ERTEC Environmental Systems

Protecting the Integrity of Global Lands and Waterways ™

Gully Stabilization System ™

Design, Installation and Maintenance Guidelines

GULLIES ARE A SPECIFIC FORM OF SEVERE EROSION typically caused by concentrated water flow on erosive soils. Concentrated water flow may begin as minor sheet flow, produce rills, and eventually result in major gully formation. Gullying is the process of stream down-cutting, deepening and widening of the channel, and head-cutting or head-ward extending of the channel. Gullies can have major impacts on an area by taking land out of production and by lowering the groundwater table, as well as being a major source of downstream sediment.

They can be caused by concentrated water flowing off roads, or they can impact roads by necessitating extra drainage crossings and more frequent maintenance. Once formed, gullies typically grow with time and will continue down-cutting until resistant material is reached. They also expand laterally as they deepen. After each storm event, the gully lowers and the sides of the channel reach their new angle of repose. Gullies often form at the outlet of culverts or cross-drains due to the concentrated flows and relatively fast water velocities. Also, gullies can form upslope of culvert pipes, especially in meadows, if the pipe is set below the meadow elevation. This causes a drop in the meadow or channel elevation and subsequent head-ward migration of the gully. Gullies formed through meadows often lower the local water table and may dry up the meadow.

In gully prevention, **early and effective actions can prevent eventual major amounts sediment loss** and damage caused. Take action to prevent the formation of gullies and to stabilize existing gullies before they grow larger. Once large, gully stabilization measures can be very difficult and expensive. Design details important for successful gully stabilization structures begin with removing the source of water.

The **goal of gully stabilization** is to:

- stop channel down-cutting
- stop head-ward extension
- re-establish vegetation

Vegetation established in the channel and along the sidewalls provides the most permanent control – the long term solution. Effective gully control is best accomplished using simple structures designed for the site, combined with a combination of re-vegetation techniques.

Stabilization of gullies typically requires **removing or reducing the source of water** flowing through the gully and refilling the gully with dikes, or small dams, built at specific intervals along the gully. Reshaping and stabilizing over-steep banks may also be needed. Biotechnical methods offer a combination of physical structure along with vegetative measures for physical protection as well as additional long term

root support and aesthetics. A head cut structure also typically is needed to stabilize the upslope, or top-most portion of the gully, and prevent additional head-ward movement.

Check structures are intended to reduce flow velocities, trap and store larger-sized sediment, and provide stabilized drops. If check structures are to reduce gully erosion until vegetation reoccurs, it is important that they be installed in a way to disperse energy. Water energy will have to be dispersed by flowing into stilling ponds between structures, and/or with energy dissipating materials under the spillway.

The recommended spacing for structures depends on the slope of the terrain or gully channel and the height of each structure. *Figure 1* shows the ideal spacing needed between structures for varying channel slope and structure height. *Figure 2* shows the physical relationship between structure height and spacing in a sloped channel so that water and material stored behind the lower structure is level with the toe of the upper structure. Thus, water will spill over the crest of the upper structure into the pool behind the lower structure.

Figure 1

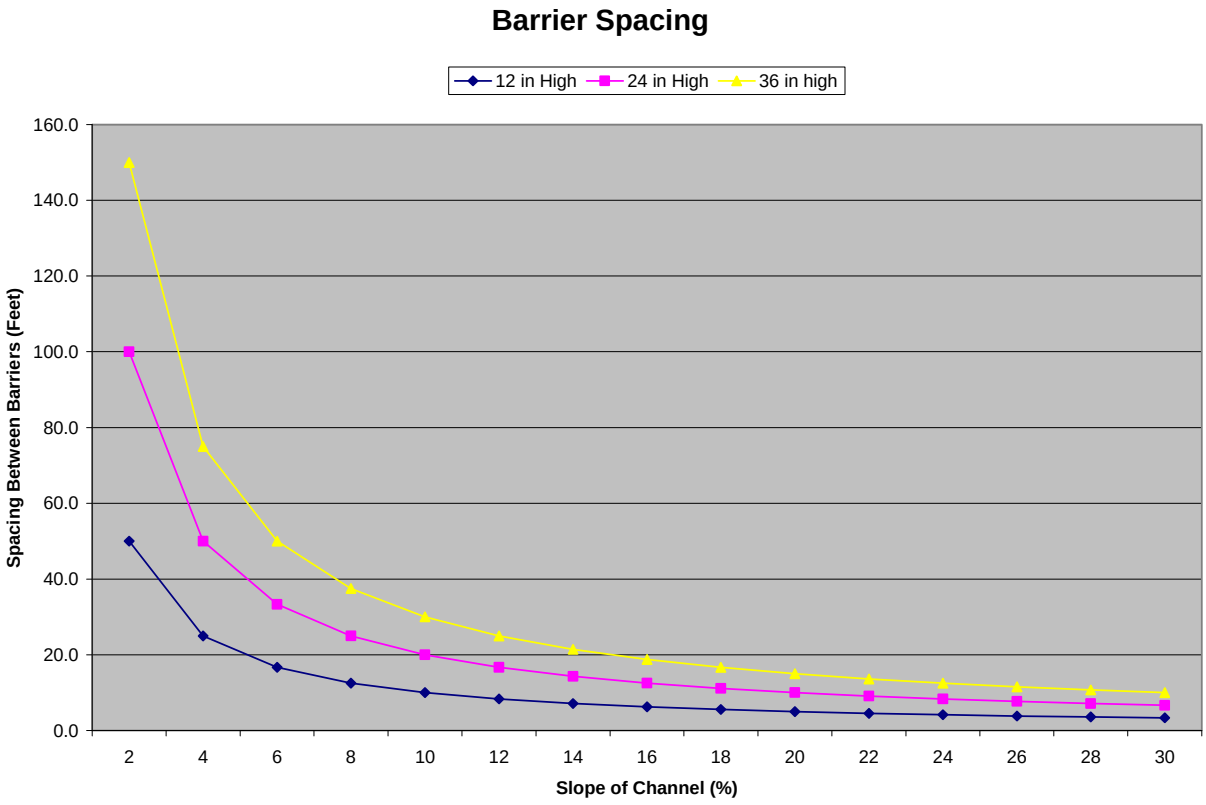
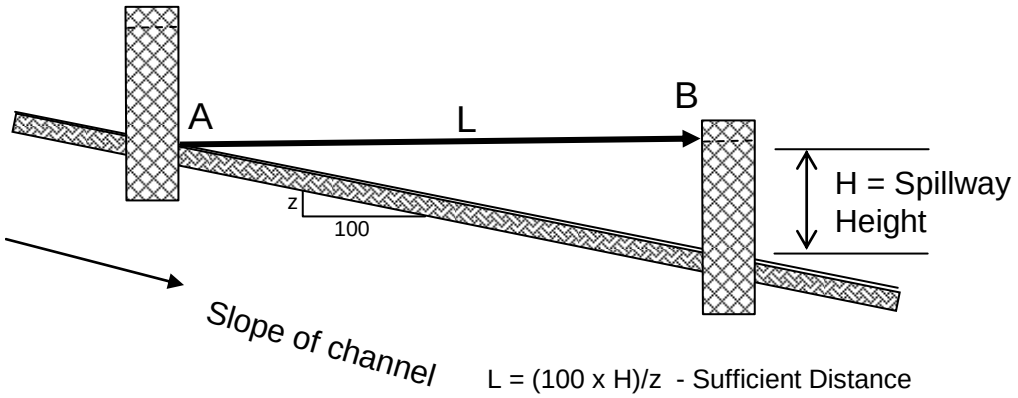


Figure 2

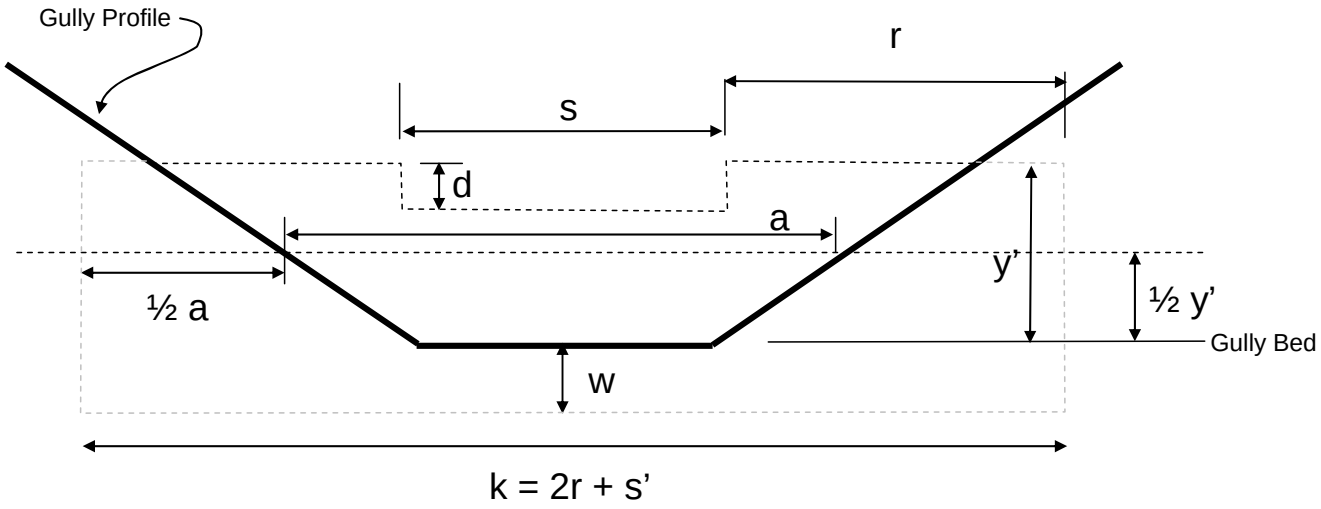


L = (100 x H)/z - Sufficient Distance between points A and B so that the two dams have the elevation (toe of B to spillway of A).

Recommended practice for successful Gully Stabilization

1	Assess and remove the source of water	Control water flow as needed with ditches, berms, flumes, and so on to divert water away from the top of gullies. Correct water drainage problems, install adequate road drainage, and redirect water into its natural drainage basin or into stable drainage channels.
2	Install gully control structures	Install check-dam structures as soon as possible after the initial formation of a gully. Gullies only get deeper and wider with time. Ensure that gully control structures are installed with needed design details. Such structures should be: • properly spaced. Space the structures close enough so that the flow over the structure can spill into backwater caused by the next structure downstream or into a stilling pond immediately downstream of the structure. • placed on top of geo-textile fabric (see figure 3) to prevent piping and undermining of the base caused by water flowing vertically down through structure. Provide geo-textile under the structure and extend downstream from structure (see figure 3). DO NOT extend geo-textile above channel floor, upstream of structure (otherwise, it may be possible for water to flow between the geo-textile and structure and eventually

		flow around the ends, flanking the structure). • well keyed into channel bottom. Burying the structures deep enough in the channel to prevent flow **under** the structure. (A minimum of 30% of the height of the structure). (Figure 3). • well keyed into the banks. Keying the structures into the adjacent banks tightly and far enough to prevent erosion around the ends of the structures (a minimum of 30% of the width of the dam to prevent breaching, flanking). (Figure 4). • notched to keep flows over the middle of the structure (spillway notch). Having a weir, notched, "U" or "V" shaped top on the structures to keep the water flow concentrated in the middle of the channel. This also keeps flow below the top of the structure, which will prevent flows from eroding the points at which the structure is keyed into the banks. Notches should be sized properly to meet the flow conditions in the channel. Cut notch into structure to the appropriate size. • anchored in place with t-posts driven down through structure or suitably anchored posts placed against the downstream side of structure. Posts should be driven deep enough to counter the force of water and sediment against the upstream surface.
3	Protect from down-slope scour.	Place energy-dissipating materials below the spillway and firmly secure to the channel bottom. This energy dissipation apron should extend out from the spillway 1 to 2 ft towards the next check-dam. Spilling the water over the structures onto a splash apron, protective layer of rock, or into a pool of water to prevent scour and undermining of the structure.
4	Install head-cut structures	Install at the top of the gully to prevent up-channel migration of gullies in meadows.
5.	Re-vegetate	Re-vegetate the site with grasses, shrubs, willows, etc. Develop local plant sources and nurseries for native vegetation that can be used in gully control measures.
6.	Limitations	Make sure the structure is properly installed, supported, keyed-in, and anchored



w+y	structure height (ERTEC GSS limit = 5')
w	key-in depth – to provide structural integrity and to prevent undercutting
x+y-d	spill way height, head-cut height
s and d	size of spillway notch - should be determined by qualified hydrologist
½ a	key-in width – to provide structural integrity and prevent end around erosion
k	structure length

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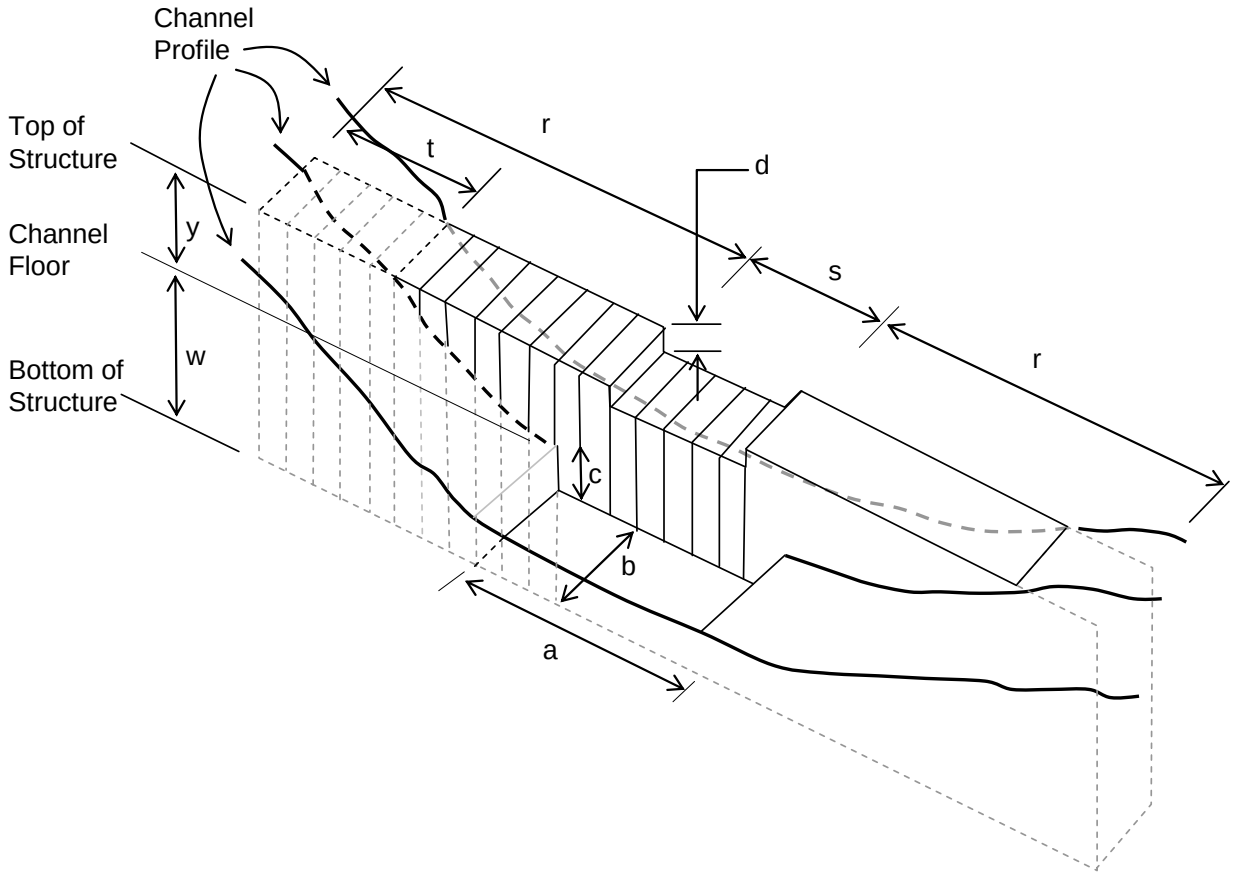

Structure Guidelines

- Minimum w = 0.3*(w + y)
- Ends of structure should not be visible

Center Notch

- Calculate size of notch based on hydrology, expected volumes

Splash Apron / Energy Dissipation

- Build a to 1.5 x width of notch = 1.5 * s
- Build b to 12.0 x height of notch = 12 * d
- Depth c to 2.0 x height of notch = 2 * d
- Install geo-textile at base
- Fill dissipation pool with rip-rap (or ERTEC splash-box)

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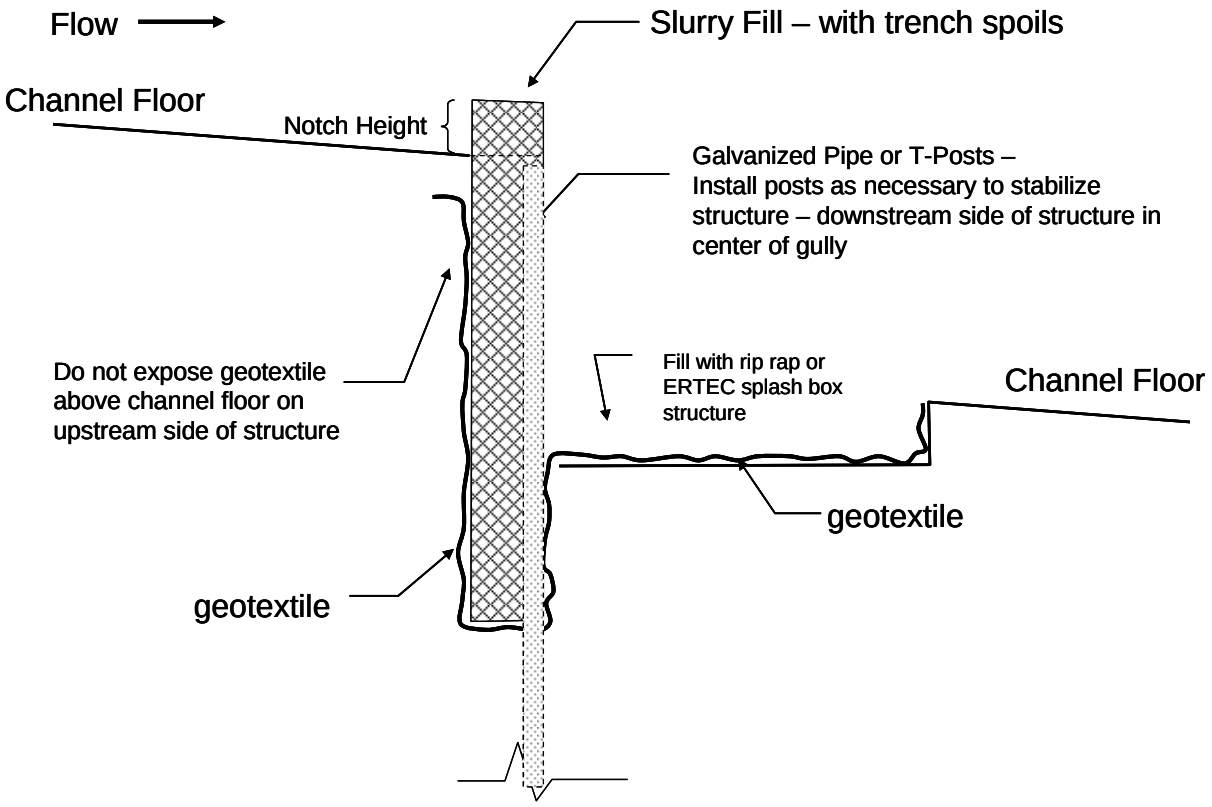

Inspection and Maintenance

Properly designed and installed Gully Stabilization Systems require very little maintenance. GSS should be inspected periodically for scour or damage. Structural damage caused by storm events should be repaired as soon as possible to prevent further damage to the structure or erosion of the bank.

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