factor to consider in predicting environmental impacts is how much visitor use the new trail can accommodate. A consideration for a new trail is that it encourages use of an area that may have had very little use before. A trail would bring visitors into the area, and accommodating visitor use often means acknowledging that some level of visitor-related impact is acceptable.

If there are no official trails in an area, but many informal trails, then new trail construction will probably have an overall beneficial impact because it will concentrate visitors and reduce informal trail creation and associated impacts. However, if an area is relatively pristine, with no informal trails at all, then a new trail may have a larger environmental impact.

Habitat Fragmentation and Species Disturbance

Another common, but more complex, issue with new trails is habitat fragmentation and species disturbance; this is more likely to be widespread when an extensive trail network is proposed. The extent to which a trail or trails contribute to habitat fragmentation is a multifaceted issue involving factors such as species type, vegetation type, and surrounding land uses.

Wildlife disturbance is one facet of this larger problem. The presence of visitors on trails can temporarily or permanently displace some species, forcing them to find new habitat and food sources and ultimately affecting the vigor and productivity of individuals. Eventually, the presence of trail users may cause a change in the abundance and distribution of entire populations. There are multiple variables here, including the sensitivity of any given species of wildlife to humans (behavioral responses to humans vary—avoidance, habituation, attraction) and the behavior of trail users (those who aggressively approach wildlife are more likely to cause stress and displacement than someone who quietly takes photos from a distance) (Marion et al. 2016).

Thus, one major consideration in evaluating habitat fragmentation and species disturbance is how frequently any given trail and the larger trail system will be used, and what conditions existed before the trail was constructed. For example, a previously pristine forested area is developed with a 12-foot-wide paved trail to view a karst cave. This new trail would introduce visitor use—and potentially a lot of it—to the area. The presence of humans in a once pristine area will undoubtedly have some negative impact on wildlife.

It is more difficult to describe and quantify how growing use of a trail (e.g., going from very few visitors per day to many) will impact nearby wildlife. Research suggests there are numerous variables at play when determining how visitors using a trail affect nearby wildlife (see references in IVUMC 2019a).

Considering visitor behavior and associated impacts to wildlife is also important. It is almost impossible to predict the behavior of any single visitor on a trail, but when trying to analyze potential impacts to wildlife, the planning team should reflect on the types and amounts of visitor use in the area and if there are steps that can mitigate potential impacts.

Visitor mode of travel is another variable influencing how a trail and its users could impact wildlife. Many assume that motorized vehicles on trails lead to higher levels of disturbance than those caused by hikers; however, several studies have concluded that the presence of hikers can be more disturbing to animals than bicyclists or motor vehicles. This may seem counterintuitive, as cycles and vehicles tend to move at higher speeds and make more noise. However, some studies suggest that animals react most strongly to the human form, and that vehicles and bicycles mask the human form, thus decreasing the likelihood of a stress reaction in the animal (Marion et al. 2016). These studies and examples illustrate the importance of understanding the types of use in an area, reviewing relevant literature, and considering the potential impacts when trail planning.

The previously described impacts are quite complex. Trails and trail users can cause other environmental impacts, many of which are more straightforward and easier to predict. Common environmental impacts include the following:

- **Modification of natural drainage patterns/hydrology.** This mostly depends on the type of trail. Trails with more engineering improvements—such as retaining walls, culverts, turnpikes, water bars, bridges, and pavement—will likely have some effect on natural water flows. Narrow, natural-surface trails constructed with sustainability in mind are far less likely to alter drainage patterns.
- **Soil disturbance.** Over time, visitor traffic on trails leads to soil compaction and erosion, as well as braiding, trenching, and widening of tread. Compaction and erosion can also cause tree root exposure, and in turn, damage to surrounding trees and shrubs.
- **Disturbance of archeological resources.** Any time we break ground, there is potential to disturb archeological resources. The greatest risk is during new trail construction, when the tread is being cut or built. Ongoing use of the trail and regular trail maintenance are far less likely to cause damage to archeological resources.
- **Loss of habitat/vegetation.** Cutting down trees; clearing rocks, vegetation, and ground cover; and building supporting facilities (such as trailheads and campsites) all contribute to loss of vegetation and its value as wildlife habitat.
- **Viewshed degradation.** A trail or trail system can degrade natural views and vistas. The amount of degradation depends on the type of trail, number of engineering improvements, and exact route. For example, a rolling contour trail is far less obvious on a hillside than a series of stone-reinforced switchbacks.

Other aspects to examine are visitation trends, trail system use, population statistics, and recreational supply and demand in the area. For a holistic approach on visitor use management, consider reviewing the IVUMC's Visitor Use Management Framework (IVUMC 2016a) and subsequent monitoring and visitor capacity guidebooks. It is essential to consider the motivations of visitors when seeking to understand issues related to visitor use. After a review of broad visitor use trends, the team should assess the value of all existing trails and any key issues with the trail system.

Addressing Informal Trails

Most visitors stay on designated trails, however, informal (visitor-created) trails are a common problem in parks. Informal trails tend to be more problematic in areas with very sensitive soils and vegetation such as alpine meadows and deserts with crypto-biotic crusts. In these sensitive places, just a few people traveling off trail is enough to create a new path and cause lasting damage on the natural setting.

Keep in mind that an informal trail is often a sign of demand. People want to access something outside the existing trail system (such as an overlook or summit), or they've found a shortcut between two places they want to be. Sometimes informal trails just reflect visitor confusion. If an area contains a spider web of trails and few navigational signs, confused visitors will continue to propagate informal trails.

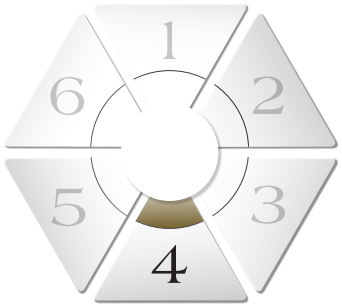
Comprehensive trail planning should address informal trails. *Why are they there? Are they harming a given area?* The planning team has several options for handling informal trails.

1. Formalize an informal trail and add it to the existing system. Keep in mind that "formalization" of an informal trail often involves modifying the route for sustainability reasons because people do not always follow a "sustainable route" when blazing their own paths.

2. Take action to encourage people to stay on the existing trail. These actions could include adding directional signs; adding signage that emphasizes the risks (e.g., poisonous plant or animal species) and environmental impacts of off-trail travel; setting social norms around staying on existing trails by using community-based social marketing techniques (Mackenzie-Mohr 2011); or adding natural and artificial barriers to the trail corridor, such as fencing, rope, boulders, or branches.

3. Restore the informal trail to natural conditions. Keep in mind, however, that restoration activities should be used in conjunction with option 2, otherwise, it is likely an informal trail will reappear.

4. Step up enforcement action—issue warnings and tickets. This option is often the least feasible given existing demands on law enforcement staff. It is also a heavy-handed technique that can detract from the visitor experience.



4. Finalize the Vision for the Trail System

Throughout the planning effort, workshops and public engagement will result in many ideas for the trail system, everything from closing trails to new trail construction to changing types of use on existing trails. The merits of each idea need to be weighed, and the list of options sorted and trimmed, before crafting the final vision. Options can be evaluated at the individual trail level, or in packages. This section provides tips for weighing proposals and finalizing the trail system.

Evaluating Proposals for New Trails

New construction is a serious decision for any land manager. It is costly and time-intensive, and facilities must be maintained indefinitely. Before committing to new construction, each new trail proposal should be carefully evaluated. Below is a sample of commonly used criteria to structure the conversation.

Redundancy: Are there several trails that feature similar points of interest (e.g., six trails that feature waterfalls) or that offer similar experiences? Do your interpretive trails highlight different interpretive themes? Does this new trail offer a different experience from what currently exists?

Value to visitor: Is there public support for this trail? Have members of the public asked for it? Would this be a fun trail? Would you want to hike it?

Cost: How much is initial construction? What is the maintenance cost for a 20-year window?

Operational implications: Closely related to cost is the operational impact of a trail. How would this new trail affect the trail crew's schedule? Do you have the staff to maintain this? Would more staff be needed? If more people cannot be hired, how would this affect overall maintenance of the trail system (e.g., would you need to less-frequently maintain other trails)? Can you expect volunteer support for construction and maintenance?

Environmental impacts: There are numerous ways to examine the environmental impacts of a trail. Some impacts are more complicated than others. For example, fragmentation of habitat and species disturbance are complex issues. Some research shows that popular trails break animal habitat into smaller pieces, decreasing their range and access to food. Other research shows that some animals living in densely vegetated areas often travel on human-made trails because the trails provide the animal with the path of least resistance, thus improving its range and access to food. The most tangible way to assess environmental impact is to determine the total area disturbed by trail construction. The area disturbed is easy to calculate for individual trails.

Trail Class (width of trail tread or trail corridor) x Trail Length = Area Disturbed

Keep in mind trail corridors can also be impacted during trail construction. In other words, impacts can extend beyond just the trail construction area. The more challenging calculation is determining the value of the disturbed area. For instance, how much of the area is vital habitat for an iconic species? The team should work with the park's natural resource staff if more refined calculations are desired.

Modifying Types of Use on Existing Trails

Types of visitor use can be appropriate for some trails and not for others. Before adding a new type of activity to a trail, consider whether or not it is appropriate. Also consider if different activities are to occur on the same trail, is there potential for user conflict? Consider whether signage emphasizing proper trail etiquette, increased patrols, redesign of certain segments, or widening of the trail tread may be needed to accommodate changes to visitor use levels and activities.

Two groups widely seen as incompatible are mountain bikers and equestrians. However, there are many situations where the two groups share trails with no serious issues, as trail users are rarely intentionally hostile toward each other. Still, accidents between bikes and horses are very possible since one user group is capable of moving at relatively high speed. A mountain biker moving at 15 miles per hour can startle a horse, especially in places where sight lines are short, such as thick forests or at blind turns along a trail. If a planning team is considering allowing these two user groups on the same trail, err on the side of caution with design and engineering, as well as signs and education. Of course, safety factors are even more critical where motorized users share trails with nonmotorized users.

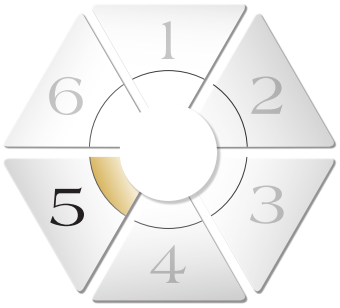
As far as changing types of use on existing trails, the other major course of action is to remove some user groups from existing trails—for example, prohibiting mountain biking on a specific trail. Removing use types from existing trails is a very sensitive decision. It is important that user-groups don't see such decisions as an attack or based on the personal values of the park managers. A history of complaints and incidences is needed to justify such decisions, among other factors.

Removing Existing Trails

Trails that have little value should be evaluated for potential removal from the system. The two best measures for determining trail value are maintenance required and visitor use levels. Trails that have low-use levels and require high levels of maintenance may not be worth the effort to keep open. Such trails could be removed from the system and restored to natural conditions, thus freeing up resources for other trails. However, in addition to trail popularity, it is important to consider the range of recreational opportunities that exist in a park or area. A trail with relatively little use can provide exceptional opportunities for solitude and other unique experiences or destinations. If there are not many other trails that provide these opportunities, it may be worth maintaining.

Another scenario is maintenance-intensive trails with high-use levels. Removing popular trails due to maintenance reasons could detract from the visitor experience. Trails in this category should be examined for reroutes. The goal is to avoid problem areas and/or to create a more sustainable alignment.

After assessing each proposed change to the trail system and making an initial decision, look at the entire list of proposals holistically. This is a good time to look at the goals for the trail system. As a whole, do the proposals achieve the goals? If so, finalize your vision and prepare to implement.



5. Refine Trail Alignments

The trail planning process can be summarized as a series of decisions that "drill down" to a final decision or action. At first, a general direction or corridor is identified along with specific goals. This is often called the 20% design. As the process evolves, so does the design and often the trail alignment. Understanding when a trail refinement is needed is a key component to a successful trail plan and ensures that implementation is smooth and realistic.

Proposed trail corridors at the 20% design level are helpful to identify "big picture" issues, such as conflicts with wildlife migration patterns, potential impacts to known cultural resource sites, and impacts to feasibility due to boundary or general topography factors. As helpful as these initial planning efforts are in identifying suitable areas for trails, they cannot substitute for a comprehensive field visit. GIS and LiDAR capabilities have helped planners develop better proposed trail corridors, but no amount of research gathered in the office can substitute for information gathered while conducting a field visit and trail assessment. Trail construction costs and impacts to natural and cultural resources can vary widely from deviations of just a few feet in many instances.

The purpose of a field visit is to verify the feasibility of the proposed route and any impacts that were unknown at the conceptual level. A global positioning system (GPS) unit, camera, and clinometer are essential tools of the trade for this type of assessment. A field assessment team of a trail designer, an ecologist, and a cultural resources specialist are important personnel for the assessment. The goal of the field visit should be to identify control points on the site as well as any site-specific factors that may hinder or help trail construction.

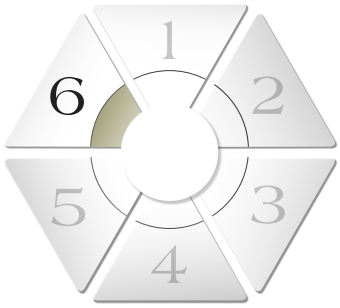
Control points are physical, natural, or cultural elements that direct where the trail can go. Every trail has at least one control point—the trailhead. Other control points include rock outcrops, major wetlands or marshy areas, feasible river crossings, overlooks, and final destinations (e.g., peak summits or waterfalls).

Trail alignments often require refinement when new data emerge. Trail surveys conducted in relatively lightly visited areas can sometimes uncover significant cultural sites or sensitive habitat. If new control points are revealed during the planning process, it may require significant redesign of the proposed routes.

The goal of a trail plan should be to identify a general corridor or buffer area (i.e., 100 to 200 feet) where a trail can be constructed. A corridor of this size gives enough specificity to prepare a meaningful environmental impact analysis and provides a specific area for follow-on surveys for sensitive resources, such as archeological sites and nesting trees for endangered birds. A corridor also helps the trail crew leads and facility managers who decide where the trail should actually go by giving them flexibility to avoid obstacles and find the most sustainable route.

After completion of the trail plan is implementation of the 100% design level. The 100% design level for trails is typically conducted with stakes, construction paint, and flagging. It involves identifying specific trees or vegetation that must be removed, identifying areas where trail structures must be installed (e.g., drains, retaining walls), and occasionally determining areas where blasting must occur. Additional elements include material and tool staging areas, high-line system locations, and potential sources of construction materials (e.g., rock). It is important to give the trail builder enough leeway in the field to make adjustments that allow for a successful and sustainable trail alignment.

6. Implement the Trail System Plan



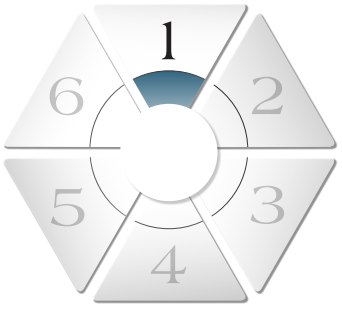
The final phase of the planning process is implementation. Implementation encompasses financing, constructing, and maintaining trails, as well as monitoring trail use and conducting trail condition assessments. In the context of trail system planning, there is a focus on the financing, phasing, and monitoring visitor use to evaluate and inform future planning efforts. Please see the "Implementing Concepts" chapter for more information.

Trail Planning Workshops

Trail planning workshops bring an interdisciplinary team together to create elements of the trail plan and to make decisions about substance and process. Each workshop should have a clear purpose. Desired outcomes should be articulated in advance and the workshop agenda should be vetted with the interdisciplinary team before the workshop.

To be most effective, workshops should include all members of the interdisciplinary team; subject matter experts in fields (e.g., law enforcement, resource protection, trail development, maintenance); and members of the management team for the park or recreation area. When considering workshop participant counts, 20 or fewer participants is a good target. Larger numbers are manageable, but require more facilitators, more time, and more resources to plan for and manage.

Developing Trail System Goals

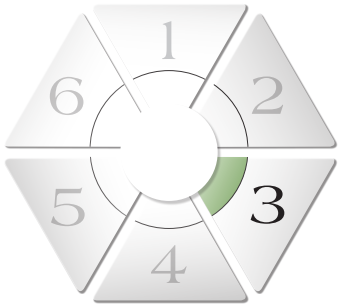


Groups should strive for goals that are also long-term targets. Early in a trail planning effort, the interdisciplinary team should establish goals for the trail system that align with zoning and desired conditions. The goals provide focus throughout the planning effort and, more importantly, during implementation. Goals also serve as criteria for assessing the merits of ideas at key points in the process. Those ideas can come from the interdisciplinary team or the public. For example, if a friends' group proposes a trail circumnavigating the entire park, the interdisciplinary team can use the list of goals to determine whether this idea fits with the trail system goals.

Goals will also guide operational decisions once the planning process is complete. Generally, goals for a trail system fall into one of four categories: trail development and maintenance, park operations, visitor experience and safety, or resource protection.

The following list of goals can be used as a starting point for goal-setting exercises with the planning team. The trail system:

- Is sustainable, meaning each trail lies lightly on the land, will last a long time, and needs little maintenance.
- Offers unique experiences for a diversity of visitors during all seasons.
- Is well-marked and understood by visitors.
- Provides interpretive opportunities.
- Does not have unnecessary redundancy.
- Protects park resources and limits impacts from trail use.
- Minimizes the potential for conflict among different user groups.
- Improves visitor circulation and safety.
- Complements trail networks outside the park.
- Is within the park's personnel and budgetary resources.



Evaluating the Current Trail System

A trail planning effort should include a review of the current trail system, including existing conditions. The US Forest Service uses the Trail Assessment and Condition Surveys (TRACs) to support trail condition data collection and to ensure trail managers have a current, working knowledge of their trail system. The three basic components of are Inventory, Assessment, and Prescription (USFS 2011). Although all of the TRACs reference guide may not be applicable to your unit, this manual provides a methodological approach to ensure the manager leaves the field with accurate, useful, and consistently collected data that can be used for a wide variety of purposes.

At the outset, it is helpful to examine visitation trends, trail system use, population statistics, and recreational supply and demand in the area. This broader context helps frame the trail planning effort. For a holistic approach on visitor use management, consider reviewing IVUMC's *Visitor Use Management Framework* (IVUMC 2016a) and subsequent monitoring and visitor capacity guidebooks (IVUMC 2019b, c).

After a review of broad visitor use trends, the team should assess the value of all existing trails and any key issues with the trail system. Regarding condition, trails can be classified as poor, acceptable, good, or excellent. The planning team should examine each "problem" trail and ask, "Why is this trail in poor condition?"

The answer is usually one or all of the following:

- poor construction practices
- terrain-related problems, such as unsuitable soils, unstable slopes, or recurring flooding
- lack of maintenance
- impacts related to visitor use

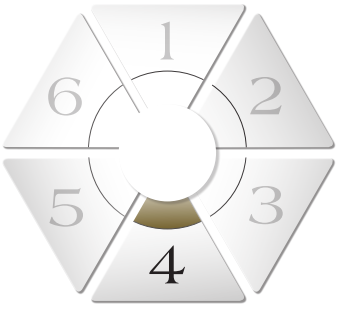
Regarding impacts related to visitor use, remember it is important to evaluate trails in context. For instance, frontcountry trails—such as a short nature hike near a visitor center—will almost always have higher use than backcountry trails. Comparing use levels on frontcountry and backcountry trails is the equivalent of comparing apples to oranges. The interdisciplinary team should compare use levels on backcountry trails against other backcountry trails and frontcountry trails against other frontcountry trails, and only if applicable. Some backcountry trails have higher use than some frontcountry trails. Keep in mind the motivations of visitors when seeking to understand issues related to visitor use.

The trail plan should prescribe actions for each existing trail according to its use-condition category or for each general category. Below are recommended actions for trails that fall into the major categories:

- **Trails in poor condition with low visitor use levels.** These trails are good candidates for decommissioning; however, consider desired conditions and opportunities to provide a diverse range of visitor opportunities. Consider closing them, restoring the corridor to its natural condition, and directing your maintenance and financial resources elsewhere.

- **Trails in good condition with high visitor use levels.** These trails should remain in the trail system. Consider rotating monitoring of these trails to ensure desired conditions are maintained.
- **Trails in poor condition as a result of environmental or terrain factors, and also have high visitor use levels.** These trails should be examined for reroutes or other engineering improvements, such as tread armoring. These trails often become the focus of maintenance resources.
- **Trails in poor condition primarily due to high levels of visitor use.** Trails in this category present a more complex situation. Visitor use management strategies should likely be implemented.

Different Alternatives/Configurations for a Future Trail System



A planning and design effort for an individual trail often involves examination of several different trail routes; each option varies by factors such as length, difficulty, and environmental impact. System-level trail plans should also examine different options; however, the number of individual options can quickly become overwhelming so it is helpful to have organizing principles.

Generally, trail system options will differ according to three categories: trail system expansion, reduction, or maintenance. It is important to have completed a trail condition assessment at some level before beginning this discussion. It is also imperative that desired conditions and management objectives for the trail system have been defined. It is helpful to think about these different system-level options on a spectrum.

- **Trail system expansion.** This option typically involves robust expansion of the trail system and supporting facilities, such as parking lots and trailheads. The focus is on maximizing visitor access and increasing opportunities.
- **Trail system maintenance.** This option likely maintains a similar amount of trail mileage but reroutes or redesigns existing trails to improve the sustainability of the trail or provide a range of visitor opportunities.
- **Trail system reduction.** This alternative typically involves very little expansion of the trail system and could reduce the overall trail mileage. Often, this alternative proposes closing some existing trails for reasons of redundancy, low-use, and/or poor condition.

In addition, different options can be organized according to geographic area. One option may call for extensive development in one area of a park and trail system reduction in another area.

Guidance for Drawing Trails and Map Reconnaissance

Trail system design almost always begins on paper maps with people gathering—elbows on the table and markers in hand—to sketch out ideas. Map reconnaissance gives an initial sense of whether there is enough "space" in a given area to implement sustainable trail design principles. It is more efficient to conduct map reconnaissance in the office than in the field, where one must climb over deadfall, bushwhack, and plod through drainages while swatting mosquitoes. When in the field, it is also easy to get tunnel vision with a sense of "looking through a straw," where one is focused on the specific area of 10 to 20 feet at a time. This is not an efficient way to explore options for a 10-mile trail, and especially inefficient for a larger trail network. While field time is a vital part of trail design, groups should start thinking about trail systems on large maps to get a quick sense of options and practicality, and to keep track of the big picture.

The following are a few tips for drawing trail routes in early map reconnaissance exercises:

1. Use the 0.25 to 0.33 rule in areas where a trail must climb and descend to estimate trail grade in relation to slope. If a trail is climbing or descending, the line drawn for the trail should be three times as long as the distance between the map contour lines in that area. For example, if the contour lines on the north slope of a hill are 2 centimeters (cm) apart on the map and you want to estimate/draw a sustainable trail grade, then the trail line would need to be at least 6 cm long between contour lines for a trail grade of 0.33 of the slope (NPS 2008). A trail line 8 cm long would be 0.25 of the slope.

2. Follow a single contour line when a trail needs to connect two points in the most efficient way possible (see figure 8).

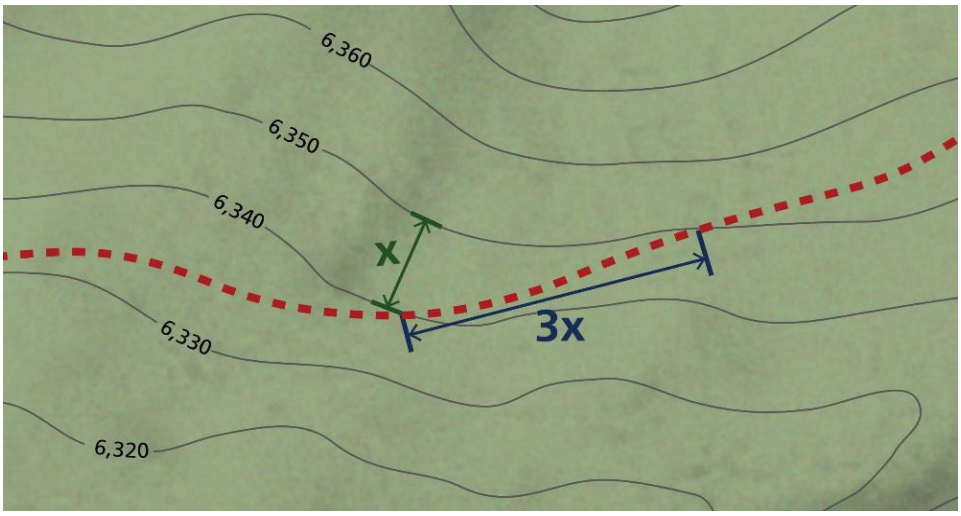


Figure 8. Drawing on Contour Map to Get Slope

3. Look for slopes under 50% grade when routing a trail. Use rise over run to calculate grade. Generally, construction and maintenance are much more difficult when trails are on slopes of more than 50%.

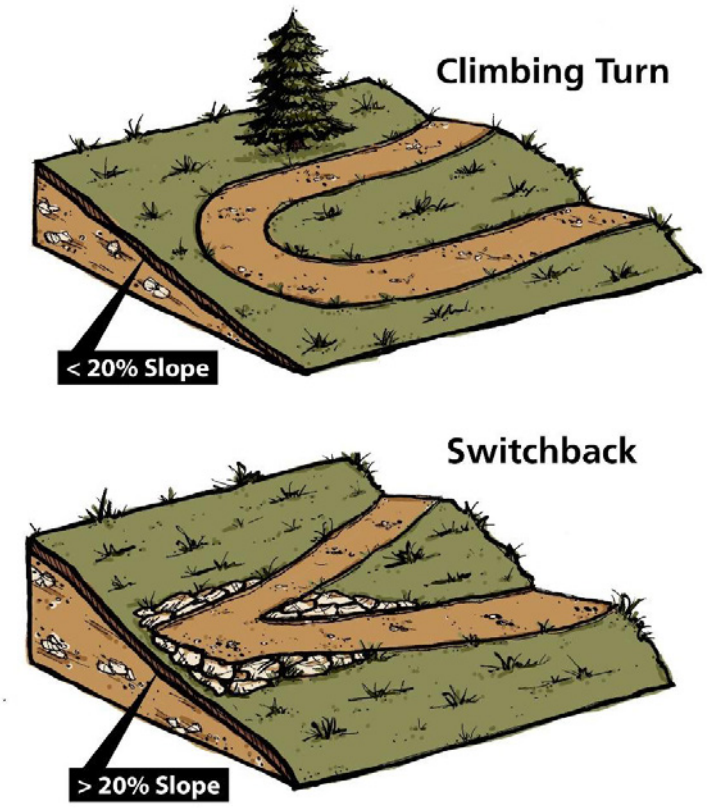


Figure 9. Images of Differences Between a Climbing Turn and a Switchback

4 Use climbing turns, rather than switchbacks, on slopes of less than 20%. Use switchbacks on slopes of more than 20% (see figure 9).

5 Consider that north slopes tend to be cooler, shadier, and muddier and they hold snow longer, while south slopes tend to be hotter, less shaded, and drier and snow typically melts faster than on north slopes.

6 Early in the process, conduct reconnaissance for challenging areas on foot or tap into the knowledge of field staff.

Tips for Workshop Facilitators

1 Initial exercises should rely on large-scale, paper maps (somewhere around the 1:150,000 scale) if working in a large park or recreation area. This helps everyone think at the right scale. Don't begin by looking through a straw at the 1:1,000 scale; that would lead to inefficient use of time (e.g., do we go left around the tree or right around the tree?). Fine-scale thinking should be saved for later in the process, specifically ground-truthing the trail routes. Then, consider ways to remove common barriers to participation. For example, when everyone in a small group gets to hold a pencil and huddle around a paper map, it leads to rich dialogue. However, when a group of 20 people works from one map projected on a wall, it tends to yield conversation among a smaller proportion of participants.

2 Once initial exercises are complete, digitize the paper maps using a program like ArcGIS or Google Earth. Working with pen and paper gets messy, especially when there are many ideas over the course of hours or days. Using geospatial systems makes idea refinement and review processes much easier and leads to less follow-up work for the planning team. Again, keep the map scale broad when transferring into digital systems—just move group ideas into a form that can be easily manipulated.

3 Don't worry about exact trail alignments in the early stages. Alignments should be refined as you go. Think of alignments as slowly evolving throughout the planning effort. Please see the "Refine Trail Alignments" section in this guidebook for more information.

4 From the beginning, it is helpful for the facilitator or designated recorder to take notes in a table that is prepopulated with required information fields. The small group is responsible for completing each field. These fields are also discussion prompts, ensuring various options are considered in the course of conversation. The table can also help the group stay on task and serve as a benchmark of group progress (e.g., when the table is done, the group is done). For example, for each trail, the data-entry prompts might be trail class, designed use, allowed uses, and purpose.

Workshop Exercises

The trail plan should be created by an interdisciplinary team with a variety of disciplines. The best way to tap into the knowledge of an interdisciplinary team is to hold workshops that bring them all together, allow them to hear each other's perspectives and concerns, and allow them to explore ideas. This section provides more detail on how to structure trail planning workshops and focus on visioning exercises for the trail system. A visioning exercise involves designing a future trail system (and/or modifying the existing one) based on specific parameters.

Working in small groups keeps a visioning exercise efficient. With groups of 15 or more, it is highly recommended to split participants into small groups because small groups are effective in idea generation. Before splitting people up, participants should agree on overall goals for the trail system and on broad concepts for system configuration. Facilitators then assign participants to groups of five to seven people. Facilitators give each group a different trail system configuration to work on or "envision."

Small-group composition matters. Forming interdisciplinary small groups is also a best practice. When considering small-group assignments, make sure individual skillsets in the group are consistent with the larger concept. Another way to split participants is to have each small group work on a specific geographic area. Each group then develops multiple options for its assigned area according to the larger themes everyone agreed upon. However, it is often easier for a group to focus on one theme and to apply that theme across the entire planning area, rather than have them develop multiple themes for a smaller geographic area. This is because shifting between themes involves a shift in mode of thought and world outlook, and this can be challenging when there are time constraints.

For an example workshop mapping exercise, please see the appendix.

Public Participation in Trail Planning

Bringing the public into trail planning efforts adds value in a number of ways—it generates ideas, vets proposals, defines opportunities and constraints, gains a better understanding of the wants and needs of trail users, and improves our understanding of visitor behavior.

Who is the Public in a Trail Planning Effort?

The public consists of trail users who may be affected by a trail planning effort. The public is not a monolithic entity. For instance, the one-time visitor will likely have different preferences than the person who visits the trail system every morning. Ideally, a public engagement effort will capture the opinions of a range of trail users. When structuring public engagement activities, it is helpful to think of "the public" in the following three subcategories:

- **Repeat visitors –** visitors who repeatedly use the trail system for a variety of motivations. Often these visitors can be residents of nearby communities.
- **Advocates for specific uses / organized stakeholder groups –** proponents of specific forms of recreation on trails, such as hiking, horseback riding, mountain biking, or cross-country skiing. Members of these groups may be repeat visitors or part of a national network.
- **Occasional visitors –** those who use the trail system less frequently than a few days per year.

Who Has the Pen?

One critical question that comes up when planning public engagement in trail planning is "Who should be given the pen?" Meaning, how should we solicit ideas and at what level of detail?

A key question in public engagement for trail systems is whether the public should be given the opportunity to draw lines on a map (e.g., draw out their own trail ideas) or whether we simply ask them to respond to the planning team's trail ideas.

There is great value in allowing citizens to draw their own trail ideas on a map. Some people, particularly repeat visitors, have very specific, well-thought out ideas based on deep local knowledge and year-round experience on a trail network. Tapping into trail-user knowledge saves a great deal of time and energy for the planning team, as well. If you are going to allow people to draw their own trail ideas during a public meeting, the team should print large paper maps showing topography and key infrastructure such as roads, trailheads, campgrounds, and existing trails.

Rather than paper maps, the planning team could instead set up a geospatial system at public meetings or during comment periods. Members of the public can then input their ideas directly into a system like Google Earth, ArcGIS, or a web mapping application, which saves steps and time on the back end. Essentially, the data are already in digital form and, thus, are easier to manipulate, share, and review during subsequent steps. Be sure to manage expectations and ensure that participants know all trails may not be feasible or appropriate.

The advantage of giving the pen to the public is the feeling of empowerment that goes with it. Better yet, the planning team is tapping into years of experience and specialized knowledge. The downside is the sheer number of ideas that can be generated. The planning team must ask itself if there are sufficient resources and capacity to carefully evaluate the merits of each trail idea, particularly if high levels of public participation are expected.

When to Engage the Public

Different agencies and organizations have specific criteria for public engagement during planning efforts. For example, federal agencies conducting trail planning efforts must comply with the National Environmental Policy Act (NEPA). During the NEPA compliance process, there are typically public comment periods at the beginning of the planning effort (public scoping) and when the draft plan is released. This section provides guidance for public involvement for NPS trail planning efforts.

Generally, the more interaction between the planning team and the public, the better. Regular interaction creates a constant feedback loop for the planning team and, in theory, should result in the best outcome. While a great deal of engagement is ideal, time and resource constraints limit the amount of public engagement that is practical. Usually, the planning team has time and money for two or three public engagement periods that coincide with major project milestones. In deciding when to engage the public, consider the following:

- Engage the public at least once during idea generation, before a draft plan is released. New, fresh ideas often come from outside the planning team. During the early stages of a trail planning effort, it is much easier to explore ideas, refine them, and study their potential consequences. The introduction of new ideas, or major refinements of existing ideas, becomes more costly later in the process because the creation of a draft plan and the resultant environmental analysis can be a lengthy, expensive, and time-intensive endeavor.
- Ask specific questions of the public, if appropriate. Public feedback is often more meaningful in response to specific questions than broad and open-ended questions such as, "what do you value about the trail system?" Often, when a member of the public is answering a specific question, he or she will implicitly answer a broader one regarding what they value about a given area.

Where to Engage the Public

In each formal meeting, whether in a brick-and-mortar building or an online format, the planning team seeks to maximize public turnout and quality of the dialogue. Traditionally, public meetings are held in visitor facilities inside a park or in public spaces, such as libraries or municipal buildings. This engagement method requires people to come to a specific place at a specific time and, thus, implies they have a relatively high level of motivation to participate.

Public turnout can be increased if the planning team goes to where trail users are, rather than asking trail users to come to the planning team. Consider seeking input from trail users as well as non-regular trail users. Decisions about meeting place and forum also depends on the trail groups you'd like to reach. Consider the following when selecting meeting venues and locations:

- **Repeat visitors.** Repeat visitors who are often residents of nearby communities account for a large percentage of the attendees at public meetings. Holding meetings in different communities will generate goodwill. Even if three communities are relatively close together geographically, it is good to hold separate meetings in each of the three communities to make it as convenient as possible for interested community members. The team also needs to be aware of perceived fairness, as represented through the often-asked question: "You had a meeting in their town, why not ours?" Regarding time of day for meetings, evening sessions give people who work during the day a chance to attend.
- **Advocates for specific uses / organized stakeholder groups.** The local mountain biking or hiking club may have recurring meetings. Those meetings are good places to make announcements about opportunities to comment or get involved in the planning effort. The other option is to reach out to the local club president or representative and allow them to disseminate information. The planning team should be very careful about making formal presentations to specific user groups at their club meetings and recording their comments, as this may create ethical and fairness issues.
- **Occasional visitors.** Consider setting up information booths inside the park, at visitor centers, and at popular trailheads. Also consider online platforms, such as digital conference services or social media, to take feedback and hold question-and-answer sessions.

Tools and Techniques for Engaging the Public

In trail planning efforts, three commonly used formats for engaging the public are the open house, design charrette, and information kiosk.

Open house events are informal and lack a traditional speech or presentation. Typically, displays or stations are set up with information about the trail system and proposed changes. Members of the public rotate through these stations, where they have a chance to talk with trail managers and planning team members, to give feedback, and have their comments recorded.

Open house events are good for soliciting feedback on specific ideas because they allow extensive one-on-one dialogue between land managers and members of the public. For this dialogue to be valuable, the planning team and staff members participating in the open house must be knowledgeable about the trail system and the larger management issues that affect it.

Design charrettes are intensive meetings where members of the public work in groups on specific problems or to generate specific ideas related to the trail planning effort. For example, a design charrette would be a great engagement model to identify an ideal trail route or to brainstorm how to mitigate conflict between mountain bikers and equestrians on a specific trail. In essence, members of the public temporarily assume the role of planning team members. The advantage of a public charrette is that it generates many new and creative ideas. It also helps members of the public gain a better understanding of opposing viewpoints and the compromises needed for a balanced solution. The downside of a public charrette is that it requires a great deal of time and effort, particularly if high public turnout is expected.

A more streamlined approach to engagement is to hold a stakeholder design charrette. For this type of meeting, invitees should be kept to a small group of stakeholders, likely no more than 30 people. These stakeholders should represent different trail users, such as families with small children, equestrians, mountain bikers, day hikers, and long-distance hikers to name a few. The stakeholders are then assigned to mixed groups and given a specific problem to work on. Ideally, this will encourage productive dialogue among the stakeholders and lead to well-balanced solutions for the planning team.

Information kiosks are used to share information and raise awareness; they are not for recording public input. They can be run as a booth, table, or kiosk. Ideally, they should be set up in a visitor center or at a popular trailhead to increase the chance of capturing a broad spectrum of trail users and visitors, including those in the "occasional visitor" category. Information kiosks are most effective when staffed by one or two planning team members so that interested people have a chance to ask questions. However, kiosks do not have to be staffed if there is a general staff presence in the area (for example, interpretive staff work at the nearby visitor center desk).

Implementing Concepts

A Financially Sustainable Trail System

A financially sustainable trail system is one that meets the goals and objectives of the park while being sustainable within its long-term financial resources. To prevent building out more trail infrastructure than a park could reasonably maintain, trail planning should use a life cycle cost approach, which is referred to as the Total Cost of Facility Ownership (TCFO) by the National Park Service. The funds necessary for the initial construction of a trail are only a small portion of the Total Cost of Facility Ownership, the majority consisting of the operations and maintenance (O&M) required throughout its life cycle.

As a preliminary step, a park should assess what resources it has available to dedicate to trail construction and maintenance over time, including its operational base funds; its ability to compete for NPS facility project funds; and any non-NPS funds, such as Federal Highway Administration funds, donations, and in-kind support provided by park volunteers. Any decision to improve or expand the existing trail system should be made with an explicit long-term funding strategy. Conversely, this analysis could also lead to some trails being removed from service.

All park trails should be included in the park's facility management program, including the asset inventory that resides in the NPS Financial and Business Management System. In addition to helping the National Park Service track its asset inventory across all park units, it is necessary to compete for any project funding source that could support trail construction or maintenance.

Construction Costs

Trail construction costs vary widely based on terrain and soil type, material selection, the need for additional features (e.g., bridges, switchbacks), geographic location, and the need for stock team or helicopter support. Careful route selection and creative design can reduce these costs significantly by avoiding the need for costly engineering such as long bridge spans or large retaining walls.

This section presents generic costs for the construction of trails and related components, which will be useful as a starting point in the planning process. These costs were generated using the NPS Cost Estimating Software System (CESS), which includes several custom-developed trail assemblies for this purpose. Note that these costs represent an NPS system-wide average, and for some park units the cost of construction may be significantly higher due to local market conditions or remote work locations. For example, a native tread class 2 trail would have an average cost of $38,762 per mile across the National Park Service; however, the cost would be $32,910 per mile in Amistad National Recreation Area and $56,981 in Golden Gate National Recreation Area.

Table 1 shows estimates for 1-mile segments of trails with different surface types and table 2 shows the costs of additional features/components.

Table 1. Estimates for 1-Mile Segments of Trails with Different Surface Types

Tread Type	Cost/Mile	Cost/ft²
Native (2 feet wide)	$38,762	$3.67
Native 40% Cross Slope (2 feet wide)	$102,373	$9.69
Stabilized Crushed Stone (10 feet wide)	$245,079	$4.64
Asphalt (10 feet wide)	$840,920	$15.93
Concrete (10 feet wide)	$662,608	$12.55

Table 2. Costs of Additional Features/Components

Trail Feature	Count	Unit	Net Cost	Cost/Unit
Boardwalk	1,000	ft²	$71,498	$71
Switchback	1	each	$4,986	$4,986
Retainer Bar (timber)	1	each	$450	$450
Trail Step (stone)	20	each	$5,450	$272
Wood Railing	10	LF	$2,183	$218
Causeway	100	LF	$34,181	$342
Culvert (12-inch diameter, 6-foot run)	1	each	$1,361	$1,361
Stepping Stone	8	each	$1,287	$161
Water Bar (stone)	1	each	$533	$533
Retaining Wall (stone)	80	ft²	$6,733	$84
Foot Bridge (prefab steel trussed) 30 feet x 10 feet	300	ft²	$94,304	$314
Foot Bridge (wooden stringer) 10 feet x 3 feet	30	ft²	$12,413	$414
Foot Bridge (steel stringer) 50 feet x 5 feet	250	ft²	$39,400	$158

Notes: LF=linear foot.

Note that any cost estimate developed in the Cost Estimating Software System (CESS) can be adjusted to include additional labor hours, stock teams, or even helicopter support to assist with remote work locations. If a trail project is unusually complex in terms of scale or engineering requirements, it may be advisable to consult an expert in construction and cost estimating either in an NPS regional office or the Denver Service Center if the park does not have its own engineer. (Note that the Cost Estimating Software System is available to all NPS staff, but requires that system access be obtained as well as training in the use of the interface.)

Operations, Maintenance, and Recapitalization Costs

The key to maximizing the life cycle of any asset, including trails, is to perform the appropriate operations and maintenance (O&M) activities at the appropriate time intervals. Generally speaking, it is less costly over time to perform light maintenance as needed, rather than allowing a trail to deteriorate to the point that much more intensive, expensive rehabilitation work is required. (Similarly, changing engine oil at regular intervals is much less expensive than replacing an engine.) This concept is central to the management of a trail throughout its life cycle and is key to minimizing the Total Cost of Facility Ownership (TCFO).

The NPS Park Facility Management Division has developed the Trails TCFO Calculator, a spreadsheet application that allow users to estimate the costs of required O&M activities for trails of different tread types. This spreadsheet application determines the requirements over a specified period of time; assigns costs based on geographic location; and calculates an annualized O&M cost, the TCFO (presented in net present value terms), and the O&M requirements in each year.

Users can modify the default assumptions—including altering the type and number of trail features (e.g., water bars, retaining walls), include cost markups for remoteness or wilderness (which limits the use of mechanized tools), and modify the frequency of the identified maintenance tasks. The latter feature is helpful because it allows users to remove activities (e.g., snow removal for trails located in warmer areas, year-round maintenance for trails used only seasonally).

Required operations and maintenance is broken down in terms of work types.

- Facility Operations – includes trimming, brushing, tree removal, leaf removal, litter cleanup
- Preventive Maintenance – inspections, cleaning water bars and retainer bars (tasks done at least once per year)
- Recurring Maintenance – restriping (if paved), repointing retaining walls (tasks done every 1 to 10 years)
- Unscheduled Maintenance – repairs to retaining walls, patching potholes
- Component Renewal – replacing trail surfaces, replacing signs, replacing water bars

The Trails TCFO Calculator can be downloaded from the internal NPS SharePoint site here: http://pfmdshare.nps.gov/Asset%20Management%20Toolbox/Forms/Grouped_ProgramArea.aspx.

Table 3 includes both annual O&M and TCFO estimates for trails with the same tread types as shown in table 1, as well as boardwalks. As with the costs shown in table 1, these are system-wide averages.

Table 3. Annual Operations and Maintenance and Total Cost of Facility Ownership Estimates for Trails with Same Tread

Tread Type	Annual O&M Per Segment	O&M Per SF	TCFO	TCFO Per SF
Native (2 feet wide)	$1,809	$0.17	$97,943	$9.27
Native 40% Cross Slope (2 feet wide)	$2,024	$0.19	$168,380	$15.95
Stabilized Crushed Stone (10 feet wide)	$8,378	$0.16	$519,103	$9.83
Asphalt (10 feet wide)	$21,818	$0.41	$1,546,117	$29.28
Concrete (10 feet wide)	$27,233	$0.52	$1,544,971	$29.26
Boardwalk (100-foot x 10-foot segment)	$1,905	$1.91	$133,359	$133.36

Notes: O&M=operations and maintenance, SF=square foot, TCFO=Total Cost of Facility Ownership

National Park Service and External Financial Resources

Since most NPS facility-related funding sources—such as cyclic maintenance and repair-rehabilitation—are focused on the maintenance of existing assets, there are relatively few internal funding sources for construction of new trails. Potential candidate fund sources for new construction include operational base funds and recreation fee funds. If a trail performs a transportation function (see NPS 2017), it could be eligible for funding from the Federal Highway Administration.

Ambitious trail development plans will likely need to look outside the National Park Service for construction funding. Keep in mind that the concept of Total Cost of Facility Ownership still applies with external funding because the park should not build a trail it cannot afford to maintain into the future, even if the construction cost is zero. In absence of a stand-alone financial analysis, the present value calculated by the TCFO calculator can be used to estimate the size of the initial donation required to support a trail over a designated time frame, equivalent to purchasing an annuity. Donors may respond favorably knowing that their contribution will not only help construct a new trail, but will also help to sustain it over time.

Careful collaboration with partner groups and volunteers is another approach to expanding a park's trail maintenance capability, provided these groups have the appropriate skills to effectively perform maintenance activities. The TCFO calculator also measures the full-time equivalent staff required to maintain a trail over time; it can be used to estimate the number of volunteer hours needed to perform the required maintenance for a trail or determine the cost savings (or value of) volunteer activities related to trail maintenance.

Monitoring Visitor Use and Experience on Trails

Monitoring Trail Use

Monitoring visitor use levels is a vital component of trail management because use data help determine visitor patterns (and, hence, where park money and personnel resources are best spent), areas to expect wear and tear, and where adverse resource impacts are more likely to occur. In an ideal world, a park manager would have plenty of money, time, and staff to maintain a comprehensive monitoring effort. This would include visitor counts on all trails, in all seasons, year after year, or even a visitor experience survey to identify what people liked and did not like about their time on park trails. Unfortunately, land managers have limited budgets and staffing to support such a comprehensive monitoring and data-collection effort.

Since time and money are often limited, monitoring use levels on the trail system should be strategic. For example, consider installing trail counters on a representative sample of trails—some frontcountry, some backcountry, and others wilderness—instead of on every trail in the park. Rather than moving counters around, consider leaving trail counters in the same location to gather long-term trend data that can be extrapolated to other areas of the park.

Observational information from the park's field staff can be an important source of information. In some cases, observational information may be the only historical data available. For example, what are the law enforcement rangers' impressions when they patrol the trails? Do they see many visitors? Are the visitors clustered at any features of interest? What does the patrol log say? On weekends, is the parking lot full at particular trailheads? If so, by what time? How about at midweek? What are people saying on the park's social media pages about the trails? Staff observation is an inexpensive form of data collection. However, with this data source come many gaps, biases, and uncertainties. In situations where objective use data are lacking, efforts to improve data collection should be prioritized. The perception among some park managers can be that data collection is incredibly costly and time intensive; however, a simple strategic data-collection system can be set up and maintained with few thousand dollars' worth of initial investment and a few hours per month of maintenance. When compared with the Total Cost of Facility Ownership for a trail system, this relatively minimal investment will enable much smarter trail system management and future decision-making. When determining the scale of data-collection efforts, consider the sliding-scale concept presented in chapter 2 of the Visitor Use Management Framework. Issue uncertainty, impact risk, stakeholder involvement, and the level of controversy/potential for litigation all impact the degree of data collection and analysis that will be needed to make a decision (IVUMC 2016a).

There are several popular procedures for collecting data on use levels. Each has its own advantages and disadvantages.

Static count (e.g., people per viewscape). One technique is to count trail users from a static location, such as at points along the trail, trail junctions, scenic overlooks, roadside pullouts, and key visitor destinations. This is often referred to as "people per viewscape."

Another form of the static count is to place a kiosk or post along a trail that asks visitors to self-register when they pass by. Requested information usually includes number of people in the party, date of visit, and length of stay. Of course, compliance will never be 100%, which can lead to inaccuracies in the data. However, this shortcoming can be mitigated by periodically calibrating the kiosk or post with a discrete staff member or camera to gain an understanding of the compliance rate in that particular area. This form of data collection does require work—someone has to retrieve the information and check the kiosks to make certain the register is not full and there is a pencil available.

Trail counters. Advantages of using a trail counter include the ability to have a longer collection window and increased level of accuracy. Once calibrated, trail counters can be left in place for months and thus provide much better datasets about long-term use patterns. The disadvantages of trail counters are that, like any technology, they have an initial cost (usually a few hundred dollars per unit); they require compatible software; and staff need to have a good working knowledge of how to operate, calibrate, download, and organize the data. With multiuse trails, another disadvantage of trail counters is that some models cannot determine what type of user has just passed by.

Trail counters are most often placed near a trailhead, which makes for easy placement and recovery of the counter. The resulting data give an excellent estimate of trail use at the beginning of the trail (e.g., 60 people passed the trail counter on Saturday). In this scenario, conclusions about use patterns become less certain with more distance from the counter. For example, did all 60 people hike 10 miles to the mountain summit where the trail ends? What percentage of people turned around at the waterfall at mile 2.3? If visitor use or resource issues arise in the waterfall area, consider placing additional trail counters farther from the trailhead to get a sense of how use levels change with distance or beyond key points of interest. After installing trail counters, check in with the counters regularly—especially early in the season—to ensure they are counting accurately and any potential issues can be troubleshot.

Trail cameras. Wildlife cameras have been used in lieu of trail counters in some settings. When someone crosses in front of a wildlife camera, it takes a picture or briefly starts filming. When the data collection period is over, you retrieve the camera and review the footage. The advantage of this technique is specificity—you see what type of user is on the trail, how many people are in each group, and other details (are they wearing heavy packs suggesting overnight camping, or just carrying water bottles?). The disadvantage of game cameras is that someone has to review the footage and make notes, so there is a much longer processing time than with trail counters. In addition, some visitors may perceive use of cameras as intrusive.

Encounter rates. Use of encounter rates is a common means of monitoring experiential conditions on trails. To monitor an encounter rate, a volunteer or park staff member sets out on a trail, hikes to an assigned destination, and records the number of people encountered (traveling in any direction). When monitoring encounter rates, it is important for those collecting the data to have a clear definition of an encounter. For example, does an encounter mean physically passing someone on the trail? Is it someone seen from the trail? Is an encounter someone heard from the trail? These are important questions to clarify as early as possible to ensure accuracy of the monitoring effort over the long term.

Commonly, the person monitoring encounter rates records information such as number of people per group, type of user encountered (equestrian, bicyclist, hiker, etc.), and any unique observations of user behavior (for example, a near-miss at a blind corner between a mountain biker and a horseback rider). In backcountry settings, it is also helpful to count the number of campers or tents seen along the trail. The advantages of this method are numerous—it is thorough, relatively error-free, and easy to train someone to do, and brings the rich detail of human observation. The disadvantage is that it is relatively time intensive and provides data for only a short window of time.

The number of people encountered on a hike or overnight trip is especially important in backcountry and wilderness areas because these "zones" are typically managed so visitors have opportunities for solitude.

Encounter rates are a proxy for measuring visitor density and can inform evaluations of perceived crowding, two closely related but different terms. Crowding is subjective, whereas density is measurable. This guidebook, like the IVUMC monitoring and visitor capacity guidebooks, use crowding to describe subjective perceptions and density to refer to the measurable and objective aspects of the amounts and types of visitor use (IVUMC 2019b, c).

It can be helpful, but cumbersome, to record the exact location of each encounter. To do this, one needs to make frequent entries into a GPS unit, which takes time. In very crowded conditions, it is almost impossible to maintain encounter rates tied to specific locations. Rather than using a GPS, use major landmarks or intersections to divide a trail into segments, each a few miles in length. Then record encounters by segment. Recording by segment is easy even for someone without extensive knowledge of an area, and it also gives a sense of how use levels change along a trail.

Visitor Surveys. Visitor surveys or crowding studies from similar areas are needed to clarify how a given density affects visitors' perceptions of crowding on trails. Some visitor surveys also include questions to gauge public support for management actions such as hardening facilities, educational campaigns, or changing allowable use types.

In some data-collection scenarios, it may be appropriate to examine density and crowding at certain points or destinations along trails rather than examine patterns along the entire trail. For example, people camping in the backcountry may be much more sensitive to others camping nearby than they are to encounters with other visitors while hiking during the day. Thus, it may be most helpful to examine visitor patterns and behavior near backcountry camping areas as opposed to the entire trail corridor.

In other data-collection scenarios, there are bottleneck locations where resources may be impacted, or visitors' experience may be particularly degraded. Examples of this include the cables on Half Dome in Yosemite and the chains on Angels Landing in Zion, where actual and perceived visitor safety is an issue; passages through cave units, where visitors may be particularly likely to impact stalactites; and viewing areas for waterfalls, where visitor density may impact ability to experience the falls. While these trails may be many miles long, the bottleneck locations are only a few hundred yards in length. These bottleneck areas are focal points for visitor use and experience issues and, as such, may influence how many people should be on the trail per day or at one time.

The problem is that without direct observation, it is difficult to equate total visitor use levels to conditions at a single pinch point. As an example scenario, on a busy Friday the trail counter at the beginning of Half Dome Trail counted 300 people using the trail. What did this mean for the cables? Did people have to wait to get up and down and, if so, for how long? It is very hard to predict because all people don't start hiking at the same time, move at the same rate, take the same number of breaks, or spend the same amount of time taking photos on the summit.

Depending on the complexity of trail use in a given area (i.e., the number of points of access, proximity to popular destinations or pinch points, number of different types of trail uses) there may be a need to gather detailed trail use data—something that goes beyond use data from a single point of access. If information is sought that will predict visitor use conditions at specific locations, possibly during a specific time of day, it may be helpful to obtain additional observational data at key points along a given trail corridor. When both datasets are collected, a regression analysis can be run to determine if there is a predictive relationship between overall trail use levels and the number of people at a certain location. Data will need to be collected over multiple days and potentially at multiple times of day to draw such conclusions. It should be noted that statistically significant results are not mandatory to make management decisions.

Indicators, Thresholds, and Visitor Capacity

Indicators translate trail management goals into measurable attributes (e.g., linear extent of informal trails). When tracked over time, these indicators help managers assess change in resource or experiential conditions. Thresholds represent the minimum acceptable condition for each indicator and are established after considering goals and objectives, data on existing conditions, research and studies, professional judgment of staff, and public comment. Use of indicators and thresholds helps monitor the effectiveness of trail system design, the popularity of the trail system, and the impact of trails and visitors on the surrounding environment.

As thresholds are approached, the manager should take action to avoid exceeding the threshold. In complex situations, it is helpful to identify triggers (intermediate points where the manager begins using mitigation measures more aggressively) and avoid approaching a threshold. Indicators, triggers, thresholds, and objectives are only briefly mentioned in this guidebook. For further guidance on establishing indicators and thresholds, see the "Monitoring Guidebook: Evaluating Effectiveness of Visitor Use Management" (IVUMC 2019b).

Indicators and thresholds also inform the identification of visitor capacity. The IVUMC's "Visitor Capacity on Federally Managed Lands and Waters: A Position Paper to Guide Policy" states, "Federal managers need to address visitor capacity in many situations when required by law or when visitor use levels threaten the desired conditions of an area" (IVUMC 2016b). The Wild and Scenic Rivers Act (1968), National Trails System Act (1968), and National Parks and Recreation Act (1978) direct agencies that manage federal lands and waters to address visitor capacity (also known as carrying capacity, user capacity, and recreational capacity). Visitor capacity is a component of visitor use management and is the maximum amounts and types of visitor use that an area can accommodate while achieving and maintaining the desired resource conditions and visitor experiences that are consistent with the purposes for which the area was established (IVUMC 2016b, 2019c).

The framework and subsequent visitor capacity guidebook (IVUMC 2016a, 2019c) suggest the following guidelines to identify visitor capacity:

1. **Determine the analysis area.** For example, is it necessary to identify visitor capacity for an entire river corridor—a large area that contains multiple access points and multiple different activities—or just a specific feature or destination point? In certain circumstances, it may be necessary to develop an overall visitor capacity that is some combination of the individual analysis areas.

2. **Review existing direction and knowledge.** Review desired conditions, indicators, and thresholds, and pay particular attention to conditions and values that must be protected and are most related to use levels. Also, review management strategies and actions from the framework. Are there lessons learned from comparable areas where desired conditions, indicators, thresholds, and management strategies are similar?

3. **Identify the limiting attribute(s).** Identify the attribute(s) that most constrains the analysis area's ability to accommodate visitor use. The limiting or constraining attribute(s) may vary across the analysis area.

4. **Identify capacity.** Use monitoring data, research, lessons learned from comparable areas, and professional judgment to identify a capacity based on desired conditions and the limiting attribute.

The visitor capacity guidebook (IVUMC 2019c) expands on guidance from the IVUMC's framework and provides specific direction to identify and implement visitor capacity.

Trail Condition Assessments

Trail condition assessments are an important but often overlooked component of a trail program (see the "Evaluating the Current Trail System" subsection in the "Trail Planning Workshop" section of this document). The goal of a condition assessment program is to collect accurate and timely data that help trail managers understand where resources are best allocated for repairs, reroutes, or closures.

Condition assessments can be formal or informal. Informal assessments are anecdotal accounts by trail users such as visitors, volunteers, or staff. These assessments can be helpful but tend to be subjective and not always accurate. They typically require verification before actions can be taken. It is not ideal to rely on informal assessments alone to track trail conditions.

The most formal and accurate condition assessments are called trail studies and are typically conducted by recreation ecologists and researchers. They adhere to strict scientific protocols and can include high-accuracy GPS data, visitor counts, tread width, trenching depth, cross slope, running slope, slope orientation, and any other measurable feature of a trail (figure 10). These studies are powerful tools for planners and trail managers, but can take significant time, money, and effort. They tend to be too costly to be applied to a large-scale trail system, but they can be very effective at gathering a cross-section of trail types. A major advantage of a trail study is the ability to accurately replicate the study, allowing an objective analysis of trail conditions over time.

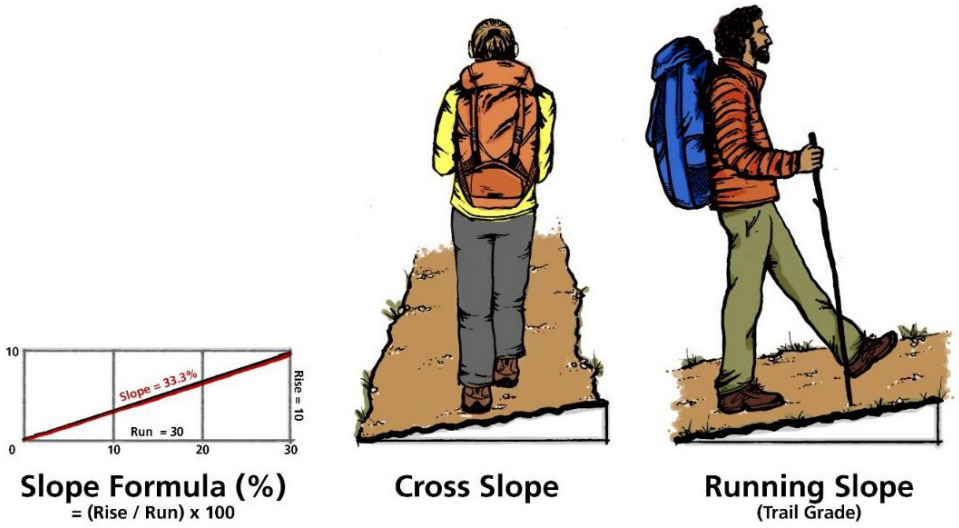


Figure 10. Images on Condition Assessment Measurements

Because of limited resources and time constraints, most "professional" trail condition assessments are a mix of formal and informal approaches. Often, quick assessments are conducted on the majority of trail assets, and detailed measurements are taken only at high-priority areas where a project needs to be scoped and executed within a relatively short timeframe. As part of the condition assessment process, parks collect asset inventory data such as the number and type of bridges, the number of drains and check dams, and the total square feet of retaining walls.

Asset inventories are used to calculate the full replacement cost of each trail, which can help trail managers better understand maintenance requirements. Trails with a significant number of bridges, for instance, may require more maintenance dollars than others. The National Park Service also assigns a life cycle to each asset, which allows trail managers to predict maintenance cycles and demonstrate the potential advantages of using materials with longer lifespans (such as native rock instead of treated timber).

Condition assessments also capture tread deficiencies such as erosion, braiding, widening, and structural failures. These types of assessments must be conducted by someone with a good working knowledge of trail maintenance techniques, such as a trail foreman or seasoned crew leader. Trail deficiencies can be ranked low, medium, and high priority. Low-priority deficiencies typically mean the trail is likely to remain stable over time, so the work can be done when resources allow. For example, a section of trail needs additional water bars installed to help prevent a moderate amount of erosion from worsening. Medium-priority deficiencies mean the condition is likely to get much worse if not addressed, so the work should be done in a timely fashion (e.g., a loose rock or log check that is holding back tread). High-priority deficiencies typically mean the condition is a safety hazard and needs to be addressed immediately, such as a compromised handrail on a bridge.

Ideally, trail condition assessments are conducted by someone with significant trail experience and familiarity with the area. It is important for an assessor to understand how a trail project may be implemented. Some work may be contracted, while other work may be better suited for in-house staff. Trail assessors also need a basic understanding of the various compliance requirements of different types of work. Rerouting a trail, for instance, can take a significant amount of staff resources at the project planning level, so these types of solutions need to be measured against the costs of repairing the trail within the tread corridor.

There are a variety of ways to capture trail conditions from the tried and true paper method, to tablets and smart phones. Advances in mobile mapping applications have helped streamline the process, but it is always good to have a back-up method in case equipment fails or a battery runs out. Condition assessments can seem like an additional "task" with so many other pressing needs facing parks, but they are an essential tool for effectively managing a trail system.

Conclusion

This guidebook focused on system planning for a medium to large park, a recreation area, or another unit managed by the National Park Service. The emphasis is on big-picture thinking for a comprehensive network of trails. The guidebook discussed fundamentals of trail system design and management, the planning process, and on-the-ground facilitation and implementation techniques. The planning efforts share a focus on producing the best quality of work and conserving natural and cultural resources, all while improving the visitor experience. All units managed by the National Park Service may benefit from the approaches and tools provided in this guidebook. The guidebook is not agency policy, but rather represents recommendations developed for consistent best practices based on the current state of knowledge. Please note that the guidebook is a dynamic document, and there may be future editions as lessons learned are collected from continued implementation.

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Appendix: Example Mapping Exercise

The following exercise can be used for trail system planning workshops. For this portion of the exercise, we will draw on large paper maps in small groups. Each group will focus on a single concept or theme for the trail system. As you conduct the exercise, be sure to consider the park's zones, desired conditions, and other key components from previous planning scheme. Trail proposals (tread width, construction techniques, surface type, and allowed uses) should be consistent with the zoning for that area.

Table A-1. Participant Cheat Sheet

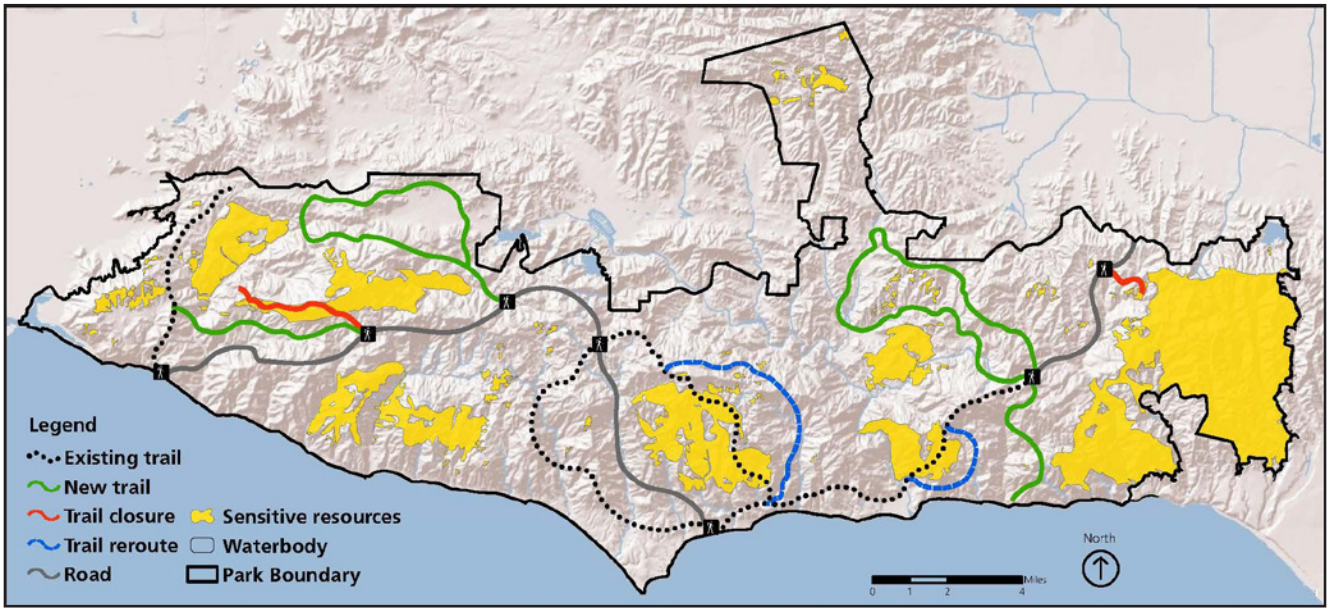
Things to Think About	Trail Design Concepts
Trail Purpose: Every trail should have a purpose. What are the key places visitors will want to go or attractions they will want to see? Will this trail get them there?	Destination and features of interest should be a prime consideration in laying out trails. Examples include a fundamental resource and value, mountain summit, rock arch, stand of old-growth forest, prominent vista, lake, or historic site.
Control Points: Control points are specific points that drive where a trail starts and ends and the direction and flow of the trail.	Control points can be positive or negative. Positive control points can be saddles, mountain passes, road crossings, campsites, and watering points for stock. Negative control points include areas that need to be avoided such as cliffs, raptor-nesting sites, archeological sites, and avalanche-prone slopes.
Connections: Identify where trails can connect to each other and to adjacent lands.	A connected trail system provides longer routes and more variation in experience. A connected trail system can also link developed areas, such as campgrounds and visitor centers, and potentially alleviate automobile traffic. The park's trail system should also connect to adjacent public lands where appropriate.
Resource Concerns: Consider habitat fragmentation, critical habitat, and other cultural resources.	Using the avoidance layer or professional judgement, the trail design concept should avoid areas where resource concerns exist.
Types of Visitor Use: Consider what visitor use activities are appropriate. Consider activities as well as commercial service opportunities.	Trail design concepts should consider types of visitor use as they could vary by area or zones.

Allow yourself the flexibility to think creatively without restrictions. Draw out your ideas. But please narrow the set of ideas before the end of the day (seek group consensus) and designate one group member to present to the entire team.

Instructions:

- Circle areas of concern (e.g., critical habitat, cultural sites, areas where user conflicts are occurring).
- Identify corridors/routes for new trails. For new trails, please draw a solid line in green.
- Identify places it might be necessary to reroute an existing trail because of trail condition, visitor use patterns, or presence of sensitive resources. Draw a dashed blue line for reroutes.
- Identify any existing trails that should be closed and restored to natural conditions. Mark them in red.
- Identify the designed and allowed uses for each trail.

Outcome: Each small group presents their proposals to the entire team and submits a coherent map for digitization.



Contributors:

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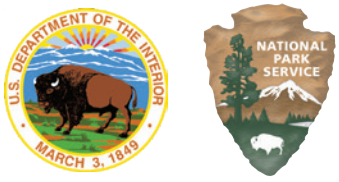

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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GREGORY