



TRAIL MAINTENANCE AND CONSTRUCTION MANUAL

GENERAL MAINTENANCE

MAINTAINING THE TRAIL CORRIDOR

Debris and Obstacles

Remove dangerous obstacles that riders may fall on - logs and branches one-half inch in diameter or greater and loose rocks two inches or larger. Cast debris out of trail corridor.

Tools: chainsaw (use only by those with safety training and personal protection equipment), handsaw, leaf rake or "flicking stick," or by hand.

Leaf Blowing

Use backpack leaf blower and walk a looped segment of trail or plan a route that allows a simple return. If working with a partner you may be able to stage a car in the middle of a long point-to-point route and leap frog. **Use of hearing and eye protection is required.**

Blow leaves away from both edges of the trail – do not leave piles of leaves close to the edge of the trail, particularly on the downslope side of the trail. Where there are natural or constructed grade reversals or drainages in the trail take extra care to blow out all leaves not only on the trail but also into the drainage.

On wider more open trails and those with berms blow leaves away from the entire width of the trail including the full berm. Be sure to clear secondary lines or features that may be adjacent to the trail.

On longer routes you will need to carry additional fuel. While somewhat awkward, the only good way is to carry a one-gallon gas can in one hand while moving the blower nozzle with the other hand. Carry water and food with you in a fanny pack or a backpack worn from the front.

Lopping

Cut intruding branches back four feet from center of tread and eight feet overhead. (Advanced trails may be tighter.) Trim branches as close to the trunk of the tree as possible. Do not leave protruding stubs. Tools: hand loppers.

Brushing

Using loppers, hands saw, or power brush saw, cut brush and all undergrowth within two to four feet from the edge of the trail. Be careful to not strike rocks with power brush saw. Pay attention to tall brush that may lean in as it grows even if it is well out of the trail corridor. When cutting with hand tools, trim brush as close to the ground as possible. Do not leave long protruding stubs.

Important: The power brush saw is potentially one of the most dangerous tools you will use. Use of hearing and eye protection is required. Be aware of your surroundings. Move the saw in an easy arcing motion. Do not try to cut anything larger than one and a half inches in diameter. Anyone working around a brush saw and needing to pass by should make a wide detour into the woods away from the saw, or wait until you can make eye contact and get the attention of the operator.

Mowing

On two-track trails and singletrack where possible, make one pass in each direction with one set of wheels near the outside edge of the tread. Prior to beginning work check the oil on the mower. If you are working on a long route carry or stage additional fuel along the way. Use great caution when working near other people – stop mowing when riders or walkers approach. **Use of hearing and eye protection is required.**

Signs and Maps

Monitor all trail markers, directional signage, and You Are Here maps. Make note of those requiring attention. Cut brush around all posts. Straighten posts. Make note of posts that are missing, broken, or require replacement due to vandalism (human or animal) or age.

The Finished Product

The tread will be clean of debris and no dangerous tread obstacles and the trail corridor will be visually clear with long sight lines and no visual obstructions.

TRAIL REPAIR TO PREVENT DRAINAGE ISSUES

Deberming is a process intended to help maintain trail outslope and return the original drainage capability of the trail tread.

Knicks are shallow drainage openings (not deep trenches or channels) to help water flow off the trail. They can be created where needed.

Rolling grade dips are larger constructed drainage features and can be installed when directed.

For all of the above see construction instructions below.

Raised trail tread may be necessary in flatter areas where there is not a lot of natural drainage. They should be installed where directed if water can't be diverted off the trail.

Trail Tread Remediation

Depending on the desired degree of difficulty for a specific trail, remove all roots and small to medium-sized singular rocks that protrude more than two inches above the trail surface. Roots crossing the tread at an angle less than 90 degrees should be removed by chopping with a Pulaski. Dig rocks out with a rock bar, Pulaski, pick axe and/or shovel. Refill any holes or depressions created by finding soil off the trail. On more difficult trails some rocks and roots may be retained to add challenge. On intermediate trails rocks may be retained if they are out of the "best line" flow of the trail.

Restore the full tread width in areas where sloughing of the backslope or trail toe has resulted in narrowing the trail tread. Removal of sloughed material and/or re-excavation of trail tread may be necessary to return the tread and backslope to its original, newly constructed condition.

Tools

McLeod, Rogue Hoe, Pulaski, loppers, rock bar, pointed shovel, flat bladed shovel, garden rake, four-tined cultivating rake.

The Finished Product

Full benchcut trail with a smooth, firmly compacted tread, three to seven percent outslope and compacted backslope. Signs of construction removed from corridor. Trail must meet CAMBA trail difficulty classification standards.

Deberming and Maintaining the Outslope

Even well-built trails with proper outslope can lose their tilt over time and begin trapping and funneling erosive water.

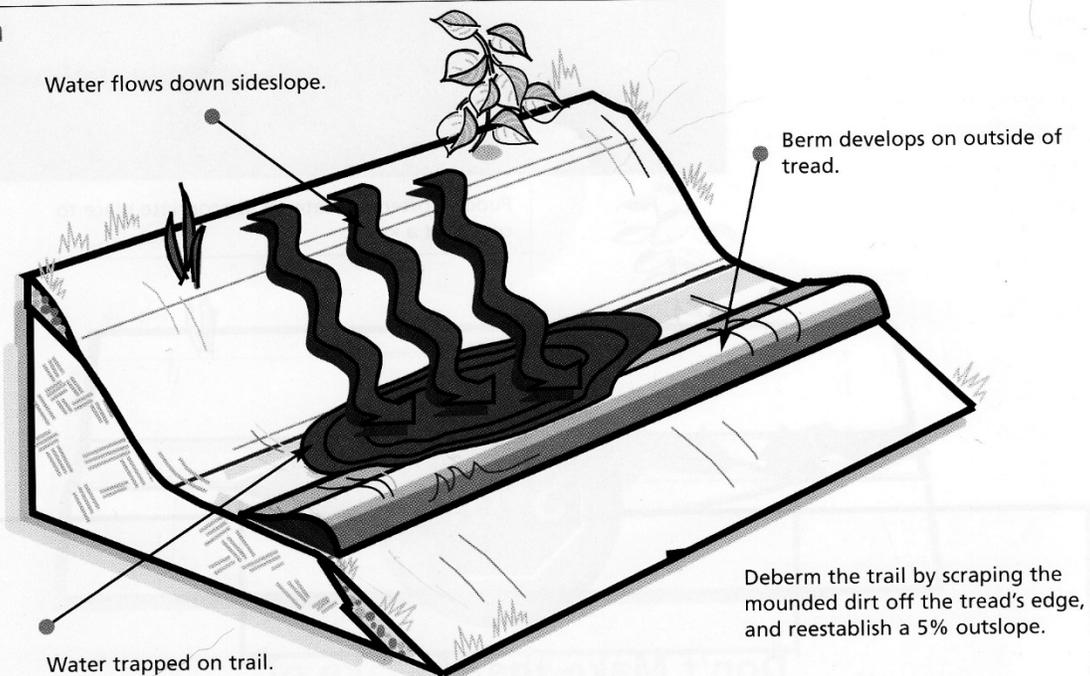
There are two reasons for this:

1. The center of the trail may become compacted with use, resulting in a U-shaped tread that traps water.
2. Loose material can collect on the outer edge of the tread, forming a berm that traps water.

Fortunately, the remedy is straightforward. **Deberm** the trail by scraping the mounded dirt off the tread's edge, and reestablish a 5-percent outslope. This is a frequent maintenance job on most trail systems.

Note: Outslope is difficult to maintain in loose soil conditions. Loose soil lacks cohesion and is easily displaced to the sides of the trail by tires, feet, and hooves. Grade reversals are essential to insure proper drainage in these situations.

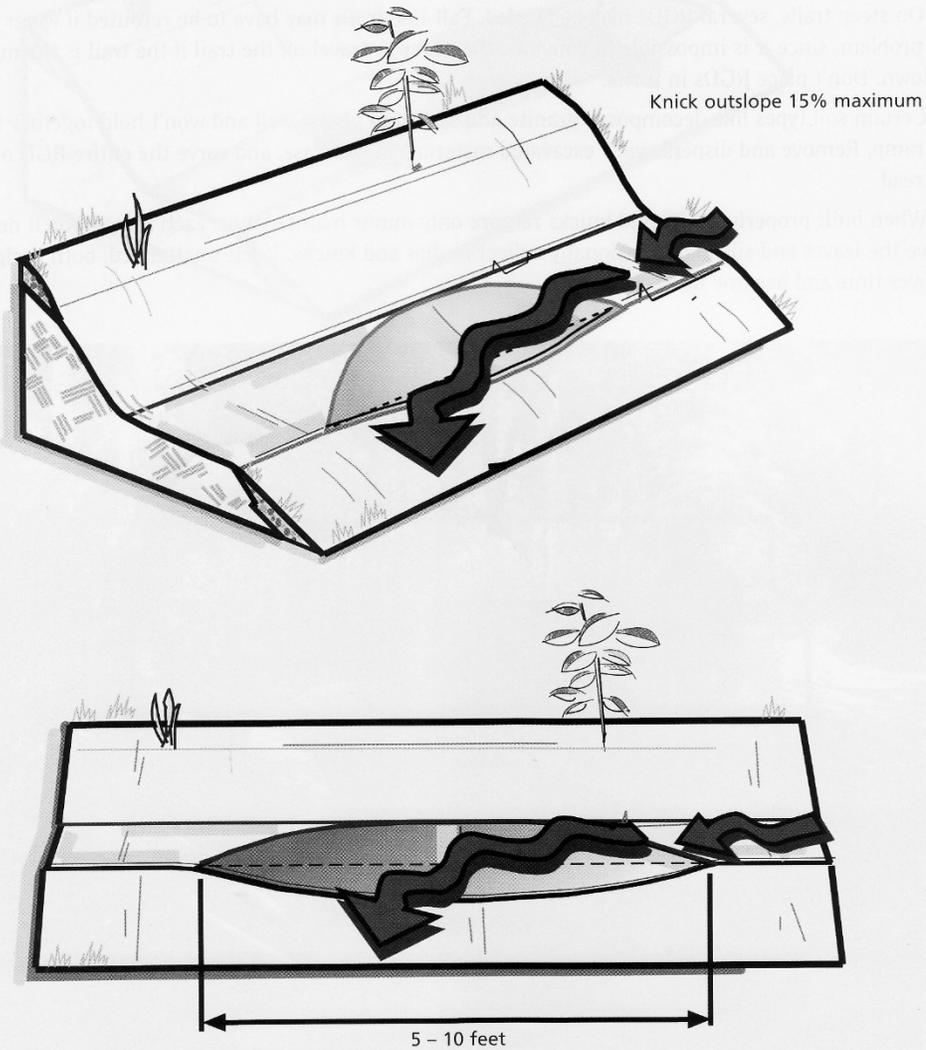
Berm



Knicks

A knick is a semi-circular, shaved-down section of trail, about 10 feet in diameter, that is canted to the outside. A knick is smooth and subtle; many visitors won't even notice its presence. The center of the knick is outsloped at about 15 percent, which is what draws water off the trail. For a knick to be effective, there must be lower ground next to the trail tread so that water will have a place to drain. Knicks are typically built on gentle sections of trail where water tends to puddle. Knicks also work well on noncohesive soils such as sand, pumice, and decomposed granite.

Knick



Rolling Grade Dips

A Rolling Grade Dip (RGD) builds on the knick device. It features a similar outsloped depression in the tread, followed by a long, gentle dirt ramp. RGDs are sometimes described as a soup spoon lying on the trail; the scoop of the spoon is the dip in the trail, and the handle of the spoon is a gentle dirt ramp that follows. The dip should be longer than a bike (about 9 feet). The excavated soils from the dip are used to create the backup ramp that fortifies the dip. This ramp is long, 10 to 20 feet from tip to tail (depending on the steepness of the tread), and outsloped at 5 percent like normal tread. The total length of an RGD varies widely depending on the steepness of the trail tread, but most are somewhere between 15 to 30 feet.

Proper placement of RGDs is crucial. Look for a natural roll or change in trail grade that can be accentuated. On steep trails, several RGDs may be needed. Fall-line trails may have to be rerouted if water is a constant problem, since it is impossible to convince the water to travel off the trail if the trail is the most direct way down. Don't place RGDs in turns.

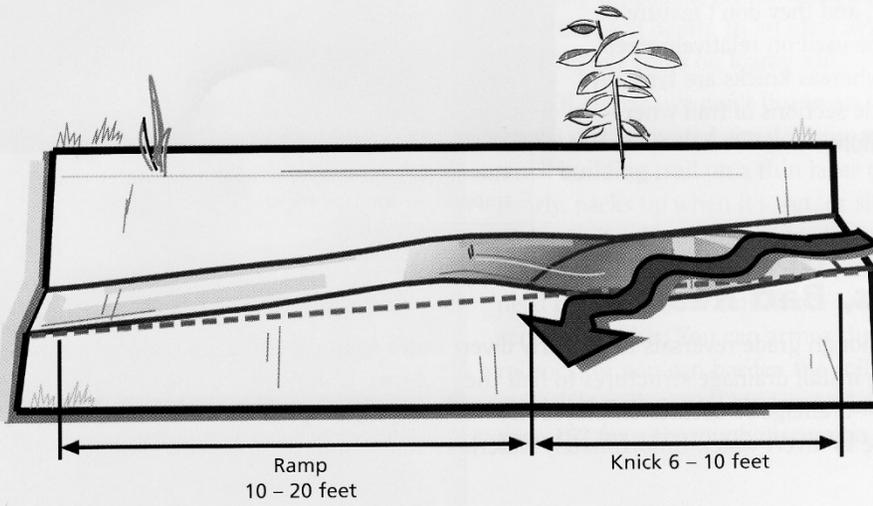
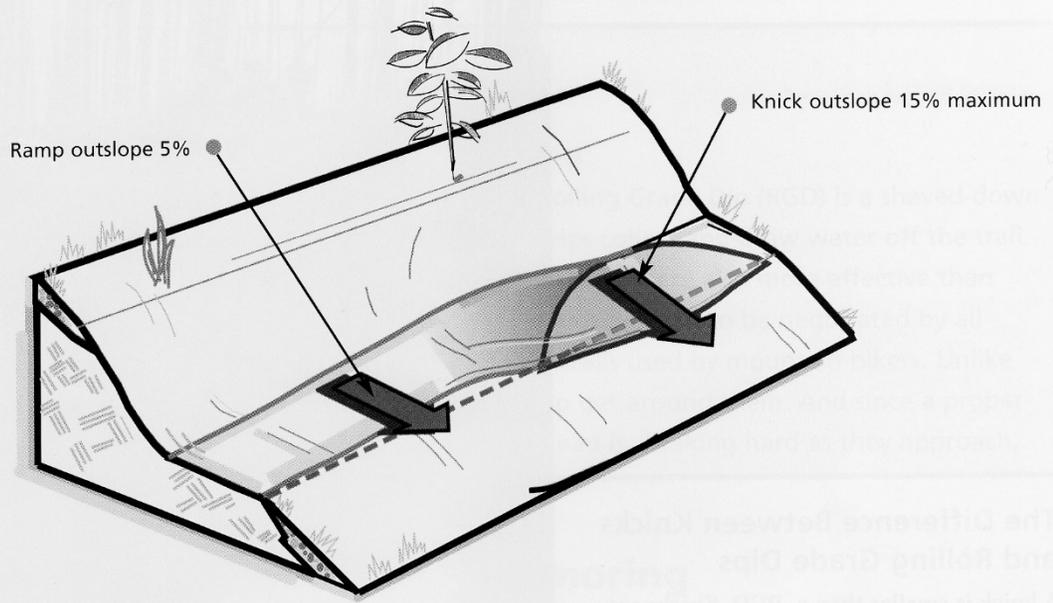
Certain soil types like decomposed granite and sand don't bond well and won't hold together to form a good ramp. Remove and disperse your excavated materials in this case, and carve the entire RGD out of the trail tread.

When built properly, RGDs and knicks require only minor maintenance; each season you'll need to remove the leaves and silt that occasionally collect in dips and knicks. If left unattended, both designs will clog over time and become ineffective.



These volunteers have nearly completed a grade dip that will be almost invisible to trail users and need very little maintenance.

Rolling Grade Dip



HAND BUILDING BENCH CUT TRAIL

Steps to be completed

(See illustrations below.)

1. Rake leaves and duff from pin flag downhill to at least three feet below the lower edge of the tread.
2. Scalp sod and organic matter three to five inches deep and down to the mineral soil to finished tread width. Cast and disperse out of tread corridor.
3. Excavate full bench cut to specified width. Disperse material well downhill.
4. Work up the tread surface the full width of the trail removing all rocks, roots, and debris.
5. Cut backslope enough to reassure riders, prevent pedal strike, and bank collapse.
6. Sculpt tread to three to five percent outslope depending on the degree of difficulty of the trail. A good gauge of outslope is that a McLeod handle will be out of plumb by six inches when stood on its face.
7. Trim all remaining roots with lopper or other cutting tool.
8. Fully compact tread and backslope.
9. Finish by removing pin flags and spreading leaves and duff to disguise construction.

Tools:

McLeod, Rogue Hoe, Pulaski, loppers, rock bar, pointed shovel, flat bladed shovel, garden rake, four-tined cultivating rake.

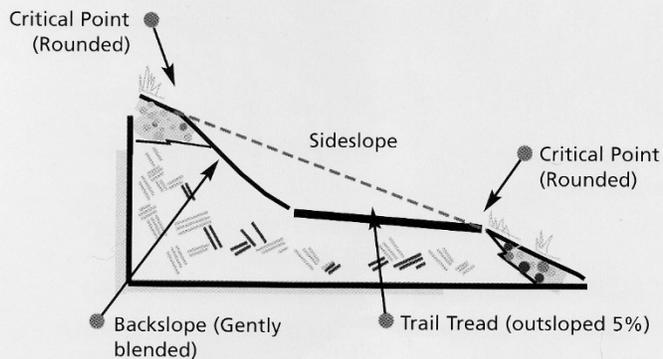
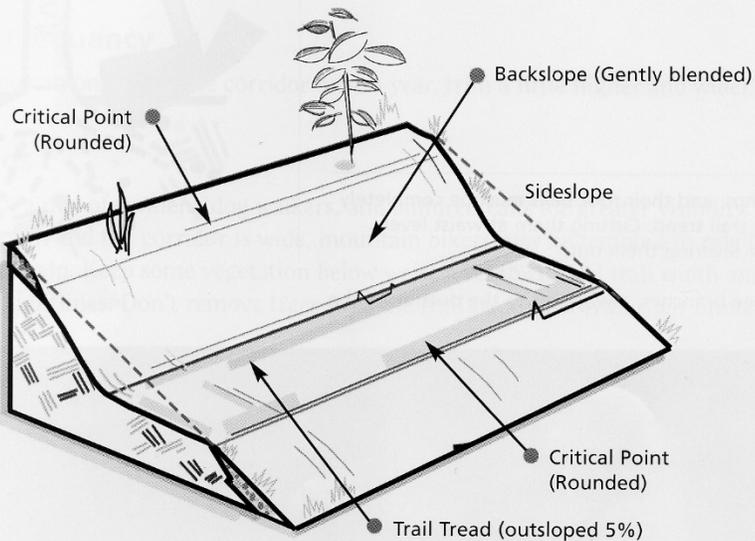
The Finished Product:

Full benchcut trail with a smooth, firmly compacted tread, three to seven percent outslope and compacted backslope. Signs of construction removed from corridor. Trail must meet classification standards.

Building Bench Cut Trails

A bench is a section of tread cut across the side, or contour, of a hill. A **full bench trail** is constructed by cutting the full width of the tread into the hillside. The entire tread is dug down to compacted mineral soil. This design creates a consistent and stable tread, but it takes time and effort, since the organic matter that normally covers mineral soil must be removed. In the end, all this effort pays off in the form of a trail that lasts indefinitely with very little maintenance.

Full Bench Trail

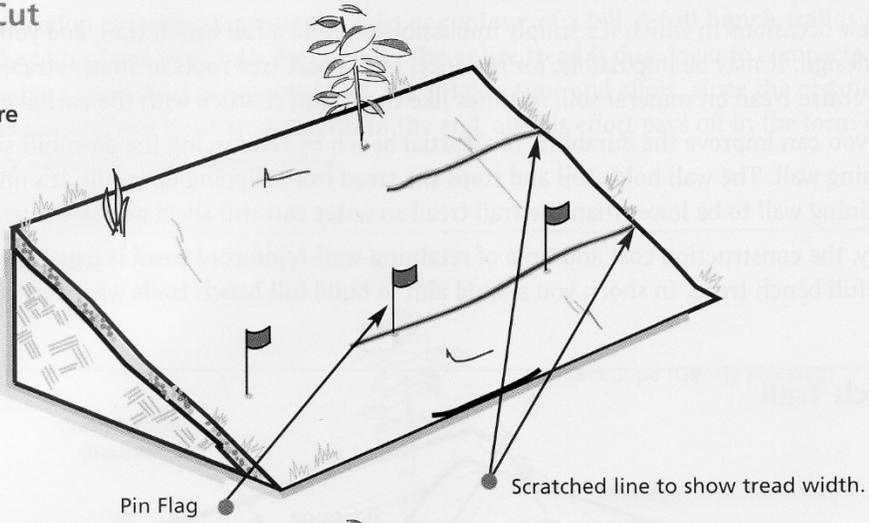


On a **partial bench trail**, only part of the hill is cut away and the soil that has been removed is placed at the **lower** edge of the trail to try to establish the desired tread width. The main benefit of the partial bench trail is that it requires considerably less digging than the full bench process.

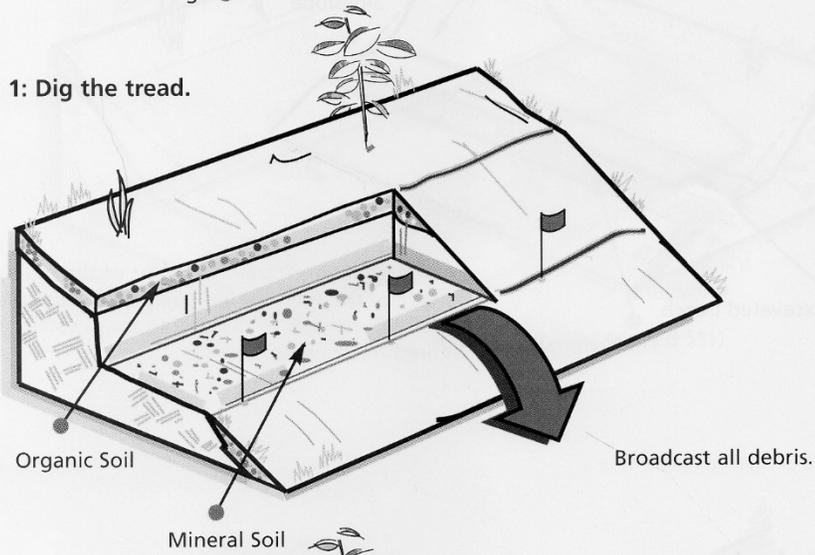
Building a Full Bench Trail with Hand Tools

Bench Cut

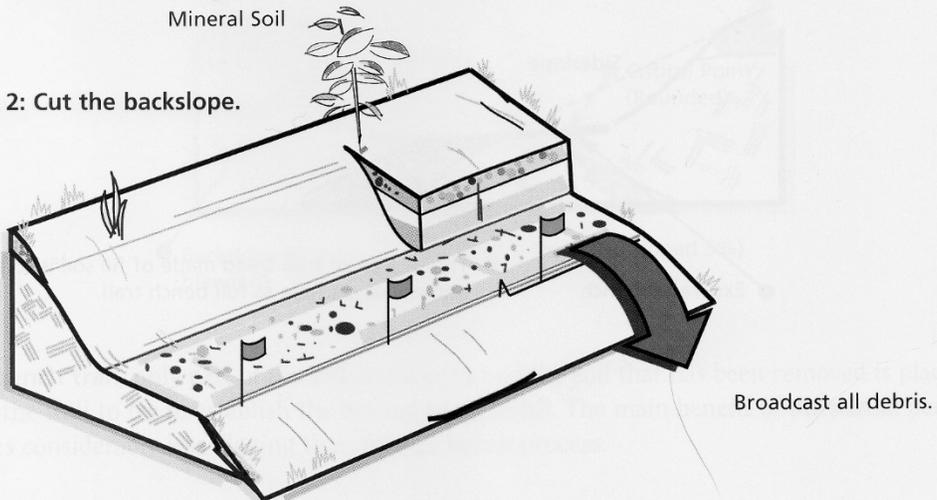
Before



Step 1: Dig the tread.

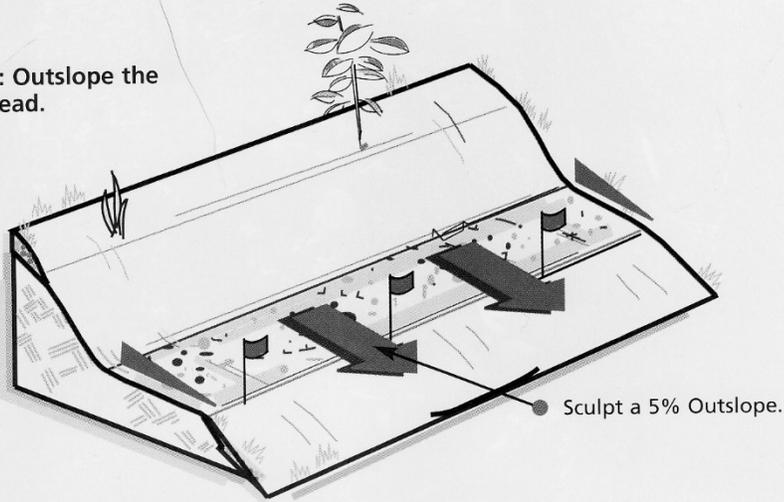


Step 2: Cut the backslope.

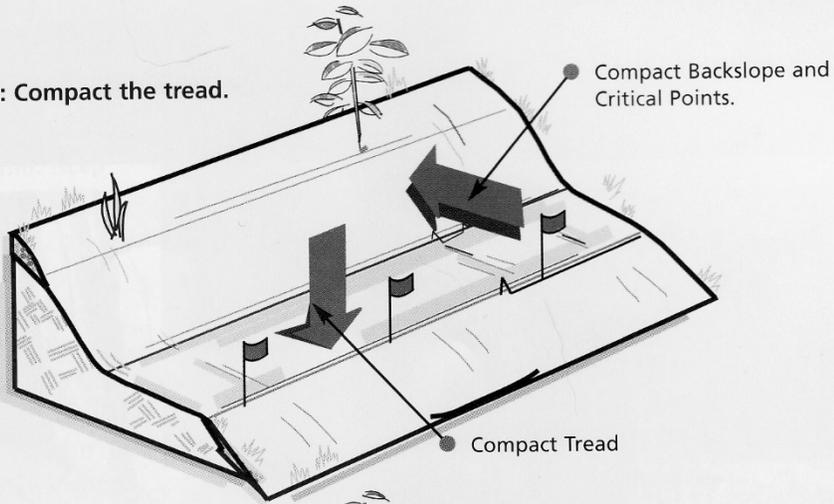


Bench Cut

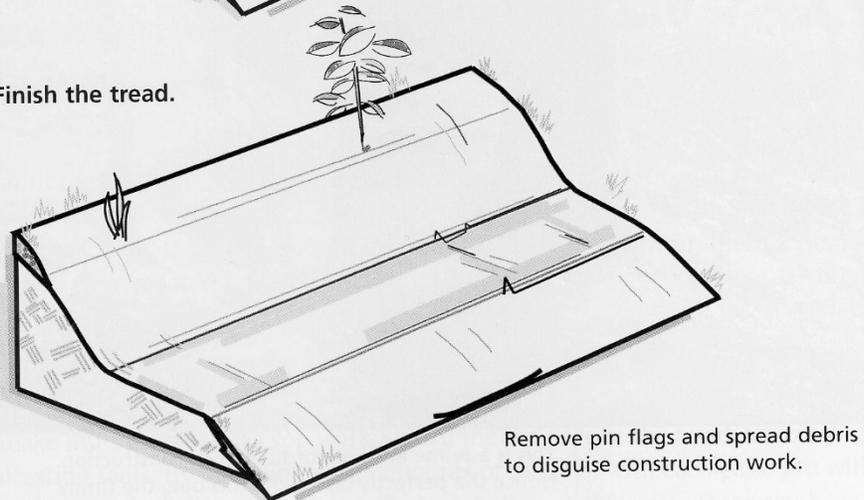
Step 3: Outslope the trail tread.



Step 4: Compact the tread.



Step 5: Finish the tread.



MACHINE BUILDING FINISH WORK

After the mini-excavator has roughed in the tread, a series of actions is required to finish the trail.

1. *Remove* rocks, roots and organic matter (duff) from the trail tread and backslope using *Pulaski, Rogue hoe, Rock bar* and/or *Loppers*. Stage rocks on uphill edge of trail to utilize if needed. Discard roots and spread evenly downhill of tread.
2. *Compact* backslope of trail by tamping with a *McLeod*. Take care to round the very upper edge of backslope – don't leave it in an abrupt angle as dug by the excavator.
3. *Pull any* remaining duff away from outside edge of tread (the "toe") with *McLeod, Rogue hoe* or *garden rake*. Make sure toe is well defined and provides good water drainage. Use Duff to cover all raw earth adjacent to tread, evenly spreading excess downhill of tread.
4. *Rake* tread smooth using *garden rake* and/or *McLeod*. For insloped berm turns, rollers and table tops pointed and *flat bladed* shovels along with the wheelbarrow may be needed to move and compact dirt.
5. *Set grade* – Use a *McLeod* to create a five to seven percent outslope except on rollers and table tops. Do not assume that the outslope created by the mini-excavator is sufficient. Insloped turns have seven percent or greater sideslope.
6. *Compact* the tread by tamping with a *McLeod*, leaving a smooth, thoroughly packed surface. *Flat bladed* shovels can also be used to "slap pack" berms.
7. *Ride* each key section before final finishing to verify proper flow before machine and operator leave the section.
8. *Utilize* sod and duff to armor back side of berms and edges of rollers and to promote revegetation.
9. "Scree" finished tread –Sprinkle or rake leaves and duff (organic matter) along edge of trail, defining the "toe" and camouflaging construction on downhill side of trail. Use care not to obstruct water flow at "toe" edge of tread.

Finishing Berms

1. Use *McLeod* to filter rocks from rough built berm.
2. Shape berm to near finished condition with *McLeod*.
3. Use *garden rake* to fine tune shape of berm and smooth surface
4. Compact entire berm with *McLeod* and/or slap pack with flat head shovel.

Tools:

Mini-Excavator, garden rake, *McLeod*, *Pulaski*, *Rogue hoe*, rock bar, pointed shovel, flat back shovel and Wheel barrow.

The Finished Product:

Trail should be *open and flowing* featuring sweeping turns smooth compacted surfaces with long, extended rollers and/or table tops. Wide tread with long sight lines reassure less-skilled riders and enable skilled riders to go faster. Tread surface compacted and sloped five percent, compacted backslope. Visual appearance: natural. Do not line the trail with logs, sticks or rocks that can trap water. Trail must meet designated CAMBA Technical Trail Classification.

TRAIL BUILDING AND MAINTENANCE TOOLS

Uses, Precautions, and Care

Hand Tools

- *McLeod*: Raking debris and duff. Moving soil. Shaving off sod and organic matter. Shaping tread. Compacting. Good for filtering rocks out of loose soil in tread or berms. Not for prying or overhead chopping.
- *Rogue Hoe*: Scalping sod and organic matter. Digging tread. Cutting smaller roots. Moving soil. Shaping tread. Not best tool for rocky soils. Keep edges sharp.
- *Pulaski*: Ax for cutting roots. Hoe for digging, chopping, scalping. Beware of rocks when using ax blade to cut roots. Keep tool sharp.
- *Loppers*: cutting branches and roots. Don't over-stress handles. Keep tool sharp.
- *Rock Bar*: Prying out and moving rocks, roots, stumps, debris.
- *Pointed Shovel*: Excavating and moving soil. Don't use as pry bar.
- *Flat Shovel*: Moving soil. Shaping tread. Compacting soil.
- *Garden Rake*: Raking debris and duff. Smoothing tread prior to compacting. Don't lay on ground with teeth facing up.
- *Four-Tine Cultivating Rake*: Loosening soil and removing rocks and debris. Don't lay on ground with teeth facing up.

Safety Precautions for Trail Building and Maintenance

- Safety begins with a good grip.
- Secure your footing.
- Maintain adequate distance (at least one tool's length) from others while using or carrying tools.
- Make sure you have a clear area in which to swing.
- Gloves are recommended when using all hand tools.
- Wear safety glasses.
- Don't swing a tool overhead.
- Keep the handle low to the ground on impact. This will put the head into the ground in case of a mishit.
- Carry tools properly with sharp edge toward the ground.
- Choose the right tool for the job.
- Announce your presence before passing on trail.

Use of Power Tools

Use of hearing and eye protection is required. Do not use a power tool if you do not feel comfortable with its use.

Chainsaws, power brush saws and leaf blowers use a gas/oil mixture of 50:1. One ounce of oil to one gallon of gas. Oil will be available in one or two ounce bottles.

The DR Mower/Trimmer and DR Brush Mower use straight gas – no oil mixture. Check engine oil prior to beginning work.

Use caution when refueling – make sure the tool has cooled for a minute or two before adding fuel.

If purchasing gas, buy only premium grade.