Chapter 12 **Rainwater tanks**

Slim-line rainwater tank

12.1 Introduction

The core sustainability objective of using **rainwater tanks** is to conserve mains water. In addition to conserving mains water, rainwater tanks help to protect urban streams by reducing **stormwater** runoff volumes, particularly from small storms, and associated stormwater pollutants from reaching downstream waterways. Rainwater and stormwater harvesting on individual allotments are some of the initiatives that can be implemented to deliver such a potable water conservation objective.

Another important household initiative to conserve water is the use of AAA plumbing fittings and AAA and AAAA appliances. These are often adopted as a first priority in water conservation initiatives as they are easy to adopt, have high cost effectiveness and broader environmental benefits such as reduced wastewater **discharges**. Recent research (Melbourne Water 2001) has found that the adoption of AAA rated showerheads and dual flush toilets can reduce indoor water use by 15%–20% (11%–15% of total internal and external water use). Following improving the efficiency of water use within a household, finding supplementary sources for water is fundamental to further reducing demand on mains water. The use of rainwater tanks to collect roof runoff is an accepted means of supplementing mains water supplies which is simpler to implement than other potential alternative water sources such as greywater or surface stormwater.

There are no quantitative performance targets (e.g. size of tank, targeted reductions in potable demand) in any existing local government and state authority policies and guidelines regarding the use of rainwater tanks. However, it can be inferred from the various policies and guidelines that do exist that a performance target for rainwater tanks (or any other form of rainwater and stormwater harvesting, storage and reuse scheme) is to provide a 'reliable' supply of suitable quality water to meet the demand requirements of a stipulated preferred 'end-use' (e.g. toilet flushing).

This design procedure focuses on factors associated with selecting and using a rainwater tank, including sizing rainwater tanks such that they will provide a reliable source of water to supplement mains water supply. Variables that need to be considered in sizing a rainwater tank include the size or area of roof directed to a tank, the quantity and nature of the demand and the rainfall pattern of a particular area.

12.2 Rainwater tank considerations

The use of rainwater tanks to reduce demand on reticulated potable water supplies and stormwater runoff volume needs to consider several issues as follows.

- *Supply and demand* – conditions such as a low roof area to occupancy ratio (e.g. high density development) and low annual rainfall regions (e.g. northern Victoria) can result in large rainwater tank volumes to provide a 'reliable' supplementary water supply to the end uses connected to a tank.
- *Water quality* – the quality of water from rainwater tanks needs to be compatible with the water quality required by the connected 'end-use'. There are several ways in which the water quality in rainwater tanks can be affected and it is important to understand these so that appropriate management measures can be implemented.
- *Stormwater quality benefits* – the quantity of the stormwater that is reused from a tank system reduces the quantity of runoff and associate pollutants discharging into a stormwater system. The benefits, in terms of pollutant reduction, should be considered as part of a stormwater treatment strategy.
- *Cost* – the cost of rainwater tanks needs to be considered against alternative demand management initiatives and alternative water sources.
- *Available space* – small lots with large building envelopes may preclude the use of external, above-ground, rainwater tanks.
- *Competing uses for stormwater runoff* – there may be situations where a preferred beneficial use for stormwater runoff (such as irrigation of a local public park, oval, or golf course) may provide a more cost-effective use of runoff from roofs than the use of rainwater tanks on individual allotments.
- *Maintenance* – most rainwater tanks will need to be maintained by the householder or a body corporate (or similar).

These issues are further discussed below.

12.2.1 Supply and demand considerations

Supply and demand considerations should be examined during the concept investigation phase of a project. Nevertheless, several key considerations are discussed below to ensure that they are sufficiently addressed before implementing a rainwater harvesting scheme.

Low roof area to occupancy ratio

An obvious limitation of rainwater tanks as an alternative water source is where a roof area is too small to yield sufficient runoff for a cost-effective supply of water. This situation is most likely to arise on projects with medium and high density residential dwellings (i.e. where the ratio of roof area to the number of occupants in the dwelling is low). In these situations, it is probably most important to maximise the use of water efficient fittings and appliances to reduce the demand on the reticulated water supply so that the additional supply opportunities that are presented by a rainwater tank are maximised.

A smaller ratio of roof area to number of occupants (i.e. increasing density) has the effect of increasing the size of rainwater tank required to deliver a given ***reliability*** of supply (the percentage of water demand that is met by that supply) to the connected end uses. With high density, multistorey developments (>4.5 people/100 m^2 of roof), there is a diminishing opportunity for the effective use of roof water for all households as a means of supplementary supply.

Increasing the number of end uses connected to a tank (e.g. laundry and garden in addition to toilets) will reduce the reliability of the supply. While the reliability decreases with increasing end uses, the total use of available rainwater increases because there is a greater frequency of drawdown and reduced frequency of overflow.

The reliability of supply, thus, may not necessarily be a concern if potable water is available to supplement a supply (e.g. as s mains water top-up). The cost of connection/plumbing to a greater number of end uses, and the additional complexity of the in-house water reticulation system, may increase and this could reduce the beneficial effect of the total potable water savings resulting from additional end uses. As a general rule, it is recommended that the reliability should be at least 50% for a viable reticulation system.

Low rainfall regions

The effectiveness of rainwater tanks as a supplementary water source is reduced in low rainfall regions such as Northern Victoria (e.g. Mildura's Mean Annual Rainfall (MAR) = 306 mm compared to Melbourne = 660 mm). The reduced rainfall and the higher seasonality effect in these areas can often lead to significant increases in rainwater tank size to achieve a similar level of supply reliability (and, hence, the cost-effectiveness reduces).

The use of rainwater tanks on projects in the north-western region of Victoria (and other similarly low annual rainfall regions) will need to consider carefully the viability of tanks as a cost-effective alternative water source. Other potential water sources such as reclaimed water and/or greywater reuse may need to be given greater consideration in these regions as these water sources are independent of local climatic conditions and can provide a higher reliability of supply.

12.2.2 Water quality

Water quality is an important consideration with all roof water systems, especially in urban and industrial areas. Possible pathways for contamination of roof water are:

- atmospheric pollution settling onto roof surfaces
- bird and other animal droppings with bacteria and gastrointestinal parasites
- insects, lizards and other small animals becoming trapped and dieing in a tank
- Roofing materials and paints – lead based paints in particular should never be used on roofs where water is collected for potable water uses; tar-based coatings are also not recommended, as they may affect the water's taste; zinc can be a significant pollutant in some paints and galvanised iron or zincalume roofs (particularly when new) should not be collected for potable use
- detergents and other chemicals from roofs painted with acrylic paints can dissolve in the runoff; runoff from roofs made of fibrous cement should be discarded for an entire winter due to the leaching of lime
- chemically treated timbers or lead flashing should not be used in roof **catchments** and rainwater should not be collected from parts of the roof incorporating flues from wood burners
- overflows or discharge pipes from roof mounted appliances, such as evaporative air-conditioners or hot water systems, should not discharge onto a roof catchment or associated gutters feeding a rainwater tank.

The presence of these contamination pathways will vary between projects and will largely depend on:

- proximity of the project to areas of heavy traffic, incinerators, smelters or heavy industry, and users of herbicide and pesticides (e.g. golf course, market gardens)
- roofing materials and roof-mounted appliances
- provision of a well-sealed rainwater tank with a first flush device and with inlet and overflow points provided with mesh covers to keep out materials such as leaves and to prevent the access of mosquitos and other insects.

The quality of roof water collated from relevant Australian studies is summarised and further discussed in Engineers Australia (2003).

Water quality requirements of an end use connected to a rainwater tank will determine whether or not additional water quality treatment needs to be provided between the tank and the end use. For all non-potable uses (e.g. toilet flushing, washing machines, garden watering) available monitoring data indicates that typically there are low levels of risk to consumers if additional water quality treatment (e.g. disinfection) is not provided (Coombes 2002). One exception in this regard is where a rainwater tank is connected to the hot water system where there is a heightened potential of human ingestion of rainwater (e.g. when showering, children in the bath). If connected to the hot water system, some disinfection is required which may include providing hot water at a certain temperature (to allow for complete pasteurisation) or other disinfection methods (e.g. chlorination).

12.2.3 Stormwater quality benefits

Using collected rainwater reduces the total volume of stormwater runoff from a site and therefore reduces pollutant discharges. The percentage reduction of stormwater from a site can be estimated based on the reuse demand, reuse reliability and MAR.

Percentage reduction = *reliability* × *reuse demand* (kL)/*Rainfall volume* (m^3)

Where, reuse demand = average annual toilet flushing demand (assumed to be 8 kL/person per year) × no. of household occupants

Rainfall volume = MAR (m) × contributing roof area (m^2)

For example, the percentage reduction in stormwater from a rainwater tank that provides 70% reliability for a house in Bendigo (MAR 570 mm) with three occupants and a roof area of 120 m^2 is calculated as follows:

Stormwater reduction = 70% × (8 kL/person per year × 3 people)/(0.57 m × 120 m^2) = 25%.

Therefore, the reduction in stormwater runoff and hence Total Soluble Solids, Total Phosphorus and Total Nitrogen loads from the roof due to reuse from the rainwater tank is 25%.

Additionally, rainwater tanks provide some treatment of water that is not removed from the tank for reuse (i.e. water that is stored for some period and then spills when the tank overflows). The dominant process is the settlement of suspended solid loads. The reduction in pollutant loads in water that is spilt from rainwater tanks is likely to be small compared with the reduction due to the removal from the system.

12.2.4 Cost considerations

Typically the cost of a rainwater tank installation for supplementary water source ranges from $1200 to $2000 for residential detached or semi-detached dwellings. Three cost components are normally involved: the tank, installation and plumbing, and a pump. Costs may increase with higher density development as space constraints could require more specialised tanks to be fitted (see Section 12.2.5) unless communal use of a centralised rainwater tank can be facilitated.

The typical payback period of a rainwater supply system purely through a reduction in domestic water charges is about 35 years under current water pricing and will often not be able to justify the use of rainwater as an alternative source of water to mains water. This is mostly because the present pricing of mains water does not reflect the true environmental and social cost of the water resource. Terms such as 'total resource cost' and 'total community cost', in addition to the more commonly used terms of 'life cycle cost' and 'whole of life cost', have emerged in recent analysis of the value of water. These terms are meant to more holistically reflect the beneficial outcomes associated with water conservation practices through the adoption of alternative water sources and associated matching of their respective water quality with fit-for-purpose usage. When such 'total resource cost' issues, and the potential benefits of rainwater capture/reuse in regard to reduced stormwater flows are considered, more positive economic benefits can apply (Coombes 2002).

12.2.5 Available space considerations

Small allotments with large building envelopes are becoming more common as dwindling land stocks require the provision of smaller lots to meet increasing demand. However, the public's desire for 'traditional'-sized houses remains strong and as a consequence front and back yards are being reduced to allow large houses to be built onto progressively smaller allotments. This phenomenon imposes a potential constraint on the use of rainwater tanks where tanks are installed external to a building and above ground (as is conventional practice). Competing demand for the use of external areas raises the potential for resistance to the imposition of rainwater tanks on small allotments with large building envelopes. This can be overcome by

Figure 12.1 A slim-line tank (left) and modular rainwater tank system (right).

burying tanks or placing them underneath houses but these techniques have associated cost implications for construction and maintenance.

Rainwater tank designs have advanced recently with slim-line rainwater tank designs reducing tank footprints. Modular rainwater tank systems are also now being developed. These systems can be interconnected to form boundary fences or potentially walls for a garden shed or carport. Eventually rainwater tanks will be developed that can be designed into the building floor or walls, thus removing any impost on the use of external areas. Rainwater tanks in buildings can also provide energy benefits through thermal inertia of the stored water moderating temperature variations within households. Examples of slim-line and modular rainwater tanks are shown in Figure 12.1.

The final decision on the acceptability of using rainwater tanks on small lots is likely to be influenced by the size of tank required (which is influenced by the available roof area and the water conservation outcome to be attained from a rainwater tank), the compatibility of commercially available tank systems with the built form and the available area for a tank. This decision needs to be made case-by-case.

12.2.6 Competing uses for stormwater runoff

There may be situations, especially on larger precinct-wide projects, where there may be one or more competing uses for stormwater runoff generated from roof areas and ground-level impervious surfaces. Rainwater tanks may not provide the optimal strategy from a sustainability perspective, especially when comparing the life cycle cost and resource use outcomes of a centralised stormwater harvesting scheme with a decentralised rainwater harvesting scheme. These issues need to be investigated thoroughly during the concept design stage of a project.

A common example of competing uses is associated with residential development adjoining public open spaces and golf courses. In development scenarios such as this, it is often more cost effective (from both a capital and asset maintenance perspective) to implement a precinct-wide stormwater harvesting scheme and supply the water for public open-space watering.

12.2.7 Maintenance considerations

Although the maintenance of a rainwater tank-based system to augment the mains supply is not particularly arduous for a property owner, it is nevertheless an additional requirement for households that normally would have their water supply sourced from a reticulated system. This may have possible long-term effects on the sustainability of a rainwater tank supply scheme, especially if homeownership changes. With more realistic water pricing policies and appropriate education practices, the impacts of this consideration should be minimal, however (see Section 12.4.4).

12.3 Australian standards for installation of rainwater tank systems

Rainwater tanks need to be installed in accordance with the Plumbing and Drainage Standards (AS/NZS 3500 2003).

Although not strictly a standard, rainwater should be sourced only from roof sources, and flows from roads, footpaths, and other common areas at ground level, are addressed through separate stormwater treatment processes. If supply is supplemented by an interconnection with a reticulated water supply, backflow prevention via either an air gap or proprietary device is required in accordance with Australian Standard ASNZS 3500.1.2 (1998) and the requirements of the local water supply authority. For treatment and usage it is suggested (Donovan 2003) that:

- the collection system should incorporate a first flush device or 'filter sock' to divert or filter initial runoff from a roof
- the tank system should be connected to the toilet, hot water, laundry and garden irrigation fixtures, and there should be no direct supply from the mains water to these services
- there should be no connection to other indoor fixtures from the rainwater tank unless measures are undertaken to make the supply fit for consumption
- the tank is enclosed and inlets screened, in order to prevent the entry of foreign matter and to prevent mosquito breeding
- overflow from a rainwater tank should be directed to a detention device, **swale** or stormwater drain.

12.4 Design procedure: rainwater tanks

Design considerations when evaluating a rainwater tank system include the following:

1. selection of end uses
2. determination of size and associated reliability relationship
3. hydraulic fixtures, such as
   - water filter or first flush diversion
   - mains water top-up supply
   - onsite detention provisions
4. maintenance provisions.

12.4.1 Selection of end-uses

Water consumption in a household varies depending on the type and location of the house. Typical water consumption figures for residential areas expressed on per capita are summarised (Table 12.1).

The effect of using water-efficient appliances on reducing the water demand when sizing rainwater tanks should be considered. Consumption of water for toilet flushing has reduced significantly since the mandatory introduction of dual flush toilets over a decade ago. Table 12.2 lists the likely reduction in indoor household water demands resulting from the adoption of such water efficient appliances.

The most obvious water uses for rainwater are toilet and garden supply as they avoid the requirement for treatment to potable standards. Replacement of mains potable water for toilet flushing is considered to be the more effective of the two because of its consistent demand

Table 12.1 Typical household water consumption in Melbourne (after Melbourne Water 2001)

Water uses	Per person usage (kL/person per year)	Percentage of total usage (%)
Garden	32	35
Kitchen	5	5
Laundry	14	15
Toilet	18	19
Bathroom	24	26
Total	92	–
Hot water	24	26

Table 12.2 Estimation of reduction in water demand by water efficient appliances
(after New South Wales Department of Infrastructure Planning and Natural Resources 2004)

Water uses	Conventional demand (kL/person per year)	Reduced demand with water efficient appliances and fittings (kL/person per year)
Shower	20.8	13.5
Bath	3.2	3.2
Hand basin	2.2	1.2
Toilet	12.8	7.3
Washing machine	17.0	11.9
Kitchen sink	4.4	2.3
Dishwashing	1.1	0.6
Total	61.5	40.0

pattern and, thus, a higher reliability of water supply can be achieved for a given size of rainwater tank. While having a higher water demand, water usage for garden watering is seasonal and the demand pattern is 'out-of-phase' with the supply pattern (i.e. high garden watering demand occurs during low rainfall periods) and thus a larger rainwater tank storage may be required to achieve comparable reductions in potable water usage compared with toilet flushing.

The next appropriate use of rainwater, after the use of rainwater for toilet flushing and garden watering, is in the laundry (e.g. washing cold tap). Supplementing the supply for hot water is also an effective option. Hot water usage constitutes about 30% of household indoor usage. The quality of water delivered from a rainwater tank via a hot water system is improved by the combined effects of high temperature pasteurisation, pressure in the pump and the instantaneous heat differentials between the rainwater tank and a hot water service.

12.4.2 Tank size and supply reliability

The supply reliability of a rainwater tank is directly influenced by three factors:

1. Supply characteristics – as defined by the size of the catchment (i.e. roof area connected to the rainwater tank) and the rainfall pattern of a region (MAR and seasonal pattern).
2. Demand characteristics – as defined by the type of uses. If indoor use, this depends on household occupancy and if for garden watering, demand depends on garden design and climatic conditions of the region.
3. Storage size.

Because rainwater is intermittent, the most appropriate analytical approach for assessing the reliability of supplies is a continuous simulation (modelling) approach using long records of rainfall data. Engineers Australia (2003) provide a detailed discussion on appropriate modelling techniques for determining a relationship between tank size and rainwater supply reliability.

A simple generic procedure that covers all regions of Victoria is presented here for selecting rainwater tanks for toilet use. The procedure is based on continuous simulations of the performance of rainwater tanks of varying sizes to meet toilet flushing demands (assumed to be 20 L/person per day) for the 45 **pluviographic** stations used in determining the treatment measure performance described in Chapter 2. Household occupancies equivalent to 1.5 persons, 2.5 persons, 3.5 persons and 4.5 persons per 100 m^2 of roof area catchment (i.e. the roof area directed to a tank) were used to represent the scenario of increasing development density. Melbourne was selected as the reference site. This procedure is only applicable for roof water used for toilet flushing (or any indoor water usage that is highly correlated to household occupancy).

For any assessments evaluating more widespread usage of rainwater, rigorous assessments using models such as PURRS, AQUACYCLE and UVQ are recommended (see Engineers Australia 2003, chapters 5 and 13). Assessments for more widespread use have already been conducted for Melbourne (Coombes and Kuczera 2003). These assessments demonstrate the significant benefits that can be gained from rainwater tank systems.

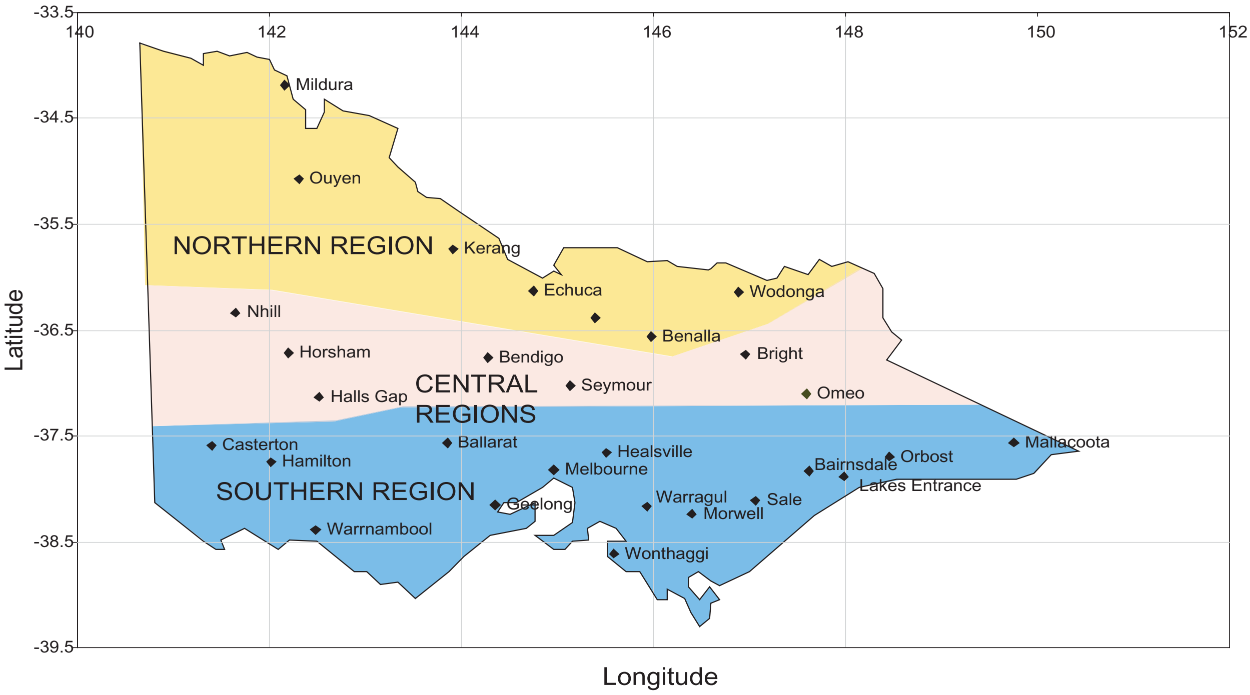

Figure 12.2 Rainwater tank design hydrologic regions.

The results of the analysis (Appendix C) using the **Model for Urban Stormwater Improvement Conceptualisation (MUSIC)** (Cooperative Research Centre for Catchment Hydrology 2003) led to the delineation of three rainwater tank design regions that cover Victoria (Figure 12.2). It was not possible to include Mildura in the Northern Region as the low rainfall in the area proved to significantly increase tank sizes compared with those required for the remaining reference pluviographic stations to achieve comparable performances.

The procedure proposed for determining an appropriate size of rainwater tanks for use in toilet flushing is as follows.

1. Using the reference site curves (Melbourne – see Figure 12.3)
   a. Select the appropriate supply and demand characteristic (represented by the occupancy to roof area ratio).
   b. Either
   i. Select a desired water supply reliability and read from the curves provided (interpolate between curves where appropriate) a required tank size;
   or
   ii. Select a tank size and read from the curves provided (interpolate between curves where appropriate) the resulting reliability of supply.
2. Relate the tank size or reliability to a location in Victoria (using design curves derived for the appropriate design region – see Figure 12.2)
   a. Select an appropriate design chart for the location in question by locating the appropriate rainwater tank **hydrologic design region** (see Figure 12.2)
   b. Determine an equivalent tank size for the location to achieve an equivalent level of supply reliability derived from the reference site (Melbourne). Interpolation between curves may be required.

Tanks sizes for Melbourne

Figure 12.3 shows relationships between water supply reliability and rainwater tank volume for a range of toilet demands and supply catchment areas (as represented by occupancy to roof area ratios). The plots are based on assuming 20 L/day per occupant in the modelling (representing water-efficient dual-flush toilets). Increasing residential density (i.e. higher occupancy to roof area ratio) results in decreasing water supply reliability. Similarly, a larger rainwater tank is required to maintain the same reliability of water supply for a higher occupancy to roof area ratio.

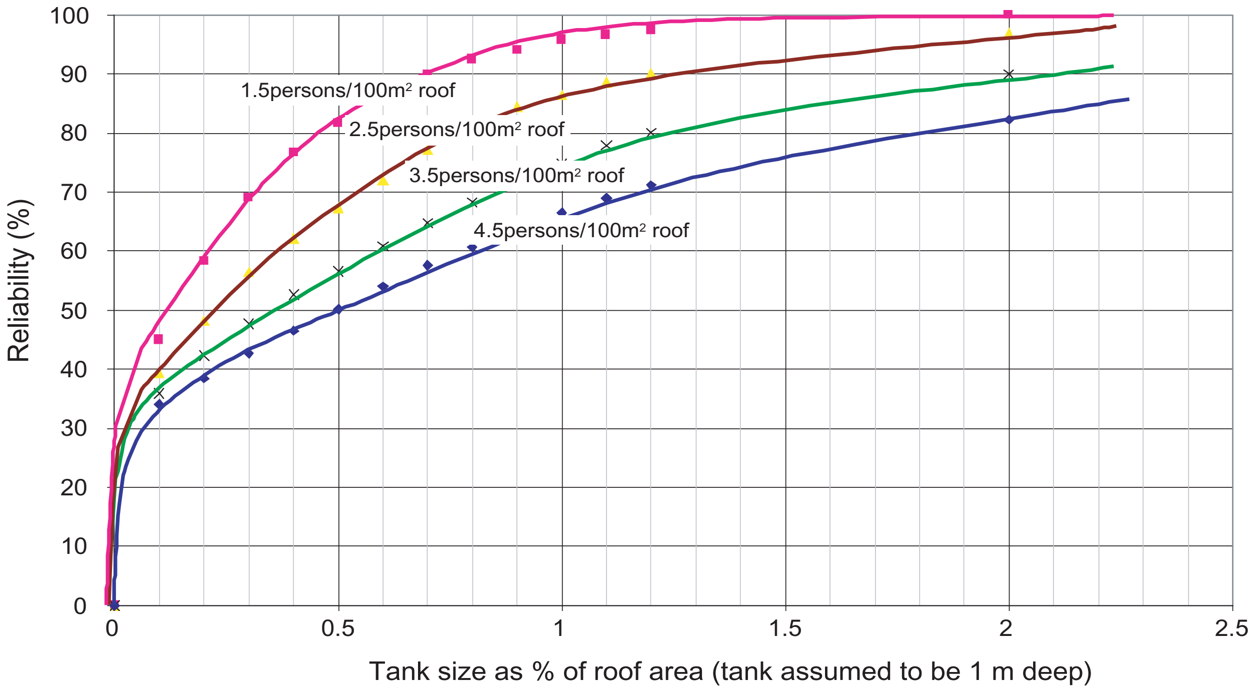

Figure 12.3 Relationship between toilet flushing water supply reliability and rainwater tank size for Melbourne.

Example: to achieve a 70% reliability of water supply for toilet flushing in a household with three people where the roof area connected to a rainwater tank is 120 m^2 will require a tank size equivalent to 0.6% of the roof area or 720 L.

Determining tanks sizes for all locations in Victoria

Figures 12.4, 12.5 and 12.6 show relationships of tank sizes and MAR for the three rainwater tank hydrologic regions in Victoria for varying reliability of supply. The tank size required is expressed as a percentage of the roof area (and assuming a 1 m deep tank) and each of the curves in the plots represents the reliability of an equivalent tank size in the Melbourne region (derived from Figure 12.3).

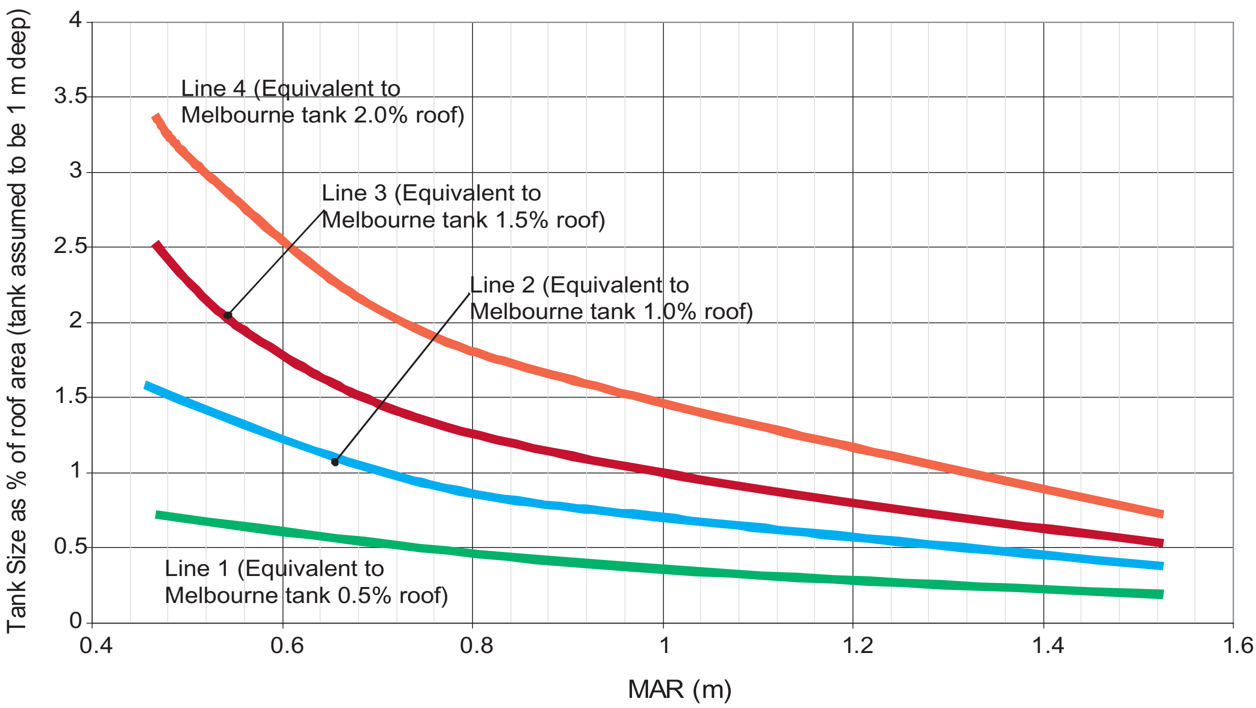

Figure 12.4 Tank size versus Mean Annual Rainfall (MAR) – Southern Region.

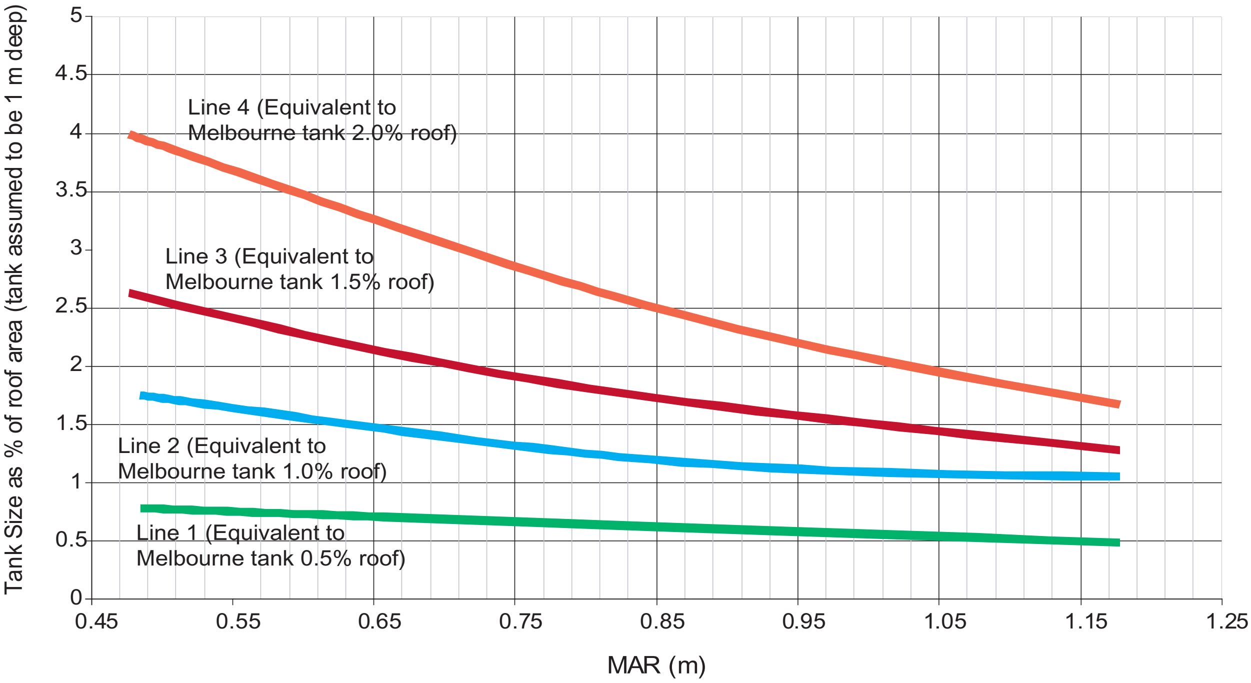

Figure 12.5 Tank size versus Mean Annual Rainfall (MAR) – Central Region.

Four reference curves were used to represent the design characteristics of rainwater tanks each in the Southern and Central regions (Figures 12.4 and 12.5).

It is not possible to represent rainwater tank performance with the same four reference performance curves for the Northern Region owing to insufficient rainfall in this region to attain water supply reliabilities equivalent to tank sizes of 1.5% and 2% of the roof area in Melbourne. Thus, curves for required tank sizes to attain water supply reliabilities equivalent to tank sizes of 0.4%, 0.5%, 0.75% and 1.0% were used.

Example: As discussed in the previous section, a 720 L rainwater tank will provide 70% reliability of toilet flushing supply to a household of 3 people with 120 m^2 roof area connected to a rainwater tank. If the same scenario occurs in Bendigo (Central Region) (MAR of 570 mm), the required rainwater tank size to achieve a 70% water supply reliability can be determined by interpolating between Line 1 and Line 2 in Figure 12.5.

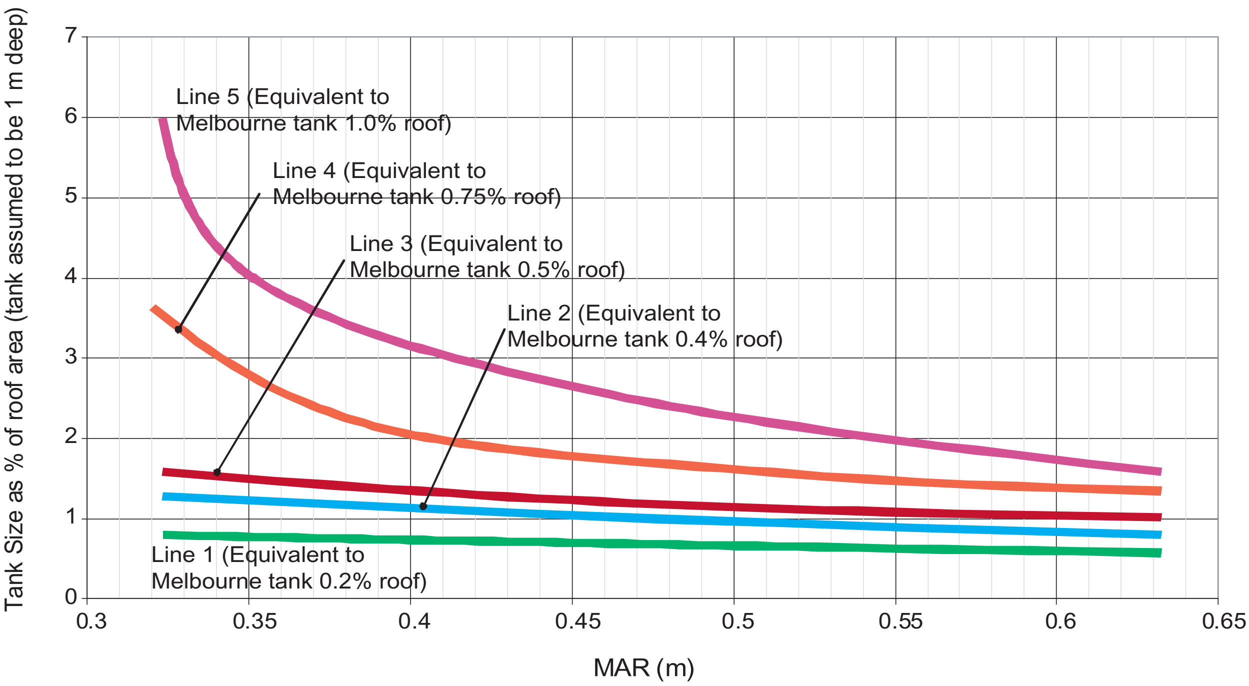

Figure 12.6 Tank size versus Mean Annual Rainfall (MAR) – Northern Region.

From Figure 12.4:
For MAR of 570 mm → Line 1 (0.5%) reading = 0.75%;
Line 2 (1%) reading = 1.6%
Interpolating between 0.75% and 1.6% gives a required tank area of
0.9% of roof area = 1.1 kL tank.

12.4.3 Tank configuration

There are many guidelines on the suitable configuration and installation of a rainwater tank system available from such water authorities as Melbourne Water and Sydney Water. The following are some websites from which these guidelines can be accessed (Table 12.3).

Table 12.3 Guidelines on the suitable configuration and installation of a rainwater tank system

Source	Web address
Gold Coast City Council	http://www.goldcoast.qld.gov.au/attachment/goldcoastwater/GuidelinesTankInstall.pdf
Lower Hunter & Central Coast Regional Environmental Management Strategy	http://www.lhccrems.nsw.gov.au/pdf_xls_zip/pdf_wsud/4_Rainwatertanks.pdf
Sydney Water	http://www.sydneywater.com.au/everydropcounts/garden/rainwater_tanks_installation.cfm
Your Home Consumers Guide (A joint initiative of the Australian government and the design and construction industries)	http://www.greenhouse.gov.au/yourhome/technical/fs22_2.htm

Inlet filter

Some form of filter is strongly recommended on all flows being directed to a rainwater tank. This filter will provide a primary treatment role in regard to removing leaf litter and some sediment that would otherwise enter the tank, and possibly contribute to water quality degradation. Such a filter can also serve to isolate the tank from access by vermin and mosquitos.

First flush diverter

Diversion of the 'first flush' from a roof is also a recommended practice, as this can minimise the ingress to the tank of fine particulates, bird/animal faeces and other potential contaminants. Current research does not enable the specification of a definitive First Flush, with values between 0.25 and 1.0 mm of runoff typically being quoted.

Proprietary devices are available that often provide a joint 'filter/first flush' diversion role.

Maintenance drain

Periodic removal of sludge and organic sediments that accumulate in the base of a rainwater tank may be necessary if buildup is excessive, and as such a suitable outlet should be provided. This sludge layer, and **biofilms** that develop on the walls of a tank, may be important in the natural purification processes occurring in the tank; therefore, removing a sludge layer should only occur when buildup impedes the tank operation.

Mains top-up

Most rainwater tanks will require an automatic top-up system to ensure uninterrupted supply to the household. This top-up should occur as a slow 'trickle' such that there are benefits in regard to reducing peak flow rates in the mains supply system (which, if properly planned, can enable smaller mains infrastructure to be installed in a 'greenfields' situation).

The volume/rate of top-up should be such that there is always at least one day's supply contained within the tank. Top-up should also occur when tank levels are drawn down to a depth of 0.3 m, or one day's capacity, whichever is the greater, to both guarantee supply and to minimise sludge/sediment resuspension.

A final consideration with any top-up system is that there is a requirement for an 'air gap' between the entry point of the top-up supply and the full supply level in the tank in order to ensure there is no potential for backflow of water from the tank into the potable supply system. A suitable air gap is about 100 mm.

Overflow

Rainwater tank overflows should be directed to the stormwater collection system. Given the clean nature of such overflows, smaller diameter pipe systems may be acceptable. In areas with suitable soils and slopes, discharge to a lot-scale infiltration trench may also be possible (see Procedure 8, Chapter 11, for more detail in this regard).

Overflows should also be located below the mains top-up supply point in order to prevent the potential for backflow.

Pump

The supply to the household from the rainwater tank can occur via a pressure pump system, or alternatively a solar panel, pump or header tank system may be implemented, if low heads are acceptable. Careful selection of a suitable pump system is recommended to minimise operational costs and noise issues.

On-site detention

In some situations, rainwater tanks can be configured with an active 'detention' zone located above the 'capture and reuse' zone. This system reduces the effective yield from a tank, but may deliver greater downstream stormwater conveyance benefits through the delivery of lower peak flows for low to moderate ARI events. In such applications, ensure that the potable supply top-up is located above the 'detention' zone, not just above the 'capture and reuse' zone.

12.4.4 Maintenance provision

Rainwater tanks are low maintenance, not 'no maintenance' systems. Good maintenance practice is necessary and should include the following.

- Routine inspection (every six months) of roof areas to ensure that they are kept relatively free of debris and leaves. Roof gutters should be inspected regularly and cleaned if necessary. There are special gutter designs available for limiting the amount of debris and litter that can accumulate in the gutter to be subsequently transported to the rainwater tank. These special gutters cost about twice normal guttering but require little maintenance.
- Pruning of surrounding vegetation and overhanging trees which may otherwise increase the deposition of debris on the roof.
- Cleaning of first flush devices once every three to six months, or as required.
- Regular inspection of all screens at inlet and overflow points from the tank to check for fouling, say, every six months.
- Tank examination for the accumulation of sludge at least every two to three years. If sludge is covering the base of the tank and affecting its operation (i.e. periodically resuspending, or reducing, storage capacity), it should be removed by siphon, flushed from the tank or by completely emptying of the tank. Professional tank cleaners can be used.
- Covering of the rainwater tank..

Any pumping system should be maintained in accordance with the manufacturer's specifications.

12.5 Worked example

Refer to the example in Section 12.4.2 for a worked example.

12.6 Inspection and maintenance schedule

The following inspection schedule is recommended for a rainwater tank system and maintenance of the pump:

- roof/gutters – six monthly, possible more frequently for gutters if required
- first flush device – three to six monthly, cleaning if required

- inlet/overflow screens – six monthly
- sludge accumulation – every two to three years, and desludge if required
- pump system – as required/specified by pump manufacturer.

12.7 References

Coombes, P.J. (2002). 'Rainwater tanks revisited: new opportunities for urban water cycle management', PhD thesis, University of Newcastle, Callaghan, NSW.

Coombes, P.J. and Kuczera, G. (2003). 'Analysis of the performance of rainwater tanks in Australian capital cities', 28th International Hydrology and Water Resources Symposium, Engineers Australia, Wollongong, New South Wales.

Cooperative Research Centre for Catchment Hydrology (CRCCH) (2003). *Model for Urban Stormwater Improvement Conceptualisation (MUSIC) User Guide*, Version 2.0, CRCCH, Monash University, Victoria.

Donovan, I. (2003). *Water Sensitive Planning Guide for the Sydney Region*, Upper Parramatta River Catchment Trust.

Engineers Australia (2003). *Australian Runoff Quality Guidelines*, Draft, June.

Melbourne Water (2001). *Water Resource Strategy*, Melbourne Water, Melbourne.

Standards Australia (1998). AS/NZS 3500.1.2: National plumbing and drainage – Part 1.2: Water Supply – Acceptable solutions, Standards Australia, Sydney.

Standards Australia (2003). AS/NZS 3500.3: Plumbing and Drainage – Stormwater drainage, Standards Australia, Sydney.