

4.1 Grassed Swale



Description

Grassed swales are constructed channels shaped and established with suitable vegetation in order to convey stormwater runoff without allowing channel erosion.

Condition Where Practice Applies

This practice is applicable where added capacity and protection by vegetation are needed to control erosion from concentrated runoff, to improve drainage, or to convey stormwater.

This practice applies generally to small channels having flow only during storm events.

This practice is not applicable in larger ephemeral streams where grass cannot be established and maintained. Chapter 3 Stream Channel Rehabilitation or further channel restoration resources should be referenced for larger channels having seasonal low perennial flow.

Use caution when design flow for the swale is greater than 100 cubic feet per second (cfs) from a 10-yr.-frequency storm. Generally, grassed swales are suitable for drainage areas less than 100 acres in flat to gently rolling terrain. In steeper terrain, it may be more difficult even on smaller drainage areas to design a stable waterway.

Planning Considerations

Constructed Channels vs. Natural Drainageways

Discretion must be used when replacing natural channels with constructed channels.

Natural drainage systems, even small intermittent and ephemeral drainageways, provide many hydraulic and environmental benefits not duplicated by constructed channels. See the introduction to Stream Practices for more discussion of natural channel design.

Permits

A construction permit may be required by the local government. Additionally, the U.S. Army Corps of Engineers and the Ohio Environmental Protection Agency, through Sections 404 and 401, respectively, of the Clean Water Act, may require a permit for grassed swales that are located adjacent to a stream. It is best to contact your local Soil and Water Conservation District (SWCD) office to determine what both agencies' permit requirements are for your project.

Water Quality

Grassed swales are designed to reduce erosion and therefore provide a limited water quality benefit. Swales may be modified to store a water quality volume by adding weirs or check dams in order to detain and treat runoff for a minimum of 24 hours.

Stable Outlet

The swale should not be constructed until a suitable stable outlet is in place, and upstream erosion control is in place.

Design Criteria

Grassed swales shall be planned, designed and constructed to comply with all Federal, State, and local laws and regulations.

Runoff

Runoff computation will be based upon the most severe soil and cover conditions that will exist in the area draining into the swale during the planned life of the structure. Use the NRCS Technical Release 55 (TR 55) or other suitable method shall be used to determine peak rate of runoff.

Capacity

The channel's capacity shall be adequate to carry the peak rate of runoff from a 10-yr. frequency storm prior to out of bank flow. Out of bank flows may be permitted in short sections of a reach to facilitate alignment or to minimize grade changes, as long as positive drainage to the swale is maintained, and flow will continue along the swale re-entering the swale prior to reaching the outlet. Where high-hazard conditions exist, higher frequency storms should be chosen to provide protection compatible with conditions. Grassed swales designed to protect residences and businesses, shall have out of bank capacity to carry the peak rate of runoff prior to flow inside adjacent planned residences or businesses.

Cross Section Shape

- *Parabolic channels* most closely approximate natural flow characteristics at low as well as high flows. Although generally preferred for esthetic reasons, design and construction procedures are more complex.
- *Trapezoidal channels* often are used where the quantity of water to be carried is large and velocities high. Channels constructed to treat stormwater runoff should be trapezoidal in shape to promote settling and infiltration. Side slopes that are 3 to 1 or flatter are recommended. Consider future maintenance when designing the shape of trapezoidal channels.

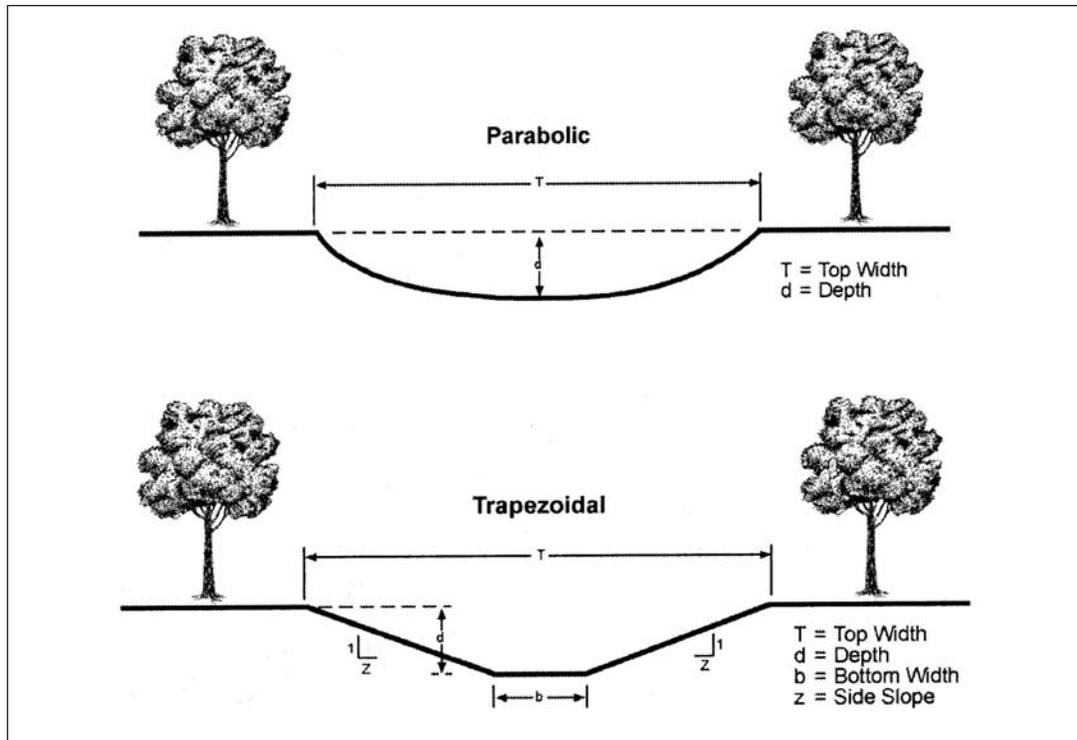


Figure 4.1.1

Special Considerations

Where out-of-bank flow would not cause erosion, property damage or flood damage, no minimum size channel is required. These conditions will most often occur in areas with little slope and established woody vegetation.

Design Velocity of Vegetative Lining:

Channels shall be designed so that the velocity of flow expected from a 10-year frequency storm does not exceed the permissible velocity for the type of lining used (see the table below). Manning’s Equation or other suitable method should be used to determine design velocity.

Table 4.1.1 Grass Lining

Maximum Flow Velocity for a 10-Yr. Frequency Storm				
Soil		Maximum Velocity (fps)		
Texture	Type	Seed & mulch	Seed & Matting	Sod
Sand, Silt, Sandy Loam, Silt Loam	Sand	1.5	3.0	3.5
Silty Clay Loam, Sandy Clay Loam	Firm Loam	2.0	4.0	4.0
Clay	Clay	2.5	4.0	5.0
N/A	Gravel	3.5	5.0	6.0
N/A	Weathering Shale	4.5	5.0	N/A

Note: Generally soil texture can be determined from soil surveys. For channels on fill, soils should be tested.

Establishing Vegetation

All grassed swales shall be vegetated or otherwise stabilized, as soon as possible after construction. Stabilization should be done according to the appropriate Standards and Specifications for Vegetative Practices (e.g. Permanent Seeding, Mulching, Matting)

- *For design velocities of less than 3.5 fps*, seeding and mulching may be used for the establishment of the desired vegetation. Mulch netting should be used to protect the seeding during establishment. It is recommended that when conditions permit temporary diversion or other means be used to prevent water from entering the grassed swale during the establishment of vegetation.
- *For design velocities of more than 3.5 fps*, the grassed swale shall be stabilized with seeding protected by erosion control matting or blankets, or with sod. It is recommended that when conditions permit temporary diversion or other means be used to prevent water from entering the grassed swale during the establishment of vegetation.

Check Dams

Check dams may be incorporated to increase channel stability by decreasing flow velocities, and reducing erosion and headcutting. Check dams are grade control structures constructed out of durable material (i.e. rock riprap) across the swale cross section to prevent headcutting. Check dams should be used where they will not be considered a nuisance or create a high maintenance burden. See Chapter __ - Water Quality Swale for planning and design details that could be used to maximizing the detention time within the grassed swale to enhance water quality benefits.

Drainage

Designs for a site having prolonged flows, a high water table, or seepage problems shall include Subsurface Drains, Rock Lined Waterway, or other suitable measures to avoid saturated conditions. See Chapter 4, part 7 Subsurface Drains and Chapter 4, part 3 Rock Lined Channel, for planning and design details.

Offset subsurface drains at least _ of the designed top width from the centerline of the swale. The drain's flowline should be at least 1 foot below the centerline grade and maintain at least 2 feet of cover. Subsurface drains should be installed on both sides of the swale if a high water table or other site conditions will create wetness on both sides. Orifice plates or other acceptable means should be used to prevent pressure flow in the subsurface drain as necessary.

Outlets

All grassed swales shall have a stable outlet with adequate capacity to prevent ponding or flooding damages.

In cases where the grassed swale outlets into a larger ditch or stream with a continual or seasonal base flow, protection of that portion of the grassed waterway / conveyance channel / swale affected by this wet condition is necessary. This may be accomplished by installation of use of a rock lined outlet or grade stabilization structure (see rock channel protection).

Maintenance

A maintenance program shall be established to maintain capacity, vegetative cover, and associated structural components such as inlets, outlets, and tile lines. Items to consider in the maintenance program include:

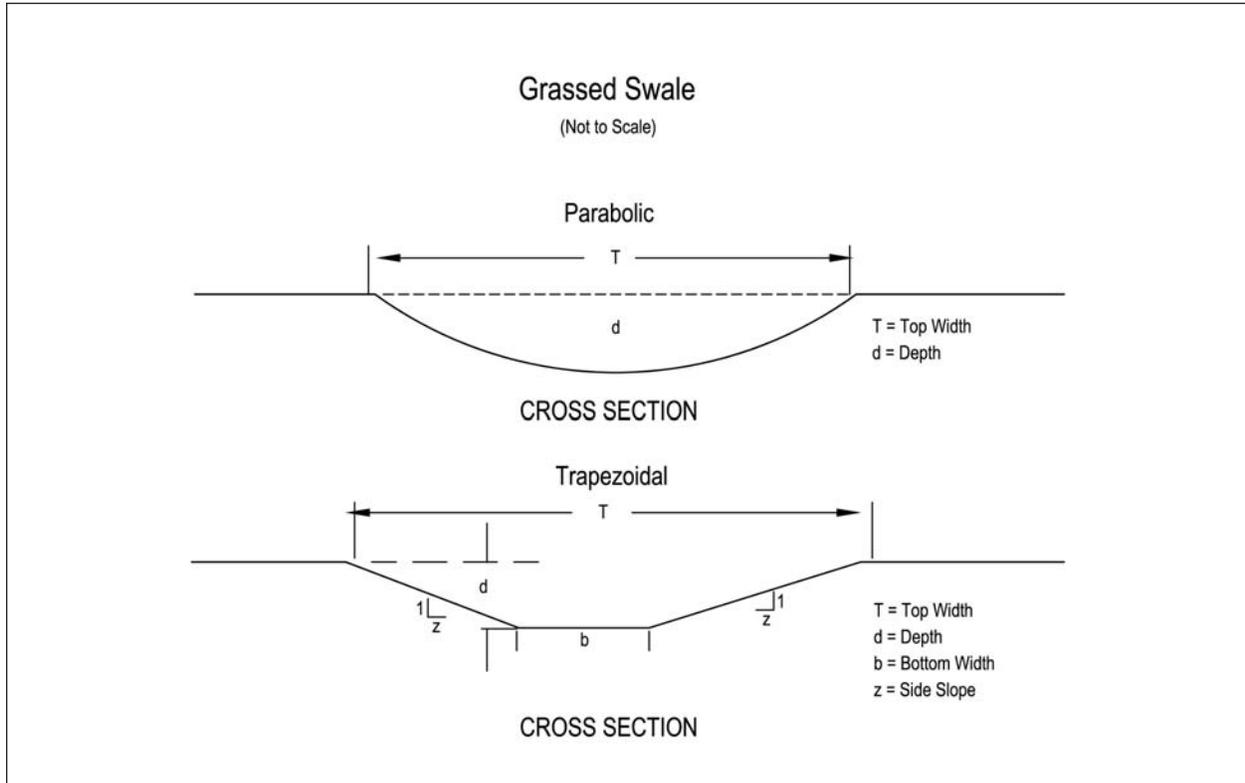
- Determine responsible party to inspect and maintain the channel after construction
- Protect the channel from damage by equipment and traffic
- Fertilize annually to and maintain a vigorous stand of grass
- Mow the channel regularly to maintain a healthy and vigorous stand of grass
- Inspect grassed swales regularly, especially following heavy rains
- Repair damage to channels immediately. Damaged areas will be filled, compacted, and seeded immediately. All broken subsurface drains should be repaired
- Remove sediment deposits to maintain capacity of grassed swale. Seed and mulch any bare areas that develop. Note: excessive deposition or erosion of the swale may indicate the need to consider changes to the current design that will be appropriate to the water and sediment transport.
- Easements should be obtained to ensure the channel is maintained as constructed.

References

Additional guidance for evaluation, planning, and design of grassed swales is given in:

- NRCS Ohio Practice Standard 412, Grassed Waterway.
- NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7 - Grassed Waterways.
- Agricultural Handbook 667, Stability Design of Grass-lined Open Channels.

Specifications
for
Grassed Swale



1. All trees, brush, stumps, and other unsuitable material shall be removed from the site.
2. The channel shall be excavated and shaped to the proper grade and cross section.
3. Fill material used in the construction of the channel shall be well compacted in uniform layers not exceeding 9 inches using the wheel treads or tracks of the construction equipment to prevent unequal settlement.
4. Excess earth shall be graded or disposed of so that it will not restrict flow to the channel or interfere with its functioning.
5. Stabilization shall be done according to the appropriate specifications for permanent seeding, vegetative practices, sodding and matting.
6. Construction shall be sequenced so that newly constructed channels are stabilized prior to becoming operational. To aid in the establishment of vegetation, surface water may be prevented from entering the newly constructed channel through the establishment period.
7. Gullies that may form in the channel or other erosion damage that occurs before the grass lining becomes established shall be repaired without delay.