

# Technical Solution Sheet 99.02

## 99: Rainwater Tanks

Duplicate solution of 5.09 (Cold water plumbing)

### Rainwater Tanks

#### AIM

The aim of this technical solution is to provide guidance on the calculations required to ensure that rainwater tanks are of an adequate size for toilet flushing with the range of annual and monthly rainfalls experienced in Victoria, and to provide advice on installation of cold water services.

#### PLUMBING REGULATIONS 2008

The *Plumbing Code of Australia* (PCA) is adopted by and forms part of the *Plumbing Regulations 2008*. Part B1 of the PCA specifies the objectives and performance requirements related to the installation of cold water services. [AS/NZS 3500.1: Plumbing and drainage Part 1: Water services](#), is a “deemed to satisfy” document listed in Part B1 of the PCA and contains a section on “Installation of water supply systems from rainwater tanks”.

The 6 Star requirements as set out in the Victorian variation to the energy provisions of the Building Code of Australia provide that, in the case of a new Class 1 building, either a rainwater tank be connected to all sanitary flushing systems, or a solar water heater system is to be installed in accordance with the *Plumbing Regulations 2008*.

Where a rainwater tank option is selected, the *Plumbing Regulations 2008* requires that the installation, in order to comply with the building regulations must:

- be installed in such a way that it receives the rainfall from a minimum catchment area of 50 square metres;
- have a minimum capacity of 2000 litres; and
- be connected to all toilets in the building for the purpose of sanitary flushing.

The option only applies where a reticulated mains water supply is available for new housing. If a mains water supply from a water authority is connected, or proposed to be connected to a building where a rainwater tank is installed for sanitary flushing, an automatic or manual interchange device that allows alternate use of mains water or rainwater must be installed to ensure that there is a continual supply of water for sanitary flushing.

#### RAINWATER FOR TOILET FLUSHING

**Q: How do I know what the rainfall is in a given region of Victoria?**

**A:** The Bureau of Meteorology provides extensive median average rainfall figures on its web page: [www.bom.gov.au/climate/data/](http://www.bom.gov.au/climate/data/)

The figures are given for places in the following eight Victorian regions: Eastern Melbourne, Western Melbourne, South West Victoria, Mallee and Wimmera, Northern Victoria, North East Victoria, East Gippsland, West and South Gippsland (see Table 1).

**Q: How do I calculate the volume of rainwater needed for toilet flushing?**

**A:** Calculating the available rainwater for toilet flushing is relatively simple once you know the average monthly figures.

# Technical Solution Sheet 99.02

In the majority of Victoria's regions the average yearly rainfall is around 600mm or more, a 2000 litre tank size served by 50m<sup>2</sup> of roof catchment area will provide for reliable annual toilet flushing.

The regions where significantly less annual rainfall is received such as those shown in red will need to have the roof catchment area and possibly the tank size increased to provide a reliable rainwater supply for toilet flushing.

The following two examples of Dandenong and Mildura show the calculations to determine the projected monthly storage and usage patterns. Note that for the Mildura example the roof catchment area has been increased to 100m<sup>2</sup> to compensate for the much lower rainfall in that region.

## MONTHLY CATCHMENT CALCULATION

Formula:	Run-off (litres) = 0.85 (efficiency) x Rainfall x Roof area
Vt	= Vt-1 + (Run-off – Demand)
Vt	= theoretical volume of water left in the tank at the end of the month
Vt-1	= volume of water left in the tank from the previous month
Run-off	= as calculated above
Demand	= 60 litres/day x 30 days = 1800/month

### Notes:

- Monthly median average rainfall is used in the formula and assumes at the start of the wetter months the tank is empty.
- The following examples shows the monthly calculations based on the above assumptions starting in August when the tank (Vt-1 = 0) is assumed to be empty.

# Technical Solution Sheet 99.02

TABLE 1 - SAMPLE MEDIAN AVERAGE RAINFALL FIGURES FOR VICTORIA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Eastern Melbourne	Brighton	39.5	36.2	39.8	55.8	58.5	46.8	53.3	55.6	51.3	64.8	53.4	46.6	691.2
	Bundoora	43.8	28	40.8	52.9	48.6	50.5	49.3	58.4	47.6	59.8	65.1	60.8	659.6
	Carrum	37.6	37	36.6	56	65.8	55.1	58.3	68.2	69.9	67.2	55.4	50.5	696.5
	Dandenong	46	31.2	42.5	60.6	70.6	62.6	67.6	76.2	64.4	62.6	61.4	54.2	754.5
	Essendon	32.5	33.2	32.9	45.2	47.4	32.7	41.7	47.2	49	57	47.6	45.6	604
	Koo Wee Rup	44.6	40	46.2	57.9	68.8	61.8	66.4	81.7	82.2	69.8	65	52.2	792.5
	Lilydale	48.6	39.3	48.1	65.3	77	70.7	71.6	81.5	78	87.2	78	68.4	897.5
	Melbourne	43.2	25.4	35	47.9	61.4	40.8	50.5	58.5	52	63.4	52.5	59.3	670.5
	Mornington	40	33	41.6	54.9	64.1	64.2	64.9	71.7	68.1	65.9	57.6	47	727.9
	Rosebud	35.8	31	43.5	65.1	78	70.7	78.8	80.4	65.4	63.5	53.3	47.8	797.3
	Scoresby	50	38.3	46.9	62.6	83.2	64.2	71.2	85.2	80.8	79.9	73.8	72.9	853.1
Wonthaggi	38.9	35	54	72.6	92.6	90.1	94.4	104.3	89.4	81.1	66.8	59.3	918.5	
Western Melbourne	Ballan	36.7	29.5	37	47.4	53.5	59	53.7	66.6	61.7	74.3	52.2	47.3	682.7
	Duridwarrah	35.8	30.8	41.2	47.2	56.2	51.1	50.8	58.1	59.7	66.3	48.8	46.3	663.4
	Flemington	30.6	32.6	30.3	43.8	47.7	38.1	42.2	46.2	48.2	57.4	43.2	48	579.6
	Geelong	29	23	27.4	36.1	47.3	41.3	43.2	49.2	46.7	49.3	38.1	37.1	539.2
	Macedon	40.6	34.9	40.1	60.2	69.9	82.3	80.1	83.6	79.7	79.7	54.8	47.2	861.2
	Melton	29	26.1	26.5	30.5	36	30.1	30.8	33.6	38.2	44.7	37.5	33.5	499.9
	Queenscliff	28.8	27	31.3	43.9	55	51.7	54.1	58.8	53.8	52.3	44.6	38.9	591.8
Werribee	38.4	29.2	29.2	39.9	47	31.6	39	46.8	47	60.2	43.4	40.6	510.2	
South West Victoria	Anglesea	38.2	28.9	35.4	57.5	69.2	69.6	80	91.8	75.6	75.4	63	46.3	797.9
	Apollo Bay	44.5	36.4	55.5	70.2	93	104.2	112.2	122.7	101.4	90.3	77.7	57.4	1037.2
	Ararat	32.8	23.6	24.4	33.6	48	55.2	63	64.1	57	55.4	47.8	28	606.7
	Ballarat	40.6	36.1	43.5	62.4	75.9	82.4	83.8	94.4	83.1	80.4	62.6	48.2	871.8
	Colac	30	22.9	35.2	50.9	68.9	74.7	71.1	85.7	74.9	64.9	52.7	39.8	719.5
	Hamilton	24.4	19.5	30.3	34.5	42.8	60.3	68.6	77.7	61.2	54.6	46.2	36	613.8
	Koroit	30.4	27.6	45.2	62.7	73	81.2	87.6	85.3	77.4	68.1	53.1	46.9	766.3
	Portland	25.9	25.7	36.7	61.8	81.2	93.5	105.4	102.1	81.3	66.8	48.3	38.6	835.1
Mallee and Wimmera	Birchip	18	7.3	9.6	14.2	28	28.6	33.4	38.9	29.4	28.8	29	10.7	381.2
	Dimboola	14.9	15.2	15	22.6	39.6	43.8	41.5	42.5	38.2	34.8	24.6	18	407.6
	Donald	20.6	12.3	15	17.8	35.1	31.5	37.8	41.1	31.1	30.8	25.8	18.4	386.2
	Halls Gap	30.4	28	33.2	52.8	82.5	99.8	133.9	120.2	106.6	73	57.4	42	1010.1
	Horsham	18.9	18.4	14.8	16.9	38.1	27.8	46.8	49.3	41	35.5	30.2	20.5	427.5
	Lake Boga	12.7	12	13.4	16.6	32.8	26.8	30.6	31.6	29.6	25	19.5	17	341
	Mildura	11.4	9.5	11.2	12.7	17.5	16.2	25.5	21.2	25.4	21.1	18.8	14.2	275.5
	Ouyen	11.5	12.9	11.9	14.1	27.2	24.4	30	31.8	26.4	25.6	20.8	17.3	329.4
Northern Victoria	Alexandra	35	25.8	36	46.5	60.5	69.6	68.1	71.7	65.5	64.4	53	41.4	710
	Avoca	21.4	20.1	20.8	28.8	42.8	56.8	59.8	57.1	45.7	44.3	29.5	26.4	548.8
	Bendigo	22.4	22.2	13.8	22.6	33.2	44.9	59.2	53.2	40.8	40.8	45.2	30.4	452.4
	Cobram	20.2	16.2	19.9	27.8	40.6	30.5	36	45.8	36	31.4	34.4	20.6	466.8
	Echuca	17.9	13.9	19.2	26.5	35.2	41.3	36.6	39.2	34	32.9	27.4	18.3	415.2
	Kerang	14	14.6	17.9	18.8	34.1	31.1	32.7	34.5	33.3	30.5	21.7	15.6	369.1
	Kyneton	33	19.6	27.8	45.8	74.5	71.4	84	94.9	74.6	63.4	49.8	41.8	767.8
Violet Town	27.2	20.3	29.3	39.8	51.8	69.6	65.7	66.7	57.7	56.2	39	27.5	645.6	
North East Victoria	Bright	53.9	45.3	46.7	57.4	101.1	103	124.6	149.4	119.8	106.2	73	68.8	1193.2
	Euroa	28.7	20.6	30.8	35.8	52	76.3	67.1	68.6	53.7	57.7	38.2	29.9	652.5
	Mansfield	36.5	26.5	37.4	42	56.3	65.4	68	72.3	66.3	69.4	51.5	40.3	722.4
	Mount Buffalo	63.7	56.2	75.1	108.3	154.8	185.9	209.4	215.2	190.5	155.8	113.3	92.8	1889.6
	Omeo	43.2	44.5	44.3	36.3	38.9	46	44	52	57.8	68.3	60.7	55.6	679
	Rutherglen	26.6	23.5	27.4	34.2	45	50.4	53.9	62.5	52.2	55.9	37.6	34.7	565.4
	Wangaratta	26	22.8	28	34	51.8	70.1	63.2	49	54.3	42.4	54.4	23.4	595.2
Yackandandah	34.4	29.4	47.5	49	80.2	105.9	101.7	104.9	86.2	82.3	54.1	48.8	938.1	
East Gippsland	Bairnsdale	51.5	45.5	46.4	48.5	33.8	37	33.4	42.6	49.9	57.6	73.6	57.6	669.5
	Bendoc	66	61.2	73	69.1	76.6	106	90.2	89	91	96.4	91.1	80.7	1176
	Cabbage Tree Creek	57.6	55.6	58.2	61.6	77.2	79.3	77.7	73.8	76	83.6	82.7	83	1057.3
	Cann River	52.5	54.4	50.7	75.4	54.5	70.9	68.4	58	72	65.9	77.2	76	891.1
	Point Hicks	51.3	47.2	53.8	70.5	75.2	81.6	77.7	74.6	70.6	67.3	69.6	64.4	918.4
	Lake Tyers	50.4	43.6	53.8	49.7	50.1	49.3	46	55.1	59	64.7	66.2	64.9	811.3
	Nowa Nowa	48	46.7	44.7	50.4	49.5	66.6	53	57.9	62	73.7	75.2	67.2	834.6
	Orbost	57	45.8	46.9	55.5	57	65.3	48.9	50.7	61.9	71.3	63.2	63.8	833.4
West and South Gippsland	East Sale	39	32.6	39.6	38.6	35.1	39.4	32.3	42.3	48.5	52.6	55	46.2	601.9
	Erica	66.6	55.9	68.7	78.8	74.9	77.5	76.4	86.2	98.9	110	106.6	96.2	1098.6
	Fish Creek	48.7	44.1	61.4	75.2	97.4	98.6	100.6	110.8	90.3	89.6	79.4	65.2	1020.2
	Leongatha South	46.1	37.6	54.2	67.8	83.6	84.6	84.3	95.6	94.2	90	73.6	67.3	948.3
	Moe	53.6	44	53.4	61.9	79.5	84.7	88.4	94.6	90.9	93.8	77.6	68.4	974.2
	Noojee	65.5	57.8	53.8	68	69.8	92	88.2	112.8	119	95.4	92.3	81.5	1064.6
Stratford	43.5	36.3	42.2	39.6	30.4	37.6	31.8	37.8	48.9	49.5	65.5	54.3	597.8	
Warragul	55.4	41.7	56.8	73.9	80.5	85.9	85.8	101.1	99	102.7	84.8	77.3	1017.5	

# Technical Solution Sheet 99.02

## EXAMPLE 1 - DANDENONG (SOUTH EASTERN MELBOURNE REGION)

Average daily flushing	60 litres (Assumes family of four, 3.8 litres from 6/3 cistern 16 flushes per day)
Average annual rainfall	
Monthly average mm	Jan 46 Apr 60.6 Jul 67.6 Oct 62.6 Feb 31.2 May 70.6 Aug 76.2 Nov 61.4 Mar 42.5 Jun 62.6 Sep 64.4 Dec 54.2
Catchment area	50 m <sup>2</sup>
Catchment efficiency	85%
Number of downpipes	1 or 2
Run-off formula	Run off (litres) = 0.85 (efficiency) × Rainfall × Roof Area e.g. January Run off = 0.85 × 46 × 50 = 1,955
Tank size	2,500 litres (standard tank size)

Month	Calculation	Month	Calculation
<b>Aug</b> 76.2mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (3,239 - 1800)$ $= 1,439$	<b>Feb</b> 34.7mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (1,326 - 1800)$ $= 2,026$ (0 overflow)
<b>Sep</b> 64.4mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 1,439 + (2,737 - 1,800)$ $= 2,376$ (0 overflow)	<b>Mar</b> 42.8mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,026 + (1,806 - 1800)$ $= 2,032$ (0 overflow)
<b>Oct</b> 66mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,376 + (2,661 - 1800)$ $= 3,236$ (736 overflow)	<b>Apr</b> 62.6mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,032 + (2,576 - 1800)$ $= 2,808$ (308 overflow)
<b>Nov</b> 60.3mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (2,610 - 1800)$ $= 3,310$ (810 overflow)	<b>May</b> 74mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (3,001 - 1800)$ $= 3,701$ (1,201 overflow)
<b>Dec</b> 49.3mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (2,304 - 1800)$ $= 3,004$ (504 overflow)	<b>Jun</b> 62.9mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (2,661 - 1800)$ $= 3,361$ (861 overflow)
<b>Jan</b> 49.6mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (1,955 - 1800)$ $= 2,655$ (155 overflow)	<b>Jul</b> 68.6mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 2,500 + (2,873 - 1800)$ $= 3,573$ (1,073 overflow)

- This scenario caters for all toilet flushing with a total overflow of 5,646 litres.

# Technical Solution Sheet 99.02

## EXAMPLE 2 - MILDURA (MALLEE AND WIMMERA REGION)

Measure	Amount
Average daily flushing	60 litres (Assumes family of four, 3.8 litres from 6/3 cistern 16 flushes per day)
Average yearly flushing	21900 litres
Average annual rainfall	755mm
Monthly average mm	Jan 11.4 Apr 12.7 Jul 25.5 Oct 21.1 Feb 9.5 May 17.5 Aug 21.2 Nov 18.8 Mar 11.2 Jun 16.2 Sep 25.4 Dec 14.2
Catchment area	100 m2
Catchment efficiency	85%
Number of downpipes	3 or 4
Run-off formula	Run off (litres) = 0.85 (efficiency) × Rainfall × Roof Area e.g. January Run off = 0.85 × 11.4 × 50 = 969
Tank size	2,500 litres (standard tank size)

Month	Calculation	Month	Calculation
<b>Jun</b> 16.2mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (1,377 - 1800)$ $= -423$	<b>Dec</b> 14.2mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 521 + (1,207 - 1800)$ $= -72$
<b>Jul</b> 25.5mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (2,168 - 1800)$ $= 368$	<b>Jan</b> 11.4mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (969 - 1800)$ $= -831$
<b>Aug</b> 21.2mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 368 + (1,802 - 1800)$ $= 370$	<b>Feb</b> 9.5mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (808 - 1800)$ $= -992$
<b>Sep</b> 25.4mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 370 + (2,159 - 1800)$ $= 729$	<b>Mar</b> 11.2mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (952 - 1800)$ $= -848$
<b>Oct</b> 21.1mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 729 + (1,794 - 1800)$ $= 723$	<b>Apr</b> 12.7mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (1,080 - 1800)$ $= -720$
<b>Nov</b> 18.8mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 723 + (1,598 - 1800)$ $= 521$	<b>May</b> 17.5mm	$V_t = V_{t-1} + (\text{Run-off} - \text{Demand})$ $= 0 + (1,488 - 1800)$ $= -312$

- Mains water supply supplement required: 4,198 litres

# Technical Solution Sheet 99.02

**Q: What size downpipe is required to connect the roof catchment to the tank?**

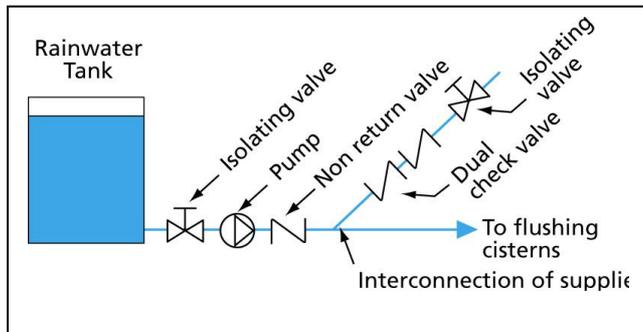
**A:** The size of the downpipe is determined as part of the normal eaves gutter and downpipe sizing process as set out in [AS/NZS 3500.3](#) or [SAA/SNZ HB39: Installation code for metal roofing and wall cladding](#). You need to know the rainfall intensity for the locality, the total roof catchment area and the effective cross sectional area of the eaves gutter to enable the downpipe size to be determined.

**Q: How do I get the rainwater from the tank to the toilet cistern?**

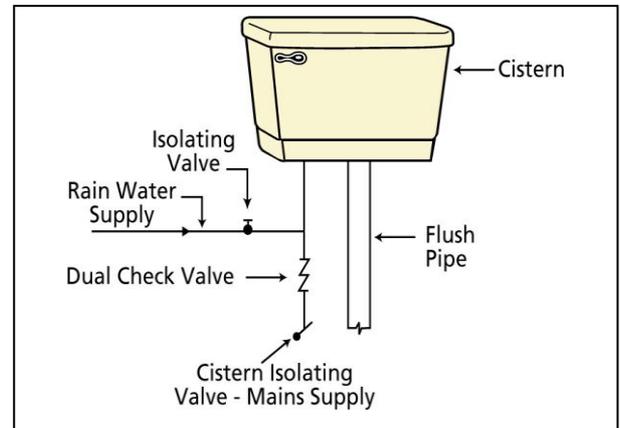
**A:** The Regulations are not prescriptive on this issue. There are several methods that can be used such as:

- A pressure pump incorporating alternative drinking water connection and backflow device (see Figure 1).
- Interconnected supply at or near the cistern (see Figures 2 and 3).
- Dual supply at the cistern (see Figure 4).

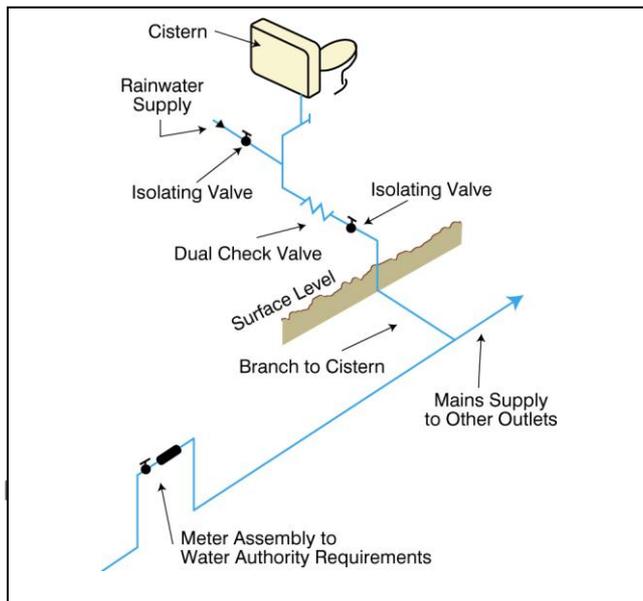
**FIGURE 1**



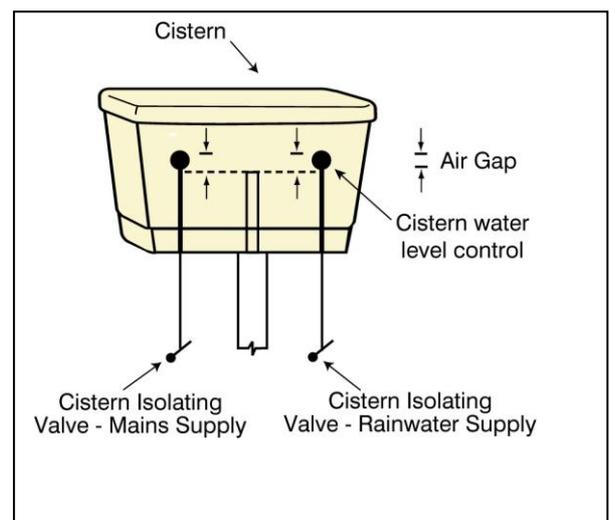
**FIGURE 3**



**FIGURE 2**



**FIGURE 4**



# Technical Solution Sheet 99.02

**Q: Is a mains water supplementary supply required?**

**A:** Yes, to satisfy the requirements of the *Plumbing Regulations 2008*, an alternative source of supply from a normal water authority reticulated supply is required as a supplementary supply should the rainwater within the tank be depleted.

**Q: How do I provide for the overflow from the tank?**

**A:** The overflow must be of sufficient size to cope with the design rainfall intensity for the area it is being installed in and must be discharged to the normal stormwater network.

**Can rainwater be used for any other purpose than toilet flushing?**

*AS/NZS 3500.1* does not specify what the rainwater can be used for. In Victoria, the Department of Health provides information on private drinking water supplies including rainwater use refer to:

[www.health.vic.gov.au/environment/water/tanks.htm](http://www.health.vic.gov.au/environment/water/tanks.htm)

**Q: Are there any restrictions on the size of the tank or where it can be installed?**

**A:** Some local government authorities may have restrictions on the maximum size of tank allowable and where it can be installed. For example a local council may require an above ground tank to be sited in a position that is not visible from the street and may require engineering computations for a large tank on a stand. The local council should be consulted by the property owner or plumber prior to installation.

**Q: What materials are approved for a rainwater tank construction?**

**A:** In general, the most common approved materials are polyethylene, concrete or zinc / aluminium for above ground tanks. *AS/NZS 3500.1* also specifies that tank materials in

contact with rainwater and drinking water shall comply with *AS/NZS 4020: Testing of products for use in contact with drinking water*.

**Q: Can rainwater tanks be installed below ground?**

**A:** Rainwater tanks may be installed above or below ground surface. However the hazard level classification in respect to backflow prevention on the water supply for a tank below the ground would differ as would overflow provision when compared to a rainwater tank located above the ground.

**Q: Do I have to install a first flush diverter on the tank?**

**A:** No, the tank manufacturer usually supplies a screening device on the inlet to the tank. The plumbing regulations do not make it mandatory to install a first flush diverter, but in some cases where leaves and other debris are a problem it may be preferable to install one.

## **REQUIREMENTS OF AS/NZS 3500.1 SECTION 14.**

Section 14 specifies the minimum requirements for the installation of the water supply system from the rainwater tank. The requirements only apply to those tanks installed where a reticulated mains water supply is also available.

**Q: What are the general requirements for the installation of a rainwater system?**

**A:** The installation and pipe material is as you would normally install a cold water service. The main difference is that the rainwater pipe must be clearly marked at intervals not exceeding 1m with the contrasting coloured wording 'RAINWATER' (see Figure 5). Water outlets shall be identified as 'RAINWATER' with a label or a rainwater tap identified by a green coloured indicator with the letters 'RW'.

# Technical Solution Sheet 99.02

**Q: Can an interconnection be made between the two water supply systems?**

**A:** The water supply system from a rainwater tank may be interconnected with the water service from a water main supply. An appropriate backflow prevention device must be provided at the interconnection to protect the water main supply. Refer to Figures in [AS/NZS 3500.1](#) (a), (b) and (c). Figure (d) shows an air gap. A suitable device should also be provided on the pipeline from the rainwater tank to prevent water flowing into the rainwater tank.

**Q: What hazard level / backflow prevention devices apply?**

**A:** A rainwater tank installed above the ground, supplying flushing cisterns only or for other general use of rainwater is classified as a “low” hazard and applicable non testable backflow prevention devices in accordance with [AS/NZS 3500.1](#) are suitable.

The hazard risk level increases where a rainwater tank is located to below the ground surface or the tank itself is used to mix chemicals / fertilizers etc. for garden irrigation. The hazard level would increase to at least a “medium” level and depending on the immediate environment could have a “high” hazard rating. For medium and high hazard ratings a testable backflow device must be provided.

**Q: Is backflow prevention required at the water meter outlet?**

**A:** The relevant Water Authority will determine the minimum “Containment Protection” that is required at the water meter outlet. A backflow prevention device may still be required at a water meter outlet regardless of whether the rainwater supply is interconnected with the water main supply.

**FIGURE 5 - RAINWATER PIPE MARKING**

