Chapter 13

Erosion Control

"Erosion control -- one of the best, most inexpensive ways to protect the road and the environment. Just do it!"

Erosion control on roads is fundamental for the protection of water quality (*Photo 13.1*). Soil stabilization and erosion control practices are needed and should be used in areas where soil is exposed and natural vegetation is inadequate. Bare ground should be covered, typically with grass seed and some form of matting or mulch. This will help prevent erosion and subsequent movement of sediment into streams, lakes and wetlands. This movement of sediment can occur during and after road construction, after road maintenance, during logging or mining activities, as the road is being used, if a road is closed but not stabilized, or from poor land management practices near the road (*Photo 13.2*). Roughly half of the erosion from a logging operation, for instance, comes from the associated roads. Also, most erosion occurs during the first rainy season after construction.

Erosion control measures need to be implemented immediately following construction and every time an area is disturbed. Soil erosion prediction models such as the Water Erosion Prediction Project (WEPP) or Unified Soil Loss Equation (USLE) can be used to quantify erosion and compare the effectiveness of various erosion control measures. Concentrated water flow can begin as minor sheet flow, produce rills, and eventually result in major gully formation (See Chapter 14).

Photo 13.1 **Do not leave disturbed or barren areas exposed to raindrops and runoff. Use erosion control measures to protect the area and protect water quality.**

Photo 13.2 Erosion on a slope adjacent to a highway due to lack of vegetation or poor land use practices. Note that vegetation is preventing erosion next to the highway.

Erosion control practices include surface armoring and ground cover with netting (*Photo 13.3*), vegetative material or slash (*Photo 13.4*), rock, and so on; installing water and sediment control structures; and mulching, seeding, and various forms of revegetation, as seen in *Figures 13.1* through *Figure 13.4*. Effective erosion control requires attention to detail, and installation work requires inspection and quality control.

Physical methods include such measures as armored ditches (*Photo 13.5*), berms, wood chips, ground cover mats, and silt or sediment fences (*Photo 13.6*). These control or direct the flow of water, protect the ground surface against erosion, or modify the soil surface to make it more resistant to erosion (*Photo 13.7*).

Vegetative methods, using grasses, brush, and trees, offer ground cover, root strength, and soil protection with inexpensive and aesthetic "natural" vegetation, as well as help control water and promote infiltration (*Photo 13.8*). Ideally, vegetation should be selected for good growth properties, hardiness, dense ground cover, and deep roots for slope stabilization. Local native species having the above mentioned properties should be used. However some grasses, such as Vetiver, have been used extensively worldwide because of their strong, deep roots, adaptability, and non-invasive properties (*Photo 13.9*).

Biotechnical methods such as brush layering, live stakes, and contour hedgerows (*Figure 13.4*) offer a combination of structures with vegetation for physical protection as well as additional long-term root support and aesthetics (*Photo 13.10*).

An **Erosion Control Plan** and use of erosion control measures should be an integral part of any road construction or resource extraction project. Most disturbed areas, including landings, construction storage areas, skid roads, road fills, some road cuts, drainage ditches, borrow pits, the road surface and shoulders, and other working areas should re-

Photo 13.3 Cover fill slopes, work areas, and other exposed soil areas with straw, netting, rock, or other material to protect the ground and promote vegetative growth.

Table 13.1

Key Elements of an Erosion Control and Revegetation Plan for Road Projects

A. Description of Project

1. Project Objectives
2. Project Location
3. Description of Local Environment

B. Planning

1. Site Analysis
    a. Climate and Microclimate
    b. Vegetation Options
    c. Soils and Fertility
2. Developing the Revegetation Plan
    a. Suitable Plant Species
    b. Soil and Site Preparation
    c. Aesthetics vs. Erosion Control Needs
    d. Use of Local "Native" Species

C. Implementation

1. Planting Methods—Cuttings and Transplants
    a. Tools and Materials
    b. Planting Holes and Methods
2. Planting Methods—Seeding and Mulching
    a. Hand Broadcasting or Hydroseeding
    b. Range Drills
    c. Type / Quantity of Seed
    d. Type / Quantity of Mulch and Fertilizer
    e. Holding Mulch with Tackifiers or Netting
3. Plant Protection
    a. Wire Caging around Plants
    b. Fencing Around the Entire Site
4. Maintenance and Care After Planting
    a. Irrigation
    b. Weed Control
    c. Fertilization
5. Biotechnical Planting Methods
    a. Wattling
    b. Brush Layering or Brush Matting
    c. Live Stakes

D. Obtaining Plants and Handling of Plant Materials

1. Timing and Planning
    a. Fall versus Spring Planting
    b. Summer Plantings
2. Types of Plant Materials
    a. Cuttings
    b. Tublings
    c. Other Container Plants
3. Hardening-off and Holding Plants (Acclimatizing)
4. Handling Live Plants and Cuttings

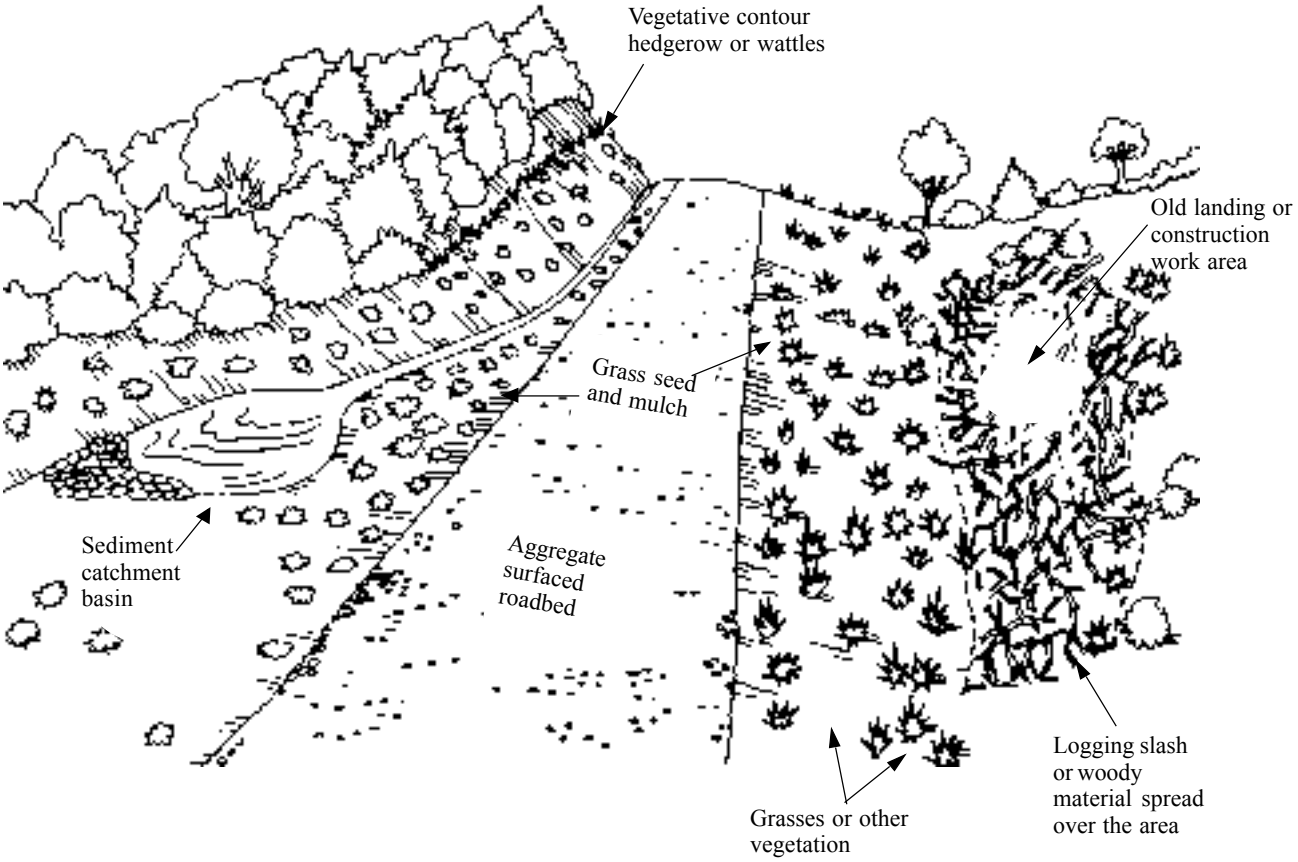
ceive erosion control treatment. It is more cost effective and efficient to prevent erosion than to repair the damage or remove sediment from streams, lakes, or groundwater.

Elements of an Erosion Control and Revegetation Plan include project location and climate, soil types, type of erosion control measures, timing of implementation of the vegetative erosion control measures, source of seeds and plants, and planting methods. *Table 13.1* presents the many aspects of planning, implementation, and care involved in an Erosion Control Plan for roads projects.

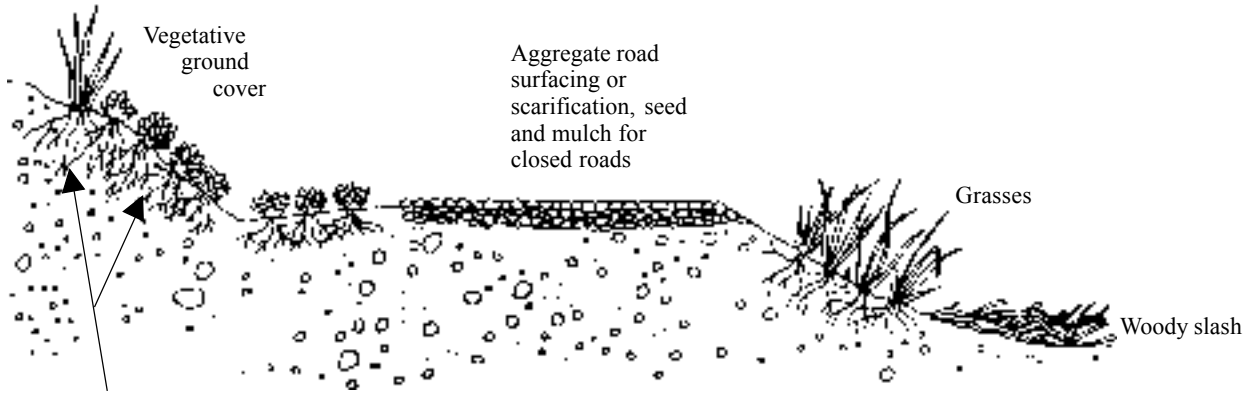
PRACTICES TO AVOID

- Disturbing unnecessarily large areas.
- Leaving native soil unprotected against erosion after new construction or ground disturbance.
- Earthwork and road construction during periods of rain or the winter.

Figure 13.1 Use of vegetation, woody material and rock for erosion control and ground cover. *(Adapted from Wisconsin's Forestry BMP for Water Quality, 1995)*



Perspective View



Cross-section

Various erosion control ground covers include seeding and straw mulch, grasses and other mulch, vegetation, rock, slash, chips, and leaves.

Photo 13.4 A disturbed work area covered with woody material such as brush from clearing or logging slash for erosion control . Ensure that the material is well mashed onto the ground.

Photo 13.5 A roadside ditch armored with graded rock (riprap) for erosion control.

Photo 13.6 Sediment control fences (silt fences), live vegetative barriers, or brush fences can all be used to control sediment movement on slopes (also see *Photo 6.6*).

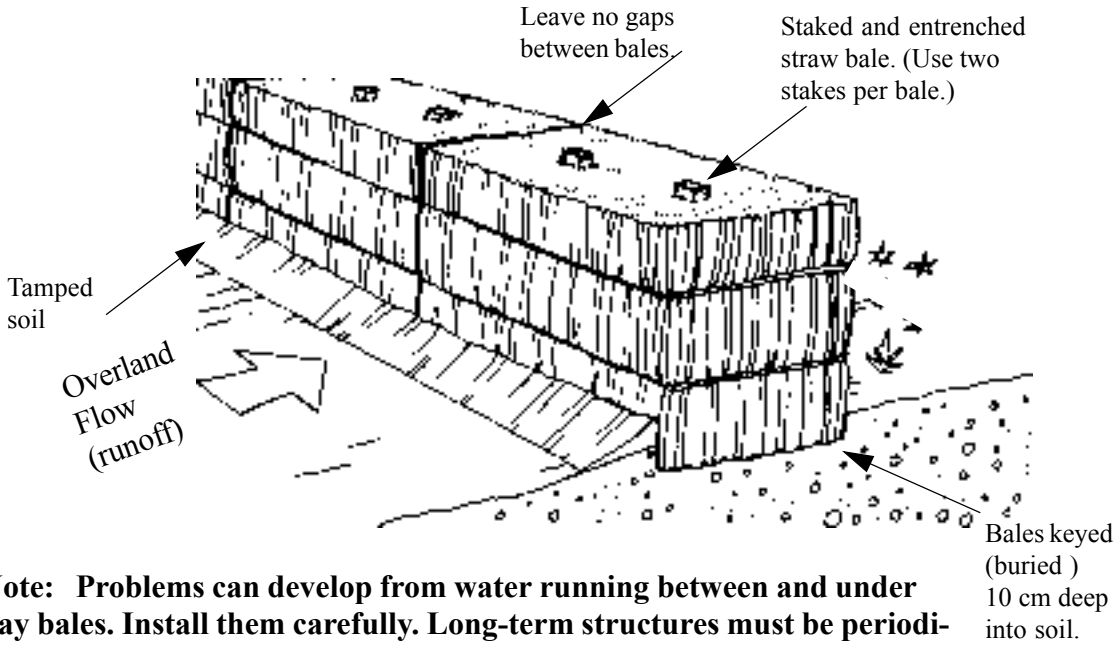
Photo 13.7 Rock armoring, placed on a very erosive soil fill slope adjacent to a creek, used for durable, permanent erosion control.

Photo 13.8 Seed and mulch (cover for seed protection and moisture retention) applied to the ground surface to promote grass growth on barren areas, closed roads, and on erosive soils.

Photo 13.9 Use of Vetiver grass for slope stabilization and erosion control. Choose vegetation that is adapted to the site, has strong roots, and provides good ground cover. Ideally, use native species.

Figure 13.2a Sediment control structures using hay bales or silt fences. Note that hay bales must be installed correctly and keyed into the ground! *(Adapted from Wisconsin's Forestry BMP for Water Quality)*

a. Hay Bales (or bundles of grass)



Note: Problems can develop from water running between and under hay bales. Install them carefully. Long-term structures must be periodically cleaned and maintained.

b. Silt Fences

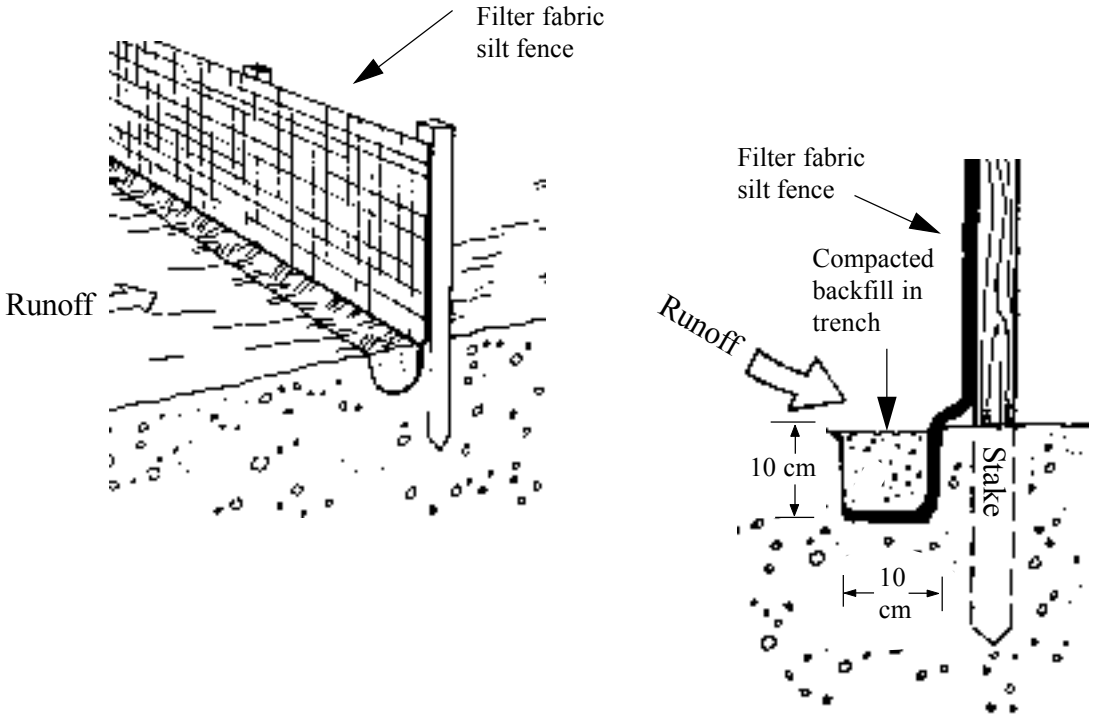
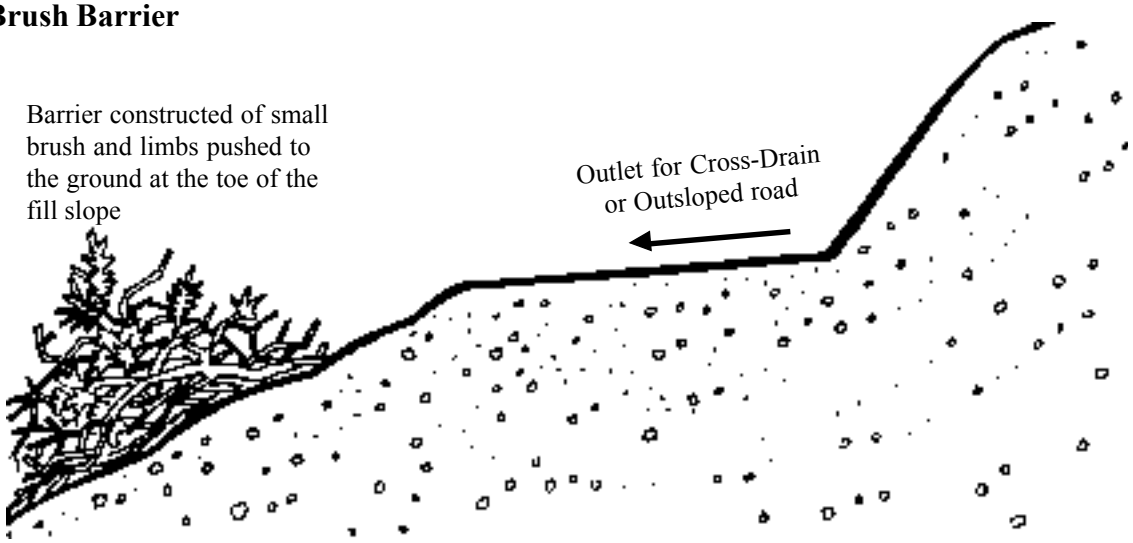


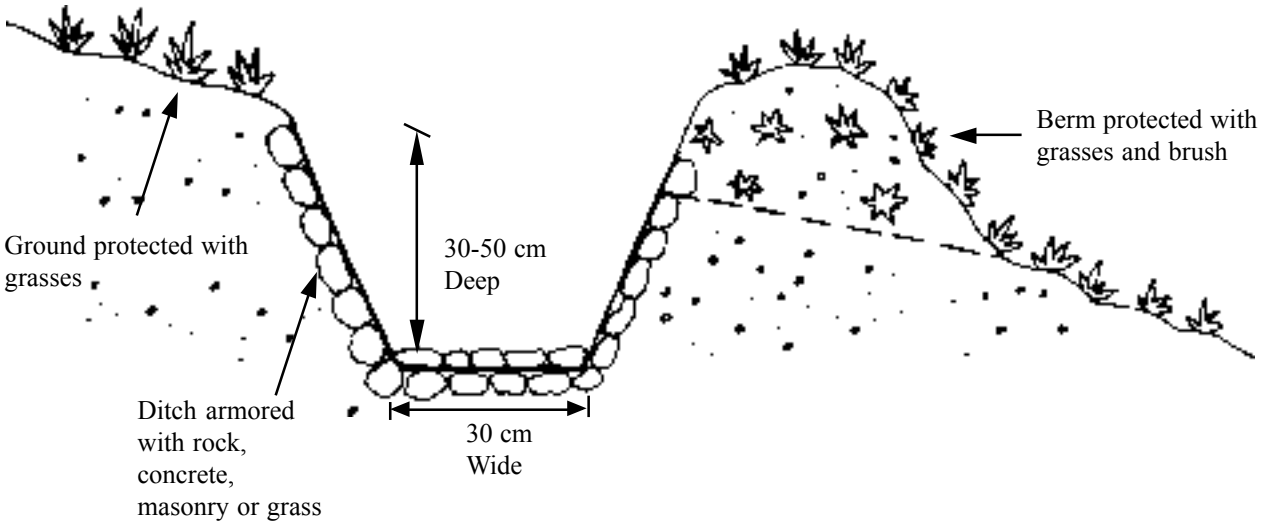
Figure 13.2b Sediment control structures using brush barriers and brush fences.

c. Brush Barrier

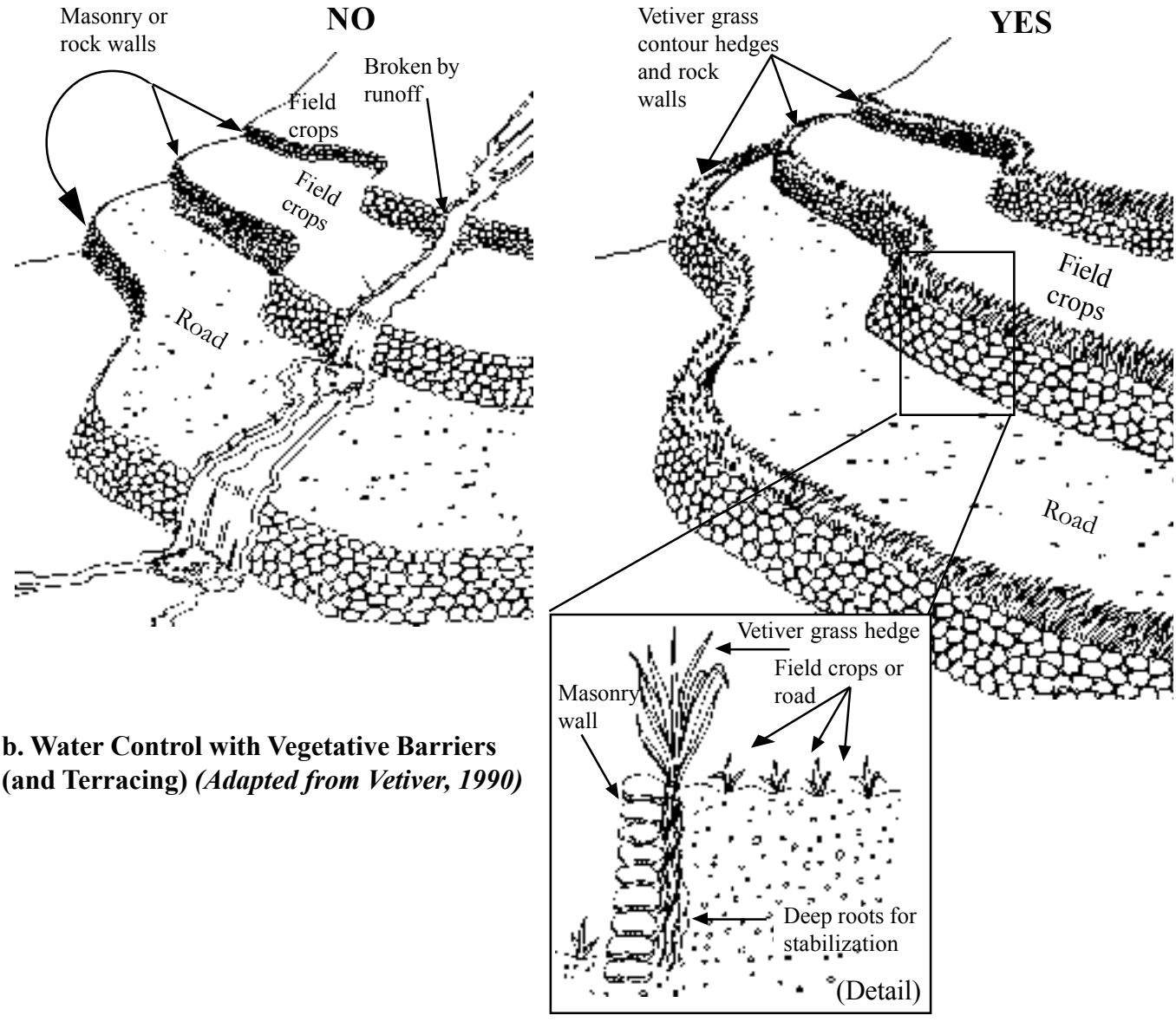


Brush Fence (buried 10 cm deep into soil).

Figure 13.3 Water control structures.



a. Water Control with Ditches and/or Berms



b. Water Control with Vegetative Barriers (and Terracing) ***(Adapted from Vetiver, 1990)***

Photo 13.10 Use of grasses, planted on contour, to provide surface slope stabilization and erosion control on a steep road cut.

Photo 13.11 Live vegetative barriers (contour hedgerows), using Vetiver, other grasses, or vegetation, located on contour to prevent down-slope erosion from barren or disturbed areas.

Photo 13.12 A local nursery, developed in conjunction with a construction project, to provide a source of plants and grow appropriate (preferably native) vegetation for the erosion control work.

RECOMMENDED PRACTICES

- Develop a project **Erosion Control Plan** to address interim and final erosion control needs, specific measures, and how to implement or install those measures. Develop typical drawings for sediment traps, sediment fences, brush barriers, ground cover, check dams, armored ditches, and biotechnical measures.

- Disturb as little ground area as possible, stabilize that area as quickly as possible, control drainage through the area, and trap sediment on-site.

- Conserve topsoil with its leaf litter and organic matter, and reapply this material to local disturbed areas to promote the growth of local native vegetation.

- Apply local, native grass seed and mulch to barren erosive soil areas or closed road surfaces. Mulch material may be straw, wood chips, bark, brush, leaves and limbs, shredded paper, or gravel. (*Figure13.1*).

- Apply erosion control measures before the rainy season begins and after each season of construction, preferably immediately following construction. Install erosion control measures as each road section is completed.

- Cover disturbed or eroding areas with limbs, tree tops and woody debris such as logging slash placed on contour and mashed down to achieve good contact with the soil (*Figure 13.1*).

- Install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is established. Sediment control structures include windrows of logging slash, rock berms, sediment catchment basins, straw bales, brush fences, and silt fencing (see *Figures 13.1*, *13.2a* and *13.2b*).

- Control water flow through construction sites or disturbed areas with ditches, berms, check structures, live grass barriers, and rock (*Figure 13.3*).

- Place windrows of logging or clearing slash along the toe of roadway fill slopes (See Low-Volume Roads Engineering, *Figure 4.2*).

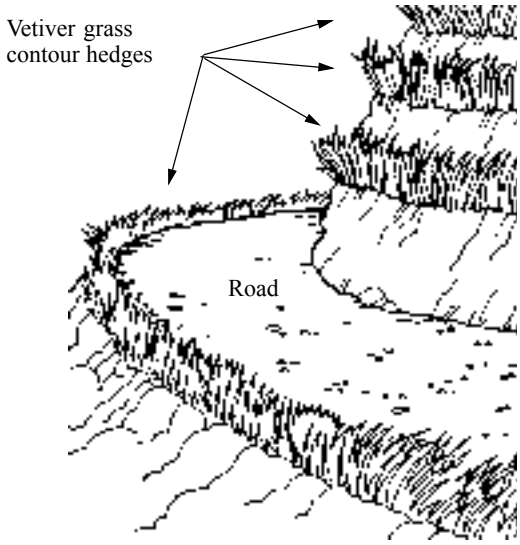
- Stabilize cut and fill slopes, sliver fills, upland barren areas, or gullies with brush layers, rock structures with live stakes, vegetative contour hedgerows (*Photo 13.11*), wattling, or other biotechnical measures (*Figure 13.4*).

- Maintain and reapply erosion control measures until vegetation is successfully established. Do soil chemistry tests if necessary to determine available soil nutrients.

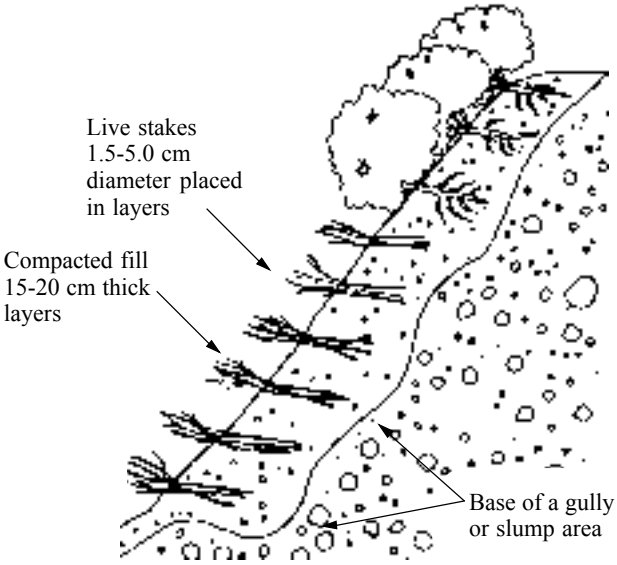
- Use fertilizers in areas of poor, nutrient deficient soils to promote faster growth and better erosion control. Fertilizer should be used only if needed. Add water or irrigation only if necessary to initially establish vegetation.

- Develop local plant sources and nurseries for vegetative erosion control materials. Use local native species whenever possible (*Photo 13.12*). Select species appropriate for the use, the site, and the bioregion.

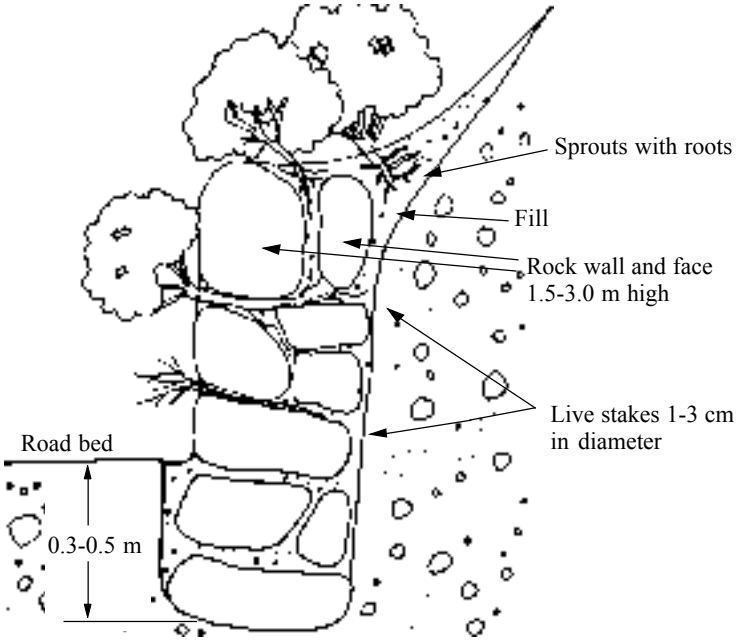
Figure 13.4 Biotechnical slope stabilization measures.



a. Contour Hedges
For Erosion Control and
Slope Stabilization *(Adapted from Vetiver, 1990)*



b. Brush Layering
(for Stabilization of Gullies and Slides)



c. Live Retaining Walls
Constructed with Rock or
Gabions and Vegetation