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NATIONAL SMALL FLOWS CLEARINGHOUSE

Small Community Wastewater Issues Explained to the Public

Graywater: Safe Reuse and Recycling

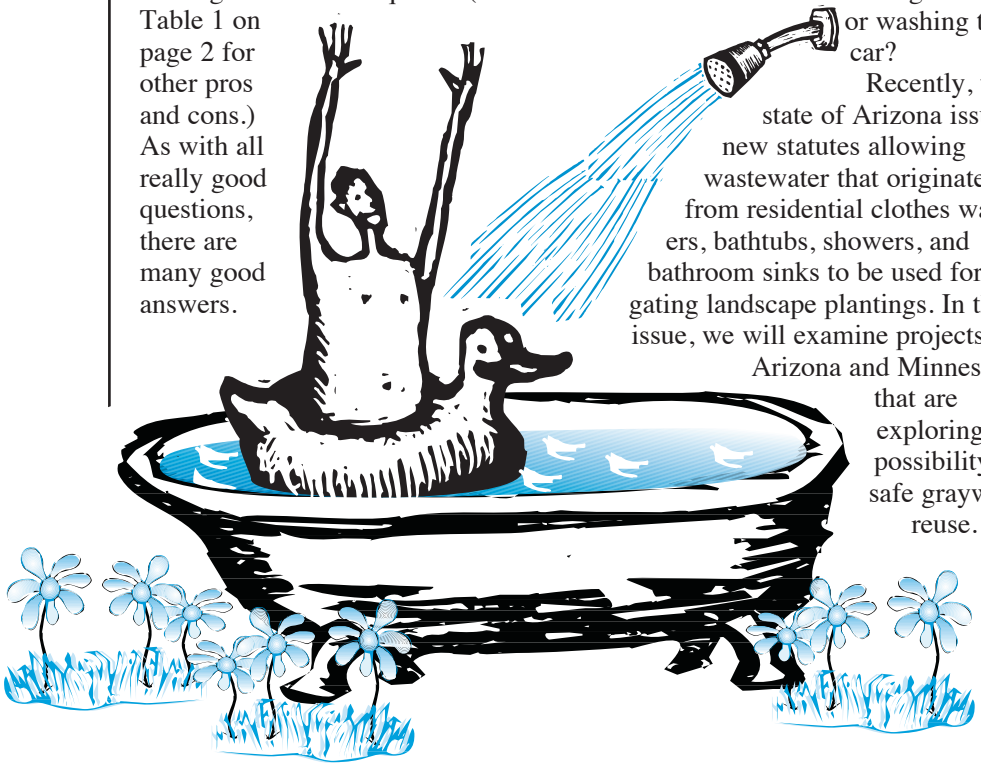
As clean water resources become more valuable, the concept of separating out the graywater from the home's waste stream and using it to supplement the family's water demand is becoming increasingly appealing. Graywater is generally defined as all wastewater generated from household activities except that produced from the toilet and the kitchen sink. Wastewater from the toilet is called blackwater.

Many questions arise when the subject of reusing graywater comes up. There are many advantages to separating the home's waste stream into black- and graywaters: for instance, it can extend the life of the existing treatment system, lower the household's water demand, and recharge the earth's aquifers (See Table 1 on page 2 for other pros and cons.) As with all really good questions, there are many good answers.

As fresh water supplies dwindle and become more expensive in many areas of the country, using water once and then 'throwing it away' is becoming too costly, both financially and practically. The idea of removing the less-concentrated graywater from the home's waste stream is attractive to engineers and homeowners alike as a way to reduce waste load and prolong the life of the system.

The average person generates approximately 40 gallons of graywater per day —a significant amount of water. (Refer to the table on page 5 for the average amounts of water generated by various household activities.) Careless misuse could mean creating a huge health risk. Can we reuse this water safely for such activities as watering the lawn, flushing the toilet or washing the car?

Recently, the state of Arizona issued new statutes allowing wastewater that originates from residential clothes washers, bathtubs, showers, and bathroom sinks to be used for irrigating landscape plantings. In this issue, we will examine projects in Arizona and Minnesota that are exploring the possibility of safe graywater reuse.



Key Terms

Graywater – wastewater generated from a household's shower, bathtub, bathroom sink, and washing machine. Water from the kitchen sink and dishwasher is usually not considered graywater, due to increased bacteria and should be sent to the septic system for treatment.

Blackwater – wastewater generated from a home's toilet.

Separate system – a treatment strategy where the waste streams are separated into graywater and blackwater and each effluent is sent to its own individual treatment system. Typically, the separate systems employ different technologies.

What is graywater?

The precise definition differs from state to state, but generally speaking, graywater is considered to be all the water from the sinks, bathtubs and showers, and the washing machine. Dishwasher and kitchen sink water are sometimes considered too full of potential contaminants and usually should be sent on to the main wastewater treatment system.

While the levels of contaminants are much lower as compared to wastewater that includes blackwater, graywater is not just soapy water. (Refer to the table on Page 4 for characteristics of domestic water.) *E. coli* is frequently present and can cause illness to humans if allowed to come into contact with it.

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(Preliminary analysis of graywater from various households indicates that *E. coli* is higher where children are living.)

In all instances, blackwater always must be disposed of through a separate treatment system, and the graywater system must be plumbed so that it can be diverted to the sewage system, if necessary.

Is graywater use legal?

Another good question – and it all depends on your state's regulations. The majority of states require graywater to be treated as carefully as blackwater, sending it through a separate system and purifying it to the same high standard before being dispersed. A few states are considering loosening the restrictions, especially in the Southwest where residents experience frequent water shortages. The National Small Flows Clearinghouse maintains an extensive regulations database with searches available upon request. (Please refer to the sidebar on Page 7 for details). Homeowners interested in graywater reuse also should contact their state or local health department for regulatory clarification or interpretation.

Depending on your state's regulations, technology for graywater reuse can be as simple as saving the rinse water from the clothes washer to rather complex treatment systems, such as one which the graywater flows to an aerobic treatment unit, then to a recirculating filter, and it is only ready for reuse after being disinfected with an ultraviolet filter.

Most state regulations do not differentiate between gray- and blackwater systems. Some states allow graywater systems to be installed; however, in many cases, it must meet all requirements of the regulations that apply to a blackwater system, including a properly sized septic tank and absorption field and all setback requirements. In these states where separate systems are allowed, technologies are quite similar to those used in any other onsite wastewater treatment systems: for example, aerobic treatment units, septic tanks, sand filters, and disinfection methods.

Tips for Homeowners Considering Graywater Reuse

When designing a household graywater reuse system, water-efficient plumbing fixtures are recommended. Examples of these are low-flow shower heads, faucet flow restrictors, and low-flow toilets. Depending on the state, these water-saving devices may be mandatory.

Graywater systems are easiest to install in new construction. Residences already constructed on concrete slabs or crawlspaces are difficult to retrofit for a separate graywater system.

To further reduce water demand, it is recommended that the homeowner consider reducing turf areas (lawn grasses typically are especially high water-demand plants) and replacing them with native plants more tolerant of dry conditions. A special horticultural consideration is that graywater typically has an alkaline pH, and therefore should not be used on acid-loving plants.

Table 1

Advantages and disadvantages of graywater reuse

Advantages

- recharges groundwater instead of depleteing it
- uses nutrients in the graywater to support plant growth
- reduces energy and chemical use
- lowers water bills

Disadvantages

- if mishandled, can spread disease
- becomes smelly if stored more than 24 hours
- may damage soil from salt build-up
- may effect movement of waste in sewer due to less water for transport

Arizona regulations allow for home irrigation with graywater

Graywater recycling makes the flowers bloom in the Arizona desert. These gardens are designed to be irrigated using the home's graywater.

"Using your graywater is a great way to practice the motto 'Reduce, Reuse, Recycle.' By using graywater, you reduce the need to pump precious groundwater, and you reuse a resource so valuable in the desert." So says the Water Conservation Alliance of Southern Arizona (CASA), an organization representing various water districts and the U.S. Bureau of Reclamation.

The Arizona Department of Environmental Quality has recently issued regulations by allowing homeowners to use reclaimed water. The new guidelines make it simple and affordable for residents to legally use graywater for landscape irrigation. Quite a few restrictions must be observed, but it is a giant step forward in the area of reusing graywater.

After in-depth research revealed the widespread reuse of graywater by homeowners (the most common use is surface irrigation of shade or ornamental trees), Arizona officials decided to make the practice allowable by law without a permit under limited conditions.

As described in the regulations, homeowners may recycle untreated graywater from washing machines, bathroom sinks, bathtubs, and showers, but only if the residence lies outside of an active floodplain. The graywater must originate from the residence and be used only for landscape irrigation. Specifically stated, the graywater from kitchen sinks, dishwashers, and toilets is not to be included. Special mechanical considerations include requiring an emergency discharge to the septic or sewer system in case of system failures, and all piping should be of PVC or ABS. Storage containers must be secured with bug- and childproof covers.

The Desert House Experiment

Desert House, a residential water and energy efficiency demonstration project located at the Center for Desert Living in the Phoenix Desert Botanical Garden, has been using graywater for landscape irrigation since 1996. The system uses the water retained from showers, baths, sinks, and washing machines resulting in an annual water savings of 11,370 gallons.

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Arizona regulations allow for home irrigation with graywater

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Desert House has recently finished a 2-year study on the effect on the landscape plants being irrigated with graywater around the residence. The system is a drip system, buried a few inches underground. The study revealed no accumulated effect on the plants or the surrounding soil besides a slight increase in boron, probably from soap. And although elevated, the boron levels detected were still below acceptable levels.

The regulations stipulate that homeowner irrigation systems may only be flood or drip types (no spray systems, for instance) and caution against allowing graywater to pool, which creates a health risk. Graywater irrigation is for landscape plants only, never for plants intended for human consumption.

Reuse Increasing

When asked about the popularity of the graywater recycling program, Val Little, manager of Water CASA explains, "A year after becoming the law of the land, we are having a tough time staying ahead of the demand: the demand for more information about putting together a system, the demand for the dual plumbing of new construction, and the demand for a roster of folks who can and will specialize in doing graywater retrofits."

Water CASA is currently developing a booklet to help homeowners analyze their own landscape water needs and their graywater accessibility to determine whether or not a graywater retrofit makes sense.

"Our county is asking us to request that all new housing stock be dual plumbed for graywater, and we are hoping to get our local plumbing contractors, etc., to work with us on generating a list of possible folks to do the retrofits that the public wants." Water CASA has a great Web site at *www.watercasa.org* with lots of water-saving tips for homeowners.

Reprint Info

Readers are encouraged to reprint Pipeline articles in local newspapers or include them in flyers, newsletters, or educational presentations. Please include the name and phone of the National Small Flows Clearinghouse (NSFC) on the reprinted information and send us a copy for our files. If you have any questions about reprinting articles or about any of the topics discussed in this newsletter, please contact the

Table 2

Water-quality characteristics of selected domestic wastewater

Water Source	Characteristics
 Automatic Clothes Washer	Bacteria, bleach, foam, high pH, hot water, nitrate, oil and grease, oxygen demand, phosphate, salinity, soaps, sodium, suspended solids, and turbidity
 Automatic Dishwasher	Bacteria, foam, food particles, high pH, hot water, odor, oil and grease, organic matter, oxygen demand, salinity, soaps, suspended solids, and turbidity
 Bath tub and shower	Bacteria, hair, hot water, odor, oil and grease, oxygen demand, soaps, suspended solids, and turbidity
 Sinks, including kitchen	Bacteria, food particles, hot water, odor, oil and grease, organic matter, oxygen demand, soaps, suspended solids, and turbidity
Evaporative Cooler	Salinity

Adapted from Water Quality Characteristics of Selected Domestic Wastewater, 1996, New Mexico State University Agricultural Communications.

Minnesota projects treat graywater separately

Unlike Arizona, Minnesota does not suffer from a shortage of water. Rather there often is too much water. Many of the remaining building sites in the state are adjacent to one of thousands of small lakes, and generally, these lots are too small for standard drainfields. An additional problem lies with the state's geology: the underlying karst topography allows for direct recharging of the groundwater.

Success with separate systems

To demonstrate ways to reduce waste loads and to downsize the required drainfield area for onsite wastewater treatment systems, the caretaker's residence at a county-owned park was retrofitted in 1993 with separate wastewater systems for graywater and blackwater. A range of public and private organizations and agencies worked together to complete this demonstration project, including the Minnesota Pollution Control Agency, the Rochester Public Utilities, the Peoples Cooperative Power Association and the South Zumbro Watershed Partnership. However, the primary partners were the Olmsted County Water Resources Center and the Equaris Corporation. Equaris (formerly Alascan®) is an engineering firm addressing sustainable onsite water treatment and wastewater recycling, specifically wastewater separation treatment coupled with nutrient and water reducing graywater reuse technologies.

Equaris has been developing alternative technologies for wastewater treatment since the 1980s. Working for the Alaska National Guard, as well as for private homeowners, the firm's engineers have developed several new systems that provide sustainable onsite water treatment and wastewater recycling solutions, earning several patents for their efforts.

The firm's main concern with current waste treatment systems is the use of so much water. Rather then using the mainstream approach of 'solution to pollution is dilution,' its intent is to reduce the amount of water needed for waste treatment and demonstrate how the water can truly be reused.

At the caretaker's residence, the firm installed a composting blackwater system and an aerobic graywater treatment system to take care of the separated waste stream. Wastewater from the sink, bath, dishwasher, and clothes washer were sent to a tank for settling, aeration, and clarification, and then discharged to an outside dosing tank. Effluent was sent from the dosing tank to a drainfield. The graywater system was closely monitored and was calculated to have achieved a 90 percent or greater reduction in loadings of total nitrogen, biochemical oxygen demand, and suspended solids to the drainfield.

No discharge system now online

With the success of the park project, Equaris has expanded its use of a totally closed loop system, meaning that all water is reused within the house—there is no discharge.

This project came about when the homeowner learned that due to poor soil conditions, an especially expensive wastewater treatment system would be necessary, and an extra-deep well would have to be dug due to high nitrate levels in the water table. The homeowner was intrigued

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Table 3

Indoor Water Use

Source	National Average (liters per capita per day)	Percent of total
Clothes washer	42.4	30
Shower/bath	39.4	23
Toilet	37.9	21
Faucets	56.4	20
Dishwasher	4.2	2
Other	5.7	
Total indoor water use	185.8	

(From the American Water Works Association, 1997)

Minnesota projects treat graywater separately

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by the idea of living in a home so environmentally-friendly, so the new residence was designed so rainwater could be collected from roof drains and one of Equaris's separation systems was installed to handle the wastewater.

The home's wastewater is separated into the blackwater, which flows to a composting waste chamber, and the graywater is pumped to a surge tank (for flow control), an aeration tank, and then to a clarification tank. Effluent is pumped across several filters and then to a reverse osmosis filter. Ultraviolet light is used for disinfection. The resulting product meets and surpasses drinking water quality standards.

Elston noted that most households require up to 75 gallons per day per person, but with this total reuse system, this need is reduced to five to seven gallons per day per person. The only real loss from the system is to the toilet, and makeup water is obtained from the rain collected from the roof.

Maintaining the system is fairly simple. On a quarterly cycle, the filters will have to be changed and the ultraviolet bulbs should be changed annually. As for cost, Elston admits the price is steep: $20,000 for the entire system. But at this site, the homeowner would have had to incur much greater expenses for the extensive well and drainfield system necessary.

In regard to any special permitting required for this project, Elston chuckled and pointed out that "You don't need a permit if you aren't discharging anything." He sees great potential for these 'closed loop' systems in any area where fresh water is scarce or where it is impossible to install the usual treatment system. "This technology avoids zoning issues and really gives possibility to typically unbuildable property," he said.

More information about the specific applications of Equaris Corporation's technologies can be found on their Web site: *www.equaris.com* or by calling them at (763) 383-5138.

Reuse Ideas

Here are a few easy ways to recycle 'slightly used' water in your household. This water can be used to pour-flush a toilet, supplement the washwater in your clothes washer, or irrigate inside or outside plants.

- Collect the 'warm-up' water from your shower or tub.
- Save the rinse water when rinsing fruits and vegetables at the kitchen sink.
- Reuse the condensed water from the air conditioner or dehumidifier.

Equaris' Total Household Recycling System