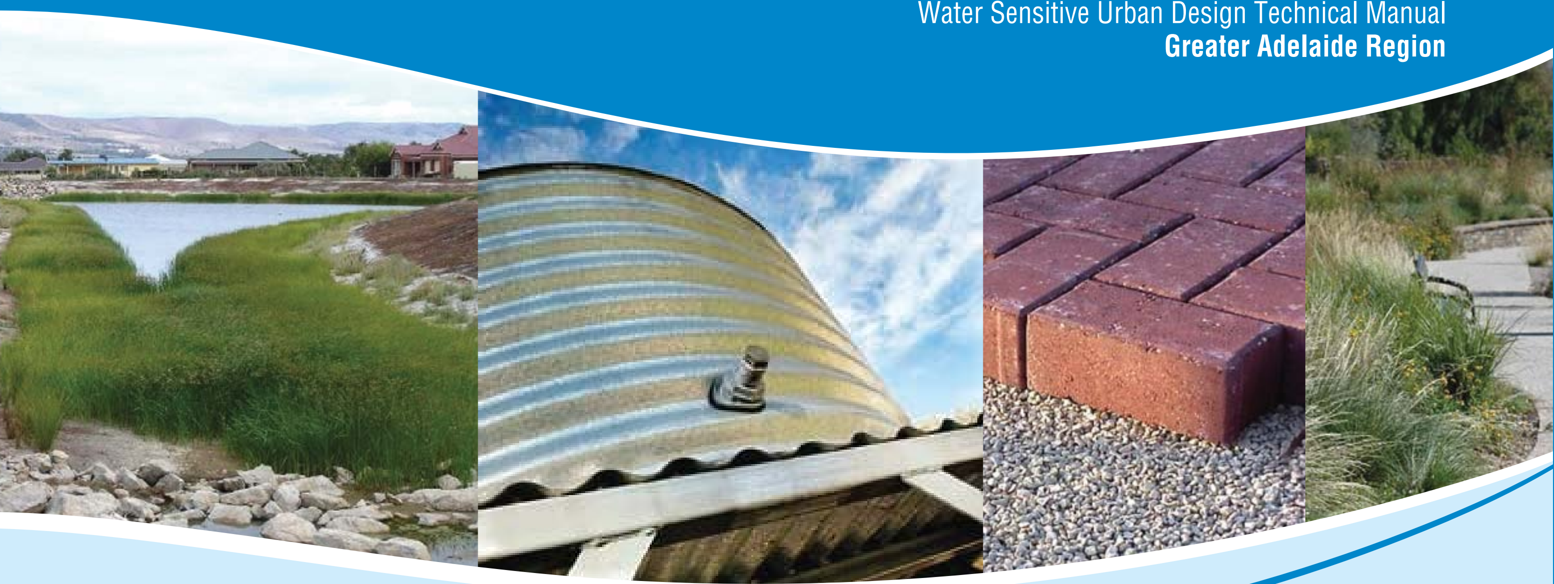
December 2010

Chapter 5

Rainwater Tanks

Water Sensitive Urban Design Technical Manual
Greater Adelaide Region



Government of South Australia

Australian Government
Department of the Environment, Water, Heritage and the Arts

Securing tomorrow's water today.

Department of Planning and Local Government
Roma Mitchell House, 136 North Terrace, Adelaide SA 5000
GPO Box 1815, Adelaide SA 5001
phone: (08) 8303 0600

The Water Sensitive Urban Design documents can be downloaded from the following website:
www.planning.sa.gov.au/go/wsud

ISBN 978-1-876702-99-1

Preferred way to cite this publication

Department of Planning and Local Government, 2010, *Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region,* Government of South Australia, Adelaide

Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is an approach to urban planning and design that integrates the management of the total water cycle into the urban development process. It includes:

- Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values;
- Storage, treatment and beneficial use of runoff;
- Treatment and reuse of wastewater;
- Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity; and
- Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non drinking water supplies.

Therefore, WSUD incorporates all water resources, including surface water, groundwater, urban and roof runoff and wastewater.

Acknowledgments

Funding for preparation of the Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region was provided by the Australian Government and the South Australian Government with support from the Local Government Association (SA).

The project partners gratefully acknowledge all persons and organisations that provided comments, suggestions and photographic material.

In particular, it is acknowledged that material was sourced and adapted from existing documents locally and interstate.

Overall Project Management

Christine Lloyd (Department of Planning and Local Government)

Steering Committee

A group of local government, industry and agency representatives provided input and feedback during preparation of the Technical Manual. This group included representatives from:

- Adelaide and Mt Lofty Ranges Natural Resources Management Board;
- Australian Water Association (AWA);
- Department for Transport, Energy and Infrastructure (DTEI);
- Department of Water, Land and Biodiversity Conservation (DWLBC);
- Environment Protection Authority (EPA);
- Housing Industry Association (HIA);
- Local Government Association (LGA);
- Department of Planning and Local Government (DPLG);
- South Australian Murray-Darling Basin Natural Resources Management Board;
- South Australian Water Corporation;
- Stormwater Industry Association (SIA); and
- Urban Development Institute of Australia (UDIA).

Technical Sub Committee

A technical sub committee, chaired by Dr David Kemp (DTEI), reviewed the technical and scientific aspects of the Technical Manual during development. This group included representatives from:

- Adelaide and Mt Lofty Ranges Natural Resources Management Board;
- City of Salisbury;
- Department for Transport, Energy and Infrastructure (DTEI);
- Department of Health;
- Department of Water, Land and Biodiversity Conservation;
- Department of Planning and Local Government; and
- Urban Development Institute of Australia.

From July 2010, DWLBC was disbanded and its responsibilities allocated to the newly created Department For Water (DFW) and the Department of Environment and Natural Resources (DENR).

Specialist consultant team

Dr Kylie Hyde (Australian Water Environments) was the project manager for a consultant team engaged for its specialist expertise and experience in water resources management, to prepare the Technical Manual.

This team comprised Australian Water Environments, the University of South Australia, Wayne Phillips and Associates and QED Pty Ltd.

Beecham and Associates prepared Chapter 16 of the Technical Manual.

Contents

Tables

Figures

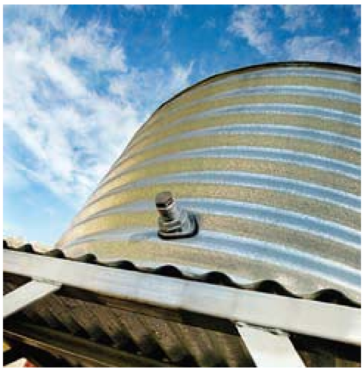
Appendices

Chapter 5
Rainwater Tanks

5.1 Overview

As detailed in **Chapter 1**, there are many different WSUD measures which together form a 'tool kit' from which individual measures can be selected as part of a specific design response suiting the characteristics of any development (or redevelopment). Rainwater tanks are one of those measures.

This chapter of the Technical Manual for the Greater Adelaide Region is aimed at providing an overview of rainwater tanks and how they can be utilised to assist in achieving the objectives and targets of WSUD.



Description

A rainwater tank is designed to capture and store rainwater from gutters or downpipes on a building.

A rainwater tank does not collect water other than rainwater or mains water. Captured water is then available for commercial, industrial or domestic uses.

Purpose

The main function of rainwater tanks is water conservation.

Rainwater can be used to irrigate gardens or used to supply interior demands, such as toilet flushing or laundry use. Meeting interior demands ensures that stored rainwater is utilised at a relatively constant rate, allowing rainwater to refill the storage more often. Using rainwater for various uses (such as toilet flushing and garden watering), each with different usage patterns, can result in optimum mains water savings and large reductions in runoff discharges.

Rainwater tanks provide limited water quality control, primarily through sedimentation processes. This can be enhanced by elevating the outlet tap to a height equal to or greater than 100 millimetres above the tank floor.

Both Beecham (2003) and Coombes et al (2001) have studied the capacity of rainwater tanks to contribute to flood control. It can be assumed that approximately one third of the tank volume can provide flood control.

Scale and Application

Rainwater tanks are generally applied at the lot level, but can be applied at the street level in larger development projects.

It should be noted that it is currently a mandatory building requirement for new Class 1 buildings to have an alternative mains water supply which is often met through installation of a rainwater tank plumbed into the dwelling (see **Section 5.2**).

5.2 Legislative Requirements and Approvals

Before undertaking a concept design of a rainwater tank system it is important to check whether there are any planning regulations, building regulations or local health requirements that apply to rainwater tanks in your area.

The legislation which is most applicable to the design and installation of rainwater tanks includes:

- *Development Act 1993* and Development Regulations 2008
- *Waterworks Act 1932* and Waterworks Regulations 1996
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993*; and
- *Public and Environmental Health Act 1987*

In addition, there are a number of standards which apply to the construction and installation of rainwater tanks which are also summarised below.

Development Act 1993 and the Building Code

Since 1 July 2006 new houses and house extensions greater than 50 square metres are required to have an additional water supply to supplement mains water. The additional water supply must be plumbed to a toilet, to a water heater or to all cold water outlets in the laundry. This requirement generally applies to new Class 1 buildings which are defined by the Building Code of Australia (BCA2006 – Volume 2). Note that all sources of water identified in the development approval (mains, rainwater tank, third pipe scheme) must be connected before the house is occupied.

Installing a rainwater tank plumbed for internal use is the most common way of achieving this requirement. Other means of providing the required additional water supply could include developments using a dual reticulated (fixed pipe) water supply system – such as Mawson Lakes – or approved bore water.

The State Government's policy is implemented through the existing development approval system in accordance with the *Development Act 1993* and Development Regulations 2008, and is contained in a South Australian variation to the BCA (SA2 to Volume 2). The plumbing aspects of the policy are regulated by the South Australian Water Corporation (SA Water) in accordance with the *Waterworks Act 1932* and Waterworks Regulations 1996.

If a rainwater tank is used to meet the requirement for additional water supply, it must have a storage capacity not less than 1 kilolitre (1000 litres). The requirement for a minimum 1 kilolitre plumbed rainwater tank is additional to any other water storage tank requirements that might be required (e.g. other tanks are required in some areas for bushfire fighting purposes).

Where a number of dwellings contribute to a communal rainwater storage tank, each dwelling must contribute rainwater from 50 square metres of its roof catchment area to the rainwater tank and water from the tank must be plumbed back to each individual dwelling. In these situations, the minimum rainwater tank size required is determined by multiplying the number of dwellings that contribute to the rainwater tank by 1 kilolitre for each dwelling.

In addition:

- An overflow device must be fitted; and
- A mosquito proof, non-degradable screen must be attached to protect the water quality.

For more information on these requirements go to **www.planning.sa.gov.au/go/rainwater-tanks**

Installation of rainwater tanks is covered under the South Australian Development Regulations 2008 Schedule 3 (acts and activities which are not development). A rainwater tank does not require development approval provided it satisfies the following criteria:

- Is part of a roof drainage system;
- Has a total floor area not exceeding 10 square metres; and
- Has no part higher than four metres above the natural surface of the ground.

Installing a rainwater tank will generally be part of a larger development (for new developments), however whenever a rainwater tank is planned (such as retrofitting), it is advised that the local council be contacted to:

- Determine whether development approval is required under the Development Act 1993; and
- Determine what restrictions (if any) there may be on the installation of rainwater tanks on the site. Factors such as height and boundary setback requirements need to be checked.

Waterworks Act 1932

The *Waterworks Act 1932* authorises the responsible Minister and SA Water to supply water to urban and regional communities and to provide safe drainage of wastewater, rating and pricing arrangements, and the construction of necessary infrastructure.

SA Water should be consulted regarding the conditions which need to be met to allow the transition between rainwater and mains water supply should the proposed rainwater harvesting system involve connection to mains supply.

Specific issues addressed by SA Water include the need for installation by a licensed plumber, signage, certification of the materials used, certificates of compliance upon installation and the need for an automated switching device. See **Section 5.9** for where to obtain more information on plumbing requirements.

Natural Resources Management Act 2004

Water resources in South Australia are primarily managed under the *Natural Resources Management Act 2004*. Where increased development causes stress on water resources and a higher level of management is warranted, the associated water resources can be prescribed under the *Natural Resources Management Act 2004*.

Any rain that falls on a roof is considered to be surface water. A water licence is required to 'take' surface water in an area where surface water is prescribed, such as the Western Mt Lofty Ranges. A licence is not required for:

- Stock and domestic purposes;
- Fire fighting;
- Chemical use on non-irrigated crops, non-irrigated pasture and for the control of pest plants and animals;
- Road making; and
- Specific exemptions (see below).

Roof runoff that is not 'taken' (collected and used) returns to the environment and does not require licensing.

Commercial, industrial, environmental and recreational users are currently exempt from requiring a water licence to take roof runoff where the volume of water collected from the connected roof area is equal to or less than 500 kilolitres per year.

Environment Protection Act 1993

Any development, including the installation of a rainwater tank, has the potential for environmental impact, which can result from vegetation removal, stormwater management, and construction processes. There is a general environmental duty, as required by Section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities on a site, including during construction, do not pollute the environment in a way which causes or may cause environmental harm.

Aspects of the *Environment Protection Act 1993* which must be considered when planning the installation of a rainwater tank are discussed below.

Water Quality

Water quality in South Australia is protected using the *Environment Protection Act 1993* and the associated Environment Protection (Water Quality) Policy 2003. The principal aim of the Water Quality Policy is to achieve the sustainable management of waters by protecting or enhancing water quality while allowing economic and social development. In particular, the policy seeks to:

- Ensure that pollution from both diffuse and point sources does not reduce water quality; and
- Promote best practice environmental management.

Through inappropriate management practices, building sites can be major contributors of sediment, suspended solids, concrete wash, building materials and wastes to the stormwater system. Consequently, all precautions will need to be taken on a site to minimise potential for environmental impact during construction. Guidance can be found in the *EPA Handbook for Pollution Avoidance on Building Sites* (see **Section 5.9**).

Measures also need to be taken to ensure that erosion and subsequent water quality impacts do not result after the installation of a rainwater tank by ensuring that overflow from the tank is directed to a location which is protected from erosion.

Waste

Any wastes arising from any excavation and construction work on a site should be stored, handled and disposed of in accordance with the requirements of the *Environment Protection Act 1993*. For example, during construction all wastes must be contained in a covered waste bin (where possible) or alternatively removed from the site on a daily basis for appropriate off-site disposal. Guidance can be found in the *EPA Handbook for Pollution Avoidance on Building Sites* (see **Section 5.9**).

Public and Environmental Health Act 1987

The Department of Health (Environmental Health Branch) is responsible for the implementation of the *Public and Environmental Health Act 1987* in South Australia. This agency provides the required information and assistance in establishing a rainwater harvesting and reuse system with regards to health issues.

Standards

Australian Standards for tank manufacturers ensure that modern tanks have child-safe access and full protection against mosquito and other animal invasion.

Rainwater tanks may need to be installed in accordance with the standards summarised in Table 5.1, depending on the type of tank.

Table 5.1 Standards Relating to Rainwater Tanks

Standard	Title	Purpose
AS/NZS 3500 2003	Plumbing and Drainage Standards and the South Australian Variations	
AS/NZ 3500.1.2	Water Supply – Acceptable Solutions	Provides guidance for the design of rainwater tanks with dual water supply (rainwater and mains water)
AS/NZS4020	Testing of Products for Use in Contact with Drinking Water	Any materials in contact with water to be used for drinking must comply with this standard A concrete or soldered galvanized tank should be lined with an approved tank liner/coating if the water is for drinking
AS2179	Rain Water Storage Tanks – Metal (Rain Water) Specifications	If a metal rain water tank is to be used, it shall comply with this Australian Standard
AS/ NZ 1170	Loads on Rainwater Tanks	
AS/NZ 4766 (Int)	Polyethylene Storage Tanks for Water and Chemicals	Polyethylene rainwater tanks shall comply with this standard

5.3 Design Considerations

Some of the design issues that should be considered when conceptualising and designing a rainwater tank harvesting system include:

- Water quality;
- Roof materials;
- Tank materials;
- System configuration; and
- Embodied energy and greenhouse gas impact.

The following sections provide an overview of these key design issues.

Water Quality

The design of a rainwater harvesting system is dependent on the intended use of the rainwater. Water quality is an important consideration for all rainwater systems, especially in urban areas. Rainwater poses little health risk for non-drinking uses such as garden watering, toilet flushing, hot water supply and washing machines. Additional treatment is generally required when rainwater is to be used as a drinking water supply (see references to further information in **Section 5.9**).

The 'roof-to-gutter-to-rainwater-tank-to-use' pathway is a treatment train. The quality of rainfall runoff from roofs is generally lower than the quality of rainfall. Soil, leaves and debris can accumulate on roof surfaces during dry periods and wash off the roof during storm events. Also, the ambient quality of rainfall is influenced by the geographic location of the rainfall event. For example, if the rainwater harvesting site is in an area of heavy air and dust pollution, the rainwater may not be suitable for potable uses, and advice should be sought.

The quality of runoff therefore depends on roofing materials (see below), the types of material deposited on the roof and the roof maintenance regime.

Acceptable water quality for potable use can be maintained in rainwater tanks provided that (Parsons Brinkerhoff 2006):

- Mesh screens are installed over all inlets and outlets to prevent leaves, debris, vermin and mosquitoes from entering the tank;

- A first flush device is installed to discard the first portion of rainfall;
- Gutters and roofs are regularly cleared of leaves, debris and branches; and
- Water ponding in gutters is prevented as it can provide breeding sites for mosquitoes and could lead to eggs being washed into tanks.

Additional guidance on cleaning, testing and disinfection can be found in documents listed in **Section 5.9**.

Roof Materials

Roofs constructed from galvanised iron, Colourbond® or Zincalume®, slate or ceramic tiles provide acceptable water quality for potable use (Department of Health South Australia 2006; Parsons Brinkerhoff 2006).

However, the following should be taken into account when considering installation of a rainwater tank (Department of Health South Australia 2006):

- Rainwater should not be collected from roofs coated with lead or bitumen-based paints;
- Some types of new tiles and freshly applied acrylic paints may affect the colour or taste of rainwater, therefore the first few runoffs may need to be discarded;
- Chemically treated timbers and lead flashing should not be used in roof catchments;
- Rainwater should not be collected from parts of roofs incorporating flues from wood burners, if possible;
- Copper roofing or guttering materials should not be used upstream of aluminium or galvanised or Zincalume® steel products;
- Avoid corrosion caused by dissimilar metals (e.g. do not use stainless steel screws on steel or on aluminium pre-painted roofing materials); and
- Galvanised gutters should not be used in combination with materials such as Zincalume® or Colourbond® steel or terracotta tiles, as this can lead to accelerated corrosion of guttering.

Tank Materials

Rainwater tanks should be made of durable, watertight, non-reflective, opaque materials with a clean, smooth interior such as Colourbond®, galvanised iron, polymer or concrete. There are also a range of innovative products available which do not use the conventional tank design (see **Sections 5.4** and **5.9**).

Sunlight should not penetrate the rainwater tank to prevent the growth of algae.

System Configuration

Possible system configurations for the use of rainwater with mains supply back up include:

- Pressurised rainwater supply with mains supply back up (Figure 5.1);
- Gravity rainwater supply with mains supply top up to tank (Figure 5.2); or
- Pressurised rainwater supply with mains supply back up from a buried or partially buried tank (Figure 5.3).

Examples of each of these possible configurations are illustrated in the figures below.

For a new development, factors to consider include:

- Roof and gutters being designed so that runoff from the whole roof is collected in a single tank or in a series of tanks. In multi storey buildings this can be most effectively achieved through the use of symphonic drainage systems;
- Integrating the tank itself into the design of the building so that it is convenient, reduces the space required and is aesthetically pleasing (e.g. tanks can be buried); and
- Locating the tank close to the mains water inlet (for mains connected systems) or close to the point of use (for gravity fed systems).

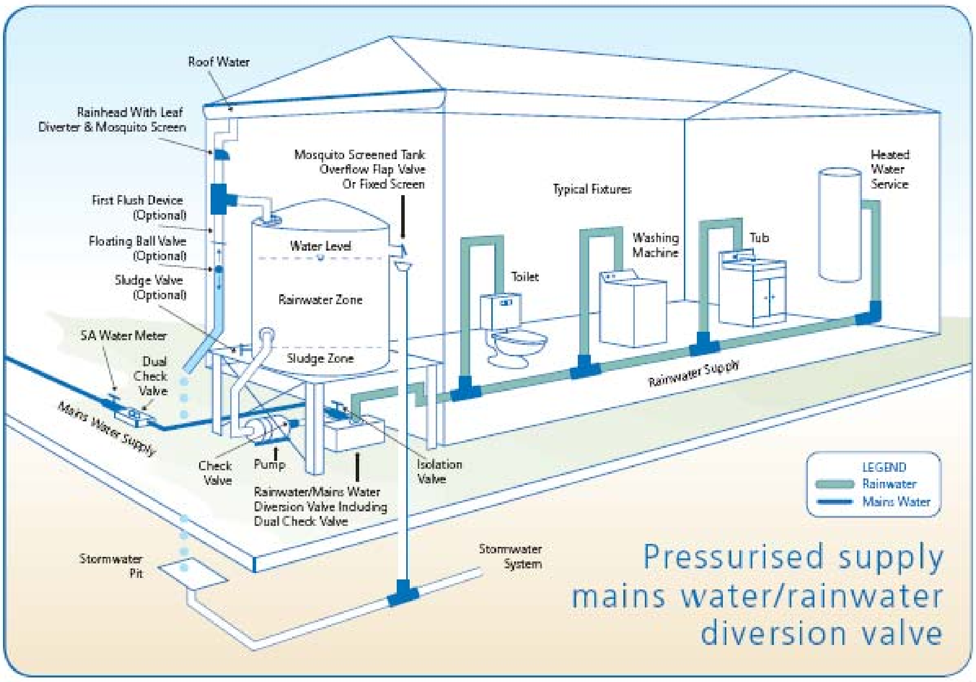


Figure 5.1 Pressurised Rainwater Supply with Mains Supply Back Up

Source: SA Water (2006)

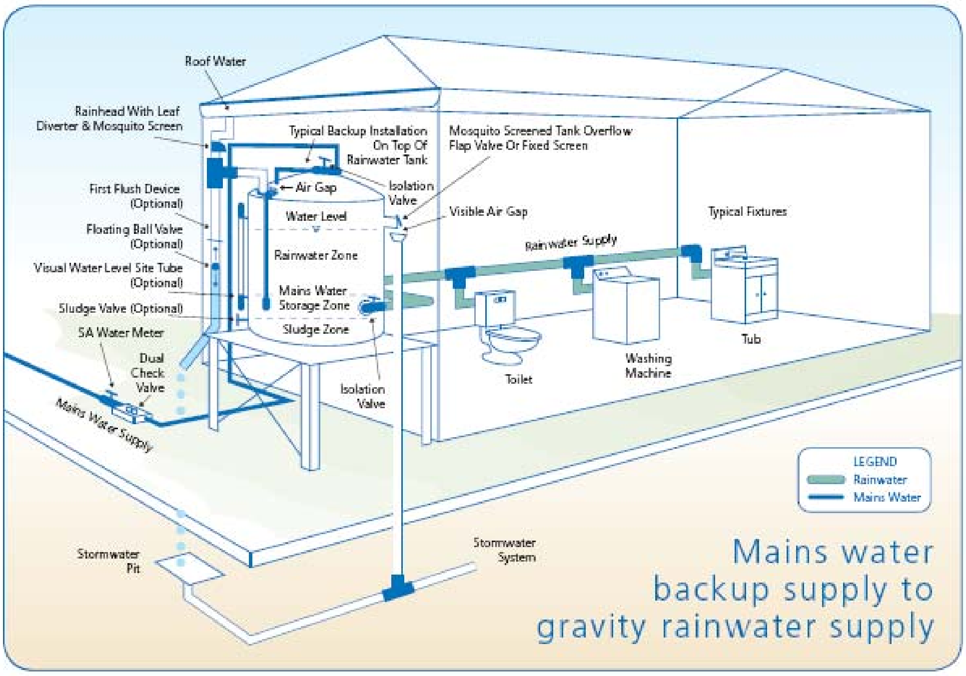


Figure 5.2 Gravity Rainwater Supply with Mains Supply Top Up to Tank

Source: SA Water (2006)

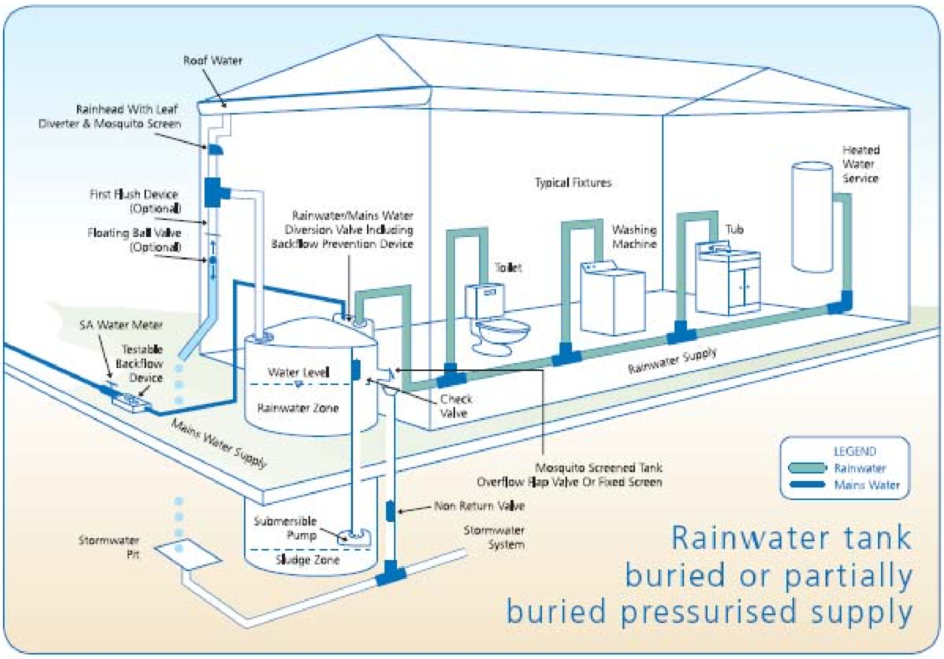


Figure 5.3 Pressurised Rainwater Supply with Mains Supply Back Up From a Buried or Partially Buried Tank

Source: SA Water (2006)

Embodied Energy and Greenhouse Gas Impact

The energy and materials impact of rainwater tank manufacture and operation are substantially higher, in percentage terms, than the energy equivalent for reticulated water supply, especially when a pump is used with the tank. However, the absolute impact of rainwater tanks is not large in proportion to other impacts. In terms of greenhouse gas emissions, the overall additional impact of a rainwater tank and pump is equivalent to 50 to 100 kilometres per year of car travel (ACT Planning and Land Authority 2007).

Water use is generally considered the most significant environmental indicator with respect to rainwater tanks. In respect to greenhouse gas emissions, steel tanks have the lowest impact, followed by concrete, with plastic tanks having the highest impact (ACT Planning and Land Authority 2007).

5.4 Design Process

Overview

The following key steps should be undertaken when considering the installation of a rainwater harvesting system:

- Assess site suitability;
- Identify objectives and targets;
- Meet with local council and other relevant authorities;
- Select a type of rainwater tank;
- Size the rainwater tank;
- Additional elements;
- Undertake approvals process (if required);
- Check the objectives; and
- Prepare a maintenance plan.

Several of the elements of the design process are discussed briefly below.

The WSUD design process is also discussed in general in **Chapter 3** of the Technical Manual.

Assess Site Suitability

WSUD responds to site conditions and land capability and cannot be applied in a standard way. Careful assessment and interpretation of site conditions is a fundamental part of designing a development that effectively incorporates WSUD.

Careful selection of where to place a rainwater tank is important – and is not only a matter of appearance.

The following factors should be considered when undertaking a site suitability assessment:

- The tank should be located in a cool place (to keep the temperature of the water low, reduce evaporation and reduce damage to the tank material);
- No tank should be fixed to the wall of a building unless certified by a practising structural engineer;
- All tanks should be placed on a structurally adequate base in accordance with the manufacturer's or engineer's details;
- Pumps must be located and operated so as not to cause offensive noise;

- Any overhanging foliage needs to be removed to decrease leaf litter, bird and possum droppings and other animal contamination;
- Location of existing downpipes;
- Location of mains water supply;
- Location of any easements and boundaries; and
- Space available.

Identify Objectives and Targets

Before the commencement of the design process, the objectives and targets for the rainwater harvesting system must be established.

An appropriate objective for rainwater harvesting on a site is to provide a 'reliable' supply of suitable quality water to meet the demand requirements of a stipulated preferred 'end use' (for example, toilet flushing, laundry use, and/or garden watering).

If the objectives for selecting a rainwater tank size are clearly defined, the task is simplified.

More general information on setting objectives and targets can be found in **Chapter 3** of the Technical Manual.

Meeting with Council or Other Relevant Authority

Before designing or installing a rainwater tank system, it is important to check whether there are any planning regulations, building regulations or local health requirements that apply to rainwater tanks in your area. A discussion with a development assessment officer at your local council is recommended.

The council will also be able to advise whether:

- Development approval is required and, if so, what information should be provided with the development application;
- Any other approving authorities should be consulted; and
- Any specific council requirements need to be taken into consideration

Further information can be obtained in **Section 5.2**.

Selecting a Type of Rainwater Tank

There are many options available for rainwater tanks. The summary tables here outline the features of various above and below ground tanks.

Table 5.2 Metal Tanks

Type	Features	Considerations
Corrugated iron	The classic outback tank. Readily available and relatively easily transported. Galvanised steel performance can be improved with rust-resistant coatings such as Zincalume or Aquaplate. Easy to install, service and maintain.	Initial corrosion of galvanised steel normally creates a thin adherent film that coats the interior surface of the tank and provides protection against further corrosion. Cleaning should not disturb this film. Avoid copper or copper alloy fittings (brass and bronze) connected directly to steel tanks as this causes corrosion.
Aquaplate Colorbond	Aquaplate steel has a polymer skin bonded to a corrosion-resistant galvanised steel base. Colours can match roofs and fences. Easy to install, service and maintain.	The polymer coating is not resistant to prolonged exposure to sunlight so tanks must have a top cover in place at all times. Avoid copper or copper alloy fittings (brass and bronze) connected directly to steel tanks as this causes corrosion.
Stainless steel	High resistance to corrosion, staining and bacteria. Available as a garden design feature and in a range of shapes and sizes. Easy to install, service and maintain.	

Source: Australian Rainwater Industry Development Group (2007)

Figure 5.4 Example of a Metal Tank

Table 5.3 Concrete Tanks

Type	Features	Considerations
Above ground	Good for larger capacity tanks. Not usually used in urban settings. Lime from cement softens the water. Easy to install, service and maintain.	Heavy, so needs strong foundations. Tanks can be poured on site. Needs sealing for maximum water retention.
In ground	Inconspicuous large tanks. Lime from cement softens water. Sealed with latex or other lining.	Can be placed in traffic areas as they can be designed as load bearing structures.

Source: Australian Rainwater Industry Development Group (2007)

Figure 5.5 Example of a Concrete Tank

Table 5.4 Plastic Tanks

Type	Features	Considerations
Above ground	Light weight and easily transported – good for smaller tanks. Flexibility in shapes and colours. Easy to install, service and maintain.	Despite having UV inhibitors, best placed in shade.
In ground	Good choice of materials and clever design maximises strength, minimises depth and increases practicality. Anti-hydrostatic lift measures, such as good design features, anchoring or ballast will be needed as pressure from high groundwater can force it out of the ground. Also need to protect tank water from overflow surges running back into tank.	Load bearing can be limited. Need to be integrated into system which can include driveways etc.

Source: Australian Rainwater Industry Development Group (2007)

Figure 5.6 Example of a Plastic Tank

Table 5.5 Innovative Tanks

Type	Features	Considerations
Water walls	Generally plastic or metal, good for limited ground space.	Can be difficult to clean and maintain in protected areas when in exposed sites.
Bladders	Innovative under-deck or under-house bladder made from tough materials. Can collect from a number of drainpipes unobtrusively and utilise previously wasted space.	Ongoing maintenance and access needs to be considered.
In slab	Used like a waffle pod. A waffle pod is where the concrete slab is sitting on and around a series of boxes (or pods) set out in a grid pattern. Each in slab is approximately 600 litres.	Used in new homes or extensions; cannot be retrofitted. Ongoing maintenance and access needs to be considered.
Fibreglass	A food-grade coating on the interior surface is cured before the tanks are offered for sale. Lightweight and strong. Flexibility in shapes and colours. Relatively salt resistant so good in coastal locations. Relatively easy to repair.	Despite having UV inhibitors, better to be placed in shade.

Source: Australian Rainwater Industry Development Group (2007)

Figure 5.7 Example of a Bladder Tank

Sizing a Rainwater Tank

Variables that need to be considered in selecting the best size for a rainwater tank include:

- The size or area of roof directed to the tank;
- The purpose the tank will serve in reaching the desired targets and fulfilling the objectives;
- The quantity and nature of demand;
- Rainfall pattern of a particular area;
- Available space; and
- Budgetary constraints.

(Note: In an urban environment where the reticulated supply is always present as a back up, all collected water use is beneficial, so any size tank is preferable to none.)

Tanks come in a wide range of shapes and sizes. The typical size of rainwater tanks installed on residential properties within urban areas (that are connected to mains water) is between 1 kilolitre (1000 litres) and 10 kilolitres (10,000 litres).

Large store volumes can be made up of a number of smaller tanks.

The various factors regarding sizing a rainwater tank are discussed below.

Roof Area

The size of the roof that is drained to a rainwater tank is a key factor that governs the amount of water that can be harvested and reused.

If determining the roof size by measuring the outside of the building, allow for eaves overhang. Include garages, sheds, carports and verandahs only if runoff from them will go to the tank. More than one tank may be required to collect water from different areas of the roof. The slope (pitch) of the roof is unimportant, it is the flat or plan area that matters.

For proposed buildings, this area can be calculated from architectural plans.

Rainfall

Rainfall varies depending on where you are located. Factors which are important to consider include:

- The average annual rainfall;
- The pattern of distribution throughout the year; and
- The variation from year to year.

The mean annual rainfall varies from more than 1100 millimetres in the Adelaide Hills to around 400 millimetres near the sea. A rainfall distribution map can be used to determine the appropriate weather station for your location. Rainfall data is available from the Bureau of Meteorology (www.bom.gov.au). Some rainfall data is provided in **Figure A1** in **Appendix A**.

It should be noted that the majority of the Adelaide Plains receives 450–600 millimetres/annum of rainfall.

Maximum Volume

The maximum volume of water that you can obtain from a roof each year, on average is:

Water volume (kL) = average annual rainfall (mm) x coefficient of runoff x roof area (m^2)

A coefficient of runoff of 0.9 can be used to obtain a rough estimate (Department for Environment and Heritage 1999).

This formula does not allow for water that may be lost because the tank is already full, or the runoff is more than the tank can hold in a heavy storm.

Intended Use / Demand

How the collected rainwater is to be used is a fundamental question in the design of a rainwater harvesting system.

The demand varies enormously depending on the type of usage (e.g. domestic, commercial and industrial) and will vary from season to season depending on:

- Number of people;
- Water use habits;
- Uses to which the rainwater can be put; and
- Type of water using appliances (if any).

The use of stored rainwater for toilet flushing, laundry and lawn/garden watering will reduce water levels in the rainwater tank and create available airspace to capture further water during the next storm. Increasing the demands on a rainwater tank by attaching more internal and external uses saves more mains water.

To determine how rainwater harvesting may be used and what form it may take (i.e. what end uses will be connected to the tank, type of distribution system) an audit of the water usage at the site in question should be conducted. There are tools and services available to assist developers, existing businesses, industry, schools and householders to complete this process (see **Section 5.9**).

Average water use figures and previous water bills and usage information can be used to inform the auditing process (see **Chapter 4**).

Design tools that can be utilised to assist with sizing a rainwater tank are discussed in **Section 5.5**.

Additional Elements – Features and Fittings

The following system features and fittings should be considered when designing a rainwater collection system. Some features are not relevant for all design purposes:

- The tank is to be provided with suitable backflow prevention to the mains supply in accordance with Australian Standard AS3500.1.2 and the requirements of the relevant water authority (i.e. SA Water);
- Tanks are to be fully enclosed to prevent mosquitoes breeding and access by insects, animals and birds;
- Gravity tanks should be constructed with sufficient head to achieve required flows;
- Gutter mesh should be installed;
- A suitable trap or filter needs to be installed prior to the tank inlet to prevent contaminants entering the tank;
- A storage system should have an inlet above the top water level, a visible air gap complying with plumbing regulations, a means to scour and clean out accumulated sediment and an outlet positioned above the maximum level of sediment; and
- Overflow outlet.

Specific features of various rainwater tank systems are discussed in further detail below.

Pump

When selecting a rainwater pump, there are three aspects to consider – application, reliability and noise. The intended application(s) will determine the flow rate and water pressure that is required which will then allow the pump capacity to be determined.

To calculate the performance that is needed, work backwards from the number of appliances that will be run at the same time, add them up and calculate the required flow rate. The relevant pressure required is determined by the pipe size used, the length of pipe and the operating pressure of the appliance.

Pumps come in a range of models and with varied power, which is indicated by litres per minute (LPM) of water they can move.

The pressure requirements for the different demands to be serviced by the rainwater harvesting system need to be considered. Table 5.6 provides some indication of the flow rate pressure required for a range of demands. In a pressurised system a pump will be required.

Table 5.6 Indicative Flow Rate and Pressure Requirements for a Range of Demands

Application	Flow Rate Recommended	Water Pressure Recommended
Lawn sprinkler / garden hose	15 litres/minute	140 kPa (20 Psi)
Garden irrigation	60 litres/minute	400 kPa (55 Psi)
Internal use	15 litres/minute at last fixture	Min 50 kPa at last fixture
Washing machine	15 litres/minute	Min 100 kPa
Toilet flushing	10 litres/minute	Min 50 kPa

Source: Australian Rainwater Industry Development Group (2007)

Pump systems are available from leading suppliers and ensure a reliable water delivery system (see **Section 5.8**).

Unless you want to turn the pump on and off at the power point all the time, you will need some type of automatic pump controller fitted to the pump. Pump controllers automatically start and stop your pump, and selection will depend on a number of factors including:

- Frequency of use;
- Pump protection;
- Energy consumption; and
- Automatic mains back up.

There are four main types of pump controllers currently available:

- Pressure switch – a pressure switch is the simplest auto controller – it will turn the pump on when the system water pressure drops (a tap turned on) and will turn it off when the pressure becomes high (a tap is turned off). A pressure switch system can 'cycle' or switch on and off rapidly if the pipe work or taps leak.
- Constant flow – like a pressure switch, these start the pump on pressure drop, but turn off on low flow. They are usually electronic and may have moving parts in the water.
- Adaptive constant flow – these are the latest generation of constant flow units and as their name implies, they adapt to the conditions the pump system is experiencing.

- Automatic interchange – these provide automatic pump control for rainwater with mains water back up – they are ideal for toilet, laundry and garden irrigation applications in metropolitan areas which need to guarantee water supply to essential services.

The reliability of the rainwater pump can be influenced by several factors including suitability to the application and quality of water.

First Flush Device

All tanks must be fitted with a first flush device, which diverts the first volume of runoff from the roof in a storm event. To improve water quality it is recommended a minimum of 10 litres per 100 square metres of water is diverted/discarded before entering the rainwater tank (Water Services Association of Australia 2005).

Individual site analysis should be undertaken at locations where heavy air pollution is known or suspected to determine if larger volumes of first flush roof water are to be diverted. Similarly at locations subject to prevailing winds from the sea, higher first flush volumes may need to be increased.

The device is to include a primary litter/leaf mesh screen and a first flush containment storage with a small orifice to empty the storage between rain events. The first flush water is to be directed to another WSUD measure (such as an infiltration trench or rain garden) before discharging to the stormwater drainage system.

A first flush diverter can be fitted to each downpipe that supplies water to the tank, or a larger diverter can be installed that can handle multiple downpipes.

5.5 Design Tools

A range of design tools is available for the concept and detailed design of rainwater tanks as detailed in **Chapter 15**. The modelling tools which are able to assist include:

- Rain tank yield curves;
- Raintank Analyser;
- MUSIC;
- WaterCress; and
- Switch-2

A simple spreadsheet analysis can be used to assess rainwater tank performance or existing models such as Raintank Analyser or MUSIC are available to perform additional analysis. Argue, J. (2009) outlines a method for developing an Excel spreadsheet that enables the assessment of the performance of a rainwater tank.

Several of the modelling tools available are discussed briefly below.

Rainwater Tank Yield Curves – Greater Adelaide Region

A series of yield curves for the assessment of different rainwater tank sizes has been developed for the Greater Adelaide Region and is provided in **Appendix A**.

Four sets of curves for domestic and commercial application have been produced, using daily rainfall data from locations that cover the range of annual rainfall variation in the Greater Adelaide Region.

Each curve provides average annual supply for a fixed roof area for a range of specific tank sizes and average daily demands (see **Figure 5.8** as an example).

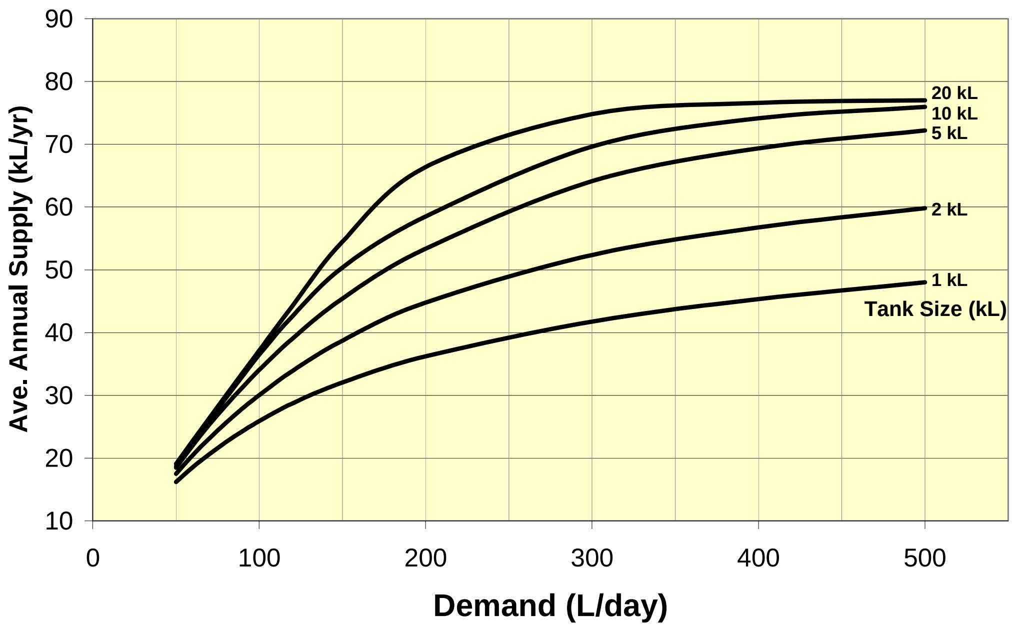


Figure 5.8 Rainwater Tank Yield Curves for a Roof Area of 150 square metres with an Average Annual Rainfall of 500–600 millimetres/year

Detail on how to use the curves and a case study are contained in **Appendix B**.

Rainwater Tank Yield Curves – City of Burnside

Modelling data based on rainfall in the Glen Osmond area has been developed to assist residents in the City of Burnside estimate tank yields with variables including connected roof area (based on 50, 100, 150, 200 square metres of connected roof area), daily consumption and tank size.

The information can be found on the City of Burnside website **www.burnside.sa.gov.au/site/page.cfm?u=958**

Rainwater Tank Yield Curves – South Australian Murray-Darling Basin Natural Resources Management (NRM) Board Region

Four rainwater use options have been modelled based upon the rainfall patterns for the major townships within the SA Murray-Darling Basin NRM region to help households select the appropriate sized rainwater tank for their needs.

The information can be found on the SA Murray-Darling Basin NRM Board's website **www.samdbnrm.sa.gov.au**

Raintank Analyser Software

In many cases, rainwater harvesting and use will be site-specific and a more detailed analysis will enable the performance of rainwater tanks to be determined.

The Raintank Analyser is a detailed spreadsheet that can be used for assessing rainfall harvesting including:

- Yields;
- Cost analysis; and
- Tank size selection.

This software is intended primarily for sizing rainwater tanks for domestic use of water – inhouse as well as outdoors, if required. The analysis considers roof material type, first flush losses, monthly irrigation demands, economic costs and security of supply. The analysis determines a suggested tank size based on an increasing and decreasing benefit approach. Economic assessments are limited to a storage volume of 20,000 litres.

The model can also be applied to commercial/industrial situations provided the 20,000 litres limit is recognised. In these situations where very large catchment roof areas are available, then a solution to the problem of sizing can be found by segmenting the catchment so that each segment requires a rainwater tank that has a capacity not exceeding 20,000 litres.

The analyser allows for the user to insert local rainfall data. A case study is provided in **Appendix B**.

The program is freely available and can be downloaded from **www.unisa.edu.au/water/UWRG/publication/raintankanalyser.asp**

5.6 Installation/Construction Process

When it is to be plumbed into a building, the rainwater tank must be installed by a licensed plumber.

It may be necessary to flush the tank before use; advice should be sought from the manufacturer.

If a non-submersible pump is to be installed, it should be located in a frost free position on a hard, dry and well drained site with good ventilation and protection from the weather. The pump should ideally be as close to the tank as possible.

Noise is increasingly becoming a cause of tension and aggravation between neighbours. Limits on pump noise are governed by the Environment Protection Authority and local government. Guidelines set maximum noise levels at the closest point to neighbouring properties (see **Section 5.2**). Housing the pump inside an acoustic pump cover or box reduces the noise, while a submersible pump will eliminate most noise.

5.7 Maintenance Requirements

Rainwater tanks should be considered a low maintenance system, not a no maintenance system. Maintaining the tank, catchment and distribution system will provide for better water quality. It is important to establish a general maintenance program to ensure the tank, its water quality and accessories will provide years of service.

Simple, pre-scheduled clearing of debris and cleaning will keep the system in good condition. An example Inspection and Maintenance Checklist is provided in **Appendix C**.

For rainwater tanks the following items should be inspected:

- Clogging and blockage of the first flush device;
- Clogging and blockage of the tank inlet leaf/litter screen; and
- Depth of sediment within the tank.

Inspections should be undertaken at the frequencies shown in the example Inspection and Maintenance Checklist for Rainwater Tanks in **Appendix C**.

The following maintenance activities should be undertaken:

- First flush device to be cleaned out;
- Leaves and debris to be removed from the inlet leaf/litter screen;
- Leaves and debris removed from roof gutters; and
- Sediment and debris removed from rainwater tank floor.

Adequate first flush systems and mesh screens on tanks inlets will reduce the amount of sediment and debris entering the tank, rendering cleaning only necessary approximately every 10 years.

5.8 Approximate Costs and Manufacturer Information

Approximate Costs

A rainwater collection system can be considered to be an investment and not a cost. When the costs of a rainwater tank and its accessories and connections are included, the cost per unit of water is initially higher than mains water but in the long-term the proportionate cost goes down until you are saving money and helping the environment.

The cost of rainwater tank systems depends on many factors including:

- The tank itself;
- Any necessary alteration to gutters and downpipes;
- A tank stand (in most cases);
- Plumbing to take water into the building;
- A device to reject initial runoff after dry periods (i.e. first flush device);
- A pump (if necessary); and
- Gutter guards (if necessary).

The cost for the supply of rainwater tanks will largely depend on the tank's fabrication material. The cost of installing a rainwater tank can vary considerably depending on site constraints.

Typically, the cost of rainwater tank installation for supplementary water source ranges from $1200 to $2000 for residential detached or semi-detached dwellings. Indicative costs are provided in **Table 5.7**.

Costs may increase with higher density development as space constraints could require more specialised tanks to be fitted.

Table 5.7 Indicative Rainwater Tank System Costs

Item	Approximate Cost for Each Tank Size			
Size	5 kL	10 kL	15 kL	20 kL
Round galvanised tank	$550	$850	$1110	$1800
Pump	$270	$270	$270	$270
Plumber and fittings	$500	$500	$500	$500
Float system	$200	$200	$200	$200
Concrete base	$200	$200	$200	$200
GST	$160	$180	$200	$230
Total	**$1800**	**$2020**	**$2210**	**$2490**

Source: Rainwater Tanks Information Sheet (based on 2001 costs from Coombes et al (2001))

A conservative estimate of annual maintenance costs incurred for a rainwater tank is approximately $70 per year (Upper Parramatta River Catchment Trust, 2004).

The ongoing operating costs for the pump motor (if required) would be approximately $150/year (based on 13.53 cents per kWh for a 0.75 kW pump for an average four hour operating day) (Upper Parramatta River Catchment Trust 2004).

Manufacturer Information

A range of rainwater tank and accessories suppliers in the Greater Adelaide Region is provided in Table 5.8.

However, it should be noted that this is not a complete (or recommended) listing.

For more options visit **www.yellowpages.com.au**. Useful searches include:

- Tanks and tank equipment;
- Tank cleaning; and
- Plumbers.

Table 5.8 Rainwater Tank Equipment Suppliers in the Greater Adelaide Region

Supplier	Location	Products	Contact Details
Betta Tanks	Pt Wakefield Rd, Burton	Galvanised aqua plate and Colourbond tanks 450 litres to 29,250 litres	mbetta2006@yahoo.com.au Ph 8280 8069
Bushman Tanks	Agent in Adelaide is Stratco	Tanks and accessories, including pumps	www.bushmantanks.com.au
Butlers Pumps and Irrigation	Sturt Street, Adelaide	Pumps	www.butlersirrigation.com.au
Davey Water Products	Range of dealers	Pumps	www.davey.com.au
Denyer Tanks	Bacon Street, Hindmarsh	Tanks	Ph 8346 5081
Grundfos Pumps	Range of dealers	Pumps	www.grundfos.com
Leafshield Gutter Protection	Armiger Court, Holden Hill	Gutter guards	www.leafshield.com.au info@leafshield.com.au Ph 8265 2000
Master Tanks	Richmond Road, Marleston	Polyethylene tanks from 340 litres to 9000 litres, slimline tanks galvanised tanks (one, two and three)	Ph 8443 9061
Nylex	Various dealers	Tanks	www.nylex.com.au
Onga	Various dealers	Pumps	www.onga.com.au
RainReviva	Various dealers	Bladder tank	reosac.com.au www.savewater.com.au/products
Stratco	Various locations	Tanks, gutters	www.stratco.com.au
TankMasta	Various dealers	Tanks	www.tankmasta.com.au
Team Poly	Waddikee Road Lonsdale (and various agents – see website)	Tanks, pumps	www.teampoly.com.au
The Rainwater Tank Centre	South Road, Melrose Park	Tanks	Ph 8277 8655

5.9 Useful Resources and Further Information

Fact Sheets

www.health.sa.gov.au/pehs/PDF-files/ph-factsheet-rainwater-tanks.pdf

Guidance on the use of rainwater tanks

www.unley.sa.gov.au/webdata/resources/files/rainwater_tanksDHS2pager1.pdf

Use of rainwater tanks

www.unley.sa.gov.au/webdata/resources/files/RainwaterFactSheet_WCPP.pdf

Rainwater tanks

www.decs.sa.gov.au/docs/documents/1/WaterSmartRainWaterToilet.pdf

Rainwater tanks for toilet flushing – schools

www.waterforgood.sa.gov.au

Fact sheets

www.amlrnrm.sa.gov.au/Portals/1/Our_Plans/Docs/WAP/WesternMtLofty/DP_9.pdf

Adelaide and Mt Lofty Ranges Natural Resources Management Board Discussion Paper 9 – Roof Runoff

www.wsud.org/downloads/Planning%20Guide%20&%20PN%27s/04-Rainwater%20tanks.pdf

Rainwater Tanks Practice Note – WSUD in the Sydney region

library.melbournewater.com.au/content/wsud/sustainable_urban_design/Rainwater_Tanks.pdf

Rainwater tanks fact sheet – Melbourne Water

Regulations and Legislation

www.planning.sa.gov.au/go/building/sustainability-and-efficiency/rainwater-tanks/rainwater-tanks

Department of Planning and Local Government web site

www.epa.sa.gov.au/pdfs/info_noise.pdf

EPA Information – Environmental Noise

General Information

www.unisa.edu.au

University of South Australia

www.newcastle.edu.au/staff/directory/coombes_peter_281.html

University of Newcastle

www.lga.sa.gov.au/site/page.cfm

Local Government Association

www.bom.gov.au/climate/averages

Bureau of Meteorology

www.arid.asn.au/

Australian Rainwater Industry Group

www.arid.asn.au/images/stories/documents/rainwatermagazine.pdf

Rainwater 2009 Consumer Guide

www.watertanks.org.au

The Water Tanks Group

www.yourhome.gov.au/technical/fs73.html

Rainwater tank information

www.stormwater.asn.au/tanks/tankresearch.html

Water tank research

www.stormwater.asn.au/sa/default.asp?id=74

List of links

Suppliers

www.atlantiscorp.com.au

Atlantis

www.rocla.com.au

Rocla Pipes

www.jameshardie.com.au

James Hardie Industries

www.rainharvesting.com.au/default.asp

Rainwater Harvesting

www.tankmasta.com.au

TankMasta

www.unley.sa.gov.au/webdata/resources/files/tanks_suppliers2.pdf

City of Unley – summary of suppliers

Development Information Guides

www.charlessturt.sa.gov.au/site/page.cfm?u=510

City of Charles Sturt – development information guide to rainwater tanks

Audits

www.sawater.com.au/NR/rdonlyres/8D45E505-8E6A-4A1F-AD95-28C877A78475/0/Business_water_saver.pdf

SA Water – Business Water Saver Program

www.sawater.com.au/SAWater/YourHome/SaveWaterInYourHome

SA Water – Home Water Audit

www.murrayusers.sa.gov.au/water_audit_kit.php

Murray Care – Water Audit Kit

Plumbing

www.sawater.com.au/NR/rdonlyres/E49EA34C-3400-40C9-9634-1B6F7966E7FA/0/RainwaterPlumbingGuide.pdf

SA Water Rainwater Plumbing Guide

www.piasa.com.au

Plumbing Industry Association

www.greenplumbers.com.au

Green Plumbers

Health Information

www.health.sa.gov.au/pehs/PDF-files/ph-factsheet-rainwater-tanks.pdf

Department of Health – rainwater tanks maintenance and water care

www.health.sa.gov.au/pehs/PDF-files/ph-factsheet-rainwater-testing.pdf

Department of Health – domestic rainwater quality testing

(Websites current at August 2010)

5.10 References

ACT Planning and Land Authority (2007). *Water Sensitive Urban Design General Code*. Canberra, ACT. July. www.legislation.act.gov.au/ni/2008-27/copy/64663/pdf/2008-27.pdf.

Argue, J. R. (Ed, 2009) *WSUD: basic procedures for 'source control' of stormwater - a Handbook for Australian practice.* Editor: Argue, J.R., Authors: Argue, J.R., Allen, M.D., Geiger, W.F., Johnston, L.D., Pezzaniti, D., Scott, P., Centre for Water Management and Reuse, University of South Australia, 5th Printing, February 2009, ISBN 1-920927-18-2, Adelaide.

Australian Rainwater Industry Development Group (2007). *Rainwater 2007 Consumer Guide*. July. www.arid.asn.au/images/stories/documents/rainwatermagazine.pdf.

Beecham, S. (2003). *Impacts of Rainwater Tanks on Stormwater Drainage Design: Rainwater Tank Modelling*. September.

Coombes, P. J., Frost, A., Kuczera, G. (2001). *Impact of Rainwater Tank and On-site Detention Options on Stormwater Management in the Upper Parramatta River Catchment.* Upper Parramatta River Catchment Trust. August. www.uprct.nsw.gov.au/sustainable_water/publications/Impact_Rainwater_tanks_&_OSD_SWMgt_UPRC,2001.pdf.

Department for Environment and Heritage (1999). *Rainwater Tanks ... Their Selection, Use and Maintenance.* Government of South Australia. May. www.dwlbc.sa.gov.au/assets/files/rainwater.pdf.

Department for Environment and Heritage (2005). *Water Conservation Handbook for Local Government.* Government of South Australia. Adelaide.

Department of Health South Australia (2006). *Rainwater Tanks Maintenance and Water Care.* Government of South Australia. Adelaide. August. www.health.sa.gov.au/pehs/PDF-files/ph-factsheet-rainwater-tanks.pdf

Department of Natural Resources and Mines Queensland (2005). *Planning Guidelines for Water Supply and Sewerage* - Chapter 5 - Demand / Flow and Projections.

Government of South Australia (2005). *Water Proofing Adelaide: A Thirst for Change (2005 - 2025).*

Melbourne Water (2005). *WSUD Engineering Procedures: Stormwater*. CSIRO Publishing.

Parsons Brinkerhoff (2006). *Peel-Harvey Coastal Catchment Water Sensitive Urban Design Technical Guidelines.* Peel Development Commission. October.

SA Water (2006). *Rainwater Plumbing Guide.* Government of South Australia. April. www.sawater.com.au/NR/rdonlyres/E49EA34C-3400-40C9-9634-1B6F7966E7FA/0/RainwaterPlumbingGuide.pdf.

Upper Parramatta River Catchment Trust (2004). *Water Sensitive Urban Design, Technical Guidelines for Western Sydney.* Prepared by URS Australia Pty Ltd. www.wsud.org/tools-resources/.

Upper Parramatta River Catchment Trust, Sydney Coastal Councils Group, Western Sydney Regional Organisation of Councils, Lower Hunter Central Coast Regional Environmental Management Strategy (2003). *Water Sensitive Planning Guide for the Sydney Region.* Upper Parramatta River Catchment Trust. Sydney. May. www.wsud.org/downloads/Planning%20Guide%20&%20PN's/WSPP%20Final.pdf.

(Websites current at August 2010)

Appendix A

Annual Rainfall and
Rainwater Tank Harvesting Curves

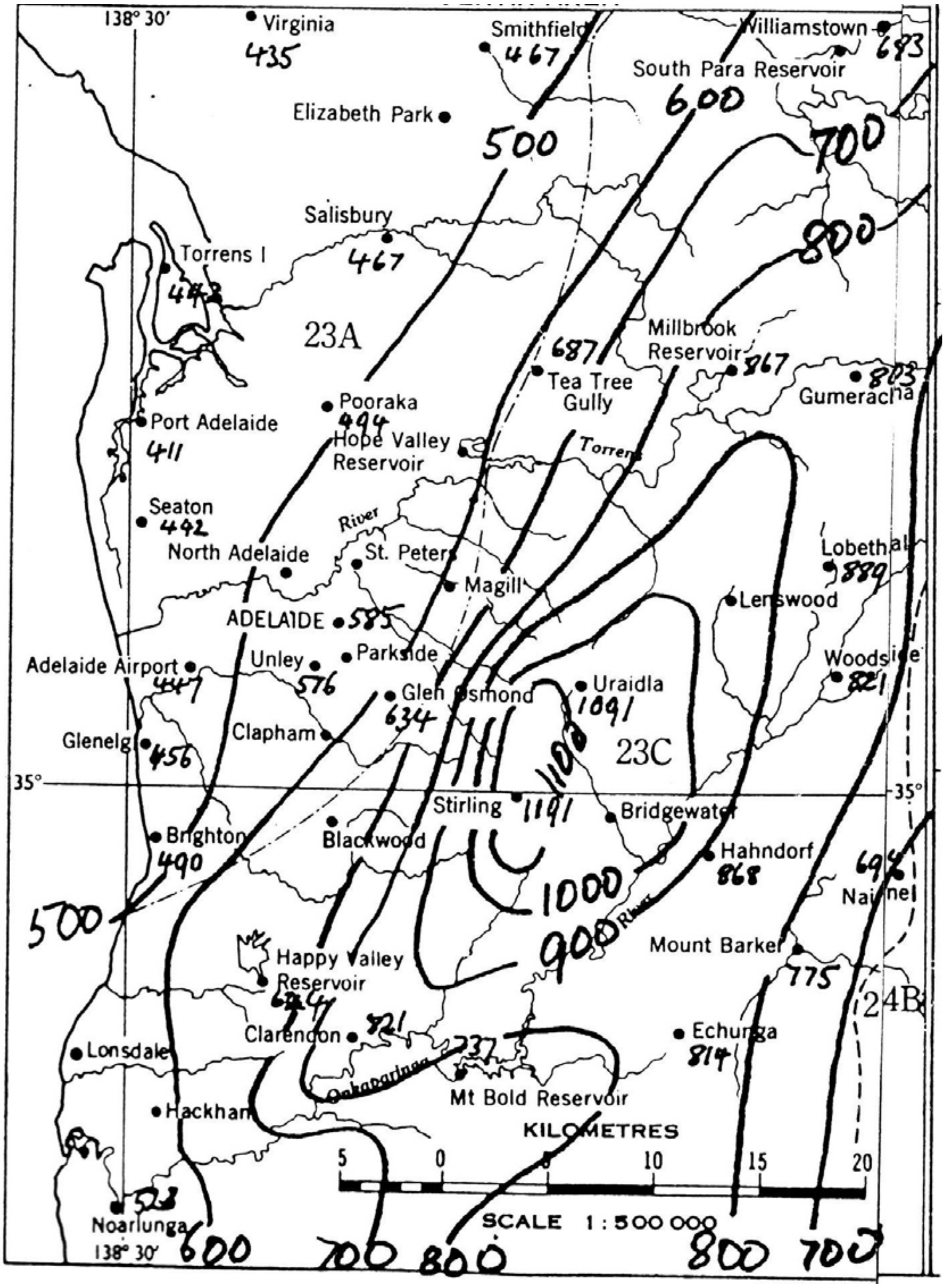


Figure A1 Average Annual Rainfall for the Greater Adelaide Region

Rainwater Tank Harvesting Curves

In order to utilise the curves outlined here, the following steps should be considered:

1. Determine the roof area that can be connected to the tank. In most situations it is not possible to gravity feed the runoff to the tank as the roof gutter slopes are flat and several downpipes are required to meet 20 year ARI flow capacity. It may be possible to drain the roof via a 'wet' system.
2. Determine your average daily demand characteristics. Refer to **Section 5.4**.
3. Select the appropriate yield curve graph according to the roof area and annual rainfall.
4. Locate the demand rate along the x-axis and project vertically until it meets the desired tank size. Then project left, horizontally to determine the average annual yield on the y-axis.

A case study is provided in **Appendix B**.

Note: In order to develop the curves, several assumptions were adopted, such as constant daily demand rate, no rainfall (depression or infiltration) losses, no first flush losses, etc.

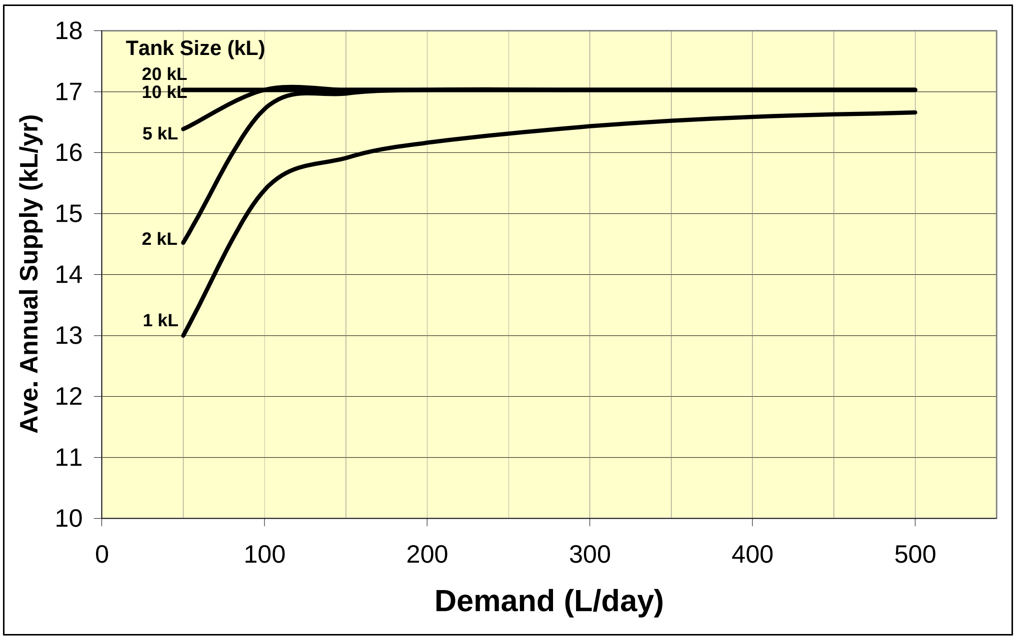
Historical rainfall data used to develop the set of curves was selected to represent the Greater Adelaide Region. The particular sites where the rainfall data was measured were:

- Largs Bay (341 millimetres/year) – for locations with annual rainfall between 300 and 400 millimetres/year;
- Adelaide Airport (445 millimetres/year) – for locations with annual rainfall between 400 and 500 millimetres/year;
- Kent Town (513 millimetres/year) – for locations with annual rainfall between 500 and 600 millimetres/year;
- Kersbrook (766 millimetres/year – for locations with annual rainfall between 600 and 800 millimetres/year; and
- For areas where the average annual rainfall is higher than 800 millimetres, the 600 – 800 millimetres/year curves should be adopted.

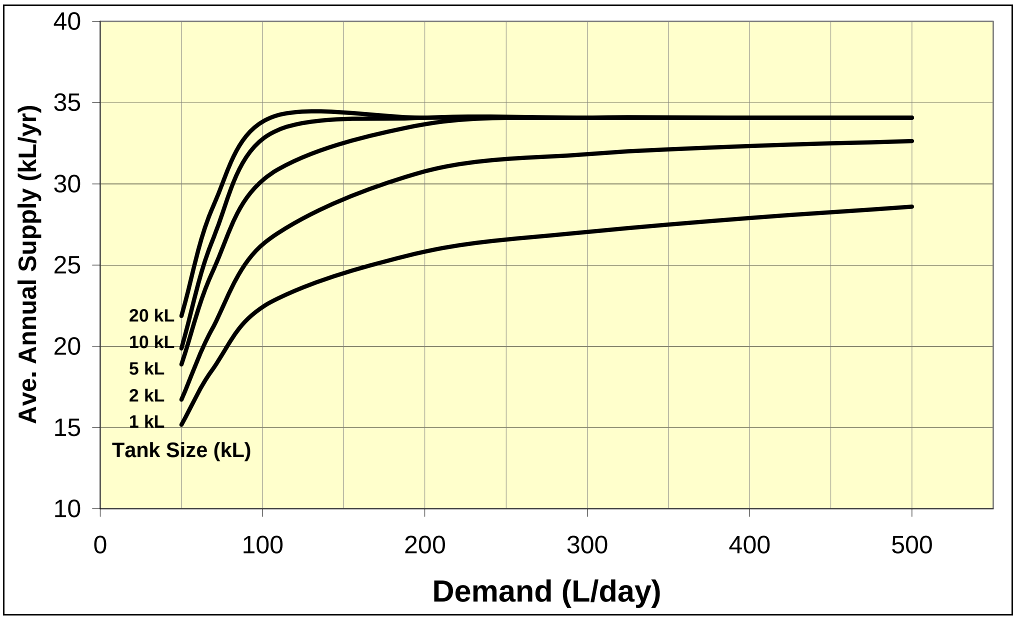
Curves for rainfall area of 300-400 millimetres **per annum**

Based on Largs Bay 6 minute rainfall data for 1998-2003. Average annual rainfall 341millemetres.

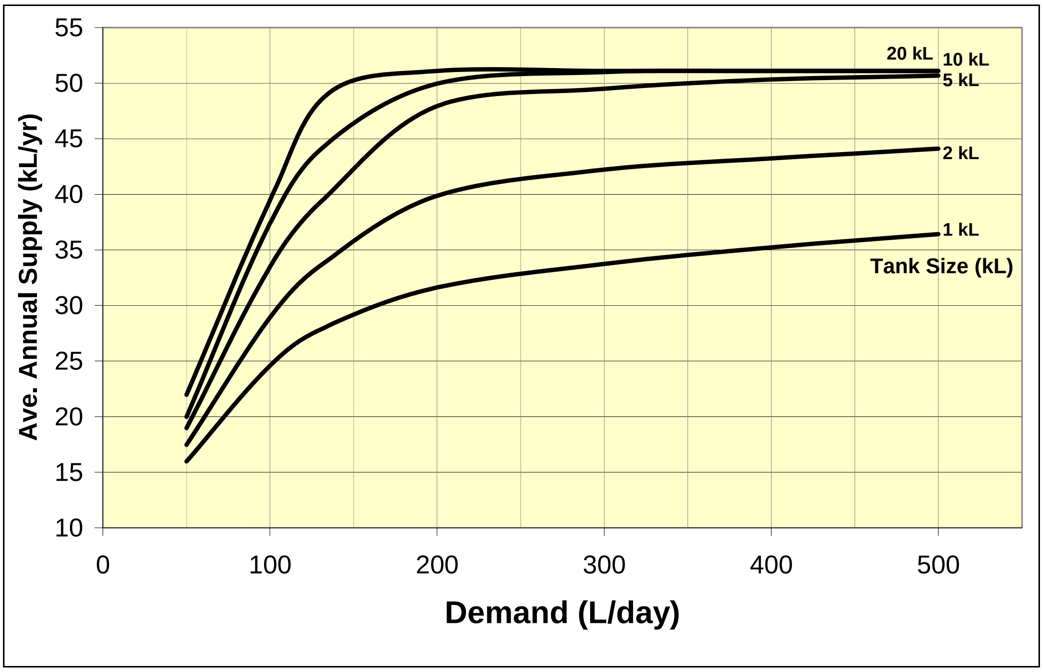
Roof area 50m² (Rainfall: 300-400 millimetres per annum)



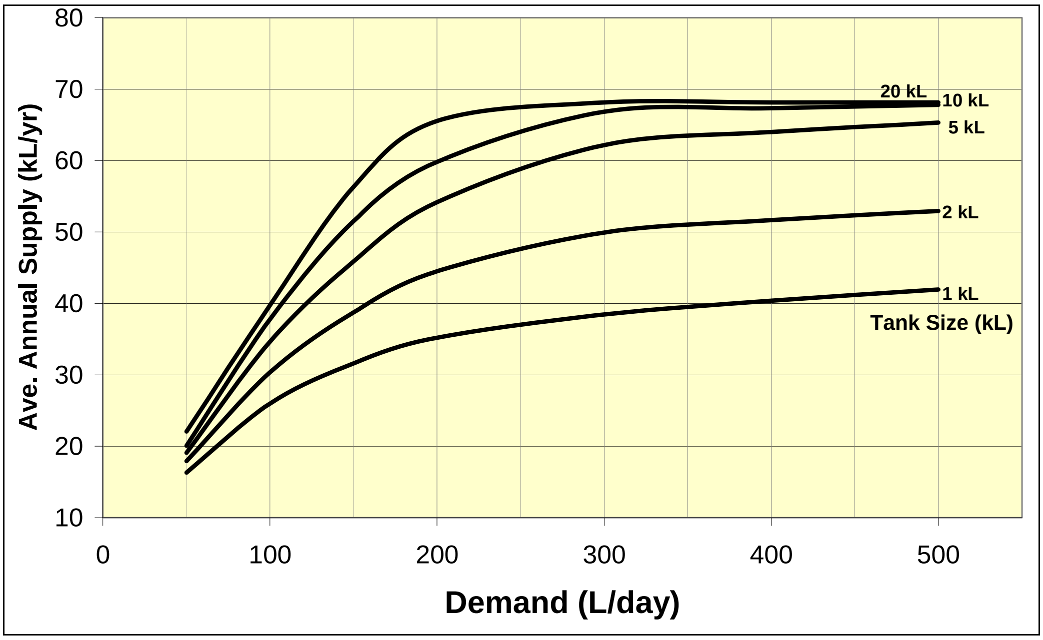
Roof area 100m² (Rainfall: 300-400 millimetres per annum)



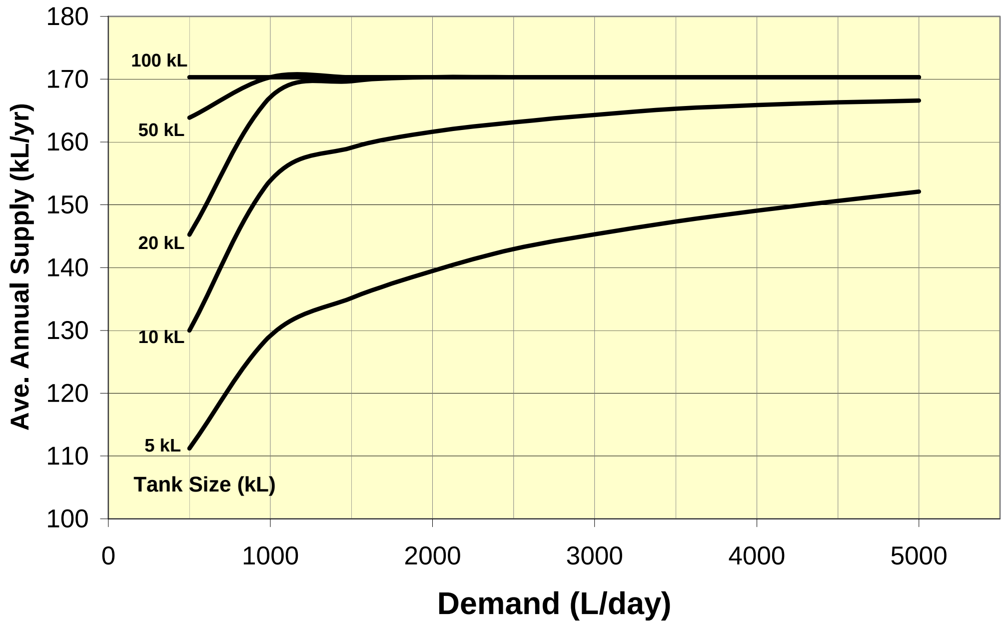
Roof area 150m² (Rainfall: 300-400 millimetres per annum)



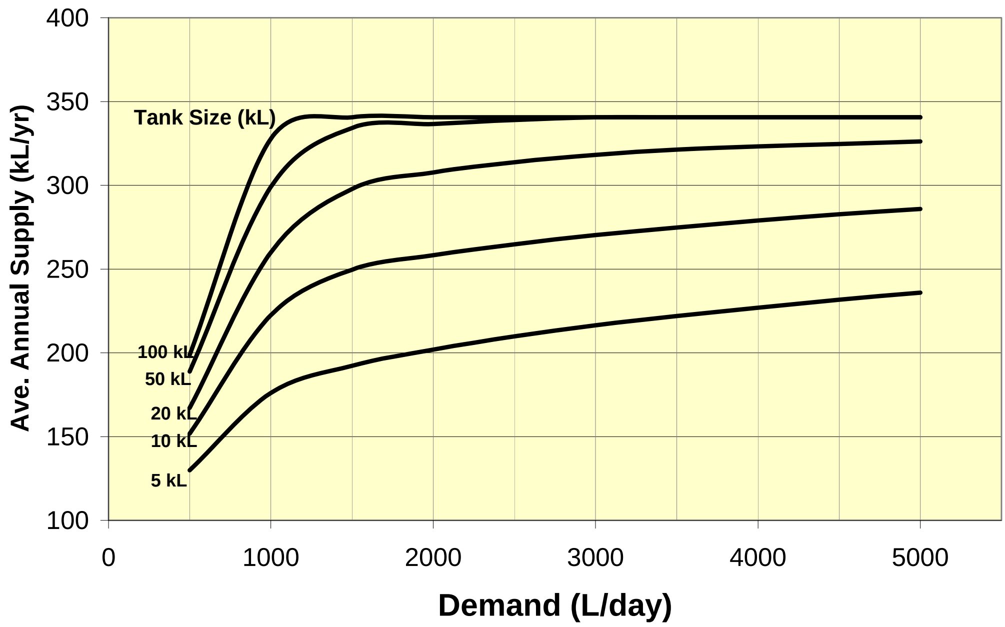
Roof area 200m² (Rainfall: 300-400 millimetres per annum)



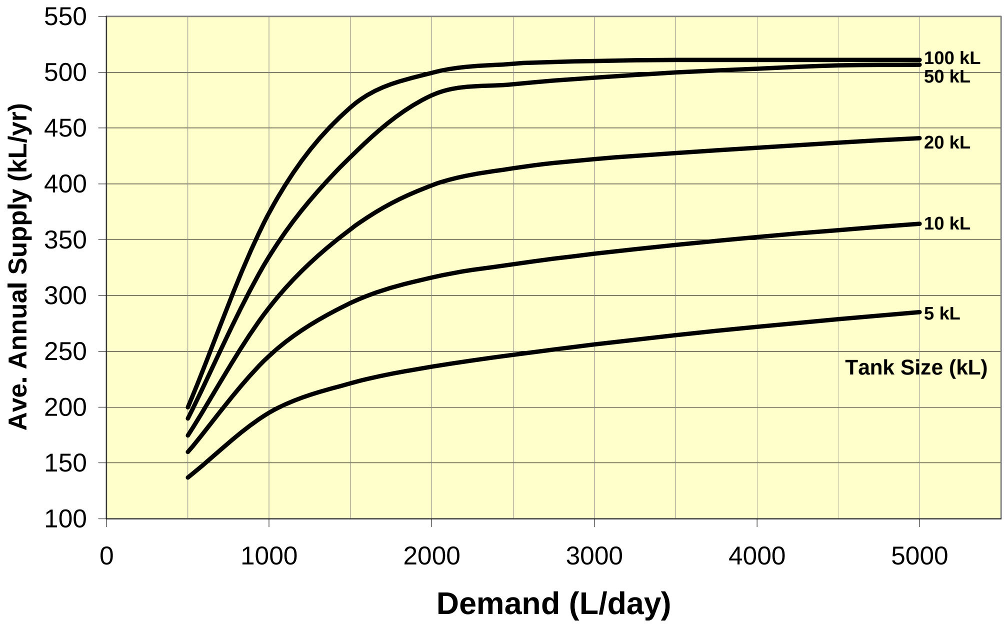
Roof area: 500m² (Rainfall: 300-400 millimetres per annum)



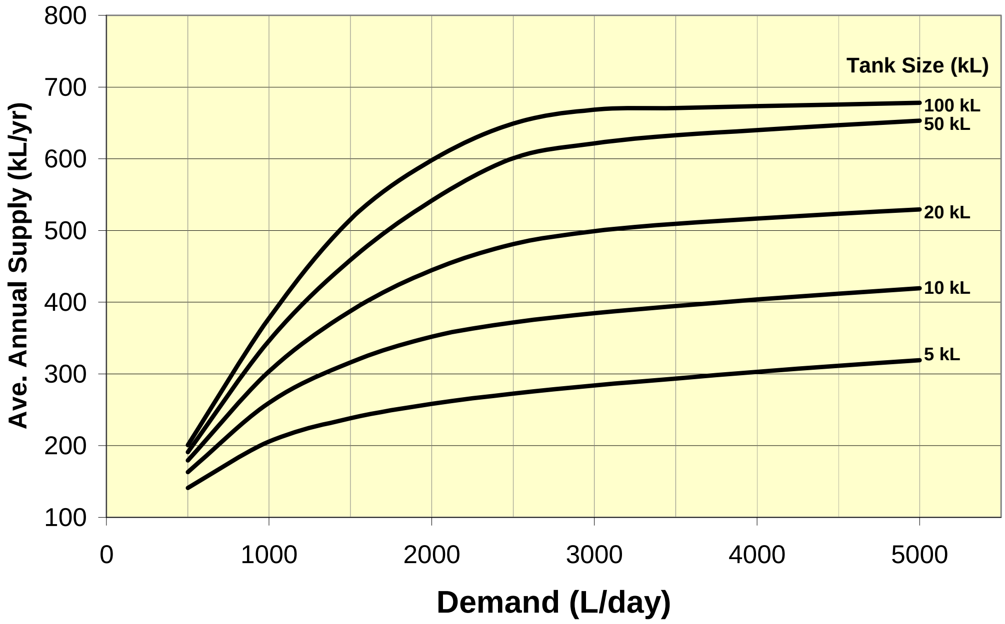
Roof area: 1000m² (Rainfall: 300-400 millimetres per annum)



Roof area: 1500m² (Rainfall: 300–400 millimetres per annum)



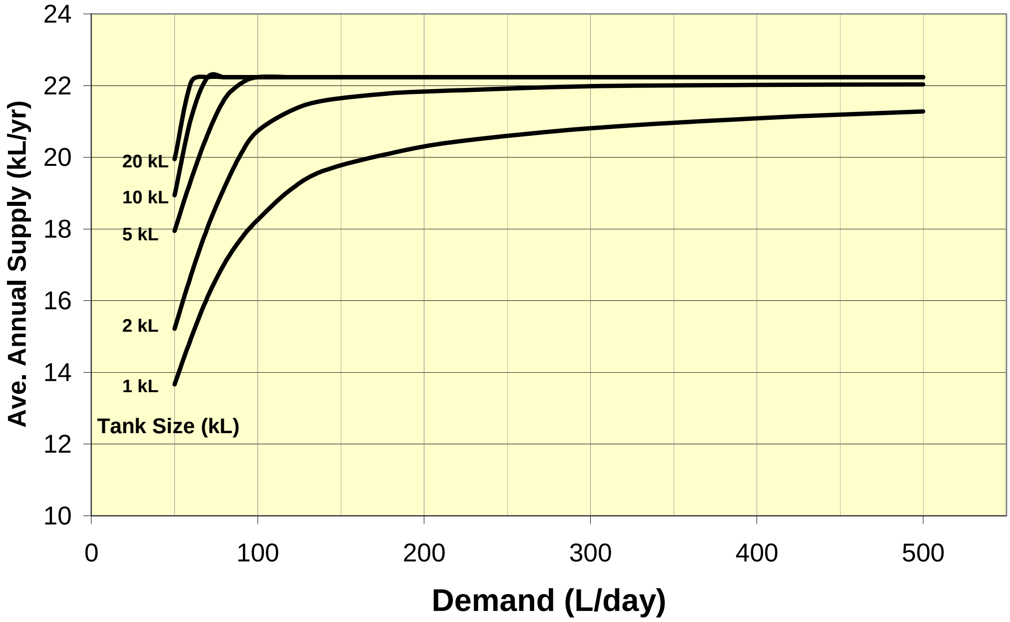
Roof area: 2000m² (Rainfall: 300-400 millimetres per annum)



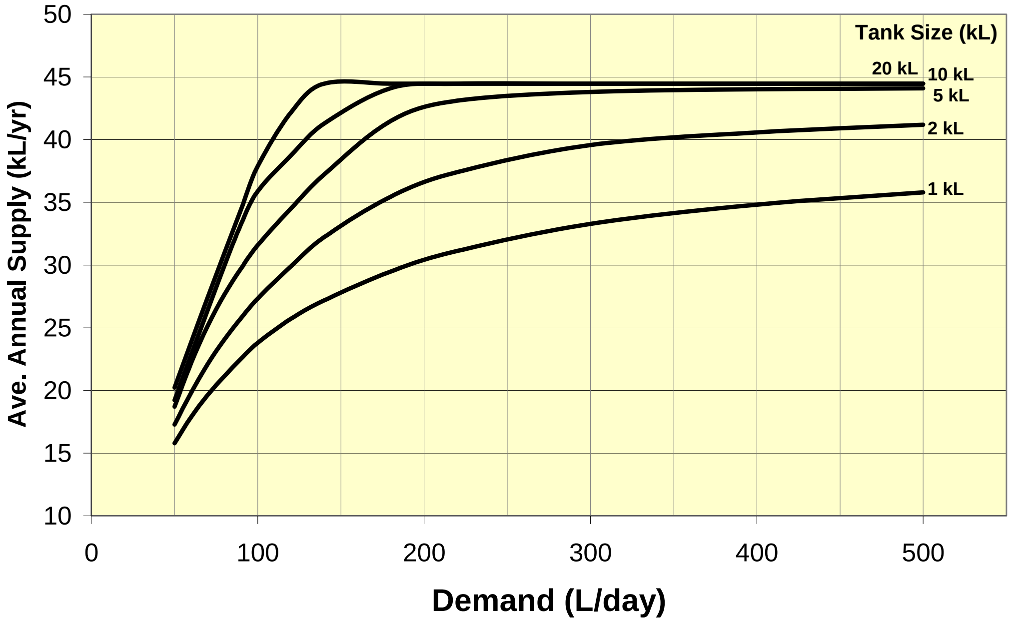
Curves for rainfall area of 400-500 millimetres per annum

Based on Adelaide Airport 6min rainfall data for 1996-2005. Average annual rainfall 445millemetres.

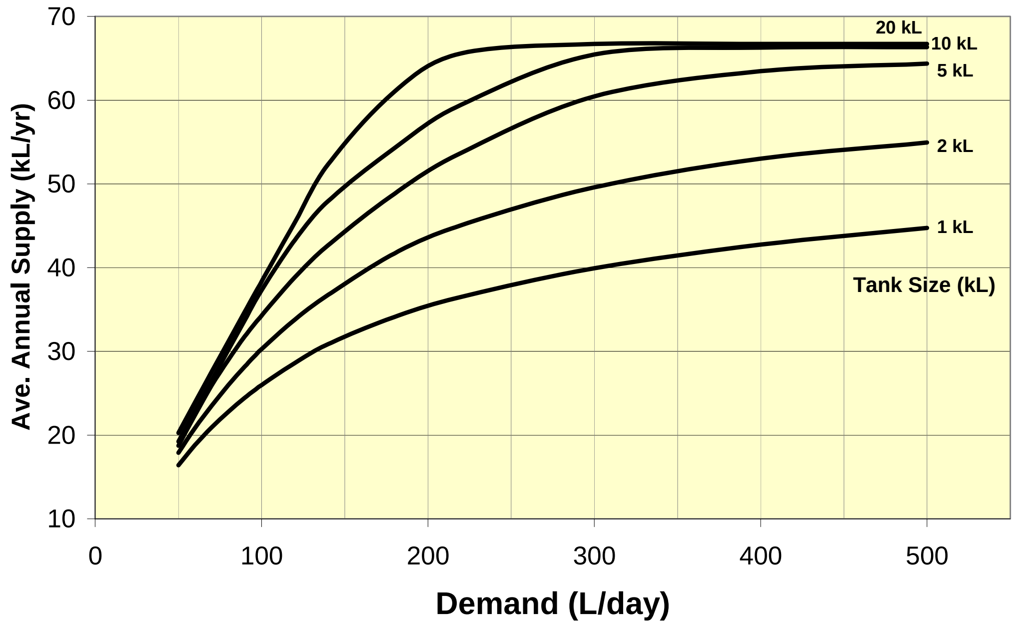
Roof area 50m² (Rainfall: 400-500 millimetres per annum)



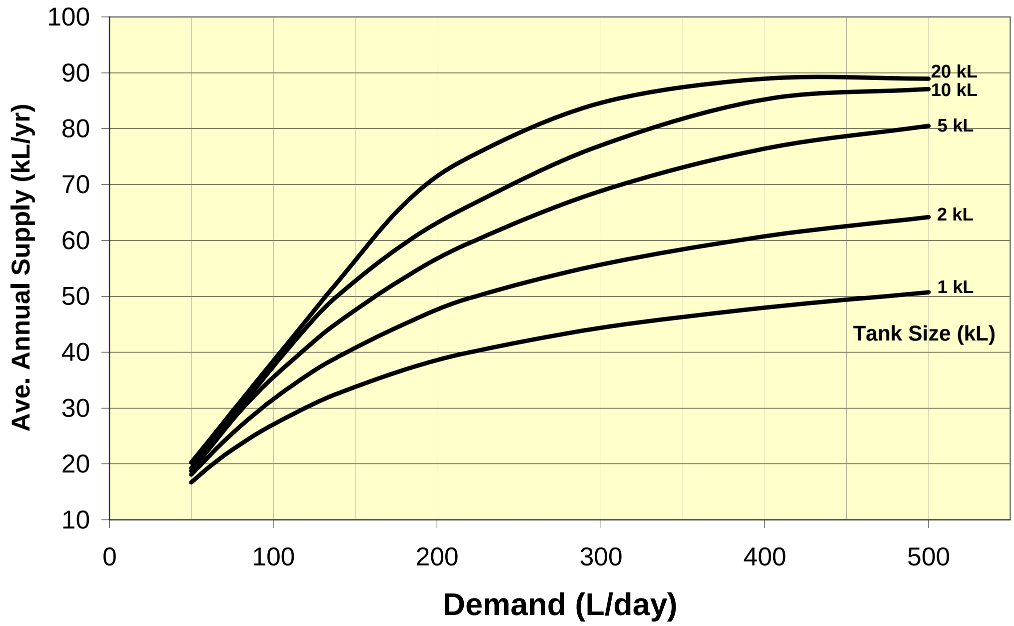
Roof area 100m² (Rainfall: 400-500 millimetres per annum)



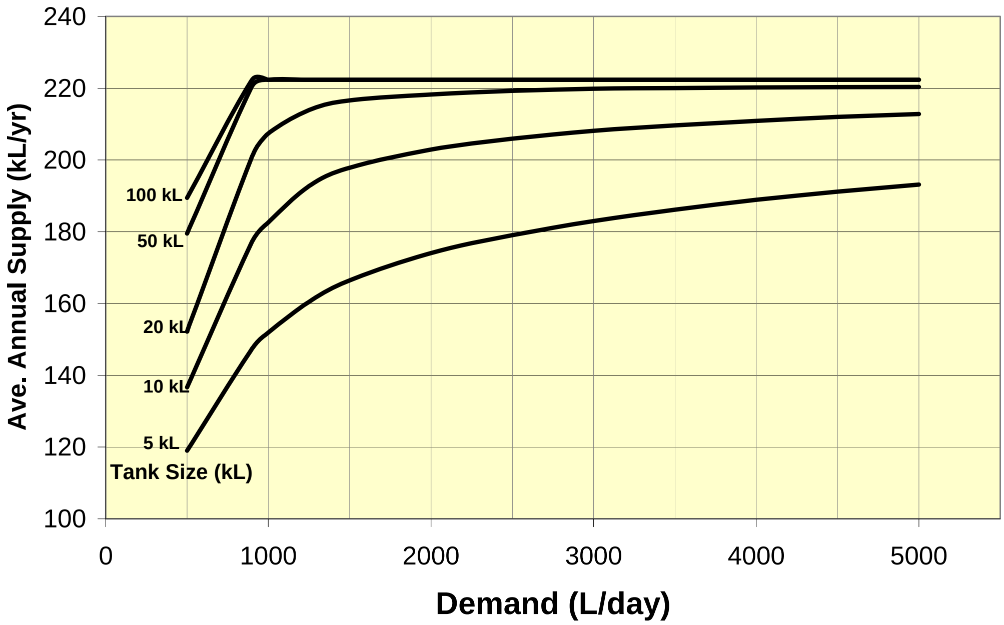
Roof area 150m² (Rainfall: 400-500 millimetres per annum)



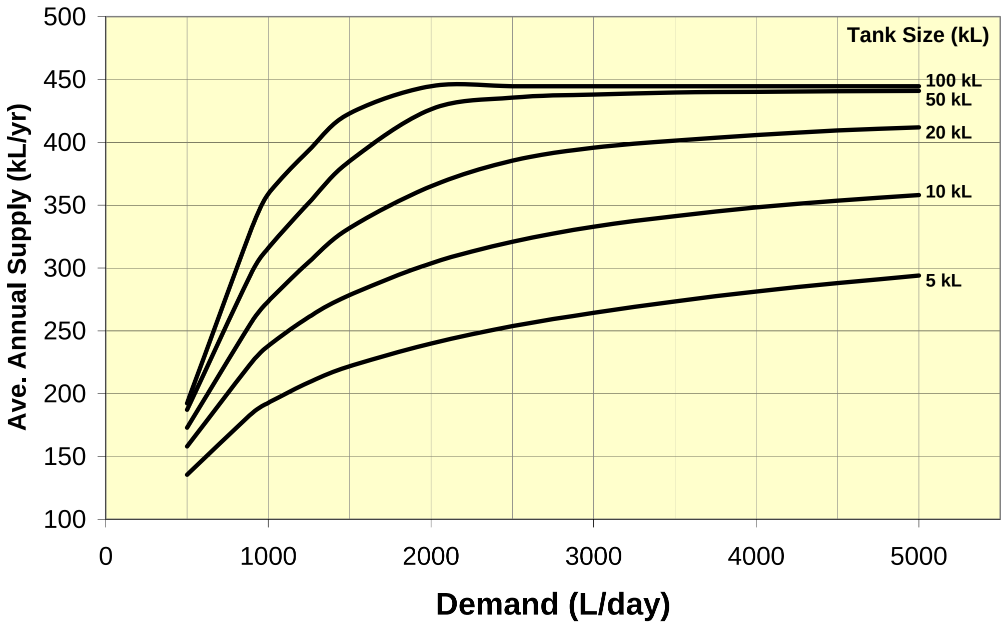
Roof area 200m² (Rainfall: 400-500 millimetres per annum)



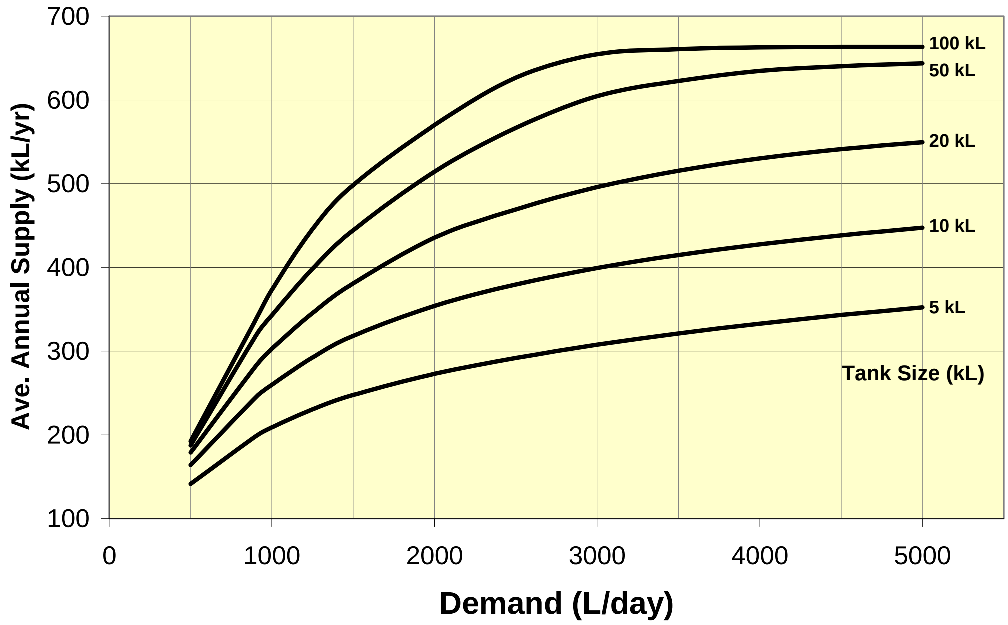
Roof area: 500m² (Rainfall: 400-500 millimetres per annum)



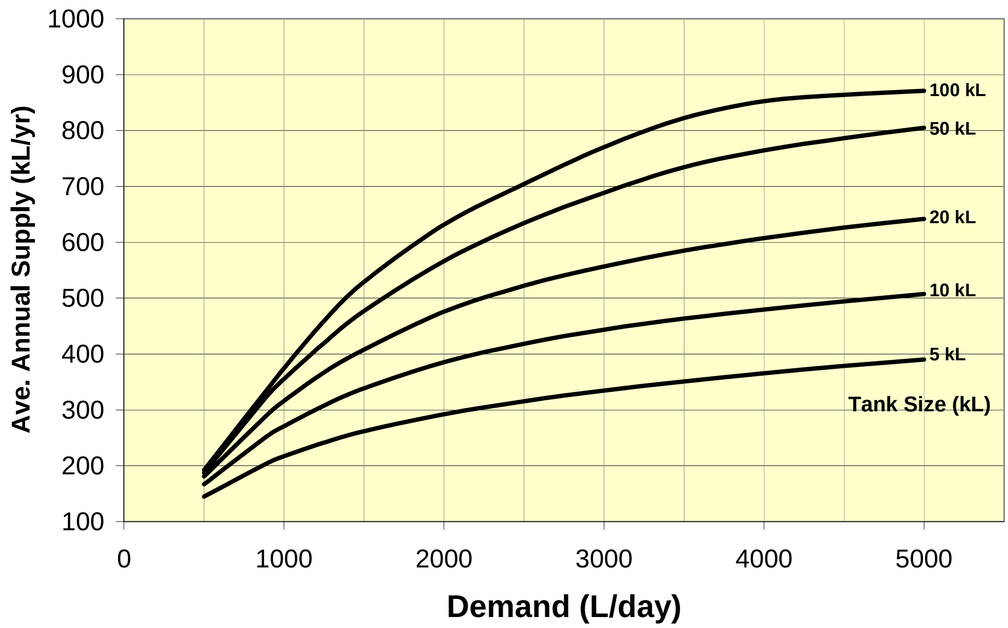
Roof area: 1000m² (Rainfall: 400-500 millimetres per annum)



Roof area: 1500m² (Rainfall: 400 – 500 millimetres per annum)



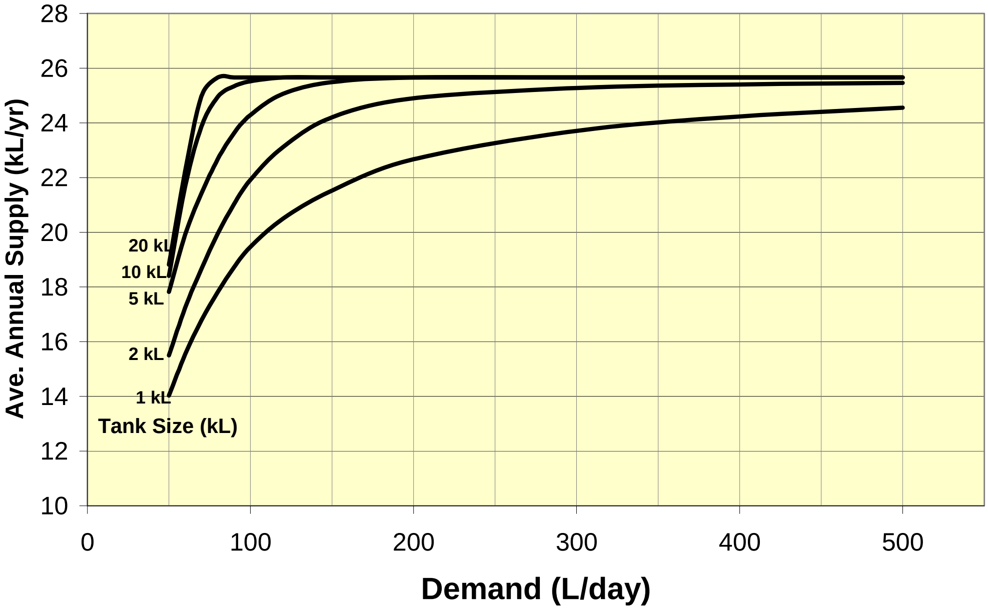
Roof area: 2000m² (Rainfall: 400-500 millimetres per annum)



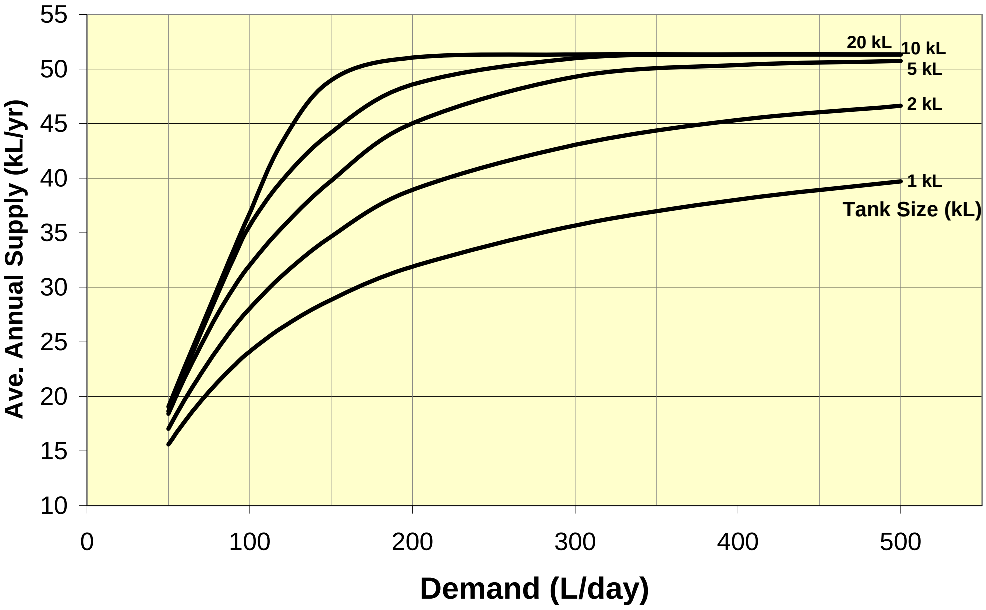
Curves for rainfall areas of 500-600millemetres per annum

Based on Kent Town 6min rainfall data for 1977-2002. Average annual rainfall 513 millimetres.

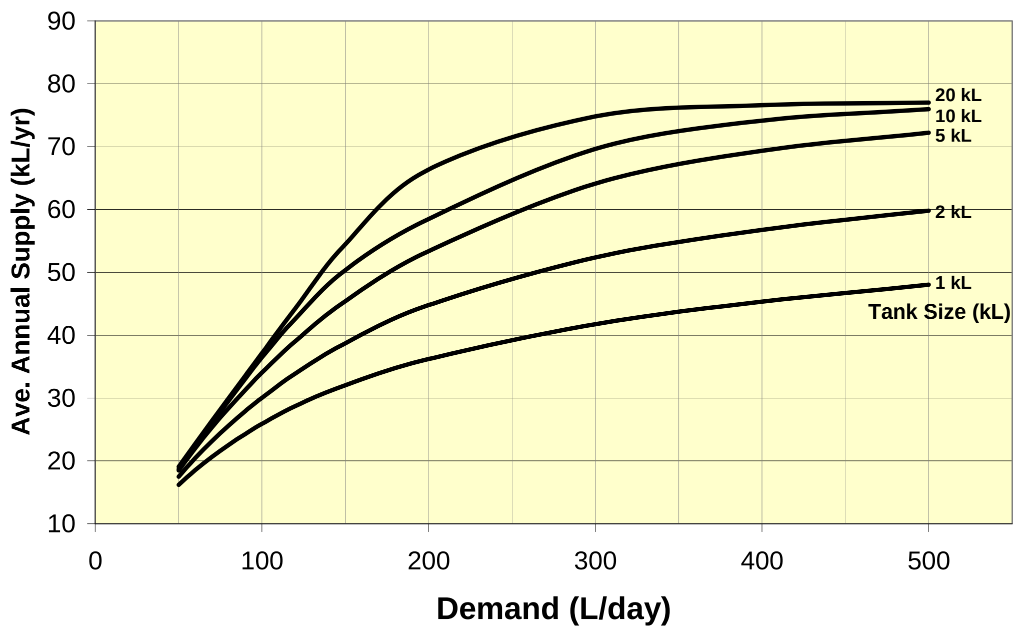
Roof area 50m² (Rainfall: 500-600 millimetres per annum)



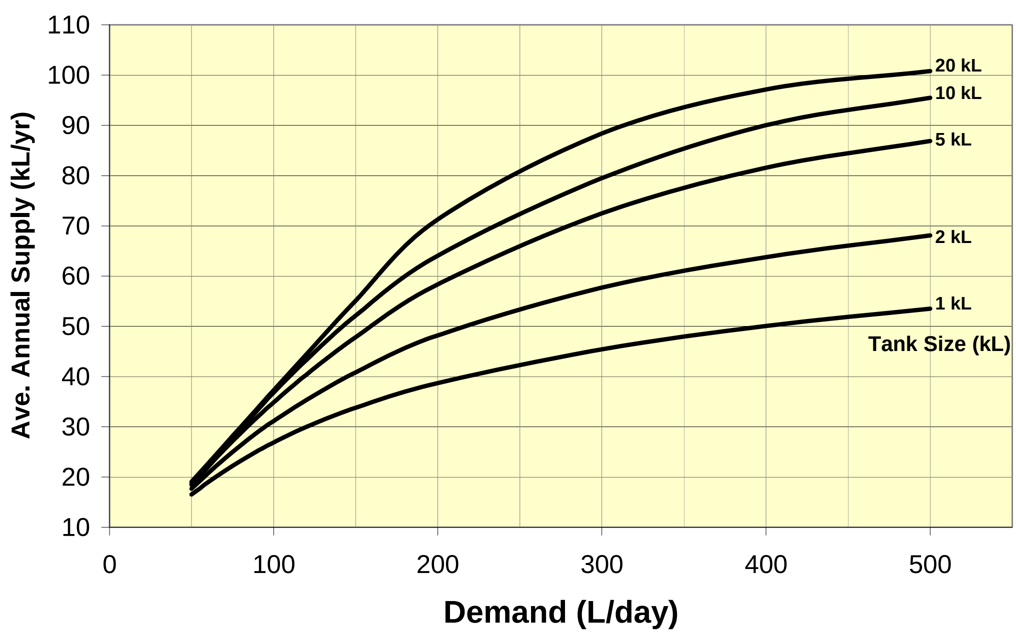
Roof area 100m² (Rainfall: 500-600 millimetres per annum)



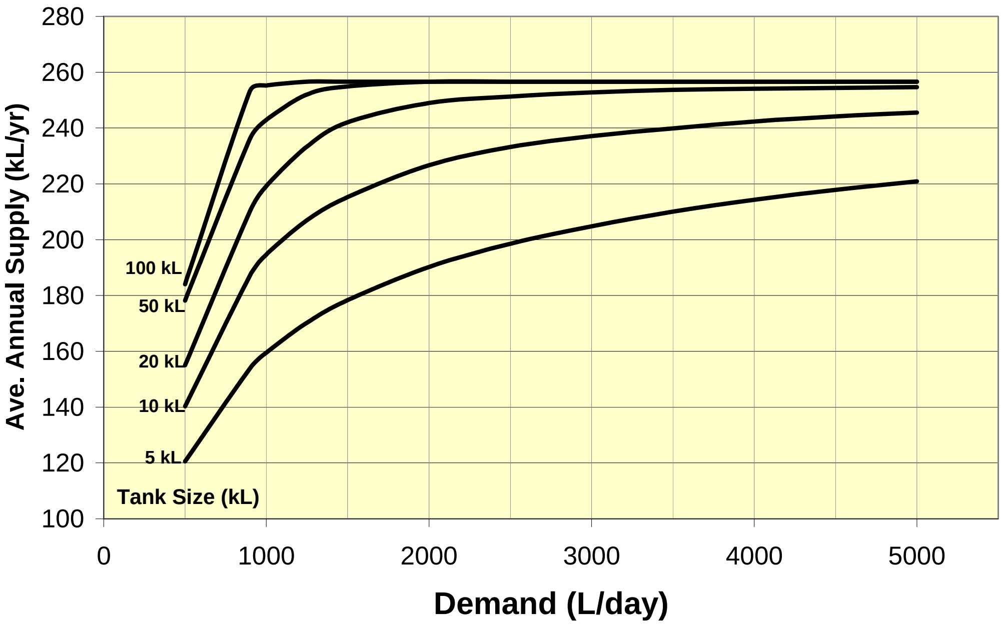
Roof area 150m² (Rainfall: 500-600 millimetres per annum)



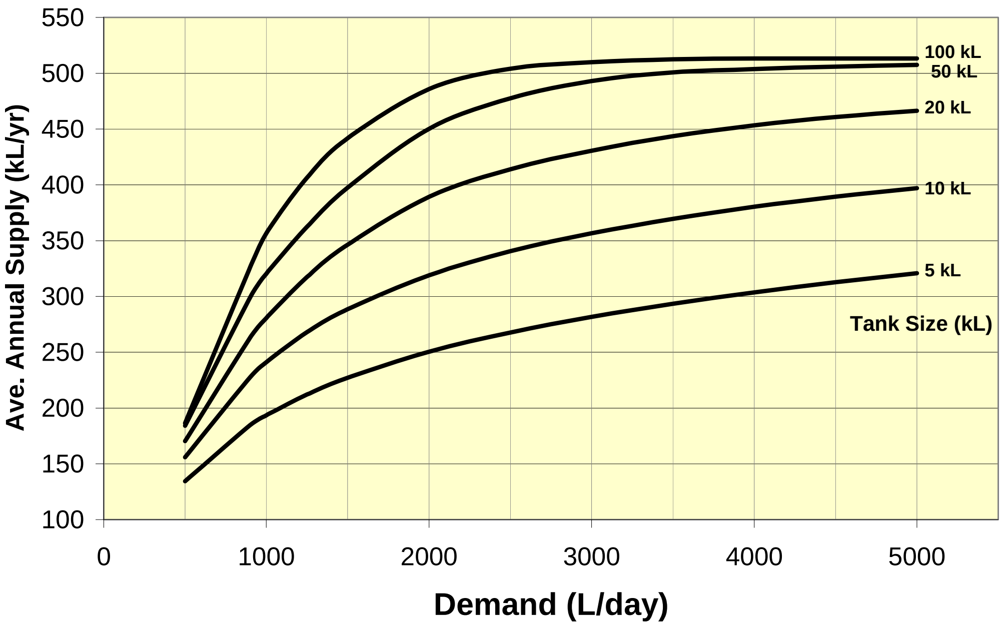
Roof area 200m² (Rainfall: 500-600 millimetres per annum)



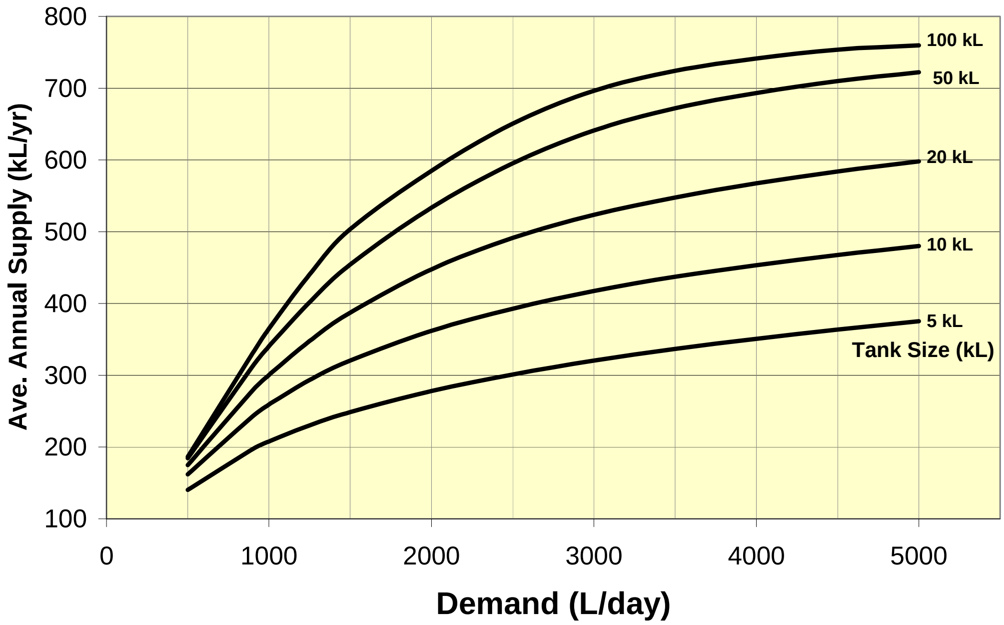
Roof area: 500m² (Rainfall: 500-600 millimetres per annum)



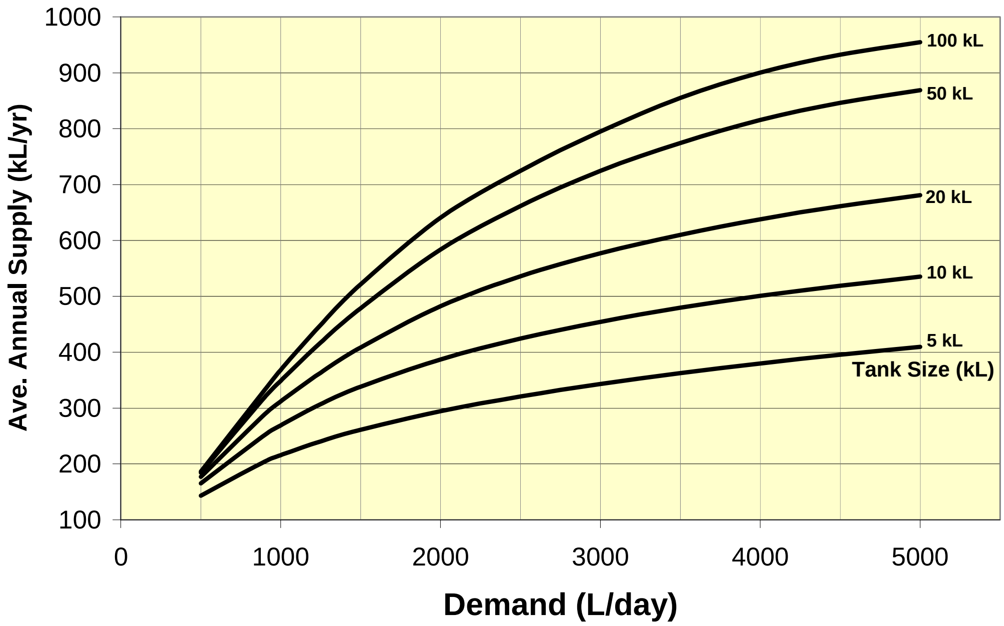
Roof area: 1000m² (Rainfall: 500-600 millimetres per annum)



Roof area: 1500m² (Rainfall: 500-600 millimetres per annum)



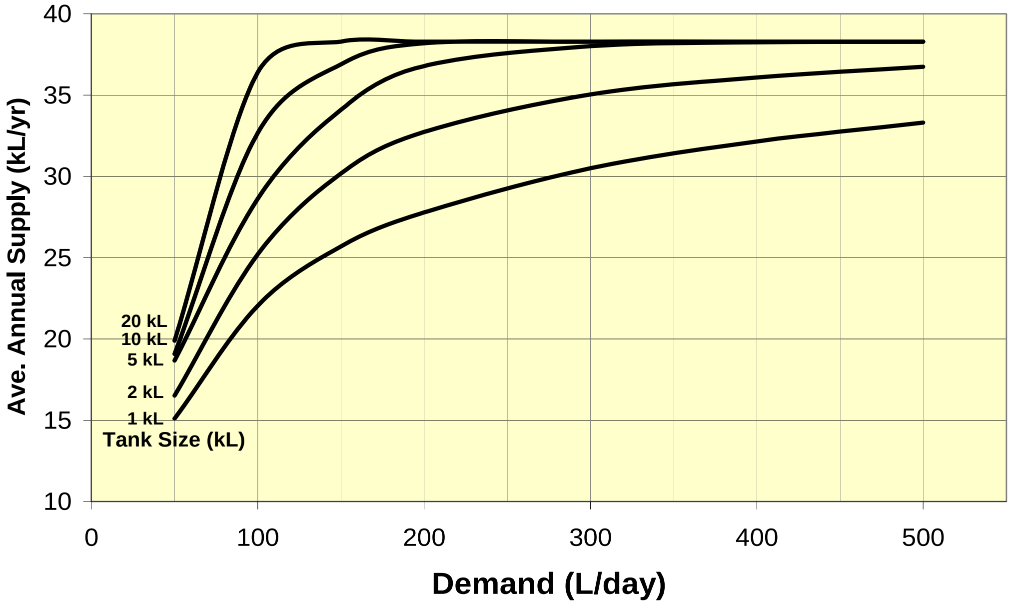
Roof area: 2000m² (Rainfall: 500-600 millimetres per annum)



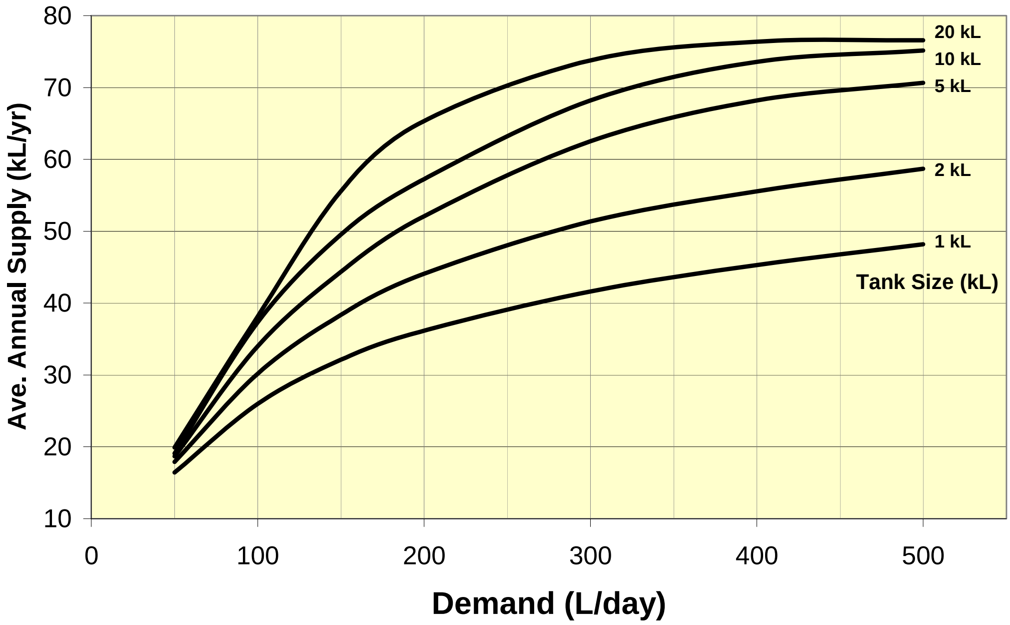
Curves for rainfall areas of 600-800 millimetres per annum

Based on Kersbrook 6min rainfall data for 1993-2005. Average annual rainfall 766 millimetres.

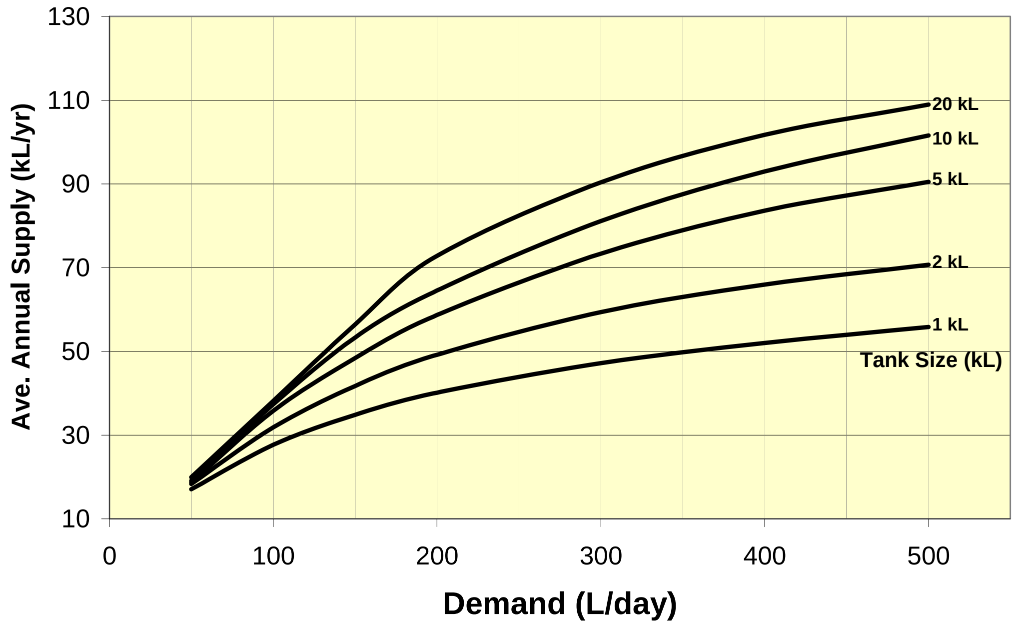
Roof area 50m² (Rainfall: 600-800 millimetres per annum)



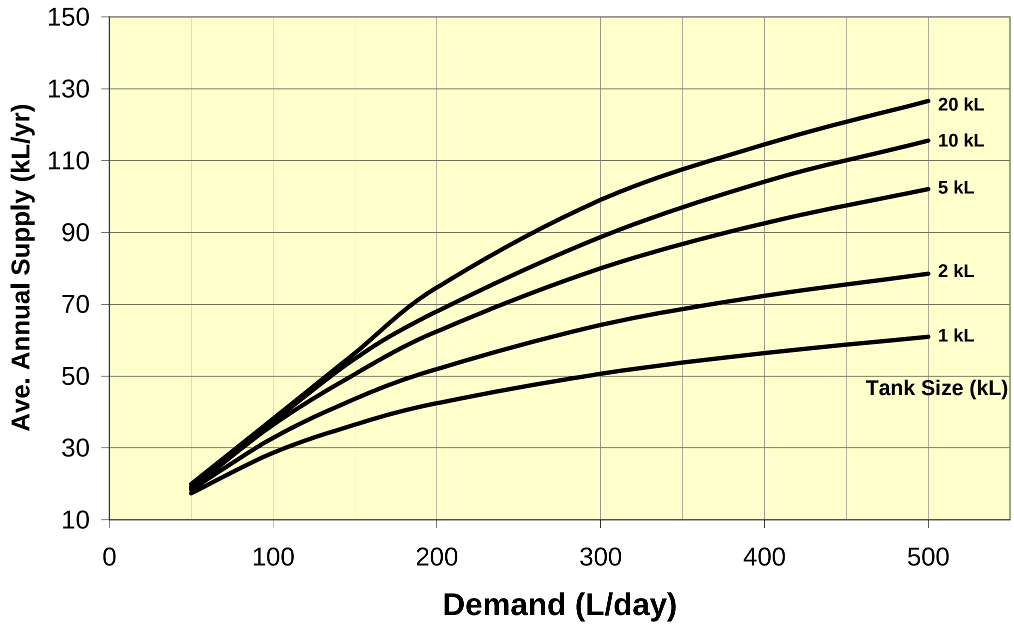
Roof area 100m² (Rainfall: 600-800 millimetres per annum)



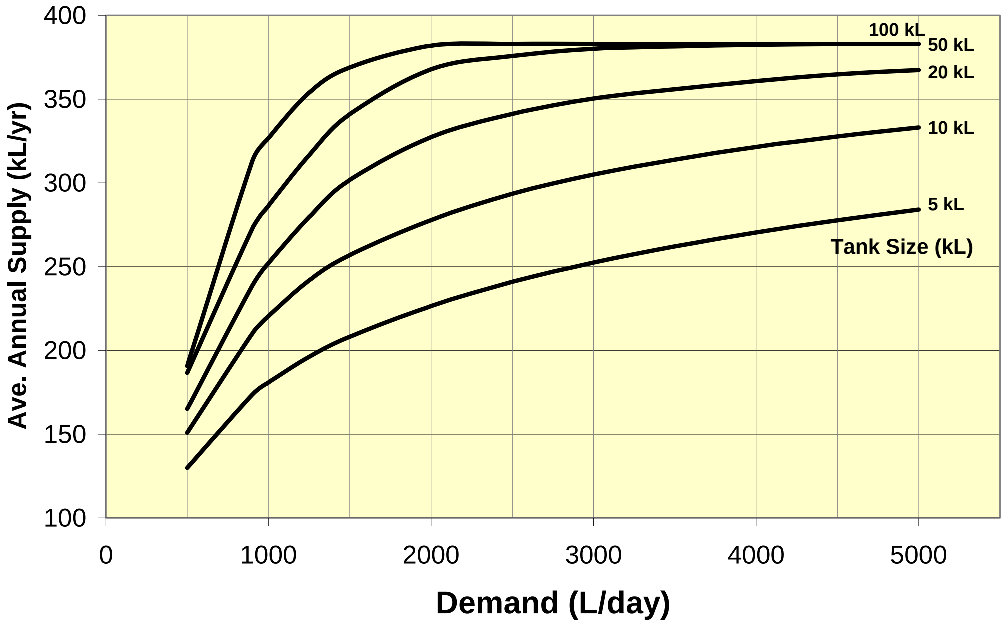
Roof area 150m² (Rainfall: 600-800 millimetres per annum)



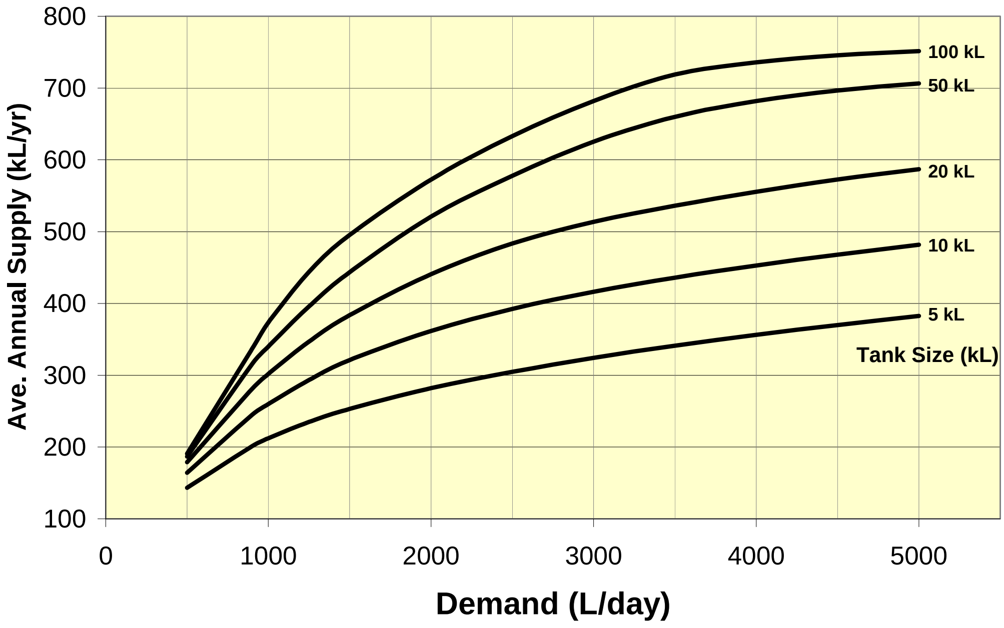
Roof area: 200m² (Rainfall: 600-800 millimetres per annum)



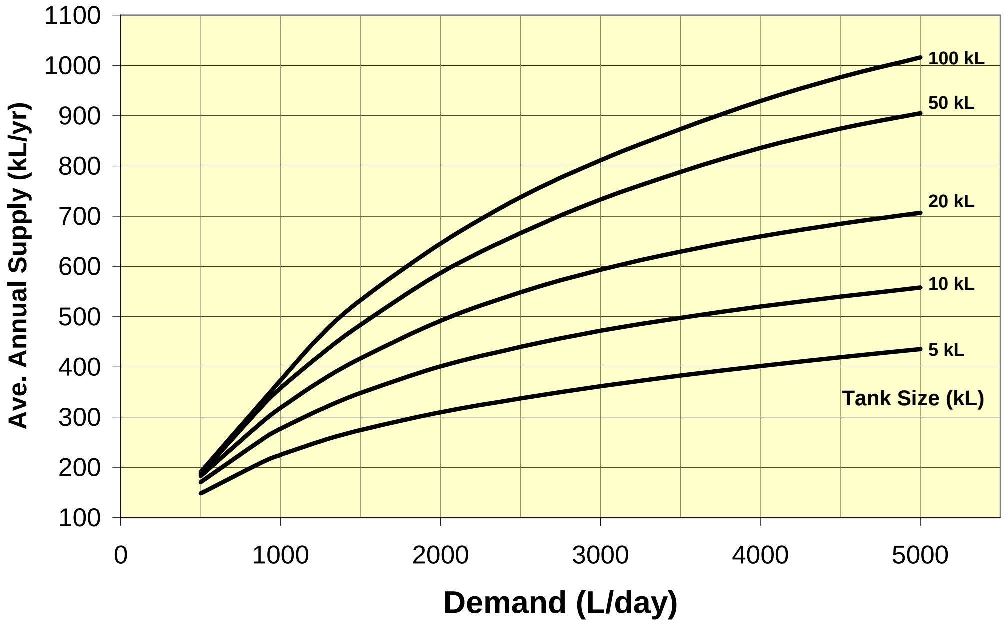
Roof area: 500m² (Rainfall: 700-800 millimetres per annum)



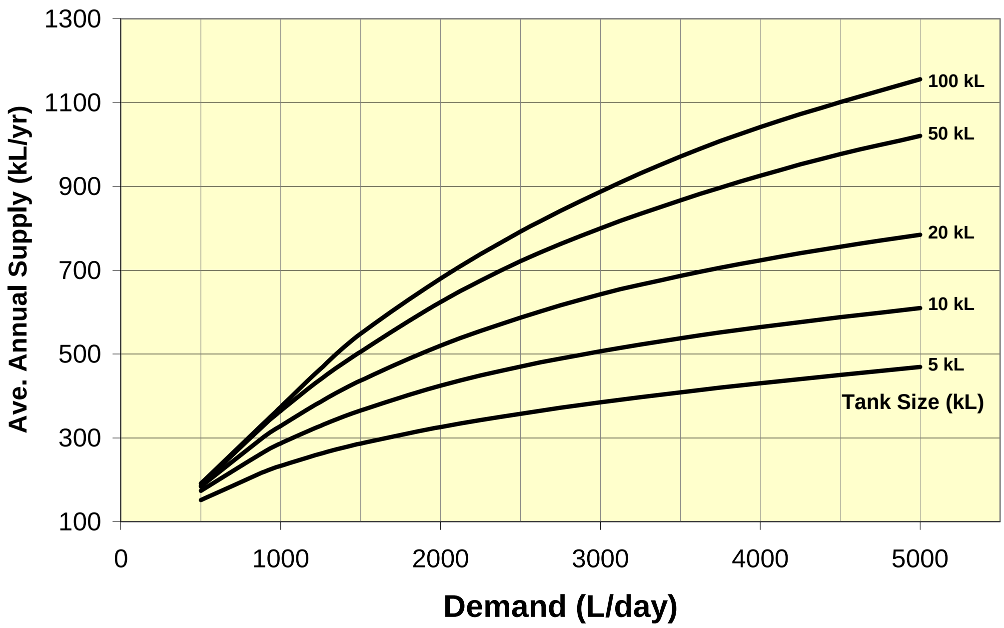
Roof area: 1000m² (Rainfall: 700-800 millimetres per annum)



Roof area: 1500m² (Rainfall: 700-800 millimetres per annum)



Roof area: 2000m² (Rainfall: 700-800 millimetres per annum)



Appendix B
Rainwater Tank Harvesting Case Study

Case Study

Task: Select appropriate rainwater tank size for a dwelling.

Details:

Location: West Beach.

Occupancy (normal): 4 persons.

Effective Roof Area: 200 square metres with one half connected via gravity system and the other half via a 'wet' system.

Demand: Inhouse demand only for laundry and toilet use.

Back Up Supply: Site has potable mains water supply.

Methodology (A): Using the Hydrological Type Curves

1. Determine average daily house demand from **Table B1** (see next page).

   For a dwelling with 4 persons daily demand for laundry and toilet is 100 and 145 litres/day respectively making a total daily demand of 245 litres/day or average annual demand of 89.4 kilolitres/year

2. Determine the average annual rainfall for the location.

   From **Figure A1** in **Appendix A** (the Average Rainfall Map) the map indicates an average annual rainfall of approximately 450 millimetres.

3. Determine the average annual yield.

   The appropriate yield curve graph for this case study is therefore the 400-500 millimetres/yr graph, with a roof area of 200 square metres. It can be seen in **Figure B1** that there are several tank size choices, as shown in **Table B2**.

   According to the yield results there is no obvious solution, however the result does show that all of the demand cannot be met in an average year and that there is a relatively small yield to storage benefit of going from a 5 kilolitre to the 10 or 20 kilolitre tanks. Selecting a tank size can sometimes be dictated by space limitations or cost and given that total demand can not be satisfied the selection can be subjective. On this basis, a 2 or 5 kilolitre tank would appear to be an appropriate size.

Table B1 Estimated Typical Household Water Demands (litres/day)

Water Use	Design Number of Occupants				
	1	2	3	4	5
Bathroom	65	107	145	189	223
Toilet	49	107	145	189	223
Laundry	38	54	100	137	174
Gardening	87	220	220	220	220
Kitchen	14	38	60	83	123
TOTAL	253	526	670	818	963

Source: Upper Parramatta River Catchment Trust (2004), Melbourne Water (2005)[1]

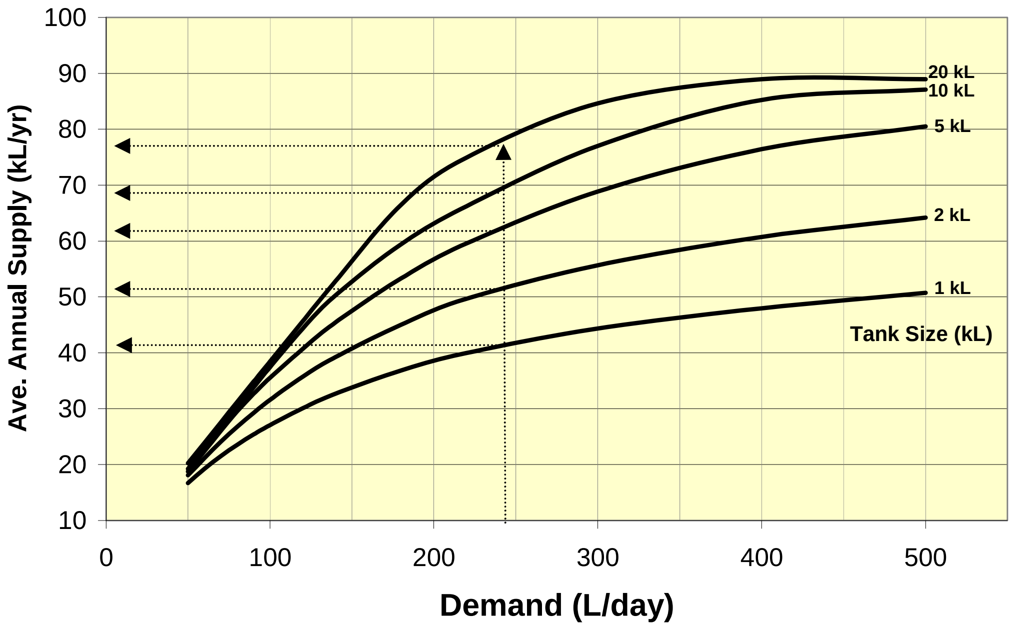


Figure B1 Yield Curves for Roof Area 200 square metres and Rainfall of 400-500 millimetres per annum

[1] Data from Melbourne Water has been used for the 1 person scenario and the remainder of information in the table is sourced from Upper Parramatta River Catchment Trust

Table B2 Yield Performance for Each Tank Size

Tank Size (kL)	Ave. Yield (kL/yr)	% of Demand Met by Rainwater Tank Water
1	42	47.0
2	52	58.2
5	63	70.5
10	69	77.2
20	8	87.2

Methodology (B): Using the Raintank Analyser

(www.unisa.edu.au/water/UWRG/publication/raintankanalyser.asp)

Using the Raintank Analyser program (see **Section 5.5**), additional variables can be considered and they include:

- Roof type and associated rainfall loss;
- First flush losses; and
- Irrigation demand.

The analyser provides additional outputs (see **Figures B3 and B4**) that allow the user to consider costs and security of supply (days without rainwater tank supply).

For this case study the program suggested a tank size based on decreasing and increasing benefit with respect to yield/storage characteristics. The tank size suggested in this case is approximately 5 kilolitres with a yield of 60 kilolitres/year. For this size tank the discounted cost of the water supplied is about $5.70 per kilolitre and the number of days without supply is 112.

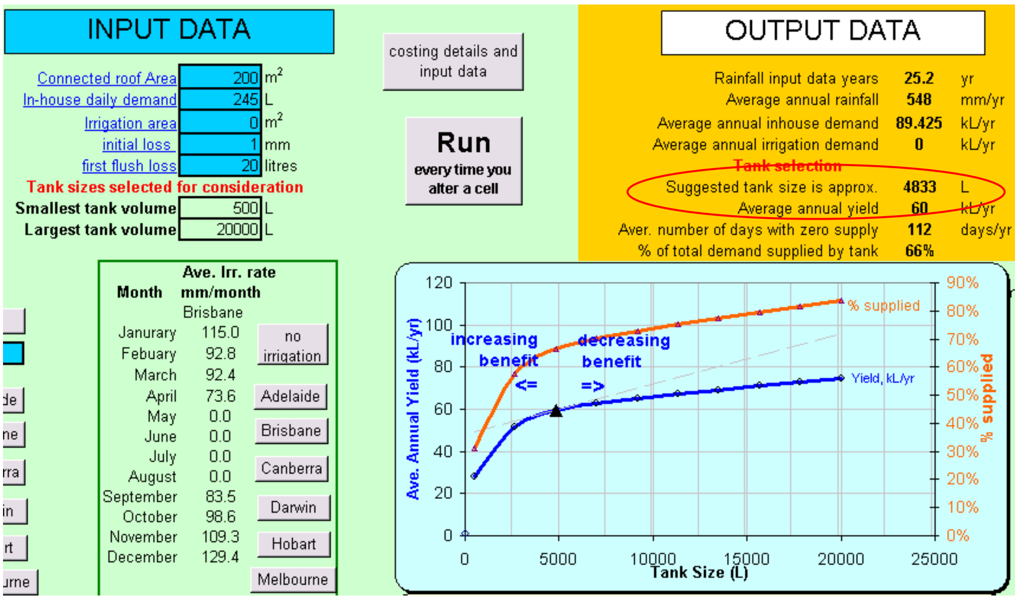


Figure B3 Raintank Analyser Results

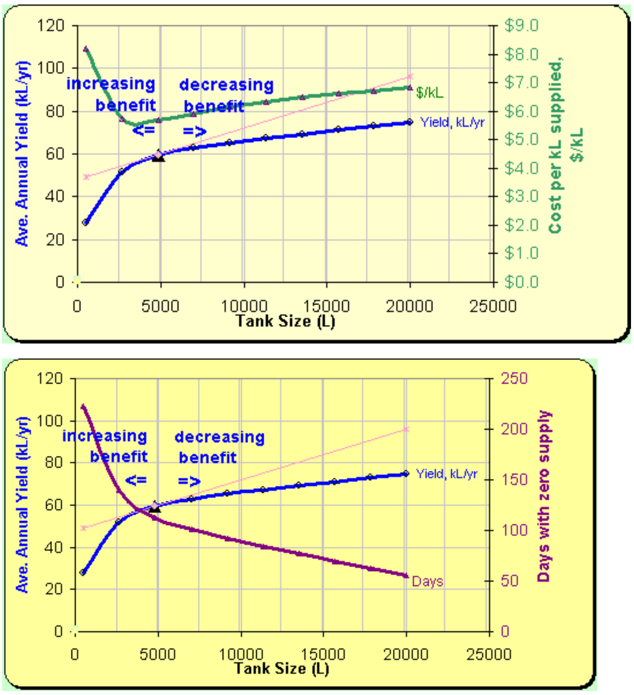


Figure B4 Raintank Analyser Results

Appendix C
Checklists

The checklists presented here have been modified for South Australian designs and conditions from checklists and forms provided in Upper Parramatta River Catchment Trust (2004), Melbourne Water (2005b), IEAust (2006), Gold Coast City Council (2007), Australian Rainwater Industry Development Group (2007) and BMT WBM (2008).

All parts of all checklists should be completed. Even if design checks or field inspections were not performed, it is important to record the reasons for this in the relevant checklists.

Rainwater Tanks

Design Assessment Checklist

Design Feature	Checked Y/N	Satisfactory Y/N	Comments
1. Minimum rainwater tank efficiency			
2. Design number of occupants			
3. Demand use			
4. Design demand			
5. Roof catchment area			
6. Rainwater tank capacity for reuse			
7. Site storage requirement			
8. Total rainwater tank volume			
9. Overflow system			
10. First flush device			
11. Maintenance plan			
12. Required approvals obtained			

Rainwater Tanks

Inspection and Maintenance Checklist

Items Inspected	Checked Y/N	Maintenance Needed Y/N	Inspection Frequency
First Flush Device/Pump			3 months
1. First flush device clear of debris and not blocked			
2. Remove acoustic cover from pump and clean in and around where leaf litter and dust can build up between the two			
Debris Cleanout			6 months
3. Inlet area clear of debris			
4. Overflow pipe clear of debris			
Inlet Screen			6 months
5. Leaves and debris on surface			
Roof Gutters/Tank Access			6 months
6. Leaves and debris in gutters			
7. Roof catchments clean and clear of moss and lichen			
8. Prune overhanging tree branches and foliage			
9. Check for evidence of animal, bird or insect access to tank, including larvae			
Sediment Level In Tank			2 years
10. Sediment level			

Items Inspected	Checked Y/N	Maintenance Needed Y/N	Inspection Frequency
Tank Structure			2 years
11. Check for corrosion			
12. Check footings			
13. Check tank for defects (dints)			
Outlet Pipe			Annual
14. Pipe condition			
15. Evidence of blockage			
Below Ground Tanks			Annual
16. Back flow prevention valves checked by a licensed plumber			
Overflow Area			6 months
17. Area where overflow is directed is not showing signs of erosion			