

Soil Erosion

According to van der Watt and van Rooyen (1995) soil erosion is the wearing away of the land surface running water, wind, ice or other geological agents, including such processes as gravitational creep. They also explained soil erosion as detachment and movement of soil or rock fragments by water, wind, ice or gravity. The study area is experiencing different types of erosion on different areas. The ranch is experiencing accelerated erosion (Figure 21); erosion is promoted by the soil that is used to construct roads on the farm. Sheet erosion is the removal of a fairly uniform layer of soil from the land surface by runoff water. Sheet erosion is most common on steep slopes of Highlands Wilderness especially on mid- and foot slopes.

Gully erosion is the process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 300 mm to 600 mm to more than 20 m. On drainage lines, gully erosion is considered to be a major problem on several parts of the ranch. Soil erosion leads to the loss of fertile soil, depositing of unproductive soil on fertile land, desiccation of soil in the vicinity of gullies due to excessive drainage and the undermining of infrastructure facilities and roads. Soil erosion is a natural process and cannot be prevented. However, reasonable management can limit soil erosion to an acceptable level, where utilisation of the ranch is not influenced negatively. This acceptable level is usually determined as the level, where no visible loss of soil is perceived.

Prevention of soil erosion begins with the prevention of the deterioration of the veld and the development of bare patches. Up to 60 percent of the land surface of South Africa contains topsoil that is low in organic matter. Some 30 percent or even more of the soil is sandy and especially vulnerable to wind erosion. Water erosion only starts to play a role in natural veld in areas receiving more than 100 mm of rain per year. Soil erosion and water erosion combined remove about 50 to 140 mm of topsoil every year from degraded areas. Currently, soil erosion removes about 20 times as much soil as is formed per year. The slope of the ground markedly accelerates soil erosion by water. Soil erosion in veld in poor condition can be three times higher than if the same area were in excellent condition. It should be clear that effective soil erosion prevention and soil reclamation are vital on a wildlife ranch (Bothma and Van Rooyen 2002).



Figure 27: Soil used to construct internal roads on Highlands Wilderness

The Ponding System

The ponding system was developed in Australia for reclaiming level soils that were compacted and exposed owing to drought, overgrazing, trampling and/or sheet erosion, especially in arid regions. This approach can be applied especially to heavy clay and duplex soils. The ponding system involves the construction of a series of shallow ponds over the whole bare area. On soils with no slopes the ponds are more or less circular, but on soils with a slope of about 0.15° they are U-shaped. On soils with a slope of about 0.35 to 1.0° they are sickle-shaped. The walls of the individual pond systems are constructed with a grader and are never longer than 250 m to prevent from breaking when it rains. A maximum wall height of 400 mm is recommended. In U-shaped and sickle-shaped ponds, the wall height increases towards the middle of the wall. The ponds are typically placed 10 m apart and their catchment's areas usually overlap. Winged and connected walls are not recommended. The walls of the ponds must be of the same height to prevent overflow water from concentrating in canals or specific places. For an expected pond depth of 300 mm, a wall of loose soil of about 400 mm should be constructed. This will provide for about 100 mm more water without the danger of the wall breaking. The base of each wall should be about 1.3 to 1.6 m wide. The walls are made when the soil is dry. The soil inside each pond can be broken with a ripper, and a suitable grass mixture can be sown. For best results,

the seedbed should be well prepared, fertilized and irrigated. Grass species such as Rhodes grass *Chloris gayana*, and tassel three-awn *Aristida congesta* can be sown with perennial grasses such as wool grass *Anthephora pubescens*, blue buffalo grass *Cenchrus ciliaris*, fingergrass *Digitaria eriantha*, weeping lovegrass *Eragrostis curvula*, Lehman's lovegrass *Eragrostis lehmanniana*, sand quick *Schmidtia pappophoroides* and bushman grasses of the genus *Stipagrostis* (Bothma and Van Rooyen 2002).

Other structures

Effective soil-use planning remains the best way to prevent erosion. It is normally advisable to isolate eroded areas by fencing to restrict animal access, and it may be necessary to divert overland flow away from the gully. Often, also, one or more mechanical structures may be required within the gully to control the flow of water. These may be earth, brick or stone structures, depending on the depth of the gully and the volume of water to be controlled. All have the aim to stabilize the base and sides of the gully and where possible, promoting silt accumulation (Tainton 1999). In the repair of dongas or erosion ditches, the following guidelines are recommended (Bothma and Van Rooyen 2002):

- Give preference to ditches that have only begun to form, over deep, established ditches.
 - Give preference to the complete repair of shorter erosion ditches over the partial repair of extensive erosion ditches.
 - Stabilise an erosion ditch first to prevent it from extending, then complete the reclamation process later.
- Water run-off to erosion ditches should be limited to the minimum by implementing conservation measures in the catchment's areas.

The first step in erosion control is to establish a good layer of grasses in the water catchment's area of the specific ditch; the next step is to direct the water away from the erosion ditch. Stabilisation of the erosion ditch itself follows, so that it can be changed into a stabilized drainage canal. In the reclamation of an erosion ditch, three basic principles are important (Bothma and Van Rooyen 2002):

- Preventing further erosion on the floor of the ditch to prevent the ditch from becoming deeper.
- Preventing the walls from caving in and eroding to prevent the ditch from becoming wider.
- Preventing the soil from being eaten away at the head of the ditch so that it does not become longer.

The most common method of depth control is the construction of weirs made of stones (Figure 25), concrete or wire baskets that are filled with stones. Structures of this kind must be anchored deep in the floor and sides of the ditch so that the water cannot flow underneath or around them. The overflow side should also be supported to prevent the soil from caving away.

The initial structure need not be high, as silt builds up behind this structure, the wall can be raised. Vegetation can be established in the collected silt (Bothma and Van Rooyen 2002).

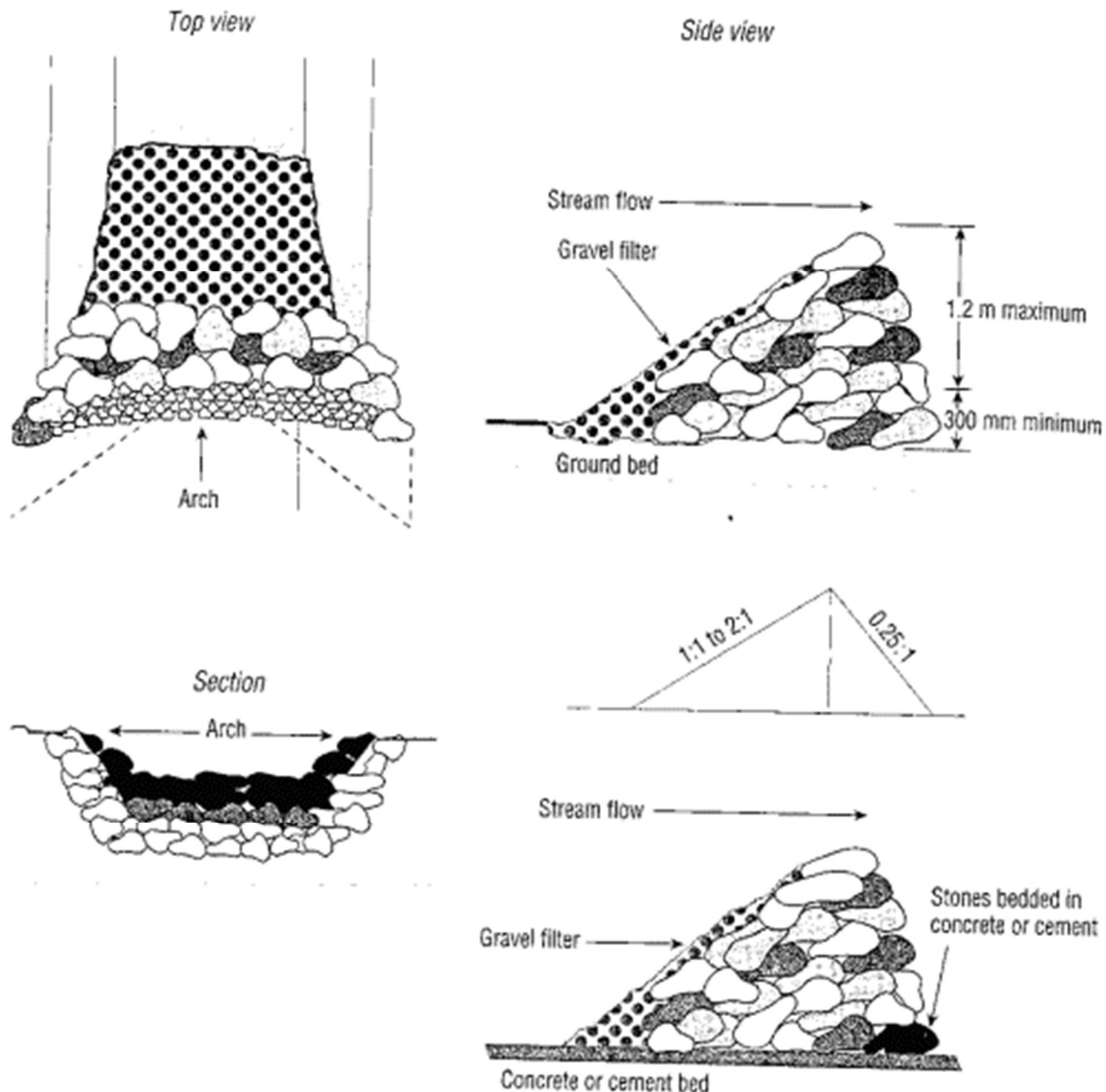


Figure 25: A barrier of stone built in an erosion ditch to prevent it from becoming deeper (Adapted from Bothma and Van Rooyen 2002, In: Bothma 2002)

The cheapest way in which to prevent a donga or erosion ditch from becoming wider is to construct a dam or weir at the head of the donga or ditch. The dam wall or weir should be build higher than the sides of the ditch and include overflows over a given distance on the contours of both sides. The excess water will flow over the wall or weir across a wide apron to prevent the water from cutting into the soil. Soil walls are seldom used and walls consisting off wire baskets filled with stones are preferred. Erosion ditches usually become wider because water flowing in from the sides causes the walls to cave in. The soil that falls into the ditch is carried away with



the water. Water should therefore be prevented from reaching the ditch from the sides. Low walls parallel to the edge of the ditch can help to solve this problem, provided there are stabilized inlets where the water can reach the ditch without the danger of further erosion. These inlets can be made of paving stone and can be stabilized with creeping grasses such as couch grass *Cynodon dactylon* (Bothma and Van Rooyen 2002).

Recommendations for Highlands Wilderness

The effective soil-use planning is the best way to prevent soil erosion. Steep slopes on Highlands dominate due to abundant hills; several areas are prone to severe water run-off when storm occurs, this lead to erosion. Erosion area (Figure 21) caused by taking out soil to construct internal roads and other activities on the ranch should be stopped. The eroded area is huge, it covers approximately 900 m². It is advisable to use the area to meet other requirements, such as damming the water or creating vleis area rich in bird life. Erosion area can be filled-up with stones or construct a bridge to convey water that lead to erosion. Smaller erosion areas can be seeded with seeded mixture to control erosion. It is advisable to use a combination of reclamation practices to control erosion gullies. Bush encroachment on drainage lines should be controlled as this promotes soil erosion due to very less grass cover.