CHAPTER 6
TRAIL DESIGN GUIDELINES

The successful design, construction, and management of trails is critical to building a trail network or active transportation system that accommodates the widest range of both recreational and transportation users. This chapter presents the design guidelines for a range of trail types, as well as trail crossings, trailhead access points, and a variety of trail amenities. These guidelines are intended to allow flexibility in trail design, appropriate to the location, site-specific environmental conditions, and expected users. In addition, the guidelines establish standard terms and definitions that can aid communication with planning partners about trail needs, design standards, and environmental issues.

The design guidelines are not engineering specifications and are not intended to replace existing applicable mandatory or advisory state and federal standards, nor the exercise of engineering judgment by licensed professionals. In certain cases some material and recommendations contained herein fall outside current standards, but are of sound principle and have been employed successfully in many communities throughout the United States and abroad.

The design guidelines are organized into the following sections:

- *Natural Surface Trails*. Includes multipurpose, mountain bike, equestrian and developed/improved trails;
- *Paved Surface Trails*. Includes Class I bike paths, Class II bike lanes, and Class III bike routes;
- *Rail Trails*. Discusses trail design in railroad rights-of-way;
- *Accessible Trail Design*. Introduces the basic concepts of accessible trail design to provide for the needs of people with varied mobility requirements;
- *Drainage and Erosion Control*. Introduces basic drainage and erosion control concepts for paved and natural surface trails;
- *Crossings*. Introduces the key variables that influence trail crossings of streets, roads, highways, driveways, railroads, streams and rivers;
- *User Conflict Reduction Strategies.* Discusses ways to separate trail users to reduce conflicts; and
- *Trail Support Facilities*. Provides a basic layout for a typical trailhead and identifies typical trail support facilities including signage, fencing, and trail amenities.

NATURAL SURFACE TRAILS

Natural surface trails are primarily unpaved trails that serve a variety of recreational user groups and may occasionally serve transportation (e.g., commuter use) and local connectivity (e.g., school and local errand access) needs. Natural surface trails are distinct from paved trails (discussed in the following section) in that they do not comply with the California Department of Transportation (Caltrans) Highway Design Manual, American Association of State Highway Transportation Officials (AASTHO) or other applicable standards for non-motorized transportation funding grant programs. Natural surface trails are classified into multipurpose, mountain bike, equestrian, and developed/improved trails. Table eight provides a summary of natural surface trail classification standard dimensions.

Table 8: Natural Surface Trail Classifications Summary

Trail Type	Tread Width	Trail Corridor	Surface	Average Grade*	Max Grade*	Outslope (soil)	Turn Radius
Multipurpose Trails	4’ – 8’	8’ -12’ (w) 8’ - 12’ (h)	Native soil or compacted granulated stone	≤ 5%	10%	2-4%	5-10’
Mountain Bike Trails	12”- 36”	2’ - 6’ (w) 6’ - 8’ (h)	Native soil and rock; compacted	2-10%	≥15%	5-10%	≥2’
Equestrian Trails	1.5’- 12’	3.5’ - 12’ (w) 10’ - 12’ (h)	Native soil and rock; compacted	2-10%	5-20%	2-10%	5-10’
Developed/Improved Trails	18”- 48”	3’ - 6’ (w) 7’ - 8’ (h)	Native soil and rock; compacted	≤ 5%	15-25%	2-5%	3’

* Max grade depends largely on soil type and running distance of slope

Multipurpose Trails

Multipurpose trails serve a variety of user groups and are substantially wider than other narrow natural-surface trails described below. The Caltrans Highway Design Manual Chapter 1000, (Section 1003.5) acknowledges that many of these trails will not be paved and will not meet the standards for Class I bike paths. As such, these facilities should not be signed as bike paths. Rather, they should be designated as multipurpose trails (or similar designation), along with regulatory signing to restrict motor vehicles, as appropriate.

If multipurpose trails are primarily to serve bicycle travel, they should be developed in accordance with standards for Class I bike paths. In general, multipurpose trails are not recommended as high speed transportation facilities for bicyclists because of conflicts between bicyclists and pedestrians. Wherever possible, separate bicycle and pedestrian paths should be provided. If this is not feasible, additional width, signing and pavement markings should be used to minimize conflicts.

Multipurpose trails accommodate the widest range of users among the natural surface trail types presented. These paths, while constructed with native surface materials or compacted, crushed or granulated stone, provide wide treads and clearances potentially accommodating significant volumes of hikers, equestrians and bicyclists. Where hikers, cyclists and equestrians are allowed on the same trail, "Yield to" signage should be installed to notify user right-of-ways.

Multipurpose trail standards include:

- Tread width varies from four to eight feet;
- Allowance for passing;
- Native materials;
- Obstacles occasionally present;
- Blockages cleared to define route and protect resources;
- Prevailing grade five percent, with limited steeper segments; and
- Clearances and turning radius to accommodate all uses.

Mountain Bike Trails

Mountain bicyclists have a broad range of riding abilities. This guideline single track mountain bike-only trail focuses on recreation and a range of technical skill on topographically varied terrain.

The International Mountain Bike Association (IMBA) has developed a classification system similar to ski runs, which indicates skill level by the use of colored symbols (see table nine). These symbols may accompany wayfinding and warning signage to alert cyclists of upcoming trail conditions. In addition, mountain bicyclists are typically permitted on multipurpose trails (described above) and should be aware that they must yield to all other users.

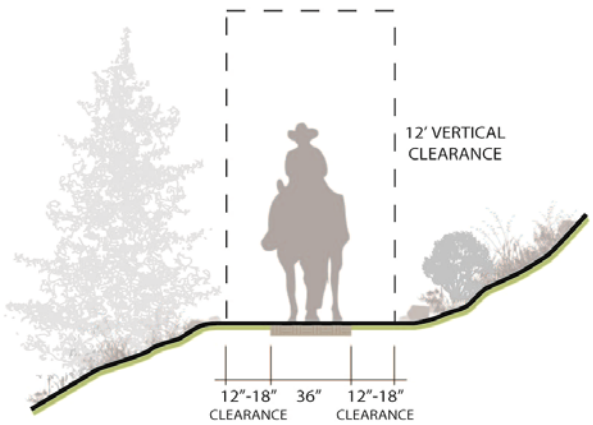
Table 9: Mountain Bike Standards Based on Skill Level

Skill Level	Tread Width	Surface	Average Grade	Max Grade	Unavoidable Obstacles
Easiest ○	≥ 72”	Hardened or Surfaced	<5%	≤10%	None
Easy ●	≥ 30”	Firm and Stable	≤ 5%	15%	≤ 2”
Moderate ■	≥ 18”	Mostly stable; some variability	≤ 10%	≥15%	≤ 8”
Difficult ◆	≥ 12”	Variable	≤15%	≥15%	≤15”
Extremely Difficult ◆◆	≥ 6”	Widely variable & unpredictable	≥ 20%	20%	≥15”

Equestrian Trails

Equestrian trails constructed as a part of the regional trails network should be designed to accommodate a horse and rider comfortably, while minimizing the required zone of trail construction and maintenance impact. Regional equestrian trails should provide for local and long-distance trail rides. These trails may also serve multiple user types.

Basic dimensional requirements include an 18 to 36 inch wide trail tread and appropriate horizontal clearances. In high use and developed areas, a minimum tread of seven to eight feet should be provided to allow for riding side by side as well as opportunities for passing when bidirectional movements are expected. Compacted natural soil is typically the preferred trail tread, but surfacing trails with crushed fines is preferred in Humboldt County due to climate conditions. A narrow 18 inch trail tread should include a minimal 12 inch vegetation clearance on both sides of the trail, providing clear passage, while preserving a backcountry trail ride experience. It should be noted that trails developed for equestrians are also comfortable for pedestrians.



Equestrian trail standards include:

- Vegetation cleared outside of trailway;
- Limited conflicts with protected natural resource areas;
- Trail bridges should be designed with five foot railings and to accommodate loaded horses;
- Compacted native materials used;
- Trail tread width may vary from 1.5 to 12 feet depending on context and level of use (see table ten); and
- Trail clearance should be maintained on both sides of trail tread.

Table 10: Equestrian Trail Standards Based on Development Level[1]

Level of Development	Tread Width	Clearance Width	Average Grade[2]	Maximum Grade	Outslope	Turn Radius
Low	1.5'- 2'	5.5'-8' (w) 10' (h)	≤ 12%	20% No more than 200'	5-10%	5'- 6'
Moderate	3'- 6'	9'-12' (w) 10-12' (h)	≤ 10%	15% No more than 200'	5%	6'- 8'
High	8'- 12'	14'-18' (w) 12' (h)	≤ 5%	5-8% (800'-1500') 8-10% (500-800') 10% (≤500')	2-5%	8'- 10'

Source: USDA/FHWA, Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds

[1] Development level or trail character in response to area setting (i.e., urban, rural, wilderness)

[2] Target range (over at least 90 percent of trail)

Developed/Improved Trail

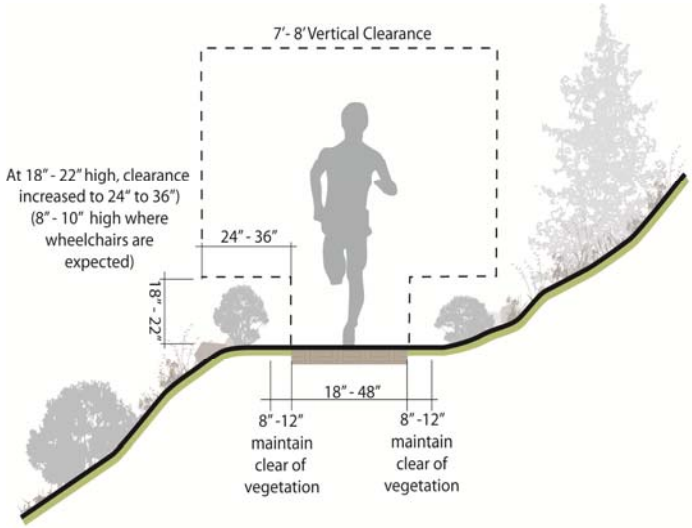
Developed/improved trails accommodate walking and hiking in a variety of contexts and are the minimum trail standard typically incorporated into a regional trails network or active transportation system. These facilities are generally defined by compacted natural soil surface, the presence of functional drainage, trail structures (i.e., retaining walls, water bars) and bridges, where required. In Humboldt County, trails may be surfaced with crushed fines to improve trail conditions due to climate. Typical width varies from 18 to 48 inches and vegetation should be maintained clear on both sides of the trail tread for a minimum of 12 to 36 inches.

To encourage the natural appearance of the trail vegetation less than 18 to 22 inches in height and eight to 12 inches from the trail edge can remain. Vegetation 18 to 22 inches and above should be cleared to meet a 24 to 36 inch horizontal clearance minimum (see graphic below). Where wheelchairs are expected, the height at which the additional clearance should begin is eight to 10 inches above the trail surface.

This facility type is typically located at local and county parks, open space areas, undeveloped public rights-of-way such as utility corridors, and in parkland and resource land units with frequent public access connecting to other regional trail network segments. Signage includes regulation, resource protection, and user reassurance such as directional and destination signs.

Developed/improved trail standards include:

- Vegetation cleared outside of trailway;
- Trail bridges as needed for resource protection and appropriate access;
- Generally native materials used;
- Trail tread width may vary from 18 to 48 inches depending on context and use;
- Trail clearance should be maintained on both sides of trail tread at 24-36 inches or greater; and
- User specific criteria are applicable if bicycling or equestrian use is allowed in addition to walking and hiking use.



PAVED SURFACE TRAILS

Paved surface trails, for purposes of this plan, include trails that meet or are proposed to meet the dimensional, geometric and functional standards set forth by Caltrans and AASHTO. Paved surface trails include bike paths, bike lanes, and bike routes that serve a variety of commuter trips, utilitarian trips, and recreational trips.

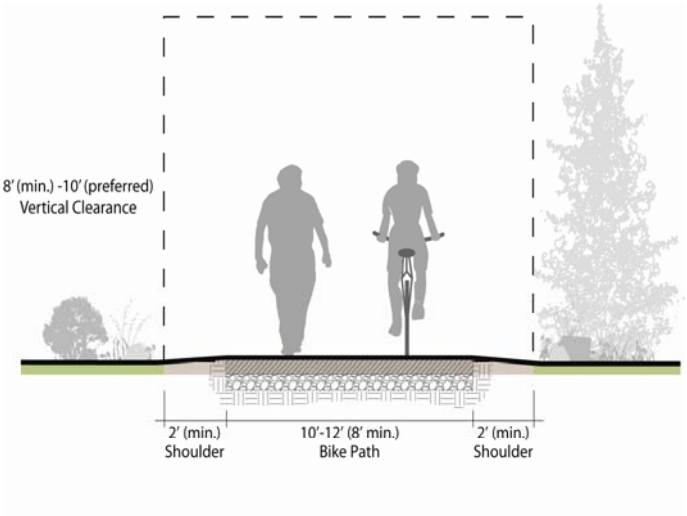
Class I (Bike Path)

Class I bike paths are facilities with exclusive right of way, with cross flows by motorists minimized. Section 890.4 of the Streets and Highways Code describes a Class I as serving "the exclusive use of bicycles and pedestrians". However, experience has shown that if significant pedestrian use is anticipated, separate facilities for pedestrians are necessary to minimize conflicts. According to the Caltrans Highway Design Manual, shared use by pedestrians and bicycles is undesirable, and the two should be separated wherever possible. In practice however, Class I bike paths are typically shared by bicyclists, pedestrian, skaters, wheelchair users, joggers and other non-motorized users.

The anticipated range of users and forecast level of use by different user groups should dictate the design of the facility. Higher use, greater variety of use, and higher speed differentials all require greater width, increased separation of uses, and greater attention to regulation and education of bikeway users. At minimum, Class I bike paths require an eight foot wide paved surface and two foot wide clear, graded shoulders on both sides. A 10 to 12 foot standard should be used for segments accommodating large volumes of high speed bicycle commuters. In areas where a variety of users are expected, expanded unpaved shoulders should be included when possible. Where a path also doubles as an access route for maintenance or emergency vehicles, a minimum 12 foot wide path is recommended, as narrower paths tend to break-up along the edges due to vehicle loads.

Class I bike paths immediately parallel and adjacent to roadways must be appropriately separated from automobile traffic by a five foot separation or barrier, per the Caltrans Highway Design Manual. Paths adjacent to roadways can provide critical links in regional trail systems where a local, county or Caltrans public right-of-way is the only viable alignment alternative.

All standards set forth in Caltrans Highway Design Manual Chapter 1000 (1003.1) shall be met in order for a Class I bike paths to serve as a transportation facility. In addition, the Manual of Uniform Traffic Control Devices provides guidance on appropriate signage and controls at trail roadway intersections.



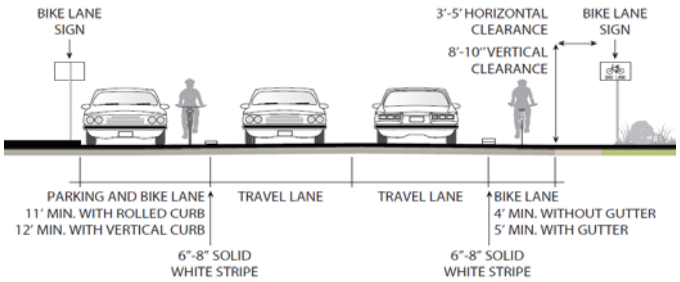
Potential Class I applications include:

- High use commuter and recreational corridors where accommodation of bicyclists and pedestrians separate from local streets and highways is desirable;
- Publicly-owned easements and right-of-ways that connect major community destinations or communities and may provide a non-motorized commute facility;
- Caltrans rights-of-way where separated path is feasible and complimentary to the existing transportation function; and
- Railroad corridors (additional standards apply, see Rail Trails section).

Class II (Bike Lanes)

Class II bike lanes are portion of the roadway that has been designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists. Bike lanes can be installed on arterial, collector and neighborhood roadways where space allows and subject to locally established minimum travel lane widths. The minimum recommended width for a bike lane is five feet.

Class II bike lane standards include:



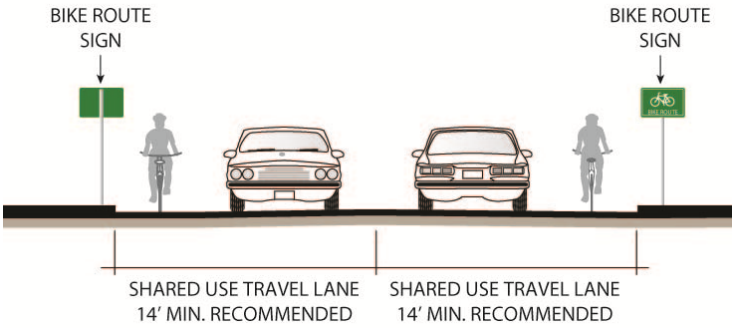
- Five foot width is recommended for bike lanes without on-street parking (existing Caltrans minimum is four feet, but is not recommended). This width will allow for added separation between bicyclists and vehicles;
- Four foot minimum if no gutter exists, measured from edge of pavement;

- Five foot minimum with normal gutter, measured from curb face; or three feet (0.9 m) measured from the gutter pan seam; and
- Five foot width when on-street parking stalls are marked.

Class III (Bike Routes)

Class III bike routes share the roadway with motor vehicles, typically on streets without adequate width for bicycle lanes. This type of facility is usually established on roads with low speeds and traffic volumes, however can be used on higher volume roads with wide outside lanes or shoulders.

Caltrans does not define a standard travel lane width. However, AASHTO recommends 14 foot wide travel lanes. Bicycle route signage should be installed at regular intervals and at decision points (i.e., route direction changes) along designated bicycle routes. Intervals should consider the location of the bike route (i.e., longer intervals for regional routes and shorter intervals for local routes).



Bicycle routes are identified through route signage using the standard "Bike Route" sign. The Manual of Uniform Traffic Control Devices allows for an alternative bike route sign to reflect a numerical route and name designation. Supplemental plaques can be used to direct bicyclists to high demand destinations (e.g., "Pacific Coast Bike Route", "California Coastal Trail", "To Downtown"). Bicycle routes can also have shared lane pavement markings, also called "sharrows" as exemplified in the photo below. Shared pavement markings alert vehicle drivers to the presence of cyclists on arterials as well as direct bicyclists of the safest portion of the travel lane to ride in.

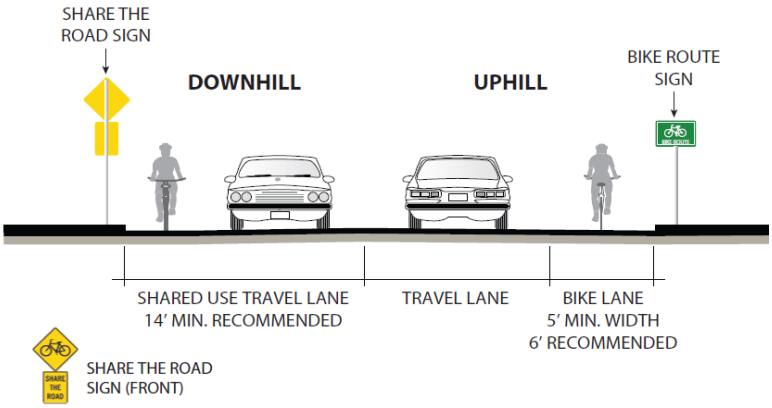
Standard bicycle guide sign on left, alternative on right

Shared lane pavement marking

Class III - Downhill Bike Routes / Class II - Uphill Bike Lanes

Sections of bicycle lane may be applied to steep grades on otherwise shared roadway (Class III) situations. These uphill climbing lanes get slow moving cyclists out of the travel lane and should be six feet wide to provide extra room for maneuvering. At downhill grades where cyclists will move at speeds approaching those of automobile traffic, bike lanes in the downhill direction are not needed or advised.

Uphill bike lanes should be five or six feet wide (six feet is preferable since extra maneuvering room on steep grades can benefit bicyclists). Shared lane markings, such as 'share the road signs' can be installed for downhill cyclists who can match prevailing traffic speeds.



RAIL TRAILS

Railroad rights-of-way can present opportunities for trails connecting community and/or recreational destinations. Typically, railroads follow favorable topography for bicycling and hiking and are located in scenic areas. Below, the process of railbanking a railroad corridor for interim trail use is described, as well as guidelines for Rails-To-trails and Rails-With-Trails.

Railbanking

In 1983, concerned for the rapid contraction of America's rail network, the U.S. Congress amended the National Trails System Act to create the railbanking program. Railbanking is a method by which lines proposed for abandonment may be preserved for future rail use through interim conversion to trail use. Either a public agency or a qualified organization may request to railbank a railroad right-of-way for trail use by sending the request to the Surface Transportation Board (STB).

RAILBANKING NATIONWIDE

Total Number of Railbanked Corridors	256
Total Number of Miles	4,628
Number Open as Trails	102
Miles Open as Trails	2,451
Number of Trails Under Development	112
Miles Under Development	1,683

Source: Rails-to-Trails Conservancy, "Railbanking and Rail-Trails: AA Legacy for the Future," July 2006.

The Rails-to-Trails Conservancy identifies the following important points regarding railbanking:

1. A railbanking request is not a contract and does not commit the interested party to acquire any property or to accept any liability. It invites negotiation with the railroad company under the umbrella of railbanking.
2. A party filing a Statement of Willingness to Assume Financial Responsibility is not accepting any financial responsibility. It is merely expressing an interest in possibly doing so.
3. The tracks and ties on a railbanked line can be removed. However, bridges and trestles must remain in place, and no permanent structures can be built on the right-of-way.
4. Railbanking can only be requested for a rail line that is still under the authority of the STB. The STB has authority over the corridor until the railroad files a notice of consummation, which must be filed within one year of the abandonment decision (unless the railroad requests an extension). If no notice of consummation is filed by the railroad within one year, abandonment authorization lapses. Railbanking requests are due within the period specified in the applicable notice of abandonment. However, late-filed requests will be accepted for good cause so long as the STB retains authority to do so.
5. Some railroad rights-of-way contain easements that revert back to adjacent landowners when abandonment is consummated. However, if a line is railbanked, the corridor is treated as if it had not been abandoned. As a result, the integrity of the corridor is maintained, and any reversions that could break it up into small pieces are prevented.
6. Railbanking can be affected through a sale, a donation or a lease of the corridor. The details of which are subject to negotiation with the railroad.
7. A railbanked line is subject to possible future restoration of rail service. The abandoning railroad maintains the right to apply to the STB to resume rail service on a railbanked corridor which will then vacate the trail use ordinance. The terms and conditions of a transfer back to rail service must be negotiated with the trail manager.

Rails-To-Trails

Rails-to-trails are former rail corridors which have been converted to trails for public use. Prior to trail conversion, the rail corridor can be railbanked to preserve the integrity of the transportation route should rail service be resumed. Due to the gentle grades and curves required of trains, rail corridors typically have subtle grade changes and geometries appealing to a wide variety of trail users. Rail corridors are typically long in length and if preserved for trail use, present opportunities for significant regional trail systems through some of the country's most beautiful landscapes. Rails-to-trails do not have specific requirements beyond the trail design standards mentioned above.

A former rail corridor provides recreation and transportation options for a multitude of users

Rails-With-Trails

Rails-with-trails are trail paths that follow existing and often active rail lines. Despite the many benefits of trails constructed in rail rights-of-way, rails-with-trails also present a range of security and safety issues for trail users that should be addressed through planning and design processes.

A popular Rail-With-Trail

National design standards have not been developed for rails with trails, although the Federal Railroad Administration (FRA) publishes minimum setback standards for fixed objects next to active railroad tracks, the distance between two active tracks, and adjacent walkways (for railroad switchmen). These published setbacks represent the legal minimum setbacks based on the physical size of the railroad cars, and are commonly employed along all railroads and at all public grade crossings. Most Public Utilities Commissions (PUCs), which regulate railroad activities within states, also have specific minimum setbacks for any structures or improvements adjacent to railroads, including any sidewalk or trail that parallels active railroad tracks.

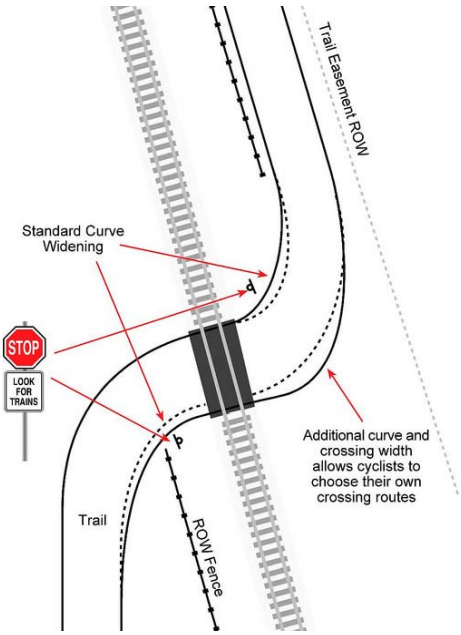
The North Coast Railroad Authority (NCRA) was created in 1989 by the California legislative body through the North Coast Railroad Authority Act. Trails within the NCRA right-of-way must be approved by the NCRA Board of Directors and trail applications are reviewed on a case-by-case basis. The NCRA Board has developed a Policy & Procedures Manual for Trail Projects on the NWP Line Rights-of-Way: Design, Construction, Safety, Operations, and Maintenance Guidelines, which was adopted in May of 2009.

The standards presented below are the result of studies completed by the Federal Highway Administration and Rails-To-Trails Conservancy, along with the PUC and NCRA guidelines. Other useful sources include AASHTO, CAMUTCD and American Disabilities Act Accessibility Guidelines (ADAAG).

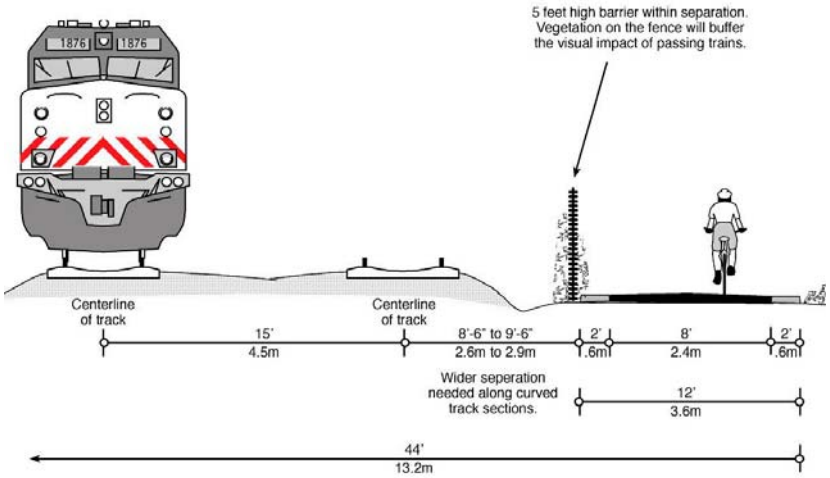
Rails with Trails design recommendations include:

- NCRA design standards specify that where trails provide the only access for maintenance and emergency vehicles, they should be built to accommodate heavy vehicle loads. A 12 foot width is strongly recommended for these dual-purpose paths, as narrower paths can crack along the edges due to vehicle loads;
- Where maintenance and emergency access is available from an existing street, pre-selected access routes and curb ramps should accommodate heavy vehicle loads;

- Setbacks should be maximized and correlate with train type, speed, frequency, and separation technique, varying from 8.5 feet (9.5 feet on curves) to 100 feet;
- 2 feet minimum distance between paved edge of trail and fencing, 3 feet preferred;
- Fencing and barriers should meet the requirements of the railroad company, i.e. NCRA. The NCRA suggests a three rail split-rail fence with landscaping in rural or environmentally sensitive areas;
- 5 to 6 foot high fencing is adequate for separation in most instances;
- Vegetation may grow on fencing to buffer noise;
- Storm and irrigation water may not flow or collect in the railroad right-of-way; and
- At-grade trail crossings should be minimized.



Crossing angle at tracks should be as close to a 90 degree angle as possible



The above graphic shows minimum setbacks as defined by most Public Utility Commissions. Best practices seek to maximize setbacks from rail centerline as much as practicable. NCRA guidelines ask that trails be placed at the outer edges of rail ROW to the greatest extent possible.

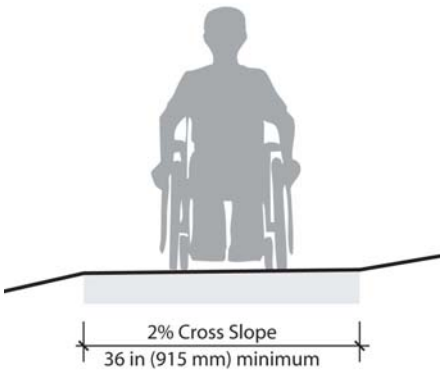
ACCESSIBLE TRAIL DESIGN

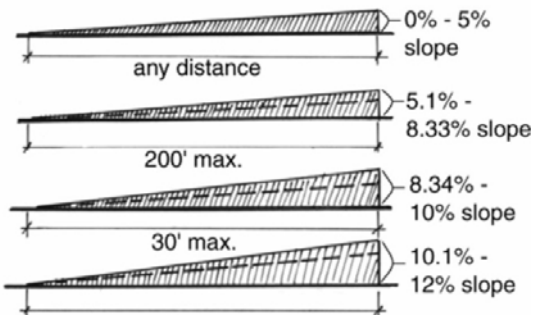
Americans with Disabilities Act (ADA) accessible trail design is important for both recreation and transportation trails. Accessibility standards are generally established by the United States Access Board and the U.S. Department of Transportation, Federal Highway Administration, Recreational Trails Program Guidance. Constructing trails may have limitations that make meeting ADA guidelines difficult and sometimes prohibitive. Prohibitive impacts include: harm to significant cultural or natural resources; a significant change in the intended purpose of the trail; requirements of construction methods that are against federal, state or local regulations; or terrain characteristics that prevent compliance.

Table eleven represents the best practices for Outdoor Developed Areas as outlined by the California State Parks Accessibility guidelines and the U.S. Access Board's Draft Final Accessibility Guidelines.

Table 11: ADA Accessible Trail Standards

Item	Recommended Treatment	Purpose
Trail Surface	Hard surface such as, asphalt, concrete, wood, compacted gravel	Provide smooth surface that accommodates wheelchairs
Trail Gradient	Five percent maximum without landings 8.33 percent maximum with landings	Greater than five percent is too strenuous for wheelchair users
Trail Cross Slope	Two percent maximum	Provide positive trail drainage, avoid excessive gravitational pull to side of trail
Trail Width	Five foot minimum	Accommodate a wide variety of users
Trail Amenities, phones, drinking fountains and pedestrian- actuated buttons	Place no higher than four feet off ground	Provide access within reach of wheelchair users
Detectable pavement changes at curb ramp approaches	Place at top of ramp before entering roadways	Provide cues for visually impaired users
Trailhead Signage	Accessibility information such as trail gradient/profile, distances, tread conditions, location of rest stops	User convenience and safety
Parking	Provide at least one accessible parking area at each trailhead	User convenience and safety
Rest Areas	On trails specifically designated as accessible, provide rest areas or widened areas on the trail optimally at every 300 feet	User convenience and safety





Trail gradients as recommended by the California State Parks Accessibility Guidelines

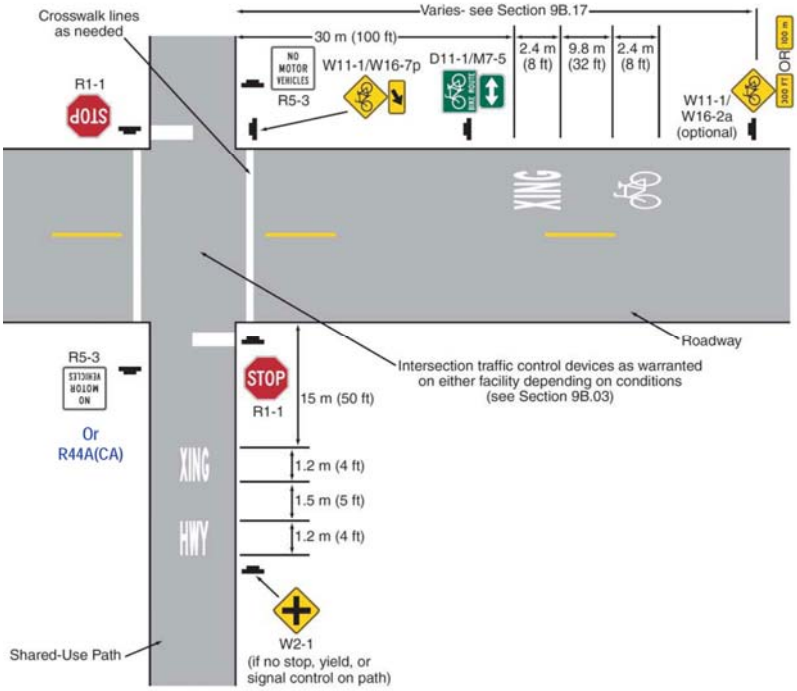
CROSSINGS

The design of trail crossings of streets, roads, highways, railroads driveways, creeks and streams must account for a variety of factors and always requires site specific engineering and safety analysis. Crossing types described below include: roadway intersections, Type one: unprotected crossings, Type two: route to existing intersections, Type three: signalized crossings, Type four: grade-separated crossings, railroad crossings, and stream or river crossings.

Roadway Intersections

Where a proposed off-street trail will cross a roadway at-grade, it is important to remember two items: 1) trail users will be enjoying an auto-free experience and may enter into an intersection unexpectedly; and 2) motorists may not anticipate bicyclists riding out from a perpendicular trail into the roadway. However, in most cases, it is possible to design an at-grade trail crossing to a reasonable degree of safety, while meeting existing traffic engineering standards.

Evaluation of trail crossings should involve an analysis of vehicular traffic patterns, as well as consideration of the behavior of trail users. This includes traffic speeds (85th percentile), street width, traffic volumes (average daily traffic and peak hour traffic), line of sight, and trail user profile (age distribution, range of mobility, destinations). A traffic safety study should be conducted as part of the actual civil engineering design of the proposed crossings to determine the most appropriate design features. This study would identify the most appropriate crossing options given available information, which must be verified and/or refined through the actual engineering and construction document stage.

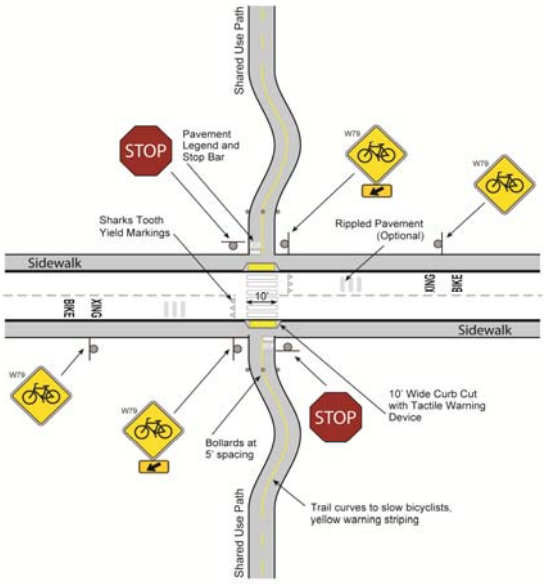


Standards from the California Manual on Uniform Traffic Control Devices (CaMUTCD) include:

- Intersection Warning (W2-1) signs should not be used where the shared-use path approaches a controlled intersection;
- Engineering judgment may determine that limited visibility of a controlled intersection may require Intersection Warning signs; and
- Bicycle Warning signs (W11-1) alert the road user to unexpected entries onto the roadway by bicyclists

Type 1: Unprotected Crossings

Uncontrolled or Type 1 crossings (i.e., unsignalized, but with other traffic control devices) are recommended for streets with 85th percentile travel speeds below 45 mph and Average Daily Trips (ADTs) below 10,000 vehicles. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, trail traffic, use patterns, road type and width, and other safety issues.

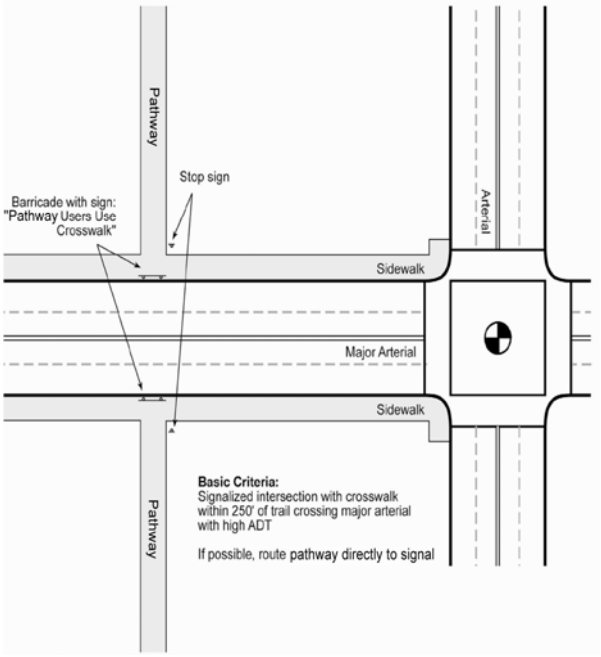


Type 2: Route to Existing Intersections

In most cases trail users should be routed to a protected crossing for trails that either parallel a roadway or emerge closer than 200 feet from a protected intersection. Crossing at a protected intersection provides safety for the user as motorists are not expecting to see pedestrians and bicyclists crossing less than 200 feet from an intersection; in addition, traffic congestion may extend the 200 feet or less distance. Furthermore, users crossing less than 200 feet from a protected intersection may unnecessarily impact traffic capacity on a corridor.

One of the key challenges with using existing intersections is that it requires bicyclists to transition from a separated two-way facility to pedestrian facilities such as sidewalks and crosswalks, normally reserved for pedestrians. Widening and striping the sidewalk (if possible) between the trail and intersection may help to alleviate some of these concerns.

Where the trail does not emerge at an existing intersection, carefully thought out physical design and directional signing will be required to keep bicyclists and others from crossing at the unmarked location. Signs warning motorists of the presence of bicycles may be needed, as well as right turn on red prohibitions.



Maximum Distance from Trail to Intersection:

- Street width 40 feet or less – 200 feet; and
- Street width over 40 feet – 350 feet.

Length of barrier to prevent informal crossing:

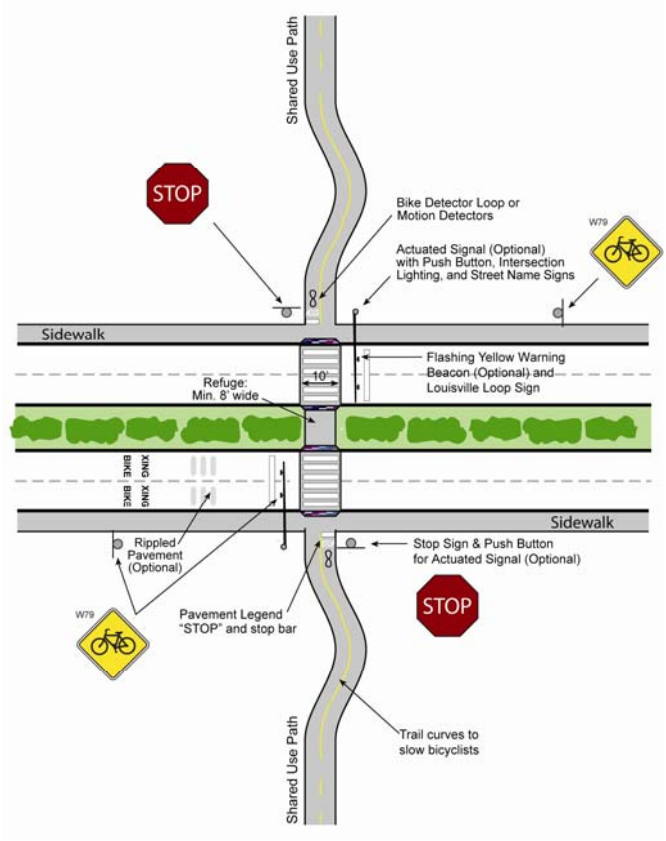
- Street width over 40 feet – 350 feet;
- Street width 40 feet or less – 50 feet; and
- Street width over 40 feet – 100 feet.

Intersection Improvements:

- Warning signs for motorists;
- Right turn on red prohibitions;
- Elimination of high speed and free right turns;
- Adequate crossing time; and
- Pedestrian activated signals.

Type 3: Signalized Crossings

New or exclusive signalized crossings (i.e., Type 3) are identified for user crossings more than 200 feet from an existing signalized intersection and where the 85th percentile travel speeds are 45 miles per hour (mph) and above and/or average daily traffic (ADT) exceeds 10,000 vehicles. Signals require the input of local traffic engineers, who review potential impacts on traffic progression, capacity, and safety. On corridors with timed signals, a new trail crossing may need to be coordinated with adjacent signals to maximize efficiency.



Trail signals are normally activated by push buttons, but also may be triggered by motion detectors. The maximum delay for activation of the signal should be 60 seconds, with minimum crossing times determined by the width of the street and trail volumes. The signals may rest on flashing yellow or green for motorists when not activated, and should be supplemented by standard advance warning signs. Typical costs for a signalized crossing range from $75,000 to $150,000.

Type 4: Grade-Separated Crossings

Grade-separated crossings are needed where ADT exceeds 25,000 vehicles, and 85th percentile speeds exceed 45 mph. Safety is a major concern with both overcrossings and under-crossings. When designed properly, grade-separated crossings practically eliminate any safety concerns related to crossing a roadway.

Grade-separated crossing approaches should minimize the out-of-direction travel required by the trail user, so that users don't alternatively attempt to dart across the roadway. Under-crossings, like parking garages, have the reputation of being places where crimes occur, but these safety concerns can be addressed through design. An undercrossing can be designed to be spacious, well-lit, equipped with emergency cell phones at each end, and completely visible for its entire length prior to entering. For cyclists and pedestrians, vertical clearance should be a minimum of eight feet, with 10 feet preferred and 12 feet minimum for equestrians.

Over-crossings, or bridges, avoid darkness and safety concerns that occur with an at- or below-grade option. Any bicycle and pedestrian bridge needs to be approached via ADA compliant ramps (running slopes less than five percent). Bridges present unique opportunities for creating landmark architectural and artistic statements.

Maximum Distance from Trail to Intersection:

- Street width 40 feet or less – 200 feet; and
- Street width over 40 feet – 350 feet.

Length of barrier to prevent informal crossing:

- Street width over 40 feet – 350 feet;
- Street width 40 feet or less – 50 feet; and
- Street width over 40 feet – 100 feet.

Intersection Improvements:

- Warning signs for motorists;
- Right turn on red prohibitions;
- Elimination of high speed and free right turns;
- Adequate crossing time; and
- Pedestrian activated signals.

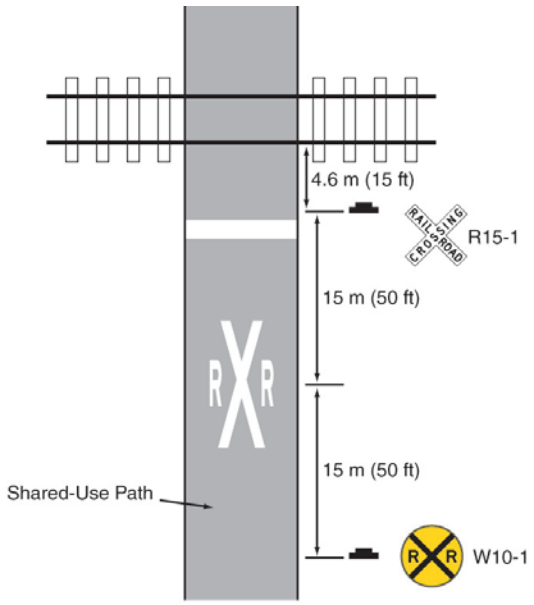
Railroad Crossings

The preferred CCT alignment may include at-grade crossings of railroad tracks. New pedestrian railroad crossing flashers are typically not required for sidewalk crossings at legal crossings as they are redundant with adjacent vehicle crossing warning equipment.

Efforts should be made to have bicyclists cross railroad tracks at as close to a 90 degree angle as possible. As crossing angles deviate from perpendicular angles, possibilities increase for a bicycle wheel to become trapped in the flangeway, or for cyclists to lose traction on wet rails.

AASHTO guidelines do not specify a minimum crossing angle; however, any crossing that is less than a 45 degree angle should be accompanied by a widening in the trail or shoulder area in order to permit a cyclist to cross the track at a safer angle, preferably perpendicular.

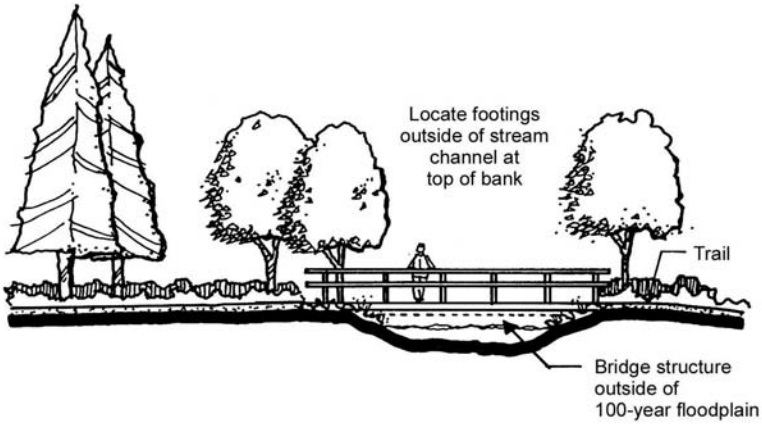
Standard concrete railroad crossings with compressible flangeway fillers permit rail operations while creating a smooth or subtle bump for cyclists. Crossing materials should be skid resistant. Colored surfaces also help alert cyclists to potential conflict points. Rubber and concrete materials require less maintenance and have a longer lifespan than wood or asphalt.



Stream or River Crossings

The preferred alignment may require a stream or river crossing with a bridge. While bridges can be some of the most interesting features of a trail system, they can also be the most challenging. Bridges should be at least as wide as the trail. ADA guidelines require handrails no shorter than 36 inches and decking material that is firm and stable. Bridges should accommodate maintenance vehicles if anticipated. Bridge structures should be located out of the 100-year floodplain. Footings should be located on the outside of the stream channel at the top of the stream bank. The bridge should not impede fish passage or constrict the floodway. In the Coastal Zone, bridges should be designed to reduce corrosion and need for maintenance, such as by using composite or other rust-free materials.

All bridges and footings will need to be designed by a registered structural engineer. Cost, design, and environmental compatibility will dictate which structure is best for the trail corridor.



DRAINAGE AND EROSION CONTROL

Erosion control is necessary to maintain a stable walkway and trail surface. Following land contours helps reduce erosion problems, minimizes maintenance and increases comfort levels on all trail types. Below is a summary of drainage and erosion control standards for paved and natural surface trails.

Paved Surface Trails: A two percent cross slope will resolve most drainage issues on a paved path and should be used for both the trail and its shoulders. A maximum 1:6 slope may be used for the shoulders although two percent is preferred. For sections of cut where uphill water is collected in a ditch and directed to a catch basin, water should be directed under the trail in a drainage pipe of suitable dimensions. Per NCRA guidelines, water should be directed away from rail tracks. It is preferable where possible (especially where precipitation rates can be high on the north coast), to reduce concentrating water into drainage systems and to design trails that dissipate runoff with crowning or cross-slope. During trail construction, local erosion control best practices should be followed.

Natural Surface Trails: Erosion will occur on natural surface trails. Natural surface trails should be designed to accommodate erosion by shaping the tread to limit how much erosion occurs and to maintain a stable walkway and trail surface. The goal is to outslope the trail so that water sheets across, instead of down, its tread. Even the most well built trails will break down over time from forces such as compaction and displacement. It is preferable to use crushed fines for surfacing of natural trails where possible, especially on slopes, to reduce trenching and rilling over time.

Designing trails with rolling grades is the preferred way to build sustainable natural surface trails. "Rolling grade" describes the series of dips, crests, climbs and drainage crossings linked in response to the existing landforms on the site to form a sustainable trail. The tread of the trail must be able to drain to a point lower than the trail at all times. When a natural rolling grade cannot be developed, grade reversals (sometimes known as grade dips, grade breaks, drain dips or rolling dips) are constructed to create trail undulations. Frequent grade reversals (grade dips, grade brakes, drain dips or rolling dips) are a critical element for controlling erosion on sustainable trails. A general rule-of-thumb is to incorporate a grade reversal every 20 to 50 linear feet along the trail to divide the trail into smaller watersheds so the drainage characteristics from one section won't affect another section. Water which is allowed to flow parallel to the direction of travel of the trail will cause incised erosion channels.

Grade reversals have the added benefit of adding interest to any trail. All trail users appreciate the short downhill break during a long climb, or the opportunity to 'let off their brakes' for a bit during a long downhill trek. Rolling grade and grade reversals are preferred to other mechanical methods of routing water off of trails such as water bars, check dams and culverts because they do not present a barrier to users.

In 2002, the Humboldt County Board of Supervisors adopted grading ordinance revisions. The purpose of these revisions is to set forth provisions related to grading, some of which relate to trail implementation. Trail construction as part of a County Public Works project is exempt from permitting, unless it is located within a Streamside Management Area, geologically unstable area or flood plain.

USER CONFLICT REDUCTION STRATEGIES

There are many means of separating trail users including: time, distance, screening, and barriers. Time separation applies when different user groups are expected to use a corridor at different times of the day or week (e.g., cyclists during weekday commute hours and equestrians during evenings or weekends only). In corridors where adequate right-of-way is available, trail users may be separated by physical space.

Vegetated buffers or barriers have successfully been used in many trail scenarios to reduce user conflict. Elevation changes are another means of effectively physically and visually separating different use corridors. Differing surfaces suitable to each user group also help foster visual separation and clarity of where each user group should be. When trail corridors are constrained, the approach is often to locate the two different trail surfaces side by side with no separation. Oftentimes, an expanded trail shoulder serves the role of the equestrian facility.

When barriers are necessary to separate user types, options include: vegetation, walls, fences (see "Trail Support Facilities" section for more on fencing and barriers), railings and bollards. The accepted height for most equestrian barriers is 54 inches. Solid barriers significantly limit an animal's peripheral vision and sense of security and thus are not recommended. When solid walls are necessary, vegetation should be used to soften the structure's appearance.

Fencing helps define the trail corridor. Pedestrians and bicyclists on the left, equestrians on the right

TRAIL SUPPORT FACILITIES

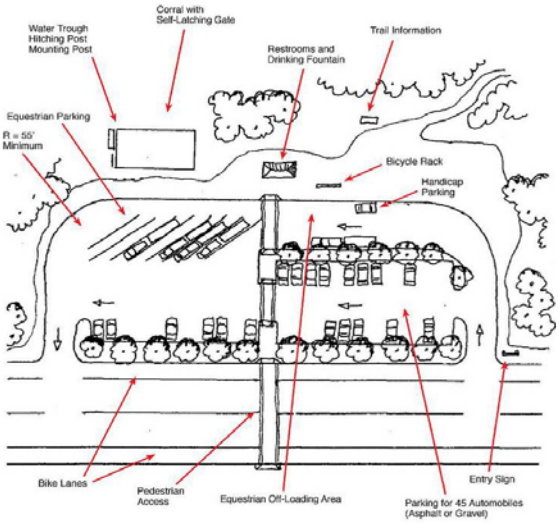
Trail support facilities should provide trail users wit
need in order to safely and comfortably enjoy the tra
educate trail users in, and assist them in complying
discusses general guidelines for trailheads, signage, fencing, and trail amenities.

Trailheads

Clearly defined trail access points are crucial to making trails inviting. Trailheads should provide the appropriate facilities to accommodate the permitted user types and expected user volumes. The graphic below is an example of a major trailhead access point to a trail that allows hiking, equestrian and bicycle use. This trail also provides ADA access as indicated by the accessible parking stall nearest the entrance.

Trail access standards include:

- Provide signage displaying permitted uses, regulations and emergency contact information;
- Provide wayfinding and informational signage;
- Provide the appropriate number of automobile, bike, and horse parking stalls based on the expected user volume; and
- For major trail heads, provide restrooms and drinking fountains.



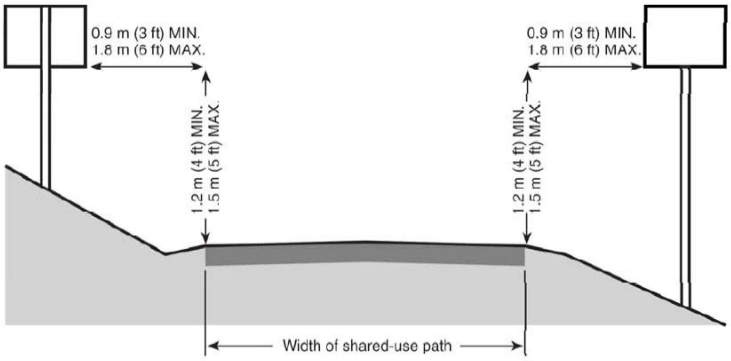
Signs

Signs and markings are an important component of safely directing and regulating bicycle, pedestrian and equestrian usage on regional trail facilities. The California Manual on Uniform Traffic Control Devices (CaMUTCD), Part 9 Traffic Controls for Bicycle Facilities, 2003, should be consulted for typical design standards, including sign selection, sizing, clearances and locations.

Sign Design and Placement

The CaMUTCD states that all signs shall be retro-reflectorized. Standard sizes for signs oriented towards bike facility and motor vehicle drivers are available in Part 9 of the CaMUTCD. Vertical sign clearances from shared-use paths shall be between four and five in height. Horizontal clearances shall be between three and six feet from path edge.

The final striping, marking, and signing for a trail should be reviewed and approved by a licensed traffic engineer or civil engineer. This will be most important at locations where there are poor sight lines from the trail to cross-traffic (either pedestrian or motor vehicle).



Regulatory Signs

Regulatory signs should state the rules and regulations associated with trail usage, as well as the managing agency, organization or group. The purpose of trail regulations is to promote user safety and enhance the enjoyment of all users. It is imperative that before the trail is opened, trail use regulations are developed and posted at trailheads and key access points. Trail maps and informational materials might include these regulations as well.

Establishing that the trail facility is a regulated traffic environment just like other public rights-of-way is critical for compliance, and often results in a facility requiring minimal enforcement. Be sure to have an attorney review the trail regulations for consistency with existing ordinances and enforceability. In some locations, it may be necessary to pass additional ordinances to implement trail regulations.

Typical trail regulations include:

- Hours of use;
- Motorized vehicles, other than power-assisted wheelchairs, are prohibited;
- Keep to the right except when passing;
- Yield to on-coming traffic when passing;
- Bicyclists yield to pedestrians;
- Give an audible warning when passing;
- Pets must always be on short leashes;
- Travel no more than two abreast;
- Alcoholic beverages are not permitted on the trail; and
- Do not wander off of trail onto adjacent properties.

Warning Signs

Warning signage alerts trail users of upcoming conditions, which may include steep grades, turns and roadway crossings. Warning signs should be installed in a location that provides the trail user with ample time to react. Care must be taken not to place too many signs at crossings; they may overwhelm the user and lose their impact. Sign selection, sizing, clearances and locations are specified in the CaMUTCD, Part 9.

Warning signs should also be installed to alert vehicle drivers of the potential presence of trail users at intersections.

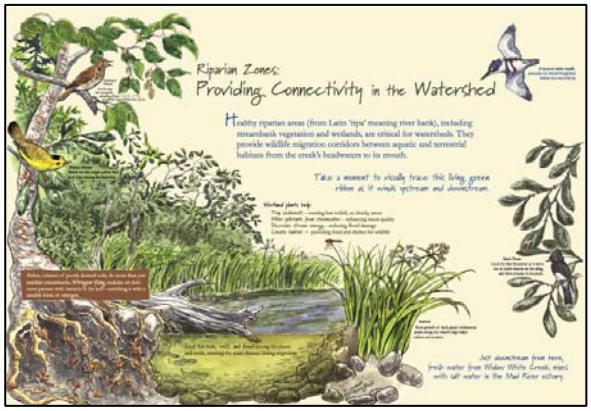
Wayfinding Signs

A comprehensive sign system makes a trail system memorable. Trail navigability and identity is enhanced by having a consistent, unique logo or design that will help guide people to and on the trail. Gateways or entry markers at major access points with trail identity information further augments the trail experience. They should be visually clear and distinctive while maintaining consistency with other sign features found on the trail.

Clear, pedestrian-scaled, signs and markers will aid in way-finding and separation of user groups. Signs should be consolidated to avoid clutter and sign fatigue. In addition to a trail logo being posted on bollards, gates and at the trailheads, way-finding markers and signs should be placed at key decision points. Distances may also be marked periodically so that trail users who wish to pace themselves have a means of doing so.

Interpretive Signs and Installations

Interpretive signs and installations can enhance the trail experience by providing information about the history, culture and ecology of the area. Installations may discuss local flora and fauna, environmental issues, and other educational information. While interpretive features are often assumed to be sign elements, a variety of means may be used to convey interpretive information including art pieces and interactive exhibits.

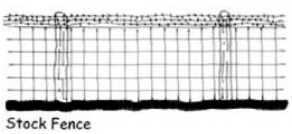


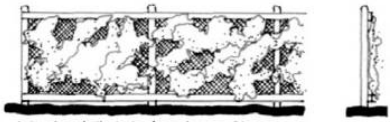
Fencing and Barriers

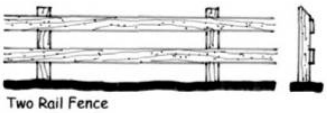
Fencing and barriers serve to protect trail users from adjacent roadways, railroads, and debris. Fence types should be selected based on location and purpose. Fencing three to four feet high constructed from natural or even native materials may be appropriate in scenic areas where trespassing is not an issue. Whereas fencing six feet and higher made from metal and serving to prevent trespassing may be installed along railroads or highways. Sight lines should also be considered when selecting a fence type.

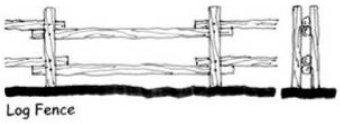
Fencing and barriers standards include:

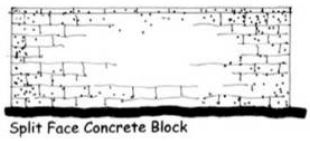
- Four foot height for rural areas without a history of trespassing, set back at least 25 feet from railroads or highways;
- Six foot height made from metal in areas with a history of trespassing;
- Five foot height for protecting users from wind and debris; and
- Two Foot minimum from edge of trail to fence.


Stock Fence


Wood and Chain Link with Vine Planting


Two Rail Fence


Log Fence


Split Face Concrete Block

Trail Amenities

Trails with high user volumes, particularly those that access a destination point and drive-in access, should provide amenities to support users. Amenities include trash and recycling receptacles, benches, drinking fountains, restrooms, and an informational kiosk. Trails that allow bicycle or equestrian use should provide parking for bikes and horses at their entrances.

The following trail amenities are described below: seating and tables; bicycle parking; lighting; and equestrian support facilities.

Seating and Tables

Providing benches at key rest areas and other appropriate locations encourages people of all ages to use the trail by ensuring that they have a place to rest along the way. Benches can be simple wood slates or more ornate with stone, wrought iron, and concrete. Tables provide picnicking opportunities and should be installed in easily accessible areas near trailheads and parks. Trash receptacles should be installed accordingly.

Bicycle Parking

Bicycle parking allows trail users to safely park their bicycles if they wish to stop along the way or leave their bicycle at trailheads while they hike. Bicycle parking may be installed at trailheads, bicycle trail intersections with trails that prohibit bicycle use, and at popular destinations along a trail.

Lighting

Lighting improves the safety of the trail or path user by increasing visibility during non-daylight hours. Lighting should consider the surrounding land use to minimize light pollution in unwanted areas such as residential areas. Lighting fixtures should be pedestrian scale and installed near benches, drinking fountains, bicycle racks, trailheads, and roadway crossings. Lighting is typically most appropriate along Class I multi-use paths used for transportation purposes.

Equestrian Support Facilities

Equestrians benefit from a number of elements that increase user comfort and encourage trail use. Elements recommended include: water facilities, mounting blocks, hitch rails and pull-through parking stalls.

Water

- Horses consume approximately 10 gallons of water per day. Due to concerns about disease transmission, some riders prefer to provide their own water and do not permit shared use of water with other horses. Other riders prefer to fill their own bucket from a hydrant, while other riders prefer a water trough. To meet the needs of all riders, a hydrant and shallow water troughs are recommended. Self-draining water troughs can reduce standing water problems and algae growth. Raised shallow basins allow horses to see in all directions.

- Water facilities should be located at the perimeter of parking areas and along paths and be free from vegetation and obstructions. Water troughs should be installed on a wearing surface. The wearing surface should be on an aggregate base, sloped for drainage, and allow for adequate clearance from the trough and hydrant on all sides.

Mounting Blocks

- Mounting blocks typically resemble a short staircase that ends in midair to assist riders in mounting their horses. Mounting blocks can be made from fiberglass, wood, metal, concrete or plastic. Mounting blocks can also be rocks, hay bales, stumps, etc. It is important to note that riders usually mount horses from the left, thus adequate clearance of any obstructions should be allowed around the horse and mounting block. A clearance between eight feet to 10 feet is recommended. Many riders provide their own mounting blocks, but some permanent fixtures are recommended.

Hitch Rails

- Hitch or Tie Rails should be available throughout the trailhead to anchor horses. Hitch rails can be made of wood, metal (i.e. rebar) or other sturdy material and should have "stops" along the rail to prevent reins from sliding.

Parking Stalls

- Pull-through stalls (15 feet by 45 feet) on a compacted natural surface for trucks and horse trailers is recommended. The pull-through stalls should allow enough room for the loading and unloading of stock and some "tacking up."