Conservation of Farmland in KwaZulu-Natal

THE CONSTRUCTION OF GRASSED WATERWAYS AND INFIELD ACCESS ROADS.

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INTRODUCTION

The grassed waterway, which is needed as part of the surface water management system for the cultivated land on a farm, is of vital importance. Once established and in operation, it must carry all of the runoff which previously ran uncontrolled down the adjacent land. Great care is therefore necessary in:

- shaping it to hold all of the expected runoff, thus ensuring that it does not spill over into the land and cause erosion;
- stabilizing it with a good grass cover to ensure that it does not erode into a deep gulley, and
- ensuring its continued existence by regular maintenance.

The first-mentioned is the subject of this pamphlet. Grassing and maintenance will be dealt with in a separate one - see Leaflet No. 2.5 "Grassing and Maintenance of Artificial Waterways".

It should be apparent that the sizing of a waterway is very important, and it is strongly recommended therefore that the land user obtain the dimensions from a qualified soil conservation officer or engineer before attempting construction.

The most suitable time of the year in which to construct the waterway is from mid-February to mid-April in the Summer Rainfall Area, but early Spring in the warmer areas may also be suitable, especially if irrigation water is available to allow early grass planting, and if weed control is effective.

![Diagram of a flat-bottomed waterway](image)

**Figure 1. Flat-bottomed waterway**

Construction in between these two periods is hazardous due to high rainfall intensities and extreme temperatures. High rainfall intensities can result in damage to the newly excavated site, and extreme temperatures in damage to the establishment of the seedlings.
Two basic shapes are recognised: the parabolic and the flat-bottomed, but for reasons of economy and safety the latter shape is the one most favoured, and therefore the shape discussed here. See Figure 1. Waterways of parabolic cross section are much more prone to erosion than waterways of trapezoidal section, especially if the subsoil is erodible.

Construction may be accomplished using a variety of implements normally in use on the farm, but no single implement is capable of successfully executing the task alone. The various techniques are discussed separately, but a few points, common to all, need to be made:

- The dimensions given are based on an investigation of all relevant factors, and can be considered the minimum specifications. They should not be altered without discussing the alterations with the designer.

- An attempt should be made to use some of the topsoil for topdressing the excavation.

- The waterway must not be used, under any circumstances, as a roadway. On the other hand, the soil excavated to form the waterway can be most gainfully used in constructing a crest road for proper access to the land and/or filling in gulleys in the land.

- Specifications will have included width and depth at various points along the proposed centre-line of the waterway. This centre-line must be marked on the ground using flagged pegs, ensuring that the waterway is at right angles to the contourline throughout its length. The outer widths are then flagged at the relevant distances, and a plough line is drawn along the perimeter, on both sides of the waterway. It will normally increase gradually from a narrow initial width at the top of the land to the widest at the outlet at the bottom end of the field, although changes in soil type, landslope and field shape could influence this. See Figure 2.
Figure 2. Marking the waterway in the field

- An island is also marked straddling the centre-line so that the width is approximately one-fifth of the waterway at all points. This is to make a source of topsoil available close at hand to spread over the completed excavation. See Figure 2. For this reason it is necessary to excavate at least 100 mm deeper than the design depth required.

- It is essential that the shape, width and depth be checked regularly during construction. The base of the waterway must be level in cross section.

The only practical way to control construction is with pegs that have been set out on the level. See Figure 3. These pegs are placed a convenient distance outside the required construction width so that equipment does not displace them. The operator is told how far he must excavate from these pegs, i.e. width is controlled.

To control depth, a mark is made on one of the pegs. This mark must be a convenient height ("y" in Figure 3) above the average level of the ground between that pair of pegs. The exact level of this mark is transferred onto the other peg with a similar mark using a dumpy level. A string pulled tightly between these marks will be level. Measuring down from this string will control the depth of excavation. For example, if a 300 mm depth is required, measurement with a "boning rod" 300 mm longer than length "a" must be carried out. Boning across the width of the waterway will ensure that the excavation is made level and has the required depth.
Figure 3. Checking the depth of excavation using boning rods

Figure 4. Construction using a grader blade

Pegs are placed at regular intervals, e.g. every 25 m along the waterway.

Moving the string and boning ahead of the construction machinery enables the operator to control excavation during excavation. If the design depth of the waterway varies along its length, this variation can be achieved by manipulating the levels of the pegs. This ensures that the length of the boning rod does not have to be adjusted at all i.e. the depth below the string remains constant throughout.

CONSTRUCTION USING VARIOUS IMPLEMENTS

Using a Grader / Grader Blade: The waterway area (excluding the island) is ploughed up-and-downslope to the depth of excavation required, plus 100 mm. If the soil is heavy, dry and/or hard, it may be useful, first of all, to loosen it with a subsoiler, ripper or chisel plough, depending upon implements available and the depth
required. With the blade angled at 45E start on the perimeter of the waterway and move parallel to it, pushing the soil sideways to the edge where it is temporarily stockpiled. Successive "slices" of soil are moved outwards by successive passes in this manner, using boning rods to check on resulting depth and shape. Once the latter is achieved, plough out and grade the island soil (using the grader blade or disc harrow) over the construction area, to form the required seedbed. Figure 4 applies. The grader can then be used in a transverse manner to spread the stockpiled soil thinly over the adjacent land, thus avoiding any bank alongside the waterway which will inhibit runoff entering the water-way.

**Using a bulldozer.** Figure 5 shows the method.

**Using a Dam Scoop or a Front End Loader:** Of all the implements described, the front end loader and the dam scoop are the two implements which will allow the most efficient movement of the soil excavated. The area between the waterway perimeter and the island is ploughed / ripped / subsoiled to the depth required and the scoop or front end loader used to load the soil and transport it away.

The Front End Loader (FEL) is best used to load the soil onto a truck or trailer for transporting and depositing the soil where needed: either in gullies in the field or along the line of the chosen crest road.

![Figure 5. Waterway construction using a bulldozer](image-url)
If the front end loader is used in conjunction with a tip-trailer the excavation will proceed most rapidly and effectively. Because of this ease of operation, these implements are those most highly recommended for waterway construction. A grader blade or disc harrow will be needed to give the final seedbed shape to the excavation, although a skilled operator should be able to accomplish this with a scoop alone. See Figure 6.

Figure 6. Construction using a dam scoop

ACCESS / INFIELD ROADS

Access roads are vital components of any runoff control layout, but they must be correctly sited in order to reduce maintenance and storm damage. Two types are recognised in the annual cropping areas: contour roads and crest roads. In both situations they are automatically protected from storm damage, and maintenance is therefore reduced.

Contour roads

These may be sited on top of the contour bank or just below it. In the former instance it merely means a contour bank built with a wider crest (recommended 3 metres wide). In the latter it means a road positioned below the conservation structure. If the soil is poorly drained, or high in clay content, it may not be a good idea to use the canal itself for this purpose.

Crest roads

These are always positioned on the highest point of a ridge where direction of flow of contour banks were changed during the survey stage. The road is built up above the surrounding ground level and cambered in order to shed water. It is tied into the contour banks in such a way that the contour bank canals actually divert the runoff away from the roads. The compacted road should stand approximately 300 mm above the surrounding land.
Construction with a dam scoop or front end loader Soil is brought from the waterway excavation (or from high spots in the land) and dumped in thin layers (approx. 150 mm thick) along the staked line. Construction traffic is planned to help in the compaction of the earth fill, and a grader blade is needed to finish it off. Best compaction will be obtained when the moisture content of the soil is 2% either side of optimum. To the farmer this means it must be as damp as possible but not so damp as to stick to the implements.

Construction with a plough
Construction entails leaving an island three metres wide and ploughing clockwise around it, thereby forcing soil onto the island and moving it further on in successive passes to meet in the middle. See Figure 7.

REFERENCES

