ATA Greywater Project Report

supported by

Smart Water Fund

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ATA Smart Water Greywater Project

Project Report

Introduction

The Alternative Technology Association (ATA), with funding from the Smart Water Fund, has carried out a trial of six greywater systems in private homes in Melbourne in order to assess the usability, health and safety issues associated with domestic greywater reuse. ATA sought funding for the project in response to growing interest in greywater expressed by our members, and by members of the public. Requests for information about greywater reuse continue to grow as the community responds to rebates offered by the Victorian Government, media focus on Australia's 'water crisis' continues, and industry interest grows the water-conservation market.

ATA's Smart Water Greywater Project has delivered valuable insights regarding the pros and cons of greywater reuse and the health, safety and regulatory issues faced by home-owners attempting to install and operate domestic greywater systems. In addition, the project has revealed significant barriers to wide-scale uptake of domestic greywater systems, allowing ATA to form conclusions about how best to reduce these barriers.

The ATA Smart Water Greywater project has been overseen by a steering committee of government and industry professionals to ensure that the results obtained are of value to the widest range of stakeholders, and to provide expert guidance. For their support, constructive criticism, and commitment to bringing about water reform, ATA extends our thanks.

Project Steering Committee

South East Water	Keith Johnson, Smart Water Representative
RMIT	Ian Thomas, Social Planning Consultant
ATA	Stuart McQuire, ATA Member Representative
ATA	Frith Kennedy, Media Manager,
Dept. Human Services	Amelia Savage, Environmental Health Consultant
EPA Victoria	Chandrika Jayatilaka, Project Manager, Water & Catchment

Project Team

Project Managers	Alison Sutherland and Robin Merrick
Publications Manager	Donna Luckman
Media Manager	Frith Kennedy
Administration Manager	Jodie Meehan
Chief Executive Officer	Rachel Ollivier

Purpose of this report

The purpose of this report is to:

1. Provide an overview of the ATA Smart Water Greywater Project
2. Communicate the Project's outcomes and provide case study summaries
3. Communicate ATA's findings about current greywater reuse in Australian homes
4. Highlight barriers to wide-scale uptake of domestic greywater reuse, and offer recommendations for their removal
5. Provide government agencies, ATA members and the broader community with guidance about re-using greywater, including specific system information.

Project Approach

ATA's Smart Water Greywater Project comprised three major components:

1. Greywater trial : Installation, operation and evaluation of six greywater systems within Metropolitan Melbourne
2. Greywater Survey: Examination of current greywater reuse
3. Communications: Education (public meetings and seminars) and print media

Greywater Systems Trial

The greywater systems trialed in this project range from largely automated systems to simple diversions. The systems were trialed under normal household conditions, the project's aim being to examine home-owner's experiences as they select, install, operate and maintain the systems.

Sites selected for the project provided a uniform geographic spread across Melbourne's retail water supply companies and municipalities, and represented a range of household types, sizes and level of knowledge about greywater reuse.

Key Project Findings

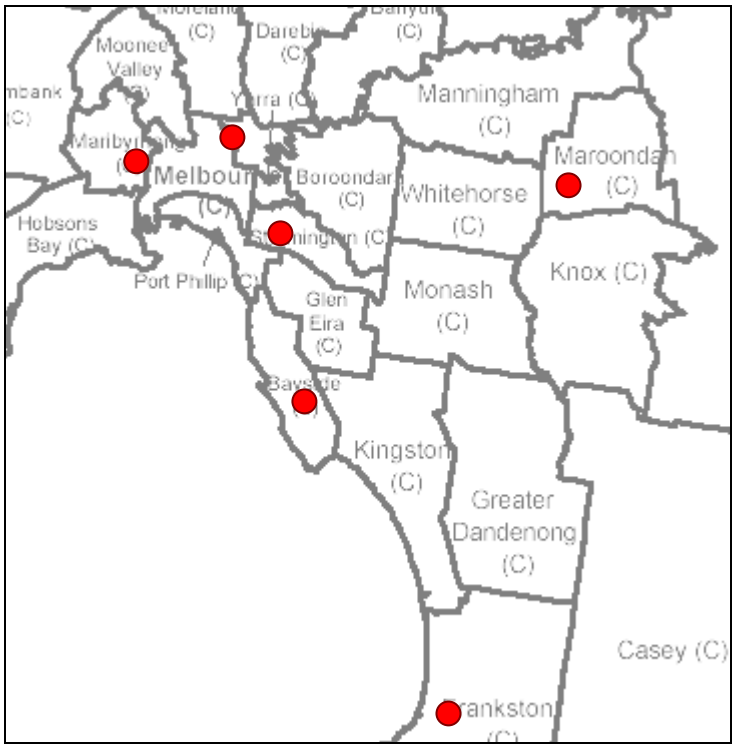
The project's key findings are listed below. Each of these points is elaborated upon in this report.

- greywater reuse has the potential to significantly reduce mains water use in private homes
- greywater reuse demonstrably encourages broader water conservation behavior and responsible chemical product selection; in turn improving the health of the broader water cycle

Despite the obvious benefits and the feasibility of using greywater as a water saving measure, the research identified a number of potential challenges and barriers that need consideration.

- greywater treatment systems can be complex and consume high levels of embodied and operational energy. This may not be justified at the domestic scale in many situations. Diversion systems, despite being the simplest, low-tech solution, need careful consideration of a number of issues in order to get the best results. However, with appropriate installation and management they can be used safely and effectively
- expert advice is required to marry greywater output with the water needs of a garden.
- permanent greywater diversions are being installed by the community, generally without knowledge of local council consultation requirements and frequently without an understanding of the potential risks to human and environmental health
- risks of harm to the environment or humans associated with greywater diversions are largely dependent upon levels of care taken by system owners
- some of the simple barriers numerous barriers prevent wide-scale uptake of greywater re-use;
    - lack of awareness about greywater reuse possibilities and/or belief that domestic water recycling is important
    - high cost of reusing greywater relative to the low (too low) cost of mains water
    - difficulty accessing consistent and accurate information about greywater reuse
    - narrow range of commercially-available greywater systems
    - onerous and expensive approval processes for treatment systems

Locations of households trialing greywater systems for the project



Greywater Systems Selection

Greywater systems were selected in response to site-specific and household-specific conditions including;

- the quantity of greywater generated by each household
- household composition (particularly the presence or absence of toddlers)
- preferred use of effluent (garden irrigation or toilet-flushing)
- garden size, slope and soil type
- proximity to rivers, creeks or other waterways
- householder willingness to minimize salt and chemical inputs
- householder willingness to actively maintain the system
- site constraints such as access to plumbing & the sewer line

Risk assessments were prepared for each of the homes to evaluate system fitness-for-purpose and to ensure safe installation & operation. This risk assessment process proved to be invaluable for selecting the right system and for pre-empting risks that must be managed. For example, it was identified that a simple diverter could block due to build-up of lint and hair. An overflow outlet connected to the sewer system was therefore installed in all of the homes to address this possible system failure. Another identified risk was possible long-term build-up of salt in the gardens. All of the homeowners, having been alerted to this risk, take care not to use high salt-content products. The risk assessment process is highly recommended by ATA (a Greywater Risk Assessment Template can be found in Appendix A).

Greywater Regulations in Metropolitan Melbourne

Reuse options for Household Wastewater, including Greywater, are outlined in EPA Victoria's Information Bulletin, Publication 812, dated November, 2001.

In a nutshell, greywater systems are broadly grouped into two distinct categories for regulatory purposes:

- diversion of untreated greywater for immediate reuse
- installation of systems to collect and treat household wastewater and reuse the resulting effluent

Diversion of untreated greywater for immediate reuse

There are no specific Local or State Government controls on household diversion systems (for garden use or toilet flushing). This is because the State Government endorses seasonal/occasional diversion of untreated greywater only, – i.e. such systems are viewed as being temporary from a regulatory point of view. Irrespective, untreated greywater reuse must not create a public health hazard, an environmental hazard or a nuisance, diverters must be installed by licensed plumbers, and home-owners should consult their local council and water authorities prior to installing the diverter. In addition, irrigation should be 'sub-surface', however the definition of sub-surface is unclear, being defined as "an area within the profile below the surface but generally above the subsoil horizons" in the Septic Tank Code of Practice.

Treatment and storage of greywater

Systems that collect, treat and reuse wastewater from individual households must be approved by EPA Victoria and be issued with a council 'septic tank permit' for each installation. For these permanently-installed systems, the State Government requires households to protect environmental and human health at a level commensurate with or higher than the existing sewer system.

Treated wastewater must be contained within allotment boundaries and not be discharged to drains or waterways, and the wastewater must be treated to a 'secondary' standard if irrigated above-ground.

Greywater Irrigation Schemes

EPA Victoria's Publication 812 provides guidance regarding garden areas required to receive different volumes of treated greywater. The publication is not, however, a design guide, and design information relating to the irrigation component of greywater systems is hard to find. Greywater Treatment systems must comply with EPA's irrigation guidelines; however the irrigation component of diversion systems is generally unregulated because a council permit is not required.

Appropriately Designed Irrigation

It is essential to carefully, and correctly assess the 'greywater capacity' of a garden before installing a greywater diversion system, taking into account the garden's slope, soil type, proximity to creeks and rivers and type of vegetation, and well as the quality and quantity of the greywater diverted into the garden. Such an assessment should be carried out by someone with appropriate expertise.

System Performance

Greywater systems selected and evaluated in this project are described in Table 1 (overleaf). The benefits and limitations of each system, as experienced by the householders, are stated, as are the reductions in mains water consumption attributed to each system.

Table 1: Greywater System Details & Performance Summary

Householder Requirements	**Household**	**Frankston**	**Ringwood East**	**East Malvern**	**North Fitzroy**	**Maidstone**	**Highett**
		Norman & Marion Eyers	Oliver & Evelina North -Coombes	Trevor & Sue Yodgee	Lisa Coffa	Andrew & Karen Edwards	Jeff & Carolyn Robinson
	Average summer mains water use before greywater system installation	750 l/day	800 l/day	900 l/day	150 l/day	800 l/day	N/A (New Home)
	Average summer mains water use after greywater system installation	600 l/day	700 l/day	900 l/day	100 l/day	670 l/day	390 l/day
	Site/household conditions	2 adults, frequent guests, very large garden, clay soil,	2 adults, 3 children, medium-sized garden, establishing orchard,	2 adults, 3 children, medium-sized lush garden,	2 adults, new home, very small native garden,	2 adults, 1 todler & baby, large vegetable garden & fruit trees, minimum lifestyle impact preferred	2 adults, 3 children, new project home, medium-sized new garden,
	Greywater source	All except kitchen sink	Washing machine	All except kitchen sink	Shower water	All except kitchen sinks	All except kitchen sink
	Potential greywater use	Garden irrigation	Garden irrigation	Garden irrigation	Toilet flushing	Garden irrigation and toilet flushing	Garden irrigation and toilet flushing

Greywater System Details	**System type**	**Diversion to garden (trench)**	**Diversion to garden (trench)**	**Diversion to garden (drip-fed)**	**Diversion to toilet**	**Treatment (above-ground)**	**Treatment (in-ground)**
	System Name	Greywater Saver (Nylex)	Greywater Diverter (Bunnings)	Greywater Gardener (Waterwise)	Wattworks (Nylex)	Peat Filtration (New Water)	Sand Filter (John Lawry)
	System Description	Household greywater diverted to sub-surface garden trenches	Household greywater diverted to sub-surface garden trenches	Washing machine water reticulated to garden via holding tank and drip-feeding irrigation system	Bath/shower water reticulated to toilet cistern via holding tank	Above-ground, peat-based filter treats household greywater for re-use in the garden	In-ground, sand-based filter treats household greywater for re-use in the garden, toilet and washing machine
	Cost (supply & install, and including irrigation where applicable)	$1,500	$1,350	$2,000	$3,000	$10,000	$14,500
System Performance	**Water savings ***	**150 l/day (20%) (summer)**	**100 l/day (13%) (summer)**	**0% (This particular homeowner did not recognize any great water saving from this system. However, this is not to say this would be the case for all homes.**	**54 l/day (33%) (year-round)**	**130 l/day min. (16%) (summer) Potential to reuse 300 l/day**	**100 l/day min. (20%) summer. Potential to reuse 270 l/day**

	System Benefits	Low cost, low maintenance, high water-saving potential.Low level of embodied & operational energy.	Low cost, low maintenance, high water-saving potential.Low level of embodied & operational energy.	Minimal excavation required. Low level of embodied & operational energy.	High year-round water-saving potential, suitable for homes with no garden.	High year-round water-saving potential, Low risk of soil contamination due to treatment.	High year-round water-saving potential, Low risk of soil contamination due to treatment.
	System Limitations	Greywater is not treated prior to diversion.Expert advice required to design garden-specific irrigation trenches	Greywater is not treated prior to diversion, expert advice required to design garden-specific irrigation trenches	Drip-fed irrigation system permits high evaporation - plants therefore require supplementary watering. Medium level of maintenance. Greywater is not treated prior to diversion.	Uses bath & shower water only. Emits a slight odour, acceptable to the homeowner.	Expensive, potentially high-maintenance, high level of embodied & operational energy, Council approval required	Expensive, potentially high-maintenance, difficult to install, high level of embodied & operational energy, Council approval required.

- Frankston and Ringwood East water savings are calculated based upon greywater production estimates. Fitzroy North water savings are calculated based upon number of toilet flushes per day. Maidstone and Highett water savings are calculated based upon the estimated volumes of water used for garden irrigation (previously supplied by mains water).

- Greywater Case Studies

Diversion to the garden via subsurface trenches

1 - GREYWATER SAVER (NYLEX)

Norman and Marion Eyers, Frankston

2 - GREYWATER DIVERTA (BUNNINGS)
Oliver and Evelina North-Coombes, Ringwood East

Cost: $1,500, inclusive of excavation costs
Greywater diverter supplied by Nylex Water Solutions
System installed by Richard Playne, Envirosmart Plumbing

Simple diversion systems were installed in two of the six homes - Frankston and Ringwood East. Both systems captured greywater from the home and directed it into the garden via an agricultural line running under an area of lawn. Diversion of untreated greywater was appropriate for these homes because they had large, sloping, nutrient-loving gardens managed by homeowners who paid careful attention to what they put down the drain.

The householders' experiences of these 'simple diversion' systems were similar.
On the whole the systems performed very well, significantly reducing householders' need to use mains water for garden-watering, whilst having a positive impact on the garden;

" We are delighted with the results, both with the small area of lawn becoming green and with the garden each side of the trenches……It is embarrassing to look back at our water bills in the year 2000 and see our peak water usage was in excess of 3000 litres per day and 1200 litres just 12 months ago. Our daily use in summer is now around 600 litres and we hope to reduce this further"
(Marion Eyers, Frankston)

"The fruit trees are loving it. Our gardener remarked how happy the first stage plants are (evidenced by over 20 buds on the citrus trees), and that the moisture was optimum-not too wet, not too dry." **(Evelina North-Coombes, Ringwood East)**

Whilst both systems are running well, installation of the systems was not without challenges. In both cases the design of garden trenches involved some guess-work to balance greywater input with the garden's water needs and in both cases the systems had to be modified after installation to get them right. Soil type (readiness to absorb and reticulate the greywater), thirstiness of plants and the garden's slope are a few of the factors that need to be considered when determining the location, diameter and length of irrigation lines. Design of the irrigation component of these diversion systems requires expert advice to get right. It would be best if anyone considering such a system contacts an irrigation supplier, landscape architect or relevant software package.

Diversion of greywater directly into the garden is not without risk, however these risks can be easily managed if householders are informed of the appropriate operation;

"I would certainly recommend the use of a greywater diverter with two reservations:-
- *the use on flat land in a small suburban block would require stringent monitoring to prevent unwanted seepage;*
- *the use of chemicals may cause damage to plants and the soil"*

(Marion Eyers, Frankston)

The Greywater Saver and Greywater Diverta proved to be very low maintenance, requiring home-owners to clean the lint filter once every seven days, and to direct the systems to sewer during long periods of rain. The systems took one day to install, and did not require local council approval These affordable systems significantly reduced total household water consumption, and encouraged the householders to minimise the use of chemicals and high salt-content products in their homes.

Overall, a reliable, effective option with the main challenges getting the water output right and using environmentally friendly products.

Diversion to the garden via drip irrigation:

GREYWATER GARDENER (WATERWISE)
Trevor & Sue Yodgee, East Malvern

Cost: $2,000
Supplied and installed by Waterwise Systems

The Greywater Gardener system is designed to temporarily store washing machine water in an above-ground surge tank (pictured below left) then to release it slowly into the garden via surface drip-feeders.

This system is best suited for small sites and flat gardens. By keeping greywater reticulation at the garden's surface, and by directing drippers to specific plants, the home-owner is better able to monitor the impact of the system and watch out for seepage.

At the Malvern site however, the finely-tuned system did not deliver the quantity of water required by Trevor's thirsty garden, in part because source greywater was limited to the washing machine and (possibly) because some of the dripping irrigation water was lost by evaporation. A layer of mulch would probably reduce the extent of this problem. Whilst the system effectively captured the washing water, Trevor would have preferred a system capable of reusing the large quantities of shower water sent down the drain by his family of five.

The Greywater Gardener system was quick and easy to install, however it required regular maintenance to stop the filter and drippers from blocking (drippers should be flushed out monthly). Like with sub-surface diversion systems, householders must pay attention to the salt and chemical content of products they put into the system. When fully developed this lower-risk system may be a cost-effective greywater reuse system for small and/or flat suburban gardens that have low water requirements.

A key learning from this case study is the importance of matching water supply and demand.

Diversion from shower to toilet

WATTWORKS
Lisa Coffa, North Fitzroy

Cost: $2,000
Supplied and installed by Richard Playne, Envirosmart Plumbing

Diversion of greywater into toilet cisterns is an effective means for reducing mains water consumption, particularly in homes without gardens. Lisa Coffa installed the Wattworks system in her North Fitzroy home, reducing her mains water consumption by 33%.

The Wattworks system captures greywater in a tank below the bath/shower and pumps it into the toilet cistern on demand. Unused greywater is pumped to the sewer system every 24 hours to prevent it from becoming septic.

In summary, the system is quiet, low-risk, cost-effective, and does not require local council approval.

“It would be great if we could catch more than just our shower water however the system has really met our expectations and we are really satisfied with it. There is a slight odour, however it's not overbearing. The system suits our house and living”

Lisa Coffa, Fitzroy North

Sand-based greywater treatment system

SAND FILTER GREYWATER TREATMENT SYSTEM
Jeff & Carolyn Robinson, Highett
Cost of system: $14,500

Pumps and alarm system by Davey Products

Pump wells by Everhard Industries

Plumbing supplies by Tradelink Environmental Solutions

Irrigation by Triangle Filtration, Toro Australia and Water Pro's Moorabbin

Supply and installation coordinated by PJT Green Plumbing

Plumbing works by PJT Green Plumbing

The Sand-Filter greywater treatment system was selected for the Robinson family for a number of reasons;

- the family of five expected to generate a large amount of greywater
- the garden was level and not large enough for a simple diversion system
- as it is a new home, the Robinsons were able to cost-effectively separate greywater and blackwater pipework (allowing all of the household's greywater to be captured) and were happy to allow significant excavation of their garden
- the family has young children, therefore health issues and potentially-contaminated nappies were a consideration.
- the Robinson's were willing to undertake a complex design, approval and installation process, and to actively maintain a complex treatment system

The treatment system was tailor-designed for the Robinson's by Melbourne-based wastewater consultant John Lawry. Because greywater was being treated, and the system was to be used on a permanent basis, local council approval was required. The approval process was challenging and time-consuming, taking in excess of 8 months. Council officers were unfamiliar with greywater treatment systems and the regulatory approach for blackwater treatment was applied in the absence of appropriate protocols. Council's conditions included requirements for backflow prevention, public signage and an audio-visual alarm for stoppages or system failures, adding $2,000 to the cost of the system.

Installation of the system was complex, involving seven different trades, numerous separate suppliers and frequent coordination meetings on site. The system required thirteen months to install, at a total cost of $14,500.

Maintenance of the Sand Filter system involves monthly cleaning of the pump filter, monitoring of effluent, removal of tank bio-solids every three years, and annual water testing. Since becoming operational in early March 2005, the system has run smoothly, no adverse environmental or human-health impacts have been observed, and the treated water appears to be clear and odour-free.

More treated greywater will be produced by the system than can be used on the Robinson's garden. The family would therefore like to use the treated water for toilet flushing however such use is currently not permitted in Victoria without a tertiary level of treatment (despite the fact that untreated diversion of greywater into the toilet cistern is legal).

Home-owner Carolyn Robinson summed up the 'sand-filter experience' beautifully:

> *"Whether people should put in such a complicated and expensive scheme as this one is questionable, given the expense, level of complexity, and difficulty in obtaining statutory approvals. Should people re-use greywater? ABSOLUTELY! Use of greywater gives householders the opportunity to irrigate their gardens at times when rainwater collection is not available. We suggest that simpler, less complex and less expensive systems are more appropriate for domestic situations"*
>
> **Carolyn Robinson, Highett.**

Peat-based Greywater Treatment System

NEW WATER GREYWATER SYSTEM
Andrew & Karen Edwards, Maidstone
Cost $10,000

Supply and installation by New Water Corp.

Irrigation by Toro Austalia and Water Pro's, Hoppers Crossing

Rainwater Tank by Nylex Water Solutions

Rainwater Plumbing works by Aquablock Plumbing Services

New Water's peat-based greywater treatment system was selected for the Edwards' home in Maidstone because the family uses large volumes of water to maintain a very productive vegetable garden and fruit trees. Untreated greywater diversion would have been too high risk for this family given that many of their vegetables are eaten raw, and that they have two young children. The Edwards also expressed a reluctance to use environmentally -friendly products exclusively, so treatment of the greywater added an additional layer of protection.

The New Water system differs from the Sand Filter in that most of its components are located above-ground, bolted onto the side of the house. The system could therefore be retrofitted to an already existing home relatively easily. Peat, rather than sand, is used as the filter medium, and the supplier of the system remains responsible to monitor and maintain the peat's condition (and filtering performance).

Because the New Water system treats the greywater, local council approval is required. Maribyrnong City Council officers liaised regularly with the Edwards and the suppliers of the system, and visited the site repeatedly during its installation, recognising that they were in the process of learning about greywater reuse as much as the rest of us. Their fluid and cooperative approach allowed the project to proceed without long approval delays.

The New Water system has performed well and is producing Class A effluent, however it is still in a stage of development and is regularly 'tweaked'. At this stage, therefore, it is difficult to determine the level of householder maintenance required, or to ascertain the reliability of the system.

When asked the question: "If you started again from scratch, what would you do?" the Maidstone household responded:

"If you set aside the cost of the system, basically the same again, but with closer attention to design. Specifically we'd connect the laundry tub direct to sewer, providing an alternative route for the more harmful chemicals. Regarding winter use - at the moment there's no winter use for the finished (treated) product. I'll be connecting the system to the toilet cistern after the formal trial period has finished"

Andrew Edwards, Maidstone

The cost of the New Water system, particularly after allowing for the water-storage bladder and the garden irrigation system, may be considered unwarranted for a typical suburban back yard. However, in the case of the Maidstone home the garden's high level of productivity and water requirement the potential for treated water to be used for toilet flushing and other purposes in winter, and the presence of young children in the family, begin to make the system a feasible option to consider.

Other Project Findings

The above case studies represent snapshots of householders' experiences as they selected, installed, operated and maintained their greywater systems. Each of the households kept detailed diaries to capture their day-to-day experiences, summaries of which can be found in Appendix E. Common to all systems were the following issues relating to systems management.

Health and safety issues

ATA's greywater households did not experience any significant health or safety problems however a number of issues required careful management to ensure that such problems did not arise. Surface pooling of greywater in Ringwood East (resolved by modifying the trench irrigation system) could have resulted in human contact with toxic greywater and/or seepage onto the neighbouring property if left unaddressed.

In Maidstone, treated greywater stored in a sub-floor bladder is difficult to inspect for water quality. Monitoring and maintenance of the system by the system supplier (New Water), and regular inspection of treated water before it enters the bladder (by the home-owner) minimises the risk of untreated greywater entering the greywater storage system.

Another risk requiring management was associated with the direct diversion of greywater into the toilet cistern for flushing at North Fitzroy. If a toilet is not flushed at least once in every 24 hours greywater stored in the cistern and toilet bowl may become toxic. This toxic greywater can be flushed away with relative ease (the system has mains water back-up) but care must be taken to turn the system off when householders are away.

Generally speaking, any in-ground surge tanks and pump wells pose a risk to children and require lids that cannot be removed (to prevent children from falling in). This issue was addressed during the design stage for the Highett and Maidstone treatment systems that included such in-ground tanks.
Overall, all systems installed can be used safely with appropriate use and measures put in place.

Attention to greywater inputs

A key issue associated with each system was the attention to system inputs demanded by keeping the greywater on site, treated or otherwise. In all cases, system performance was reduced by the build-up of lint, hair or slurry in filters or pumps, requiring them to be cleaned on a regular basis. More importantly, short term and long term impacts of salts and other chemicals on the gardens were difficult to ascertain. As a precautionary measure, all six households paid careful attention to the chemical and salt content of products they sent down their drains. Five of the six households used only 'environmentally responsible' products (labeled as such by reputable bodies). This behavior-change in terms of product selection was a significant outcome of the project; however five of the six households had already chosen to live in accordance with sustainability principles prior to the project's commencement.

Greywater system management

All householders were committed to the monitoring and maintenance of their systems however many felt that the level of maintenance was higher than they anticipated, and that without such maintenance the systems might pose a health and/or environmental risk. All of the systems divert to the sewer system if they become blocked however greywater diversion systems will continue to direct greywater into a garden irrespective of the content of that water, and irrespective of recent rainfall levels. This places a management onus on the householder to turn off their system if they are using products that may harm the garden, and during rainy months of the year. The risk is lessened in the case of treated greywater, however routine monitoring maintenance of treatment systems is required to ensure that the treatment system itself is not harmed.

Note: Each of the households were provided with the following guidance documents to assist with the management of their greywater systems:

- EPA Victoria, “The Do’s and Don’ts of Greywater Reuse”
- Department of Human Services, “Appropriate Use of Greywater”
- Domestic Wastewater Management Series, Reuse Options for Household Wastewater, Publication 812
- Detergents Guide (Lanfax Laboratories)

These documents provide valuable advice, and are now supplemented with "Using Greywater: The Essential Guide to Getting the Best for Your garden and your Home", produced by ATA, the Victorian Government Department of Sustainability and Environment, EPA Victoria and the Victorian Government Department of Human (See Appendix F).

Greywater Survey

ATA surveyed 120 of our members, nation-wide, to gauge the nature and extent of current greywater reuse in Australia (See ATA Greywater Survey, Appendices E & F). The survey's results suggest that:

- people wanting to reuse greywater avoid red tape – 88% of systems were installed without council consultation.
- people are not up-to-speed with the key rules for using greywater safely.
- one in four (27%) are irrigating vegetables with untreated greywater and 33% of users are recycling kitchen water, which carries a higher risk of soil contamination than laundry or bathroom water.
- 86% of respondents did not engage a licensed plumber to carry out the work.
- 95% of people surveyed were home-made diversion systems. None of the respondents expressed interest to treat the greywater however the expense of treatment systems was not raised as a concern.
- 88% of respondents were motivated solely by a desire to conserve water, 9% of respondents were motivated by reducing their water bills.

The survey painted a clear picture that regulations prohibiting the installation of greywater diverters (or requiring them to be temporary) are not achieving their desired effect. Many respondents expressed frustration about seeing near-potable water flowing into the sewer system when water is becoming an increasingly scarce resource.

Project Communications

Throughout this project, public meetings and seminars provided a forum for ATA to gauge public interest in greywater reuse, communicate the objectives and outcomes of the Smart Water Project and inform the public about how to manage risks associated with greywater re-use.

ATA Greywater Conference

ATA's conference, "Beyond the Grey", held at the Melbourne Museum in September, 2004, raised awareness about the key issues surrounding greywater reuse (risks, benefits and barriers to uptake) motivating discussion about how best to address these issues. Particular attention was given to greywater regulation at state and local levels. The objectives of the conference were:

1. to display all EPA-approved greywater systems in one place
2. to raise awareness about the multiplicity of issues and perspectives surrounding greywater use
3. to facilitate stakeholder's valuing of greywater use, in consideration of all of the pros and cons
4. to increase commitment from stakeholders to actively assist the public in using greywater, including lowering barriers to uptake.

The conference was attended by in excess of 150 participants being primarily government and industry representatives, and some members of the public who traveled from Tasmania, New South Wales and Canberra (see Appendix C: ATA Conference Agenda).

Key themes emerging from the conference included;

- concern regarding the total ecological impact of greywater systems, including energy consumption (embodied and operational) as well as the potential for soil contamination and harm to human health.
- consensus that greywater regulation in Victoria requires further development, causing limited uptake of greywater reuse by householders due to a lack of information and confidence and industry investment in research and development.
- confusion about authority responsibilities, and about who might lead the process for developing a consistent, whole-of-government approach to domestic greywater reuse.

Other Public Forums

ATA has engaged with the public on the topic of Greywater at numerous other forums;

National Water Week, October, 2004 Melbourne Museum	"Greywater Do's & Don'ts" Rachel Olivier, CEO ATA
Sustainable Living Festival, February, 2005 Federation Square	"Greywater Blues" Robin Merrick, Project Manager, ATA
Sustainable Living Festival, February, 2005 ATA Smart Water Greywater Open House 26 February and 5 March, 2005	"Greywater Radio", Robin Merrick, ATA Presented by ATA's Greywater Households
Greywater Bus Tours 5 March and 14 May, 2005	Presented by ATA's Greywater Households
RMIT, Water Futures 2, October, 2005 Melbourne Museum, October, 2005 Nillumbik Greywater Expo, September, 2005 Community Environment Centre, Eltham	"Greywater Re-use – Why & How?" Robin Merrick, Project Manager, ATA "Greywater Re-use – Why & How?" Robin Merrick, Project Manager, ATA

Media Promotion

ATA has progressively published the Project's progress in the print media, both internally (in ATA's ReNew magazine), and in local and state newspapers and magazines (The Sun Herald, Gardening Australia, The Melbourne Times, Yarra Leader, and other local newspapers). Dissemination of the project's results forms part of ATA's agreement with Smart Water. More importantly it supports ATA's mission "to connect, grow and give voice to people making sustainable technology and lifestyle choices in their homes".

“Grey turns to Green”	The Melbourne Times, March 2005
“Grey Matter”	The Sun Herald, 'Home' February, 2005
“Your Green Guide to Grey Water”	Gardening Australia, June, 2005
"Greywater Diversion Advisory Note”	Alternative Technology Association

Key project findings

A number of key messages have emerging from ATA's Smart Water Greywater Project, as listed below:

- *greywater reuse has the potential to significantly reduce mains water use in private homes*

  ATA's greywater project has demonstrated that the use of laundry and/or shower waste-water for toilet-flushing and garden-watering can reduce a household's annual water consumption by up to 33%.

- *diversion systems commonly require expert advice to get right.*

  expert advice is required to marry greywater output with the water needs of a garden. Issues such as garden size, slope, soil type, and vegetation type need to be carefully considered to avoid pooling of water and/or soil contamination.

- *greywater treatment systems are complex and consume high levels of embodied and operational energy.*

  The greywater treatment systems trialed by ATA were significantly more complex than simple diversion systems. Such treatment may be appropriate for large consumers of water (and producers of wastewater) or for households wanting to use greywater on edible plants however ATA would not support their general use at the domestic scale.

- *permanent greywater diversions are being installed by the community, generally without local council consultation, and often without an understanding of the associated risks*

  ATA's survey revealed that many greywater systems are being installed without council consultation, that many of these people are not up-to-speed with the key rules for using greywater safely and that a majority of households do not engage a licensed plumber to carry out the work.

- *risks of harm to the environment or humans associated with greywater diversions are largely dependent upon levels of care taken by system owners*

  Actions taken to minimise identified risks to human health and the environmental during the trial generally required households to monitor and maintain the systems regularly and/or turn them off during wet periods. Without such management environmental and human health risks may escalate. However, with an appropriate management plan most systems can be operated safely.

- *reuse of greywater demonstrably encourages broader water conservation behaviour and responsible product selection (in turn improving the health of the broader water cycle)*

  Many of the participants in ATA's greywater trial reported altered water consumption behaviour and

- *numerous barriers prevent wide-scale uptake of greywater re-use*

In response to feedback from our greywater households, and from ATA's broader membership during the Greywater Project, we have identified the key barriers to greywater uptake as being:

- a lack of awareness about greywater reuse possibilities and/or belief that domestic water recycling is important
- the high cost of greywater systems relative to the low (too low) cost of mains water
- difficulty accessing consistent and accurate information about greywater reuse (What is allowed? What systems are available? Who can provide technical advice? Do I need approval?)
- the narrow range of commercially-available greywater systems
- onerous and expensive approval processes for treatment systems

Recommendations

In recognition of these findings, ATA would like to see:

- responsible greywater diversion encouraged for suitable homes as one of a suite of water conservation measures (see Appendix D: "ATA's Water Conservation Priorities")
- information disseminated regarding greywater system design, selection and operation. ATA acknowledges that environmental and health risks are associated with greywater reuse. If well-managed these risks are outweighed by the potential water conservation and behaviour-change benefits.
- greywater treatment encouraged for clusters of homes (such as apartment blocks and new residential communities), and by large-volume users
- ongoing research & development of treatment systems encouraged in order to:
  - make a wider range of alternative systems available to the public, particularly systems that sit somewhere between diversion and full scale treatment
  - reduce the environmental costs associated with manufacturing, transporting, installing and operating treatment systems
  - make treatment systems more affordable and user-friendly
- training of government officers to facilitate the provision of consistent and supportive advice
- a system of registration for domestic greywater systems, and implementation of random annual inspections of these systems

Conclusion

A new culture of water conservation is required if Australia is to live within our water-means. ATA is witnessing the emergence of just such a cultural as increasing numbers of Victorians adopt water-conserving technologies and practices, and is committed to fostering this cultural change.

This project has shown that reuse of greywater is an important part of this shift. Not only did we find that greywater reuse significantly reduced mains water consumption, but we saw that such reuse raises community awareness about other critical water-related issues (water over-use, use of unnecessarily high-quality water for day-to-day tasks such as toilet-flushing, and irresponsible disposal of salts and other household chemicals into our environment).

ATA would like see growth in the uptake of greywater reuse. We are actively promoting responsible greywater reuse in Renew and at public forums. We are working with the Victorian Government to inform the community about greywater risks and how best to manage them, and we are liaising with Government at many levels in the hope that a simple and consistent regulatory framework that encourages domestic greywater reuse is in the pipeline.

Acknowledgements

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Finally, we extend particular thanks to John Lawry, Jenny Bailey (Yarra Valley Water), Liza Dale-Hallett (Museum Victoria), and Brendan Coburn (I-Comm) for their time and belief in the project.

Project Supporters

Aquablock Plumbing Service

Davey Products

Everhard Industries

Envirosmart Plumbing

Museum Victoria

New Water Corp.

PJT Green Plumbing

Toro Australia

Tradelink Environmental Solutions

Triangle Filtration

Water Pro's, Hoppers Crossing

Appendices

Appendix A: *Greywater Risk Assessment Template*

Appendix B: *ATA Greywater Survey*

Appendix C *Summary of Survey Results*

Appendix D *ATA's Water Saving Priorities*

Appendix E *Greywater Diaries Summary*

Appendix F *Using Greywater – The Essential Guide (a point of sale document)*

Appendix G *ATA's Rough Guide to Selecting your Greywater System*

Appendix A

Greywater Risk Assessment Template

HUMAN HEALTH RISKS			
Risk	**Cause of risk**	**Generic Risk Management Measure**	**Site-specific / System-Specific Risk Management Measure**
Human contact with toxic water	Human (or pet) access to toxic greywater runoff	• Avoid runoff by sizing the system to suit the garden's water needs • Prevent runoff from entering neighbouring properties by locating irrigated areas well within site boundaries	•
	Human (or pet) contact with toxic pooled/stored greywater	• Avoid pooling of water by sizing the system to suit the garden's water needs • Design storage systems to preclude access by children and pets • Don't store untreated greywater for more than 24 hours	•
	Contamination of drinking water supply	• Design the system to ensure there is no possibility of cross-connection with drinking water supply	•

	Other human health risks	•	•

ENVIRONMENTAL RISKS			
Risk	**Cause of risk**	**Generic Risk Management Measure**	**System / Site Specific Risk Management Measure**
Contamination of soil	Greywater contains toxic or otherwise damaging substances (such as salt)	• Use only 'environmentally responsible' detergents, shampoos, washing powders etc. taking particular care to avoid high salt content products. • Turn the system off when not required (e.g. during rainy winter months) to avoid nutrient overload. • Monitor treatment systems to ensure the treatment process is operating effectively • If selling or renting the home, provide training about operation and maintenance of the greywater system, or divert all greywater to sewer.	•
	Garden too small to cope with greywater nutrient load	• Size the system to suit the garden's water needs (for example, a small garden may require washing machine greywater only whereas a large garden is likely to use total household	•

		greywater)	
	Irrigated area too small for nutrient load	• Ensure that greywater is distributed over a large area, or rotate irrigated areas. Use the garden's slope to gravity-distribute greywater, ensuring that greywater does not pool.	•

ENVIRONMENTAL RISKS (CONT.)			
Risk	**Cause of risk**	**Generic Risk Management Measure**	**System / Site Specific Risk Management Measure**
Contamination of waterways	Leakage into the water table	• Size the system to suit the soil type (for example, lower volumes of greywater should be used on sandy soils that do not 'hold' the greywater) • Use only environmentally responsible detergents, shampoos, washing powders etc. taking particular care to avoid high salt content products.	•
	Runoff into local rivers and streams	• Size the system to suit the garden's water needs to avoid runoff • Locate irrigated areas well within site boundaries • Ensure that the system automatically diverts greywater to the sewer system in the case of blockage	•
	Other environmental risks	•	•

Appendix B
ATA Greywater Survey

Appendix C

ATA Greywater Survey Results, (2005)

1. Overview of respondents, by state.

state	quantity	%
VIC	81	68
TAS	0	0
QLD	9	8
NSW	13	11
NT	1	1
ACT	6	5
WA	7	6
SA	3	3
total	**120**	**100**

2. Drainage circumstances: sewered / unsewered (%)

sewered	76
unsewered	24

3. Size of house %

</=2 bedrooms	50%
>/=3 bedrooms	50%

4. Contact with local council or water authority?

Yes	12%
NO	88%

5. ReNew as source of information

Yes	39%
No	61%

6. Main reasons for recycling water

To save money	9%
Reduce demand on the sewer	19%
Conserve water	88%
Irrigate garden/lawn	56%

Note: Other motivations included: common sense, to water fruit trees, to replace septic tank, to "do my bit for the planet and future generations", to flush toilets and to get rid of wastewater

7. Type of greywater system

bucketing	42%
simple diversion system	28%
commercial system	5%
do it yourself system	42%

Other systems:

- pumping out bath water onto garden
- holding tank in ground, float valve pump auto pumps to surface (hose moved about by home-owner to desired locations)
- siphoning from shower/bath to garden sprayers
- tank with sprinkler system

8. Total cost of system (Supply and Install)

<$50	43%
$50-150	18%
$150-500	19%
$500-1000	4%
>$1000	16%

9. Who installed the system?

Home-owner	86%
greywater system provider	4%
licensed plumber	12%
friends & family	4%

10. Use of greywater?

native garden	29%
exotic garden	8%
vegetable patch	27%
mixed plant garden	48%
lawn	33%
toilet flushing	13%

Other:

- fruit trees, orchard
- shrubs, wood lot
- floorwashing, carwashing
- clothes washing / washing machine
- pot plants

11. % Source of greywater

laundry	79%
bathroom	69%
kitchen	33%

12. % who have/have not tested soil

tested	5
not tested	95

13. Do you have any of these elements entering your greywater system?

Food scraps	23%
kitchen oil / grease	28%
laundry oil / grease	43%
animal / human hair	65%
animal / human faeces	5%
nappy water	2%

14. Do you have any of these elements being discharged from your greywater system?

Food scraps	29%
kitchen oil / grease	29%
laundry oil / grease	45%
animal / human hair	47%
animal / human faeces	3%
nappy water	3%

15. Surface / sub-surface irrigation

sub-surface	24%
surface	78%

16. Problems with the greywater systems?

root intrusion of pipes	1%
filters clogging	13%
soil structure changes	0%
Slime distribution	5%
clogging of outlets	11%
odour	12%
ponding of greywater	7%
waterlogged soil	6%
run off into stormwater drains or street	1%
run off into neighbouring land	2%

17. Access to information on greywater

easy to find	44%
difficult to find	16%
easy to understand	30%
difficult to understand	9%
comprehensive	9%
inadequate	23%
Didn't look for information	28%

18. Type of laundry detergent used %

powdered	66
liquid	37

19. Brand of laundry detergent used %

Aware	6
Omo	6
Earth Choice	6
‘homemade/self-made’	5
Planet Ark	5
Herbon	4
Amway	4
Trinature	3
Radiant	3
Cold Power	3
Bio Zet	2

Appendix D
Alternative Technology Association
Water Savings Priorities

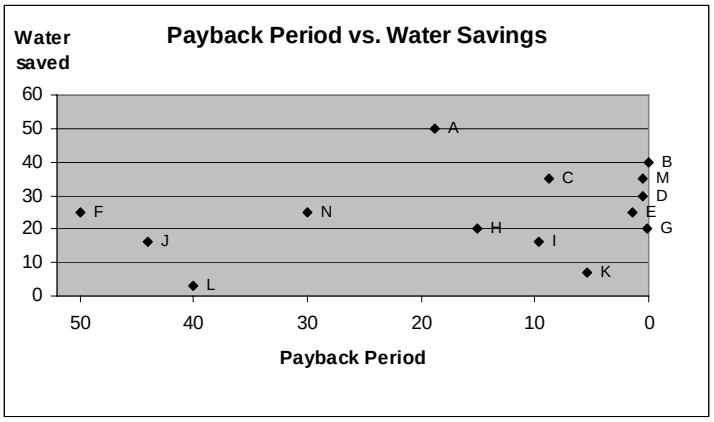
Yarra Valley Water has assessed a number of water saving measures, ranking each in terms of water saved and return on investment (payback period).

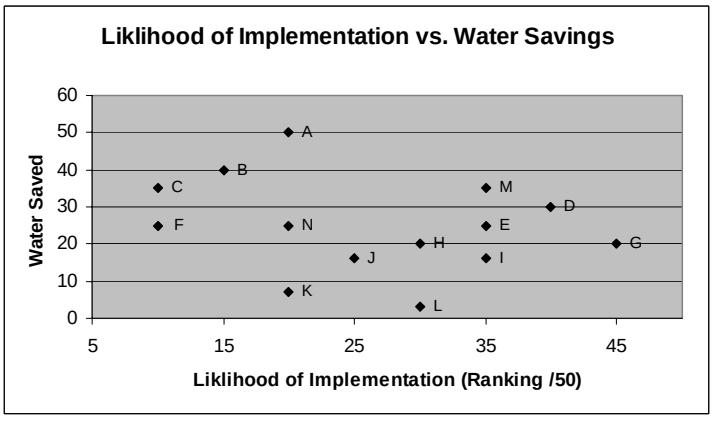
The ATA has reviewed YVW's results, and has referred to them during our own process of determining ATA's water-saving recommendations. The result is a list of ATA's 'Top 8' water-saving measures recommended for implementation by Victorians living in urban areas.

ATA's recommendation considers, in addition to water savings and payback period, the likelihood that consumers will implement each of the water measures. Our assessment of the likelihood of implementation is based upon consumer-feedback collected by ATA over the last two years, and recently-completed water conservation trials. 'Likelihood of implementation' takes into account the 'sex-appeal' of each measure, perceived ease of installation and maintenance, upfront cost, and the anticipated impact that a water-saving measure will have upon consumers' lifestyles.

Consideration has also been given to the broader environmental impact of each initiative, including the embodied energy associated with fabrication, transport and installation of measures (as-installed cost has been used as an indicator in the absence of a more robust life cycle assessment).

Results:





Water-savings Measure (Legend)		ATA Ranking
A	Install Rainwater Tank (2.25kL) with Connection to Toilet	6
B	Reduce Shower Time from 7 mins to 4 minutes	7
C	Replace Single Flush With 6/3 Dual Flush Toilet	
D	Fix Leaking Toilet	1
E	Install AAA Shower Head	4
F	Permanent Greywater System (treatment)	
G	Fix Dripping Tap	2
H	Install Drip Irrigation System	5
I	Buy Front Loader instead of Top Loader Washing Machine	
J	Install Rainwater Tank (2.25 kL) for garden only	
K	Install Soil Moisture Sensor for Automatic Irrigation System	
L	Buy AAA dishwasher instead of A	
M	Modify existing toilet cystern	3
N	Greywater diversion system to toilet or garden (no treatment)	8

Water Savings Priorities

ATA's Top 8 water-saving measures are listed below, in order of priority for implementation. The recommendation takes into account the following aspects of each measure;

- water-saving performance
- up front cost
- payback period
- environmental cost
- likelihood of implementation ('sex-appeal', ease of installation & maintenance, perceived impact upon lifestyle)

ATA's Top 8 water saving measures:

1. Change water use patterns – e.g. fewer and shorter showers
2. Fix leaking toilet
3. Fix dripping tap
4. Convert (not replace!) toilet to reduced flush
5. Install AAA shower head
6. Install drip irrigation system
7. Install rainwater tank with connection to toilet
8. Divert greywater to garden or toilet

Appendix E
Greywater Diaries Summary

Appendix F

Using Greywater – The Essential Guide (a point of sale document)

Appendix G

ATA's Rough Guide to

Selecting your Greywater System

Instructions:

1. Answer each question in Column 1 by selecting your preferred Column 2 response.
2. Circle all ticks (√) and M's located on that line
3. Select your preferred system based upon the maximum No. of ticks (√), taking into account the level of management required (indicated by the frequency of M's)

Criterion		**Diversion to toilet**	**Diversion to garden**	**Treatment system**
Column 1	**Column 2**			
Quantity of greywater generated	low	√	√	
	medium	√	√	
	high	√	M	√
Household composition	young children present	M	M	√
	young children absent	√	√	√
Household visitation	frequent visitors	M	M	√
	occasional visitors	√	√	
Willingness to minimize chemical inputs	high	√	√	
	low	√	M	√
Use of effluent	native garden		M	√
	nutrient-hungry garden		√	
	edibles eaten raw		M	√
	Orchard/edibles eaten cooked		√	
	toilet flushing	√		√
	clothes washing			√
Garden size	large	√	√	√
	medium	√	√	
	small	√	M	
Soil type	clay	√	√	
	sand	√	M	√
Proximity to water body	close	√	M	√
	far	√	√	
Willingness to maintain system	high	√	√	√
	low	√	√	M
Cost	< $1,000		√	
	<$6,000	√	√	M
	>$6,000			√
Total No. of ticks (√) indicating suitability of the system				
Total No. of issues requiring careful management (M)				

M: this is a risk requiring careful management

Blank cell: the system is not suitable for the selected task (or the selected use does not justify the financial and environmental costs associated with this system)