Figures

Photos

Chapter 25. Trail Tread Maintenance

Trail tread maintenance is the cyclical and routine repair necessary to keep the trail surface in compliance with its design and construction standards. This work includes ensuring that the tread is uniformly smooth, compacted, and within the design standards for linear grade, width, cross slope, and surface drainage. The need for trail maintenance is described in Chapter 5, *Principles of Trail Layout and Design*, Chapter 11, *Principles of Trail Construction,* and Chapter 23, *Trail Maintenance Principles*. All trails require maintenance but a sustainable trail will require the least amount of maintenance.

Removal of accumulated debris and vegetation from the outboard hinge ensures proper drainage of the trail surface. Maintenance includes reshaping the tread to its original design standard and construction specifications, reshaping the back slope (cutbank) to where it is stable, and removing or covering rocks and roots that have intruded into the trail tread. It also includes repairing damage to the trail tread caused by minor slides or uprooted trees, as well as restoring the approaches to bridges and puncheon structures. Finally, tread maintenance restores the surface of switchbacks, turnpikes, and causeways.

Maintenance is conducted on a cyclical schedule that depends on the types and amounts of use, soil and weather conditions, and the extent of canopy cover. For example, a trail that has soft dry soil and is used by equestrians and mountain bikers requires more frequent maintenance than a trail with rocky soil.

The maintenance schedule must take into account the soil moisture content. Maintenance should be completed when moisture is adequate. When the soil is too dry, it becomes difficult to shape and compact and unravels quickly. When the soil is too wet, it becomes plastic and deforms when a load is applied. A good test to ensure soil moisture is optimal for maintenance work is to take a handful of soil and squeeze it. When released, the material should be in a clump, not fall apart, and no water should squeeze out. The clump of soil should be firm enough that the clump can be broken in half without crumbling apart.

25.1. Outslope, Inslope, and Crown

Depending on the design of the trail, the surface of the tread will be outsloped, insloped, or crowned. Typically, tread maintenance activities should return the tread profile to the original design, however, a redesign may be necessary for sustainability. (See Chapter 11, *Trail Construction,* and Chapter 23*, Trail Maintenance Principles.*)

25.2. Tread Maintenance

25.2.1. Accessibility

Whenever maintenance is performed on a trail, there is an opportunity to improve the trail's level of accessibility by widening the tread to meet the minimum 36-inch

width requirement. There is also an opportunity to improve the smoothness, uniformity, firmness, and stability, as well as to reduce the number of obstacles in the trail tread by removing or capping tree roots and rocks. These improvements may not make the trail fully compliant with accessibility standards, but they allow some trail users with mobility impairment to use a trail that would not otherwise be available to them.

25.2.2. Light Tread Maintenance

Once the trail tread begins to show minor cupping, rilling, loss of cross slope, or the ability to drain, it should be scheduled for "light tread maintenance", which involves removal of the vegetation and organics accumulated on the inboard and outboard edges of the trail, and reshaping the tread surface by lightly cutting, filling, and compacting. (See Photo 25.1.) A small crew of four to six workers can perform this work in a hook line. The workers in the front of the line rake the organics off the downhill side of the trail and remove vegetation encroaching on the trail corridor. The middle of the line de-compacts and reshapes the trail tread. They remove soil from the high areas and place it in the depressions in the tread. The end of the line performs the final shaping to the desired smoothness and cross slope grade. The end of the line also performs the final compaction. Once the shaping and compaction are completed, the organics below the trail can be spread in a thin layer on top of the tread to help protect the trail surface and to retain soil moisture.

25.2.3. Trio Maintenance

When the tread surface develops a build-up of soil and organics along the inboard hinge of the trail (slough) or along the outside edge of the trail (berm), and the center of the trail becomes entrenched, "trio maintenance" is required. (See Photo 25.2.) Trio maintenance is a three-step process that (1) brushes the trail back to its original construction limits; (2) removes slough and berm; and (3) reshapes the trail tread to its designed standard and construction specifications.

Trio maintenance is usually performed on a two to seven year cycle (depending on the rate of trail degradation) in a similar manner to hook-line construction. (See Chapter 11, *Principles of Trail Construction.*) Prior to performing slough and berm removal, brush and clear the trail back to its original construction limits. These limits are determined by trail class, user groups, and design standards. (See Chapter 2, *Trail System Development and Management.*) Cut all woody and herbaceous plants at ground level within the travelway, as well as any portion of those plants growing outside of the travelway that are encroaching into the travelway. Clear the trail as necessary for the trail crew to re-shape the cut bank and trail bed. All brush and woody debris are removed and stashed above the trail, out of sight, and away from any watercourses. Rake organic material down slope below the excavation area, where it can serve as a soil containment wattle or organic berm until the soil excavation, shaping, and compaction are complete. The organic material is saved to be scattered over the trail tread upon completion of maintenance.

Photo 25.1 - Trail Requiring Light Tread Maintenance

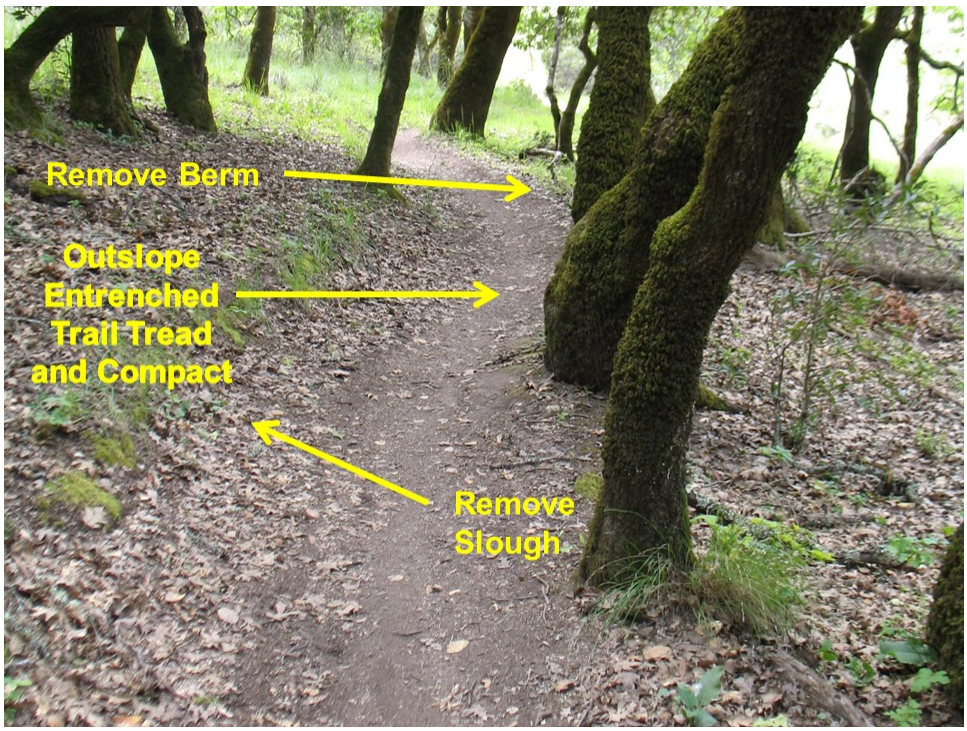

Photo 25.2 - Trail Requiring Trio Maintenance

Photo 25.3 - Crew Performing Trio Maintenance After Brushing

Once the trail has been brushed and cleared, the slough and berm are removed and the material is used to reshape the trail tread. (See Photo 25.3.) To ensure that the soil bonds and compacts properly, the front of the crew line de-compacts or scarifies the soil in all areas that will receive slough and berm material. The middle of the line reshapes the cut bank to the maximum angle at which it will retain its position without sliding down the slope (as necessary), and excavates the slough and berm areas to the appropriate elevation. It is important not to over-excavate these areas or the crew will have to fill them later. This section of the line also rakes the excavated soil to the de-compacted low areas. Large holes or divots in the trail tread are filled with crushed rock, compacted, and caped with soil. Any excess soil is removed and exported to trail sections where there is a soil deficit. The end of the crew line performs the final shaping, smoothing, and compaction of the trail tread. Compaction is accomplished using hand tampers or vibration plate compactors ("vibraplates"). Soil used to fill in low areas is compacted in maximum 3-inch lifts. The final step is to remove the organic berm material that had been placed below the trail and scatter it over the trail bed and cut bank to protect the newly reworked soil and help retain moisture. (See Figure 25.1.)

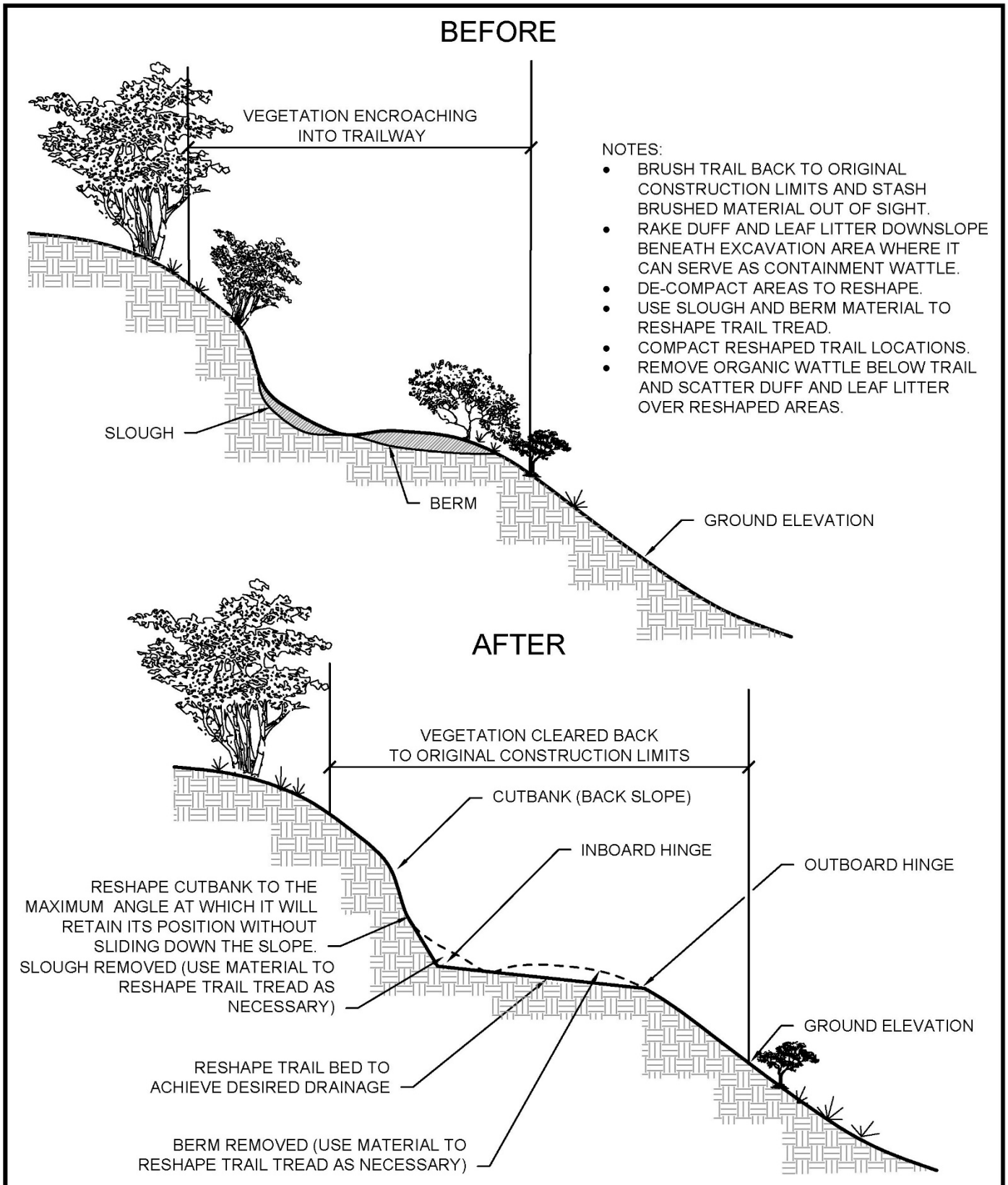

Figure 25.1 - Trio Maintenance

TRIO MAINTENANCE

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25.3. Trail Reconstruction

When the work required to repair the tread exceeds what can be accomplished under trio maintenance, the trail needs to be reconstructed. Trail reconstruction occurs only when the trail alignment is suitable to achieve a sustainable trail or when political, cultural, or environmental issues require retaining a substandard alignment. (See Photos 25.4 and 25.5.) Reconstruction involves returning the trail back to its original design standards and construction specifications and may include minor reroutes that are within the original trail corridor. Using curvilinear techniques, these adjustments can reduce the linear grade and improve drainage by lengthening the trail and decoupling it from natural watercourses. Linear grades can also be reduced by installing steps where appropriate. Trail reconstruction involves reshaping the back slope, removing the berm, scarifying the tread, and restoring designed tread elevations and drainage. (See Figure 25.2.) Typically, work of this scope also involves repair or reconstruction of other trail structures, such as switchbacks, climbing turns, retaining walls, steps, bridges, and puncheons. A trail reconstruction project needs to be managed similarly to new trail construction in terms of logistics, crew management, utilization of native materials, and balancing cuts and fills.

Photo 25.4 - Trail Reconstruction Project: Before

Photo 25.5 - Trail Reconstruction Project: After

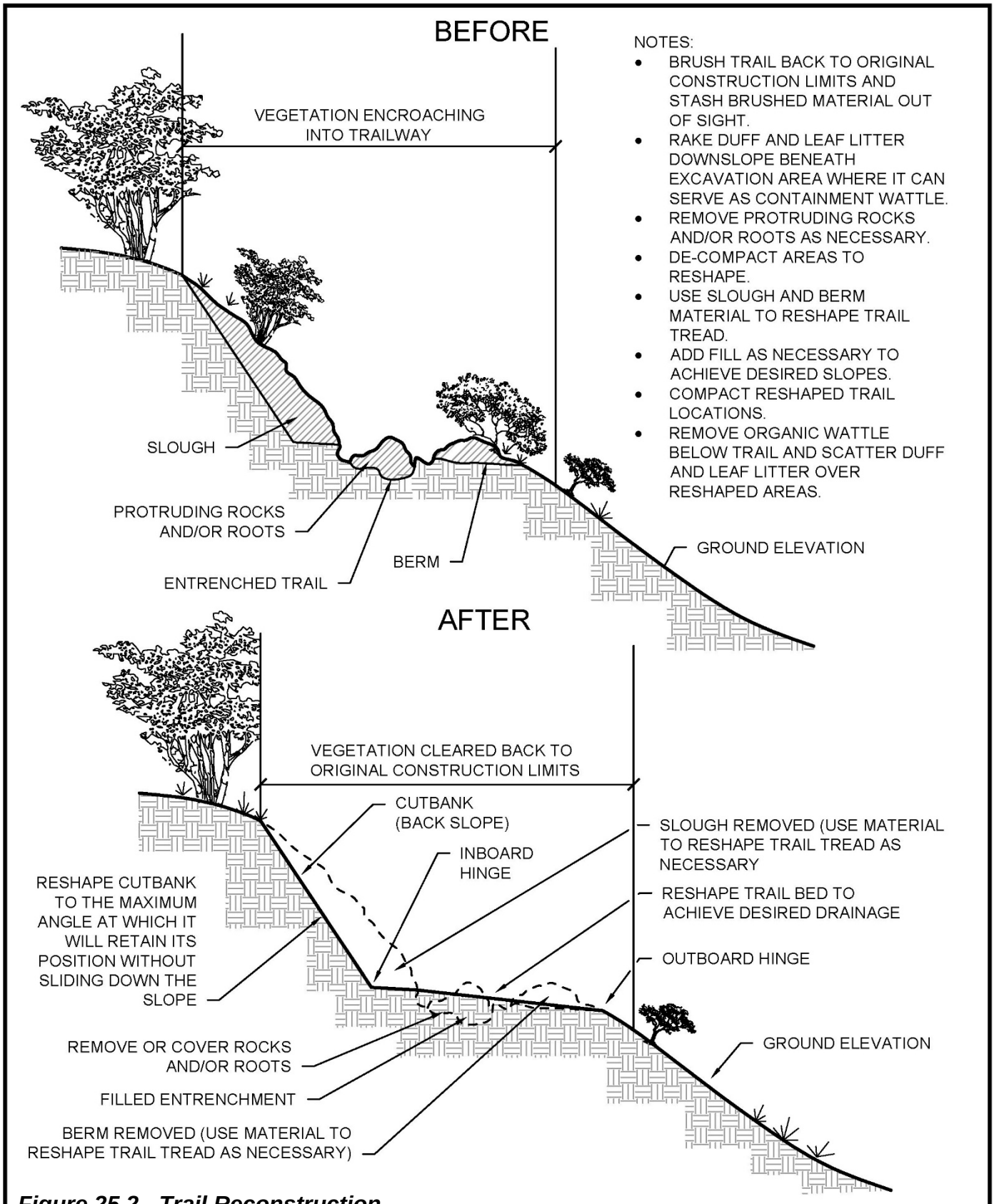

Figure 25.2 - Trail Reconstruction

TRAIL RECONSTRUCTION

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25.4. Entrenched Trails

Trails become entrenched when the center of the tread becomes worn or eroded lower than the surrounding ground. An entrenched trail does not allow the natural sheet flow of water across the landform, but instead captures it and acts as a watercourse. (See Photo 25.6.) To repair this problem, the entrenched portion of trail needs to be elevated by importing surplus gravel or soil from other sections of the trail where slough and berm removal or back slope repair have occurred. If local material is not available, crushed rock may need to be purchased and imported from the trailhead. Prior to importing fill material, the tread surface needs to be scarified (de-compacted) as described above. Fill material is imported, shaped, and compacted in maximum 3-inch lifts. The trail tread is elevated until it is well above the surrounding soil horizon. In flat terrain, the trail tread is crowned so that water flows off the tread into a parallel ditch or onto the surrounding terrain. On a hillslope, the trail tread is outsloped per design standards. (See Figure 25.3.)

Photo 25.6 - Entrenched Trail

25.5. Aggregate Surfacing

When crushed aggregate has been installed as surface material, it is because of special needs such as accessibility, equestrian use, mountain bike use, or to harden soil with very low capabilities. Maintenance of this surface includes re-establishing original tread elevations, shape, and drainage. The surface must be uniform and free of dips, voids, or any place that allows water to collect. (See Photo 25.7.)

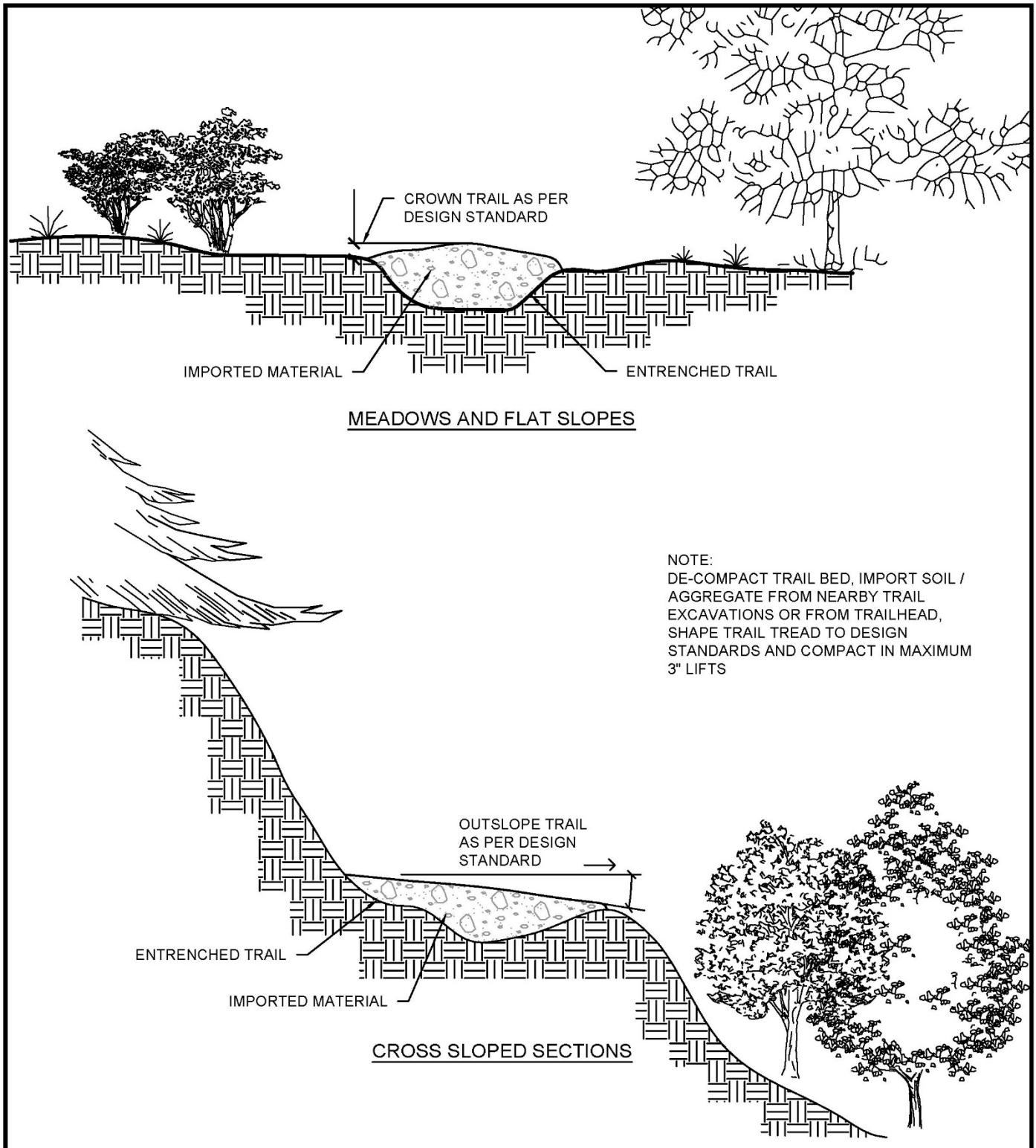

Figure 25.3 - Elevated/Crowned Surfaces/Entrenched Trails

ELEVATED / CROWNED SURFACES / ENTRENCHED TRAILS

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Sections of tread needing repair must be scarified or de-compacted to allow for new crushed aggregate to bond to the old surface. Without scarification, the new layer slips across the surface of the existing material and unravels, resulting in an unstable and poorly performing surface. Once the tread is scarified, new crushed aggregate is installed, shaped, graded, and compacted with a vibraplate. Long-term success of aggregate surfacing depends on appropriate uses and material composition. For further detail on aggregate use and material, see Chapter 11, *Principles of Trail Construction.*

In very moist areas, geotextile fabric may be required to support the crushed aggregate. In this case, cover any exposed fabric with a minimum of 4 inches of crushed aggregate on pedestrian trails and 6 inches of crushed aggregate for equestrian or mountain bike trails.

Photo 25.7 - Aggregate Surfacing Requiring Maintenance

25.6. Exposed Roots

Roots exposed in the trail tread are possible obstacles for trail users with mobility impairments. Exposed roots are a “slip and trip” hazard for all trail users, and can be easily damaged by users, resulting in injury or death to the plant. (See Photo 25.8.) Roots can also trap and/or reroute water on the tread surface leading to soft, unstable soil conditions or erosion.

When performing maintenance, loose or dead roots at the surface are excavated and removed to well below the tread surface. Roots connected to live plants are identified as either support roots for trees and large shrubs or small, feeder roots bringing nutrients to the plant. Feeder roots can be removed without damaging the plant and will quickly re-grow. Large roots are the support for the plant and are slow to re-grow. When removing roots, caution must be taken not to jeopardize the health and stability of the plant. When in doubt, consult a resource specialist or leave the root intact. As a rule, no root over 3 inches in diameter should be removed without consulting a resource specialist. However, each park is responsible for the protocols for removing tree roots.

The best practice is to import fill material left over from excavations elsewhere on the trail and cover the roots. The fill should cover the roots by a minimum of 4 inches and provide drainage off the entire tread surface. The surface should be free of voids and should not allow any water to collect. When the fill area is greater than a few inches, a turnpike may be necessary. (See Chapter 16, *Drainage Structures.*)

Photo 25.8 - Exposed Roots

25.7. Uprooted Trees

When a tree growing adjacent to the trail falls, it will pull up a root ball with characteristics that depend on the species and size of the tree. With some trees, the root ball can be rather small, while others are extremely large. When a large tree falls close to the trail and the root ball extends into the trail, it can leave a large hole or obliterate the trail, leaving a tread that requires restoration. (See Photo 25.9.)

When the tree falls downhill on the lower side of the trail, it can leave a hole in the tread. The hole created by the void of the root ball can be filled with material collected from other excavations on the trail or with soil from the root ball. When re-establishing the

tread, fill material is installed and compacted in maximum 3-inch lifts with a tamper or vibraplate until the proper elevation is achieved. The final grade, width, and drainage must be consistent with the standards for that trail. If necessary, a retaining wall can be constructed to hold the fill material. (See Chapter 15, *Retaining Structures.*)

Photo 25.9 - Uprooted Tree

When a tree from the cut bank above the trail falls downhill, it can pull up a large root wad that blocks the trail. Logging out a tree in this situation is difficult and time-consuming. Sometimes the tree can be bucked off near its base and the stump pulled back into its hole with rigging. Often, it is more efficient to perform a small reroute above the root wad by excavating into the hillslope. (See Chapter 11, *Principles of Trail Construction.*) The bank is laid back to the maximum angle at which it will retain its position without sliding down the slope and the excavated material used to fill the hole left by the root wad. Excess soil is transported to another site or sidecast off the trail away from watercourses. The tread is constructed to match the standards of the existing trail. (See Figure 25.4)

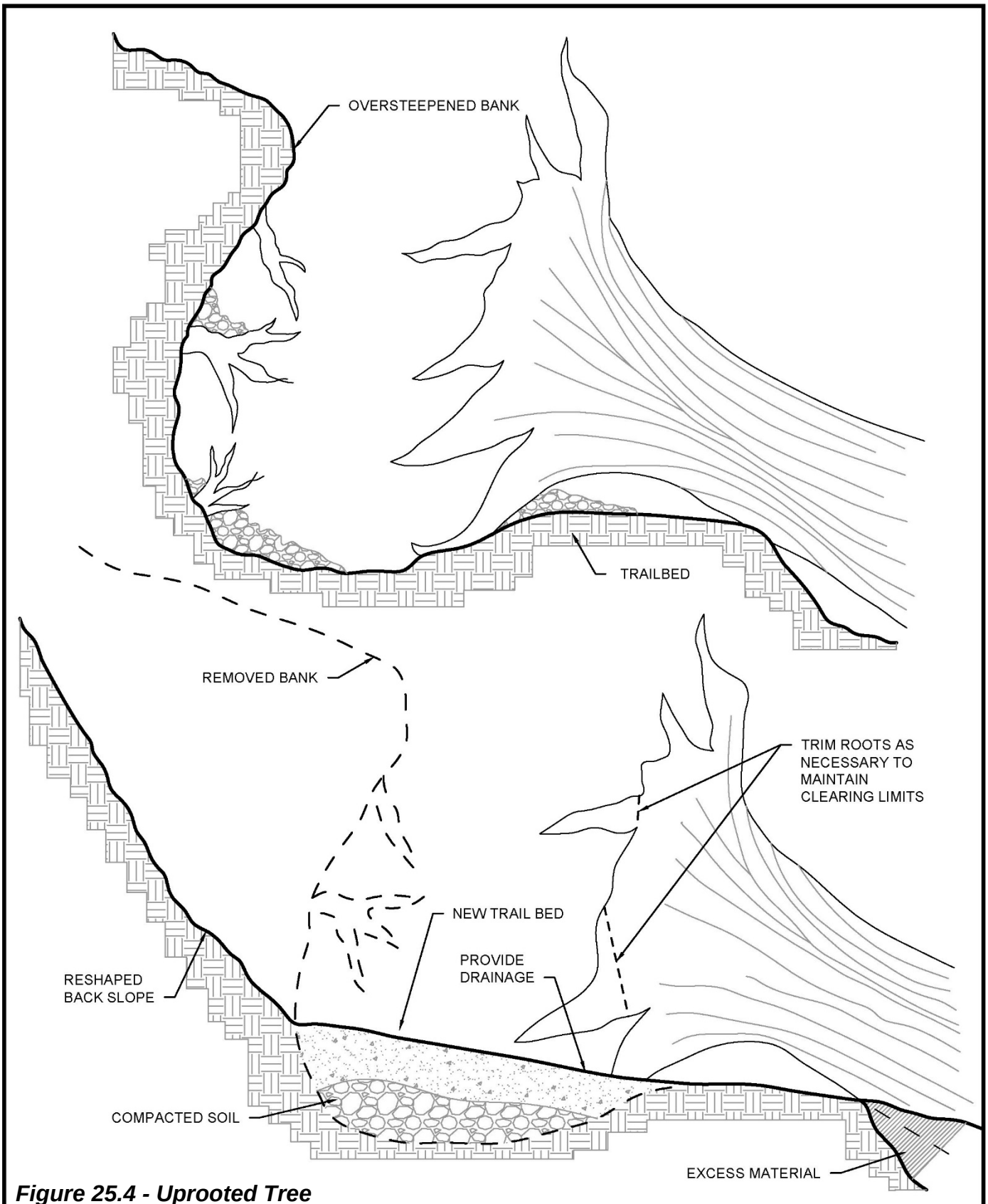

Figure 25.4 - Uprooted Tree

UPROOTED TREE

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25.8. Slides

When a small landslide (“slipout” or “slump”) occurs adjacent to the trail, it can destabilize the fill slope and trail bed or cover it with debris. (See Photo 25.10.) After a landslide occurs, determine if the trail can remain in the same alignment or must be rerouted. If the landslide is shallow and not part of a larger slope instability problem, the trail may be re-established in the same alignment.

Usually when a cut bank has failed, it is because the back slope has been cut too steep. The bank finally gives way and falls onto the tread. Re-cut the tread to the original standard, with the proper outslope and width. Cut the back slope back to the maximum angle at which it will retain its position without sliding down the slope and transport excess soil to another worksite or sidecast away from watercourses. (See Figure 25.5.) Repair failures on the outer portion of the trail by moving the trail into the hillslope (similar to repairs on root ball holes described above), or by installing a retaining wall that spans the entire slip out and is anchored into stable, undisturbed ground. (See Chapter 15, *Retaining Structures.*)

Photo 25.10 - Slide Covering Trail

25.9. Turnpikes, Causeways, and Approaches

Over time, turnpikes, causeways, and approaches to bridges and puncheons will become worn and entrenched from mechanical wear, which can lead to poor drainage and soil erosion. To correct these problems, the tread is reconstructed and returned to its designed elevation, shape, and firmness by importing fill from other worksites along the trail or aggregate from the nearest trailhead for a firmer and more durable tread. (See Figure 25.6.)

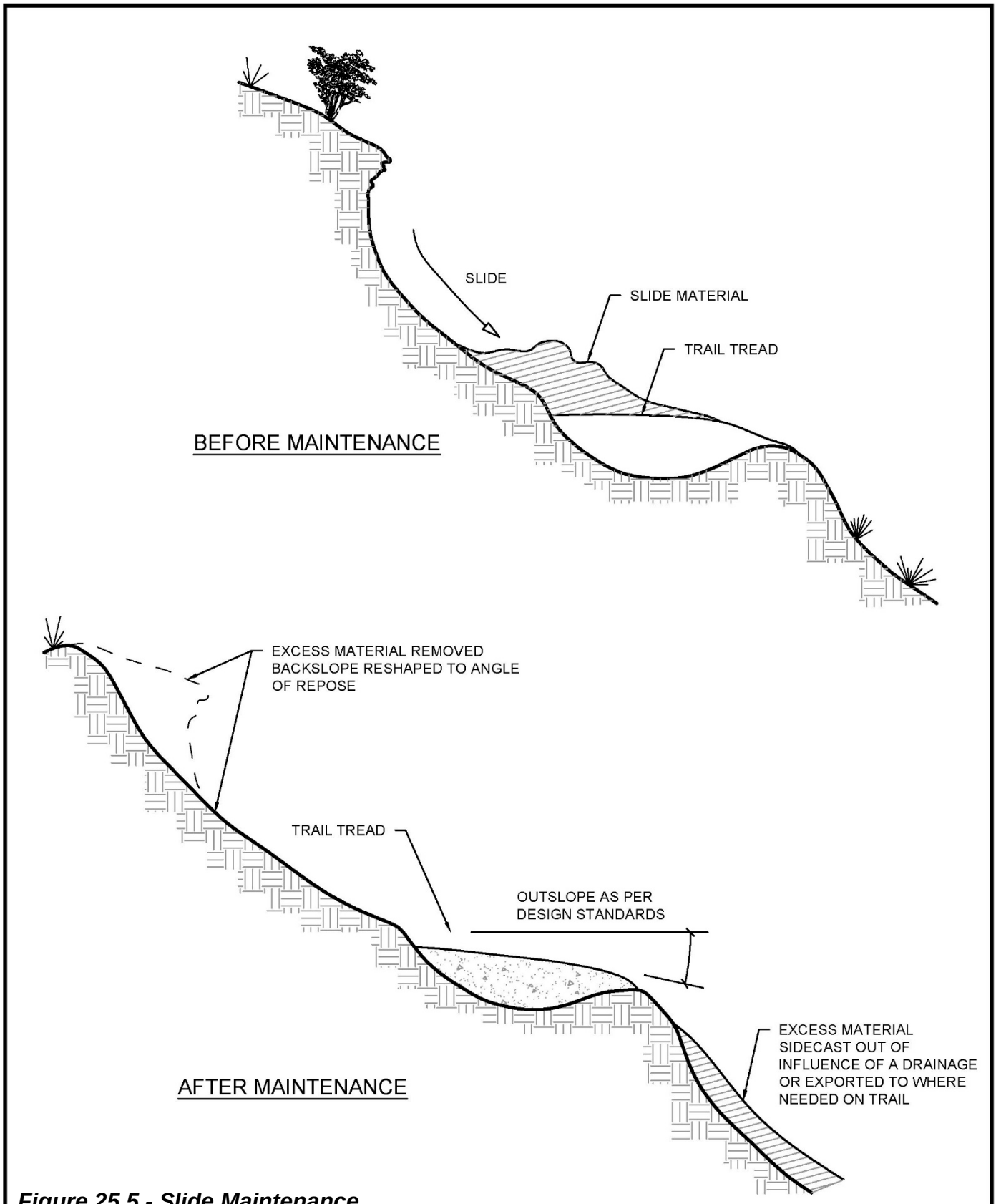

Figure 25.5 - Slide Maintenance

SLIDE MAINTENANCE

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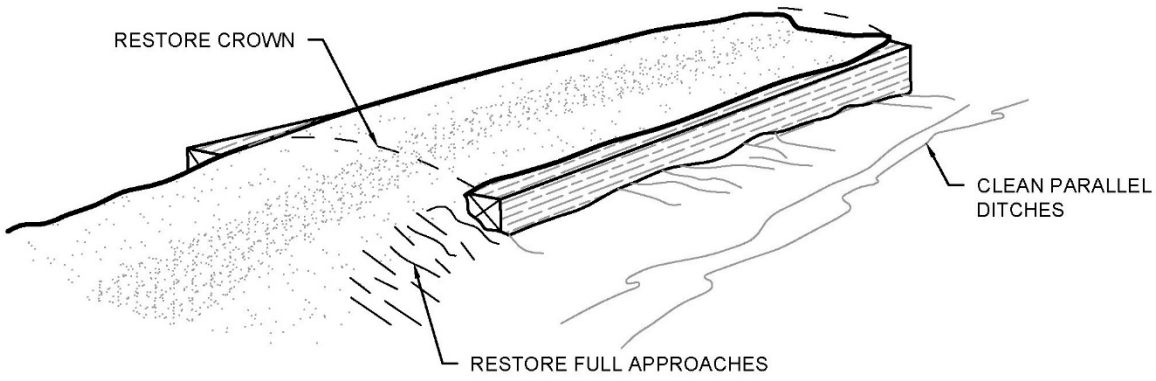
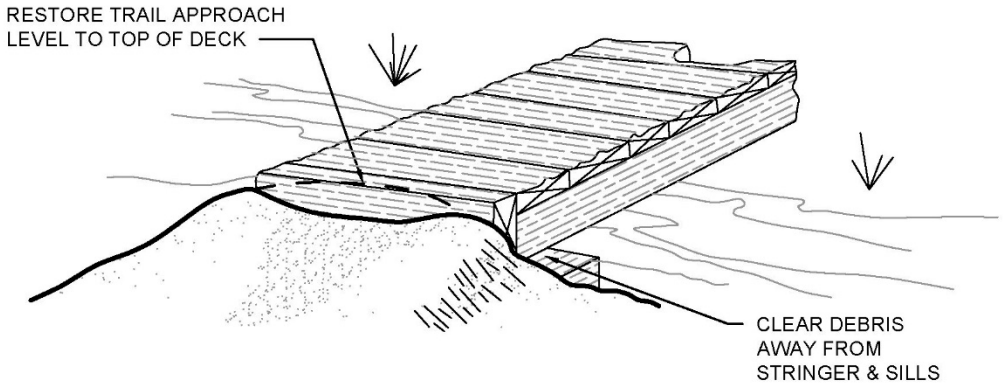


TURNPIKE TREAD

NOTE:
INSTALLATION OF ADDITIONAL TRAIL SURFACE MATERIAL SHOULD OCCUR IN MIN 2-3" THICK LIFTS. EXCAVATION OF EXISTING MATERIAL MAY BE REQUIRED TO ACHIEVE THIS THICKNESS.



PUNCHEON AND BRIDGES

Figure 25.6 - Turnpike, Causeway, Bridge, and Puncheon Approaches

TURNPIKE, CAUSEWAY, BRIDGE, AND PUNCHEON APPROACHES

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The surface of the tread approaching a bridge or puncheon should be level with the top of the structure's deck. (See Figure 25.6.) Tread below the elevation of the decking can be a tripping hazard and barrier to users with mobility assistive devices. (See Photo 25.11.) To return the tread to its original standard, areas receiving fill material must be scarified to promote the bonding of existing and imported fill material. The combined depth of the existing, scarified tread material and the new fill should be a minimum of 3 inches to ensure a consolidated and durable trail tread. The fill must have adequate moisture content to be shaped and compacted. Fill is installed in maximum 3 inch lifts. The surface of the tread should be installed to the original specifications and crowned to provide drainage.

The tread of turnpikes and causeways is maintained similarly to the approach to a bridge or puncheon, except that the entire length of the structure is crowned above the logs and rocks containing the fill for proper drainage. (See Photo 25.12.)

Photo 25.11 - Worn Tread Approach

25.10. Switchbacks and Climbing Turns

Switchbacks and climbing turns are expensive structures that require regular maintenance to ensure proper function and prevent erosion and costly reconstruction. Over time, the tread on switchbacks and climbing turns becomes loose and either migrates to the edge of the trail or washes off the trail leaving ruts and gullies. With most turns, the mechanical wear is due to poor initial design and construction. These structures should be designed and constructed as explained in Chapter 5, *Trail Layout and Design*, and Chapter 12, *Topographic Turn, Climbing Turn, and Switchback Construction*.

Photo 25.12 - Turnpike Requiring Surface Maintenance

Photo 25.13 - Switchback Requiring Maintenance

Photo 25.14 - Switchback Requiring Maintenance, continued

Maintenance of switchbacks and climbing turns involves re-shaping the upper leg, turn, and lower leg. (See Photos 25.13 and 25.14.) The upper leg should have a transition where the outsloped trail switches to an insloped trail, creating a subtle berm that crosses the trail at an angle of approximately 45 degrees. This berm may need to be re-shaped to facilitate drainage from outslope to inslope. The inboard hinge of the trail may need clearing, due to sloughing from the cut bank and soil migration from the tread. The drain at the end of the turn is cleared and dug out as necessary. If there is a channel beyond the drain from the upper leg, it should be unobstructed, and the drainage ditch armored with a rock energy dissipater to protect the slope below the drain point. Scarify any entrenched or deformed tread, and use the excess soil from the inboard hinge and drain to fill and restore the tread to its designed specifications. If there are insufficient materials, surplus materials from maintenance activities elsewhere on the trail can be used.

Due to the twisting, pivoting, pushing off, and braking of users traversing the turn, the turn's landing will become entrenched and a berm will develop on the outside edge. Entrenched or deformed areas are scarified, and excess berm material removed to fill and reshape the turn. The turn transitions from an inslope on the upper leg to an outslope on the lower leg. This transition needs to be maintained. In addition, the width of the turn is restored to its originally designed standard. See Chapter 12, *Topographic Turns, Switchbacks, and Climbing Turns*, for more information on design standards. The lower legs of these structures often become entrenched from mechanical wear and erosion caused by water concentration, and dislodged soil accumulates on the outboard hinge of the trail in the form of a berm. The entrenched or deformed tread is scarified, and berm material used to restore the tread to its original design standards. If there is insufficient berm material to accomplish this task, surplus material from elsewhere on the trail is imported to achieve the desired elevation and tread shape.