



United States  
Department of  
Agriculture

Soil  
Conservation  
Service

Columbia,  
Missouri



## Urban Conservation Tips



# Riprap

### Description

Riprap is loose rock used to protect the soil surface. It can be used in severe situations to stabilize banks and prevent erosion when vegetation cannot. Riprap is an expensive alternative because of the costs of quarrying, transporting and placing the rock.

### Application

**Rock Chutes** - Riprap-lined chutes are useful for channeling large flows of water over steep banks where there is no temporary storage available and where flow rates exceed the capacity of a practical size pipe. These chutes require a precise design which must include a level inlet and outlet section to prevent upstream and downstream erosion.

**Streambank Protection** - Riprap is an effective way to stabilize eroding streambanks. A stable toe at the bottom of the riprap hill must be established for the success of this measure. This requires that the riprap start at the bottom of a trench several feet below the creek bottom, or on bedrock if it is encountered. The weight of the rock should rest on the bank rather than on lower courses of rock. This can be accomplished by sloping the bank no steeper than 1.5 horizontal to 1 vertical.

**Slope Stability** - Steep slopes, whether natural or man-made, can be unstable and slide because of soil structure or subsurface seepage. A saturated layer of soil beneath the surface can act as a lubricated plane on which the upper layers of soil can slide. Riprap, when properly applied to these areas, can add needed weight to the surface as well as let the subsurface water flow safely away. This riprap application needs to be designed with a stable toe with special attention given to the underlying bedding system. If the slope is not subject to heavy overland flows, the rock can be smaller. If the slope is steeper than 2 horizontal to 1 vertical, other alternatives, such as a retaining wall, should be considered.

**Pipe Outlets** - Downstream scouring is inevitable where large pipes and culverts discharge great volumes of water unless some measure of protection is taken to dissipate the energy. A grouted riprap splash pad or a riprap-lined plunge pool of water to absorb the

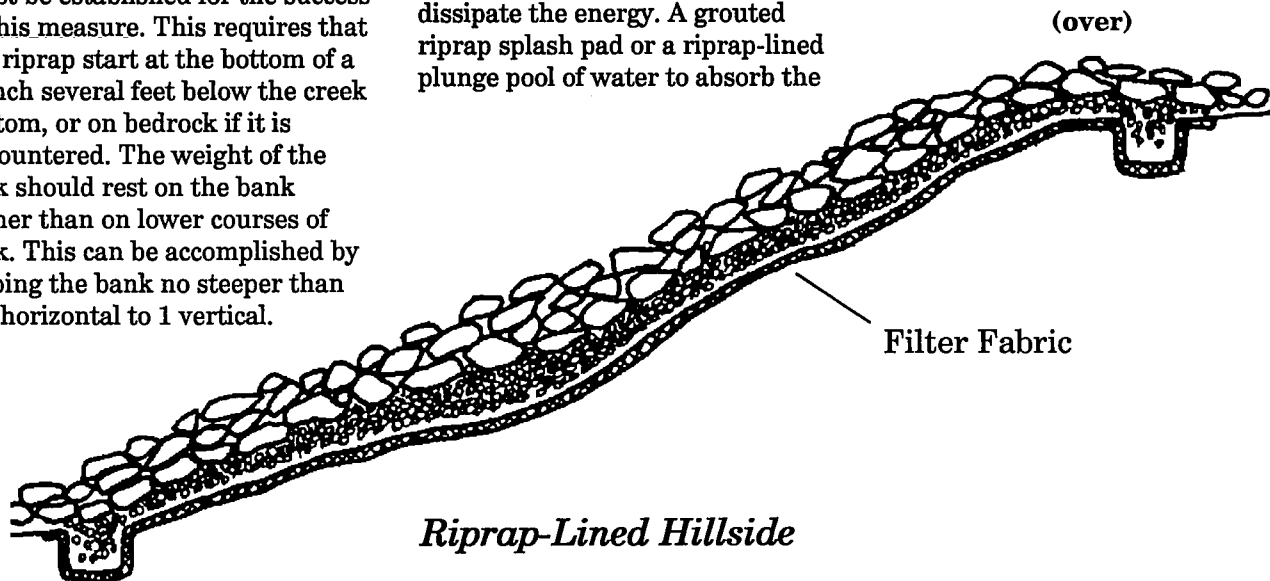
energy are comparatively inexpensive solutions.

### Construction

The thickness of the riprap layer and rock size is determined by specific site conditions. Generally, the riprap layer should be 50 percent thicker than the largest rock used. To assure the success of a riprap project, the design should be completed by someone fully trained and experienced in this line of work. In general, riprap is installed as follows:

The initial excavation for the job must be deep enough to include the thickness of the riprap layer, the bedding and the anticipated water depth. The final bottom grade of the excavation must be free of topsoil, roots, frozen material and other debris which could cause instability.

To be effective, riprap must



*Riprap-Lined Hillside*

protect the underlying soil from water flowing swiftly over the surface, and at the same time allow excess water within the soil to freely drain without displacing the soil particles. To accomplish this, the larger rock is underlain first with a bedding of well-graded gravel, sand mix or filter fabric.

Where riprap is subject to exceptionally fast-flowing water, a slurry of Portland cement and sand, called grout, can be poured over the rock surface. This further

binds the rock fragments together. Grouting the rock also discourages vandalism, and prevents the intrusion of vegetative growth.

### **Maintenance**

Riprap structures should be inspected periodically to make sure rock has not been displaced. If rock displacement is severe, and occurs quite often, grouting or larger rock may be warranted. Cracked, grouted riprap should be repaired as needed. Unwanted vegetation

can be sprayed, but it often is advantageous to allow vegetation to gradually take over and obliterate the rock.

### **Where To Get Help**

For more information about the use of riprap in urban areas, contact your local Soil Conservation Service office. It is listed in the telephone directory under "U.S. Government, Department of Agriculture."