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Improving Water Quality with Grassed Waterways

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A grassed waterway is a broad, shallow channel that is covered with vegetation. It is used to reduce erosion and improve water quality by slowing and diverting runoff. This runoff drains into another conveyance or a landscape area where the water can spread out and be absorbed.

A grassed waterway can be natural or constructed. A natural waterway is usually a U shaped depression that has no bed or bank. Grassed waterways can also be constructed either by building a set of parallel levee banks or by excavating a shallow channel:

- Parallel levee banks can be built up and down evenly sloped pasture land to form a wide, trapezoid-shaped channel with the vegetated ground as the floor.
- A waterway can be built on a grade across a slope with a spoil bank on the downslope side that has a trapezoid-shaped cross-section. This type of waterway is usually used for crops and designed to be accessible to farming equipment.
- A waterway can be formed by building levee banks on both sides of a natural depression or flow line to increase its carrying capacity.
- A waterway can be established by excavating a natural depression to form a shallow, U-shaped channel without levee banks.

What purpose do they serve?

Grassed waterways are part of an overall farm management system; they improve water quality and provide water, food, and shelter for wildlife. They carry runoff from terraces and other water diversion structures to a safe discharge area without causing erosion or flooding. Constructed waterways safely channel runoff that would otherwise erode sloping land areas.

Figure 1. A grassed waterway. Courtesy of USDA-NRCS

How do they work?

During heavy rains, grassed waterways receive runoff from fields and carry the excess water away without damaging the landscape. Their broad and shallow configuration allows water to flow through them as a wide sheet. Grassed waterways create a slow, steady flow that reduces erosion and keeps sediment from entering nearby bodies of water by trapping suspended soil particles.

Vegetation on the bed of the waterway uses phosphorus and nitrogen that is bound to the sediment it traps. Herbicides and pesticides are removed by plant uptake or are bound in the soil. The vegetation can also improve soil aeration.

Where can grassed waterways be useful?

A grassed waterway can be used wherever there is the need for more capacity to convey water and/or where vegetation is needed to control erosion:

- An agricultural landscape where runoff accumulates and flows downslope through croplands
- Where the base of a slope or hillside ditch concentrates flow into a water channel
- Where water exits a terrace, diversion, roof runoff or other structure to a protected outlet
- Where a broad channel is needed to convey concentrated flow
- Where channels have eroded and farm equipment cannot cross

Some specific advantages and disadvantages are described in Table 1.

Table 1. Advantages and disadvantages of grassed waterways

Advantages	Disadvantages
Control erosion	Costly to install; land, labor and planting expense
Prevent flood damage	Effectiveness varies according to runoff rates and frequency
Improve landscape aesthetic appeal	Sometimes difficult to work around with farm equipment
Improve and protect water quality	May be an unsuitable tile drainage outlet because of depth and vegetation
Designs permit farmer or land-owner input	Construction depends on the location's erosion potential
Can generally be crossed by farm machinery	Require maintenance

Planning a waterway

Grassed waterways work best as part of an overall farm plan. Generally, they must be designed and constructed according to federal, state, and local regulations. Considerations include:

- Location
- Installation time
- Vegetation selection
- Outlet capacity
- Vehicle crossings
- Utility lines

Location

Grassed waterways can be located in natural drainages along development boundaries, road rights-of-way, property lines, or storm sewer center lines. Natural drainage ways are best because:

- They allow water to drain into the grassed waterway from all sides.
- They usually provide the best soil moisture and fertility conditions for establishing vegetation.

- They provide the flattest grade in the immediate area.
- They offer the most stable waterway conditions.
- They provide adequate depth and capacity for discharge from diversions, terraces, and rows with minimum earthwork.

Take special care when building a waterway that starts or ends near a property line, or runs along property lines. Always prevent sediment from damaging downstream properties. Ensure that there is a stable transition at the upstream end of the waterway to prevent erosion of neighboring land. Do not build grassed waterways on a watercourse where it could destroy wetlands or wildlife cover. Grassed waterways should not create sharp, unnatural changes in flow direction.

When to build it

Schedule the construction of a grassed waterway to allow time to plant vegetation and have good grass growth before the spring or fall rainy seasons. Time the grading and planting to ensure that the cover can establish and thereby prevent erosion.

Selecting vegetation

Long grass and rough, irregular surfaces will slow water flow. Choose species that establish quickly, have deep roots, and produce dense foliage and vertical seedlings. Plant a mixture of tall and short vegetation. The plants must also tolerate sediment buildup and be resistant to the agricultural chemicals used in the drainage area. The optimum species are those that provide long-term uniform cover. Do not plant trees or shrubs in a grassed waterway because they can obstruct water flow and cause erosion.

Outlet capacity

In general, the outlet must be large enough to distribute the expected discharge without causing erosion. It can be another vegetated channel, a natural water course, an earthen ditch, a grade-stabilization structure, or a vegetated filter strip.

The outlet area must be stabilized before using the waterway to convey runoff.

Vehicle crossings

Do not use grassed waterways for vehicular access or as firebreaks because wheel tracks erode easily and can form gullies that are expensive to fix. If you need vehicle crossings, build them in a way that protects the waterway bed and its vegetation.

Safety and legal considerations

To ensure safety, contact the appropriate utility companies if you plan to build a waterway near buried utility lines. You must by law contact the local transportation authority and the Natural Resources Conservation Service (NRCS) if you plan to use public road ditches to channel water. Obey all state laws and local ordinances and regulations when locating waterways and outlets.

Design considerations

Designs for grassed waterways depend on soil properties, slope/topography of the area, the area's ability to support vegetation, and on the size of the area draining into the grassed waterway.

Grassed waterways should be able to convey the peak runoff generated by a 24-hour rain which occurs every 10 years. Out-of-bank flow is acceptable for grassed waterways with less than 1 percent slope if it does not cause excessive erosion or damage houses, buildings, or other important features.

Waterways may be parabolic, trapezoidal or V-shaped, but parabolic designs are most common and usually most satisfactory.

Wider waterways are better at cleaning runoff because their greater surface area and contact time allows more sediment and pollutants to settle out. However, waterways are usually built less than 100 feet wide to keep low flows from meandering.

A waterway should be deep enough for its planned flow to be lower than tributary channels, terraces, or diversions flowing into the waterway. The slope of the waterway should follow the selected channel alignment. Though there is some flexibility, the slope should balance sediment deposition and erosion during heavy flow. Workable slopes range from 1 to 5 percent.

Soil that is acidic or rich in sodium can limit plant growth and should be avoided for waterways. Where possible, avoid other soil conditions such as heavily compacted soils, low fertility soils, or soils with low organic matter content that may restrict root growth. If you must use an area that has poor soil, contact a soil scientist for ways to improve the ground conditions.

Maintaining a waterway

Common waterway problems include weeds, erosion sedimentation, insufficient grass and lack of capacity.

Poor soil and competition from weeds or nearby trees can cause bare spots or sparse grass coverage. Improper herbicide use can also damage the waterway's vegetation. Though reestablishing grass coverage on a wet waterway can be difficult, mulching and replanting bare spots is recommended. Fertilizing the waterway according to soil analysis recommendations can improve grass coverage. Herbicides or hand weeding may sometimes be necessary; however, healthy stands of grass can usually suppress weeds.

If gullies form in the waterway, fill in and reseeded them to avoid further erosion. Keep vehicles and wheeled equipment off the waterways as much as possible. They may be needed however, because sediment accumulation must be removed to maintain the waterway's carrying capacity. Using high-residue tillage and crop rotations also can reduce sediment flow.

How much do waterways cost?

A waterway costs about 66 cents per linear foot to build and about 33 cents per linear foot to maintain. Land cost varies from region to region, as do grading labor and machinery. Other costs include clearing sediment buildup and filling in eroded areas.

Also vegetation must be fertilized and reseeded periodically as well as irrigated during drought. Maintenance costs can rise dramatically according to the severity and frequency of sedimentation, erosion, fertilization and replanting.

Additional resources and references

NRCS. 2003. *Grassed Waterway and Vegetative Filter Strip.* Conservative Practice Job Sheet 412.

University of Kentucky Cooperative Extension Service. *Grassed Waterways.* ENRI-108.

USDA NRCS. *Grassed Waterways for Pacific Island Farms.* USDA NRCS Practice 412.

USDA NRCS. "Grassed Waterways." Part 650 *Engineering Field Handbook.*

University of California Cooperative Extension. 2003. *Estimated Costs and Potential Benefits for Non-Engineered Grassed Waterways.*

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