Blue River Trails
Policies/Procedures

Blue River Trails Committee

Mission
To assist the Board of Trustees with determining possible trail projects mainly geared towards enhancement of existing trails and possible future trails within the Town of Blue River.

Goals

- Create maps of existing trails, perform confirmation of their locations, and that correct easements are in place for the existing trails.

- Create list of existing trails that need additional easements in place, and a second list of possible connection points that do not currently exist.

- Present by the May 2019 Board of Trustee's meeting; List should be of existing trails that need additional paperwork completed and/or of new possible connection points that need easements.

Background
The Blue River Trails Committee was established in 2018 as a way to facilitate the development of trails through the Town of Blue River connecting into surrounding areas. The method established was to identify existing easements and trails created by resident enthusiasts. Through the process all pedestrian easements have been identified as well-established bike trails within the Forest Service and those connecting to Breckenridge.

It is noted that the existing pedestrian easements are dedicated to residents within their respective subdivisions and not the Town of Blue River. In order to establish a Town of Blue River trail system, the Committee has identified routes connecting into the Forest Service Trails and established trails into Breckenridge. *See Appendix A*. To complete the development of the trail system, new clean easements dedicated to the Town will be necessary to finalize the trail system.

Trail Uses
Town of Blue River Trails will be restricted to non-motorized uses. This will include hiking, non-motorized biking, horses, and skiing.

Exceptions:

- Motorized vehicles to be used except for rescue vehicles or vehicles needed for construction.
- Motorized wheelchairs
- E-bikes will be restricted for ADA use only and Class I only and only on paved surfaces. E-bikes will not be allowed on any non-paved surface.

Owners granting easements will agree to the above uses and restrictions.

Trail Design

Where new trails are constructed on provided easements, substantial altering of the existing grade of the property will be prohibited. The new trails and will be required to be consistent with the existing topography. Trails will be designed to minimize impact on the natural environment and will be designed according to Forest Service Standards. See Appendix B.

Design Objectives

The Blue River Trail System will provide safe connectivity to the sounding towns and areas. The trail design will be consistent with the culture of mission of the Town of Blue River and harmonious with the natural environment.

- Safety will be the top priority. Where possible, trails will remain off of major roads and avoid use of Highway 9.
- The trails will be use by hikers, bicyclists, horses and skiers of varying abilities. Access will for the physically handicapped will be provided, whenever possible.
- Design will be conducted to minimize impacts on the natural environment.
- The design will be sensitive to the area's preservation/restoration.
- Trails will provide connectivity through Town connecting to the Forest Service and Town of Blue River trails
- Trails will be for year round use. Limitations may be put into place during "mud" seasons to limit damage and erosion.
- A detailed trail vision map will be created and referenced when determining connections. Alternatives will be explored where necessary.
- Trails shall be designed to minimize future maintenance.
- When possible trails should be planned, designed and constructed to match trail standards with the U.S. Forest Service.
- Signage shall be conforming to U.S Forest Service standards. Signage shall be provided when entering private property restricting access to the trail.
- Trails will not be maintained in the winter. Winter use will be limited to cross-country skiing and restricted to established trails.

Trail Alignment

- Trails should consider comfort, safety, enjoyment, minimal maintenance, environmental impacts for year round use. Where possible trails should be constructed with a grade of 10% or less within the Town of Blue River.
- Trails should consider sight distances, noting narrow sections, intersections, hills and curves.

- Trails should, where possible, follow the natural terrain minimizing the need for cuts into hillsides and erosion.
- Trails should minimize the impacts to habitat and avoid wetland areas.
- Bridges shall be constructed with natural materials and be sustainable minimizing maintenance needs.
- Alignment should be located away from tree trunks and at the edge of heavily wooded areas to minimize vegetative clearing and tread damage from roots.
- Easements shall be placed according to owner's wishes to minimize impacts to individual lots.

Design Standards

**It is noted that the design standards are in alignment with and have been adopted from the Breckenridge Open Space and Trails to provide consistency.*

Trail Corridor

The trail corridor is the cleared area above and on either side of the tread needed to accommodate the trail and its users. It varies in size depending on the type of trail and trail use and requires clearing and limbing, grading of adjacent slopes, drainage structures, and revegetation.

Trail Prism

The trail prism is the cleared area necessary for safe use of the trail. To create the prism, an opening needs to be cleared through trees and shrubs. Tree trunks, projecting rock ledges, limbs, logs and brush should be removed for a minimum distance on both sides of the tread and a minimum height above the trail. The exact distances for the vertical and horizontal clearance will be vary based on a trail type, width, use, etc. The opening created by this clearing should not be apparent to users, hence vegetation should be pruned selectively and irregularly to make the prism look as natural as possible. Do not disturb the natural environment outside of the trail corridor. When small trees and bushes are within the tread, do not cut them flush with the ground. Dig them out, including the roots, to avoid future erosion around them that would cause greater trail damage. When trimming branches do not cut the branch flush with the trunk. Leaving a branch nub will help the cut heal more quickly. Place felled trees and cut braches at least 10 feet from the corridor with the cut end pointing away from the trail.

A trail corridor should be at least twice as wide as the tread width. This can vary with terrain and the type of user the trail is designated. Vertical and horizontal clearance standards are located within the standards and guidelines for trail types (Section IV, J, pages 31-34).

Sightlines

To reduce the potential for collisions or accidents, the trail user should be able to safely and clearly observe the trail ahead and upcoming intersections or obstacles. When determining sightline, the speed of the trail user will lengthen or shorten the distance required for proper reaction time to occur. In conjunction with sightline, grade should be considered. When possible, curves, stops and reduced speed zones should be on a flat grade with an adequate sightline. If a curve is required on a grade, a longer sightline should be designed. When sightlines cannot be an adequate length, a slow sign should be considered.

Design Speed	Sight Distance
20 mph	130-200’
15 mph	85-130’
10 mph	35-60’

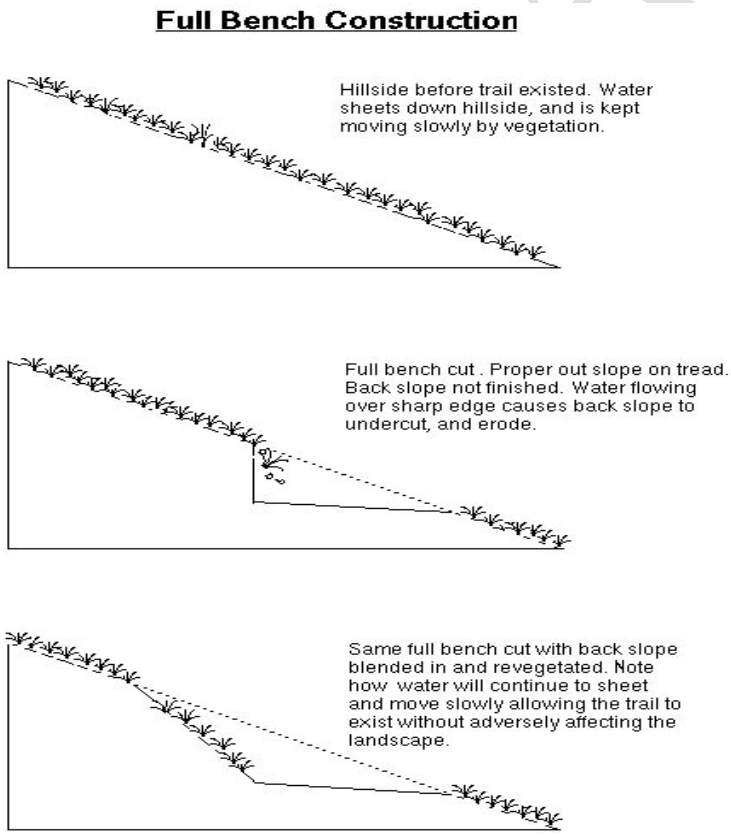
Above are some guidelines to use when determining sight distance, exceptions may be required for certain sections of trails. Source: Pitkin, 1994.

Adjacent Slopes

Ideally, all trails would be constructed using full-bench construction techniques (see illustration). The process of removing soil from one area and placing it somewhere else to form a base for any given activity is called cut and fill. To create a more uniform trail, this technique is recommended over hauling in material from an outside location, although both are less preferable than full bench construction. Any cut and fill slopes adjacent to the tread should not exceed two horizontal to one vertical unless Town staff determines soils are of qualities that justify the stability of a steeper slope. On slopes above 30%, retaining measures (e.g. walls) may be necessary to avoid excessive disturbance created by extreme cut and fill slopes. Most cut and fill slopes should be revegetated. (See the "slope stabilization, revegetation and landscaping" and "retaining walls" sections for details on dealing with adjacent slopes.)

Width

The width of the tread will vary depending on the type of trail, type of user, number of users and steepness of slope being traversed. Generally, equestrians require wider treads than hikers and mountain bikers. On steeper slopes (generally 30% or greater), construction at the minimum tread width may be necessary to reduce the impact of cut and fill slopes and construction costs. For wheelchair use, 5-foot tread width will allow two wheelchairs to pass one other. Width standards are located within the standards and guidelines for trail types.



Full bench construction is preferred over half bench or other construction techniques because it

avoids long-term settlement and other stability issues.

Grade

The proper grading on a trail is essential for maximum use and minimum maintenance. A grade that is too steep may deter trail use and will provide an easy path for water to flow. An increase in water on the trail creates an opportunity for erosion and trail damage.

Grade is determined with the formula rise/run x 100 (See illustration). In general a 10% average or less for the entire trail is the most sustainable.

Run=20'
Rise=2'
Grade=2/20 x 100=10%

Details on grade are located within the standards and guidelines for trail types. However, some general guidelines when determining trail grade include:

- When trying to gain a lot of elevation, use shorter, steeper gradients broken up by more gradual (resting) sections of trail as opposed to long even gradients, which are more tiring to the user and tend to collect and carry water. If a sustained elevation gain is necessary, (i.e., over 200 feet), every effort should be made to keep it below 6% for hard surface pathways and soft surface trails and 8% for natural and rough trails. Use the chart below for more guidelines on the size if the grade for the length of trail.
- Where shorter, steeper grades are used to break up a long, sustained pitch, it should be recognized that soft surface, natural, and rough trails with grades above 10% are more prone to erosion, especially when they exceed 15%. Maintenance and sustainability of these trail types are easiest when grades are below 10%.
- Avoid the fall line. A trail along the fall line will become an easy path for water to flow creating significant environmental damage from erosion.
- Where possible, avoid trails constructed in flat topography as they do not facilitate effective drainage and present the possibility for the trail to retain water.
- Climbing turns and switchbacks are curves in the trail that reverse the direction of travel. They may be needed to reduce grade when gaining elevation. Climbing turns are wide, ascending curves that work only on gentle to medium slopes of less than 20%. They are preferred over switchbacks because they are easier to construct and use. A switchback is a sharp, short radius curve that should be used as a last resort on hillsides where the working area is limited and slopes are greater than 20%. Switchbacks are difficult to construct, require continual maintenance, do not always accommodate mountain bikes, and are a challenge to manage because users may shortcut the turn.

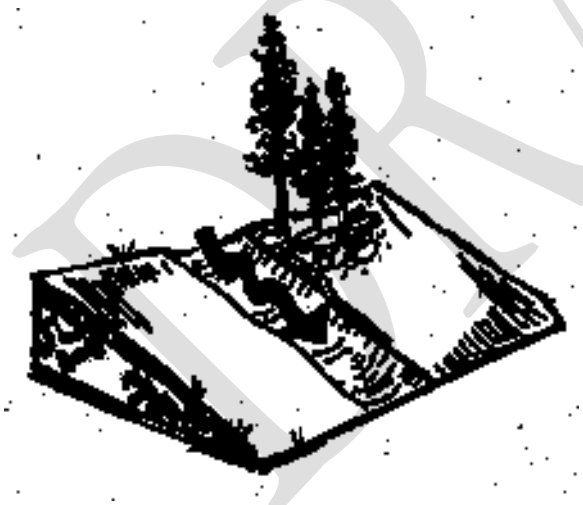
This chart provides some guidelines to use when determine the length of the trail on certain grades, exceptions may be required for certain sections of trails.
Source: Pitkin, 1994, with some modifications by Town Trails Planner

Trail Length Limits on Grades	
Grade	Limit on Length at that grade

<5%	None
5+ to 6%	700’
6+ to 7%	400’
7+ to 8%	200’
8+ to 9%	100’
9+ to 10%	50’
10+ to 15%	25’
15%+	0’

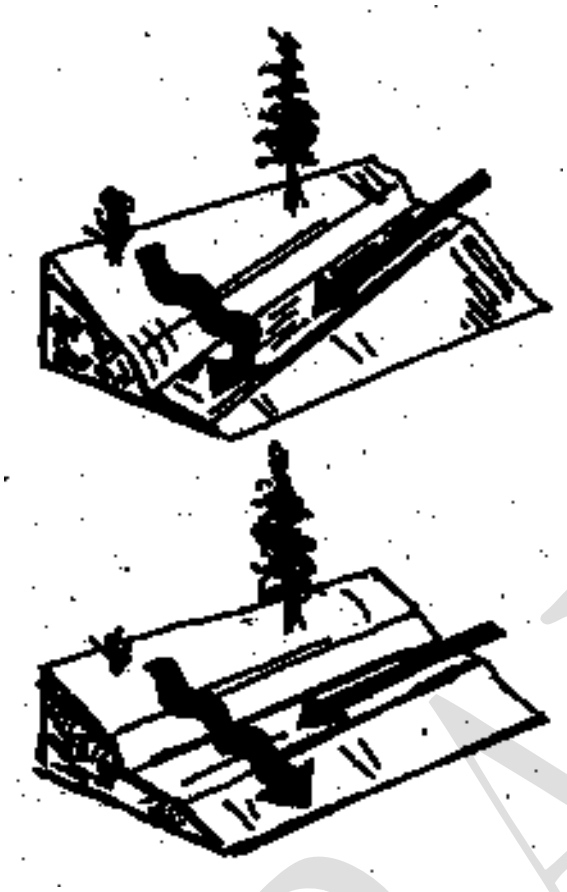
The Half Rule

The half rule is a common rule of thumb when determining proper grade. To ensure proper drainage, a trail’s tread grade should not exceed half of the grade of the hillside or side slope that the trail is traversing. If the trail is more than half of the side slope, it is considered to be a fall–line trail. In this case water will flow down the trail as opposed to sheet across it. For example, a trail passing through an area with a gentle 6% side slope must have a tread grade of less than 3% in order for water to escape the fall line. Some trail conditions such as soil type and location also need to be considered when determining trail grade.



Water flowing down a hill will follow the path of least resistance, called a fall line. Trails built on the fall line will have water flowing down (rather than across) them.

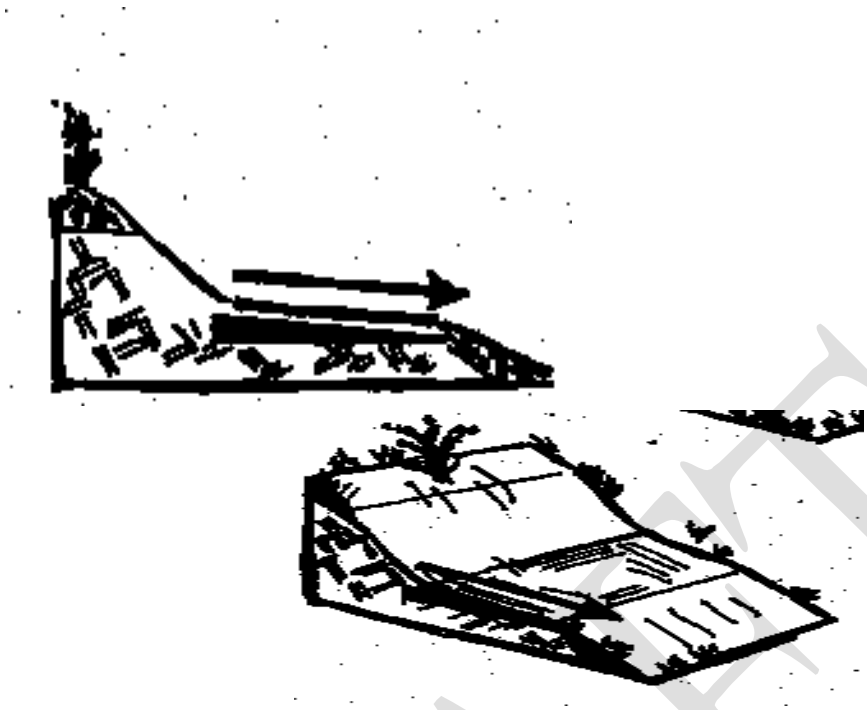
This trail does not meet the Half Rule, therefore, water will flow down the trail.
20% side slope 15% Trail Grade



This trail meets the Half Rule, therefore, water will sheet across the trail.
20% side slope 8% Trail Grade

Out Slope

On trails that traverse hillsides, creating an out slope on the tread is a common erosion control method. This consists of a slight tilt in the tread that leaves the outside edge of the trail lower than the inside to promote drainage. This method is effective in getting water to cross or sheet the trail rather than follow it. In flat terrain, the edge of the trail should match existing grade and the trail should be crowned to drain the trail surface. Trails constructed with proper out slope still need to meet the Half Rule objective. Out slope standards are located within the standards and guidelines for trail types.



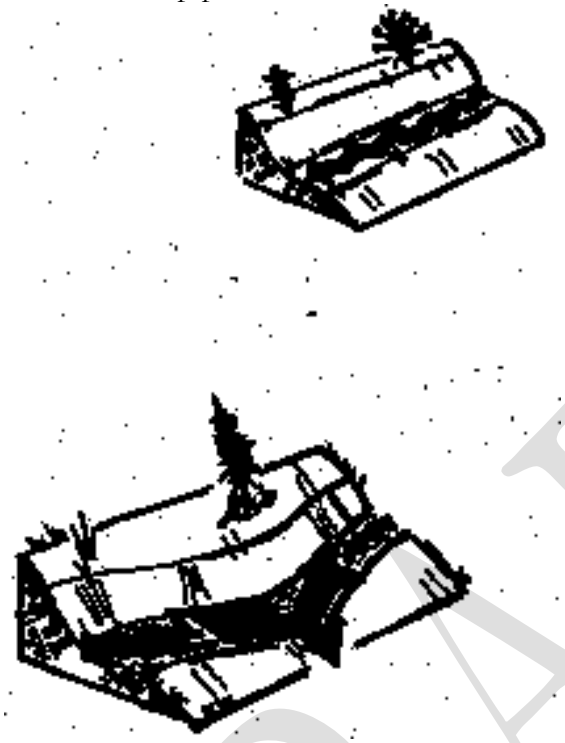
Switchbacks and Curves
Cross slope and curve radii are two important trail design elements that need to be considered when designing curves. During a curve, the trail briefly becomes aligned with the fall line creating the possibility of increased erosion. By building turns on a side slope of no more than 7% and building the upper part of the curve with an in slope and the lower part with an out slope you create a curve that allows water to flow across and continue down without getting captured by the trail tread. Retaining walls and armoring may also be necessary to decrease erosion and trail damage. Crowning a turn can also help mitigate erosive forces.

Curve radii are another important trail design element to be considered in turns. Larger turning radii protect user safety and help reduce erosion. A general rule of thumb is the faster a trail user is traveling, the wider the curve should be. A proper sightline before a curve is also necessary to prevent collisions or accidents. For more information refer to Trail Designations (Section IV, J, pages 31-34).

Drainage

Erosion is the natural process by which soil particles are detached from the ground surface and transported down slope by the action of moving water or wind. The combination of water falling on the trail, water running down the trail, freeze/thaw, and the wear and tear of user traffic can create significant erosion problems on trails with poor drainage. In order to create a sustainable trail with low maintenance requirements, erosion on the trail needs to be mitigated. Many preventable circumstances create a situation

resulting in high erosion rates on the trail, such as trails that follow the fall line or have no out slope. Such trail design issues may result in the use of multiple drainage structures and the need for more frequent maintenance. Trail alignment, grade, design and drainage structures will help prevent water on the trail and are discussed in more detail below.



Water trapped on trails can cause erosion and damage to the trail (top). Grade breaks and out slope help direct the water off of the trail (bottom).

Installing well-designed drainage with adequate capacity to address erosive forces is the most important element in trail design. Utilizing and protecting natural drainage patterns when aligning the trail while also constructing adequate cross slope during construction will remedy surface runoff in most situations. However, when runoff is concentrated uphill of the tread, the trail grade is steep, or a water course is likely to create drainage problems, drainage structures such as culverts, swales, drainage dips, water bars, crowning or grade breaks are required to protect the trail. The steeper the trail, the more frequently structures are needed.

The following are general guidelines for use of drainage structures.

Grade breaks

Definition: Grade breaks (also called grade dips or rolling grade dips) are different from drainage dips in that they are actually planned design into the trail alignment. The drainage is created when the descending trail gently rises, then resumes its descent.
Purpose: This reversal in trail grade creates a low point that diverts water running down the tread off the downhill side.
Trail Types: Grade breaks can be used on soft surface or natural trails.
Design: Grade breaks are most effective when they take advantage of natural features by

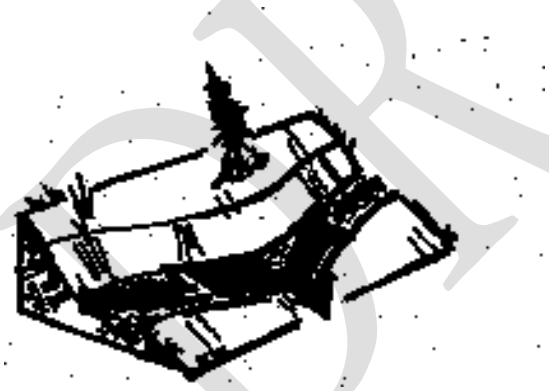
dropping in and out of slight dips in the terrain. Grade breaks of this nature require little or no construction, other than minor grading.

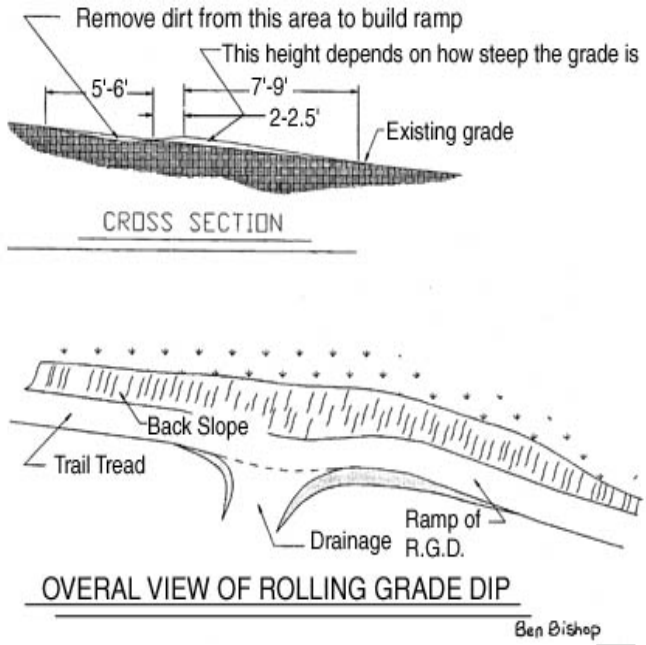
Grade Break	**Spacing**
Spacing	Trail Grade
500’	3-5%
300’	7-10%
100’	11-15%
<50’	>15%

Graph provides a general guideline of spacing between grade breaks
Source: Parker. 2001.

Drainage Dips

Definition: Drainage dips are carefully shaped depressions built into an existing trail to divert water from the tread.
Purpose: Drainage dips are effective in removing rainwater and snowmelt runoff from the trail tread.
Trail Type: They should be used only on soft surface or natural trails with slight to medium grades.
Design: Drainage dips are most effective on contouring trails in which the dip drains toward the trail’s outside edge (a.k.a. positive drainage).





Water bars

Definition: A water bar is a reinforced drainage dip containing a raised row of fitted stones or timber that helps divert runoff from the trail. Water bars are less desirable than drainage dips and grade dips because they are jolting and may preclude some wheeled users.
Purpose: These heavy-duty structures are typically band-aid type remedies used to repair an existing, eroded trail.
Material: Natural material such as rock or rot resistant logs is preferred but rubber barriers are also available.
Trail Type: They should be used only on natural trails. If cyclists or wheelchairs use the trail, the preferred alternative is a more wheel-friendly drainage dip.
Design: Water bars should be constructed at a 30-degree angle from the trail's edge and should extend beyond both sides of the trail to prevent water or people from going around them. The logs should be at least 6-8 inches in diameter and buried firmly. As the trail grade increased (i.e. becomes steeper), the number of water bars used should also increase.

Percent Grade	Spacing Between Water bars (feet)
2	250
5	130
10	80
15	50
20+	40

The above table provides a guideline when deciding on the spacing between water bars. Some changes may be necessary for certain trail sections.

Source: Rathke and Baughman, 2006

Armoring

Definition: Armoring is the use of large rocks to "pave" the trail to prevent erosion or protect a sensitive environment. Armoring raises the trail's elevation while still allowing water percolation.

Purpose: Armoring is used in seasonally wet areas, or areas with accelerated erosion areas (e.g. jump landings).

Materials: When armoring, it is best to use local rock material to uphold a natural look and prevent the spread of invasive plant matter.

Trail Type: Armoring is used on natural trails.

Design: Do not remove rocks that will damage vegetation or sensitive areas. When armoring, refer to recommended practices regarding trail grade.

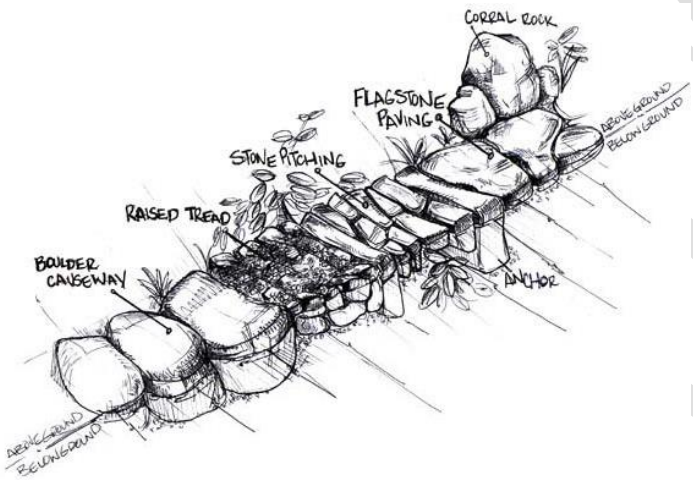


Illustration of various armoring techniques. (IMBA)

Armoring on the Lower Flume Trail.

Culverts

Definition: A culvert is a covered channel or pipe that takes a watercourse under a trail.
Purpose: Culverts can be used to accommodate drainages that carry more than occasional storm runoff or which continue to flow after rainfall has ceased. Culverts can also be used for low flow and intermittent stream crossings, and for side swale drainage.
Trail Type: Culverts are commonly used on both hard surface pathways and soft surface trails.
Materials: A culvert is typically made of metal or plastic.
Design: Due to the complexity of culvert design, installation should be coordinated with the Town Engineering Department and the Town Trails Planner.

Swale Crossings

Definition: A swale crossing is a low spot in the trail that allows water to flow across the trail under controlled circumstances.
Purpose: Swale crossings are used when water flows are minimal and/or intermittent.
Trail Type: Swale crossings can be used on all trail types although they are not recommended on hard surface pathways.
Materials: On crusher fine trails, swales with minimal flows can be made with crusher fines but in areas of concentrated flow, concrete or stone paving should be used.
Design: Usually swale crossings are small and can be stepped or jumped across.

Side Swales

Definition: Side swales are broad, shallow ditches which parallel the trail.
Purpose: They prevent runoff water from reaching the trail surface and also give water on the tread a lower place to drain.
Trail Type: Side swales can be used on all trail types.
Design: Side swales can either empty into natural drainages or be drained at intervals by culverts under the trail.

Crowning

Definition: Crowning is a method of trail construction where the center part of the tread is built up to allow water to run off each side.
Purpose: Crowning assists with drainage by forcing water off of the trail tread.

Trail Type: This technique is most commonly used on flat soft surface and natural trails and should be used only if both sides of the trail have someplace to drain.

Design: Crowning should be steep enough to shed water, but not too steep as to cause discomfort for trail

Environmentally Sensitive and Hazardous Areas

Trails should avoid environmentally sensitive and hazardous sites whenever possible. If unavoidable, special alignment and construction methods must be used to protect the site from negative environmental impacts and provide for safety of the trail user.

The following are guidelines for constructing a trail at or near environmentally sensitive and hazardous sites. The Town's Water Quality and Sediment Transport Control Standards may supersede these requirements and there may be other permits necessary such as Clean Water Act permits, etc.

- Construction impacts to the area surrounding the trail should be minimized when building a trail. When possible, trails in environmentally sensitive areas should be constructed using hand tools. Whenever possible, the use of heavy equipment should be avoided to prevent impacts to sensitive environments.
- The trail alignment should be planned to preserve significant vegetation.
- Plants native to the site should be used in revegetation of environmentally sensitive areas that have been disturbed. (See the "slope stabilization, revegetation and landscaping" section for details on revegetation.)
- Deviation from these guidelines via special alignment or construction methods may be necessary to reduce impacts and/or disturbance to environmentally sensitive and hazardous areas. Town staff must approve these deviations.
- Trails that cross or are located adjacent to wetlands must be designed for minimal impact. Boardwalks or other structural techniques may be required.
- When aligning trails, the use of areas with existing disturbance such as existing social trails, utility line easements, abandoned ditches and abandoned road cuts should be considered.
- Development of trails in areas of critical wildlife and plant habitat may require site-specific studies to determine impacts, mitigation and appropriate alignments.
- In order to protect environmentally sensitive areas during and after trail construction, erosion control methods such as siltation fences and straw bale barriers may be required. Revegetation may also be required.

Winter Trails

In most cases, Town trails will be used in both summer and winter. Winter trail use will be primarily oriented toward on-snow usage such as Nordic skiing or snowshoeing. When locating trails that can support winter use consider:

- Aligning trails to take advantage of opportunities for shade and wind protection (i.e., locating in northern exposures and maximizing shading from evergreens).
- Avoiding conflicts with roadside snow storage by placing trails a minimum setback of 20 feet from any road to be plowed during winter.
- Widening the trail corridor to provide for a safer and more enjoyable winter travel

corridor.

- Installing additional signage that is high enough to be visible during winter and far enough away from plowed routes to also ensure winter visibility. Blue diamond markers are typically used to mark winter travel routes.

As trails used for Nordic skiing become steeper, the minimum horizontal clearance should increase. This increased width does not need to be cleared of all vegetation but should provide skiers a wide area for turning, "herring boning" and snowplowing when the trail is snow covered. Steep Nordic ski trails may need to provide gently sloped clearings and run-outs for skiers to slow down, particularly at switchbacks. For additional information on the design of Nordic trails, please contact Town staff.

In general, winter trails to be plowed to accommodate heavy use should be hard surface pathways. Soft surface and natural surface trails with design features that cannot support plowing equipment will not be plowed. Where the potential for groomed and developed winter trail systems exists (such as Nordic centers), wider easements, or separate trails, may be necessary to accommodate both groomed trails and other public use.

Existing Trails

If an existing trail must be realigned, the new trail should, when appropriate, duplicate or improve the original trail's standards and character as much as possible.

Trails with Universal Access

Trails should be designed, particularly hard surface pathways in the more heavily populated areas of Town, to accommodate access by the physically disabled. A trail should not exceed a 5% grade where access by physically disabled users is possible. In addition, special design considerations (such as modified drainage structures) should be incorporated. Due to mountainous conditions, some hard surface pathways may not be accessible to the entire spectrum of physically disabled users. While it is clearly not practical for all trails in a mountain community to be fully accessible to the disabled, the Town will make every effort to comply with the standards set forth in the Americans with Disabilities Act of 1992 (ADA) and in the American Association of State Highway Transportation Officials (AASHTO) bike and pedestrian trail guidelines, where reasonably appropriate. Most natural trails and some soft surface trails are not expected to comply with ADA, or may be identified as acceptable for only a more advanced level of physically disabled user.

Wetlands and Water Crossings

When dealing with riparian environments, special precautions need to be made in order to mitigate or prevent sedimentation and damage to sensitive ecosystems. Preventing and minimizing impacts to wetland areas is critical to aquatic health and, in relation to trails, can often be accomplished by minimizing vegetation removal and soil disturbance. If construction on stream banks, lakes, shores and wetlands is unavoidable, the trail tread should be raised using turnpikes, boardwalks, or armoring. To avoid water quality impacts from chemical leaching from treated wood, structures should be constructed with natural untreated wood, precast concrete or steel. If the wood is pretreated, the structure should be isolated in poly wrap below grade. If trails enter wetland areas, permits may be required, and the U.S. Army Corps of Engineers should be contacted.

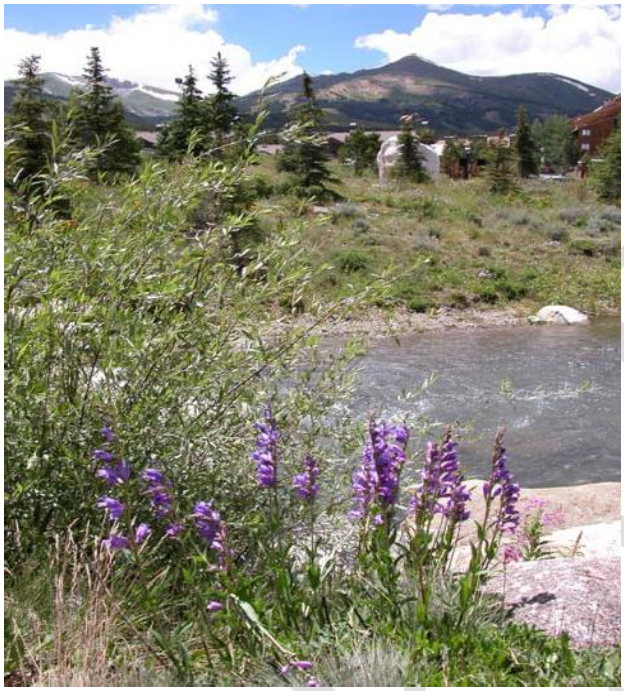
Slope Stabilization, Revegetation and Landscaping

Revegetation is important to control erosion and stabilize slopes, as well as to improve aesthetics. It is important that revegetation be sensitive to existing on-site plant species in order to maintain a natural character and balance. The most important areas for revegetation are where major disturbance occurs, usually related to hard surface pathways. Another disturbance area of concern is related to cut and fill slopes or full bench cuts on steeply sloping sites (over 30%). Town staff must be consulted regarding all revegetation plans. The following guidelines should be followed in all cases.

- Care should be taken to maintain existing vegetation (including the understory) wherever possible.
- Plantings should consist of low maintenance, drought resistant, and native species.
- On-site native plant species should be identified and revegetation should occur with an appropriate mixture of these native plants if possible. This is especially important in environmentally sensitive areas.
- Non-native plant species or standard high-altitude seed mix should not be used where such revegetation would promote invasion by introduced species that are not found on site and which would have an adverse effect on native plants. This is especially important in environmentally sensitive areas.
- In environmentally sensitive areas it may be best not to plant anything but instead to simply prepare and mulch the seedbed with a seed-free erosion control/mulch blanket.
- In areas of minimal disturbance and with sparse under story vegetation (lodge pole pine forests), revegetation may not be necessary, but excavated soils should be widely dispersed away from the corridor.
- The type of plants and the formality of plantings should complement the natural and man-made plantings around the site and neighborhood. The trail corridor should either seem like part of a native ecosystem or part of an adjacent landscaped area.
- Revegetation should occur as soon as grading work is completed and weather permits. Revegetated sites should be maintained until sufficient establishment has occurred to reasonably stabilize the site.

The following guidelines should be followed where there is major disturbance:

- Temporary slope stabilization and revegetation will be necessary during construction, and until permanent drainage and successful revegetation is achieved.
- Landscaping may be necessary to recreate natural character, minimize visual impact or to create a buffer between the trail and adjacent uses. Landscaping recommendations in the Town Development Code should be followed.



Structures

Structures are trail corridor improvements necessary for user comfort or to solve specific drainage, grading, safety and water crossing situations. For public safety and economy, most structures should be designed by a design professional. Trail structures should complement the character of the surrounding landscape. Typical structures related to trail development are: retaining walls, bridges, boardwalks, turnpikes, fences, steps, stairways, railings and other user amenities such as restrooms and benches. Some structures have already been discussed in the Drainage section of this manual.

Retaining Walls

Definition: A retaining wall is a vertical structure usually consisting of rock or timber that enables construction of a trail around obstacles, stabilization and widening of trail sections and stabilization of trails on loose soil.

Purpose: Retaining walls are often used to reduce erosion on cut and fill slopes when slopes exceed a stable angle. In addition, retaining walls may be necessary to reduce the size of a cut and fill, or minimize disturbance on an environmentally or visually sensitive site. The Town Engineer should be involved during the design and construction of retaining walls.

Materials: Whenever possible, natural materials should be used in wall construction such as rock or wood. To decrease long term maintenance, rock is preferred.

Design: Walls located in visually sensitive areas should be designed to blend with the surroundings. Retaining walls should not be too continuous, thereby avoiding a channelized feeling. The wall should tilt into the slope. An inward tilt of 1 foot for every 4 feet of height is the maximum recommendation with a ratio of 2:1 being more typical and acceptable.

Trail Type: To avoid both the "engineered" look and abrupt drop-off sometimes created by retaining walls, they should be used only in select circumstances (especially when developing soft surface, natural or rough trails).

Bridges

Purpose: Bridges are used to cross a natural or man-made drainage that has a year-round flow and also to span a ravine or gully-type terrain feature.

Trail Type: Bridges should be used to cross a perennial stream where a water crossing would create hazardous conditions or damage to the environment.

Materials: Whenever possible, natural materials should be used.

Design: Bridges should be designed to withstand floods and should be placed to avoid sharp curves or deflections. Bridge width should be able to accommodate the largest trail use such as bikes, horses, or pedestrian. Emergency access or maintenance vehicles may also need to be considered in the design phase.

On most bridges, the minimum width should be the same as the approach trail plus the horizontal clearance. An exception to this would be a simple bridge on a pedestrian-only soft surface, natural or rough trail. On hard surface pathways and multi-use soft surface trails, bridges should be 2 to 4 feet wider than the approaching trail. Railings may be required where the distance from the ground is 30 inches or more (see "railings" for additional details). Bumpers and ramps may also be required on trial-based bridges. On natural and rough trails, with small streams that can be stepped over during normal flow, a bridge may

not be necessary. In this case refer to the section on armoring. Where bridges are necessary on these trails, design should be simple and incorporate use of native materials, when possible. Bridges must be approved by the Town Engineering Department and in many cases will have to be designed by a civil engineer.

Tips For Successful Bridge Building:

1) Make bridges strong enough to support the heaviest potential user and snow loads
2) For wooden bridges choose a material that is rot resistant. Bark must be stripped off the logs to prevent rot and insect damage
3) For wooden bridges, use screws or bolts not nails
4) Extend approach ramps onto the trail
5) Avoid letting bridge stringers touch the ground. Sit stringers on stones or replaceable wood
6) Bridges and their approaches should not have sharp turns; this can be dangerous when icy or wet
7) Design the bridge so that travelers can see each other on either end

Fences

Purpose: Fences should be installed only when physical separation is necessary for safety and/or to preserve adjacent landowner privacy.
Design: Where possible, fencing should be located only on one side of the trail at a time. Fencing designs which create a narrow corridor effect for long stretches should be avoided. Whenever possible, fences should be no closer than 5 feet from the trail edge. Where fences are necessary along both sides of a trail, minimum width should be 20 feet between the two sections of fence. Fencing should be compatible with wildlife migration patterns.
Materials: Whenever possible, natural materials should be used.

Steps or Stairs

Purpose: Steps can be used on sections of trail where elevation must be gained quickly, usually in areas where the grade exceeds the recommended maximum.
Design: Where steps are located on steep grades, a handrail may be required on one or both sides to provide for safety and user comfort (see "railings" for additional details). When stairs are located in the more urban areas of Town, design should comply with Town building codes.
Trail Types: Steps are not recommended for trails used by horses, bikes and the disabled.
Materials: Stone is preferred for steps, however, treated timber can also be used.

Railings

Purpose: Railings are recommended on high volume, hard surface pathways and soft surface trails where a steep drop off exists within 5 feet of the trail edge.
Purpose: Railings can be used on trails as necessary for user safety and comfort.
Materials: Whenever possible, natural materials should be used.
Design: Railings on pedestrian trails should be 42 inches high. Railings on multi-use hard surface pathways which receive considerable use by bicyclists should be 54 inches high. For general use in mixed bicycle/pedestrian situations and in zones which are not high speed bike zones, 42 inch railings are preferred. Railing ends should be flared away from the trail at either end of the railing. Where railings are used on trails located in the more urban areas of Town, design should comply with Town building codes.

Trailheads and Signage

Signage at the trailhead and throughout the trail should be used to inform and educate trail users. Properly located signs can be an indicator of location, distance, property boundaries or restricted uses, preventing unwanted conflicts, or confusion. Listed below are some objectives for trail signage. Town staff must approve all signs.

- Signs should be consistent with those used throughout the Town.
- Signs should be legible; this includes typography, vocabulary and other design elements.
- Signs should inform users of the trail's use types, direction, location of the trail, location of private property, or other information that can assist and inform trail users.
- Signs should be low maintenance and be capable of withstanding extreme weather conditions and abuse.

- Signs should not obstruct the trail or natural scenery. Informational signs can be grouped together at the trailhead while warning signs should be located to give trail users a chance to react.
- Over use of signs can diminish the natural effect while under use can leave the trail user confused.
- Rot resistant wood or stone should be used to maintain the most natural appearance.

Intersections

Intersections should be highly visible and provide good sight distance, clear zones and proper signage. Accommodation of sufficient stopping sight distance at roadway intersections is critical and adequate warning should be given to permit trail users to stop before reaching the intersection, especially on downgrades. On high volume trail/vehicular intersections, a flat approach grade is especially important and appropriate striping and regulatory signage may be necessary. (See the Signage Chapter for details on intersection signs.) In less developed areas containing low volume soft surface or natural trails, less formal intersections may be possible (depending on the volume of traffic) and signage may not be necessary. The appropriate road management department or agency should be contacted regarding trail/road intersections. Their involvement at the design phase may be necessary. Whenever possible, a 90-degree intersection is preferable to one with a lesser angle.

Appendix A

Appendix B

Standards (desired)	ROS Class			
	Urban	Rural and Roadbed Natural	Semi primitive	Primitive
Tread Width Hiking Segments Accessible Segments	48" 60"	24" 36"	18" 28"	*
Clearing Width (each side of tread))	24"	12" (WIDNR-24")	12"	*
Clearing Height (min.)	10'	8' (WIDNR-10')	8'	*
Slope(max.sustained) Hiking Segments Accessible Segments	10% 5%	10% 8%	15% 12%	*

Slope (max.) Hiking Segments Accessible Segments	15% for 100' 8% for 30'	20% for 100' 10% for 50'	30% for 100' 10% for 50'	*
Cross Slope (max)	3%	5%	8%	*
Other Accessible Segment Standards Passing Spot Int.-max Rest Area Interval-max	N/A 1200'	600' 1200'	1200' 1/2 mile	N/A N/A
Surfaces	Asphalt. Concrete. Stabilized-aggregate. Screening (1). Wood Chip. Sod.	Native. Wood Chip (2). Stabilized-aggregate. Screening (1).	Native	Native
Accessible Surfaces	Asphalt. Concrete. Stabilized-aggregate.	Asphalt. Stabilized-aggregate.	Native. Stabilized-aggregate.	Native