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Greywater Re-Use: Hardware, Health, Environment and the Law

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Abstract

Greywater re-use for garden irrigation should be encouraged in urban and rural households. It utilises a valuable on-site resource, conserves precious drinking water and reduces the load on wastewater disposal systems (both on-site and centralised). If applied appropriately to gardens, greywater re-use presents minimal health and environmental pollution risks.

The key to appropriate greywater re-use is user-awareness of the issues surrounding greywater. This includes hardware, health, environmental and legal aspects, which are summarised in this presentation. The presentation covers simple and complex greywater re-use systems, health risks with re-use, potential environmental degradation, minimisation of greywater pollutants and additives, and the changing attitude of water authorities in Australia to greywater re-use. With increased greywater knowledge, permaculturists can play an important role in promoting the sensible re-use of this household 'waste' water.

Introduction – what is greywater?

Greywater is the term given to all used water discharged from a house, *except* for toilet water. Greywater includes shower, bath, hand basin, kitchen sink, dishwasher, washing machine and laundry tub water. This water is called 'grey' water because it turns grey if stored for a while. It also becomes quite smelly if stored for a day or so.

Greywater is sometimes called *sullage* in Australian literature. Toilet water is generally called *blackwater* or *sewage*. In most literature, both are lumped together as *wastewater*. This convenient label is misleading because greywater is very different from blackwater, and neither should be wasted water. Both can be re-used for garden irrigation, but require different methods and levels of handling because of their fundamental differences. Greywater is far easier, safer and cheaper to re-use than

blackwater, and is the focus of this paper. Houses with composting toilets have no blackwater, and should be encouraged.

Why bother to re-use greywater?

Greywater re-use for garden irrigation provides several beneficial results. It utilises a valuable on-site resource which is otherwise wasted, it conserves fresh water which can remain in natural ecosystems, and it reduces the load on wastewater disposal systems (both on-site and centralised). This last point is important as many on-site septic tank systems in Australia are failing, resulting in effluent surfacing in the leach field area. This presents a significant health and environmental pollution risk for occupants and the local catchment. Direct greywater re-use for garden irrigation diverts much of the low-pollutant water load from a septic tank system, allowing the system to function under far less stress.

How much greywater do we create each day?

An average urban Australian house uses 820 litres of water per day for indoor and outdoor use. This encompasses toilet (140 L), greywater (340 L) and outdoor (340 L) use. Toilet water use is reducing as dual flush toilets become more widespread. Greywater is generated in the bathroom (180 L), laundry (110 L) and kitchen (55 L). Each house varies from these averages depending on appliances and habits, but the volumes indicate a lot of greywater is generated that generally disappears down the plug-hole never to be seen or re-used again.

Can we create less greywater?

Yes, and it is a positive step. Creating less greywater means we use less fresh water, which can therefore stay in rivers and lakes where it is needed by natural ecosystems. We can create less greywater in two ways – use water efficient appliances and practice a water conservation ethic. The most effective water saving devices are flow restrictor discs inserted in the shower rose, low flow shower heads, aerators on taps, low water-use dishwashers and front loading washing machines. A water conservation ethic is easily learnt – shorter showers, bath to relax, wash full loads, turn off the tap when brushing teeth – all the things local water authorities have been encouraging for years.

So what is in greywater?

Greywater contains what is washed down the drain, and so varies from house to house. For most houses it is soap, shampoo, toothpaste, shaving cream, food scraps, cooking oils, dishwashing detergents, laundry detergents, hair and lint. Normal use of these products appears to do no harm to garden soils and plants if greywater is used for garden irrigation. The most significant general pollutant of greywater is powdered laundry detergents. These are often high in salts (check for ingredients with *sodium*), many still contain phosphorus (which is known to contribute to algal blooms in Australian waterways), and are often very alkaline. Continual garden re-use of laundry water containing high salt, phosphorus-containing detergents can lead to salt accumulations in re-use areas, and stunting of native

Australian plants with low phosphorus tolerance. Regions with regular rainfall may not suffer salt build-ups due to leaching of salts from soil after rain.

There are several alternatives to using powdered laundry detergents. These include liquid detergents (which are generally much lower in salt content, eg. Ark), pure soap flakes (eg. Lux soap flakes) or ceramic disks (eg. Tri-Clean laundry disks). High strength cleaners should be avoided in the home, as they are often toxic to both people and the environment. If caustic cleaners are washed down the drain, they are likely to kill beneficial treatment bacteria in septic tanks, sewage treatment plants or soils if greywater is re-used for on-site garden irrigation. Many ?green cleaners? are effective alternatives to high strength cleaners, and can be found in books such as *The Green Cleaner* by Barbara Lord (1989). An environmentally friendly option to using bleach is to use hydrogen peroxide, which breaks down quickly to hydrogen and water in the environment. Products containing boron should be avoided as this is toxic to plants even in small amounts. Nutrient levels in greywater are generally low (except where phosphorus-bearing laundry detergents are used) and are easily utilised by vegetation in the garden.

Accessing greywater

Many slab-based houses have plumbing pipes entombed in the concrete slab, making access to greywater for re-use very difficult. Often greywater is mixed with black-water by the time it exits the slab, making direct garden re-use inadvisable for health and environmental reasons. Housing construction regulations could be changed to make mandatory the separation of greywater and blackwater plumbing inside floor slabs so that greywater can be accessed for direct re-use if desired. Non-slab houses generally can be replumbed fairly easily to allow greywater re-use in the garden.

Greywater Re-use – is it legal or illegal?

Direct greywater re-use for garden irrigation is currently illegal in all Australian states. Greywater which has passed through a secondary treatment system (eg. reedbed or aerating package plant) may be re-used for irrigation in certain states if disinfection is provided (eg. chlorine tablets, UV or ozone). Regulations are set by conservative state health departments whose main concern is the perceived public health risks associated with greywater re-use. This fear seems to be unjustified based on greywater health risk research in Australia and America. Regulators are also concerned with high nutrient loads in greywater. Research in Australia and America shows this to be unfounded in households which do not use phosphorus-containing detergents. Local councils can choose to override state regulations, and this has occurred in some unsewered areas of Australia. A notable victory for permaculturists came with the successful struggle of Michael Wilson and Fiona Buining to be granted approval for a composting toilet and greywater reedbed system in a sewerered area of Hepburn, Victoria in early 1996 (see *Permaculture International Journal* #58 and/or *Earth Garden* #95).

Encouragingly, direct greywater re-use for garden irrigation is now being examined by some Australian water authorities as an option for reducing fresh water demands in rural and urban areas. In January 1996, the Queensland Department of Primary Industries released a Policy Options Paper on the Use of Greywater, which examines

the potential for regulated re-use of greywater in sewered and unsewered areas of Queensland. Regulators realise significant direct greywater re-use already occurs in Australia, and are working towards recommending specific re-use techniques that minimise health and environmental pollution risks.

How unhealthy is greywater?

Diseases are potentially present in used house water only where occupants are ill. The majority of diseases in used house water derive from enteric pathogens excreted from human intestines (eg. Giardia and Cryptosporidium). Greywater contains no faeces (except where nappies are present) and any urine from showers is generally sterile. An important study by the Los Angeles Office of Water Reclamation in 1992 monitored eight greywater re-use systems for a one year period in the City of Los Angeles. The study concluded "the use of gray water at the pilot project sites does not pose a significant risk to the users or the community". The study found disease organisms were not present in greywater-irrigated areas, nor in stored greywater and stated "this may indicate either an entirely healthy test population (highly unlikely), or a mechanism for deactivation of pathogens". There have been no recorded cases of people in Australia, America or Britain ever getting sick from contact with greywater re-used in the garden.

To spread disease, people must come into contact with the contaminated water. With sensible greywater management, this should never happen because greywater should only be applied beneath mulch or soil. Topsoil is alive with micro- and macro-organisms, and disease organisms struggle to survive in such a competitive environment. Households with kids in nappies can use a three-way diverter (eg. Sulti valve) on the washing machine tub to divert poo-ey water to the blackwater stream.

Basic recommendations when re-using greywater

Greywater re-use systems can vary in complexity from bucketing water out to the garden through to automatic sand filter/pump/drip irrigation systems. The choice of individual homeowners will depend upon lifestyle, size of garden, site layout, climate, available finances and other factors. Some basic parameters should be adhered to whatever system is used.

Storage of greywater should be avoided where possible. Pathogen numbers can increase rapidly in a favourable greywater environment, and stored greywater will begin to smell strongly as it becomes anaerobic (within a day or so).

It is best to apply greywater beneath mulch or soil. This stops the possibility of greywater pooling on the surface where children and pets can play in it or mosquitoes can breed. Surface spraying of greywater is not recommended, as the potential for people/greywater contact is significantly increased. Direct contact is virtually the only way for people to get sick from greywater re-use. Sub-soil or sub-mulch application of greywater also reduces the chance of water flowing overland into neighbours' properties or into gutters and waterways. The easiest way to apply greywater sub-mulch is to position greywater outlet points in swales or mulch basins then cover with mulch. Applying greywater beneath mulch means the greywater must soak

through topsoil where micro-organisms and roots are most active. This biologically active soil facilitates destruction of any pathogens, breaks down organic matter and utilises nutrients in greywater. Greywater applied too deep in the soil (around six inches depending on the site) does not have contact with this most active soil horizon and will not get the same efficiency of treatment.

Both bathroom and laundry water are generally far less polluted than kitchen water, and so are easier to re-use. Kitchen water can be re-used through an independent system (eg. directed to one or two mulch basins around trees near the kitchen), or can be directed to the blackwater management system if the household greywater system cannot handle the high-pollutant load. Remember that kitchen water pollutants are mostly compost, and if applied directly to soil under mulch, should decompose quite rapidly.

A three-way diverter valve (eg. Saldi valve) plumbed under the kitchen sink and/or laundry tub allows specific greywater loads to be directed away from the greywater re-use system. This may be useful when harsh chemicals have been used (eg. bleach) or nappies are being washed.

Re-using greywater on the vegetable garden is probably not a good idea because of the (remote) possibility of transferring bacteria from greywater to food. Many permaculture practitioners will re-use greywater on vegetable gardens, and should ensure greywater is applied beneath mulch and that root crops are not watered with greywater for at least one week before harvest. Never drink greywater or re-use it for showers, washing clothes and dishwashing. If water is that scarce, then invest in water saving appliances, a water conservation ethic and a larger rainwater capture area. This will be far cheaper and safer than treating greywater back to full contact standard. An old wastewater saying holds true here – clear water is not always clean water.

Types of greywater re-use systems

Detailed explanations of greywater re-use systems are not going to be attempted here. For a comprehensive description of greywater re-use systems, I recommend the booklet *Create an Oasis with Greywater* by Art Ludwig. This American booklet is applicable to Australian conditions, and is well illustrated and explained. It is available through the *Permaculture International Journal* mail order catalogue for A\$14.

Greywater re-use can be broadly classed in two categories – untreated greywater re-use and treated greywater re-use. Untreated greywater goes straight from the house to the garden, sometimes with temporary surge storage (eg. plastic barrel) so that large flows from the bath or washing machine do not back up into the house. Untreated greywater may pass through a filter (eg. old pantyhose), but will still contain suspended particles and organic matter which can clog a drip irrigation system. Untreated greywater is therefore generally applied to the garden through larger diameter emitters (pipes or hoses). Treated greywater has passed through a treatment system (eg. reedbed, sand filter or soil filter) before application to the garden, and has few suspended particles or dissolved organic matter remaining in the water. Treated greywater is therefore appropriate for drip irrigation re-use. The

use of drip irrigation increases the potential for high-efficiency greywater re-use because water can be applied in well-regulated and well-directed doses to trees, gardens or lawns. The biggest drawback with drip irrigation re-use is that water must be delivered under pressure for the drippers to function as intended. This requires either a pump or good gravity fall. Installation of a treatment system (and most likely a pump) means treated greywater re-use is generally more expensive than untreated greywater re-use.

Untreated greywater re-use systems include:

- bucketing water out to plants;
- siphoning water out of the bath/shower with a hose and directing to plants of choice;
- showering in the garden;
- connecting a (non-kinkable, large diameter) hose to the washing machine and directing water to plants of choice;
- discharging laundry/bathroom water to a surge barrel (with pantyhose filter) then gravity feeding or pumping to plants of choice;
- directly discharging kitchen sink water to a tree with mulch basin (a mulch basin is a depression dug around a bush/tree/banana circle, and excavated soil is positioned to form a wall around the basin. The basin is then backfilled with mulch. Greywater is directed to the basin, cannot escape, and cannot surface above the mulch).

These systems are generally simple to install and maintain, are inexpensive, and provide reasonably efficient re-use of greywater.

Treated greywater re-use systems include:

- constructed wetlands (reedbeds),
- intermittent sand filters,
- soil filters,
- greywater septic tanks, and
- aerated wastewater treatment systems (which use considerable quantities of electricity).

These require detailed installation and maintenance and are relatively expensive, but provide a high quality treated water which can be used in drip irrigation systems. Regulatory authorities are more inclined (at this point in time) to approve a system like this rather than an untreated greywater system. This will hopefully change as untreated greywater re-use systems are installed and successfully trialed in different areas of Australia.

Conclusion

This paper has been an introduction to greywater re-use. It has not attempted to describe re-use systems in detail, nor present a literature review of greywater research

in Australia and overseas. The author intends to compile a greywater booklet which covers these issues in greater detail, and which describes greywater re-use systems suitable for Australian conditions. It is hoped the booklet will be used by homeowners, and by local and state regulators seeking more information on greywater and its potential for direct garden re-use.

More information can be obtained from:

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Glen Marshall, completed his B.Applied Science (Hons.) in 1995, entitled On-site Management of Greywater and Human Wastes. Djanbung Gardens, Nimbin, was one of the properties where Glen researched and implemented his composting toilet and greywater wetland systems. He has recently begun documenting various greywater systems operating at many different permaculture properties around Australia and overseas, with the intention of publishing a ?How to build? booklet. Glen has also worked as a volunteer at the Permaculture International Journal (1994-95).