BRANZ

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RESIDENTIAL RAINWATER SYSTEMS

August 2021

- Rainwater collection systems can provide a source of water for a property. Many homes in New Zealand already rely on rainwater collected from their roofs, especially in areas where mains water is not available.
- Rainwater systems can provide water suitable for drinking and food preparation if it is filtered and/or treated adequately and can also be used for garden irrigation, swimming pools, toilet flushing, baths and showers.
- Before installing a system at a dwelling, check the local council's requirements as these may vary.

1 INTRODUCTION

1.0.1 Rainwater collected and stored can provide an alternative source of water to networked mains water for some housing. These systems range in size from small garden rainwater barrels through to large storage tanks with filtration and treatment.

1.0.2 Depending on how it is collected, filtered and treated, rainwater can be used to meet all the water needs of a home including drinking water and for showers and baths, flushing toilets, swimming pools and watering the garden.

1.0.3 The benefits of collecting rainwater include:
- less reliance on mains water supply and a reduced volume of water entering the stormwater system
- can provide water to households where a mains water supply is not available
- reduced demand on the mains water supply network
- savings for houses with water meters
- increased resilience for homes during drought and local water restrictions
- community resilience during natural disasters and emergencies when the mains water supply may be cut off or contaminated
- more-efficient use of water as a natural resource at a national level.

1.0.4 Piped mains water is not available in many areas of New Zealand. A significant proportion of households currently use rainwater collection systems across the country. If rainwater collection is the sole or main source of potable water, the system must be designed to minimise the risk of contamination. If the water is connected to a system that is also supplied by mains water, an approved backflow prevention device must be fitted. The system must also be maintained adequately.

2 GENERAL REQUIREMENTS

2.1 WATER SUPPLIES TO HOMES

2.1.1 All buildings with water outlets and washing and toilet facilities must have safe and adequate water supplies under New Zealand Building Code clause G12 *Water supplies*.

2.1.2 A building consent is required for new installations if collected rainwater is piped into a house and/or will share pipes that are also supplied by a mains system. The installation work must be carried out by a certifying plumber.

2.1.3 Any water supply system must:
- be supplied at adequate flow rates if intended to be used for basins, bathtubs, toilets and other sanitary fixtures and appliances
- provide reasonable access for maintenance so that its components and any backflow prevention devices can be isolated for testing and maintenance
- not leak.

2.1.4 All private water supplies must be designed so there is no risk of contaminating mains water with other water sources or mixing potable and non-potable water supplies. This is achieved by including an air gap or backflow prevention device (see Acceptable Solution G12/AS1 Table 2). This must be installed by a certifying plumber.

2.1.5 A building consent may be required for the rainwater storage tank depending on its size and how high it is supported above the ground. Table 1 shows storage tanks that do not need building consent.

2.2 POTABLE WATER SUPPLIES

2.2.1 If the collected rainwater is intended to be potable (suitable for drinking water, rinsing and preparing food, washing cooking utensils and mouth hygiene such as tooth brushing, mouth rinsing and gargling):
- the system must be installed to avoid the likelihood of contamination into and within the system
- the water collected must be protected from external contamination
- the system installed must use components that will not contaminate the water (Acceptable Solution G12/AS1 *Water supplies*).

2.2.2 All parts of the system – roofing materials, gutters, pipes and the tank – must meet the requirements of AS/NZS 4020:2018 *Testing of products for use in contact with drinking water*.

2.2.3 The required quality for potable water supplied by local authorities is set under the *Drinking water standards for New Zealand 2005 (revised 2018)*, issued by the Ministry of Health. Although these standards are not mandatory for private households, they are a good guide to achieving acceptable water standards. They recommend that, where mains

Table 1. Water storage tanks that do not need building consent.

Tank volume (litres)	Height above the ground
Up to 35,000	Supported directly on the ground
Up to 16,000	Not more than 0.25 m
Up to 8,000	Not more than 0.5 m
Up to 4,000	Not more than 1 m
Up to 2,000	Not more than 2 m
Up to 1,000	Not more than 3 m
Up to 500	Not more than 4 m

supply is available, it should be used for drinking, food preparation and oral hygiene in preference to collected rainwater. It also recommends water filtration and treatment for rainwater as drinking water where no mains supply is available. For older rainwater systems, bringing the treatment level up to the level of quality specified is advisable.

2.2.4 Some local authorities may not recommend the use of rainwater for drinking, particularly in urban areas.

2.3 NON-POTABLE WATER INSIDE THE HOME

2.3.1 If a non-potable water supply is installed in or outside a home, it must be installed and clearly labelled as non-potable in line with AS/NZS 3500.1.2021 *Plumbing and drainage – Part 1: Water services* sections 9.6 and 9.7, Acceptable Solution G12/AS1 section 4 and NZS 5807:1980 *Code of practice for industrial identification by colour, wording, or other coding* Part 2.

2.3.2 If non-potable water is intended to be used for personal hygiene, the system must be installed in a way that minimises the risk of spreading illness or causing any injury.

2.3.3 Non-potable outlets must be clearly labelled with a safety sign (see Acceptable Solution G12/AS1 section 4.2). Lilac-coloured piping indicates a non-potable supply.

2.3.4 Piping containing non-potable water must not be located where food is processed or above potable water tanks.

2.4 OTHER CONSIDERATIONS

2.4.1 Building Code clause B1 *Structure* will apply to the restraint of tanks. Ensure storage tanks in areas prone to earthquakes are adequately secured.

2.4.2 Building Code clause E1 *Surface water* covers the collection and disposal of surface water in a way that protects people and property. Acceptable Solution E1/AS1 includes requirements for roof drainage and the capacity of gutters and downpipes.

2.4.3 Work that must be carried out by a certifying plumber:
- Piping stored rainwater into a house that is also connected to the mains supply.
- Piping stored water into a toilet cistern (non-potable).
- Installing backflow protection devices.
- Installation of some filtration systems for the storage tank and underbench point-of-use fittings.

2.4.4 Work that other trades can carry out:
- Cleaning and maintenance of existing systems not connected to a potable water system.
- Replacing roofing and guttering.
- Replacing filters.
- Installing spouting, leaf guards, strainers or a first-flush diverter.
- Installing storage tanks.
- Plumbing in garden irrigation systems not connected to a potable water system.

3 SPECIFICATIONS

3.0.1 The simplest rainwater collection systems (Figure 1 and 2) comprise:
- a collecting area, usually a roof
- pipes into a tank (this can range from a small rainwater barrel to a large storage tank)
- guards to keep debris out of the water before it reaches the storage tank
- access to the water in the tank through taps or piping (gravity-fed or pumped)
- an overflow pipe.

3.0.2 The complexity of the system can increase depending on the intended end use of the rainwater and measures to ensure and protect the water quality – for example, by including filtration and water treatment.

3.0.3 The system should be designed in line with:
- the likely water needs of the household – when calculating the amount that could be collected to ensure it meets a household's needs, assume around 10–20% loss through spillage and evaporation
- the likely amount of water that can be collected in that location – this depends on the local average rainfall and the area used for water collection (usually the roof).

3.0.4 Make sure all parts of the system are accessible for regular maintenance.

3.1 RAINWATER COLLECTION AREA

3.1.1 Designing the water collection area appropriately and maintaining it during operation are critical for maintaining the water quality as the water can become:
- chemically contaminated if inappropriate materials are used in the roof or water-collecting area
- unhealthy to use if contaminated by wind-blown dust, leaves, animal droppings, insects or dead animals
- contaminated by local pesticide or herbicide spray drift.

3.1.2 Suitable roofing materials for a rainwater collection system include:
- unpainted zinc/aluminium-coated steel or galvanised steel
- steel (factory-coated, painted zinc/aluminium alloy-coated or galvanised)
- stainless steel
- concrete or clay tiles
- PVC (without lead stabilisers)
- fibreglass sheeting
- untreated timber shingles (usually imported western red cedar)
- butyl rubber
- asphalt shingles
- most torch-on membrane roofing (check with the supplier to ensure it is suitable).

3.1.3 For roofs where drinking water is to be collected, do not use:
- uncoated lead flashings on new roofs (coat lead flashings on existing roofs with a suitable paint)
- treated timber
- paints that are lead-based or bitumen-based (some special-purpose lead-based paints containing red lead

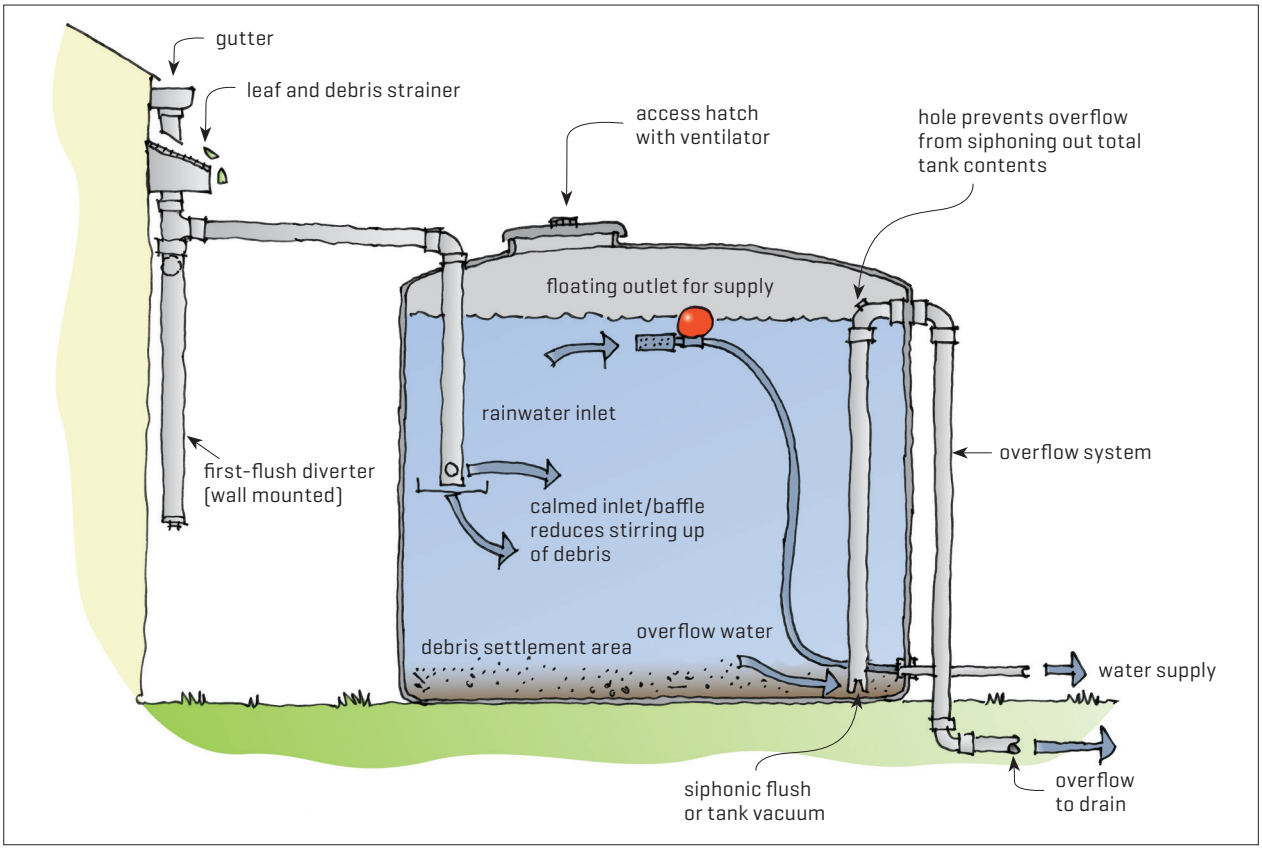

Figure 1. Components of a rainwater collection area and tank. Leaf and debris strainer, first-flush diverter, calmed inlet and floating outlet are installed to minimise contamination and ensure water quality.

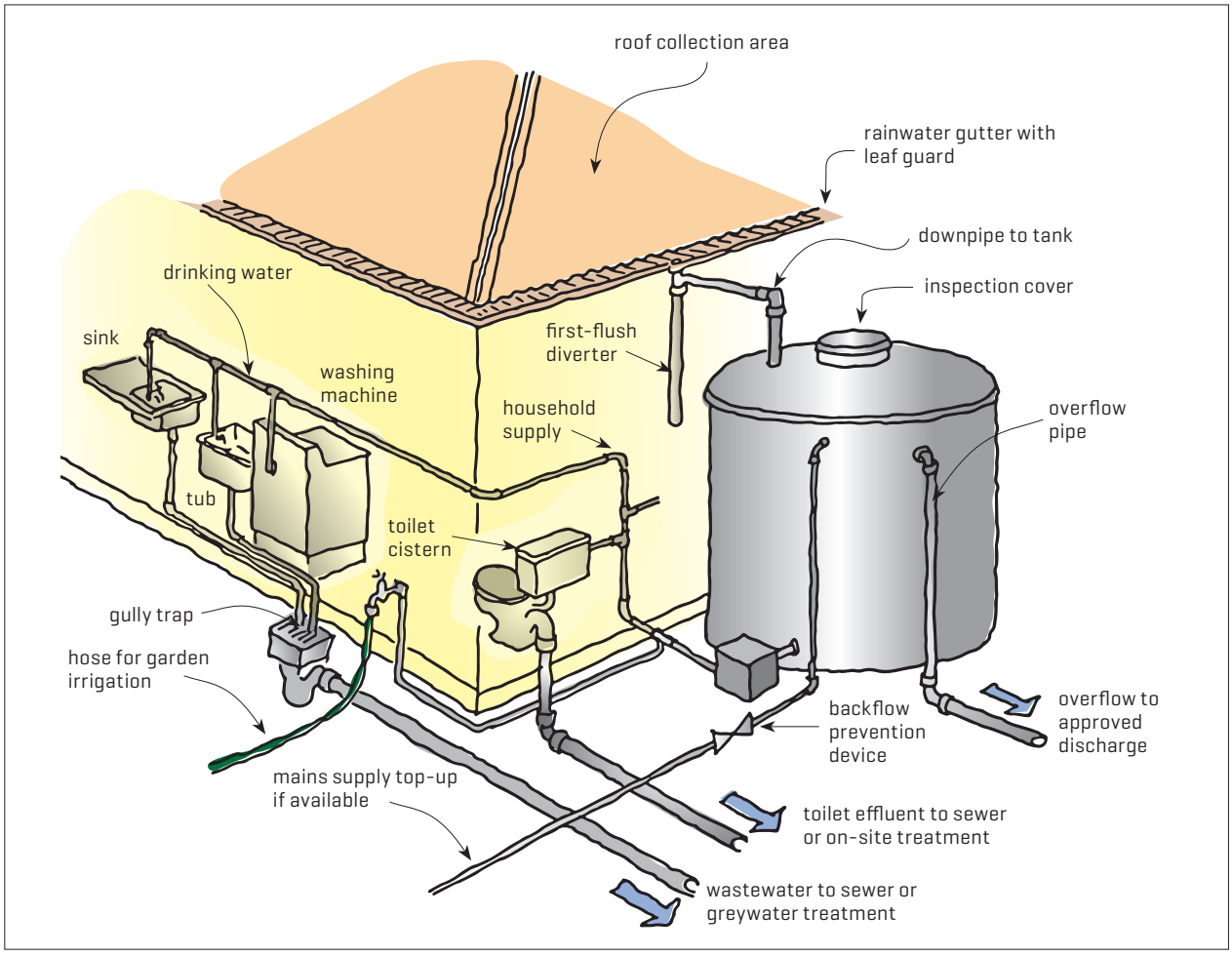

Figure 2. Rainwater collection system supporting household needs, including drinking water.

are still available, and anti-rust primers sometimes contain chromium salts)
- roofs coated with acrylic paints until they have been washed by a good rainfall
- bitumen membranes
- an older asbestos-cement roof cladding
- roofs with lead head nail fixings.

3.1.4 To ensure the water is clean enough for its intended end use:
- make sure the collection area is clear of overhanging tree branches where birds may perch or roost
- where possible, limit access to the water collection area by rodents, possums or cats
- position any equipment such as aerials, antennae or satellite dishes away from the collection area to avoid contamination by bird droppings
- if designing a new home, make note of any chimney flues and ensure their discharge will be carried clear of the roof collection area
- it is always a good idea to get a sample of the water tested – most district health boards (DHBs) provide this service and DIY test kits are also available.

3.2 GUTTERS AND PIPEWORK

3.2.1 The common materials used for gutters and downpipes are suitable for water collection (uPVC, factory-coated zinc/aluminium alloy-coated steel or galvanised steel, copper, seamless extruded aluminium and polyethylene/polypropylene).

3.2.2 All new roofs should receive at least one good period of rainfall to wash the area thoroughly before connecting the downpipes to the tank.

3.2.3 The collection area should be able to be disconnected when there is repainting or maintenance of the roof, flashings or other surfaces that run off into the system.

3.2.4 Collection areas can accumulate sediment, debris and other pollutants that can be washed from the roof when it rains. To reduce dirt and debris from the roof and gutters entering the storage tank, specify:
- mesh leaf screens in roof gutters and downpipes (Figure 3)
- a first-flush diverter to divert the first portion of the rainwater away from the storage tank (Figure 4)
- insect screens on any vents or openings, however small
- tightly fitting covers for all tank inspection ports.

3.2.5 In areas where dust, dirt, leaves, rust, smoke from solid fuel fires, traffic pollution and other pollutants are minimal, allow a minimum first flush of 0.2 litres/m^2 of roof area. In more-heavily polluted areas, allow 0.5 litres/m^2 of roof area. Ideally, leaf screens and first-flush diverters should be positioned where they can be easily inspected and located in plain sight to encourage regular inspections.

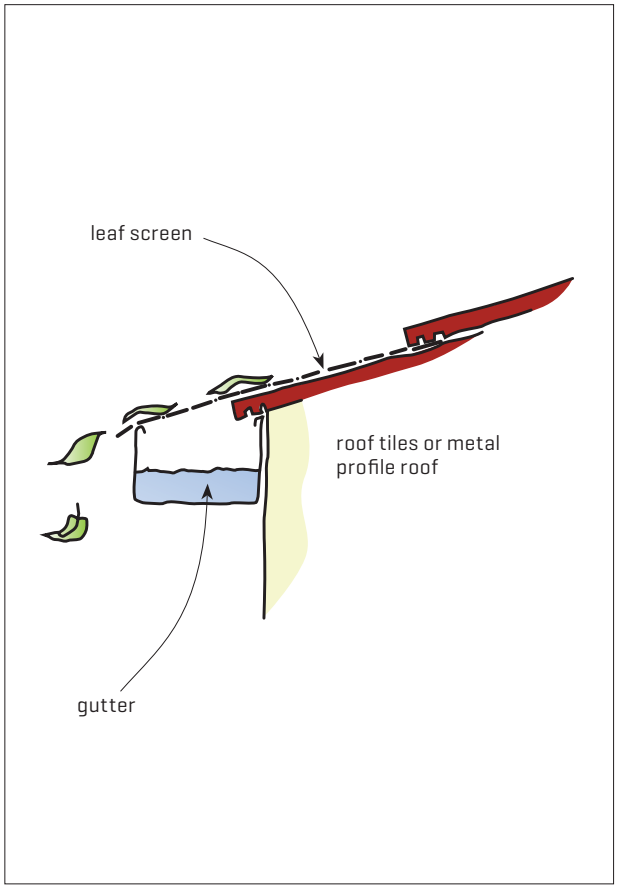

Figure 3(a). Leaf screen prevents leaves from entering gutter to ensure they are not flushed into the water storage tank.

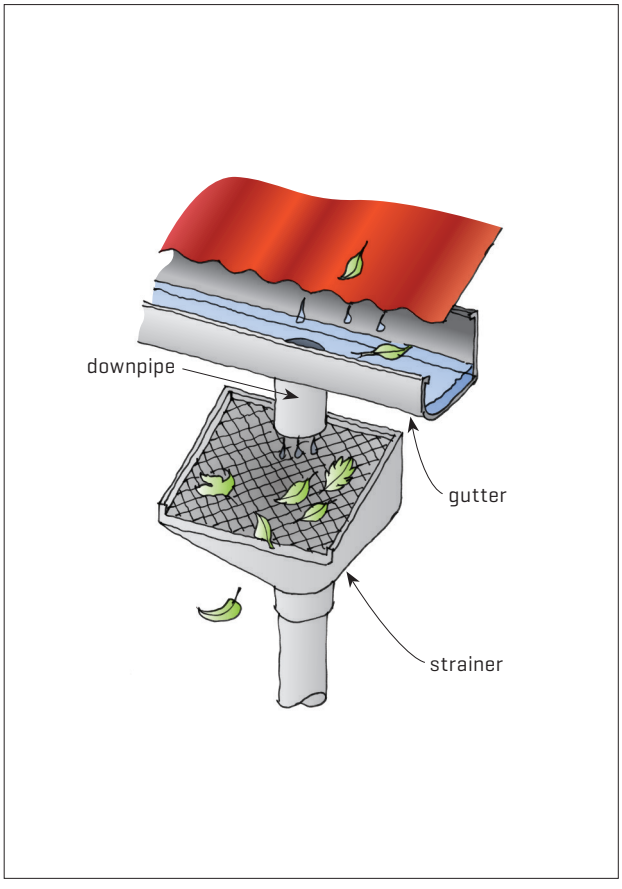

Figure 3(b). Downpipe leaf screen/strainer.

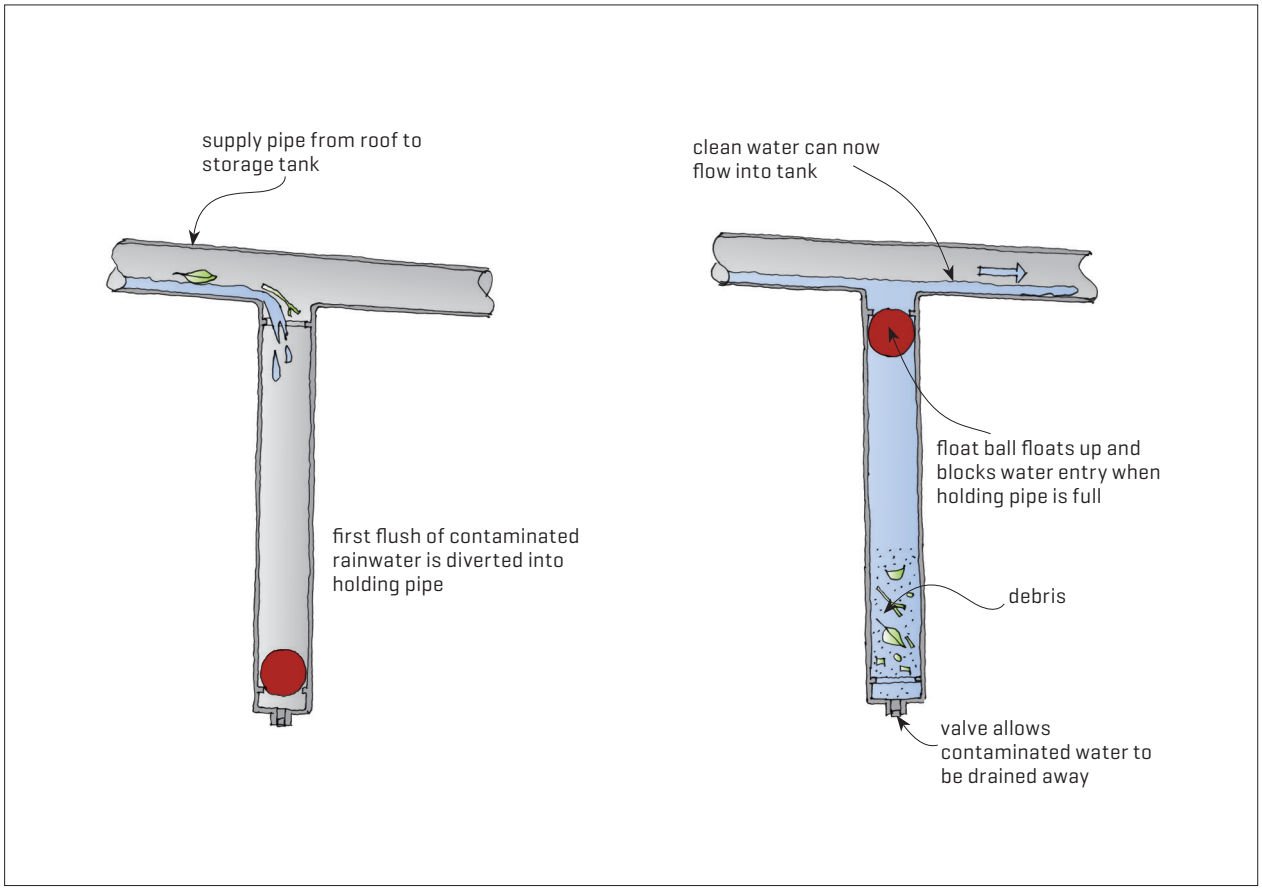

Figure 4. How first-flush diverters divert the first portion of the rainwater away from the storage tank.

3.3 RAINWATER STORAGE TANKS

3.3.1 Choose an appropriate size for the water tank. This will depend on:

- the water needs of the household (Table 2)
- what the water will be used for (irrigation and/or household use)
- whether rainwater collection is the main or only source of water for the household
- the local average annual rainfall
- whether stored water is required during a dry season
- the area available to locate the tank (slimline tanks are available for properties that are short of space).

3.3.2 Tanks can be above ground or underground and should be fitted with a secure lid.

3.3.3 Check with a structural engineer and your local council if you are thinking about installing the tank in the ground, especially if near building foundations, retaining walls or property boundaries.

3.3.4 Ensure the tank has adequate bracing if installing in an area prone to earthquakes.

3.3.5 If possible, the tank should be located so that it is shaded from the sun, particularly at the hottest time of the day.

3.3.6 Water storage tanks can be made of galvanised steel, zinc/aluminium alloy-coated steel (only if not in ground contact), fibreglass, plastic, concrete or ferro-concrete. AS 2070-1999 *Plastics materials for food contact use* is frequently applied to tank manufacture in New Zealand. Tank materials must not be able to transmit light, as this will encourage organic growth such as algae.

3.3.7 Some materials used in tanks may affect water taste when they are new. A galvanised steel tank may initially cause a metallic taste. A new concrete tank may release lime that increases the pH of the water and cause a slightly bitter taste.

3.3.8 To manage the water quality, particularly for systems delivering potable water:

- a calmed inlet for rainwater entering the storage tank can be added to minimise the disturbance of sediments in the bottom of the tank (Figure 1)
- a floating water intake inside the tank takes the clearest water from the top, avoiding any sediment in the water that will settle to the bottom of the tank – this must always be fitted in conjunction with a calmed water inlet
- any fine sludge (sediment and micro-organisms) at the bottom of the tank can be removed automatically by siphoning water from the tank each time it overflows – fit a siphonic flush or vacuum overflow system with an inlet positioned near the bottom of the tank (Figure 1).

3.3.9 A fixed low-level outlet is positioned at least 300 mm above the base of the tank. This can be used for water supply and for emptying the tank for maintenance.

Table 2. Typical polyethylene storage tank capacity and how long the water would last without top-ups from rainfall if four people are using the water.

Tank capacity (litres)	Approximate days of use available to four people		
	Use at 90 l/person/day (with no rainfall)	Use at 150 l/person/day (with no rainfall)	Use at 260 l/person/day (with no rainfall)
450	1-2	Less than 1	Less than 1
1,000	3	1-2	1
2,000	6	3	2
3,000	9	5	3
4,550	14	7.5	4.5
9,000	28	15	9
10,000	31	16.5	10
15,000	47	25	15
25,000	78	41.5	25

3.3.10 If mains supply water is connected and used to top up the rainwater tank, always install backflow protection (Figure 2) and ensure that the top-up water is only added when the tank is low. Use a switch valve rather than a float valve, as a float valve would add water whenever there is any draw-off and cause the rainwater tank to overflow during the next rainfall.

3.3.11 Installing a greywater reuse system on the property can reduce the amount of water drawn from a rainwater system.

3.4 FILTERING AND TREATMENT

3.4.1 Filtration and/or treatment systems can improve the water quality. The selection of the filtering and treatment systems depends on the intended end use of the water and on likely local sources of contamination.

3.4.2 Even when leaf screens and first-flush diverters are used, the harvested rainwater may contain bacteria, viruses, algae, pesticides and other contaminants. Filtering and treating the water further can reduce contaminants and some odours. Some local authorities will only allow treated water to be used for drinking, food preparation and bathing.

3.4.3 There are many options. A filter under a kitchen bench can provide cleaner water for just one tap. Systems can also be installed to filter and treat all water entering a house from the tank.

3.4.4 Different types of filter are typically used together. Installing different types to work together is common.

3.4.5 Filters generally used first are mesh or cartridge filters that screen out sediment and dirt. A 0.5 micron filter would be needed to remove some organisms, such as *Giardia* cysts. This type of filter can extend the life of the taps, appliances and filters that come after them. Some filters can be cleaned by washing them out under running water but will need to be replaced regularly (Figure 5). Follow the manufacturer's instructions.

3.4.6 Carbon filters can be used as a second-stage filter for purification to reduce the quantities of chemicals and minerals, numbers of bacteria and unwanted tastes and odours. Water purification is usually carried out at the point of use at the tap. Follow the manufacturer's guidelines for replacing these filters.

3.4.7 Where a higher quality of water is needed, a reverse osmosis filter can remove lead, pesticides and bacteria. This sort of filter works by passing water through a semi-permeable membrane.

3.4.8 Additional water treatment can be added after the filtration:

- Systems that expose the water to ultraviolet (UV) light to disrupt the DNA of micro-organisms, such as bacteria and viruses, to stop them from multiplying.

Figure 5. A new pleated mesh cartridge filter and the used filter it is replacing. Filters should be replaced regularly in line with the manufacturer's instructions.

- Ozone treatment (where ozone gas is bubbled into the water) kills micro-organisms and can reduce levels of pesticides in the water and remove unpleasant odours.
- Chlorine can be added to water in liquid or tablet form. This may leave a chemical residue after treatment and can affect the taste of the water.
- Liquid hydrogen peroxide, an antiseptic bleaching agent, can be added to remove algal growths at 2 litres per 20,000 litres of stored water. It works over a larger water pH range and does not affect the taste.

3.4.9 Automatic treatment systems are recommended over manual treatment. For systems intended to provide drinking water, annual testing of the water quality is recommended.

3.5 OVERFLOW AND DISPOSAL OF EXCESS WATER

3.5.1 Overflow from rainwater tanks should either be contained on the property or diverted to the stormwater system.

4 MAINTENANCE

4.0.1 Regular maintenance in line with the system manufacturer's instructions is needed to ensure that rainwater system operates properly.

4.0.2 Research shows that few owners maintain their rainwater systems adequately. Informing owners and giving them a maintenance schedule and details about maintenance procedures is recommended. It should specify when to:

- wash down roof surfaces with a suitable environmentally friendly detergent (use a diverter or disconnect the pipe to the tank first)
- clean gutters and drainpipes, leaf screens and downpipe diverters
- check for branches growing over the collection area and cut them back
- inspect the tank for build-up of sludge
- check filtration and any treatment systems as recommended by the manufacturer
- check pump operation and condition
- if possible, chemically test a water sample.

4.0.3 If the water storage tank is large enough, cleaning may involve climbing inside it. Take suitable precautions for working in confined spaces, especially if using electrical tools or chemicals. Ensure someone reliable knows what you are doing before beginning the task and agree on a check-in time for when the task is finished.

4.0.4 The homeowner should be advised to have a supply of sodium hydrochlorite or hydrogen peroxide-based products for emergency water treatment.

5 MORE INFORMATION

BRANZ Good Repair Guide *Rainwater storage systems*

BRANZ Level Sustainable Building Series *Water*

BRANZ Facts series *Water*

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