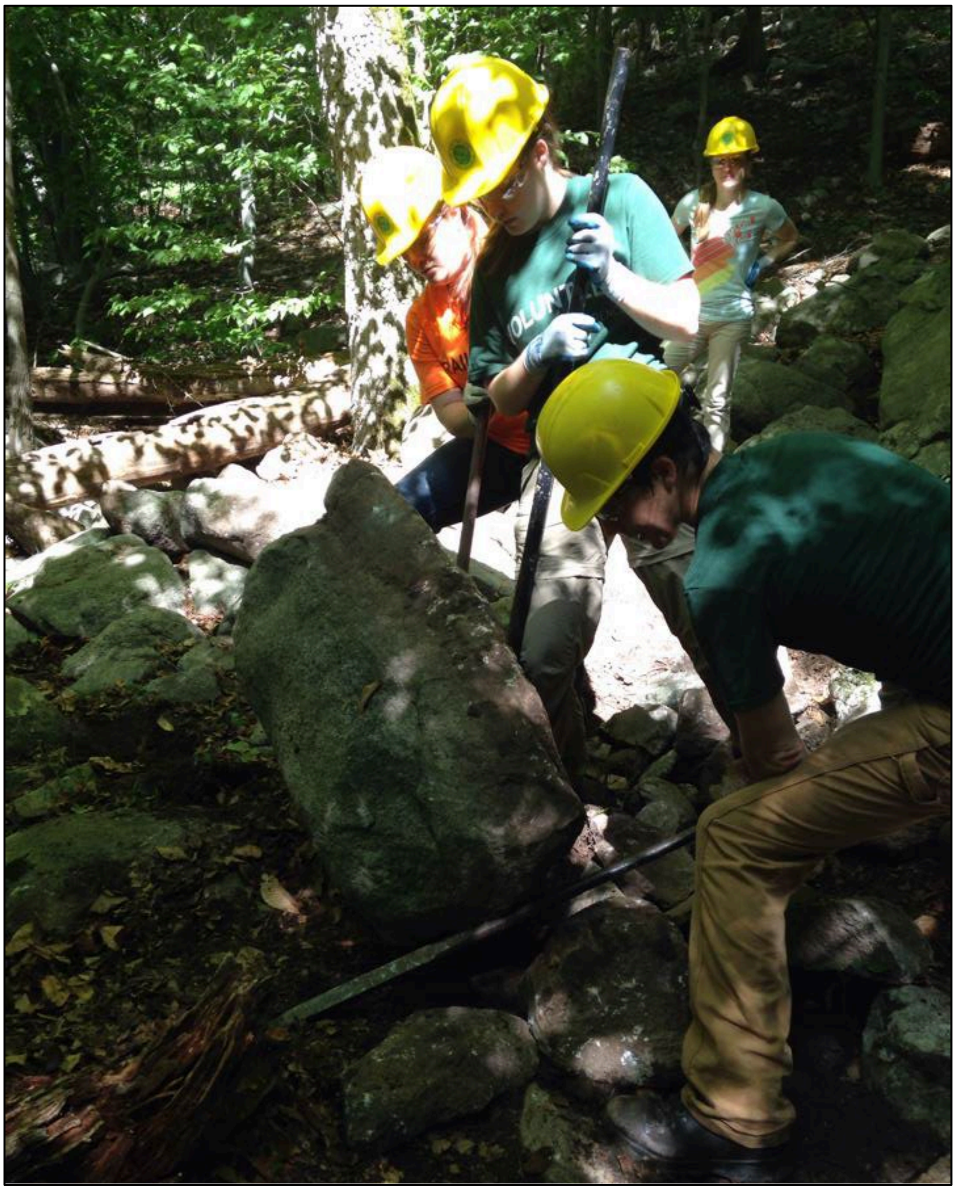
Primitive Footpath Trail Construction

Common Structures and Techniques



About the New York-New Jersey Trail Conference

The New York-New Jersey Trail Conference has partnered with parks to create, protect, and promote a network of over 2,100 miles of public trails in the New York-New Jersey metropolitan region.

The Trail Conference organizes volunteer service projects that keep these trails open, safe, and enjoyable for the public. We publish maps and books that guide public use of these trails.

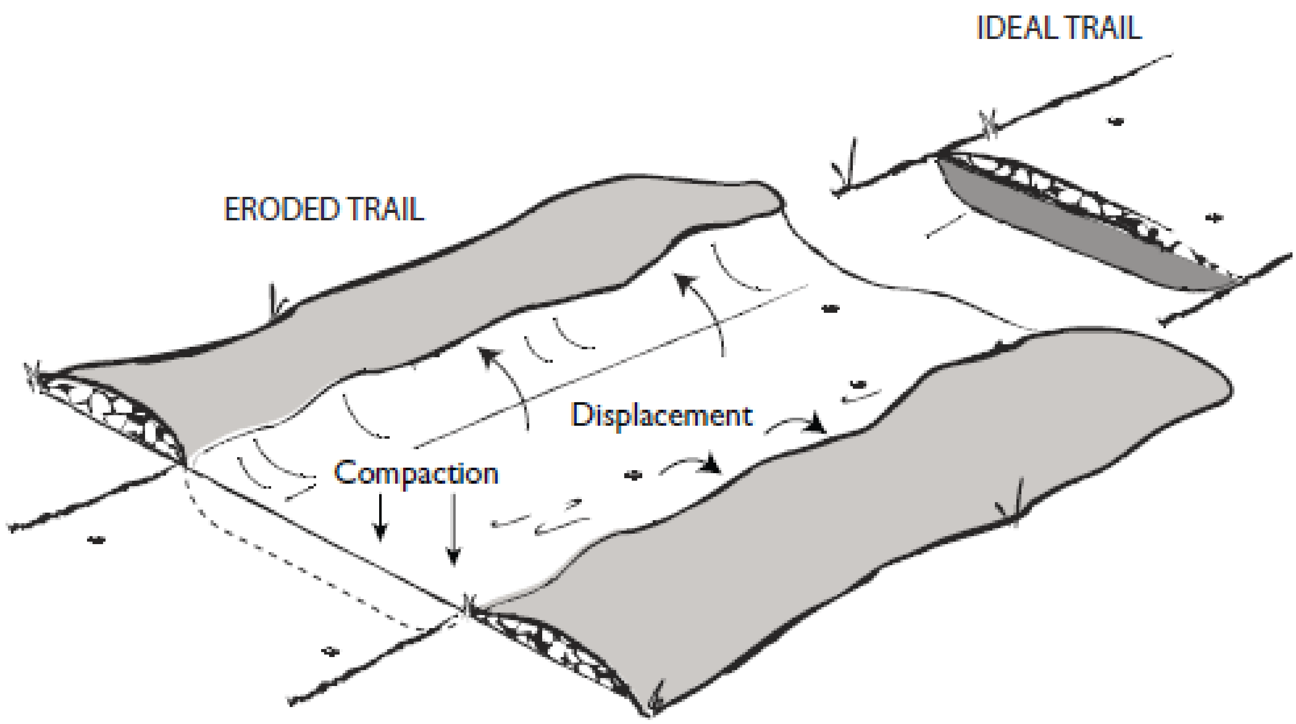
The Trail Conference is a nonprofit organization with a membership of 10,000 individuals and 100 clubs that have a combined membership of over 100,000 active, outdoor-loving people.

Last Revised 11.3.18
Peter Dolan

Why We Build These Structures

The intent of a "primitive footpath" hiking trail is to be as low-impact as possible. These trails often rely on the minimum trailbuilding required to provide a safe, navigable, and sustainable experience. However, even these primitive footpaths almost always require a bit of trail construction to avoid erosion and drainage issues due to the twin factors of compaction and displacement.

When walking, boots push down and compress soil (compaction) while kicking aside loose material (displacement). Over time, on most surfaces, this causes the trail itself to become lower than the surrounding area. As a result, the trail can form a depression in which water flows or pools. Water flowing down the trail causes further erosion, and water pooling causes hikers to skirt the wet spot – thus widening the area of impact.



Ideally, we want the reverse to be true – trails on flat ground should be convex or elevated, not concave, so that they stay dry and firm instead of wet and mucky. On slopes we want trails to gently slope out, which allows water to flow naturally downslope instead of catching in trail troughs. The correct solution when dealing with wet spots can vary widely depending on trail users, soil types, local materials, etc., but the intent is the same: undertake some work in advance, which may minimally disturb the ground, in order to offset potentially severe long-term erosion consequences.

The structures and techniques shown in this document are meant to be used in combination with trail work plans by an experienced trail builder, or by volunteers trained and supervised by a trail professional, and undertaken with the full knowledge and permission of all pertinent land managers.

Examples of eroded trails built without the structures discussed in this document.

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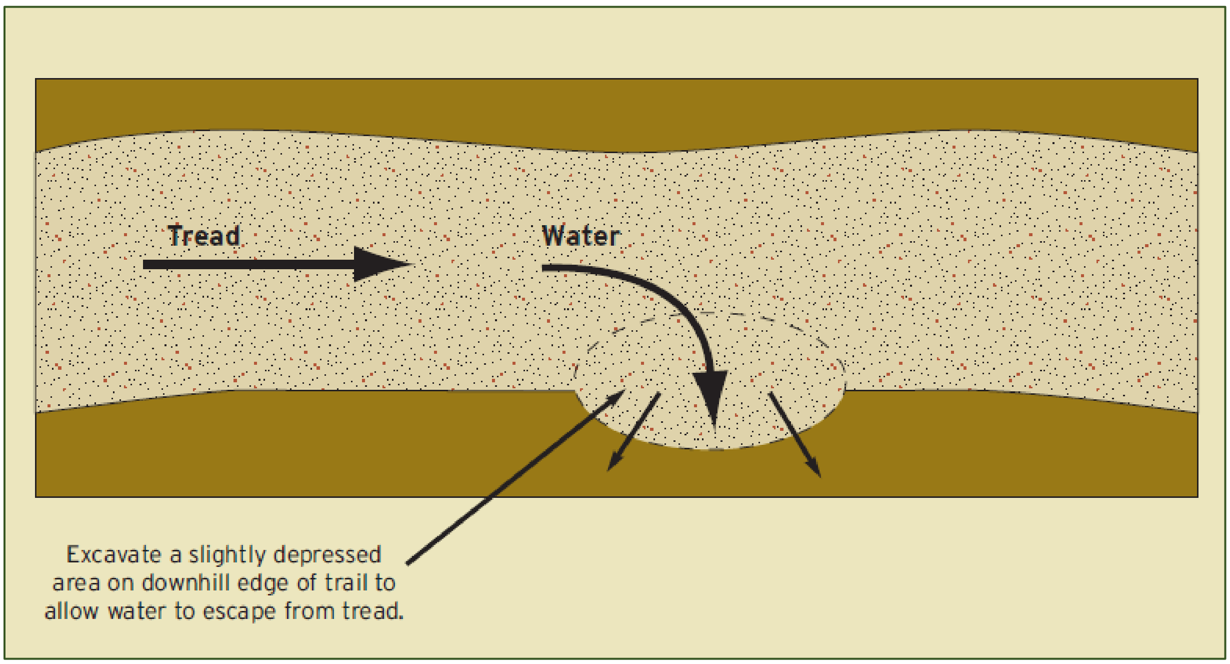
Tread Drainage: Drainage Dip 1.1

Intent: To help shed water off the trail, particularly in stretches with prolonged constant grades. By guiding water off the trail downslope, regular drainage dips help keep water velocity low and reduce the amount of erosion that the trail undergoes.

How it Works: Water flows down the trail. When it hits a drainage dip, it naturally flows down the dip and off the trail instead of continuing to flow down the trail in a prolonged sluice.

Impact: By getting water off the trail before it accumulates volume and velocity, drainage dips help prevent trails from being carved into ditches or gullies. This reduces the sediment that water can displace, reducing overall erosion.

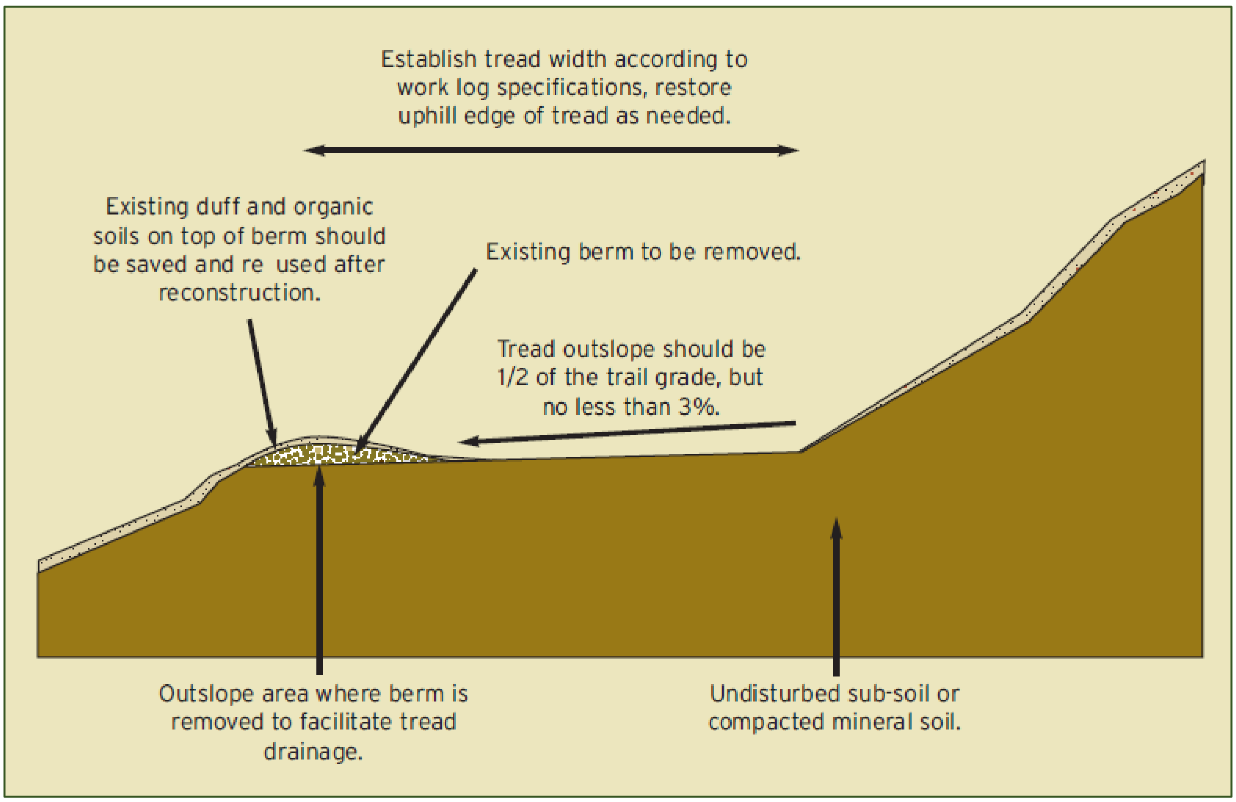


Tread Drainage: De-Berm (Remove Berm) 1.2

Intent: To keep water from being trapped on the trail and funneling down it – instead, to allow water to flow across the trail and continue downslope on its natural course.

How it Works: Berms can be formed either by natural compaction, displacement, and erosion or by improper construction. When the berm is cut down with a tool and the sediment spread thinly across the environment, water can again freely flow across the outsloped trail.

Impact: Restoring laminar (or sheet) flow across the trail keeps turbulent water from channeling down the trail and causing severe erosion.

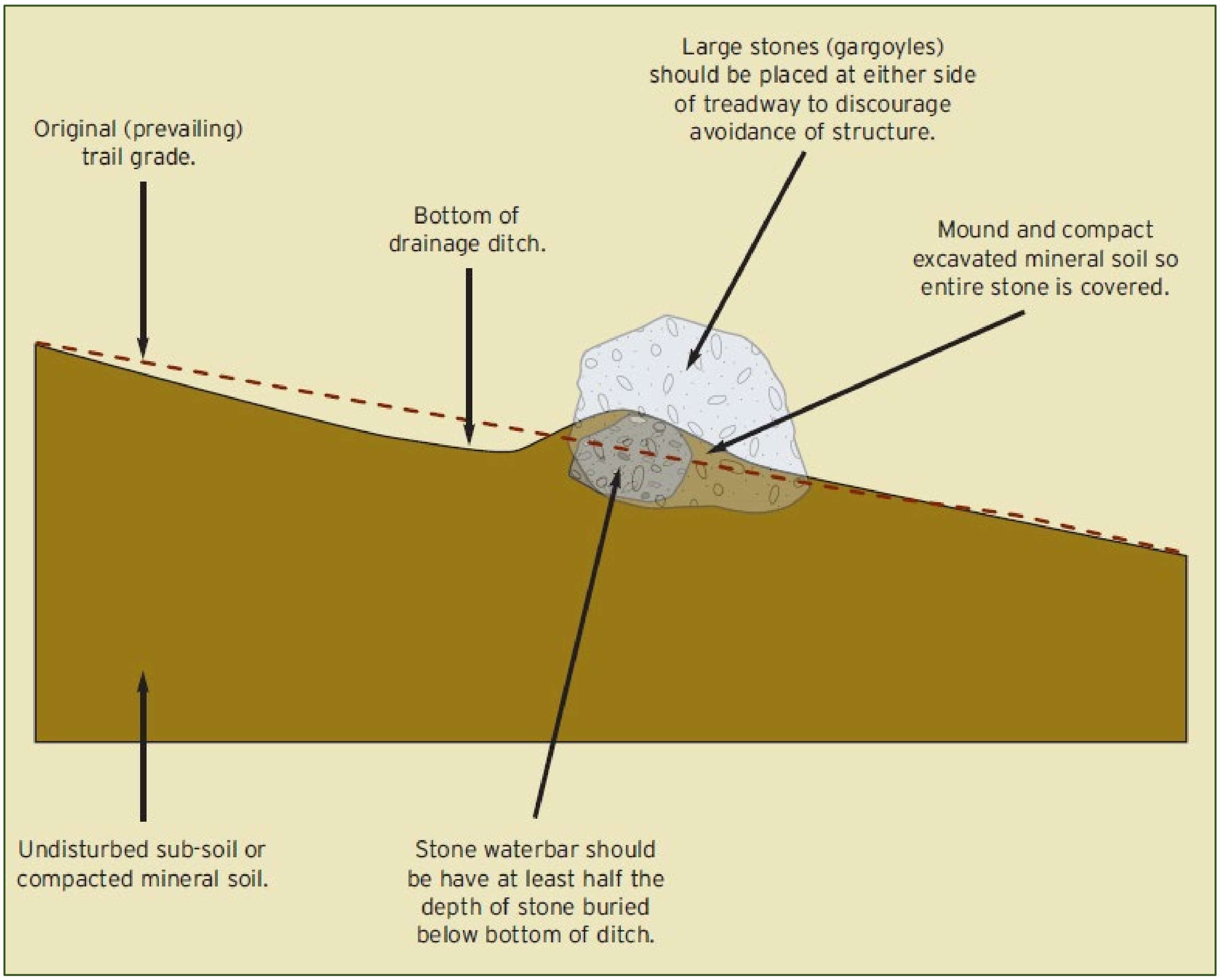


Tread Drainage: Stone-Reinforced Earthen Waterbar 1.3a

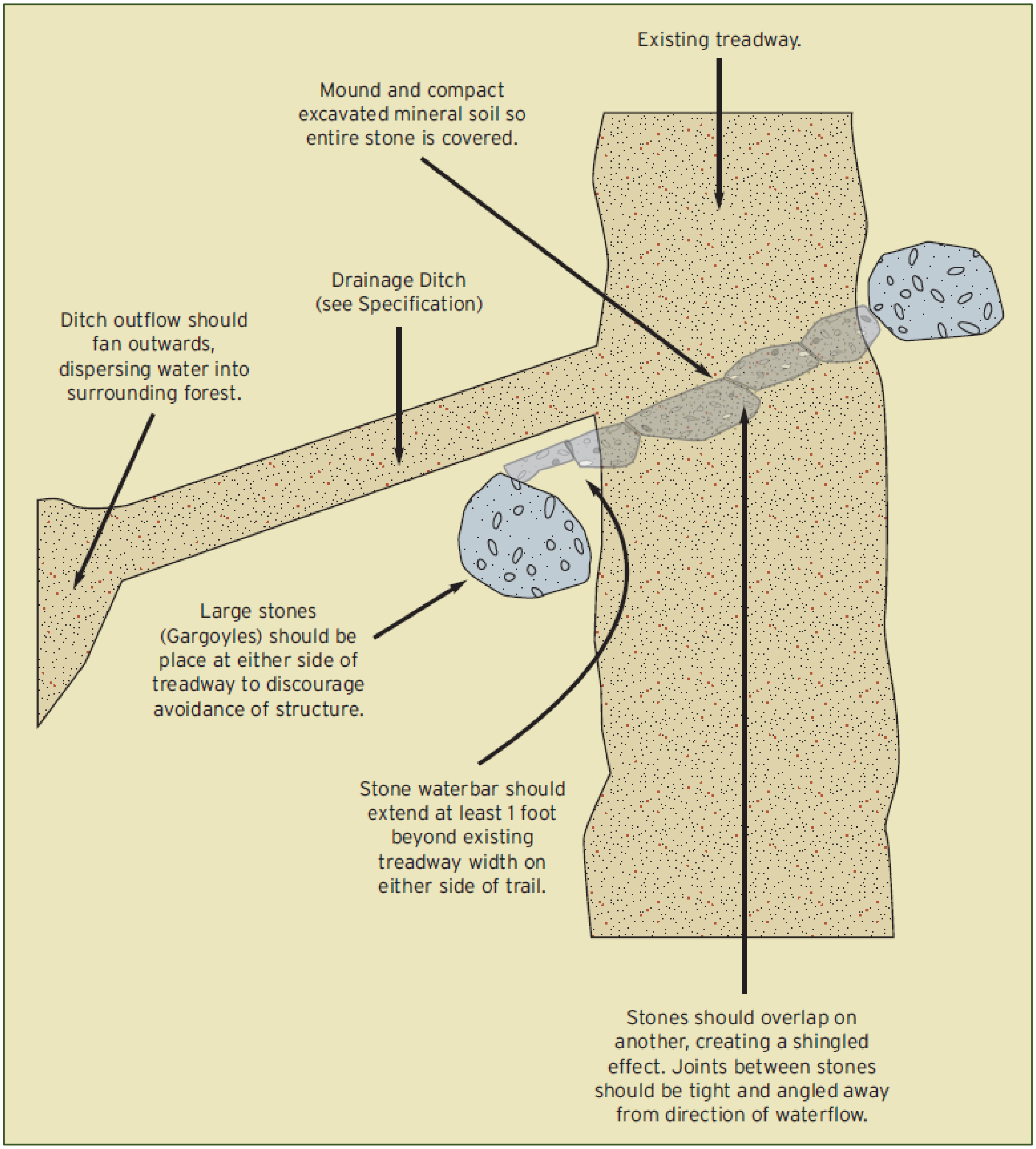
Intent: To help shed water off the trail, particularly in stretches with prolonged constant grades. Waterbars are used where water flow is too severe for drainage dips to function – because of their stone construction, waterbars are very durable. By guiding water off the trail downslope, waterbars help keep water velocity low and reduce the amount of erosion that the trail undergoes.

How it Works: Water flows down the trail. When it hits a waterbar, its flow is guided down the drain and off the trail instead of continuing to flow down the trail in a prolonged sluice.

Impact: By getting water off the trail before it accumulates volume and velocity, waterbars help prevent trails from being carved into ditches or gullies. This reduces the sediment that water can displace, reducing overall erosion.



Tread Drainage: Stone-Reinforced Earthen Waterbar Plan View 1.3b



Tread Drainage: Stone-Reinforced Earthen Waterbar Plan View 1.3c

A stone waterbar, with the runoff drain visible on the left.

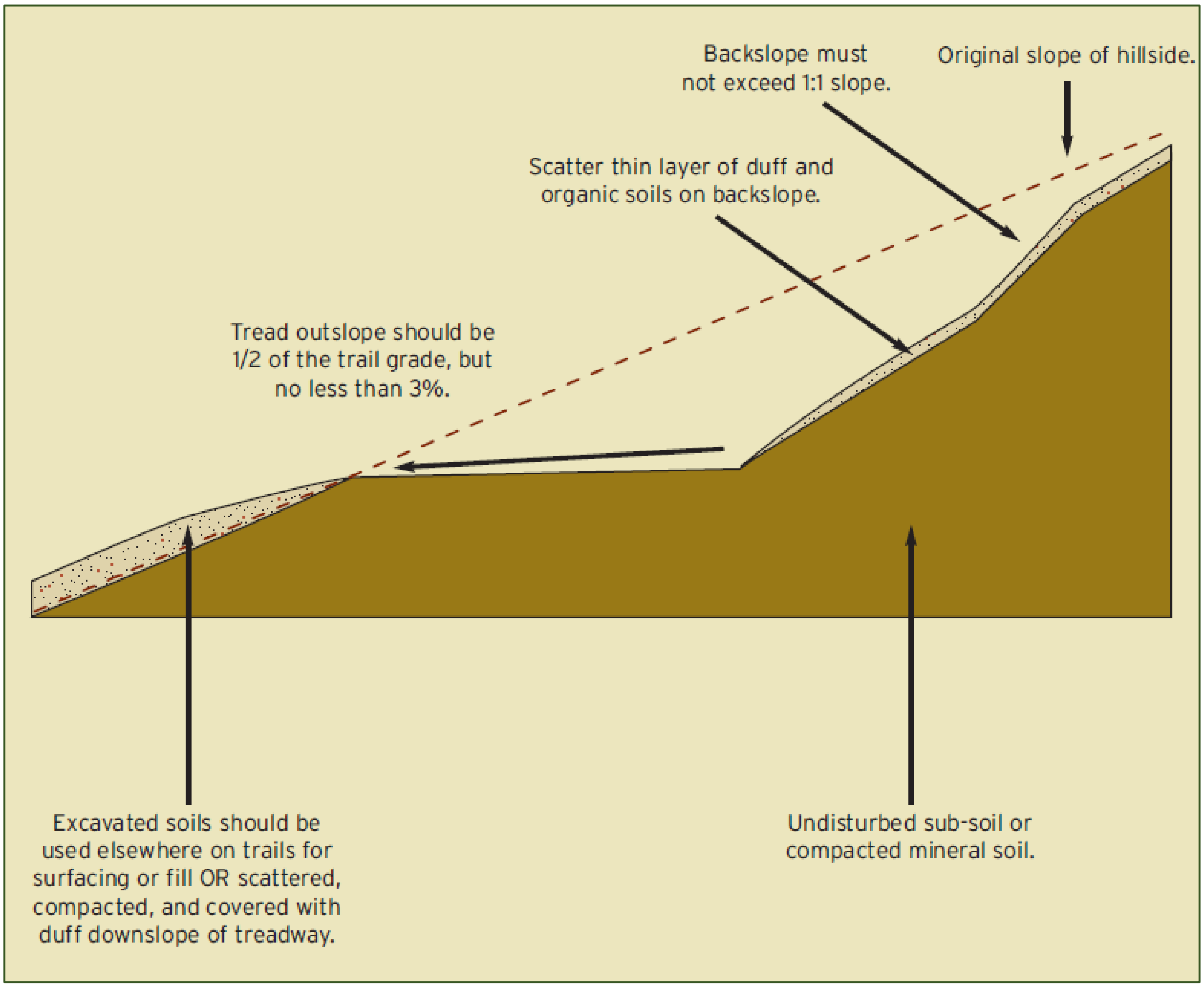
Source: http://hardcorps.blogs.redding.com/2016/06/trail-construction-water-bars/

Tread Construction: Full Bench Sidehill Construction — 2.1a

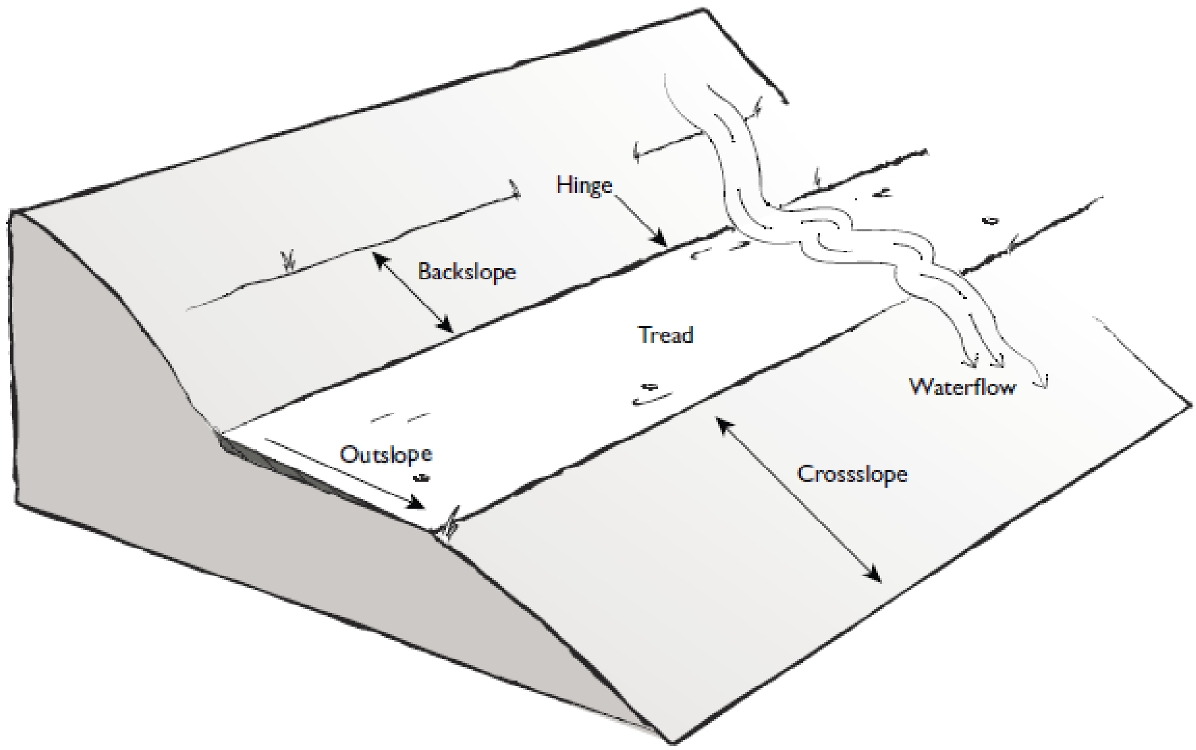
Intent: Create a gently outsloped walking surface which comfortably supports users while allowing water to naturally flow and drain downslope.

How it Works: Substrate is excavated with hand tools (picks, mattocks, shovels, etc.) and placed immediately downslope before being covered with leaves, sticks, and forest litter. The walking surface is intentionally graded to slope outward and down at no less than 3 percent grade (as seen in cross-section).

Impact: By cutting into steeply-sloped substrate, sidehill construction allows a relatively level walking surface even on steep slopes. The gentle outslope left on the trail surface allows water to naturally flow over and past the trail on its way downhill, instead of gathering in the trail and causing erosion as it moves down the trail.



Tread Construction: Full Bench Sidehill Construction 2.1b

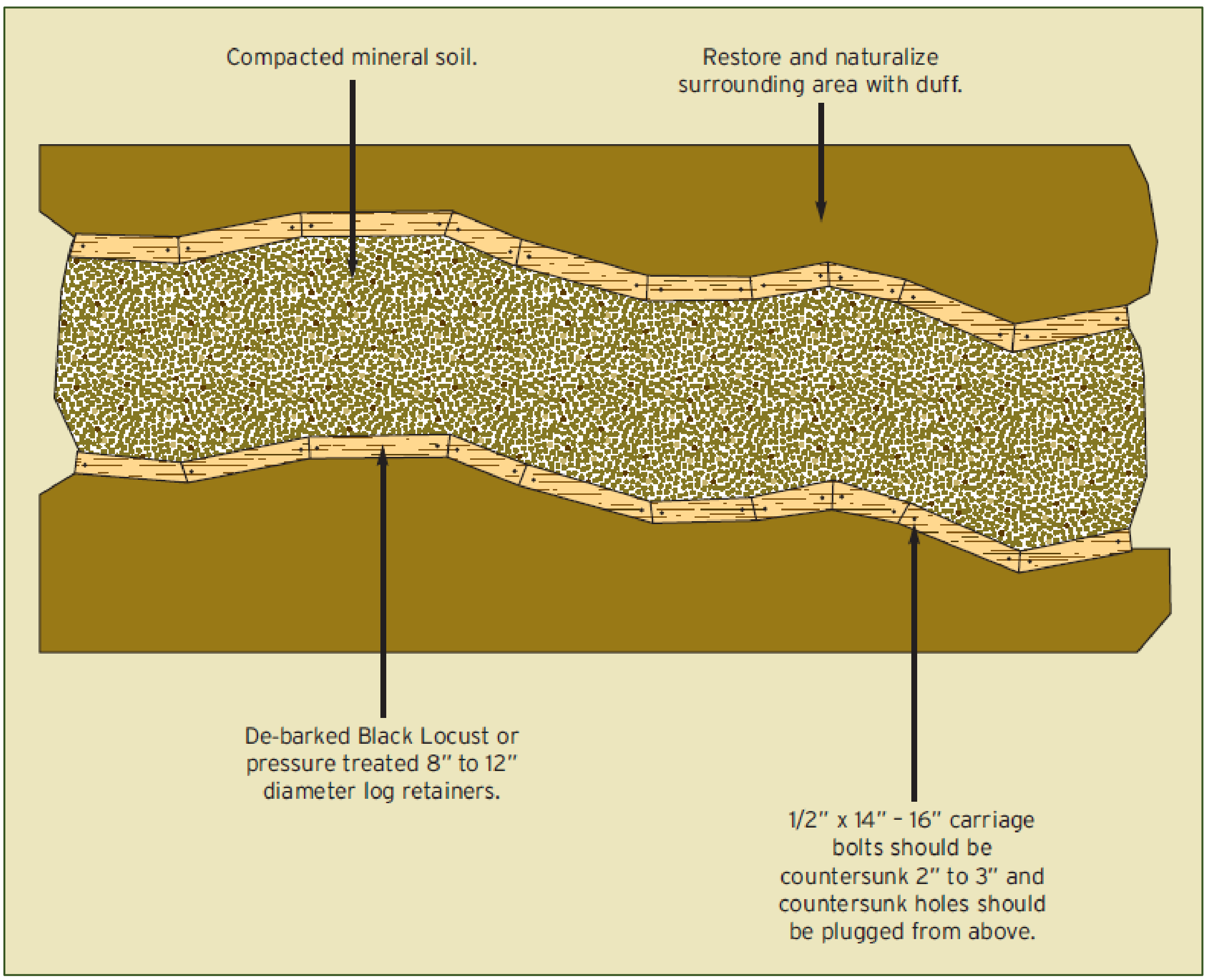


Tread Construction: Wood Turnpike 2.2a

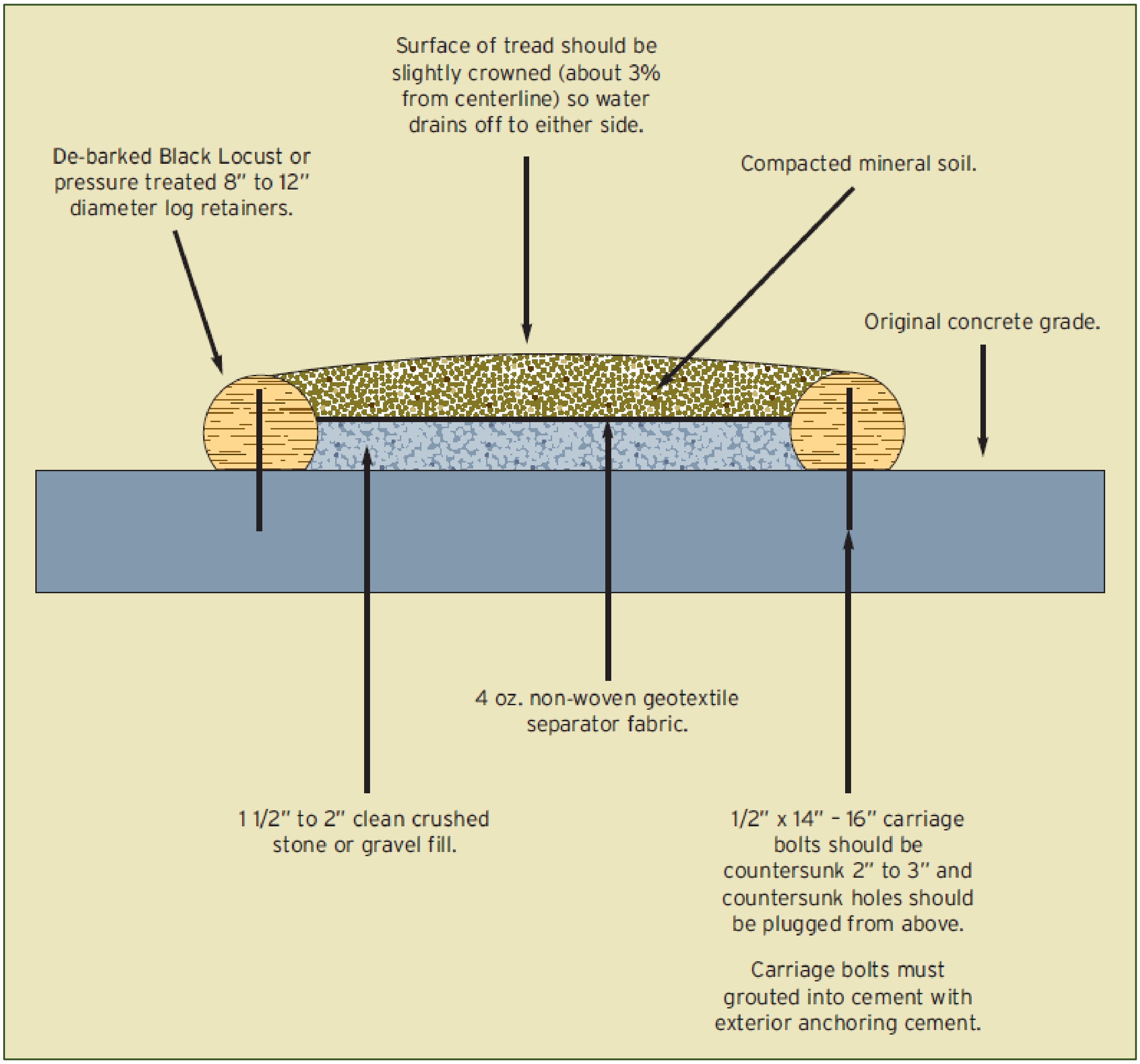
Intent: To slightly elevate short portions of tread across wet areas, allowing a firm and dry walking surface so that trail users do not attempt to circumvent the spot (thus widening the wet area and exacerbating the problem).

How it Works: Local timber (often small fallen trees) is set in two rows, comprising the "retaining walls" of the structure. The area between these rows is filled with smaller rocks or crush made onsite, then covered with onsite-sourced mineral soil (which is more resistant to erosion than organic "duff" topsoil).

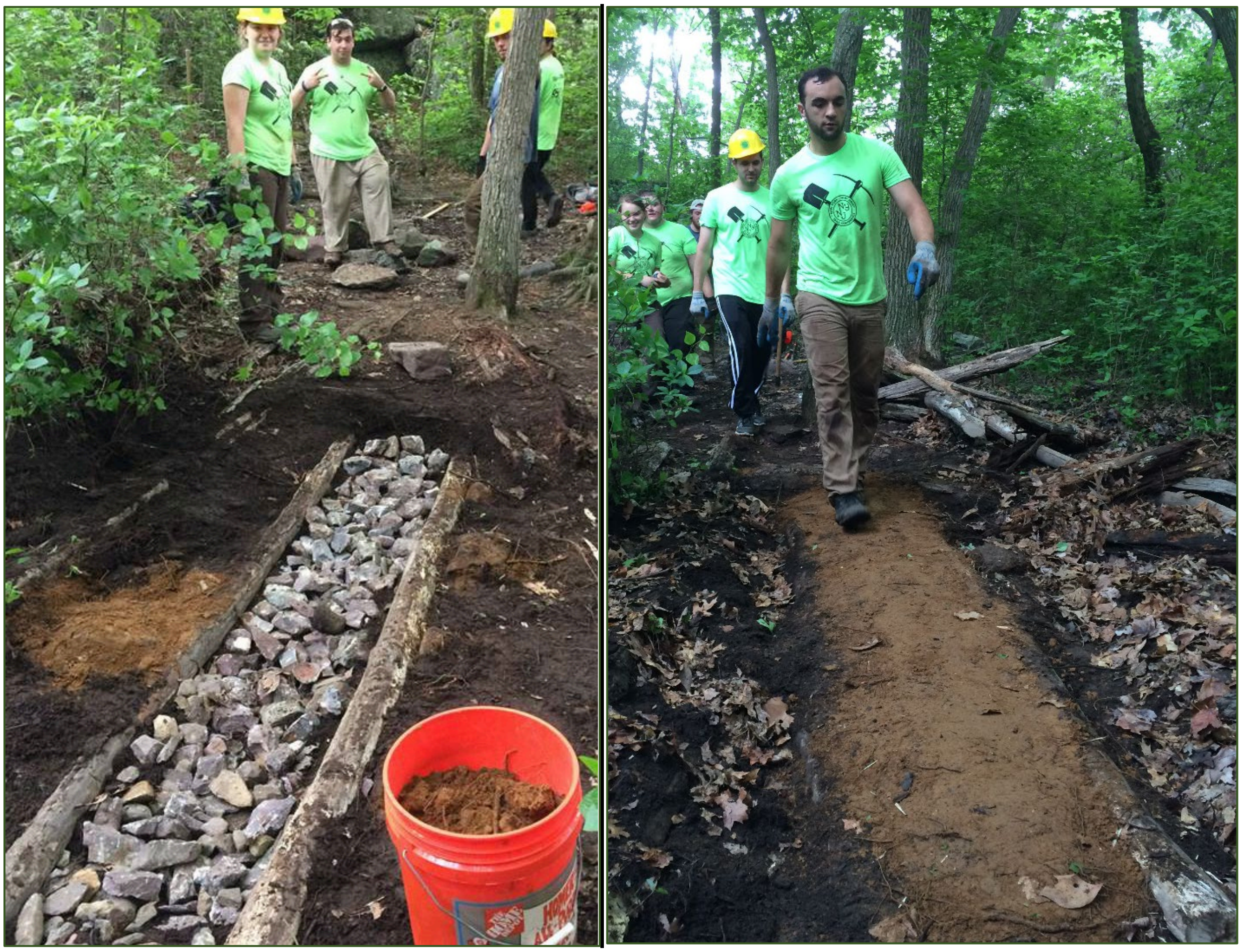
Impact: Having a dry and pleasant walking surface keeps users on the established trail, minimizing unintended damage to the local environment.



Tread Construction: Wood Turnpike - Section View 2.2b



Tread Construction: Wood Turnpike 2.2c



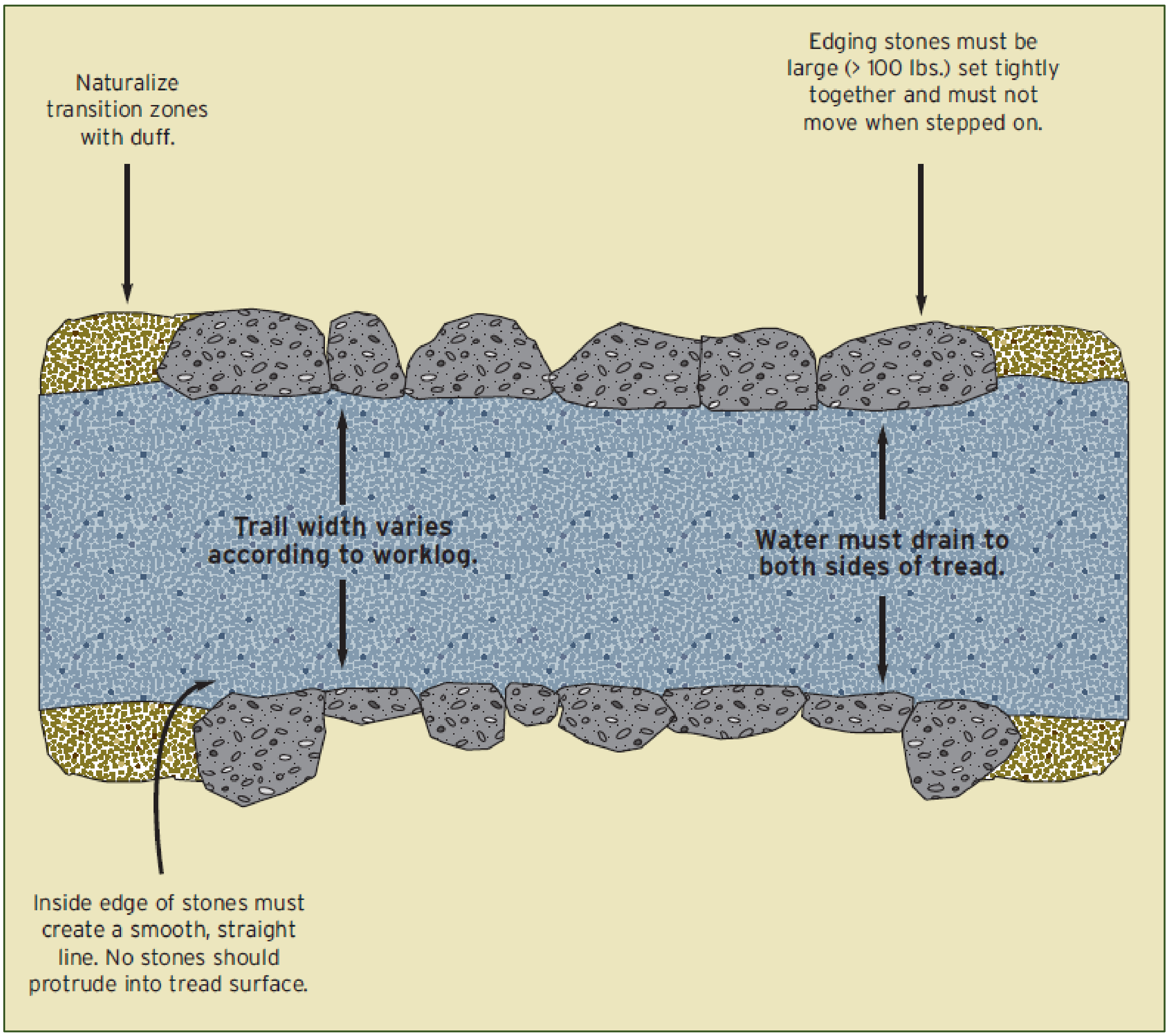
Timber turnpike after crush fill, and after mineral soil surfacing.

Tread Construction: Stone Turnpike 2.3a

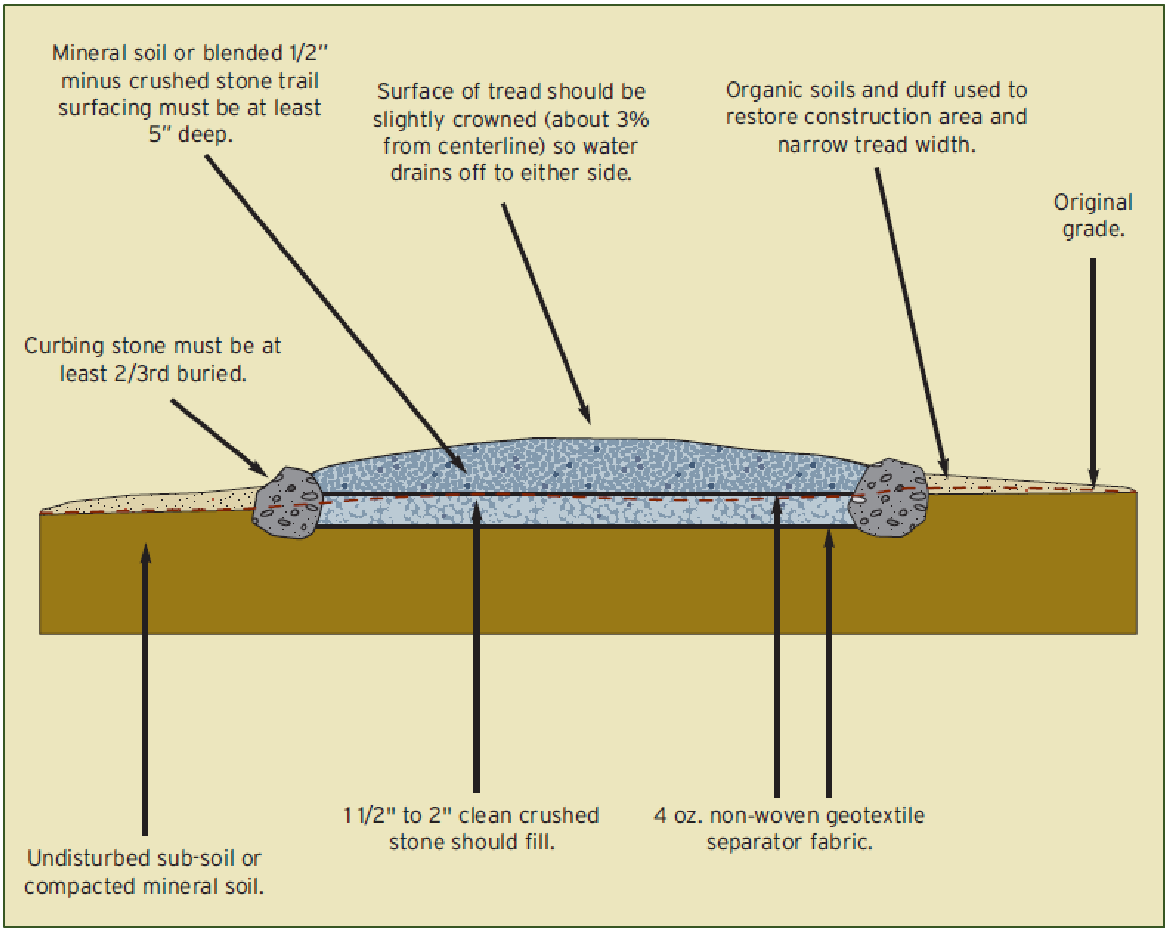
Intent: To slightly elevate short portions of tread across wet areas, allowing a firm and dry walking surface so that trail users do not attempt to circumvent the spot (thus widening the wet area and exacerbating the problem).

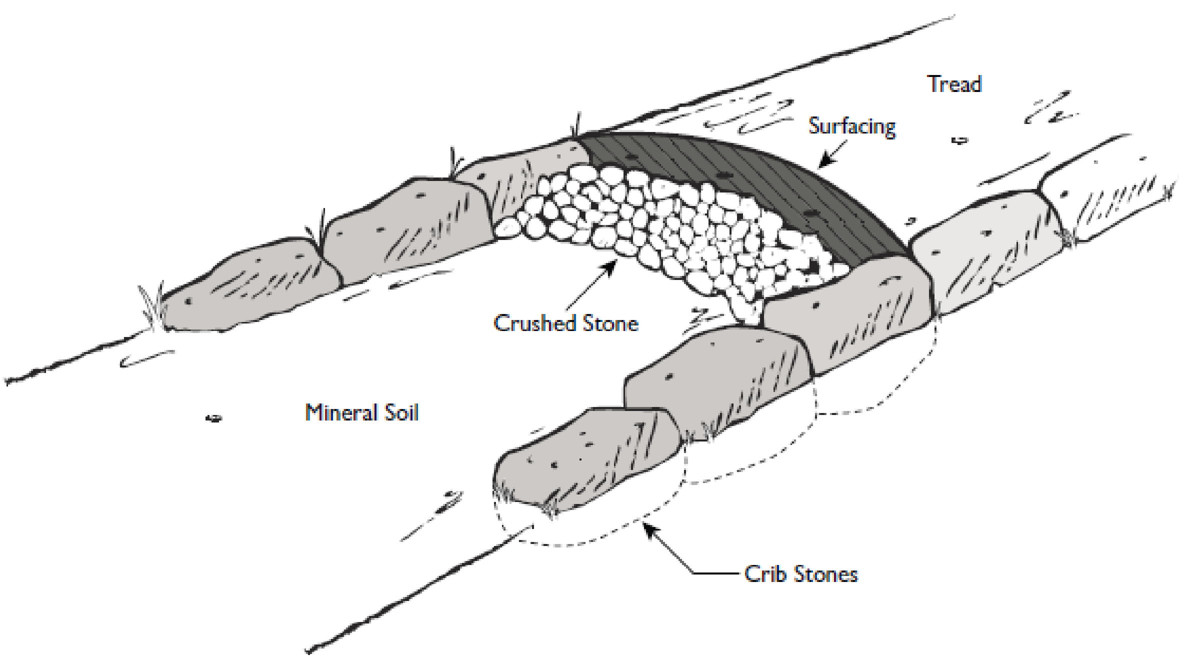
How it Works: Local rocks are set in two rows, comprising the "retaining walls" of the structure. The area between these rows is filled with smaller rocks or crush made onsite, then covered with onsite-sourced mineral soil (which is more resistant to erosion than organic "duff" topsoil).

Impact: Having a dry and pleasant walking surface keeps users on the established trail, minimizing unintended damage to the local environment.



Tread Construction: Stone Turnpike - Section View 2.3b



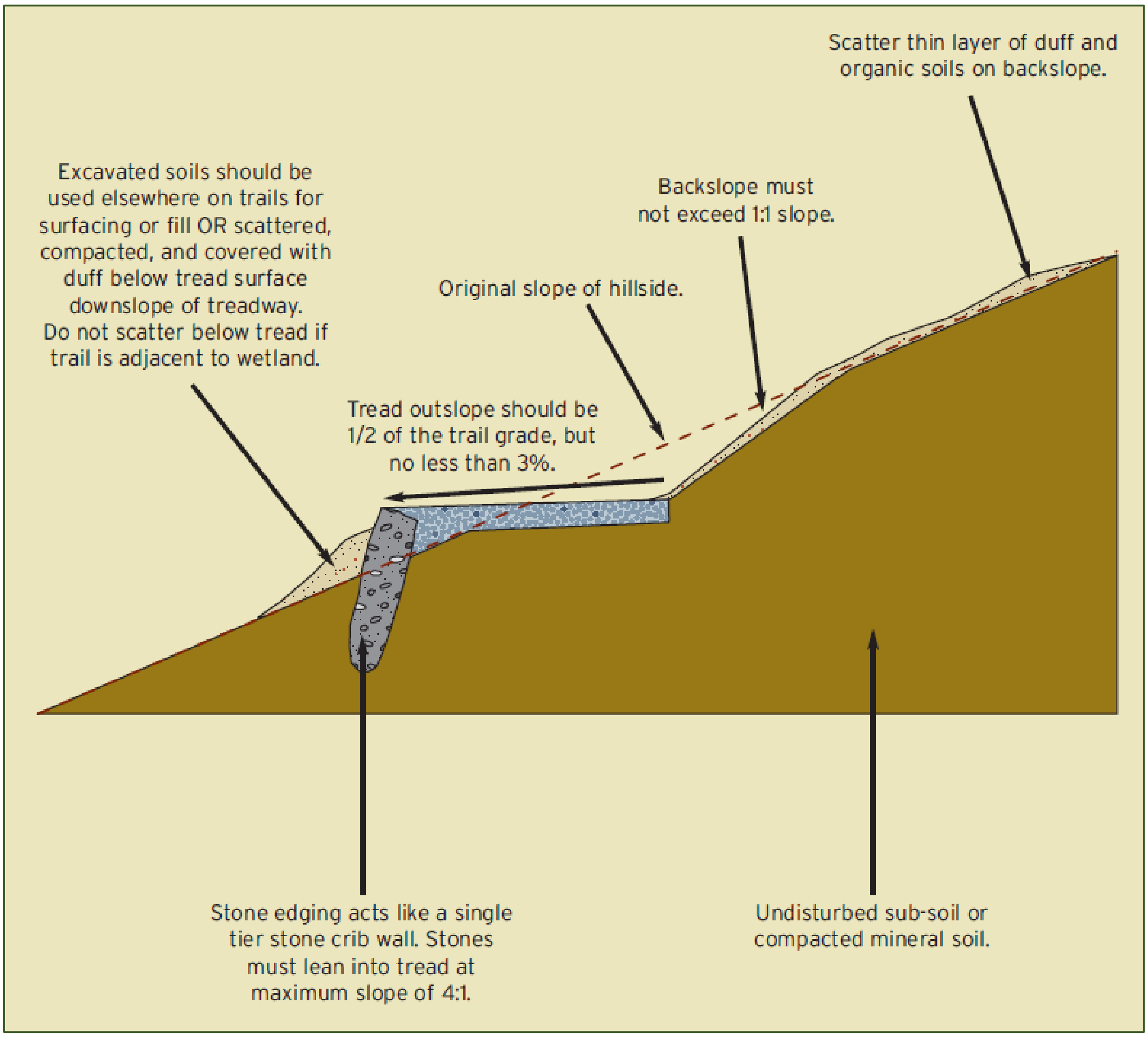


Tread Construction: Stone Edging 2.4a

Intent: To retain soil and keep a solid walking surface.

How it Works: Local stones are placed along the edge of the trail, helping minimize erosion and keep the walking surface relatively level. As always on slopes, the tread surface should slope out at no less than 3 percent grade so that water flows easily across the trail and downhill.

Impact: Trails last longer, are subject to less erosion, and provide a more comfortable, level and stable walking surface.



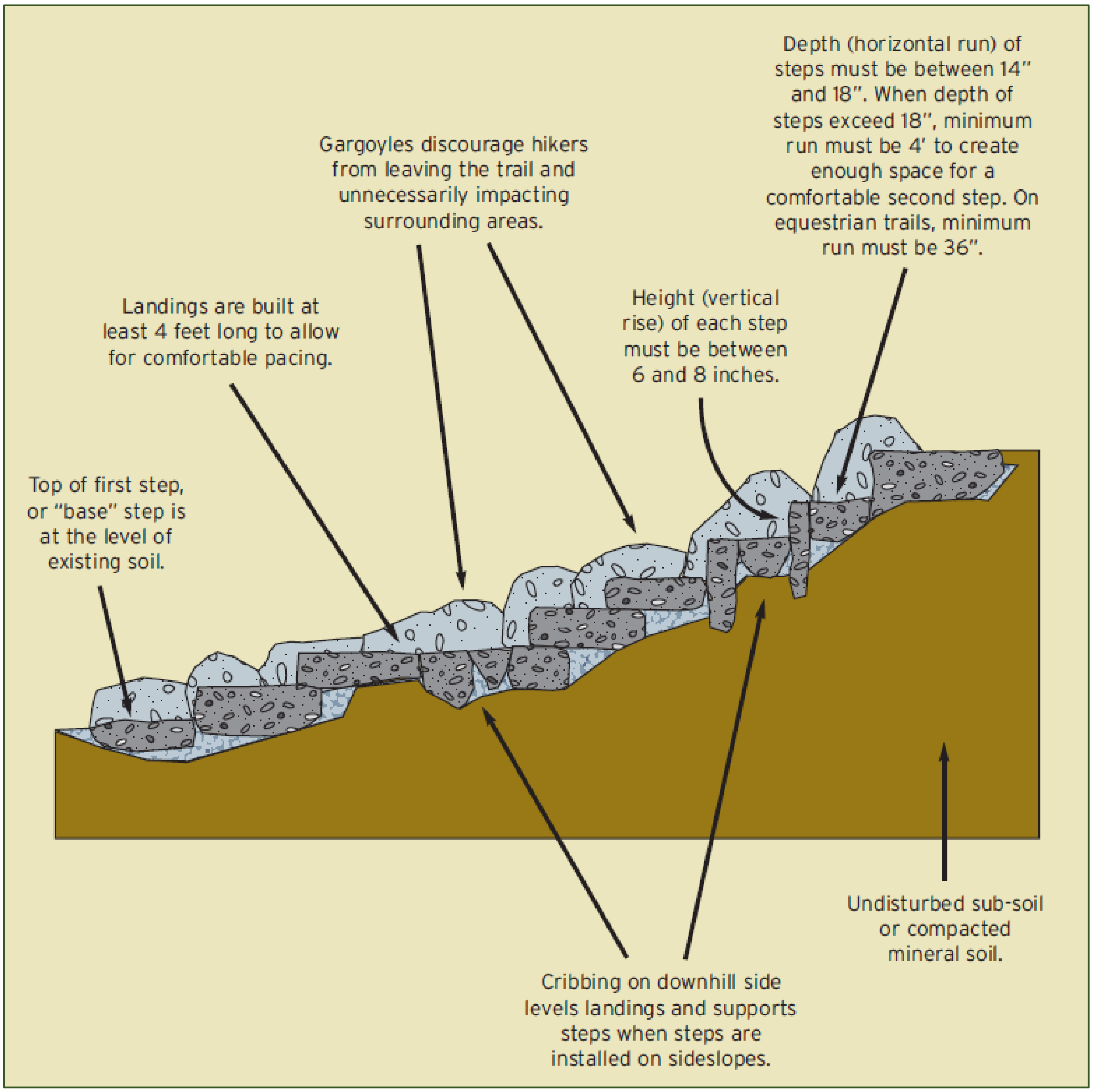
Tread Construction: Stone Edging 2.4b

Tread Hardening Structures: Stone Steps - Section View | 3.1a

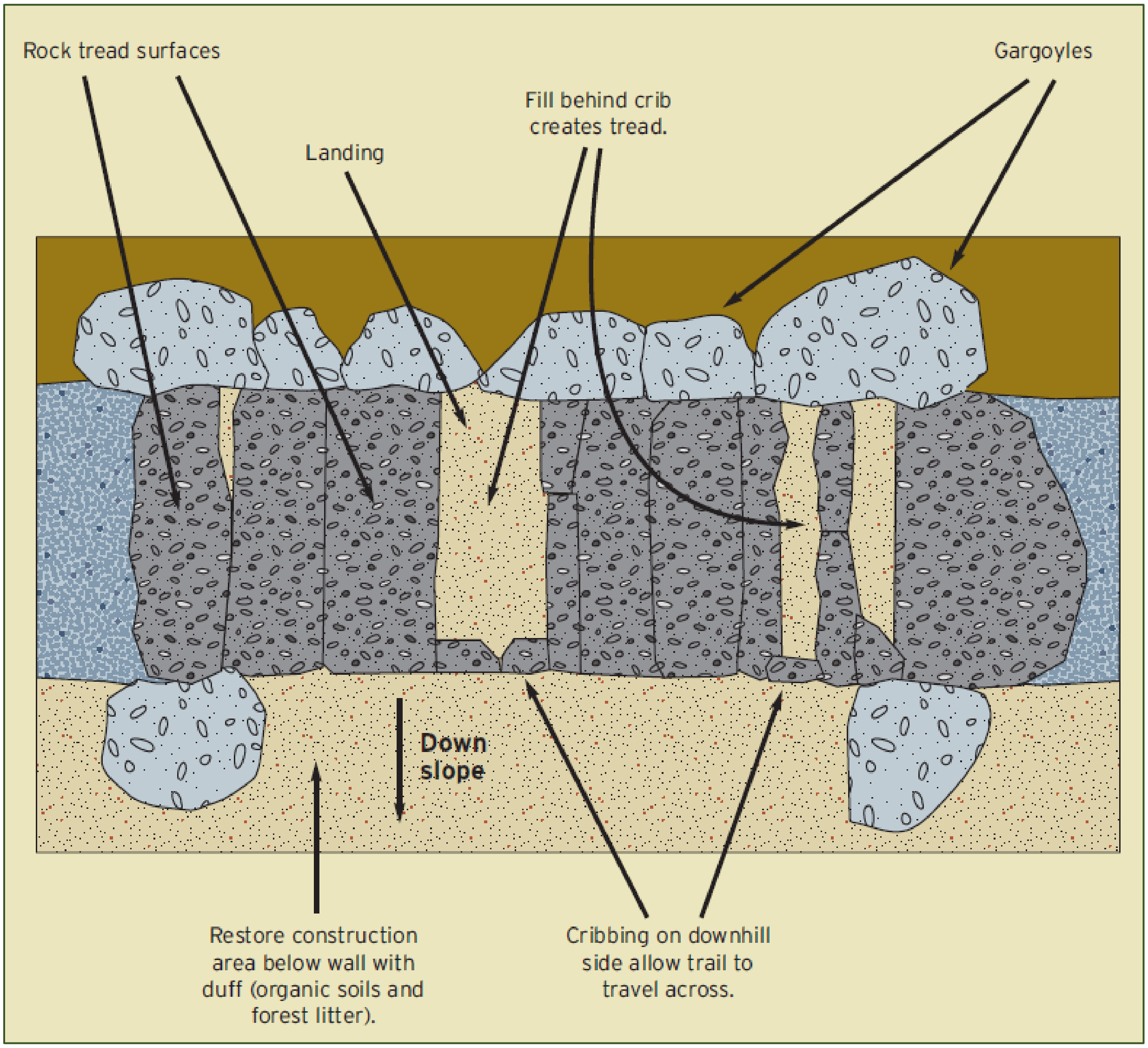
Intent: To rearrange local stones to provide safe, comfortable hiking ascents up steep, eroded, gullied, or otherwise unsafe trail sections.

How it Works: Local stones are rearranged so that flat faces are exposed on top. Successive stone steps typically "lock in" behind the step below so that the series of steps remains stable, durable, and resistant to under-cutting erosion.

Impact: Stone steps serve to check erosion in deeply gullied ascents where no other solution is possible. If built correctly they are low-impact, look like part of the natural environment, and last indefinitely with little needed maintenance.



Tread Hardening Structures: Stone Steps 3.1b



Tread Hardening Structures: Stone Steps - Section View 3.1c

Before and after shots of a previously unsafe trail stretch converted to steps.

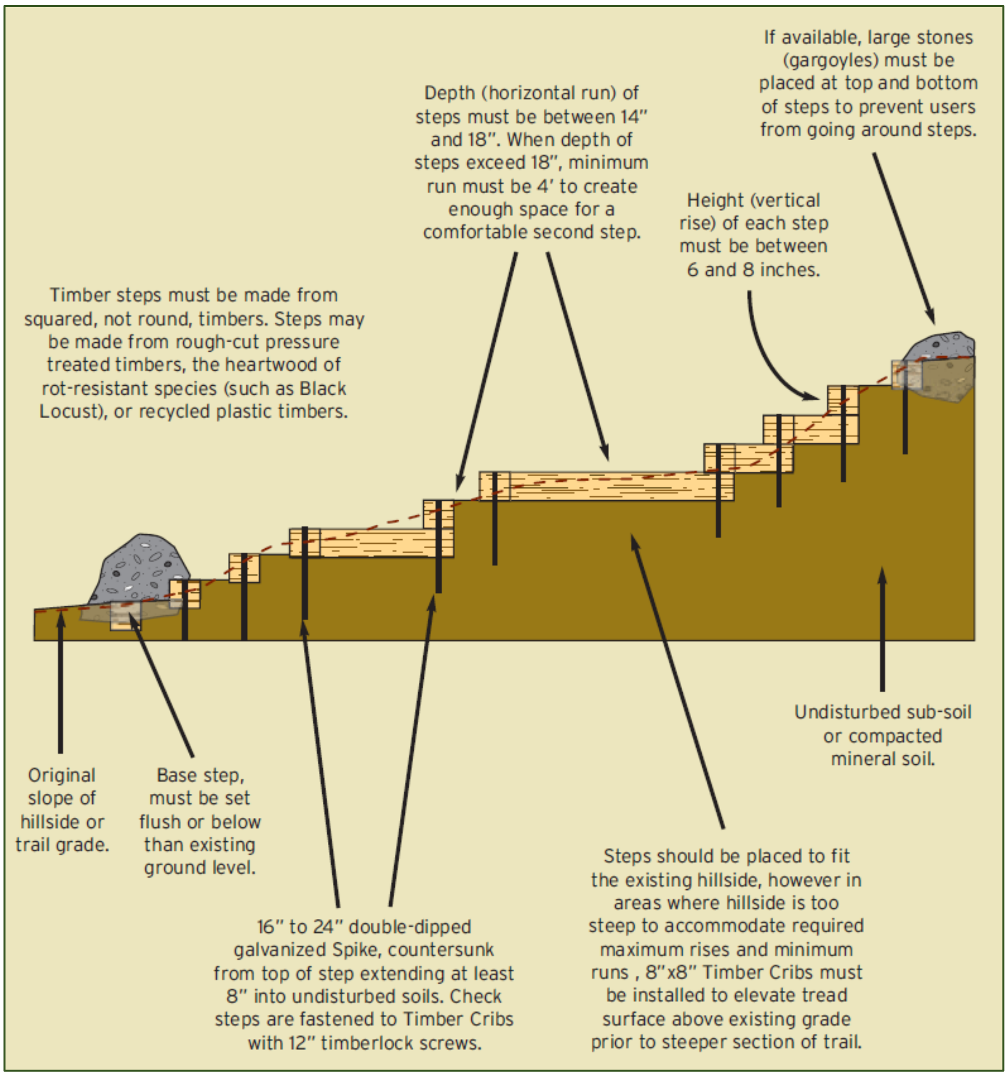
Source: Jolly Rovers Trail Crew, http://www.jollyrovers.org/

Tread Hardening Structures: Timber Steps 3.2a

Intent: To use local or imported timber to provide safe, comfortable hiking ascents up steep, eroded, gullied, or otherwise unsafe trail sections.

How it Works: Timber segments are locked together, typically with pins or bolts, to form the frames of steps. Landings are filled with local stone crush and mineral soil to provide a stable walking surface.

Impact: Timber steps serve to check erosion and provide access up steep ascents where no other solution is possible. If built correctly they are low-impact, provide a comfortable ascent/descent, and last indefinitely with little needed maintenance.



Tread Hardening Structures: Timber Steps 3.2b

Tread Hardening Structures: Stepping Stones 3.3

Intent: Provide a low-impact way to traverse seasonally wet or muddy areas.

How it Works: Local stones are rearranged so that their flat faces are set facing up as a stable walking surface. Adequate space is left between stones for water and light debris to flow through.

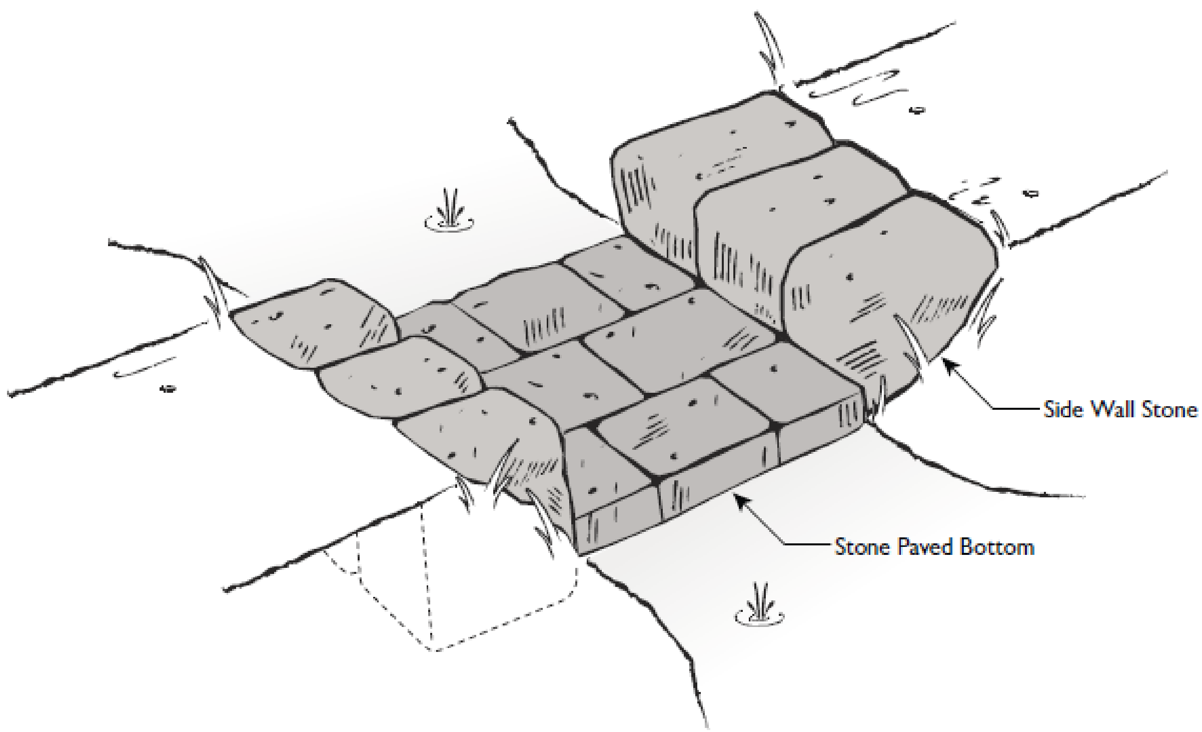
Impact: Stepping stones are most frequently used to cross muddy areas, rather than deep flowing water, and are typically set so that the majority of the stone mass is buried with only a few inches exposed on top. Water can easily flow over or between stones. Allowing this dry and stable walking surface prevents hikers from disturbing muddy ground or, by attempting to avoid wet spots, enlarging the wet area.

Two examples of stepping stones used to cross muddy ground.

Tread Hardening Structures: Culvert 3.4

Intent: To provide a firm, erosion-resistant surface across very short areas which see intermittent water flow or seep.

How it Works: Stones are used to "pave" the surface over which water flows, and larger side stones hold everything in place firmly.
Impact: By providing a firm walking surface, users can cross the area without agitating sediment, widening the channel, or necessitating stepping stones.

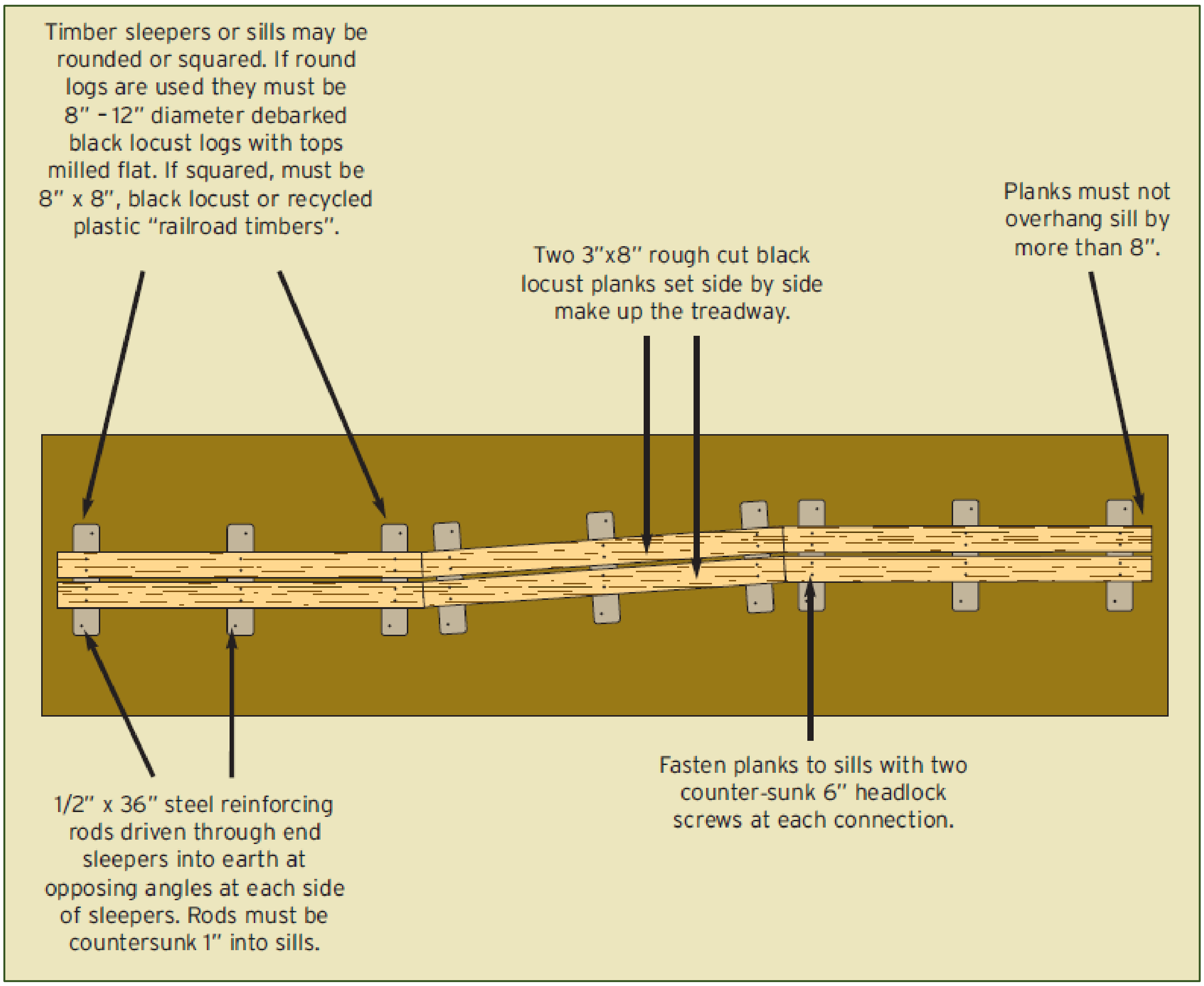


Tread Hardening Structures: Bog Bridging/Plank Walkway 3.5a

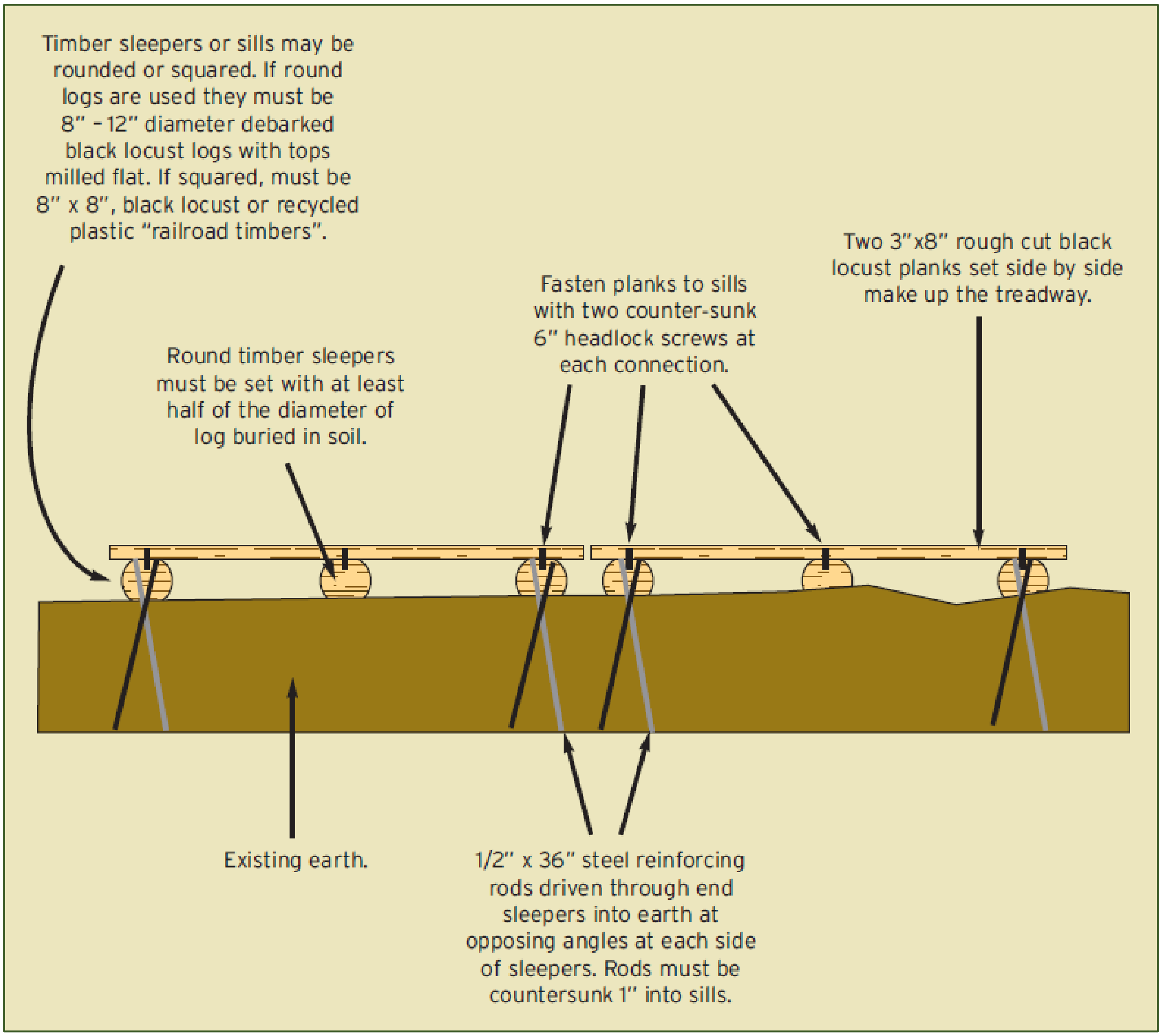
Intent: Provide a low-impact way to traverse seasonally wet or muddy areas.

How it Works: Timber sills are spaced out and placed on the ground, often pinned in place. Planks are set atop the sills, without touching the ground, allowing water to seep or flow underneath.

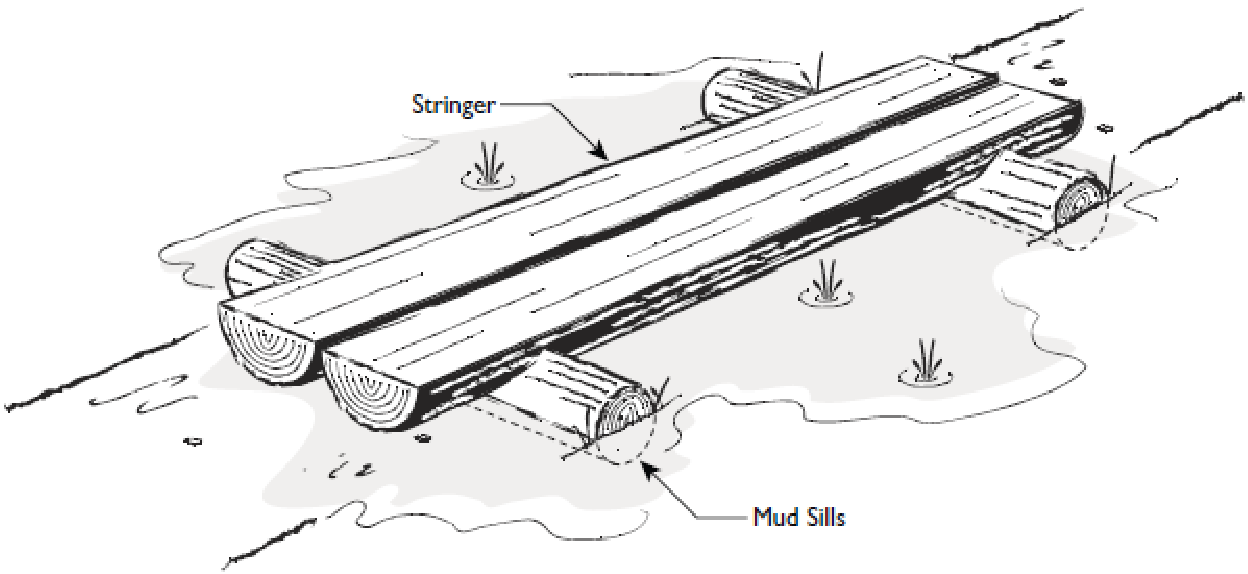
Impact: The structure casts shade on the ground beneath it but, aside from where the sills make contact, the underlying ground is undisturbed. Allowing this dry and stable walking surface prevents hikers from disturbing muddy ground or, by attempting to avoid wet spots, enlarging the wet area.

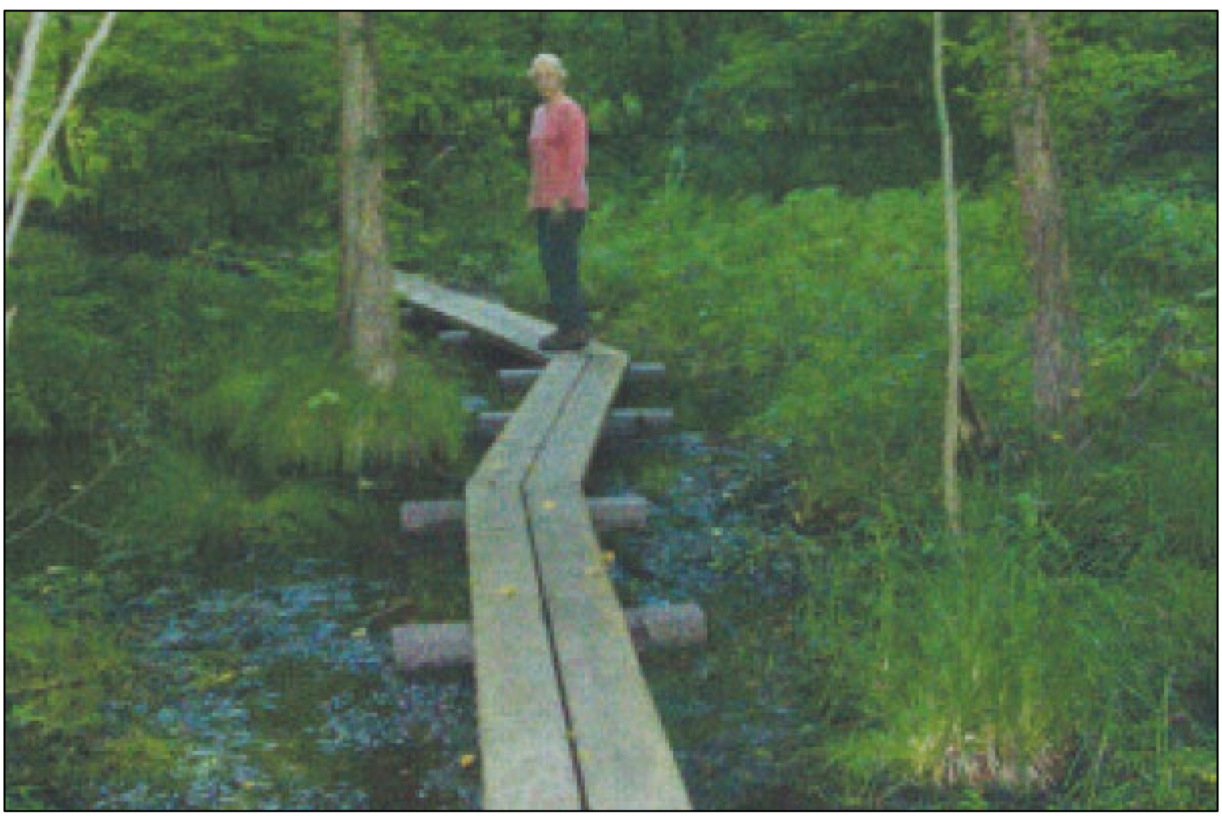


Tread Hardening Structures: Plank Walkway - Section View 3.5b



Tread Hardening Structures: Plank Walkway 3.5c





Tread Hardening Structures: Primitive Footbridge — 4.1a

Intent: Provide safe passage over water.

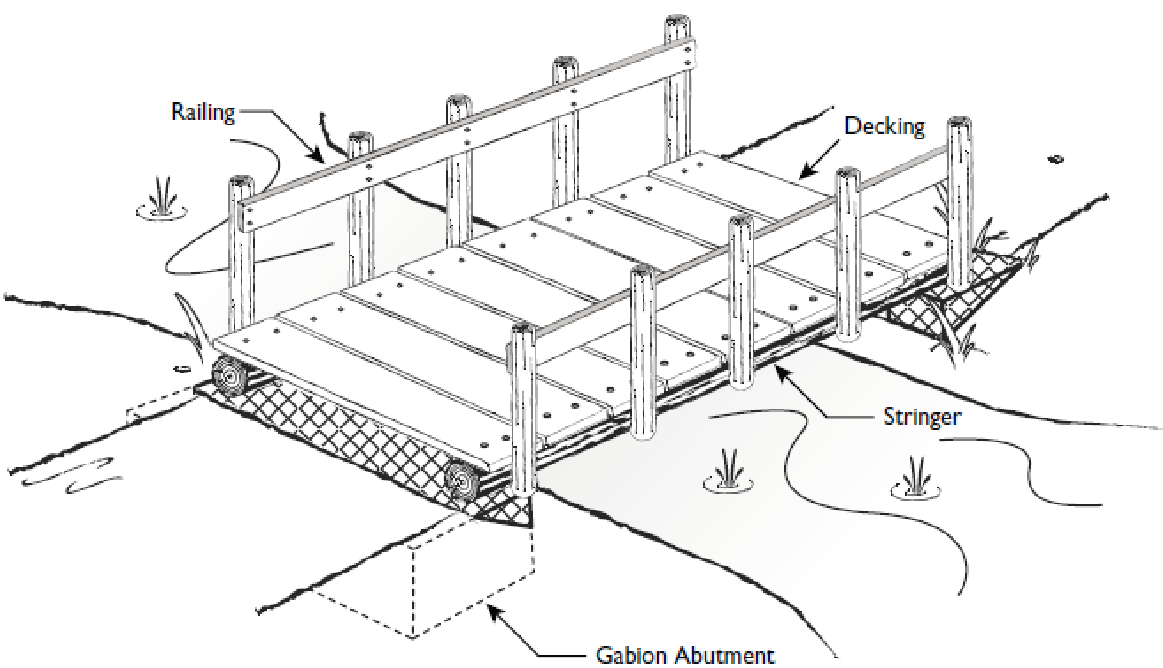
How it Works: Abutments are embedded in the ground on each bank, far enough from the bank edges and deep enough to prevent erosion and undercutting. Stringers connect the abutments and deck boards provide a walking surface across the stringer.

Impact: The structure casts shade on the water beneath it but, aside from where the abutments are set, the underlying stream channel is undisturbed. Allowing this dry and stable walking surface prevents hikers from disturbing sensitive waterways and streambanks.

NOTE: Bridges vary widely in size and scope. For the purposes of the "primitive footpath bridge" designation, the bridge must adhere to the following specifications:

- No more than 4' in width.
- No more than 14" from top of deck to bottom of stringer.
- Stringers made from wood or timber.
- Only intended for use by pedestrians and, where appropriate, bicycles.

Note that these standards do not address abutments or foundations, which may require separate approvals.



Tread Hardening Structures: Primitive Footbridge 4.1b

Two variations of simple pedestrian footbridges built by Eagle Scouts.