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J. E. Watson

J. C. Grasby

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PLANNING NEW FARM DAMS

Excavated earth tanks

By J. E. WATSON, B.Sc., Soil Conservation Adviser and J. C. GRASBY, B.Sc. (Agric.),
District Soil Conservation Adviser, Geraldton

A GOOD farm dam is a valuable asset, and well worth its cost, but there are many aspects to consider when a new dam is required. Careful planning with adequate testing and checking will help to get the best value for money and reduce the chance of costly failures.

This article discusses these aspects in relation to the excavated earth tank type of dam.

Water Needs of the Farm

Before planning a new dam, it is best to consider the whole farm. Make an inventory of the present stock water position, and an assessment of future needs.

Farm Water Supplies Plan

A plan of the property showing fences and all present water supplies is necessary. A suitable plan scale is 1 in. = 20 chains. An aerial photograph on this scale is a valuable base map for any planning.

Study this plan. It will indicate where new water supplies are needed. There may also be possibilities for enlarging existing supplies, reticulating water to more paddocks or altering fencing arrangements to make better use of existing supplies.

The ideal, of course, is to prepare a soil conservation farm plan. This is a method of integrating erosion control measures, fencing, farm roads, firebreaks and water supplies into one overall plan of development which is put into effect over a number of years.

The method is described in Department of Agriculture Bulletin 2592.

While helping farmers prepare farm plans, soil conservation officers have found that the systematic planning nearly always leads to more efficient use of existing water supplies. It may even result in the provision of a watering point in every paddock without other changes being made. Where a farm plan cannot achieve this, it will certainly show clearly the areas which most urgently need new water supplies. By careful planning, these areas can often be grouped to make most efficient use of the new supplies.

Allow for Increased Stock Numbers

The legumes now available, plus better establishment methods, mean continuing development of improved pastures over a wide range of soil types and rainfall areas. New grazing management methods allow better utilisation of the pastures by greater numbers of animals. There is potential for a large increase in stock numbers on most farms. Allow for this in planning future water needs.

Water Supply in Every Paddock

Soil conservationists have always stressed the need for a water supply in every paddock. This was discussed in an article on soil erosion related to farm water supplies in the June, 1964, issue of...
PLANNING FOR SOIL AND WATER CONSERVATION

OLD PLAN
- No water in paddocks 1 and 2.
- All sheep water from brackish creek.
- Run-off from clay ridge and rocky ground, plus stock pads through gateways has caused gully erosion.
- Mixture of salt land and good land in paddocks 3 and 4.
- Fencing has no relationship to topography and land use capabilities of the area.

NEW PLAN
- Dam site selected on clay ridge.
- Dam has very little natural catchment, but is filled by contour drains.
- Contour drains control run-off, and allow gullies to be reclaimed.
- From mill and tank at dam, fresh water is piped a short distance to all paddocks.
- No stock traffic through gates to water.
- All salt land in paddock C to allow special management.

Scale 1 in. = 20 chains
Length of fencing: Old plan—120 chains.
New plan—130 chains.

the Journal of Agriculture. Also, many farmers are adopting set stocking, which requires a permanent water supply in each paddock. "Permanent" means that the stock have a supply available at all times without having to go out of the paddock. Careful, systematic planning is essential to achieve this.

For some farms the final planned result may be a supply in each paddock from a bore, well, soak or dam. Fewer supplies but more development in the form of mills, tanks, piping and troughs may be planned for other properties. Complete reticulation by piping and troughs may be necessary in some cases.

How Big a Dam?
During the planning stage, decisions must be made about the number and size
of proposed dams. For instance, should suitable sites be plentiful, it may be necessary to choose between one key dam (say 5,000 or 6,000 cubic yards capacity) and three smaller dams.

The following factors should be carefully considered:

• A minimum depth of 12 ft. is recommended to allow for evaporation during the long dry summer. This usually means a dam of 2,000 cubic yards or more. This still allows for evaporation in one summer only.

• Farmers who depend mainly on surface storages for stock water are advised to have at least one larger dam 20 ft. or more deep. This applies particularly in the drier areas where in some years there may be practically no run-off to replenish storages. Larger properties may require several such dams as a drought year reserve.

• One big dam may cost more for reticulation to serve the same number of paddocks as three smaller dams. Two miles of ¾ inch, medium density polythene piping, will pay for the construction of a 2,000 cubic yard dam.

• Contractors often quote a lower price per cubic yard for larger dams.

• The large dam will require a greater area and depth of good clay holding ground for its construction, and a larger catchment to fill it.

• Large dams must be constructed carefully and often require experienced contractors and special construction techniques.

1. The Excavated Earth Tank

This type offers the most scope for selection of site. It only needs an area of clay ground of sufficient depth, free of rock and above any salt water table. Most of the water is stored below the original ground level, and this storage capacity is equal to the volume of soil excavated. On sloping ground the excavated soil is placed in banks below and on either side of the excavation to give additional storage above ground.

When planning to use the excavated earth tank type of farm dam, keep in mind that checks should be made to ensure that the dam can be placed where planned and that it will be an efficient storage.

These are:

• Check the depth of soil.

When a site is selected test holes should be drilled to 2 ft. below the planned depth of excavation. Drill at least five holes—one in the centre and one to each corner of the bottom of the proposed excavation. These are necessary to ensure that there is sufficient depth of clay with no sand seams, rock or salt water table.

• Take appropriate levels

Levels should be checked for best placement of the dam. The uphill edge of any proposed excavation should be surveyed to place the top corners at equal height. Some dams overflow at one corner while several feet of excavation at the other corner is still high and dry above the water. A simple check of the levels will avoid this. The check can be done with the hose level or any other accurate surveying instrument.

• Check the height of the back wall

The vertical fall from the overflow point to the position of the back wall should be found. This measurement will be the height to which water will rise against the back wall. If it is more than 5 ft. a special construction effort is necessary to
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CHECK POINTS FOR FARM DAM SITING AND CONSTRUCTION

BEFORE STARTING EXCAVATION

• Mark out boundaries of excavated earth tank X Y Z V.

• Check levels to ensure that points X and Y are on the same level.

• Estimate where the walls will be and mark with pegs points W (the overflow around the wall) and G (the centre of the back wall.)

• Check that point W is higher than points X and Y. This is to ensure that the excavation will be filled before the dam starts to overflow. In many cases it is desirable to select point W about 6 inches higher than X Y and ask the contractor to build the wall exactly to that point.

• Measure the difference in vertical height between points W and G. The back wall of the dam must be built at least 3 ft. higher than this measurement—for example, if the vertical height difference is 5 ft., build a wall 8 ft. high.

• Drill test holes (to 2 ft. deeper than the proposed excavation) at the five points marked D.

WHEN CONSTRUCTION IS COMPLETED

• Commencing at point W, survey a true contour line around the inside wall of the dam, marking it with pegs as shown by points marked w.

• Measure to see that all points b on the top of the walls are at least 3 ft. vertically higher than points w.
make the wall high enough and sufficiently compacted to be safe with this depth of water against it.

- **Find the water level**

  When the dam is nearly finished, survey a contour line from the overflow point around the inside wall of the dam to show the expected water level when the dam is full. The wall should be at least 3 ft. above this line at all places to be safe. Freeboard is the term used for the height of wall above the level of the water. In large dams, the walls will settle a lot after initial construction, and this must be allowed for in calculating the final freeboard.

- **Remove the overburden**

  When construction is started it is important to remove the overburden from the dam site. This means the whole area of the excavation and out as far as the centre of the back and side walls. The overburden is any topsoil or porous layer above the good clay. If this is not thoroughly removed water will seep through it and all above-ground storage will be lost. The usual practice is to push the overburden downhill to form the backing for the rear wall. It is important that there should be a thickness of at least 2 ft. of clay on the inside surface of the walls. When planning potential dam sites, remember that up to 3 ft. of overburden may be removed if there is enough good clay below.

2. **A Dam Across a Creek**

   This type of dam impounds the water of a stream, and most streams (particularly in the wheatbelt) are subject to flood flows. A failure of the wall could release a large volume of water which could cause severe damage to property and roads, and stock losses and even loss of human life. Farmers considering such dams are strongly advised to seek engineering advice to ensure that the proper safety requirements for wall construction and spillway design are met.

   Availability of site is more restricted for creek dams, as the requirements are more exacting.

3. **Turkey-nest and Ring Tanks**

   Dams of this type consist of a completely enclosed earth embankment which is usually filled by pumping. They require fairly flat ground and good clay close to the surface. Their advantage is that they have a large capacity compared with the amount of soil moved. This capacity is obtained, however, by holding a large area of water at comparatively shallow depth. For this reason they have limited value for West Australian conditions—a long dry summer and high evaporation.
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THE CATCHMENT

Having decided where a water supply is needed and selected a possible damsite which meets the construction requirements, the next thing to consider is the catchment.

Natural Catchments

When considering a possible damsite an assessment should be made of the catchment area and of its potential for providing run-off to fill the dam.

Each catchment has its own characteristics which will affect the amount of run-off from any particular rain. It is impossible to state a definite area of catchment needed for 1,000 cubic yards of storage because so many variable factors are involved. However the following notes may be of some help in deciding whether a particular catchment is sufficient for the required dam size.

- **Nature of the Soil:** Run-off is more likely from heavy soils than from lighter soils. When there is an impervious subsoil or laterite at shallow depth, the surface soil becomes saturated easily and run-off will occur. If the surface has poor structure either naturally or from excessive cultivation and cropping, quick run-off can be expected.

- **Surface Cover:** This is one of the most important factors affecting run-off. A good pasture cover will reduce run-off and of course this is recommended as a vital part of a soil conservation programme.

- **Cultivation:** Cultivated soils usually absorb water more readily than bare compacted surfaces. Soils with poor structure, however, will seal over very quickly in heavy rain. This can happen to any soil which has been cultivated too finely.

- **Surface Storage:** Any small hollows will hold water and reduce run-off. Contour banks and contour cultivation will reduce run-off by providing surface storage for many points of rainfall. Contouring plus pasture improvement may eliminate run-off entirely in average years.

- **Rainfall:** Whether run-off occurs from a particular rainfall event depends on the above factors and also on the

This dam has been sited near the fence to benefit from the quick run-off catchment provided by the public road in the foreground. If necessary a contour drain could collect the water from the road and divert it some distance to a dam.
INCREASING THE CATCHMENT AREA OF A FARM DAM

Articles have appeared in this Journal describing methods of improving dam catchments by using contour drains and roadeed catchments.* The important thing to remember here is that these methods allow much greater scope in selecting new sites, especially for excavated earth tanks.

A patch of clay-holding ground with only eight acres of higher land above it will provide an assured water supply for a dam of 2,000 cubic yards capacity if the higher land can be formed into a roaed catchment. A smaller area could be sufficient in high rainfall areas.

Sometimes the only clay ground is on a sloping ridge. Although the damsite may have practically no natural catchment,

* Reprinted as Department of Agriculture Bulletins 2725 and 2393.

Good clay soil dam site on ridge with little natural catchment. Contour drains collect the run-off from a much larger area.

Natural Catchments can be Increased

intensity and duration of the rain and on the previous wetness of the soil.

Keeping these factors in mind and with local knowledge of where water runs it is often possible to site a dam with confidence that it will fill with run-off from its natural catchment in most years.

Most farms have some areas which are known to give quick run-off. These include heavy clay ridges, rocky areas, gravel hills and breakaways, and areas with laterite at shallow depth. Homestead areas and farm roads shed water quickly. Run-off water from a public road can often be diverted along a contour drain to a dam.

All the above should be kept in mind when planning a new dam—as well as the possibilities for improving the catchment as discussed below.
Water flowing down to a full dam. When planning a dam provision must be made for the overflow waters to avoid gully erosion or damage to the dam.

Contour banks can bring water to the dam from both sides of the ridge.

It may not be safe to build a dam in a creek or gully even though this is the best source of water. A small check dam across the gully can divert the water into a contour drain leading to a dam some distance away. A flood flow or silting may damage the check dam but the main dam will be safe and the check dam can be repaired at small cost.

If there are plenty of sites for holding ground, one can be selected where it fits in best with the farm plan, and water can be brought to it with contour drains.

Using these methods there is a wide range of possibilities for selecting dam-sites to meet the needs of any particular situation, without being limited by the natural catchment.

EROSION NEAR FARM DAMS

Silt washing from the catchment into the dam, scouring of spillways and gullying caused by overflow water are potential problems that must be considered at the planning stage. These were discussed in the article "Soil Erosion and Farm Water Supplies" in the July, 1964 issue of the Journal of Agriculture.

SUMMARY

Although there are many aspects to be considered the siting and construction of a dam is usually straightforward if it is planned thoughtfully and the necessary checks are made.

The vital points are:

- Decide where the water is needed and look for suitable holding ground.
- Consider the catchment and remember the value of contour drains or roaded catchments where necessary. Keep in mind the possibility of silting and remember the importance of a safe overflow.
- Select and peg out the proposed excavation and check the levels of the site and of the contour methods if they are to be used.
- If this is all satisfactory, put down the test holes in the excavation site.
- When the dam construction is complete check the levels around the dam to make sure it is safe. Do this before the dam-sinking equipment leaves the job.
- Make sure the overflow waters will not cause damage to crop land.
- Finally, do not build a dam across a creek or gully, without getting engineering advice.
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