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Rainwater tanks

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Roof run-off or rainwater generally provides a supply of clear, very soft and low-salinity water. Water from a properly installed and maintained rainwater system is normally safe for domestic use, but water from a poorly installed and maintained system can cause contamination and become a health hazard.

Roof-raintank systems need to be designed to take the best advantage of the available roof area from which water can be collected and diverted into the storage tank. In the majority of cases the available roof area can be easily calculated by measuring the size of the buildings on the properties this including the house and garage, machine sheds, hay sheds or other buildings that may have a sizeable roof area. To ensure capture efficiency each roof should have adequate guttering and down-pipes to cater for the expected run-off. For larger buildings (ie in excess of 300 square metres) it may be more appropriate to install a raintank at opposite corners or sides of the building rather than divert water through a combined guttering system to single tank. This will enable the system to cope with runoff from larger rainfall events.

For smaller roof areas or for existing systems that have undersized tanks, it is possible to interconnect these systems so that they discharge into a larger rainwater storage near the homestead to ensure that the overall system is able to provide adequate storage to meet the calculated or expected demand.

Assessing roof areas and tank sizes

To understand the relationship between roof area, rainfall and expected run-off yield, the Department of Agriculture has developed a simple roof-run-off calculator. This can determine the amount of run-off that will be generated from a roof area and determine the size of storage needed to meet an expected demand. The calculator can also be used to evaluate the existing system to see if it meets the optimum design.

The calculator uses daily rainfall data (for the period set by the user) and a simple water balance model to simulate run-off collection and draw-down based on the estimated or calculated demand. The program is not all-inclusive; it does not allow for variability:

- in demand during the year and is based on using the average daily demand;
- roof design, coating (i.e. tiles, corrugated iron) or condition;
- tank maintenance;
- poor or inadequate guttering and piping; or
- other problems that might affect the yield of the roof-raintank system.

The program does provide an indication of what might be required at the designated location. It is the user's responsibility to evaluate results and apply the knowledge gained from this tool with due consideration to expected site circumstances.

Tank size, roof area and water needs

The factors that affect roof-raintank system design are:

- amount and distribution of annual rainfall;
- raintank volume;
- roof area;
- water demand; and
- required reliability of supply.

Storage

Roof run-off for a domestic water supply is normally stored in rainwater tanks constructed from galvanised iron, concrete or fibreglass. The type of tank depends on household requirements and available finance. More expensive tanks generally last longer, and the trade-off is a matter for personal decision. In all cases, a cover or lid on the tank is essential to reduce pollution of the stored water, reduce growth of algae and bacteria and minimise evaporation.

Roof area

The effective roof area is one where water can be collected and diverted into a storage tank. The roof must have effective gutters and down-pipes to ensure that the majority of rain channelled into them is transferred to the tank. For large roof areas (greater than 300 square metres) or with roofs that are multi-layered or have small sub-compartments (as with some house designs) it is recommended that more than one tank is attached to the roof area to optimise run-off collection. RAINTANK (V2) is a simple roof-raintank calculator that can be used to assess the efficiency of existing and new run-off collection systems. The software is available from the Department of Agriculture, WA.

House water needs

Water-use varies significantly between houses, depending upon the number of people per household and the number, type and frequency of use of particular household appliances. To minimise water-use, install water-saving clothes washers, dish washers and shower heads. For example, front-loading clothes washers use less water than top-loading types.

Dual-flush toilet cisterns offer significant water savings compared to single-flush (nine litre) cisterns. However, the preferred option for rainwater-users is to substitute a lower quality, but more abundant water supply for this use, especially where the rainwater supply is limited.

The Perth Metropolitan Water-Use Survey showed that the average daily in-house water-use was 150 litres per person per day. This survey also showed that in-house water-use varied very little throughout the year. Average daily use in February was only 20 per cent more than in August.

Data from the Water Corporation shows that the average Perth metropolitan house uses 337 kilolitres of scheme water each year. In many country towns, this average is much higher water. For supply design purposes, water demand can be assumed to be in the range of 10 to 180 litres per person per day. About 40% of all domestic water is used inside the home, the rest is used outside the home, mostly in the garden. Inside the home, about 30-40% of water is used in the shower/bath, 30% in the laundry, 20% in toilets and the remaining 10-20% in other indoor areas, including the kitchen.

Calculating Crop spray requirements

The crop-spraying requirements in each year will vary according to the distribution of crop/pasture on each farm within each shire. Crop-spraying requirements are based on the number of applications per year (usually 3); the rate of water mixed with the pesticide (35–50 L/ha) multiplied by the area of land sprayed (hectares) each year. Crop spraying requirements of canola for the applications of different chemicals per season is 150 L/ha. The quality of water used for spraying varies depending on the pesticide used. Factors affecting water quality include pH, muddiness, salinity, hardness and organic matter content.

For designing water supplies that are to be used *exclusively* for crop-spray, the total drawdown for a single spray operation (i.e. one pass) should be used to calculate the reliability of the supply. Use of the total volume of a raintank is justified when the water requirement to complete a single spraying operation equals the storage capacity of the roof-raintank system (i.e. 45 kL tank 45 kL required for single pass). In such cases, the water supply cannot be replenished before the next spraying program begins, given that a series of passes would be carried out over a 6 -8 week period.

To compute the annual water delivery, at 98% reliability, the tenth percentile average annual rainfall given in Figure 1 is assumed to provide 80 % run-off from the available roof area. The following equation is used:

$$\frac{\text{10th Percentile Average Annual Rainfall (mm)} \times 0.80 \times \text{Roof Area (m}^2\text{)}}{1000} = \text{kL/yr}$$

This value is then used to determine the supply relative to the crop-spraying requirements. For multiple use systems, then a combination of roof-raintank supply calculations should be used.

Reliability of water supply

The reliability of supply is the percentage of time in any given period for which the daily water demand can be satisfied.

For example, a level of reliability of 98% indicates that the design level of demand can be satisfied for 98% of the time or 98 days out of 100. On average, the supply will fail for approximately seven days per year, or for a total of 70 days in 10 years. In the wheatbelt, rain tank systems with 98% reliability are likely to fail approximately twice in 10 years for about 5 weeks at a time. The most likely time of a failure occurring is from April to May, following a dry summer.

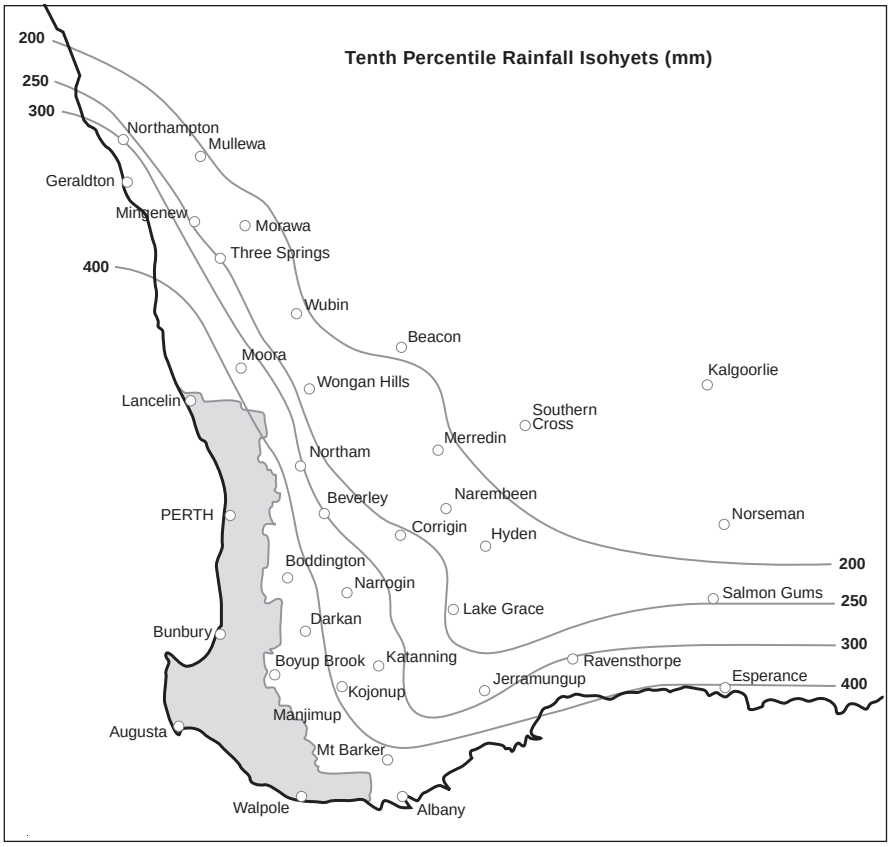

Figure 1. The tenth percentile average annual rainfall for south-western Australia. Hatched area is high rainfall and the formula given does not apply.

An alternative or supplementary water supply must be available to make up the short-fall during times of water deficiency. Alternatively, the use of rationing when the supply falls below a given level will assist in the management of the short-fall.

Installation

The installation must include an effective means of keeping leaves, animals, birds and insects out of both intake and the overflow. Sunlight should be excluded as much as possible to minimise the growth of algae and the inspection and access points should have tight-fitting lids.

Since all roofs collect debris, dust and bird droppings, a device that permits the first flush or run-off from the roof to be drained or excluded from the tank lids is recommended.

One such device or 'diverter' traps in a sump the first 10 litres of run-off from each storm. When the sump is full, a float-operated valve closes, directing any subsequent run-off into the storage tank. When run-off stops, a small drain-pipe allows the water in the sump to trickle out to waste over a period of an hour, in readiness for the next storm. Accumulated debris in the sump must be removed regularly.

Other 'diverters' are available that allow very low rates of run-off to by-pass the tank and higher rates to enter the storage tank. This type of device is only suitable if the regular loss of some inflow water is of no concern. 'Diverters' should be regarded only as a means of reducing sludge accumulation in storage tanks. They will not necessarily improve water quality.

Maintenance

If the tank has an effective inlet strainer and lids, only a minimum amount of maintenance is needed:

- Keep gutters clear of leaves, dead animals and birds; check every three months or more often if trees overhang.
- Clean the inlet strainer whenever necessary.
- De-sludge the tank every year. With galvanised iron tanks it is important not to disturb the film that builds up on the wars inside the tanks, since it protects the metal from corrosion.
- Mosquito larvae or "wrigglers": A film of liquid paraffin (for preference) or lighting kerosene on the water will prevent mosquitoes breeding. Put a tablespoon of oil per 10 square metres of the water surface (about 10 ml per 20 k of tank capacity) at the end of the winter rains and again if the water overflows. Liquid paraffin evaporates more slowly than kerosene, but it will need replacing a couple of times during the summer. Do not use power kerosene since it taints the water.

De-sludging the tank is not a complicated operation, although it can be hazardous.

Conditions inside a tank that contains little or no water will be extremely hot and humid. This can cause heat exhaustion during cleaning. Clean tanks early in the morning or when the area is shaded.

If extra light is needed, it is safer to use a battery-powered torch rather than a gas or kerosene lantern or an electric extension lamp

If chemicals are being used inside a tank, a respirator may be necessary. Always closely follow instructions regarding the use of chemicals.

Cleaning a dry tank that collects water from an asbestos roof is potentially hazardous and advice should be obtained beforehand (see the note below on asbestos). Keep the inside walls and the sludge wet while removing sludge to minimise the chance of inhaling dangerous asbestos fibres.

Do major maintenance operations before the rainy season. If a diverter is not fitted, cover the inlet and turn the down-pipe to one side so the water from the first good rain rinses down the roof and gutters, then runs to waste. If the tank is the sole, house water-supply and cannot be cleaned out regularly, treat the water chemically with chlorine, and/or boil all water for human consumption. The best arrangement is to have two tanks and clean them out alternately.

Micro-organisms in the tank

When the water enters the tank, heavy material drops to the bottom, thick, sludge-layer. The outlet tap on a tank at least 10 cm from the base, so that water can be drawn from above the sludge-line.

Any micro-organisms that were on the roof or in the gutters build up in the nutrient-rich sludge layer. Many of them do not pose a health risk, but if disease organisms are present, they may build up to become a health risk.

The disease organisms commonly found in rainwater tanks are enteric bacteria. They cause stomach aches, diarrhoea and similar ailments that are quite dangerous for the very young and the very old. Amoebae may also be found. They may cause amoebic meningitis if the water is forced up the nose.

Chlorinating

If you suspect that the water in your rainwater tank has been contaminated by bacteria, add chlorine to the water.

Treat the water with non-stabilised chlorine such as calcium hypochlorite, or sodium hypochlorite. Stabilised chlorine, which contains cyanuric acid, may be toxic and should not be used. The initial dose to treat the contamination should be with 14 grams of calcium hypochlorite (60-70%) per 2000 litres or 40 ml of sodium hypochlorite (12%) per 1000 litres of water. Stir the water, let it stand for at least 24 hours to allow the chlorine taste and smell to dissipate. This dosage will disinfect the tank.

It is important to mix the chlorine in a plastic bucket in the open air, before adding it to the tank, and then mix it as thoroughly as possible with the tank water. Note that chlorine breaks down rapidly in sunlight. The water will be safe to drink provided the chlorine smell is not too strong. See also Farmnote 44/2004.

Roofing materials and paints

Surface deposits that remain after manufacturing will be present on most new roofs, gutters and tanks, so allow the run-off from the first few storms to run to waste.

Lime will leach from concrete tiles, asbestos cement roofing and concrete tanks, causing some increase in hardness and alkalinity of rainwater. However, this problem will generally disappear after the first 12 months. The lowered water quality during that time should not be so severe as to stop the water being used.

Lead-based paints (including primers) should never be used on roofs from which rainwater is collected.

Bitumen, asphalt and tar-based roof coating materials should be avoided if water is to be collected, as the phenolic and other organic compounds they contain will impair the taste of the water. Seek advice from the manufacturers of particular materials.

Asbestos

Asbestos-related diseases are caused by the inhalation of very minute air-borne fibres into the lungs over a period of time. There is no evidence to suggest that any asbestos-related diseases will result from the drinking of water collected from a roof constructed of asbestos cement sheeting.

Fluoride

There is no fluoride in rainwater. Dental authorities recommend that children who drink only rainwater should have fluoride tablets to help prevent dental decay.

Interconnection of tanks and mains water supply

To protect public health and the security of public water supplies, direct connections of mains water supplies to rainwater-tanks are not permitted. However, tanks may be fed from the mains supply by use of a control valve and an approved physical air-break. Employ a licensed plumber, who is familiar with requirements and the need for use of authorised materials, to make such connections.

Further advice is available by contacting water-plumbing inspectors.

Further reading

Farmnote 41/2004 ‘Water quality for farm, garden and household use’

Farmnote 43/2004 ‘Water quality for farm, domestic and livestock use’

Farmnote 44/2004 ‘Emergency chlorination of farm water’

Farmnote 2004.’Reliability of water supplies’

Computer software

RAINTANK V2 – program and manual available from the Department of Agriculture.

Acknowledgement

Information on water quality is largely based on the Environmental Health Guide - “Is the Water in your Rainwater Tank Safe to Drink?” published by the Health Promotion Services Branch, Health Department of Western Australia.

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