Clay cover for roaded catchments

J L. Frith
R. A. Nulsen

Follow this and additional works at: https://researchlibrary.agric.wa.gov.au/journal_agriculture4

Part of the Environmental Engineering Commons, Hydrology Commons, and the Water Resource Management Commons

Recommended Citation
Available at: https://researchlibrary.agric.wa.gov.au/journal_agriculture4/vol12/iss6/25

This article is brought to you for free and open access by Research Library. It has been accepted for inclusion in Journal of the Department of Agriculture, Western Australia, Series 4 by an authorized administrator of Research Library. For more information, please contact library@dpi.wa.gov.au.
CLAY COVER FOR ROADED CATCHMENTS

By J. L. FRITH, Soil Conservation Adviser, Katanning, and R. A. NULSEN, Soil Conservation Adviser, Moora.

RECENT dry years have stimulated interest in improved catchments for farm dams. Although roaded catchments have been installed on many farm dams in Western Australia, most of them fall short of their potential for increasing run-off.

This is mainly due to deficiencies in design and construction of the roads themselves.

Efficiency of roaded catchments

When properly shaped from suitable materials the best roaded catchment can be almost as effective as a bitumen surface. The efficiency of roaded catchment is due partly to the camber (degree of slope from crest to trough) and partly to the water shedding ability of its surface. The steeper the camber and the more impermeable the surface, the more readily will the catchment shed water.

Usually it is not possible to achieve a camber steeper than 1 in 4 and it is undesirable to have it less than 1 in 8.

Surface impermeability can be increased by grading the topsoil (overburden) to the centre of the road and completely covering it with a mantle of clay subsoil which is then compacted by rolling. The troughs between roads must extend sufficiently deep into the subsoil to provide material for a complete clay cover.

Depth of excavation

Figure 1 shows diagrammatically how the clay from the trough between the roads is used to form a mantle over the porous topsoil.

The approximate mathematical relationship between the depth of trough below original ground level (D), depth of overburden (S) and thickness of clay mantle (C) is—

\[ \frac{D^2 - 2DS + S^2}{D + S} = 2C \]

This relationship is graphed in Figure 2 for 3 in. and 6 in. clay mantles, showing that the trough excavation must be deeper where the overburden is deeper or where a thicker clay cover on the roads is required.

Minimum road width

Road width, the distance between successive crests, is determined by the depth of excavation needed to yield sufficient clay and the slope, or camber, of the roads which is desired or is possible to build with the equipment available. (Mathematically, width of road equals 4Dm, where D is the depth of excavation and m is the camber, or ratio of the horizontal to the vertical distance from crest to trough.)

Three cambers have been chosen in Figures 3 and 4 to illustrate how camber, mantle thickness and overburden thickness affect the width of roads.

For a specified depth of overburden the roads will be narrowest for a thin mantle over steep slopes. The roads must be wider where a thicker clay mantle is required or where the roads have a shallower slope, and even wider where thick clay mantle and shallow slope are combined.
Taking as an example a site where the overburden is 12 in. deep, the approximate crest-to-crest widths for 2 thicknesses of clay mantle and 3 slopes are as follows (taken from Figures 3 and 4):

<table>
<thead>
<tr>
<th>Slope</th>
<th>1 in 4</th>
<th>1 in 6</th>
<th>1 in 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in. mantle</td>
<td>36 ft.</td>
<td>55 ft.</td>
<td>73 ft.</td>
</tr>
<tr>
<td>6 in. mantle</td>
<td>48 ft.</td>
<td>72 ft.</td>
<td>96 ft.</td>
</tr>
</tbody>
</table>

**Cost and design of roaded catchments**

The cost of roaded catchment increases with width of road and merits consideration, especially when road widths exceed 45 ft. Reference to Figures 3 and 4 shows that, with 48 ft. roads and overburden depths of 6 in. or less, a complete clay mantle of 3 in. can be achieved at all cambers between 1 in 4 and 1 in 8, and a mantle of 6 in. can be achieved with cambers of 1 in 4 and 1 in 6.

With greater depths of overburden and shallow cambers the width of roads must be increased if clay cover is to be achieved.

Many existing roaded catchments in W.A. have inadequate clay cover because road widths are too narrow and cambers are too shallow in relation to the depths of overburden.

**Construction**

Before pegging roads on a proposed site, three points must be considered.

1. *The depth to clay*

   Where clay is not evident on the surface, the depth of overburden should be investigated with a spade or hand auger. Six holes on each acre of site should give sufficient indication. The greatest depth encountered should be the determining value, unless only one hole is very much deeper than the others.

2. *Siting of roads*

   Knowing the depth of overburden and the desired thickness of the mantle, the depth of trough should be obtained from Figure 2. The roads should be sited so that the lowest point of any trough is above the full water level of the dam. If this is not done, water may back up into the roads and reduce their effectiveness.

3. *The camber*

   A power grader working with only slightly moist clay can manage a camber of 1 in 4. A plough will take many runs to make a camber of 1 in 8 if roads are very wide.

   With depth of overburden and camber known, either Figure 3 or Figure 4 can be used to determine width of road necessary to achieve clay cover. Simply trace horizontally from the value for depth of overburden on the vertical axis to the appropriate graph line for camber; then vertically downwards to meet the horizontal axis at the value for road width.

   Some mixing of clay with overburden during construction is inevitable. It is also likely that considerable point to point variation in mantle thickness will exist. It is suggested that design for a 3 in. mantle is a practical minimum which will provide complete clay cover on grader-built roads and 6 in. for plough-built roads.
It should be noted that at cambers likely to be achieved with a plough—probably no steeper than 1 in 6—and with 6 in. or more of overburden, very wide roads are necessary to achieve a clay mantle of 6 in. This indicates that a plough is not a satisfactory roading implement where overburden is deeper than 6 in. The extra cost per acre of using a power grader may be offset by a reduced acreage of roading necessary to keep stock watered.

This roaded catchment at Wongan Hills Research Station was constructed by road grader. In the area shown, clay was close to the surface. The crest width is 30 ft. and the camber 1 in 6.

CORRECTION

"Mycotic Dermatitis (Lumpy Wool) of Sheep"—July Journal of Agriculture.

Page 185, column 2, line 3 should read—

"at the rate of 32,000 units per lb. of body weight."