Figures

Photos

Chapter 27. Erosion/Sediment Control and Trail Removal

Erosion and sediment control is the work required to minimize soil erosion and sediment transport during trail construction and maintenance activities. Trail removal includes the removal and restoration of unauthorized volunteer trails and sanctioned system trails no longer required due to obsolescence or replacement by a new trail or reroute.

27.1. Erosion and Sediment Control

While performing trail construction and maintenance work, it is important to minimize soil erosion and prevent sediment from entering nearby watercourses. One of the most basic measures to minimize soil erosion and provide sediment control is to refrain from performing soil excavation during inclement weather or when soil is very wet. Under these conditions, soil cannot be shaped or compacted. As a result, it can be washed into nearby waterways. (See Photo 27.1).

Photo 27.1 - Tread Excavation When Soil is Very Wet

A basic sediment retention measure previously discussed in Chapter 11, *Principles of Trail Construction*, is to rake the organic layer removed from the brushed and cleared trail alignment to downhill of the intended trail tread where it serves as a wattle that catches sediment coming from the trail alignment. This organic material can later be spread over the finished trail tread and backslope. (See Photo 27.2.)

Photo 27.2 - Raking Organic Material Below the Trail to Form a Wattle

Another sediment control method identified in Chapter 11, *Principles of Trail Construction*, is exporting all soil excavated within the influence of a watercourse. Excavated soil is transported to locations where it can be used as fill material or spread onto the hillslope outside the influence of the watercourse. Soil that is temporarily stored on the trail alignment should also be encapsulated and contained in a sediment retention structure. (See Photo 27.3).

Photo 27.3 - Excavated Soil Retained by Straw Wattles and Covered to Protected from Erosion

In addition to the soil erosion and sediment retention methods identified above, sediment retention structures such as silt fences, straw wattles, or bales of sterile straw should be installed below the trail or trail structure if adjacent to a water course.

Silt fences can be installed with or without the wire fence backing. (See Photos 27.4 and 27.5 and Figure 27.1.) When installed where there is minimal soil catchment anticipated, the geotextile fabric can be attached with 9-gauge wires directly to the steel T posts. Where substantial soil catchment is anticipated the fence wire is installed to provide additional structural support to the silt fence.

Straw wattles are designed for low surface flows and can be installed on flat ground or a slope. (See Photo 27.6.) They should always be installed perpendicular to the surface runoff (sheet flow). To keep water from running under the wattle, a shallow trench with a depth of 3-5 inches, depending on the size of the wattle, is dug for the wattle to be laid. When installed on a slope, the spacing of wattles is as follows:

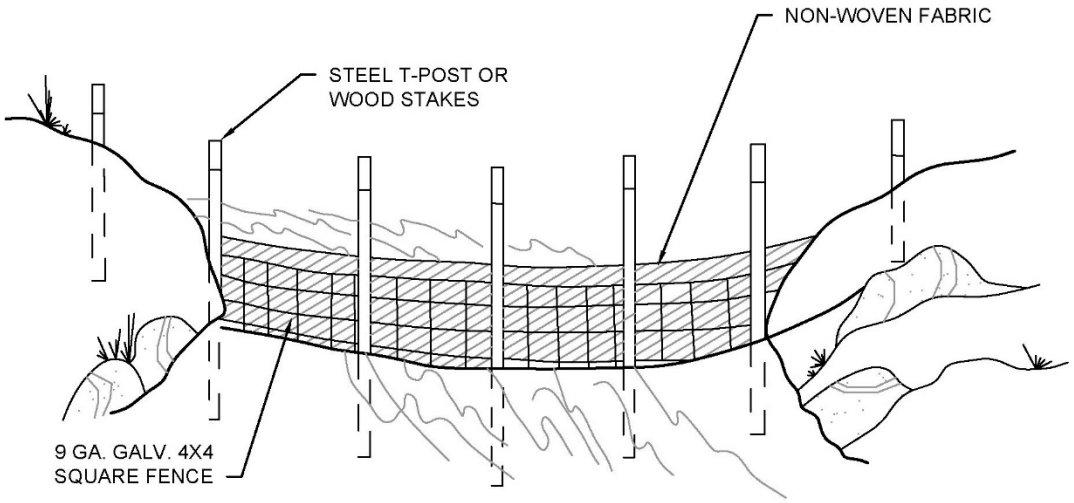
% Hillslope	Maximum Spacing between Wattles
<25%	40 feet
25-33.5%	30 feet
33.5-50%	20 feet
50-100%	10 feet

Wattles are secured to the ground with wooden stakes that are 18 inches long for 9-inch diameter wattles and 24 inches long for 12-inch diameter wattles. The stake is driven through the center of the wattle and perpendicular to the ground. Stakes are driven in at the end of each wattle as well as at 3- to 4-foot intervals for the rest of the length of the wattle. (See Figure 27.2.) When installing wattles in a riparian area, willow cuttings can be substituted for wooden stakes to provide extra slope stabilization because their roots will help retain soil and their canopy will help protect the soil from rainfall impact.

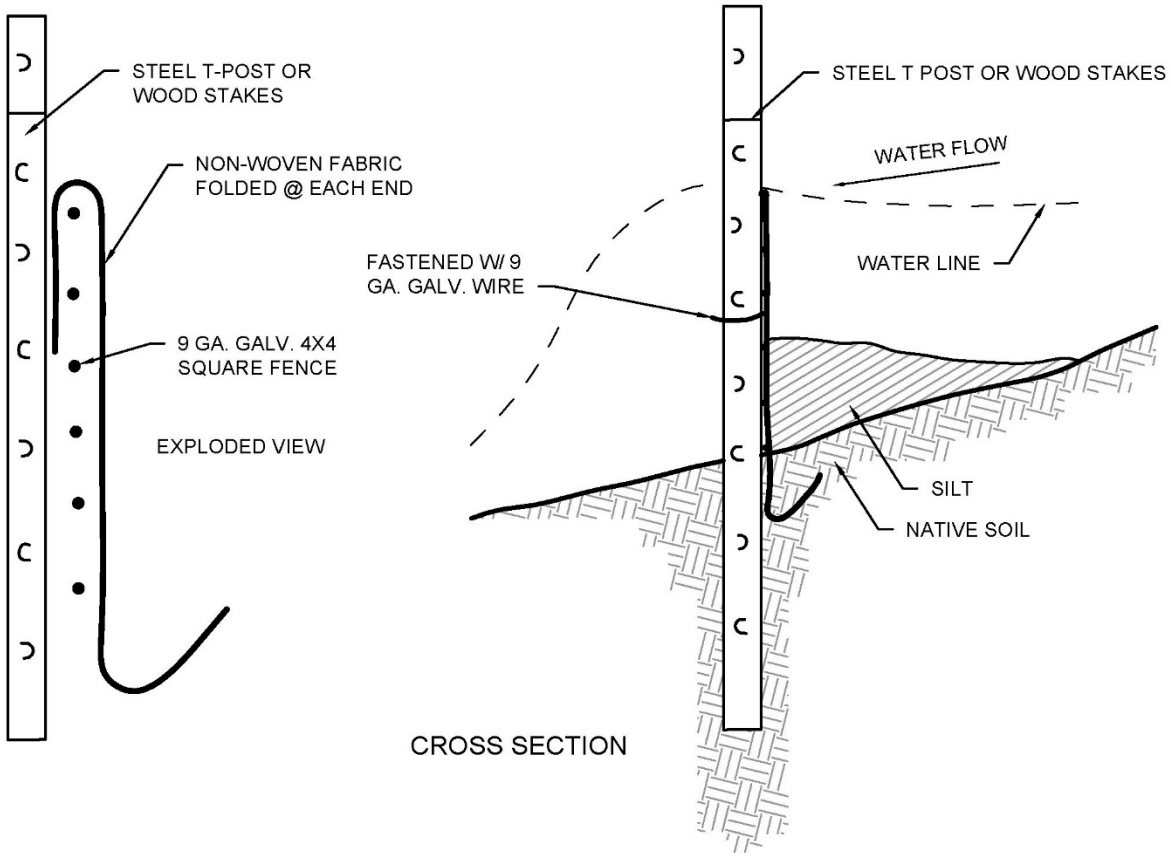
Once the silt fences and straw wattles are no longer required, the soil behind them is carefully removed and taken to a location where it can be used as fill material or dispersed below the trail alignment. Bare areas should be replanted with native vegetation and covered with organics to prevent erosion. The straw wattles and silt fences are removed and transported back to the shop or storage area. Wooden stakes, straw wattles, T posts, fencing, and geotextile fabric that are reusable are stored for use on future projects. Wooden stakes, straw wattles, and geotextile fabric that are not reusable are recycled or properly disposed.

Photo 27.4 - Silt Fences Installed Between Bridge Abutments and Stream Channel

Photo 27.5 - Silt Fence Retaining Soil Above and Below Work Area



FRONT VIEW



CROSS SECTION

Figure 27.1 - Silt Fence

SILT FENCE

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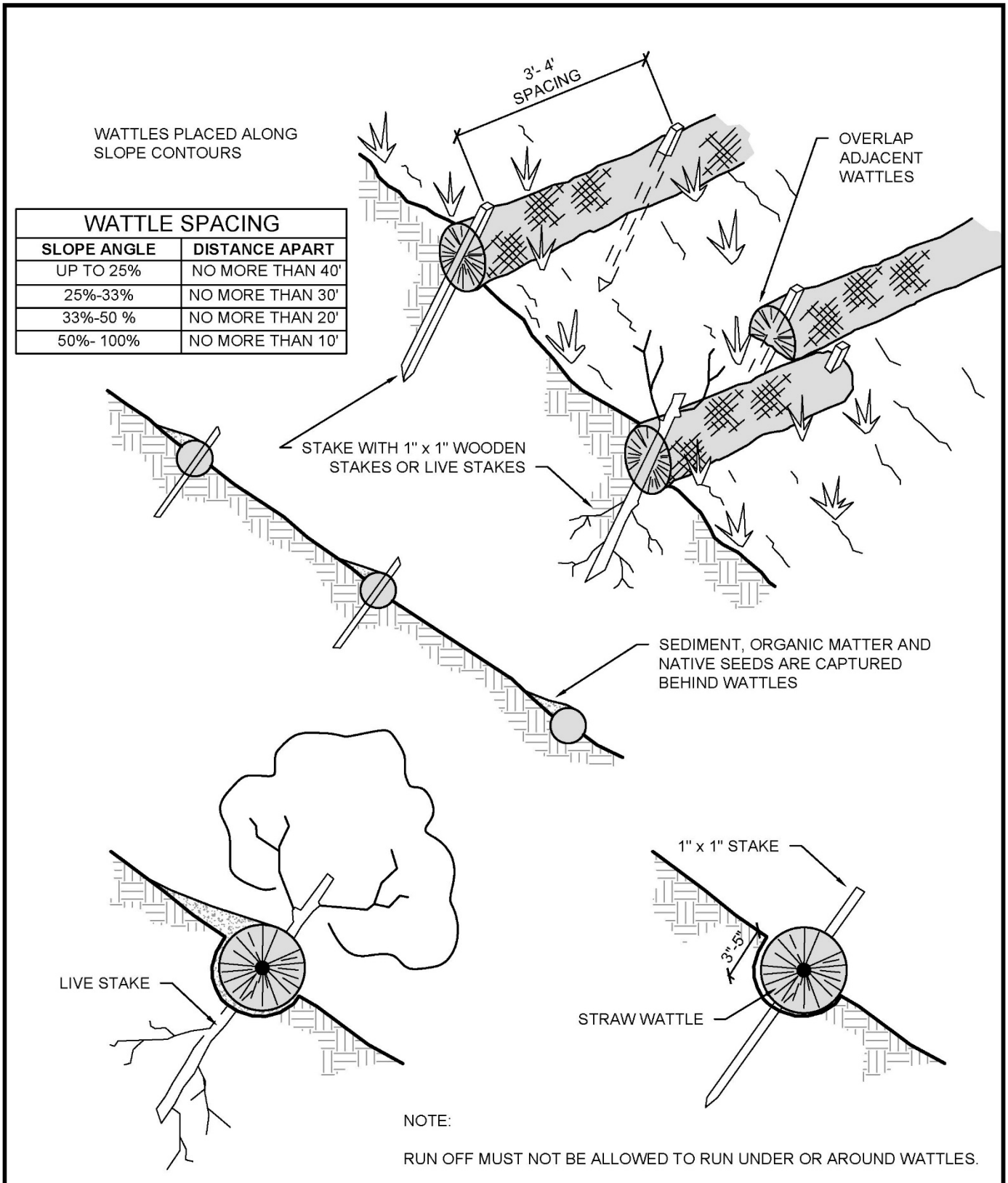

WATTLE SPACING	
SLOPE ANGLE	**DISTANCE APART**
UP TO 25%	NO MORE THAN 40'
25%-33%	NO MORE THAN 30'
33%-50 %	NO MORE THAN 20'
50%- 100%	NO MORE THAN 10'

Figure 27.2 - Installing a Straw Wattle

INSTALLING STRAW WATTLES

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Photo 27.6 - Straw Wattle Installed Below Work Area for Construction of Armored Swale

27.2. Trail Removal and Restoration

Typically when a trail is removed and the area restored, it is because the trail is not authorized ("volunteer trail") or because it is not sustainable or maintainable and must be rerouted. Keeping users from recreating these trails once they are removed can be difficult. Users can become emotionally attached to a trail, especially if it has been in use for a long period of time. In the case of volunteer trails, they usually develop because no other trail provides access to an area of public interest or no other trail provides an experience desired by users.

The removal of an existing, authorized trail requires environmental review and public input. This process provides an opportunity to hold public meetings and/or meet with specific user groups to discuss the need to remove the trail; if and how the trail will be replaced; and how removal and restoration of the trail will be performed. These meetings also provide the public with an opportunity to express their concerns about the loss of the trail and identify potential alternatives.

User groups can help spread the word about the project among trail users and assist with maintaining the trail closure and realignment through formal or informal trail patrols. Peer pressure is often the most effective way to get user compliance. Interpretive panels and signage identifying the need and benefits of a trail removal project can be installed prior to the start of a trail removal project and left in place until use ends and restoration to a natural condition is complete. Temporary symbolic or barrier fencing may also be necessary. If all other measures fail and use along a removed trail

alignment continues, it may be necessary to enforce the trail closure with law enforcement patrols.

If a trail is being rerouted, the existing alignment can be left open for public use until the new alignment is ready, relieving some of the pressure for public access. The new alignment can be kept closed by not constructing the last 150 feet or so of the trail until the rest of the trail is ready to open. Once the new trail is open, the old trail can be removed and the area restored to a natural condition.

When a trail is removed, take time to obliterate the trail and restore the area to its natural condition to the extent possible to eliminate continued impact on resources, as well as remove the visual scar created by the trail. For trails that have been abandoned in the past but never restored, restoration needs to be included in the trail program's project schedule.

By implementing the trail removal and restoration techniques identified below, users will be less inclined to re-occupy the removed trail.

Restoration work includes the following:

1. All woody debris, organics, and loose rocks are removed from the travelway (2 feet beyond the top of cut bank to 2 feet below the outboard hinge). This material is placed above the trail for use later.

2. Natural drainage features of the landform are fully restored. All watercourse crossings (including small swales and crenulations) are decoupled from the trail alignment and restored to their original channel morphology. Ruts and rills are eliminated to prevent further water accumulation and soil loss. They can be eliminated by de-compacting the bottom of the rills and filling them with local soil and gravel to return the surface to its original shape and contour. Again, soil and rock from the new alignment can be used for this purpose when necessary. Do not use organic-rich materials such as sod for fill because the organics will eventually deteriorate and compact, allowing the depressions to return.

3. Cut bank and bench are de-compacted and the soil aerated to promote re-vegetation of the trail bench and improve bonding of imported soil. Soil below the outboard hinge (from the original trail excavation) is excavated and placed against the cut bank and trail bench to restore the natural slope and contour of the hillslope and recover the topsoil and seed bank, which greatly enhances the process of re-vegetation. (See Figure 27.3.) If the trail is on flat ground, soil can be recovered from both sides of the trail. This work can be performed by hand crews or by mechanized equipment. A mini excavator is very effective at recontouring a trail alignment. (See Photo 27.7) If there is a soil deficit, import soil from the new trail or trail reroute. The need for imported soil should be identified before construction of the new trail, so that soil can be saved and stockpiled.

4. In some situations, ruts can be so severe and deep that they become gullies. Filling in these gullies with native soil will ultimately fail because the soil will be mobilized by water flowing down these erosional features. Furthermore, local fill material may be unavailable and projects too remote to import materials. In these situations, check dams are installed to halt further erosion and to allow backfilling to occur through sediment trapping. Fill the gullies between check dams with brush cuttings to slow down water runoff, reduce head cutting on the downhill side of check dams, and trap soil.

Photo 27.7 - Mini Excavator Recontouring a Trail Prism

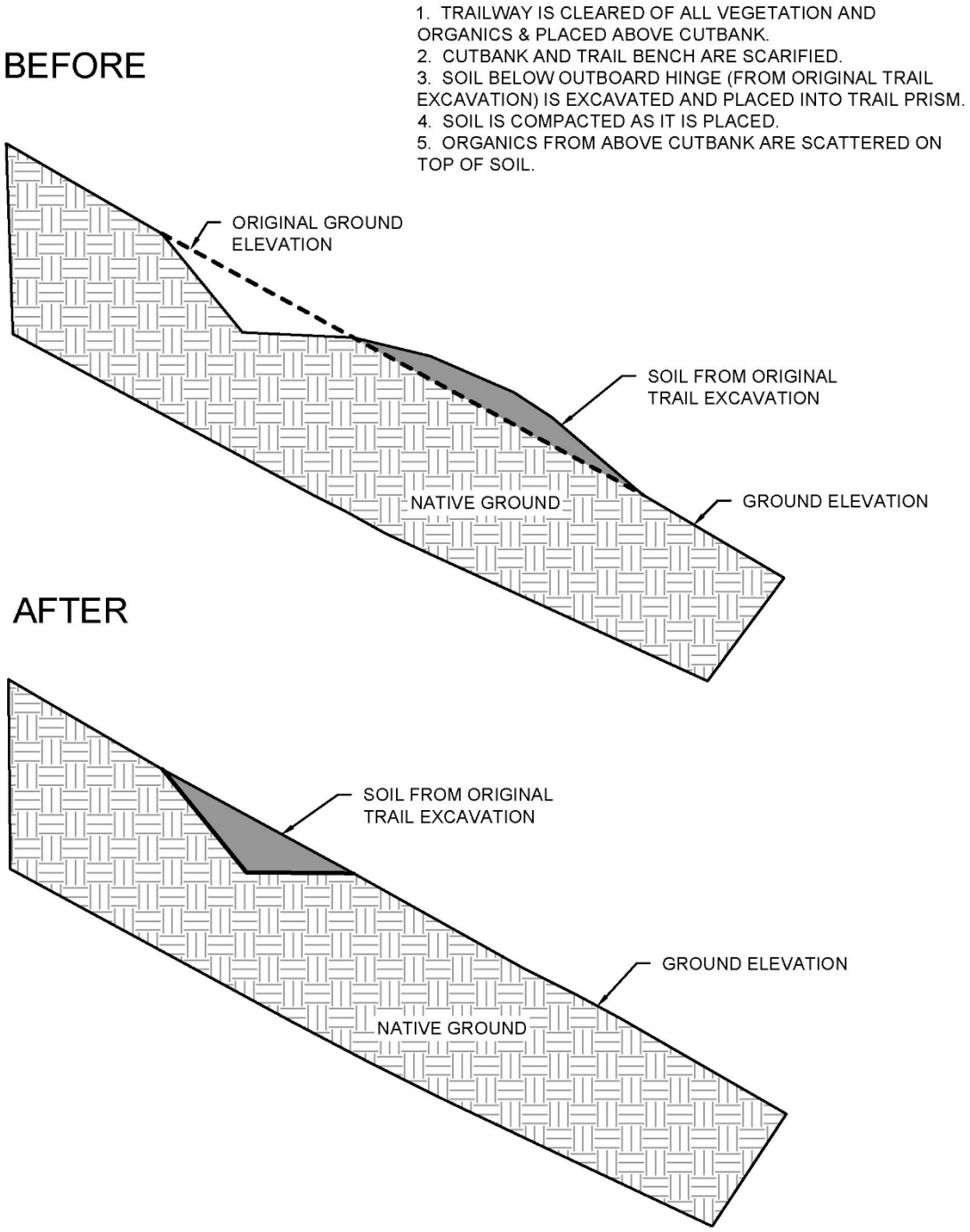

Figure 27.3 - Trail Re-Contouring

TRAIL RE-CONTOURING

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5. Simple check dams are installed by placing rocks, logs, or boards within the channel, perpendicular to the flow. They are keyed into the bottom of the gully and adjacent banks to prevent water from flowing under or around the dams. (See Figures 25.4 and 25.5.) The spacing of these dams is as follows:

% Hillslope	Maximum Spacing between Check Dams
<20%	25 feet
20-30%	15 feet
>30%	10 feet

   Once installed, check dams are monitored to ensure they are functioning. Additional dams are installed as needed. Once filled, leave check dams in place and allow them to become part of the slope's natural contour. Re-vegetation of the filled channel may be necessary if plant growth does not occur naturally. Further stabilization is accomplished by the use of erosion cloth, nets, wattles, or other biodegradable coverings to slow the velocity of water runoff and inhibit gullying and rilling.

6. Once the trail bench is recontoured and gullies are stabilized, vegetation is re-established. Vegetation for planting must be native to the area and hardy enough to survive transplanting. Maintaining genetic integrity is critical in every re-vegetation project. Typically, the vegetation and seeds come from the same sub-watershed where the project is located. The best place to obtain vegetation is from the new trail route. Suitable plants are harvested during brushing and clearing and stored in wet burlap sacks until transplanted. (See Photo 27.8.) Plants can also be collected from the surrounding area in a dispersed fashion, if collecting them does not adversely affect local plant populations. Collecting seeds and cuttings from the watershed and growing them at a local nursery will produce a viable plant source. (See Photo 27.9.) Protocols for plant collection and nursery operations with the goal of maintaining genetic integrity must be developed and followed. (See Appendix S.) Within every plant community there are species that are more resilient to transplanting than others. Trail supervisors must be familiar with the local species and consult with a resource specialist to use them in appropriate numbers and locations.

7. Transplanting must occur at the appropriate time of year to improve plant survival. Usually this time coincides with the wet season. Transplanting when plants are dormant and soil conditions are moist reduces the shock of transplanting and ensures that the plant has enough moisture to re-develop its root system before encountering more stressful summer conditions.

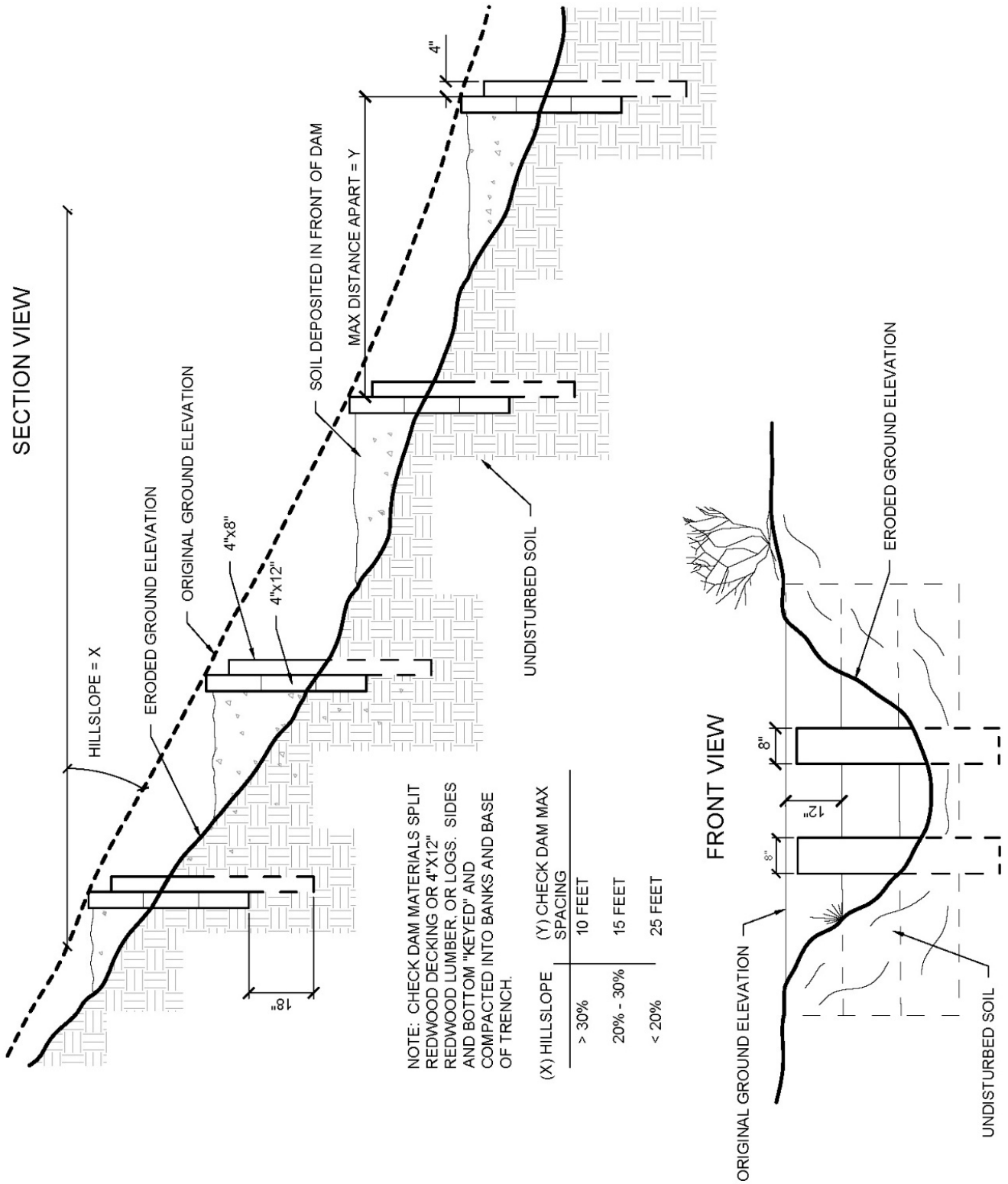

Figure 27.4 - Wooden Check Dams

WOODEN CHECK DAMS

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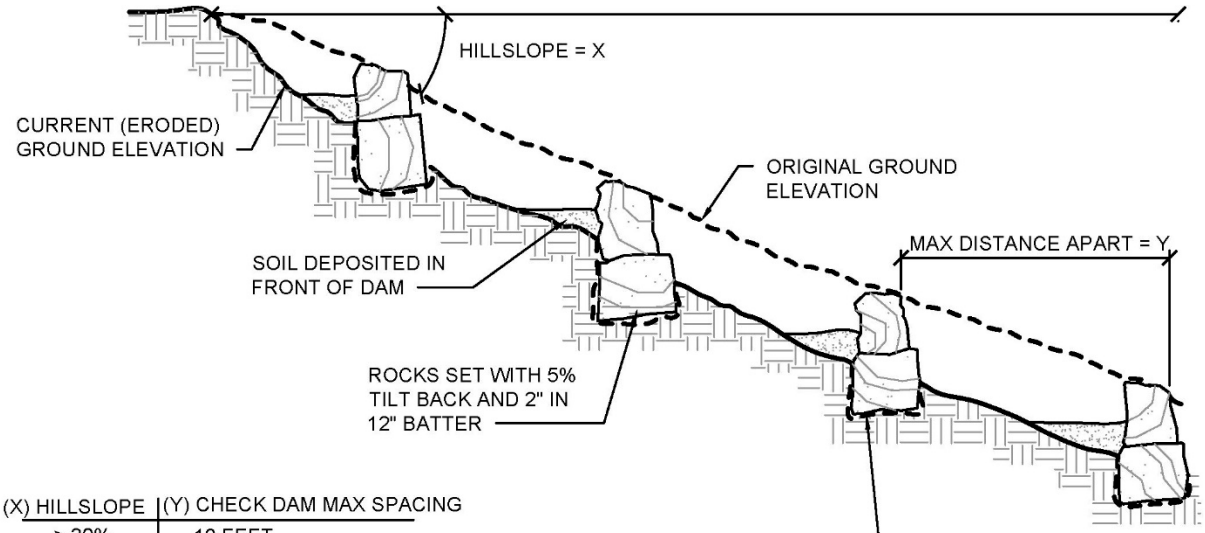
ROCK CHECK DAMS SIDE VIEW



(X) HILLSLOPE	(Y) CHECK DAM MAX SPACING
> 30%	10 FEET
20% - 30%	15 FEET
< 20%	25 FEET

ROCK CHECK DAMS FRONT VIEW

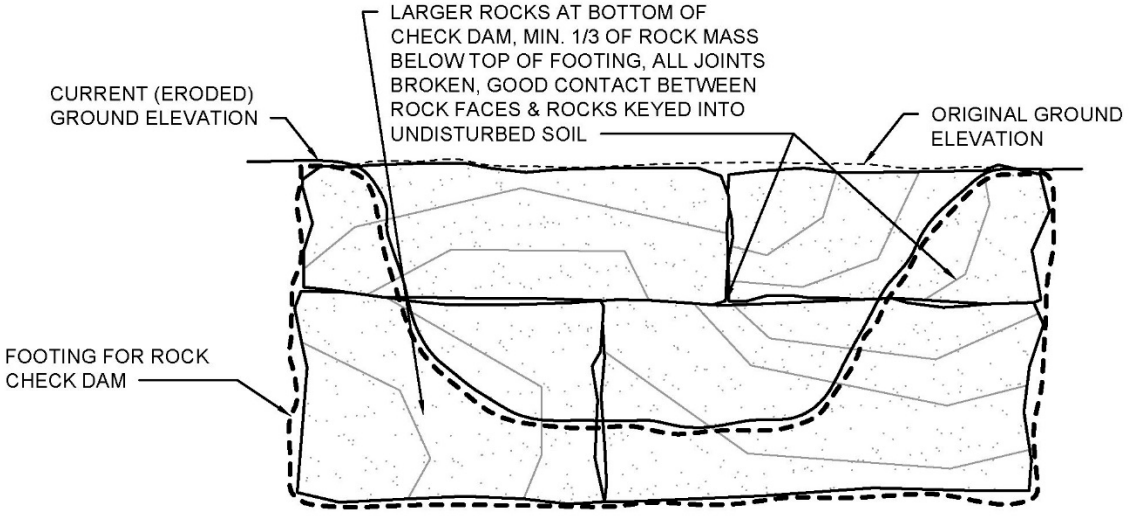


Figure 27.5 - Rock Check Dams

ROCK CHECK DAMS

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Photo 27.8 - Salvaging Native Plants

Photo 27.9 - Native Plant Greenhouse

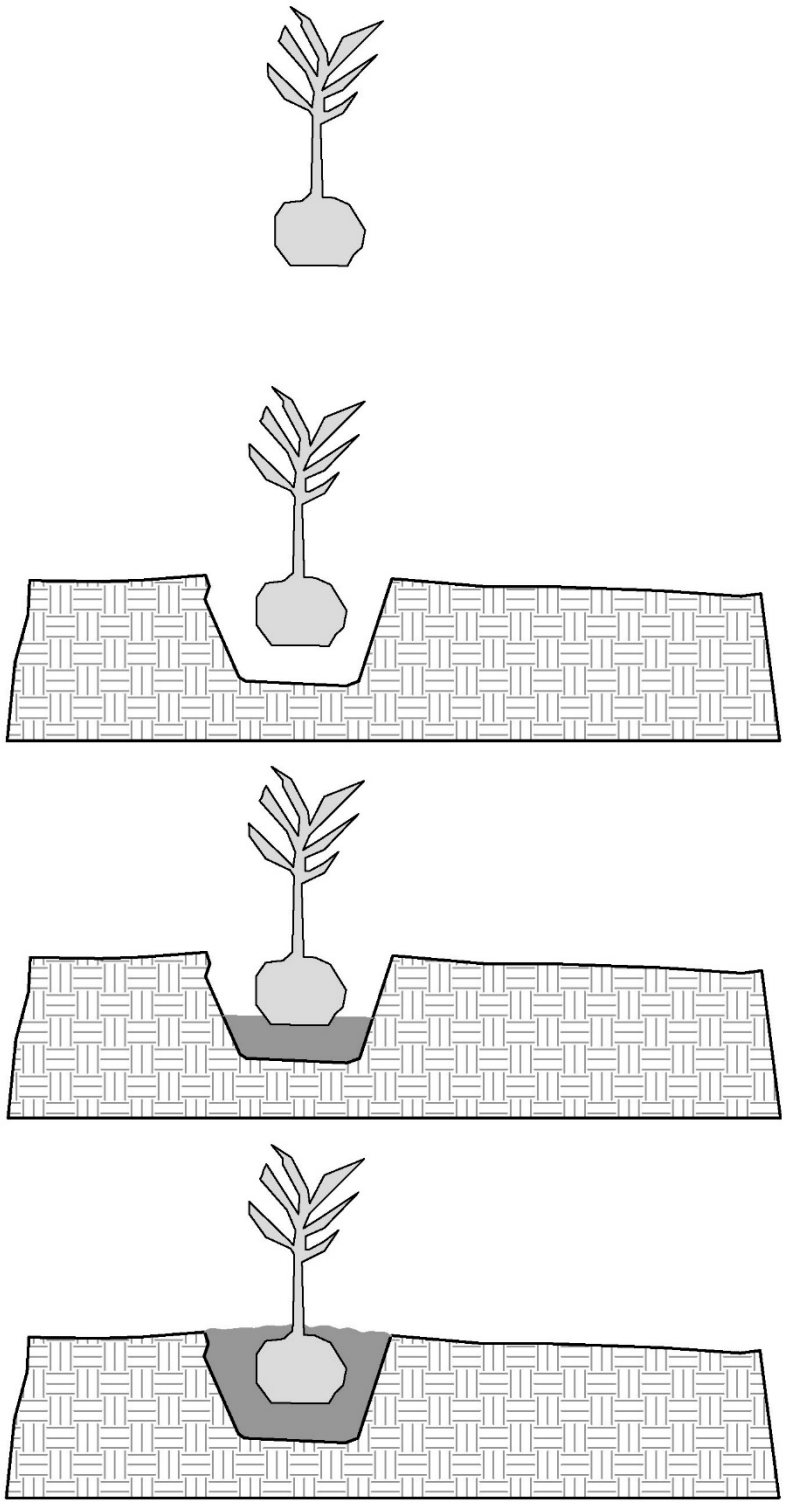
8. Proper transplanting procedures are followed to reduce mortality and improve plant vigor. When plants are harvested from the new trail alignment or from the surrounding area, they are removed from the ground so that the entire root ball is intact and encased in soil. The hole excavated to receive the plant is twice as wide as the diameter of the root ball and at a depth of one and a half to twice the size of the root ball. When the plant is placed within the hole, loose topsoil is formed around the root ball to fill voids and elevate the plant stem to a level similar to its position pre-harvest. The soil is then firmly packed around the plant by hand until it matches ground elevation. If the soil is dry, the plants are manually watered until rain can maintain the soil moisture. (See Figure 27.6.) Nursery plants are planted in the same fashion, except the roots are loosened and trimmed when removed from their containers so they grow into the surrounding native soil and do not become root bound.

   When rehabilitating a trail alignment through a meadow, prairie, or grassland, grasses adjacent to the old alignment are cut and spread over the re-contoured alignment. In addition, during the late summer or early fall, grass seeds from these plants will be naturally dispersed onto the re-contoured soil. Check with a resource specialist first to ensure that the grasses to be cut are native species and appropriate for re-vegetation purposes.

9. Vegetation is planted randomly in the old trail alignment to mimic natural conditions. Vegetation planted in a row or in a linear arrangement will look unnatural. Use the plant dispersal patterns of the surrounding area to guide the placement of plants. (See Photo 27.10.) Once the old trail is re-vegetated, large woody debris and rocks are placed randomly along the former trail alignment, consistent with the dispersal of these objects in the surrounding area. (See Figure 27.7.) Finally, the duff collected earlier and placed above the alignment is scattered over the old trail. Upon the completion of a properly recontoured and revegetated trail removal project, the landform should appear as though the trail never existed. With practice, this level of restoration can be achieved in most environmental conditions. (See Photos 27.10, 27.11, and 27.12.)

10. When all of the above measures have been completed, the old trail alignment will be obscured from view. Large rocks and downed trees are winched across the entrance to the old alignment, so that the old trail cannot be easily used by the public. (See Figure 27.7.)

11. In some cases there may not be enough vegetation, logs, or rocks to obscure the old trail. In this case, you can install symbolic or barrier fencing and interpretive signage to keep the public from using the trail. (See Photos 27.13 and 27.14.) Once the old trail has fully recovered and is no longer visible, the fencing and signs are removed. Occasional monitoring is required to ensure the public does not resume using the old trail alignment.



1. WHEN DIGGING UP VEGETATION TO TRANSPLANT, EXCAVATE THE PLANTS ENTIRE ROOT BALL AND SOME OF THE SURROUNDING SOIL. IF TRANSPLANTING NURSERY PLANTS IN POTS TRIM THE MARGINS OF THE ROOT BALL TO PROMOTE OUTWARD GROWTH.

2. EXCAVATE A HOLE TWICE AS WIDE AND ONE AND HALF TO TWICE THE SIZE AS THE INTACT ROOT BALL OF THE PLANT

3. FILL THE HOLE WITH LIGHTLY COMPACTED TOP SOIL SO THE BASE OF THE STEM IS AT GROUND LEVEL.

4. FILL AROUND THE PLANT WITH LIGHTLY COMPACTED TOP SOIL UP TO THE BASE OF THE STEM. WATER PLANT.

Figure 27.6 - Vegetation Transplanting

VEGETATION TRANSPLANTING

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Photo 27.10 - Trail Removal and Recontour Project in a Temperate Rain Forest

Photo 27.11 - Trail Removal and Recontour Project in a Forest

Photo 27.12 - Trail Removal and Recontour Project in the Desert

Photo 27.13 - Signage for a Trail Removal Project

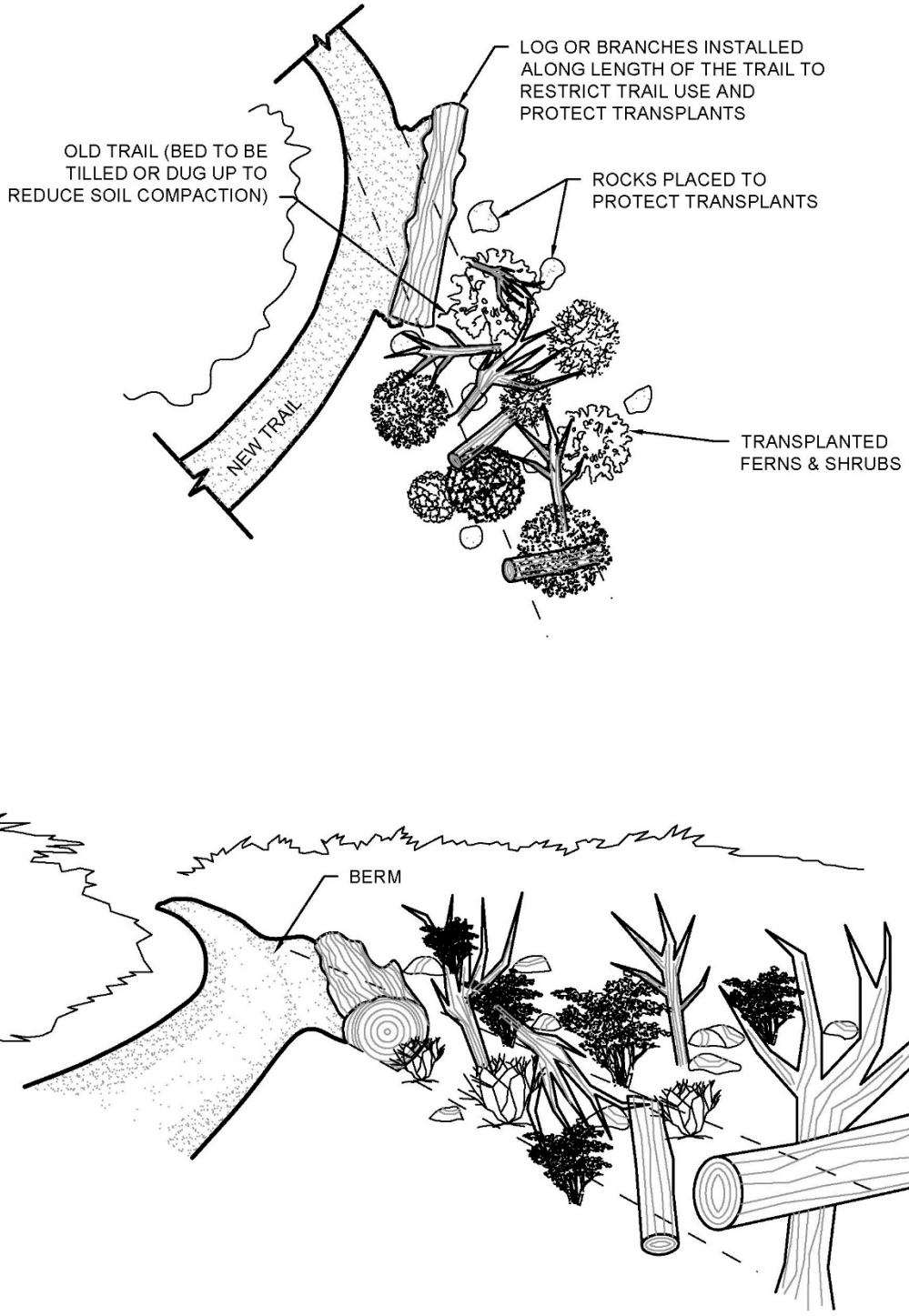

Figure 27.7 - Trail Obliteration and Rehab

TRAIL OBLITERATION AND REHAB

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Photo 27.14 - Symbolic Fencing for a Trail Removal Project

27.3. Removing Volunteer Trails

It is common for shortcuts and volunteer trails to develop within a trail system, especially around switchbacks where the user can see the trail below and choose the most direct route. Shortcuts and volunteer trails must be eliminated as soon as they are discovered. If left uncorrected, these trails encourage use and can lead to damaged vegetation, soil erosion, and drainage problems. Additionally, the longer volunteer trails are in place, the more difficult it is to change the resulting patterns of use.

Once discovered, volunteer trails are blocked with native materials, such as limbs, logs, rocks, and brush. If suitable native material is not available or effective, railing or fencing can be installed to block access to the unwanted trail.

When removing a volunteer trail, the trail bed must also be rehabilitated. Entrenched trails are de-compacted, filled, reshaped to the natural contour, and re-vegetated following the procedures identified above. Once rehabilitation is complete, the volunteer trail should be obscured and/or present a difficult and unappealing route to potential users. In the case of a volunteer trail between switchbacks rehabilitation should block the view of the trail down slope, if possible.

Rehabilitation of a fall line oriented volunteer trail on an open slope in a grassland environment may require the use of straw wattles and grass seeds to stabilize the rehabilitated trail. The straw wattles are installed as previously discussed in this chapter and grass seeds are spread and raked into the bare soil. (See Photo 27.15.) If native grass seeds can be obtained, they should be used. Otherwise, a non-invasive annual

grass such as red fescue may be used to help protect the bare soil until native grasses adjacent to the trail can populate the area. Check with a resource specialist first to ensure that the proposed grass seeds are appropriate for re-vegetation purposes.

Photo 27.15 - Fall Line Volunteer Trail Restoration Before (left) and After (right)

27.4. Trail Narrowing

A trail that exceeds the standard for width can be narrowed in one of two ways, as follows.

1. For trails cut on a side slope, part of the sidecast (material deposited on the hillslope below the trail during construction) is pulled in and placed against the cut bank. If plants are present in ether the sidecast material or cut bank, they are removed with their root ball intact and replanted into the remaining side slope.

2. For trails on flat ground, decompact the ground to loosen the soil. Block off the section of trail to be removed with natural debris, such as downed logs, limbs, brush, rocks, or fill. Scatter material in an irregular pattern so it looks natural. Rocks and logs are partially buried with the weathered side up (side previously exposed to air). Re-plant restored areas with native vegetation and scatter duff over the entire area. (See Photo 27.16.) In grassland areas, sod can be transplanted along the edge of the trail after it has been de-compacted.

Photo 27.16 - Trail Narrowing Project Before (left) and After (right)