Protecting soil and water

Mulches, meshes and mats keep soil in place

A guide to effective erosion control on the golf course.

Tim Lancaster

Picture this: You are the superintendent of a golf course under construction. Work on the back nine has left the soil uncovered. A major storm hits, inflicting severe erosion around elevated tees and greens, in swales across the fairways — washing soil back into excavated bunkers.

These areas will have to be repaired, causing a delay in opening the course, restricted playing

Photos courtesy of Tim Lancaster

Proper selection of erosion-control materials can protect golf course soil and water Here, on an out-of-bounds slope, temporary straw fiber erosion-control blankets prevent erosion and sediment runoff while promoting establishment of permanent vegetative cover.

areas and lost revenue. Repairing eroded areas involves more than reseeding — costly re-excavation is also required. You learn the hard way that effective erosion control is the key to avoiding the high price of erosion on your course.

In fact, in many cases erosion control is required by law. The National Pollution Discharge Elimination System, a provision of the Environmental Protection Agency's 1990 Clean Water Act, addresses stormwater runoff from construction sites of 5 acres or more. On such projects, the person responsible for erosion and sediment control planning must submit documentation and obtain a permit before construction activities can begin. More information on erosion regulations is available from local and state conservation agencies.

Swales and streambeds often require aggressive protection from erosion. Rock riprap and mat-reinforced vegetation provide stabilization for this channel.

Erosion control materials for various slopes

Typical applications	Slope grade (h:v)	Required longevity	Recommended materials
Fairways, flat tee boxes	< 6:1	1 growing season	Loose mulch Loose mulch crimped or tacked Hydromulch
Sloping fairways, tee boxes	6:1 - 5:1	1 growing season	Loose mulch crimped or tacked Loose mulch with quick-degrading net Hydromulch with bonding agent
Steep fairway slopes, tees, greens, bunkers	6:1 - 2:1	1 growing season	Quick-degrading erosion-control mesh Quick-degrading single-net, erosion-control blanket
Very steep fairway slopes, tees, greens, bunkers	2:1 - 1:1	1 growing season	Double-net erosion-control blanket
Steep out-of-bounds slopes	5:1 - 2:1	1 growing season	Erosion-control mesh Single-net erosion-control blanket
Very steep out-of-bounds slopes	2:1 - 1:1	1 growing season	Double-net erosion-control blanket
Very steep out-of-bounds slopes	2:1 - 1:1	1-3 growing seasons	Double-net, long-term erosion-control blanket
Severe out-of-bounds slopes	> 1:1	1-3 growing seasons	Double-net, long-term erosion-control blanket

EROSION

Knowing your options

A wide variety of materials offer solutions to nearly any erosion problem. However, deciding what type of erosion-control materials you need can be a confusing task. The key to selecting materials is defining the problems found on your golf course.

Specifically: What type of terrain do you have? Would it be considered a slope where rainfall and runoff in the form of "sheet" flows are the prevalent erosive forces? Is it a drainage channel where water flow concentrates? Or is it a pond or lake edge where variable water levels and wave action erode the shoreline?

Once the type of erosion is defined, you must consider what form of stabilizing materials are appropriate.

Loose mulches without sufficient anchoring will not be as effective at preventing erosion in areas where water flow concentrates, compared with hillside areas of less concentrated water flow

Vegetative cover

Vegetation is often the first choice on golf courses because of its relatively low cost, easy maintenance with existing equipment, aesthetic appeal, playability and low hazard to players. David Yost of the Virginia Cooperative Extension writes that vegetative covers provide the best known soil protection.

"Vegetation reduces the impact of raindrops, reduces the velocity of runoff, holds soil in place, and is generally less expensive than structural controls," Yost reports (6).

However, when starting vegetative cover from seed, seedbeds often require temporary erosion protection and mulch to hold the soil, seed and moisture in place to ensure its establishment.

Loose mulches

Loose mulches consist of straw and hay fibers, which decompose within one growing season. These materials are hand-spread or machine-blown at

Erosion control materials for various slopes

Typical applications	Shear stress lb. per sq. ft.	Required longevity	Recommended materials
Fairways swales	≤ 1.45	1 growing season	Loose mulch in quick-degrading net Quick-degrading erosion-control mesh Quick-degrading single-net blanket
Out-of-bounds swales	≤ 1.45	1 growing season	Loose mulch netted Erosion-control mesh Single-net erosion-control blanket
Fairway swales	≤ 1.55	1 growing season	Quick-degrading single-net blanket
Out-of-bounds swales	≤ 1.55	1 growing season	Single-net erosion-control blanket
Fairway swales	≤ 1.65	1 growing season	Quick-degrading double-net blanket
Out-of-bounds swales, streambanks	≤ 1.65	1 growing season	Double-net erosion-control blanket
Fairway, out-of-bounds swales, streambanks	≤ 2.25	1- 3 growing seasons	Double-net, long-term blanket
Fairway, out-of-bounds swales, streambanks	2.25 - 8.00	permanent	Permanent turf-reinforcement mat Riprap
Fairway, out-of-bounds swales, streambanks	> 8.00	permanent	Gabionized riprap Interlocking concrete blocks Poured concrete

a rate of 3,000 to 4,000 pounds per acre over previously seeded areas (2). Loose mulches have little resistance to movement by wind or water flow, and should only be used to protect seeded areas exposed to mild erosive conditions, such as on flat or slightly sloping terrain (5:1 ratio of horizontal-to-vertical distances, or flatter).

Loose mulches applied to slopes approaching 5:1 or areas with significant exposure to the wind should be crimped into the soil with a coulter disk, oversprayed with a chemical bonding agent or mechanically anchored with erosion-control netting. In areas where close mowing will occur, it's important to select a netting that will degrade fairly rapidly.

Sufficiently anchored loose mulches can also be used in low-flow swales where flow-induced shear stress does not exceed 1.45 pounds per square foot (1). Shear stress is the actual pulling or erosive force of the water flowing over the channel lining material. Calculate shear stress within a channel or swale by multiplying the maximum expected flow depth (in feet) by the channel bed slope by the unit weight of water (62.4 pounds per cubic foot).

Hydraulically applied mulches

Hydraulically applied mulches typically consist of wood or paper fibers mixed with water, seed and fertilizer. These materials are sprayed directly onto the soil at a rate of 1,500 to 3,000 pounds per acre. Hydraulic mulches have similar longevity and share many of the same applications as loose mulches but offer the convenience of onestep application in the revegetation process. As with loose mulches, hydraulic mulches are often applied with chemical bonding agents (glues) to improve short-term stability and attachment to the soil.

Erosion-control meshes

Open-weave geotextile meshes are made from jute, coconut or polypropylene yarns woven into open-structured fabrics. These fabrics are more closely woven than erosion-control nettings, enabling them to function under similar site conditions without an underlying mulch layer. Depending on the type of yarn used in weaving erosion-control meshes, they may last one to five years in the field. Therefore, if these materials are to be applied in closely mowed areas, use only those that will quickly degrade.

Wire gabion baskets encapsulate rock riprap to provide hard-armor protection and permanent stabilization for the banks of this perennial stream.

Erosion-control blankets

Erosion-control blankets are effective for terrain ranging from mild slopes and swales to steep slopes, high-flow channels and highly erodible areas. Blankets are constructed of a mulch fiber (most commonly straw, excelsior, coconut or blends of such fibers) sewn or glued to synthetic or biodegradable netting. Blanket durability, longevity and effectiveness are dependent on the combination of fibers and nettings.

Erosion-control blankets used in high-maintenance areas should consist of quick-degrading structural components to allow for uninhibited mowing. Single-netted products with photodegradable or biodegradable netting are generally used on moderate slopes (up to 2:1 gradient) and swales with shear stresses of 1.55 pounds per square foot or less.

Double-netted erosion-control blankets can provide a higher degree of structural integrity and erosion protection for more severe terrain where slope gradients reach 1.5:1 and in channels where shear stresses approach 1.65 pounds per square foot. Straw-coconut and coconut blankets provide long-term erosion protection for slopes exceeding 1:1 and in channels where shear stresses reach 2.25 pounds per square foot (4). Erosion-control blankets are applicable to most areas where expected long-term erosive conditions will not exceed the limits of established vegetation.

Geosynthetic turf mats

Although well-established vegetation offers excellent erosion control capabilities, areas such as high-flow channels and steep slopes exposed to large volumes of runoff may require supplemental support for permanent stability. Geosynthetic turf reinforcement mattings are designed to work with vegetation to increase erosion resistance. These

mattings use heavy-duty, nondegradable, three-dimensional structures to provide permanent reinforcement for vegetation roots and stems.

Turf reinforcement mats often contain a fiber matrix (usually polypropylene or coconut fiber) sewn into the netting to provide long-term or even permanent erosion protection. This product allows vegetation to stabilize areas that were once treatable only with hard-armor materials such as rock riprap or concrete.

Tolerating shear stresses up to 8 pounds per square foot, (5), geosynthetically reinforced turf provides erosion resistance similar to 24-inch rock riprap (1). But, unlike riprap, reinforced turf maintains the "user-friendly" qualities of regular turf by offering a playable surface you can drive over with a golf car — making geosynthetically reinforced turf linings ideal for high-flow swales, streambanks and pond shores in or along fairways.

Hard-armor materials

Although geosynthetically reinforced vegetation can be a very cost-effective solution for protecting high-flow channels, streambanks and pond shorelines, it has limitations because the vegetation must be maintained as a dense, healthy stand. If this is not possible — because of environmental conditions such as excessive shading, wetness or intermittent drought — "hard-armor" protection may be necessary.

Furthermore, in very high discharge channels where flow-induced shear stresses exceed 8 pounds per square foot, hard-armor materials are the only choice. Hard-armor materials include rock riprap, gabions (wire enclosed riprap), interlocking concrete blocks and poured concrete.

Designing for erosion control

Design procedures for erosion-control materials have been developed and published by the Federal Highway Administration, the U.S. Department of Agriculture and the National Cooperative Highway Research Program. Local and state transportation departments may also have guidelines for materials selection and use. Many of these widely accepted design and selection procedures have also been incorporated into computer programs. Most suppliers of erosion-control materials can offer additional information resources.

Failure to use the most effective erosion-control method can have disastrous results.

Conclusion

It's important to practice effective erosion control methods before, during and after golf course construction projects. Otherwise, you may wind up paying more in maintenance and reconstruction. Furthermore, public environmental awareness demands that the golf course superintendent work with nature and not against it. Using proper erosion-control materials and methods will allow you to accomplish this.

The environmental movement is also pushing the erosion-control industry to develop new products, according to Ben Northcutt, executive director of the International Erosion Control Association.

"The trend for using softer materials will continue because people are demanding a more natural look," Northcutt says (3). "Hard-armor manufacturers are beginning to incorporate vegetation and other natural features in their products, and harder materials will still be needed in areas requiring maximum protection from erosion. " □

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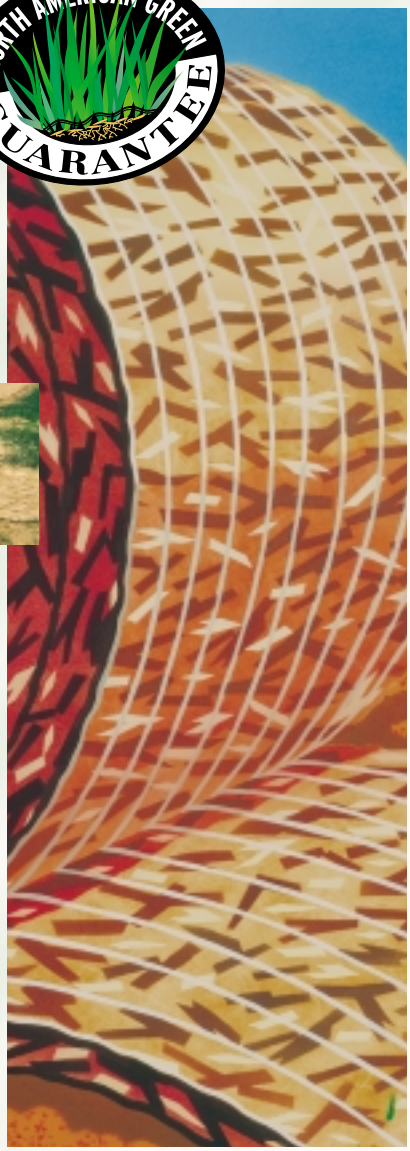

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