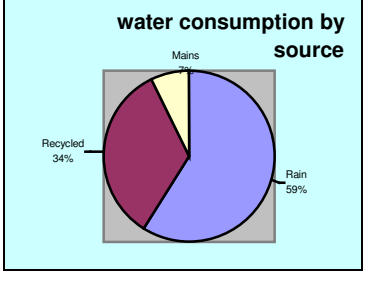

West Brunswick Sustainable House
Water Systems Retrofit

Final Project Report
February 2006

Smart Water Fund

Stuart McQuire
www.greenmakeover.com.au

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Executive Summary

After being given a Smart Water Fund grant to retrofit the West Brunswick Sustainable House with new rainwater and recycled water systems, Stuart McQuire and his family have cut their consumption of mains water down to under two and a half buckets a day — 97 per cent less than the average Melbourne household. They've done this without compromising their lifestyle and still manage to water a thirsty garden with over 20 fruit and nut trees. This report explains how and discusses the potential for similar initiatives on a wider scale.

Through installing a new rainwater system and new water recycling system the household's mains water consumption has been cut to 23 litres or less than 2½ buckets per day. With four people in the house this is around 6 litres per person per day. Only two of the households taps now use mains water, the kitchen cold water tap for cooking and drinking, and the bathroom basin cold water tap for brushing teeth. All the other taps are supplied with either rainwater or recycled water from the site.

The rainwater systems consists of four rainwater tanks with total capacity of 20,000 litres that supply water for the shower (hot & cold), laundry, all water via the hot water system, and several garden taps. A pump is used to provide pressure to supply the water and a Rainbank is used to provide mains water back up as security of supply. The recycled water system consists of an Envirowater treatment unit that processes water in batches from the shower, bathroom basin and laundry. Two 5500 litre water storage sacs are positioned under the house to store the recycled water. The water is treated to the 20/30/10 standard as recommended by the Department of Human Services and as required by the EPA and Moreland Council. This standard allows the water to be stored indefinitely. The recycled water is used for toilet flushing, and in the garden via above ground irrigation.

The project aimed to explore technical solutions for reducing mains water consumption in the context of a suburban lifestyle. The family's experience living with the rainwater and recycled water systems is an important part of the project. The positive experience of living with the rainwater system shows the potential for widespread use of rainwater systems as a key part of Melbourne's water supply. Teething problems were experienced with the water recycling system reflecting the prototype status of the Envirowater unit. Difficulty in obtaining approvals is identified as a barrier to the wide spread uptake of water recycling systems. Management and maintenance issues also need to be addressed at the household level, by service providers and by regulatory agencies.

The project included open days, tours and public presentations. Partnerships were undertaken with Melbourne Museum and the ATA. Project partners also included Envirowater who developed the water treatment technology and RMIT who provided advice in relation to water quality. The project was also communicated via a range of media, including featuring in the *Our Water, Our Future* documentary and in a segment of the *Running on Empty* television series, as well as in magazine and newspaper articles.

1 Background

The Project has involved retrofitting the West Brunswick Sustainable House so that it is a state of the art real life demonstration site for water recycling and rainwater use. It's part of exploring the range of options for securing water supplies to Melbourne.

The West Brunswick Sustainable House is a Californian Bungalow style weatherboard house built in 1929. It is home for Stuart McQuire and Wendy Orams and their two daughters. Without renovating or rebuilding, the house has progressively been re-fitted or retrofitted for environmental sustainability. The West Brunswick Sustainable House has attracted a national and international profile for its role in pioneering environmental technologies and sustainable living. Because it is primarily a comfortable family home the house is able to demonstrate the performance of innovative water smart technologies in a real life situation. The profile of the house for sustainability provided an ideal opportunity to showcase water smart technologies in the context of holistic environmental sustainability.

Prior to this Project the household had recycled water since 1992 using a simple system of diverting laundry and shower water to the garden. Rainwater tanks had been in use since 1994, initially for garden watering, then for supply to the laundry and toilet. Water conservation initiatives undertaken prior to the Project meant that the household mains water consumption was less than half that of a typical Melbourne home (ie approximately 120,000 litres per annum).

The Project aimed to demonstrate a reduction in reliance on mains water by around 90% and a reduction in discharge to the sewer of around 80% compared to a typical Melbourne home. The project aimed to break new ground and expand the perception of what is possible in relation to sustainable water use in a suburban environment. In planning for Melbourne's future water requirements these reductions can be extrapolated to other existing houses and to new developments. The technologies used for the rainwater and recycled water systems are innovative and are also relevant to applications in commercial, municipal and sports facilities.

The Project commenced in 2003 with the initial focus on designing the recycled water and rainwater systems. The Project had initially intended to use eletroflocculation treatment technology because it could treat water to a standard that allowed long-term storage and use of the recycled water for toilet, laundry and garden. However, the Envirowater treatment unit was chosen because it could also achieve this standard, was less expensive, and had the added appeal of doubling as a water feature in the garden.

The process of obtaining approval for installation of the Envirowater unit was difficult. The EPA seemed unclear about approving a water recycling system that aimed to recycle water for use inside the house, and at that point the guidelines for reuse had not been issued by DHS. Commencing in August 2003, a series of batch tests were run with the Envirowater unit to obtain data on the quality of water treated.

By October 2003 DHS had issued guidelines for water recycling that specified the 20/30/10 standard for single unit dwellings. The 20/30/10 standard is referred to in the document *Appropriate reuse of greywater* published by the Environmental Health Unit in the Victorian Department of Human Services. It refers to 20 mg/l BOD, 30 mg/l suspended solids and 10 E.coli/100 ml.

It wasn't until May 2005 that EPA approval was issued for use of the Envirowater unit. Approval for installation was then obtained from Moreland City Council. The EPA and council approvals included the condition specifying that effluent from the treatment system must not exceed the following 90th percentile limits:

For all discharges:

- Biochemical Oxygen Demand 20 mg/l
- Suspended Solids 30mg/l

For surface irrigation:

- E.coli 10 orgs/100ml

The rainwater system was progressively installed and plumbed into the house. By December 2004 the rainwater and water recycling systems were fully operational. The Project then tracked the experience of the household in living with the systems and monitored the performance of the systems in terms of maintenance and management issues.

2 Project outcomes

2.1 Water consumption

Water consumption was recorded using water meters for each of the household's water sources, ie rainwater, recycled water and mains water. The household's consumption of mains water during 2005 was 8317 litres, or an average of 22.7 litres per day. This compares to the benchmark of 270,000* litres per annum or 739.7 litres per day for a typical Melbourne home. This means the household achieved mains water consumption that was 97% less than the typical Melbourne home, against the project target of 90% less.

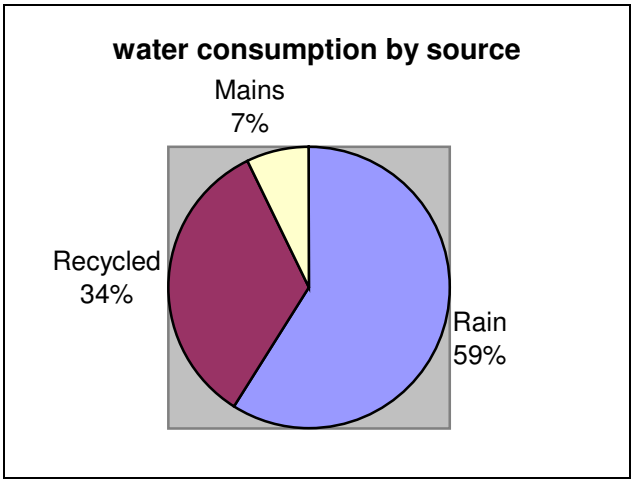
Sewage discharge is estimated to have been approximately 42,000 litres for the year. This is equivalent to 73% less discharge to the sewer than a typical Melbourne house, against the project target of 80% less. This is based on the estimates that approximately 50 litres per day were discharged to the sewer from toilet flushing and 15 litres per day via the kitchen sink. In addition, it's estimated that average of 50 litres per day from the shower, bathroom basin and laundry (ie about 25% of water from these sources) was discharged to sewer when the water recycling system was processing water from these sources.

*The benchmark figure for the typical Melbourne house's mains water consumption is 270,000 litres per year, with 65% or 175,500 litres used indoors and the remaining 35% or 94,500 litres used outdoors (Source: South East Water, 2003). The benchmark figure for discharge to the sewer for the typical Melbourne house is 157,950 litres (assuming a discharge factor of 0.9 for indoor water use).

2.1.1 Water consumption by source

3/1/2005 to 4/1/2006

Rainwater provided most of the household's water (59%), followed by recycled water (34%), with mains water use 7% of the overall water consumption.

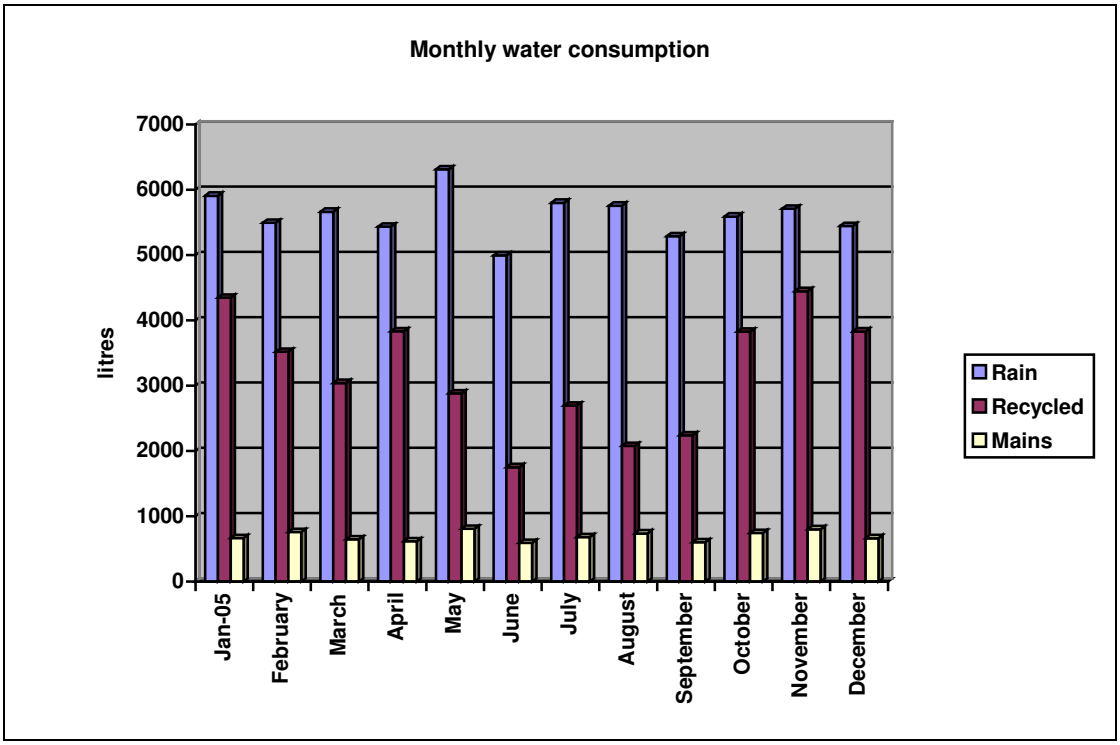


Source	Amount (litres)	Daily amount (litres) (366 days)	Percentage
Rain	67416	184.2	59%
Recycled	38516	105.2	34%
Mains	8317	22.7	7%
Total	114293	312.1	

2.1.2 Monthly water consumption

Household monthly water consumption varied between approximately 11000 litres in January down to 7000 litres in June. Mains water consumption varied between 600 to 800 litres per

month. Monthly rainwater consumption varied from approximately 5000 to 6000 litres per month. Recycled water consumption showed the greatest variation with consumption between 1750 and 4450 litres per month. This variation reflects the varying use of recycled water on the garden.



	Jan 05	February	March	April	May	June	July	August	Septem-ber	October	Novem-ber	Decem-ber
Rain	5910	5496	5665	5437	6313	4997	5802	5758	5289	5591	5711	5447
Recycled	4348	3519	3041	3832	2882	1752	2696	2078	2239	3829	4449	3851
Mains	664.9	760	647.5	617	808.8	593.7	679.7	736.7	601	744.3	800.2	663
Total	10922.9	9775	9353.5	9886	10003.8	7342.7	9177.7	8572.7	8129	10164.3	10960.2	9961

Energy use
Solar electricity is used to supply energy for the pumps. The house was the first in Victoria to have grid-connected solar electricity and generates more than it uses. Electricity use for the treatment system and pumps to deliver the rainwater and recycled water is estimated to be around 35 kWh per month. The pump in the treatment tank uses 90 watts when it's on, while the pressure pumps for the rainwater and recycled water use 600 watts when pumping. The ultra-violet lamp uses 15 watts and is only on when water is passing through it.

2.2 Water quality

2.2.1 Recycled water

Prior to installing the Envirowater unit batch tests were run to assess the quality of the treated water. Then, as part of the permit conditions for installing the unit, water quality is monitored every 3 months. The unit has consistently achieved the 20/30/10 standard which refers to 20 mg/l BOD, 30 mg/l suspended solids and 10 E.coli/100 ml. The recycled water has also been monitored for nitrogen, phosphorus, turbidity, pH and TDS (ie Total Dissolved Solids, an indicator of salt).

The 20/30/10 standard is referred to in the document *Appropriate reuse of greywater* published by the Environmental Health Unit in the Victorian Department of Human Services. It refers to 20 mg/l BOD, 30 mg/l suspended solids and 10 E.coli/100 ml.

The table below summarises the results of water quality analysis for recycled water samples taken in 2005. The test result from the sample taken on 30/9/2005 showed suspended solids at 36 mg/l. Contamination of the storage sacs was suspected through plumbing work that had occurred prior to the sampling. Subsequent samples taken on 13/10/2005 showed suspended solids at 4 and 5 mg/l (ie consistent with the standard of <30 mg/l).

Recycled water	7/2/2005	7/6/2005	30/9/2005	13/10/2005		28/11/2005
Suspended solids	<1	<1	36	5	4	2
BOD	3	9	15			9
E coli	0	0	0			0
Nitrogen	4.7	6.2	5.7			5.0
Phosphorus	0.6	0.65	0.2			1.0
pH (units)	6.8	7.9	6.7			6.9
Turbidity, NTU	5.4	1.5	16			1.7
TDS	140	110	90			110

Results in mg/l, unless stated. E.coli results in organisms per 100ml.

Full results of the water quality monitoring for the 2005 period are included in Appendix 1.

Odour was an issue with the recycled water initially. The odour of the water in the storage sacs became progressively worse to the point that it created an unpleasant smell in the bathroom each time the toilet was flushed. The recycled water also created an unpleasant smell when the garden was watered. Plans to use the recycled water for laundry washing were changed due to the odour issue.

To reduce odour calcium hypochlorite was added to the treated water using a canister in-line after the UV lamp and prior to the storage sacs. This reduced odour to a more acceptable level from the householder's perspective, but raised concerns about the use of chemicals. Subsequent investigation revealed that a solenoid valve at the pebble bed was restricting flow of the water during the treatment cycle. Removal of the solenoid valve allowed increased flow of the water and resulted in reduced odour problems. The calcium hypochlorite was no longer used. Further adjustment of the flow rate increased the fountain flow rate from 6 to 17 litres per minute eliminating odour problems.

2.2.2 Rainwater

The rainwater was initially tested for E.coli, nitrogen, phosphorus, pH and TDS. One test was done for turbidity, and subsequent tests were done for E.coli. The results are collated in the table below. No disinfection is used on the rainwater and E.coli levels have varied between 0 and 43 organisms per 100ml. As the household is not drinking the rainwater this is not seen as a concern. Disinfection could be added if the household were to drink the rainwater.

Rainwater	7/2/2005	7/6/2005	30/9/2005	28/11/2005
E coli	43	0	10	2
Nitrogen	4.6			
Phosphorus	<0.05			
pH (units)	5.9			
Turbidity, NTU		0.6		
TDS	<1			

Results in mg/l, unless stated. E.coli results in organisms per 100ml.

2.3 Education program

The education program consisted of open days and tours at the West Brunswick Sustainable House, presentations about the project off site, and promotion of the project through the media. Participants in the tours included people from the general public, government agencies, water industry and plumbers. Feedback from participants was positive with many

expressing interest and enthusiasm in the initiatives undertaken. The following is a summary of the education program outcomes:

2.3.1 Tours and open days

There were 12 open days / tours held at the West Brunswick Sustainable House during the Project:

- Open Day / tours, 14/11/2004, as part of the Water Smart Homes project coordinated by Melbourne Museum. Attended by approximately 50 people from the general public (but including some from government & industry).
- Open Day / tours, 26/2/2005 as part of the ATA Grey Water Open Days. Attended by approximately 30 people from the general public (but including some from government & industry).
- Open Day / tours, 5/3/2005 as part of the ATA Grey Water Open Days. Attended by approximately 45 people from the general public (but including some from government & industry).
- Open Day / tour, 16/3/2005 in conjunction with Envirowater. Attended by approximately 15 people, from industry & government.
- Tour for RMIT plumbing students & staff, 26/4/2005 (17 people, industry).
- Tour for ATA Grey Water Project, 14/5/2005, 9 people, including other householders, ATA, EPA & SWF staff.
- Tour for DHS policy review staff, 16/9/2005 (2 people, government).
- Open day for Vietnamese community as part of Melbourne Museums Water Smart Homes & Gardens tours, 15/10/2005 (~25 people, residents).
- Tour for Brunswick Sustainability Street group, 16/10/2005 (4 people, residents & program manager).
- Tour for DHS managers, 17/10/2005 (5 people, government).
- Open day as part of Melbourne Museums Water Smart Homes & Gardens tours, 22/10/2005 (~90 people, general public but including some government & industry).
- Tour for Korean environmental delegation in conjunction with Friends of the Earth, 21/12/2005 (~15 people from government, business & NGOs).

2.3.2 Presentations

Six presentations were made about the project at a range of functions:

- Presentation at Melbourne Museum, 7/11/2004, as part of the Water Smart Homes project coordinated by Melbourne Museum. Attended by approximately 15 people, mainly from industry but including some from the general public.
- Presentation at RMIT University, 28/2/2005 as part of the Environmental Policy Practice course. Attended by approximately 80 environment and planning students.
- Presentation undertaken at City of Darebin workshop, *Making your home sustainable* workshop, 9/6/2005 (~ 40 people, mainly residents).
- Presentation at *Water Futures 2* seminar organised by RMIT, held at Melbourne Museum, 18-11-2005, (~30 people, mainly academics, industry & government).
- Panel member for *Running on Empty, Water Futures Forum*, held at Melbourne Museum, 18-11-2005 (~45 people, general public, industry & government).
- Presentation to staff at SE Water's Innovation Fair, 1-12-2005 (~60 people, industry)

2.3.3 Media

The following is a list of print media results and electronic media results. Some examples of magazine and newspaper articles are included in Appendix 2, along with a copy of one of the tour sheets handed out to tour participants.

Print media results:

1. Moreland Leader, article *Water saver to please council*, 22/11/2004
2. Leader Newspapers, article *Green Commitment*, Moreland Leader 21/2/2005.
3. Fairfax Community Newspapers, article *Sustainable house to open for public view*, Moreland Community News 22/2/2005.
4. Leader Newspapers, Yarra Valley Water `advertorial' *Water Smart House Open Day*, 28/2/2005.

5. Melbourne Times, article *Grey turns to green*, 2/3/2005.
6. Herald Sun, article *It's all thanks to tanks*, 28/3/2005.
7. Tour Sheet, West Brunswick Sustainable House, February 2005.
8. Fact Sheet, 19 Murray Street West Brunswick, November 2004.
9. Gardening Australia Magazine, article *Your Green Guide to Grey Water*, June 2005, Josh Byrne;
10. Plumbing Connection, article *Underground unit under scrutiny*, Winter 2005, Caroline Kearney.
11. Interview & photo for Moreland Leader (5/10/2005).
12. Tour Sheet, West Brunswick Sustainable House, October 2005.
13. Media release issued November 2005: *Two and a half buckets of water a day and still enough for the garden!*
14. Article written & photos provided for ReNew magazine, *Two and a half buckets of water a day,* Issue 94 Jan-Mar 2006.

Electronic media results:

1. Melbourne Museum, interview & photos for Water Smart Home Exhibit, website & archive.
2. RRR, 17/10/2004, live to air from Melbourne Museum during launch of National Water Week.
3. 3AW, 14/11/2004, interview with Jane Edmanson & Darren James.
4. Interview for Channel 7, 24/1/2005. *Our Future, Our Water*, shown 26/3/2005.
5. Radio interview on Now FM (13/10/2005).
6. Website established for the West Brunswick Sustainable House, www.greenmakeover.com.au (November 2005).
7. Interview for *Running on Empty* series for Foxtels' Weather Channel (5 & 8/12/2005), scheduled for screening late Dec 2005 – Jan 2006.

3 The rainwater system

The rainwater system uses four rainwater tanks to store up to 20,000 litres of water. The rainwater is used for showers (hot & cold water), the laundry, all water via the hot water system, and a couple of garden taps. A pump automatically provides pressure when taps are turned on. The rainwater system also has a device that switches across to mains water supply automatically if the rainwater tanks run low (Davey Rainbank), but during 2005 the tanks did not reach the low level point.

The rainwater tanks are all connected at ground level, and water flows between them via gravity as the water level rises and falls in the main tank adjacent to the house. The other three tanks are nestled under trees behind the garage about 25 metres away. Catchment for the tanks is about 200 m^2 of roof on the house and adjacent home office. Based on rainfall records it is estimated that about 100,000 litres of rain will be available from the roofs each year.

To improve water quality Enviroflow guttering that has two layers has been installed in areas where there are overhanging trees. The top layer has filters every half a metre that prevent leaves and debris entering the bottom layer, but allow water to flow through. First rain diverters have been used on two of the downpipes, while at the front of the house a gate valve has been fitted to allow the pipe to be flushed out periodically at the low point of the `wet system' transferring water to the tanks.

In terms of assessing the potential for widespread uptake of rainwater tanks as part of household water supply it's worth looking at the past experience of the West Brunswick Sustainable House.

Rainwater now supplies about 60% of the household's water. For the household it's been a progression to move to using rainwater as their main source of water. In 1994 initially a rainwater tank was installed for watering the garden, but was found to be of limited use. It would fill up and sit full for most of the year when the garden didn't need watering which meant it would not be catching any more water. When dry weather came it would quickly empty. It wasn't until the household installed a pump (in 2000) and connected the rainwater to supply the laundry and toilet that they started to get the best value from having a tank. By connecting the rainwater tank to something the household used everyday it meant that when it rained the tanks would catch some of that water.

The household estimated that water use for the shower was over half their water use inside the house, so now by supplying water for the shower from rainwater they have made a major reduction in their mains water consumption.

The experience of using the rainwater system differs little to using mains water from the householder's perspective. The use of a household pressure pump means water flows from taps as soon as they are turned on. When they are switched off the pump automatically switches off. The rainwater system has required very little maintenance. Periodic cleaning of

gutters is needed, along with flushing of the first rain diverters and opening the valve that releases sediment from the low point of the pipes in the `wet system'.

In terms of planning a rainwater system it's best to have a connection to something inside the house. In order of priority this would be the toilet, laundry, shower and then kitchen. This order is based on an increasing need for control of water quality and also depends on being able to match the storage capacity to the volumes of water you need. The use of the Rainbank means there is security of supply with mains water back up. This means rainwater systems do not need to be designed to be self sufficient if they are in areas of mains water supply.

Rainwater systems could be widespread for use for toilet flushing, laundry and garden. Several issues impact on the extent to which rainwater systems will be used. Cost is an issue, along with a related issue of perceptions of good value. Beyond basic affordability many consumers will compare the cost of a rainwater system to the cost of mains water in deciding whether to install a rainwater system. This may mean that even where consumers could afford rainwater systems many will not choose them because of a perception that they are not good value or that they don't `pay for themselves'. This `pay back filter' is one of the barriers to wide spread uptake.

Access is an issue for installing rainwater tanks in existing properties, and may mean it is necessary to use multiple smaller tanks instead of one larger tank. This was the case with the West Brunswick Sustainable House. Permit conditions may be an issue in some areas, but no planning or building permits were needed at the West Brunswick Sustainable House. The limited availability of plumbers who are experienced and confident in recommending rainwater systems may slow their uptake. A further issue is the sustainability of the materials used to manufacture rainwater tanks, which have used a lot of plastic. It is recyclable, but none of it is from recycled sources. There may be technical reasons for using only virgin resin, but otherwise ideally tanks would include at least some recycled resin.

Rainwater system approximate costs:
Rainwater tanks: $730 (4500 litre), $1100 (6800 litre).
Rainbank: $410
Pumps: $300 -$400
Enviroflow guttering: $30 metre

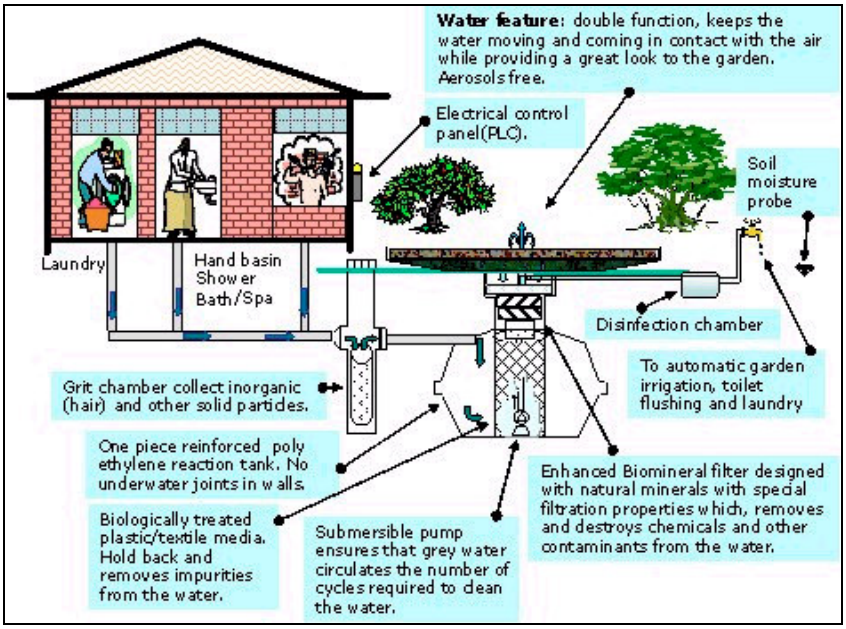
Using less in the first place.
Overall the household uses about half the water of a typical Melbourne home. This has been achieved through four key things:

- A low flow shower rose, rated at 6.75 litres per minute (bought in 1991 for less than $20);
- Dual flush toilets, (3 / 6 litres, cost ~$120);
- A water efficient washing machine that uses between 35 – 60 litres per load (from ~$700); and,
- Mulching the garden, to reduce evaporation and improve the soil.

4 The recycled water system

The water recycling system uses a new water treatment technology called Envirowater. This technology has been developed in Melbourne and is based on similar technology that has been used on an industrial scale. It uses biological and mineral filters to treat water and has the added appeal of doubling as a water feature in the garden.

The Envirowater water recycling unit uses a tank underground to receive water from the shower, bathroom basin and laundry, which it then processes in batches using mineral and biological filters. Initially a stocking like hair and lint filter screens water flowing into the treatment tank. It takes about two days for us to fill the treatment tank, and then a float switch activates a pump at the bottom of the tank that sends water up to the fountain at the surface. This has the effect of aerating and circulating the water as it lands on the pebble bed at the surface before flowing via gravity back into the treatment tank. Micro-organisms growing on balls filled with aggregate inside the treatment tank help to make the water clean. The cycle runs for 9 hours, after which a timer controls a solenoid valve that then allows the water to be pumped out of the treatment tank. The water passes through a particle filter and then an ultra violet light that disinfects the water on its way to two large storage sacs, which resemble waterbeds under the house.



Graphic from www.envirowater.com.au

The water is no longer grey water and has been treated to a standard that allows it to be stored indefinitely. It is treated to a level called the 20/30/10 standard that allows the water to be used for toilet flushing, garden irrigation (even above ground) and laundry washing. A pump is used to deliver water from the storage sacs to our toilets and also to a network of pipes connected to taps in the garden. Recycled water is automatically pumped from the sacs when the toilet is flushed or when one of the recycled water taps is turned on. The water could be stored in tanks above ground in the absence of space under the house.

Part of the appeal of the Envirowater unit is that it is designed primarily as a unit that allows recycling of water rather than simply an alternative method of disposal. The potential for recycling is maximised by treating water to a standard that allows it to be stored indefinitely and also allows the treated water to be used through conventional irrigation methods rather than through dispersion trenches under ground.

Prior to installing the Envirowater unit batch tests were run to assess the quality of the treated water. Also, as part of the permit conditions for installing the unit we are required to monitor water quality every 3 months. The unit has consistently achieved the 20/30/10 standard and the water has also been monitored for nitrogen, phosphorus and TDS (ie Total Dissolved Solids, an indicator of salt).

Odour has been an issue at times with the treated water. Because of this the West Brunswick household has not used the recycled water in the laundry. Odour issues were overcome by increasing the flow rate of the fountain at the pebble bed. The increased flow means the water is aerated more and the number of times the water is cycled has increased.

The Envirowater unit has effectively been a prototype and in using it the West Brunswick household has experienced teething problems that have needed to be dealt with as they arose. These relate to the performance and availability of suitable plumbing fittings rather than the biological treatment process. Issues that still remain include the need for a self cleaning particle filter (ie rather than one that needs to be manually washed), and the need for valves that allow the treatment tank to be pumped out quicker at the end of the cycle.

At this stage it seems water recycling systems like the Envirowater unit are likely to be limited in their uptake with appeal only to niche markets. These markets include `enthusiasts' as in the case of the West Brunswick household, and also households where water supply or water treatment options are limited. The cost of the technology will be a barrier for most people. As with the rainwater system, because of the perception that environmental technology needs to pay for itself, this will be an issue for many people even in cases where they could afford it.

Maintenance and monitoring are also issues for water recycling systems. Where householders are not likely to pay attention to maintenance and monitoring issues themselves there will be a need for service providers or regulators to take on that role.

The regulatory framework in Victoria for approval of water recycling treatment systems is cumbersome and is dominated by a risk management perspective, rather than a sustainability perspective that includes risk management. There is potential to introduce a regulatory system that focuses on sustainable use of water, rather than regulation that sees water recycling primarily as an alternative method of disposal.

There seems to be a shortage of plumbers with experience and enthusiasm for installing rainwater and recycled water systems. This is understandable with relatively new technology for water recycling, but points to the need for further training options and incentives to encourage plumbers to pursue these.

Recycled water system approximate costs:

- Envirowater unit: $3500 (not yet on market, except in the ACT), plus installation between $1000 to $3000 (site specific).
- Water storage sacs: $1300 (5,500 litre).
- Pressure pump with sensor: $400

Appendices

Appendix 1 Water quality test results
(See separate document: WBSH Appendix 1, available on request.)

Appendix 1.1 Rainwater 7/2/2005
Appendix 1.2 Rainwater 7/6/2005
Appendix 1.3 Recycled water 7/2/2005
Appendix 1.4 Recycled water 7/6/2005
Appendix 1.5 Recycled water & rainwater 30/9/2005
Appendix 1.6 Recycled water 13/10/2005
Appendix 1.7 Recycled water & rainwater 28/11/2005

Appendix 2 Examples of media articles
(See separate document: WBSH Appendix 2, available on request.)

Appendix 2.1 Herald Sun, 28/3/2005
Appendix 2.2 Moreland Leader, 21/2/2005
Appendix 2.3 Tour sheet, West Brunswick Sustainable House, October 2005