

# RIPRAP FOR SHORELINE PROTECTION

Produced by;  
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Maine Soil & Water Conservation Commission  
Portland Water District  
Time & Tide RC&D Area  
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## WHAT IS IT?

Riprap is a heavy stone facing (armor) on a shorebank used to protect it and the adjacent upland against wave scour. Riprap depends on the soil beneath it for support and should be built only on stable shores or bank slopes.

## ENVIRONMENTAL CONSIDERATIONS

Stabilizing shore banks with shrub and tree vegetation provides excellent habitat for fish and wildlife species. It also provides a vegetated buffer strip along the lake capable of taking up pollutants and nutrients (such as phosphorus). **Avoid at all costs using riprap** If vegetation can solve your erosion problem. If riprap is unavoidable, use a combination of riprap and plantings to provide the vegetative cover needed.

No riprap can be installed or repaired along a pond or lake without permission from the DEP. An application for a permit under the Natural Resources Protection Act must be filed and approved. Contact the DEP Augusta Office, 289-7779 or Portland Office, 879-6300, for more information.

## WHAT IS RIPRAP COMPOSED OF?

Riprap is composed of three sections: the armor or stone layer, the filter layer, and the toe protection.

Typical armor is composed of rough, angular rock. The second component, the underlying filter layer, supports the stone against settlement, allows groundwater to drain through the structure, and prevents the soil beneath from being washed through the armor layer by waves or groundwater seepage.

In certain cases, overtopping of the top of the riprap slope may be a factor which needs to be considered. The top of the slope can be protected by including a stone overtopping apron in the design.

## STONE SIZE

To assure that a riprap shoreline will remain stable, you must specify the size of the stone to be used. Stone size is commonly expressed in terms of a D50 value. D50 values are generally expressed in inches, and can be thought of as the average stone size in a rock mix. For example, if the D50 at a rock mix is 12 inches, 50% of the stones will pass through a sieve with 12 inch openings. The remaining rocks will be larger. Their largest stone in the mix should be no larger than 1.5 times the D50 (18 inches). The thickness of

the riprap layer should be 2.25 times the D50, or 27 inches. For conditions around the smaller lakes and ponds of Maine, a D50 of 10 to 12 inches should be adequate under most circumstances. Be sure that you get a mixture which includes smaller stone sizes to be sure the small voids in the rock mix are filled.

Sebago Lake and other large Maine lakes are subject to erosion from large waves as well and large pieces of ice. Depending on your location on the shore, stone size may need to be increased. Determine the largest wave height your property is subjected to and use the wave size chart to determine stone size for your riprap.

## STONE SIZING CHART

WAVE HEIGHT (FEET)	ROCK D50 (INCHES)	ROCK WEIGHT (POUNDS)
0.5	4	4
1.0	7	13
1.5	8	26
2.0	11	61
2.5	13	105
3.0	16	205
3.5	20	355
4.0	22	490
4.5	26	845
5.0	27	975
5.5	30	1203
6.0	33	1648
6.5	36	2145
7.0	38	2616

Chart based on 2:1 slopes (H:V)

Consult an engineer if slopes are steeper. Assumed stone weight: 155 lbs/cubic foot.

## FILTER LAYER

Filter layers of either special filter cloth (also called geotextile) or 6 inches of well-graded stone should be provided to prevent loss of slope material through voids in the armor. A wellgraded stone will contain a mix of stone sizes ranging from 3/4 of an inch to 3 inches. It should be washed to remove all fines (small soil particles). When using filter cloth, an intermediate layer of 3/4 inch washed stone about 3 inches thick between the riprap layer and the fabric helps to distribute the load and prevent rupture of the filter cloth.

**LARGEST STONE c 1.5 X 050 THICKNESS OF RIPRAP LAYER  
x:25 X D50**

## LIMITATIONS OF RIPRAP

Riprap protects only the land immediately behind it and not adjacent areas. Near the riprap, erosion may be accelerated by wave reflection from the structure.

Riprap by itself does not provide a good habitat for fish. Using a combination of riprap with trees and woody shrubs planted between will provide wave protection as well as the vegetative cover required by spawning and young fish.

## **SLOPE**

Prior to riprap construction, the existing ground should be graded to an appropriate slope, preferably no steeper than 1.5 horizontal to 1 vertical (1.5 to 1). The DEP calls for the slope to be no flatter than 2 horizontal to 1 vertical (2 to 1). Clean, well-graded 611 material should be added as needed to achieve a uniform grade. The fill should be free of large stones (larger than 6 inches) and firmly compacted before construction proceeds.

## **CONSTRUCTION CONSIDERATIONS**

### **Site Accessibility**

Determine if the project can be built using only hand tools and portable power equipment or if heavy equipment is also necessary. If heavy equipment is required, you must locate a good access to the site. Be careful to keep movement of heavy machinery to a minimum in these sensitive areas. Expect to have to replant some vegetation after the project is completed

### **Choosing a Contractor**

Identify a reputable firm in your area. Ask for a list of their similar projects. Contact the owners to arrange for personal inspection of the work and ask questions to help you assess if the contractor's past performance equals their claims.

### **Erosion Control Measures**

Plan to Install your riprap when the water level is the lowest, usually during the fall. Before any work is begun, a barrier of silt fencing should be installed on the downslope side of construction. Be sure the fencing is installed properly! If there is any evidence of siltation reaching the lake or pond, you can be fined by the DEPT If the silt fencing needs to be installed in the water, rather than embedding the fencing 6 inches, place a row of sand bags at the base of the fencing to hold it down. Be sure the construction is performed quickly and efficiently -- delays during construction can lead to a major impact to the lake.

The way in which the riprap is installed makes a big difference. Be sure the contractor does not have heavy equipment in the lake. Ideally, machinery should be parked on a flat area at the top of the slope and construction should be done by reaching out over the slope. This will help prevent damage to the top of the slope.

Construction should start at the base and work upwards. If the job takes several days, the face of each section should be stabilized with stone before leaving for the day.

Once the riprap is installed, any mud and dirty water between the construction area and the fencing should be pumped out and disposed of in a wooded area away from the lake. Be sure any areas of bare soil have been reseeded and mulched. When a good cover of vegetation is growing, the silt fencing can be removed.

### **Inspecting the Work**

Close inspection of the contractor's work is required. Keep a photographic record beginning with existing conditions and proceeding through completion of construction. If possible, check lines, grades, slopes and elevations of structures to assure compliance with your plans. Materials should be examined for adequate conformity with specifications. After construction, maintain a photographic record throughout the life of the structure.

