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Agenda Item #11
REPORT #RWSC 2009 - 19

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, 16 SEPTEMBER 2009

SUBJECT RESIDENTIAL RAIN BARRELS

PURPOSE

To evaluate if a rain barrel program would provide a benefit for water conservation or storm water management.

BACKGROUND

At the FCM conference in June 2009, one of the trade show booths featured large rain barrels. Several Commissioners suggested that information on the use of rain barrels be brought to the next Commission meeting.

Over the years, the public has requested rain barrel information from Demand Management staff, or that the CRD subsidize rain barrels as a water conservation measure. The public commonly perceive rain barrels as a water conservation tool that decreases potable water consumption and provides storm water management benefits, such as reduced flow to storm water or combined storm/sanitary sewers and ground water aquifer replenishment. Furthermore, rain barrel retailers promote rain barrel use with claims of water savings that result in reduced water bills, reduced energy costs and water pollution through decreased storm water runoff.

To develop accurate responses to the public's inquiries and assess the potential benefits of rain barrel water use, historical rainfall data was analyzed to determine the actual amount of times within the growing season that the rain barres would be a source of water. The analysis follows the criteria as outlined in the Veritec report, "Rain Barrels: Are they Effective" (**Attachment 1**) and simple paybacks noted below assume the following:

1. Based on a roof size of 100 m^2 (1,076 ft^2) and a typical rain barrel size of 220 litres, and assuming all the rain harvested is through one downspout, the rainfall event must provide a minimum of 2.2 mm of rain to fill a rain barrel.

2. Following a rain event, it is unlikely that a homeowner will use the collected rain water for irrigation purposes within two days of the rain barrel filling. Therefore, subsequent rain fall events within this time period will not fill the rain barrel since it is likely full from the first event.

Water Conservation

Based on the information above and given a growing season from May to September, historical rainfall events (**Attachment 2**) were analyzed to determine the frequency of rain barrels filling. Within Greater Victoria, a rain barrel will fill on average, 9 times per growing season, collecting approximately 2,000 litres of water. Assuming a 220 litre rain barrel is $100 and the average cost of water within the CRD is $1.01 per m^3 of water, a simple payback period for the purchase of a rain barrel is 49 years.

The payback period assumes the homeowner uses the collected water for outdoor purposes rather than simply using potable water that is under pressure and readily available at the outdoor tap for their outdoor water requirements.

Seattle Public Utilities provides information about rain barrel and rain barrel use through their website and public outreach materials. The paper entitled "The Seattle Rain Barrel" (**Attachment 3**) provides an overview of rain barrel use and best management practices to ensure that the rain barrel is used properly. The paper states "rain barrels won't make a noticeable difference in your water bill" and directs the reader to practice conventional water conservation practices for outdoor and indoor water use. Despite the bold claims of water savings from various rain barrel retailers, information from municipalities suggest otherwise; significant water savings are not realized from proper use of a rain barrel alone.

Other papers regarding potential water savings attributed to rainwater harvesting practices indicate that significant water savings are not realized until large volume cisterns (5,000 litres and greater) are used to collect the rain water and the collected water is used for indoor water uses such as toilet flushing and laundry use (**Attachment 4**). The engineering, permitting process and installation requirements associated with a large volume tank may be cost prohibitive to the average homeowner, unless in a new build situation. The Province also plans to require 'purple pipes' in new homes which would facilitate use of rainwater harvesting for non-potable uses such as toilet flushing.

Other factors that hinder potential water conservation efforts attributed to rain barrels include:

- *Roof type*: Roof materials such as asphalt shingle, copper, wood shingles that have been chemically treated may not be appropriate due to potentially chemical leaching into the garden. Best management policies instruct home owners that harvest rain water from these roof types to avoid using the water to irrigate vegetable gardens. Asphalt shingle roofs are common in Greater Victoria and therefore, water use from rainwater harvesting maybe limited.

- *Maintenance*: First flush diverter valves and screens are required on each rain barrel to reduce potential contamination of the rainwater and to hinder mosquito populations. Furthermore, gutters must be maintained to prevent leaves and other materials from fouling the first flush diverter and screens.

- *Quantity of rain barrels*: Since most homes have more than one downspout, multiple rain barrels may be necessary to collect the equivalent volume of one rain barrel. Increasing the number of rain barrels on the property increases the amount of maintenance required, which may influence the homeowner to choose the easier option of irrigation from potable sources.

Storm Water Management

Collecting rain water in large volume containers (cisterns) that hold 800 litres or more can provide benefits in reducing peak storm water run off, providing the tanks are drained slowly between storm events or if the water is used for non-potable indoor use (toilet use). However, due to the limited volume (220 litres) of residential rain barrels, they are likely ineffective in reducing peak storm water run off given that the barrel will fill quickly during a large storm event and only rain that has fallen on the roof is diverted from the storm sewer. The Veritec report estimated less than a 1% reduction in the volume of storm water entering the sewer system. Residential rain barrels should be considered a component of an overall storm water management program that also promotes natural yard care, permeable paving, rain gardens, as well as infiltration trenches.

Despite the size of the collection vessel, it is imperative that the water is consumed in some manner prior to providing storage volume for the next rains. Rain barrels must be equipped with a valve that is left open during the winter months to ensure that the rain barrel is evacuated during periods of no rain.

Should the homeowner forget to open the valve once the rain barrel is full, it will not provide further benefit to storm water diversion until such time as it is emptied again. Water that is collected in the rain barrel must be drained away at least 3 m from the home or neighboring buildings, and the water must not cause flooding. Furthermore, water should be drained on slopes greater than 15% due to potential erosion concerns.

<u>SUMMARY</u>

Rain water harvesting practices using large volume cisterns (greater than 800 litres) have been shown to provide benefits to water conservation and storm water management practices. However, due to the small volume of a typical rain barrel (220 litres), rain barrels will not provide the typical homeowner with significant reductions in potable water use and may provide only a limited benefit to storm water diversion.

RECOMMENDATION(S)

That the Regional Water Supply Commission receive the staff report for information.

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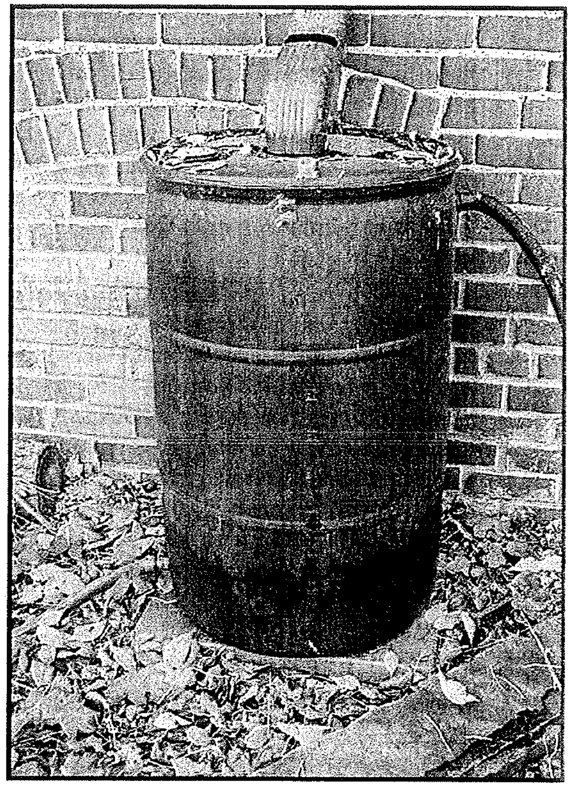
Rain Barrels: Are They Effective?



Are rain barrels making a comeback?

It seems that some municipalities are now endorsing rainbarrels as a means to:
a) decrease residential irrigation demands,
b) reduce volumes of storm water entering sanitary sewer systems and/or
c) educate/promote water efficient practices.

There are many different types and sizes of rain barrels available. The Region of Waterloo, Ontario alone lists nine different types of barrels on their webpage. Most barrels are made of plastic, weigh between 9 to 15 kg and hold between 190 to 400 litres of rainwater. They are generally fitted with a child-resistant lid, an overflow, a filter or screen, and a hose bibb installed near the bottom of the barrel. Rainbarrels can be quite decorative or very plain, and most range in price between $75 to $150, though some municipal programs subsidize this cost. The City of Ottawa even has a brochure explaining *How to Build Your Own Rain Barrel* with costs in the $30 to $50 range.

But... how much water do rain barrels actually save?
And... how much storm water do rain barrels actually divert?

Decision makers need accurate field data, not simply intuition, anecdotal information, or promotional material to correctly evaluate the potential for water savings or storm water reductions.

An example of the promotional literature from one Ontario rain barrel supplier claims:

- "The 220-litre barrel will 'fill-up' an average of 15 times per month."
- "You will reduce your water consumption by 27,000 litres per growing season."
- At a combined water/sewer cost of $0.74/m^3$, you will save about $20 per year and the payback for the $90 barrel is less than 5 years.

These claims would only be true if your growing season were nine months long and it rained every second day (but then, if it rained every second day you wouldn't need a rain barrel).

Municipal Objectives for Distributing Rain Barrels

Improving Water Efficiency

Consider -

1. Rain barrels tend to be full immediately after a rainfall (when the water is not required), and empty after a long dry period (when the water would be useful for watering).
2. Although a 220-litre rain barrel appears to hold a large volume of water, it actually holds the equivalent of about 9 minutes of watering with a garden hose. Most literature states that 25 mm (one inch) of water per week is required to keep a lawn healthy – a 300 m^2 property with 150 m^2 of either lawn or garden would require about *seventeen* 220-litre rain barrels to provide this depth of water.
3. Some home-owners use the collected rainwater as an *additional* rather than an *alternative* source of irrigation water. When used this way, rain barrels will not lower household water bills nor reduce demands on municipal water supply systems.

Reduced Storm Water Runoff

1. A total of 3,000 litres of water falls on a 300 m^2 property during a 10 mm rain event. Collecting 220 litres in a rainbarrel equates to capturing about 7% of this volume. Reducing storm water runoff is generally only a concern during heavier rain events (i.e., events greater than 10mm) when the percentage of captured water would be reduced even further.
2. Rain barrels collect rain that falls on a home's roof. They do not affect rain that falls on sidewalks, driveways, boulevards, and roadways – all of which may all drain to the storm sewers. During significant rainfall events, a rain barrel program may reduce overall storm water runoff by 1% or less.

Educational and Promotional Messages

1. Several behavioural studies have indicated that it is difficult to get people to change their habits. Since watering plants from a rain barrel takes more time and effort than using a garden hose, rain barrels may not always be emptied between rain events.
2. Sometimes rain barrels are distributed by municipalities simply as a water conservation educational tool. In this case they are intended to act as a prompt or a reminder to encourage people to conserve water in their homes and yards, and significant water savings or storm water diversions directly related to rain barrels are not expected.
3. Rain barrels are sometimes used as an incentive to entice participation in programs, such as a downspout disconnection programs. In this case there is little or no water savings or storm water diversion expected directly from the installation of rain barrels.

Considerations for Municipal Programs that Could Further Reduce Potential for Water Savings and Storm Water Diversion

1. The size of barrels used as part of customer 'pick up' programs must be small enough to be transported in an automobile. Although a 400-litre barrel will hold more water than a smaller unit, it is likely too large to fit in most car trunks.
2. Free or subsidized barrels may be undervalued by customers, i.e., people who think that 'the barrel is only worth what it cost' may never actually install it.
3. Barrels that are no longer used or wanted may end up in the landfill or being used for other purposes.

Potential Effectiveness

Table 1 at the end of this paper was created using Environment Canada data for the Waterloo area. The table documents all rainfall events greater than a 'trace' from May to September for the four years from 1998 to 2001. The shaded areas indicate days when rainfall could be captured, i.e., they are preceded by at least two *non-rain* days to allow some time for the barrels to be emptied. At the bottom of each column is the number of potentially captured events in each month.

Calculations based on Environment Canada precipitation data for Waterloo, Ontario (1998-2001) -

- The total average rainfall per 5-month growing season is 365 mm.
- There was an average of 62 rain days per season during this period, but there was an average of only 20.5 *potentially captured* rainfall events per season (about 33%).
- An average of 4.5 m^3 would be potentially captured each year during the growing season using a single 220-litre rain barrel (i.e. 20.5 captured events x 220 litres per capture = 4.5 m^3). Note that based on a roof area of 100 m^2 the total average volume of rain that would fall on the roof each growing season would be about 36.5 m^3 (i.e. 365 mm of rainfall x 100 m^2 = 36.5 m^3).
- At a combined water and sewer cost of $1.00 per m^3 (approximate average of Ontario rates), **the water savings equates to about $4.51 per year.**
- At a cost of $75 per barrel (the cost of an inexpensive rain barrel) ***the payback period is about 16.6 years.*** *(Note*: if the figures referred to in the previously mentioned promotional material are used, i.e., a cost of water of $0.74 per m^3 and a $90 barrel, *the payback period is about 27 years.)*

Although the number and severity of rain events changes from year to year, it appears that achieving a payback of 5 years is extremely optimistic. The payback period of 16.6 years identified in the example above assumes that the rain barrel is used *as effectively as possible* - the savings and associated payback period would be even poorer if the rain barrel is not emptied after each time there are at least two consecutive non-rain days.

Conclusion

Some people ***like*** rain barrels! Perhaps they feel that using a rain barrel is "*doing their part*" to save water. Perhaps they feel that using rainwater on plants is better than using treated tap water.

But ... should municipalities distribute rain barrels?
And ... will a rain barrel program achieve municipal objectives?

Let's review the municipal objectives for rain barrels.

Water Efficiency: Some rain barrel distribution programs are intended to reduce residential irrigation demands, divert storm water, and/or promote water efficiency. Using Environment Canada data for Waterloo, this paper has demonstrated that the annual water savings achieved by installing a rain barrel, *and using it effectively*, would equate to approximately 4.5 m^3, or a savings of between about $3 to $7 per rain barrel per year on a household water bill.

Storm Water Reduction: The use of rain barrels throughout a municipality may reduce the volume of storm water entering the sanitary sewer system by as little as 1% or less during significant rainfall events.

Education/Promotion: The use of rain barrels to successfully promote water efficiency is up for debate. Homeowners may believe that rain barrels, especially when they are offered as part of a municipal program, are effective tools for saving water and, ultimately, for improving the environment. In reality, even the most successful rain barrel programs may save or divert less than 5 m^3 per barrel per year.

In conclusion, it appears that the actual volume of water savings or storm water retention associated with rain barrel distribution programs may be less than that promoted by rain barrel companies or expected by the public or municipalities participating in rain barrel programs. It is hoped that the information contained in this paper will help decision makers to make more informed decisions regarding their programs.

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Table 1: Rainfall Data in mm from 1998-2001 for Waterloo, Ontario

(Shaded Areas denote a 'Captured' rainfall event)

Day	1998					1999					2000					2001				
	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September
1	1.2						19.4	4.2			7.9			16.8			5.6	0.6		
2	0.4	2.2			7.8		9.4					2.6	3.0	1.8	18.0		1.2			
3			0.6					1.2	2.2				1.6		6.2		9.2			2.7
4			2.0						4.6							4.2		1.4		
5	0.2			1.8						0.6		7.0		1.2						
6			3.2	16.6		1.4			0.2	57.8		6.0		1.4						
7			6.0	4.8	0.8		0.2		6.0	1.2	5.8	0.2						4.6		
8	0.4		6.2		3.2	3.0			4.6					1.6	3.2	9.1				
9								6.8		2.4	30.0	18.8	22.2	4.6	5.6		1.1		0.4	
10	10.2								3.8		7.0				1.6		6.2	2.0		2.0
11	8.6	6.2									3.6	6.0				0.6	5.2			
12	0.6	9.4			0.3				0.2		42.0	1.2			4.0					
13		3.2							21.6	10.6	2.0	30.0								
14							17.6			0.2		7.4	18.4		10.1					
15				4.4	1.4							0.2	6.2	1.6	7.0		0.7			
16		10.0	0.8								2.4	8.4	0.8		0.2		2.1	1.1	10.3	
17			8.0	1.6			1.0	5.8			1.4	0.2	0.2			2.4	8.0			
18	0.2					10.2					24.2	9.0	0.4	2.0		0.9			1.2	
19			0.4			4.8	0.2	15.6	0.2		2.6						0.4		19.2	14.1
20									4.6	1.2	1.0	4.0	1.0		3.3		2.6		3.2	6.7
21		0.4	1.0									9.4			0.7	6.0	6.2	1.1		44.0
22		0.4	0.2		0.6	0.8					0.2	0.4		10.4	6.0	24.2	4.2	0.3		0.2
23		14.8		4.4		1.0					15.2			7.2	29.2			9.2	0.6	2.6
24				6.0		14.0	4.0	5.8	2.6	5.4	4.6	13.4		0.2	0.4	10.0				0.3
25	12.4	0.8		0.6		4.8	7.4		3.2			17.0				19.6				9.7
26		5.2			0.8	0.2			9.2			5.2		2.2		2.2			0.8	3.8
27			2.0		20.0		20.0							2.0		6.4				0.2
28							0.4	0.4					29.2			2.6			22.1	1.6
29							6.4			35.2		3.6	0.2							
30		22.4			7.6					1.0			9.2				1.0			
31	5.6					2.6		31.2			0.4		5.6							
Events	6	4	3	3	7	4	4	5	3	5	4	2	4	4	3	5	4	5	4	3

Average Rainfall per 5-Month Growing Season = 365 mm

Average Number of Captured Events During 5-Month Growing Season = 20.5

Number of Captured Events x 220-litre Rain Barrel = 4,510 litres per year.

Cost savings @ a cost of water of \$1.00 per m^3 = \$4.51 per year.

Payback Period for a \$75 Rain Barrel = 16.6 years.

ATTACHMENT 2

Precipitation values (mm) are average of Victoria Int'l Airport and Gonzales Weather Stations

Day	2005 May	2005 June	2005 July	2005 August	2005 September
1	1.3	0.1	-	-	0.1
2	0.8	-	-	-	-
3	0.4	-	0.2	-	1.0
4	0.5	-	5.3	-	0.2
5	-	-	2.4	-	0.1
6	-	-	0.1	-	-
7	1.4	3.0	2.1	-	-
8	2.7	1.9	2.3	-	0.1
9	0.1	0.4	-	-	-
10	0.1	0.5	0.4	-	-
11	-	1.0	-	-	-
12	0.1	1.1	-	-	-
13	0.7	0.1	-	-	-
14	4.0	-	0.2	-	-
15	4.0	0.1	0.5	-	0.9
16	1.8	4.1	-	10.8	1.0
17	2.5	6.1	-	10.3	0.1
18	2.8	-	-	-	-
19	1.8	-	-	-	-
20	0.4	1.1	-	-	-
21	0.5	2.2	-	-	-
22	0.4	-	-	-	-
23	0.1	-	-	-	-
24	-	-	-	-	-
25	-	0.8	-	-	-
26	-	3.8	-	-	-
27	-	3.1	-	0.2	0.2
28	-	-	-	1.2	5.0
29	-	-	-	1.0	17.3
30	2.6	0.3	-	-	1.8
31	2.0		-	-	
Total	31.0	29.7	13.5	23.5	27.8
Rain Events to Fill Barrel	2	3	1	1	1
# Annual Events					8
Average Events per year					9

Day	2006 May	2006 June	2006 July	2006 August	2006 September
1	-	5.0	-	-	-
2	-	0.4	-	-	-
3	-	-	-	-	-
4	-	6.9	-	-	-
5	-	-	-	-	-
6	1.1	-	-	-	-
7	2.6	-	-	-	-
8	-	5.7	-	0.1	-
9	-	9.1	-	-	13.2
10	-	-	-	2.6	0.1
11	0.2	-	-	-	-
12	0.5	-	1.6	-	-
13	-	-	0.8	-	0.3
14	-	-	0.4	-	0.5
15	-	-	-	-	0.2
16	-	0.6	-	-	-
17	-	1.5	-	-	2.7
18	-	-	-	-	3.5
19	-	-	-	-	1.6
20	-	-	-	-	6.9
21	2.3	-	-	-	0.2
22	18.3	-	-	-	-
23	0.3	-	-	-	-
24	0.8	-	-	-	-
25	0.7	-	-	-	-
26	0.9	-	-	-	-
27	0.4	-	-	-	-
28	0.1	-	-	-	-
29	0.1	-	-	-	-
30	-	-	2.4	0.1	-
31	1.6		-	-	
Total	29.9	29.2	5.2	2.8	29.2
Rain Events to Fill Barrel	2	2	1	1	2
# Annual Events					8

Day	2007 May	2007 June	2007 July	2007 August	2007 September
1	0.1	-	-	-	-
2	3.5	-	-	-	-
3	1.7	0.1	-	-	3.4
4	-	2.2	-	-	2.8
5	0.4	1.7	-	-	-
6	0.8	0.7	-	-	0.2
7	-	-	-	-	-
8	0.1	-	-	-	-
9	-	5.0	-	-	-
10	-	0.3	-	-	-
11	-	-	-	-	-
12	-	0.1	-	-	-
13	-	-	-	-	0.1
14	-	-	-	-	-
15	-	1.8	-	-	-
16	-	-	-	1.3	2.2
17	-	-	7.8	0.1	-
18	0.1	-	6.1	0.6	1.2
19	0.3	-	1.6	13.3	-
20	3.8	-	2.7	0.6	0.2
21	-	2.5	5.9	3.4	0.5
22	-	1.1	6.3	-	0.1
23	-	0.1	0.5	-	-
24	-	3.3	-	-	0.6
25	-	-	-	0.3	0.4
26	-	-	-	0.1	-
27	-	-	-	-	-
28	-	4.1	-	-	0.3
29	-	2.7	-	-	0.9
30	-	-	-	-	5.7
31	-		-	0.6	
Total	10.8	25.7	30.9	20.3	18.5
Rain Events to Fill Barrel	1	5	1	1	2
# Annual Events					10

Day	2008 May	2008 June	2008 July	2008 August	2008 September
1	-	-	-	0.8	-
2	0.9	1.6	1.0	-	-
3	2.8	3.6	0.9	-	-
4	0.1	-	-	-	-
5	-	3.0	0.6	-	-
6	-	4.7	-	-	-
7	-	-	-	-	-
8	0.2	-	-	-	-
9	-	8.0	-	2.9	-
10	1.1	0.9	-	0.2	-
11	-	-	-	-	-
12	-	-	-	0.2	-
13	4.6	-	-	-	-
14	0.8	-	-	-	-
15	-	-	-	-	-
16	0.1	-	-	-	-
17	-	-	-	-	-
18	-	-	-	0.2	-
19	1.6	-	-	4.3	-
20	0.9	-	-	3.2	-
21	2.2	-	-	0.6	-
22	-	-	-	-	-
23	-	-	-	-	0.1
24	-	-	-	12.2	8.1
25	-	-	-	-	5.0
26	0.5	-	0.4	7.2	0.6
27	0.4	-	-	3.7	0.2
28	-	-	-	2.0	-
29	-	-	3.4	-	-
30	-	-	-	-	-
31	-		2.8	-	
Total	16.2	21.7	9.1	37.5	14.0
Rain Events to Fill Barrel	2	2	1	3	1
# Annual Events					9

Day	2009 May	2009 June	2009 July	2009 August	2009 September
1	-	-	-	-	
2	4.2	-	-	-	
3	0.1	-	-	-	
4	2.5	-	-	-	
5	3.5	-	-	-	
6	8.3	-	-	-	
7	0.1	-	1.4	-	
8	0.1	-	6.4	-	
9	-	-	0.1	1.9	
10	1.9	-	-	9.3	
11	2.2	-	-	0.4	
12	0.3	-	-	-	
13	6.6	-	-	4.7	
14	5.8	-	-	0.1	
15	0.1	-	-	-	
16	-	-	-	-	
17	-	0.3	-	-	
18	7.1	-	-	-	
19	0.3	1.2	-	-	
20	0.1	-	-	-	
21	-	0.1	-	-	
22	-	-	-	-	
23	-	-	-	-	
24	-	2.4	-	-	
25	-	0.5	2.8	-	
26	1.3	-	0.2	-	
27	-	0.5	-	[redacted]	
28	-	0.1	-	[redacted]	
29	-	-	-	[redacted]	
30	-	-	-	[redacted]	
31	-	-	-	[redacted]	
Total	44.4	5.1	10.9	16.4	
Rain Events to Fill Barrel	3	1	2	2	
# Annual Events				8	

The Seattle Rain Barrel

A service of Seattle Conservation Corps and Seattle Public Utilities

Seattle Public Utilities

Thank you for purchasing a Seattle Rain Barrel

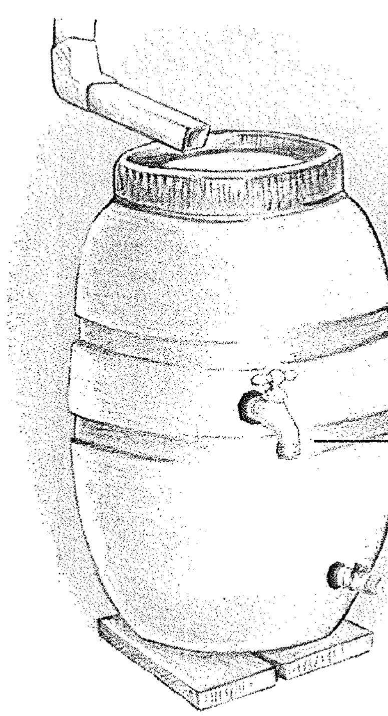
Your new rain barrel (or barrels!) will help you use water in your garden wisely. Smart watering is an important part of Natural Yard Care, described in the brochure you received with your barrel. Through Natural Yard Care, including watering from your rain barrel and using other water saving techniques, you'll be making your small piece of the planet a healthier and more environmentally friendly place to live.

Thank you from Seattle Public Utilities and Seattle Conservation Corps.

Installing your Seattle Rain Barrel

Position your barrel on level ground in front of a downspout close to the gardens you want to water. (Some people prefer to set their barrels on cinder blocks to provide easier access to the lower valve. If you do this, make sure the ground is firm and the blocks level.) Cut the downspout—a hacksaw works well for both metal and plastic downspouts—eight to 12 inches above the top of the barrel. Remove the lower section of downspout and slide the barrel into its permanent place.

Attach a downspout elbow and a short section of downspout to the remaining upper section to direct water onto the screened lid of your rain barrel. (See illustration.) You may already have an elbow if the bottom of your downspout was directed onto a splash block. Otherwise, you'll need to get one at a hardware store. Whether plastic or metal, downspouts come in only a few standard sizes, commonly three-inch and four-inch rectangular, and two-inch round, but it's a good idea to take a section with you to the store.



As an alternative, you may want to invest in a downspout adapter. These are relatively simple hinged downspout sections usually costing less than $20. The device enables you to direct water flow onto the top of the barrel when you need it but switch back to the downspout carrying water to your drainage system during the winter when heavy rains cause regular overflows. Downspout adapters may not be in stock at your hardware store, so call before making a trip.

Attach a section of hose to the overflow fitting

Next, attach a section of hose to the threaded overflow fitting. (This is the fitting on the outside of the barrel at the bottom of the internal overflow tube.)

Using an old piece of hose which you can cut to any desired length, direct the overflow where you want it to go. This can be back into the downspout, or away from the foundation of your house — to avoid basement flooding, for example — into a low area or rain garden. A rain garden is a low spot in a lawn or planting area, often dug out and refilled with absorbent, compost-amended soils and planted with water-tolerant vegetation. It fills with runoff during heavy rains and dries as the runoff soaks in.

The overflow discharge point should be at least eight feet from your foundation and in an area where it will soak into the ground rather than flowing into the street or onto neighboring properties. Where you need more infiltration due to the nature of the soil around your house, try directing the overflow to a French drain (usually a trench or pit filled with gravel under a garden or lawn). French drains can be built to take water through a pipe directly from your downspout or overflow, or located under a low area to promote rapid absorption of water into the soil.

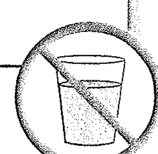
Please note: if your home is on a steep slope or in a landslide-prone area be sure to direct the rain barrel overflow ONLY back into your existing drainage system. In most cases, this will carry the water away through your side sewer. It's important to avoid adding to the volume of ground water in steep-slope areas because more water can increase the chance of slides.

Also, be sure to attach an overflow hose as soon as your barrel is set up. This prevents mosquitoes from entering through the overflow fitting.

Using water from your Seattle Rain Barrel

Your rain barrel has a spigot (sometimes called a hose bib) attached 12 to 14 inches from the bottom. It's designed to be a handy height for filling your watering can, making it easy to water small plantings of annuals or potted plants on a deck. Using a watering can, it's easy to water carefully, applying just the right amount. You can also attach a soaker hose to the drain cock at the bottom of your rain barrel, using that to water nearby gardens as needed.

Warning! ¡Peligro!



Remember, the water in your rain barrel is NOT POTABLE. Do not use for drinking, washing or cooking.

The water in your rain barrel likely will contain fecal coliform bacteria from bird droppings, and other potentially harmful microbes.

Agua no es potable. No se use para tomar, lavar, ni cocinar.

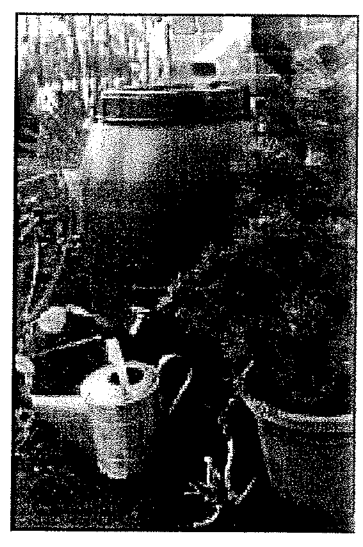
About your new barrel

The rain barrel you've purchased has been recycled from the food industry. Most of the barrels sold by Seattle Conservation Corps and Seattle Public Utilities (SPU) come from Greece or other Mediterranean countries. They were shipped from the Mediterrnean full of olives or peppers for bottling in the U.S. If your barrel is marked 190 liters, it's about 50 gallons; 230-liter barrels hold about 60 gallons.

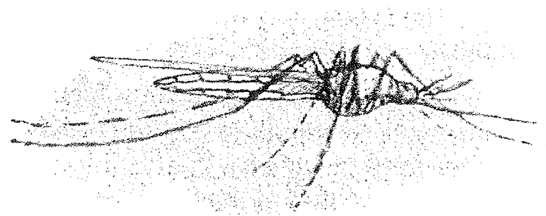
After the barrels are emptied at packing plants in other parts of the U.S., they are shipped by truck to the Conservation Corps assembly center at Sand Point Magnuson Park. A jobs-training program of the Seattle Department of Parks and Recreation, the corps attaches all the fittings—drain cock, spigot and overflow and mosquito screening for the lid.

Your new barrel is guaranteed not to leak or crack for 90 days or it will be repaired or replaced for free by the Conservation Corps, 206-684-0190.

Thank you for using water wisely. We hope you enjoy your new rain barrel.



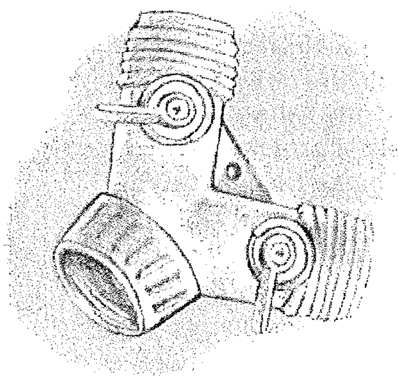
What about mosquitoes?



Your rain barrel lid is screened to keep out mosquitoes. To keep them from entering through the overflow fitting, be sure you always have an overflow hose attached.

In fact, now that you have a rain barrel, it's a good time to clean your gutters so puddles where mosquitoes can breed don't form behind dams of moss or rotting leaves. You should also adjust the brackets holding your gutters to make sure all gutters slope continuously toward downspouts and quickly drain dry after a rain. Sagging gutters create puddles where mosquitoes can breed.

Connecting barrels together



You can connect two or more barrels together at any time with a short length of hose and a device called a hose Y. (See illustration.) They're available at most garden stores. You'll also need two female garden hose end fittings—the fittings that screw onto the faucet. Attach these fittings to each end of a length of old hose. Attach the Y to the drain cock on one barrel and fasten the short piece of hose you made to it and to the drain cock on your second barrel. With additional Y's, you can connect as many barrels as you want this way. Connecting barrels lets you draw water from all of them using the same spigot or drain cock, which is handy since you may want to locate additional barrels in hard-to-reach places such as camouflaged behind shrubbery. To prevent mosquitoes from entering, be sure to cap any overflow fittings to which you do not connect a hose.

When NOT to use a rain barrel for watering

If you have certain kinds of roofing material you shouldn't use rain barrels for watering plants. If your roof is made of wood shingles or shakes that have been treated with any chemical (usually chromated copper arsenate—CCA) to make them resistant to rot and moss, lichen and algae growth, don't water your plants from a rain barrel. Water collected from copper roofs or copper gutters also should not be used. Zinc (galvanized metal) anti-moss strips—usually mounted at the roof peak—also produce toxic chemicals you don't want in your garden. Don't use rain barrels if you have these strips (you may want to remove them), or if you have had your roof treated with moss-, lichen- or algae-killing chemicals within the last several years. Note that nowadays there are asphalt shingles on the market which have zinc particles imbedded in the surface. Check your shingle specifications if you have recently re-roofed.

In addition, general practice is to avoid watering vegetables and other edible plants, such as herbs you plan to use in cooking, with rain barrel water collected from asphalt-shingle roofs. These kinds of roofs may leach various complex hydrocarbon compounds, so most people avoid using water from asphalt-shingle roofs or flat tar roofs on plants meant for human consumption. To date there is no definitive research on the amounts and types of hydrocarbon compounds which may leach from such roofs, though it is common practice to use water collected from asphalt-shingle roofs for watering ornamental plants and shrubs. Enameled steel and glazed tile roofs generate little or no contamination and rainwater harvested from them is commonly used to water vegetables.

Maintaining your Seattle Rain Barrel

Rain barrels take very little maintenance, but from time to time, particularly in the fall, you'll need to clean leaves and other material off the top to keep the screen from clogging. Also make sure the overflow is not clogged. In the winter when rains are heaviest, you may want to reconnect your downspouts, or use a downspout adapter (described above), to send the heaviest flows back into your drainage system.

As noted, the most important maintenance you can do is keep your gutters clean and sloped so they dry quickly between rains.

This is also a good time to change your outside hose bibs to use the new, safer atmospheric vacuum breakers which prevent water from flowing backwards into your water pipes in case of a pressure drop in the house or city mains while you have your hose running to fill a bucket, wading pool, decorative pond and the like. Atmospheric vacuum breakers are required in new construction.

By the way, while it can be done, we don't recommend painting your rain barrel. They are flexible and will expand and contract with the weather, so many paints are likely to chip off, leaving paint flakes in your soil.

A note on water saving

Rain barrels won't make a noticeable difference in your water bill unless you have quite a few. But over time, using your rain barrel(s) and gardening the Natural Yard Care way will add up to savings — for your pocketbook and the environment. Composting, mulching, using soaker hoses instead of sprinklers and using a watering can instead of a hose even when your rain barrels are empty will conserve even more water.

And while you're thinking about water conservation, remember that if you haven't done so already, changing to modern 1.6-gallon-per-flush toilets, energy- and water-efficient clothes washers and low-flow water-saving showerheads are excellent ways to save both money and water.

Thank you for purchasing a Seattle Rain Barrel

For more information on gardening the natural way, call the Natural Lawn & Garden Hotline at 206-633-0224 or email info@lawnandgardenhotline.org

For web pages and links to other information about rain barrels, conservation and Natural Yard Care, just go to the City of Seattle's home page, www.seattle.gov, type 'rain barrels' in the search box and click 'go'.

To order additional barrels call the Seattle Conservation Corps office at 206-684-0190.

Seattle Public Utilities

SEATTLE CONSERVATION CORPS City of Seattle

Natural Yard Care

Rain barrels are a perfect fit with all the other techniques of Natural Yard Care. Building healthy soil, planting right for your site, practicing smart watering (making every drop count and watering from rain barrels when you can), thinking twice before using pesticides or herbicides, and practicing natural lawn care are all part of gardening the natural, Seattle-friendly way.
For more information on Natural Yard Care techniques, look through the Natural Yard Care booklet you received when you bought your barrel. And if you have more questions you can call the Natural Lawn & Garden Hotline at 206-633-0224 or email: info@lawnandgardenhotline.org

The Institution of Engineers, Australia
28th International Hydrology and Water Resources Symposium
10 – 14 November 2003
Wollongong NSW

Analysis of the Performance of Rainwater Tanks in Australian Capital Cities

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Abstract:
The performance of 1kL to 10 kL rainwater tanks with mains water tickle topup used to supplement mains water supply for domestic toilet, laundry, hot water and outdoor uses was evaluated for Brisbane, Sydney, Melbourne and Adelaide. The PURRS (Probabilistic Urban Rainwater and wastewater Reuse Simulator) model developed by Coombes and Kuczera (2001) was employed to continuously simulate the performance of rainwater tanks using synthetic pluviograph rainfall generated by the DRIP (Disaggregated Rectangular Intensity Pulse) event based rainfall model by Heneker et al. (2001). Depending on roof area and number of occupants in a household, the use of rainwater tanks resulted in annual mains water savings ranging from 18 kL to 55 kL for 1 kL rainwater tanks to 25 kL to 144 kL for 10 kL rainwaters tanks. The average retention volumes available in rainwater tanks prior to storm events ranged from 0.26 m^3 to 0.71 m^3 for 1 kL tanks to 2.34 m^3 to 8.4 m^3 for 10 kL tanks.

Keywords: rainwater tanks, mains water savings, stormwater runoff, climate, continuous simulation

1. INTRODUCTION

The use of roof runoff collected in rainwater tanks with mains water trickle topup to supplement mains water supplies for domestic consumption was shown by Coombes et al. [2002; 2002a] and Mitchell et al. [1997] to significantly reduce household mains water use. Indeed Coombes et al. [2002] found that the widespread introduction of 10 kL rainwater tanks for domestic hot water, toilet and outdoor uses will defer the requirement to augment the Lower Hunter and Central Coast water supply headworks systems by 28 to100 years.

Importantly Coombes et al. [2000; 2000a; 2002a] and Spinks et al. [2003; 2003a] found that the quality of water supply from rainwater tanks was acceptable for hot water, toilet, and outdoor uses. Spinks et al. [2003] confirmed that *E. Coli* and selected pathogens are rapidly eliminated from water heated to temperatures above 55°C by the processes of heat shock and pasteurisation. Note that ASNZ2500.2.4 requires that hot water systems be set to heat water to 60°C to eliminate *Legionella Spp.* from mains water.

Coombes et al. [2003] concluded that installation of 5 kL rainwater tanks for domestic hot water, toilet, laundry and outdoor uses will defer the requirement to augment the Sydney water supply headworks system by 21 – 84 years. Analysis of the impact of installing 10 kL rainwater tanks in the Upper Parramatta River catchment in Sydney revealed that the tanks will have on average 42% of their storage available for retention of stormwater prior to the 100 year average recurrence interval (ARI) storm events.

These studies into the effectiveness of rainwater tanks for water supply and stormwater management have focused on a narrow range of tank sizes (5 kL and 10 KL) operating in a temperate climate zone with seasonally uniform rainfall. This study evaluates the water supply and stormwater management impacts of rainwater tanks with capacities ranging from 1 kL to 10 kL in Adelaide, Brisbane, Melbourne and Sydney. The city of Adelaide has a temperate climate with winter rainfall, Melbourne and Sydney have temperate climates with uniform rainfall and Brisbane has a sub-tropical climate with summer rainfall [Heneker, 2002]. Brisbane and Sydney also experience greater annual rainfall depths in comparison to Adelaide and Melbourne.

2. Why Rainwater Tanks Can Defer the Requirement for New Dams

Before embarking on an assessment of the performance of domestic rainwater tanks, it is important to provide a process-based explanation of why rainwater tanks can defer major infrastructure for the provision of urban water cycle services.

Until recent times it was commonly assumed that rainwater tanks are of little benefit to the community because during drought the rainwater tank is empty and the consumer is totally reliant on mains water. This wisdom appears to be based more on belief than fact. There are a number of "hidden" processes by which rainwater tanks significantly reduce impact on water supply headworks systems. These are described below.

It is true that during drought major urban water supply systems rely on water storages. For example on the east coast of Australia droughts represent extended periods of below average rainfall. In the last 150 or so years the annual rainfall at Sydney's Observatory Hill has dipped a few times to between 600 to 700 mm. Figure 1 presents a schematic comparing the efficiency of a water supply catchment and a roofed catchment feeding a rainwater tank.

Plots of annual runoff against annual rainfall for water supply catchments typically display a threshold effect. Once annual rainfall falls below about 500 mm annual runoff in water supply catchments is insignificant. In such years evapotranspiration and infiltration accounts for virtually all of the rainfall and the water supply system is almost totally dependent on water stored from more bountiful years. In contrast the roofed catchment, being impervious, only experiences a small loss at the commencement of each rain event. In addition urban areas such as Sydney and the Central Coast in NSW typically receive more rainfall than water supply catchments. As a result, a rainwater tank can harvest significant volumes of water even during drought years.

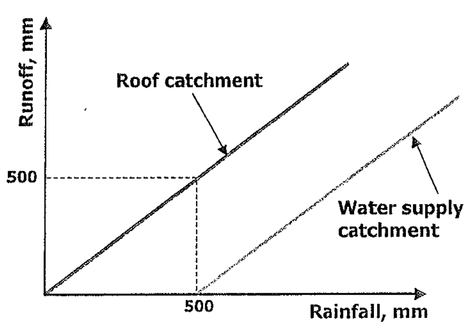

Figure 1. Harvest efficiencies of natural and roofed catchments.

Conventional wisdom assumes that rainwater tanks in urban areas only provide water for outdoor uses such as garden watering. As a result, the tank is only utilised during the growing season. If, however, the tank is used for toilet flushing, laundry and hot water, which represent a significant fraction (about 85%) of indoor usage, the tank is constantly being drawn down. This has two unexpected benefits. First, for small storm events much of the potential runoff is captured by the tank – that is why use of the rainwater tanks produces considerable reduction in stormwater runoff for small ARI storm events. Second, because toilet flushing, laundry water and hot water are sourced from the rainwater tank, the base load on the mains water system is reduced. As a result, reservoirs will fill more rapidly during periods of good streamflow. In headworks systems with over-year storage capacity, the reduction in base demand provides a buffer against the effects of droughts and growth in water demand due to population growth.

2. METHOD

The PURRS (Probabilistic Urban Rainwater and wastewater Reuse Simulator) model [Coombes and Kuczera, 2001] was used in combination with the DRIP event based synthetic rainfall model [Heneker et al,. 2001] to evaluate the effectiveness of rainwater tanks in each city.

The PURRS model was used to analyse the performance of 1 kL to 10 kL rainwater tanks used to supply domestic hot water, toilet, laundry and outdoor uses. Continuous simulation of the performance of rainwater tanks was conducted at time steps of 5 minutes over a period of 100 years using synthetic pluviograph rainfall records generated by DRIP. Hot water, laundry and toilet use was estimated to be 85% of indoor water demand. When a water level in a rainwater tank falls below a minimum depth of 200 mm the tank is topped up with mains water to a minimum level at a rate of 30 litres per hour (Figure 2).

The performance of rainwater tanks connected to dwellings with roof areas of 100 m^2, 150 m^2 and 200 m^2 with 1 to 5 occupants was analysed in this study. The average annual reduction in mains water use and the average retention storage volume available prior to storm events is used to assess the performance of the rainwater tanks.

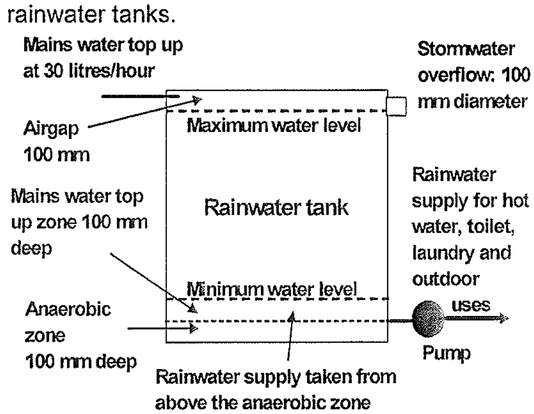

Figure 2: Elevation view of the rainwater tank

3. ADELAIDE

The performance of rainwater tanks in Adelaide was analysed using synthetic rainfall generated by DRIP based on the West Terrace pluviograph record [see Heneker, 2002 for details]. Adelaide has an annual rainfall depth of about 520 mm. Domestic water use for Adelaide shown in Table 1 was estimated using the results from Environment Australia [2001] and methods developed by Coombes et al. [2000].

3.1 Adelaide Water Savings

Mains water savings that resulted from the use of 1 kL to 10 kL rainwater tanks used to supply domestic hot water, toilet, laundry and outdoor uses are shown in Figures 3, 4 and 5. Figure 3 shows that rainwater tanks connected to roofs with an area of 100 m^2 produced average annual mains water savings of 17 kL (6%) to 25 kL (16%). Rainwater tanks connected to roofs with areas of 150 m^2 and 200 m^2 provide average annual mains water savings of 25 kL (9%) to 45 kL (29%) and 31 kL (11%) to 67 kL (39%) respectively (Figures 4 and 5).

Table 1. Estimated average daily household water use in the city of Adelaide

	Average water use (Litres per day)					
	Outdoor	Inhouse (number of occupants)				
Month		1	2	3	4	5+
January	470	193	339	484	630	776
February	459	187	333	478	624	770
March	458	194	339	485	631	776
April	378	180	326	471	617	763
May	168	184	330	475	621	767
June	171	171	317	463	608	754
July	188	170	316	461	607	753
August	266	175	321	466	612	758
September	396	179	324	470	616	761
October	634	181	327	473	618	764
November	638	185	331	476	622	768
December	569	183	329	475	620	766

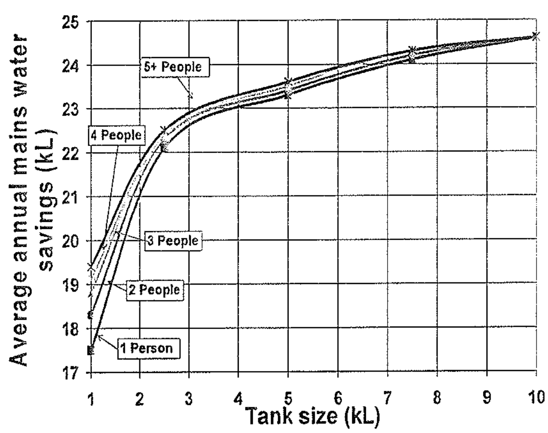

Figure 3: Mains water savings at dwellings with 100 m^2 roof areas in Adelaide

Mains water savings provided by the rainwater tanks are shown to increase with larger roof areas. Significantly, small rainwater tanks with volumes of 1 kL to 5 kL produce the majority of mains water savings. Indeed increases in water savings diminish with larger tank sizes especially for the smaller roof area of 100 m^2 and dwellings with 4 and 5 occupants.

The results show greater mains water savings with increases in numbers of occupants. Higher water demand from greater numbers of occupants in dwellings draws down water levels in the rainwater tanks more often allowing greater capture of rainwater. The impact of this phenomenon on mains water savings is limited by the availability of rainfall and the different temporal patterns of water demand and rainfall. Dwellings with 5 occupants do not show significantly greater mains water savings than dwellings with 3 and 4 occupants showing that supply from the rainwater tank is also limited by rainfall depth, tank volume and roof areas.

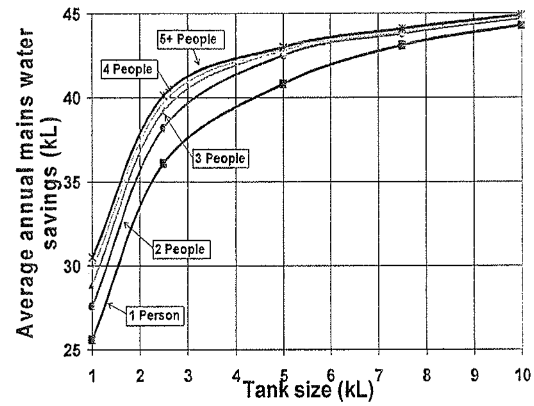

Figure 4: Mains water savings at dwellings with 150 m^2 roof areas in Adelaide

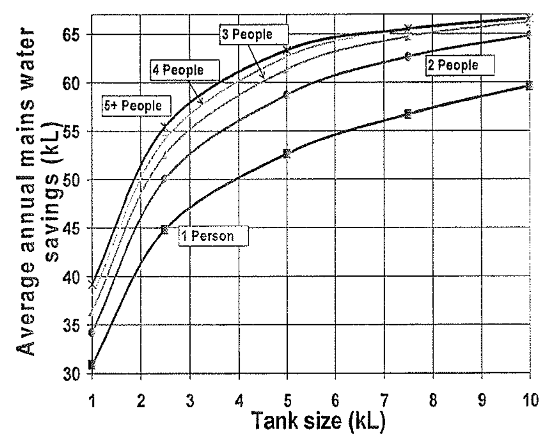

Figure 5: Mains water savings at dwellings with 200 m^2 roof areas in Adelaide

Figure 6 shows the average proportion of rainwater tank volume available for retention of roof water prior to storm events in Adelaide. It is noted that in this study a storm event is defined by a dry spell of 2 or more hours.

Water levels in the rainwater tanks used to supply indoor uses are constantly drawn down as shown in Figure 6. Scenarios with the smallest roof areas of 100 m^2 have the largest retention storage available prior to storms ranging from 64% (0.64 m^3) – 71% (0.71 m^3) for

1 kL rainwater tanks to (82%) 8.18 m^3 – 84% (8.4 m^3) for 10 kL rainwater tanks whilst tanks connected to the dwelling with the 200 m^2 roof and one occupant provided the smallest retention storages of 36% (0.36 m^3) to 46% (4.64 m^3) for the 1 and 10 kL rainwater tanks respectively.

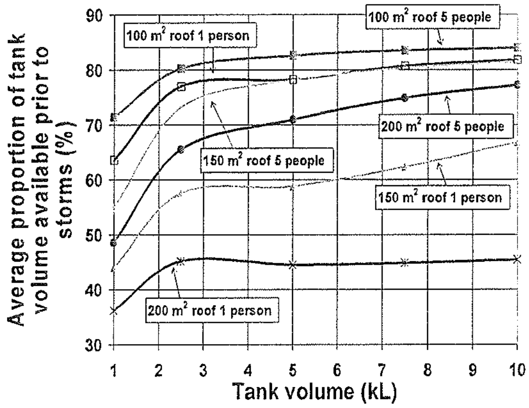

Figure 6: Average retention storage available prior to storm events in Adelaide

Average retention storages available in a rainwater tank prior to storm events increases with tank volume and the number of occupants in dwellings. A reduced volume of retention storage in tanks is available for larger roof areas although considerable stormwater retention is provided by most tank sizes. A 5 kL rainwater tank in Adelaide will on average provide 43 kL/ annum mains water savings and retention storage of 80% (4 m^3) prior to storm events.

4. BRISBANE

The performance of rainwater tanks in Brisbane was analysed using 100 years of synthetic rainfall generated by DRIP based on the central Brisbane pluviograph record with an annual rainfall depth of about 1110 mm [see Heneker, 2002 for details]. Domestic water use for Brisbane shown in Table 2 was estimated from Environment Australia [2001] using methods developed by Coombes et al. [2000].

4.1 Brisbane Water Savings

Mains water savings resulting from the use of rainwater tanks used to supply domestic hot water, toilet, laundry and outdoor uses in Brisbane are shown in Figures 7, 8 and 9.

Rainwater tanks connected to roofs with areas of 100 m^2, 150 m^2 and 200 m^2 produced average annual mains water savings of 31 kL (20%) to 85 kL (27%), 37 kL (26%) to 119 kL (38%) and 40 kL (29%) to 144 kL (45%). Substantial mains water savings of 12% - 74% were produced by the use of rainwater tanks. The greater mains water savings in Brisbane in comparison to Adelaide was due to the larger rainfall depth in Brisbane.

Table 2. Estimated average daily household water use in the city of Brisbane

	Average water use (Litres per day)					
	Outdoor	Inhouse (number of occupants)				
Month		1	2	3	4	5+
January	409	130	230	380	541	701
February	399	131	221	392	522	653
March	370	117	234	351	508	585
April	328	111	223	344	506	597
May	146	115	200	355	540	626
June	148	113	216	359	472	565
July	164	115	209	324	518	623
August	232	119	197	296	494	593
September	344	118	196	294	493	591
October	551	113	226	339	452	565
November	554	103	205	338	431	614
December	495	121	243	364	485	607

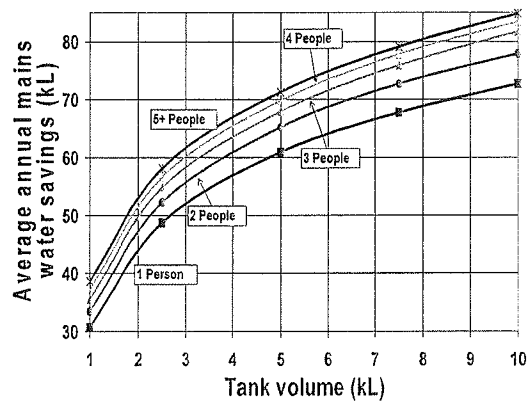

Figure 7: Mains water savings at dwellings with 100 m^2 roof areas in Brisbane

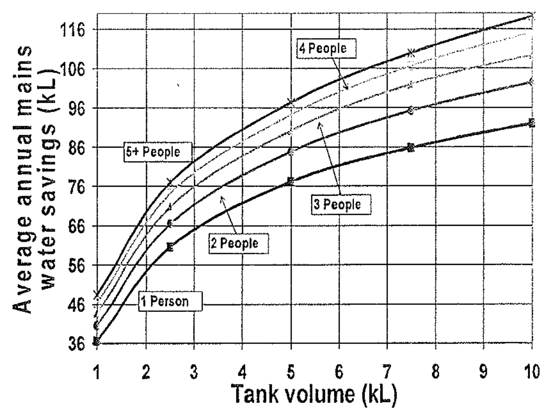

Figure 8: Mains water savings at dwellings with 150 m^2 roof areas in Brisbane

Figure 10 shows the average proportion of rainwater tank volume available for retention of roof water prior to storm events in Brisbane.

Dwellings with roof areas of 100 m^2 have retention storages available prior to storms ranging from 38% (0.38 m^3) – 48% (0.48 m^3) for 1 kL rainwater tanks to 56% (5.58 m^3) – 71% (7.07 m^3) for 10 kL rainwater tanks whilst tanks connected to the dwelling with the 200 m^2 roof and one occupant provided retention storages of 26% (0.26 m^3) to 32% (3.24 m^3) for the 1 and 10 kL rainwater tanks respectively.

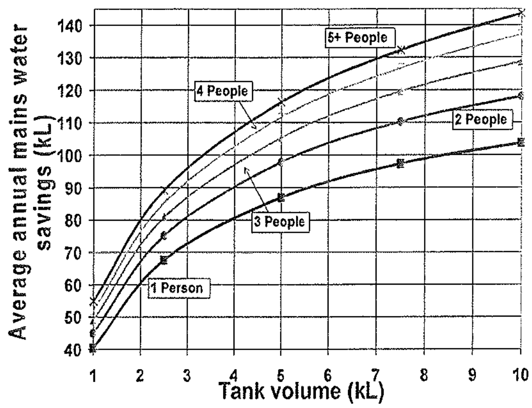

Figure 9: Mains water savings at dwellings with 200 m^2 roof areas in Brisbane

The higher annual rainfall depth in Brisbane resulted in decreased storage volumes in rainwater tanks available prior to storm events in comparison to the storages available in Adelaide.

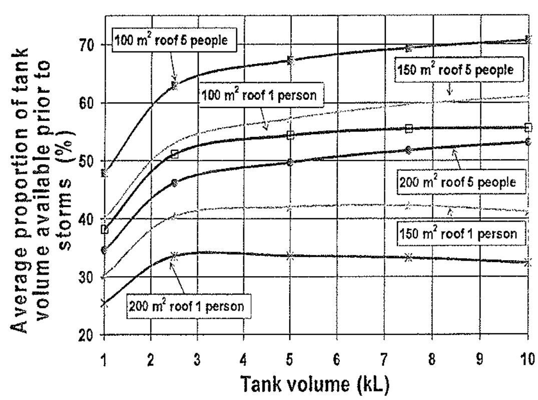

Figure 10: Average retention storage available prior to storm events in Brisbane

5. MELBOURNE

The performance of rainwater tanks in Melbourne was analysed using 100 years of synthetic rainfall generated by DRIP based on a pluviograph record with an annual rainfall depth of about 663 mm [see Heneker, 2002 for details]. Domestic water use for Melbourne shown in Table 3 was estimated from Environment Australia [2001] using methods developed by Coombes et al. [2000].

5.1 Melbourne Water Savings

Table 3. Estimated average daily household water use in the city of Melbourne

	Average water use (Litres per day)					
	Outdoor	Inhouse (number of occupants)				
Month		1	2	3	4	5+
January	243	158	298	436	575	715
February	247	151	290	429	567	706
March	243	159	298	437	576	715
April	212	142	281	420	559	698
May	166	159	298	437	576	715
June	122	153	292	430	569	708
July	131	148	287	426	565	703
August	179	144	283	421	560	699
September	217	146	285	423	562	701
October	262	156	296	434	573	713
November	295	157	296	435	574	713
December	347	154	293	432	571	710

Mains water savings that resulted from the use of rainwater tanks used to supply domestic hot water, toilet, laundry and outdoor uses in Melbourne are shown in Figures 11, 12 and 13.

Rainwater tanks connected to roofs with areas of 100 m^2, 150 m^2 and 200 m^2 produced average annual mains water savings of 20 kL (18%) to 30 kL (9%), 29 kL (26%) to 55 kL (16%) and 35 kL (31%) to 81 kL (24%). Mains water savings ranged from 7% to 27% of total household water use for a dwelling with a roof area of 100 m^2 to savings of 13% to 67% for a dwelling with a 200 m^2 roof.

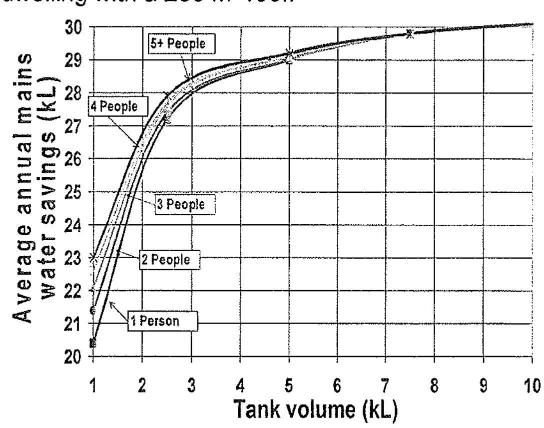

Figure 11: Mains water savings at dwellings with 100 m^2 roof areas in Melbourne

Figures 11, 12 and 13 show that rainwater tanks with volumes of 1 kL provide significant mains water savings. Similar to the results for Adelaide the magnitude of increases in mains water savings diminishes with greater tank sizes due to limited roof water supply. A 5 kL rainwater tank appears to be the optimum size for providing mains water savings. A rainwater tank with a volume of 5 kL will on average supply 29 kL to 75 kL of rainwater per annum to a household.

Figures 12 and 13 show that for households with roof areas of 150 m^2 and 200 m^2 mains water savings increase with the number of occupants although increases in yield from the tanks decrease with increasing tank size and greater numbers of occupants. The combination of roof area and low rainfall depth produces an upper limit on potential mains water savings for a given tank size. Nonetheless, even in the temperate low rainfall climate in Melbourne, the use of rainwater tanks produce considerable mains water savings.

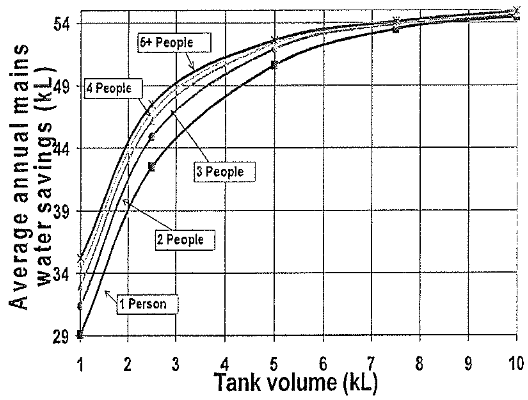

Figure 12: Mains water savings at dwellings with 150 m^2 roof areas in Melbourne

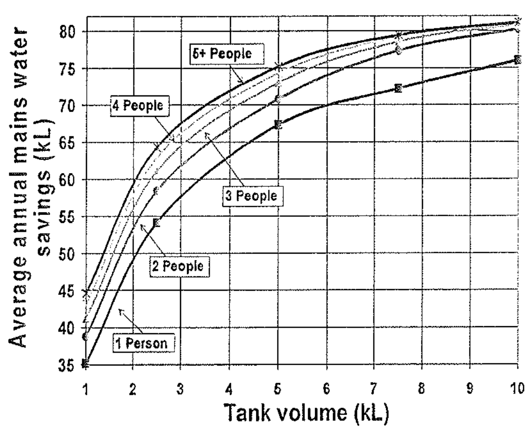

Figure 13: Mains water savings at dwellings with 200 m^2 roof areas in Melbourne

Figure 14 shows that average proportion of rainwater tank volume available for retention prior to storm events range from 36% (0.36 m^3) – 61% (0.61 m^3) for 1 kL rainwater tanks to 49% (4.90 m^3) – 84% (8.36 m^3) for 10 kL rainwater tanks. Similar to the results for Adelaide, greater retention storages are available in rainwater tanks prior to storm events in Melbourne in comparison to Brisbane due to the lower annual rainfall depth.

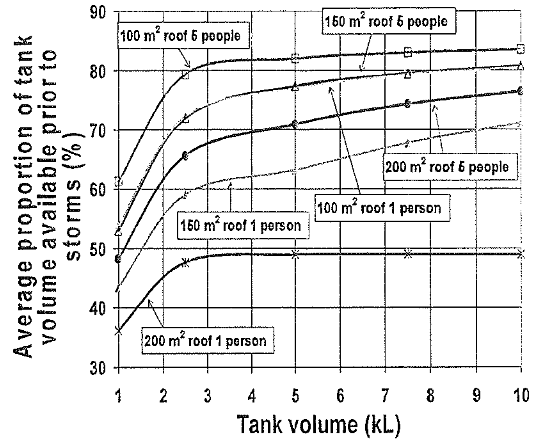

Figure 14: Average retention storage available prior to storm events

A 5 kL rainwater tank in Melbourne will on average provide 52 kL/annum mains water savings and an average retention storage of 3.7 m^3 prior to storm events.

6. WESTERN SYDNEY

The performance of rainwater tanks in Sydney was analysed using 100 years of synthetic rainfall generated by DRIP based on the North Ryde pluviograph record with an annual rainfall depth of about 959 mm [see Coombes et al., 2002 for details]. Domestic water use for Western Sydney shown in Table 4 was estimated from Environment Australia [2001] using methods developed by Coombes et al. [2000].

Table 4. Estimated average daily household water use for Western Sydney

	Average water use (Litres per day)					
	Outdoor	Inhouse (number of occupants)				
Month		1	2	3	4	5+
January	303	236	453	670	887	1104
February	311	229	447	664	881	1098
March	287	237	454	671	888	1105
April	239	229	446	663	880	1097
May	176	237	454	671	888	1105
June	121	222	439	656	874	1091
July	128	219	436	653	870	1087
August	204	223	440	657	874	1091
September	256	232	449	666	884	1101
October	316	237	454	671	888	1105
November	363	233	450	667	885	1102
December	419	235	452	669	886	1103

6.1 Western Sydney Water Savings

Mains water savings that resulted from the use of rainwater tanks used to supply domestic hot water, toilet, laundry and outdoor uses in

Western Sydney are shown in Figures 15, 16 and 17.

Rainwater tanks connected to roofs with areas of 100 m^2, 150 m^2 and 200 m^2 produced average annual mains water savings of 25 kL (16%) to 56 kL (11%), 32 kL (20%) to 87 kL (17%) and 37 kL (23%) to 114 kL (22%) respectively. Mains water savings ranged from 6% to 33% of total household water use for a dwelling with a roof area of 100 m^2 to savings of 10% to 58% for a dwelling with a 200 m^2 roof. Mains water savings provided by the rainwater tanks increase with larger roof areas. Moreover tanks with volumes in the range 1 kL to 5 kL produce the majority of mains water savings.

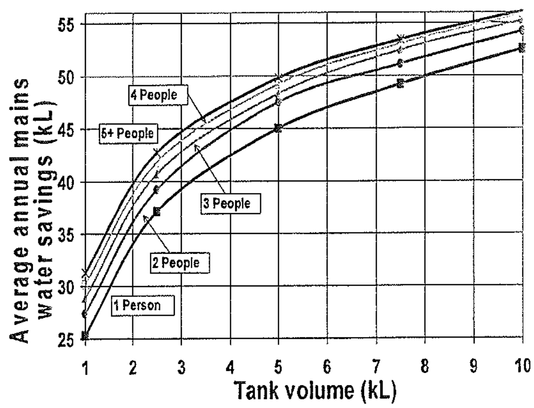

Figure 15: Mains water savings at dwellings with 100 m^2 roof areas in Western Sydney

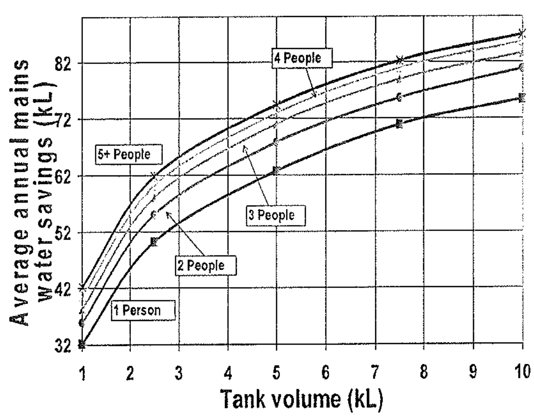

Figure 16: Mains water savings at dwellings with 150 m^2 roof areas in Western Sydney

Similar to the results from Adelaide and Melbourne, increases in mains water savings decline with greater numbers of occupants. Although the annual rainfall depth in Western Sydney (959 mm) is greater the ability to supply water demand is limited due to higher water demand.

The average proportion of a rainwater tank volume available for roof water retention prior to storm events in Western Sydney is shown in Figure 18.

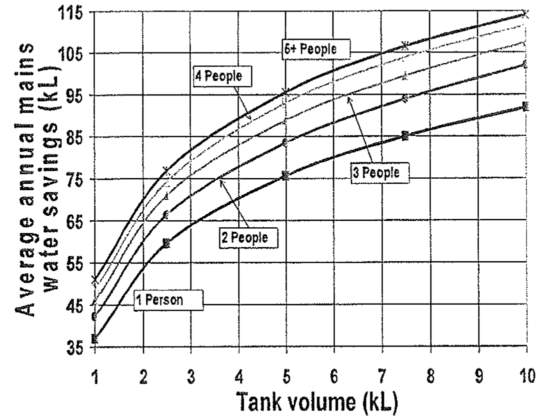

Figure 17: Mains water savings at dwellings with 200 m^2 roof areas in Western Sydney

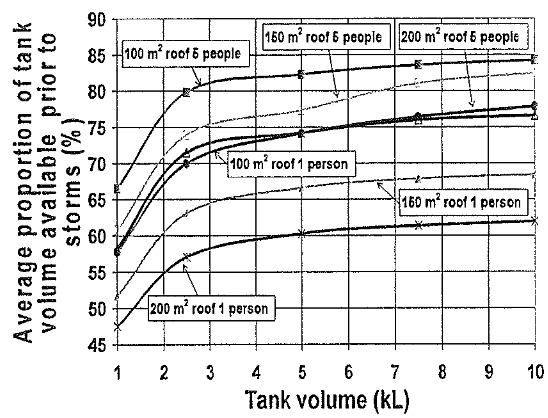

Figure 18: Average retention storage available prior to storm events in Western Sydney

Figure 18 shows that the average proportion of rainwater tank volume available for retention prior to storm events range from 48% (0.48 m^3) – 67% (0.67 m^3) for 1 kL rainwater tanks to 62% (6.2 m^3) – 84% (8.42 m^3) for 10 kL rainwater tanks. Similar to the results for Brisbane, smaller retention storages are available in rainwater tanks prior to storm events in Western Sydney than in Melbourne and Adelaide – this is due to the higher annual rainfall depth.

A 5 kL rainwater tank in Western Sydney will on average provide 71 kL/annum mains water savings and an average retention storage of 3.7 m^3 prior to storm events.

7. CONCLUSIONS

This study analysed the impact of collecting roof runoff in rainwater tanks with volumes from 1 kL to 10 kL that have mains water trickle topup used to supply domestic hot water, toilet, laundry and outdoor uses in Adelaide, Brisbane, Melbourne and Sydney. The water supply and stormwater benefits derived from the use of rainwater tanks are dependent on rainfall depth, domestic water use, tank volume and roof area.

The use of rainwater tanks resulted in considerable mains water savings in each city. Brisbane and Sydney with larger annual rainfall depths provided greater yields from the rainwater tanks. Significant retention volumes were found to be available in rainwater tanks prior to storm events in each city. Rainwater tanks will reduce stormwater peak and volumetric discharges from roof areas; especially for larger tank volumes. The largest retention volumes were available in Adelaide and Melbourne that have lower annual rainfall depths. Mains water savings increased with tank volume, number of occupants in dwellings and roof areas. In lower rainfall climates (Adelaide and Melbourne) and for smaller roof areas (100 m^2) increases in mains water savings diminish with larger tank volumes and greater numbers of occupants in dwellings.

For the cities examined in this study increases in water supply benefits from rainwater tanks diminished with larger tank volumes while stormwater management benefits increased with tank volume. In each city the optimum sized rainwater tank seemed to be about 5 kL for mains water savings whilst 10 kL rainwater tanks provided the greatest stormwater retention volumes. An important phenomenon is revealed by this study, unlike the design of reservoirs which require maximising water storage, the design of rainwater tanks with mains water trickle top up should aim to drawn down water levels in the tanks as often as possible.

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Using Rain Barrels in Northwest Gardens

WHAT WILL YOU SAVE TODAY?

SAVING WATER PARTNERSHIP

Conserving water–improving the efficiency of its use–is one important way to address local water needs and ensure adequate supplies in the future. Finding other sources of water can complement conservation. Rainwater is one source, and systems designed to catch and store rainwater take many forms. Rain barrels are one rainwater storage option.

What are Rain Barrels?

They're systems designed to capture and store rainwater coming off a roof, usually attached to a downspout. They consist of a storage container (usually plastic), a system for diverting downspout water into the barrel, and an overflow that returns to the downspout or diverts water safely away from the house to percolate into the soil.

They should also have the following:

- Durable, rot resistant construction.
- Opaque containers to discourage bacteria/algae growth.
- Kid, pet, and pest-proof openings.
- Valves for hose attachment.
- Screens and/or filters to keep debris out of the barrel.

Cisterns are above or below ground water storage systems, designed to serve large portions, or all, the water needs of a building or landscape. See Resources (back) for more information on larger rain harvest and storage systems.

What are Some Benefits of Rain Barrels?

- **Flexibility** As water storage needs change, the number of barrels in a system can follow suit.
- **Happier plants** Rainwater is free of the additives (e.g., chlorine and fluoride) in tap water that plants don't need or want. Rainwater is also slightly acidic, helping plants access soil nutrients. However, certain roofs can affect water quality. See "Is a Rain Barrel Right for Me?" on the back of this page.
- **Reduced stormwater runoff** Rain barrels can divert a limited amount of stormwater from roofs, reducing strains on urban creeks and storm systems.
- **Some water savings** Rain barrels can save water, but saving depend on the storage capacity of the system and proper use and maintenance. Additional outdoor water savings can be achieved by creating a water-wise yard and garden–call (206) 684-SAVE or see www.savingwater.org.

How much water can I catch?

Puget Sound averages about 3 feet of rain per year, but 2/3 of it falls from November to March. Most areas in the region average less than 2 inches total rainfall for July and August. To determine the amount of rain your roof catches, multiply your home's width by its length (in feet) to estimate its footprint. Then estimate the portion of this area that drains to the downspout you'll be using to catch your rain. The following formula will give a rough estimate of how much rain you can catch:

Rain caught (gallons) = (inches of rain) x .6* x (portion of building footprint)
For example, if your home's footprint is 1,400ft^2, and you want to know the amount of water that comes from a 1/4" (.25") rain event, you would solve the following:

Rain caught (gallons) = (.25) x (.6) x (1,400), or 210 gallons. However, storage is limited to the capacity of your system. Added capacity helps your system weather the dry spells. Capacity and cost are directly related: decide how much you want to spend for saving!

**One inch of rain falling on a square foot of surface yields approximately .6 gallons of water.*

Printed on paper made from 100% recycled fibers and including 30% post-consumer waste.

WHAT WILL YOU SAVE TODAY?

Brought to You by Your Local Water Providers

Bryn Mawr – Lakeridge Water & Sewer District
Cedar River Water & Sewer District
City of Bothell
City of Duvall
City of Mercer Island
Coal Creek Utility District
Highline Water District
King County Water District No. 20
King County Water District No. 45
King County Water District No. 49
King County Water District No. 90
King County Water District No. 119
King County Water District No. 125
Northshore Utility District
Olympic View Water & Sewer District
Seattle Public Utilities
Shoreline Water District
Soos Creek Water & Sewer District
Woodinville Water District

Is a Rain Barrel Right for Me?

Before installing a rain barrel, find answers to the following:

- **What are my landscape water needs?** Most rain barrels hold about 50 gallons. The difference between your summer and winter water use provides an estimate of current outdoor use. Multiple barrels increase storage capacity, but also cost more. Reducing landscape water demand (with compost-amended soil or water-wise plantings, for example) will help your rain barrel water last longer. Visit www.savingwater.org or call (206) 684-SAVE for more information.
- **What kind of payback do I want?** Rain barrel kits run from \$80 to \$130 or more for one-barrel models. Payback depends on system size, cost, rain patterns, use and maintenance, and your water rates. A "Do it Yourself" rain barrel can make the payback much shorter.
- **Do I have the space?** Be sure you have room near the downspout for a rain barrel. Some designs allow for the barrel to lay flat against the house.
- **Will I care for a rain barrel?** Barrels need to be kept free of debris and inspected to ensure they're working as intended. Untended barrels can breed mosquitoes and algae. Poorly directed overflow can damage siding, foundations, introduce moisture into the home, or cause runoff and erosion, impacting surface water quality.
- **Am I creating a safety hazard?** Children like to play in water–use barrels designed to keep kids safe. Make sure homemade rain barrels are kid-proof too.
- **Is the water from my roof safe to use?** Roof materials and treatments such as treated shakes, copper, or asphalt can affect water quality. Also, the "first flush" of rain after a dry spell can wash contaminants into the barrel–look for systems with devices that divert this water.

Where Can I Find a Rain Barrel?

Rain barrels can be bought pre-assembled, as kits, or homemade. King County maintains a list of local and online retailers, local city departments and water providers offering barrels and/or rebates (see Resources, below). Seattle Public Utilities does not currently offer rain barrel rebates.

You can save money by building your own rain barrel, using common hardware store items. Finding a used barrel reduces cost even further. Locally, barrels can be found at some industrial surplus business and hardware stores or by searching the online Industrial Materials Exchange (IMEX: http://www.metrokc.gov/hazwaste/imex/). Never use barrels that have stored hazardous materials–find barrels that held food or food-grade substances.

Resources

General Information:

- King County Dept of Natural Resources: http://dnr.metrokc.gov/wlr/pi/rainbarrels.htm (206) 296-4439
- "Harvesting Rainwater for Landscape Use" by P. Waterfall, Arizona Cooperative Extension: http://ag.arizona.edu/pubs/water/az1052/harvest.html has detailed information on rainwater systems.
- "Rainwater Harvesting" by Daniel Winterbottom (Landscape Architecture, April 2000). On the King County website: http://dnr.metrokc.gov/market/RainwaterHarvesting.pdf (requires Adobe Acrobat).

Do-It-Yourself rain barrel design drawings and assembly instructions:

- King County: http://dnr.metrokc.gov/wlr/pi/covrainbarrels.pdf (requires Adobe Acrobat).
- Maryland: http://www.dnr.state.md.us/programs/greenbuilding/rainbarrels.html

Cisterns and large rainwater storage systems:

- *Texas Guide to Rainwater Harvesting*: http://www.twdb.state.tx.us/publications/reports/RainHarv.pdf
- *Sustainable Building Sourcebook*: http://www.greenbuilder.com/sourcebook/RainwaterGuide3.html
- Treepeople (a non-profit Los Angeles group advocating urban forestry) cistern and on-site stormwater retention demonstration project: http://www.treepeople.org/trees/PBsite1.htm

#80976 1/02

Rain Wise
Managing Storm Water at Home

Installing a Cistern

to reduce runoff and conserve water

Seattle Public Utilities

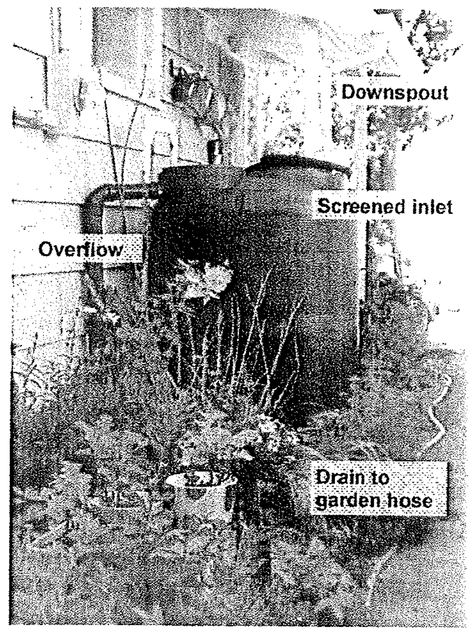
Note: These factsheets are for voluntary improvements by homeowners.
You can check permit requirements at DPD Applicant Services: 684-5362, email SideSewerInfo@Seattle.gov

Why install a cistern?

Cisterns (big rain barrels that hold 200-1000 gallons or more) can help reduce the peak storm runoff that damages our streams and causes sewer overflows. They can also hold water to irrigate your lawn and garden in summer. To get both those benefits, you need to leave the drain valve open October to May so that heavy rains can fill the cistern and then slowly drain out (before the next storm). Then in mid-May, you can close the drain so your cistern fills to store water for summer landscape irrigation. Open the drain again in fall – it's that easy!

Is a cistern right for me?

If you are good with tools, or can afford to hire a contractor, there are cisterns (or multiple smaller cistern/barrel systems) that can fit most yards.



You need:

- ☑ A **level location** near a downspout, **outside** (not inside a building)
- ☑ A **solid base** (packed earth or sand, concrete, etc.)
- ☑ At least **5 feet** from the cistern to your **property line**
- ☑ A safe place to **discharge the overflow** (after cistern fills) a minimum of:
  - 5 feet from your home, if you have a crawlspace
  - 10 feet from your home, if you have a basement
  - 5 feet from a property line, and 10 feet from neighboring buildings
  - or connect overflow to sewer (requires permit – call DPD number above)

Getting started – planning and shopping

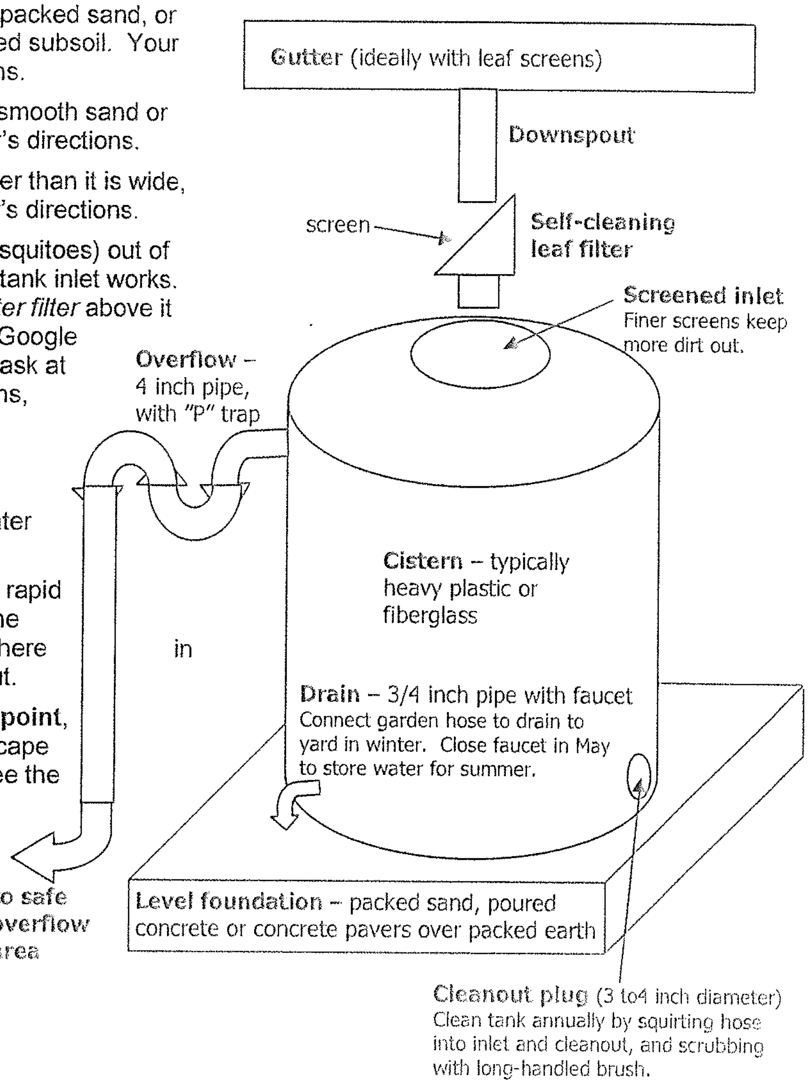
Because cisterns are still a fairly new idea in Seattle, you'll need to plan carefully, and shop around for your cistern tank, other materials, and a contractor (if needed). See the RainWise website for help.

- Start by talking to your neighbors, if it will be visible to them. A low fence or trellis can help improve appearance.
- Read the *Disconnecting Downspouts* and *Materials & Suppliers* factsheets at www.seattle.gov/util/RainWise
  If considering a larger system, permits may be required: read the Seattle Department of Planning & Development CAM 701 *Rainwater Harvesting for Beneficial Use* http://www.seattle.gov/DPD/Publications/CAM/CAM701.pdf
  If considering indoor use (such as toilet flushing), read the plumbing code *Rainwater Harvesting and Connection to Plumbing Fixtures*, which is available along with more rain water harvesting design resources at http://www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Rain_Water_Harvesting/index.asp
- How big a cistern do I need? Whatever size fits your space (200 to 1000 gallons) can help reduce winter peak runoff from your property. For roof runoff calculations, follow the "Rain Water Harvesting" link on the RainWise website.
- Additional sizing and other requirements apply if designing a system for stormwater code compliance, or if applying for a Stormwater Facility Credit – see the RainWise website or contact DPD at the number above for more information.
- Shop around for cistern tanks. While reused tanks may be available, the safest choice is a new tank. The cheapest source may be agricultural suppliers, since farmers already use plastic tanks for many purposes (see *Materials & Suppliers* fact sheet). Choose a dark-colored tank to limit algae growth, and place in a shaded location.
- Decide whether to go above ground or below. (Below-ground tanks are more expensive and harder to install.)
- Decide on a location, and foundation. A full tank is heavy (water weighs 8.4 lb./gallon) – you need a level, firm foundation to hold one safely. Tanks that are higher than they are wide typically need to be secured for earthquake protection, so it's easier to use shorter, wider tank. A shaded location (on north side of house) will limit algae growth.
- Shop for pipe and connectors (ABS or PVC Schedule 40 plastic is best) to connect your downspout to a screened inlet, to your tank, to an overflow, and to a drain valve (a garden-hose faucet works well).
- **Hire a qualified contractor or engineer** to plan or install, if any of this sounds like too much to do on your own!

How to Install a Cistern

1) **Level the ground** (use a carpenter's level) and pack the soil hard.
2) **Build a <u>level</u> foundation**. Place 4-6 inches of packed sand, or concrete pavers, or poured concrete, over packed subsoil. Your cistern tank supplier should provide specifications.
3) **Place the tank** – check that it's level, sitting on smooth sand or concrete without rocks. Follow the tank supplier's directions.
4) **Secure the tank** for earthquake safety, if it's taller than it is wide, to a building or metal frame. Follow the supplier's directions.
5) **Install a screened inlet** to keep debris (and mosquitoes) out of the tank. An aluminum window screen over the tank inlet works. Adding a *self-cleaning downspout screen or gutter filter* above it will keep leaves from clogging the inlet screen. Google "Downspout Filters, Screens" on the internet, or ask at your hardware store. For more elaborate systems, Google "First Flush Diverters, Roof Washers, *or* Cistern Installation" or check local plumbing and drainage suppliers.
6) **Make gutter connections** so that roof runoff water falls into the screened inlet.
7) **Install a 4 inch diameter overflow pipe** so that rapid flows from big storms can overflow safely after the tank fills. Place a "P" trap (see diagram) somewhere in the overflow, to keep mosquitoes and rodents out.
8) **Extend the overflow pipe to a safe discharge point**, where water can spread out into a lawn or landscape area. See "discharge distances" on front, and see the *Disconnecting Downspouts* factsheet on the RainWise website below.
9) **Install a drain valve**, usually a garden-hose faucet. Connect a garden hose to the faucet. Like the overflow pipe, run the garden hose from the drain to a safe place for water to soak into the soil or flow to the street drain.

Sample layout –
follow manufacturer's instructions



Using your cistern

From October through May, leave the drain faucet open, or partly open, so the cistern can slowly drain out through the hose between storms. That way, when a big storm comes, it's ready to hold and slowly release the excess flow from your roof. That helps reduce flooding, sewer overflows, and erosion in our streams. In mid-May, close the faucet valve so your cistern fills up to store water for summer. Use your cistern to catch rainwater for irrigation or other outdoor uses all summer. Then open the valve again October 1, to help protect our streams all winter.

Disclaimer: *This sheet contains general principles only, which may not be appropriate or safe for every property or project. Use good common sense. You assume the risk and are responsible for all consequences of your modifications to drainage flow or your property, for legal compliance, and for necessary permits and authorizations. The City of Seattle is not responsible for your modifications and disclaims liability for your actions.*

See links on the RainWise website if designing with intent to apply for a <u>Stormwater Facility Credit</u>, or for code requirements and additional design guidance in the <u>Stormwater Flow Control Manual</u>.

Learn more: For more design ideas, see "Rain Water Harvesting" on the RainWise website below, or Google "Cistern". Read the cautions in the *Disconnecting Downspouts* fact sheet, and see *Materials and Suppliers* for sources of cistern equipment. You can read them along with fact sheets on Rain Gardens, Cisterns, Infiltration Trenches, Permeable Paving, Compost-Amended Soil, Trees, and other RainWise ideas at <u>www.seattle.gov/util/rainwise</u> For printed copies contact the **Garden Hotline at (206) 633-0224** or email ***help@gardenhotline.org***