



SECOND TIME AROUND

Re-using greywater—in areas where it's permitted—can cut residential water consumption in half. Fernando Pages Ruiz

According to EPA estimates, nearly 50% of the clean, potable water delivered for use inside an average home in the U.S. goes down the drain from sinks, showers, and washing machines. So finding a way to put this “lightly used” household wastewater—otherwise known as greywater—to work flushing toilets and irrigating landscaping could cut a home’s consumption in half.

Plumbers in Europe, Canada, Japan, and Australia are already as familiar with installing greywater systems as they are bathtubs and kitchen sinks. But here in the United States, the adoption of on-site water recycling has only just gotten started. And as more cities and states explore and open up to greywater systems, the technology and the technicians to install it are becoming more

available and affordable. Still, we’re a long way from common practice.

SHADES OF GRAY

In broad strokes, greywater recycling systems come in three categories of complexity and cost: Untreated greywater used for deep-water (i.e., root-level) ornamental landscaping; filtered greywater to water landscape including vegetable gardens; and treated greywater for most non-potable uses such as flushing toilets.

Untreated Greywater Systems. The simplest and least expensive systems (some for as little as \$300) separate and drain greywater from sources such as the washing machine and shower, and then, using gravity, pipe this raw greywater to deep-water ornamental shrubs and trees. In

some municipalities, such as San Francisco, a homeowner can install a small, simple greywater system (single-fixture and/or clothes-washer systems) without a permit. Many homeowners concerned with water consumption simply discharge washing machine or shower drains straight into garden troughs, but there exist legitimate public health concerns with surface application of raw greywater, especially on edible plants. For one, greywater can still contain organic compounds, such as fecal matter from soiled clothing, diapers, or bathing. Greywater can also contain high levels of phosphorus, good for the garden, but not rivers and lakes.

Therefore, most jurisdictions that permit the recycling of untreated greywater require it piped and disposed of below the frost line to deep-water

BORD NA MONA. The Puraflo Wastewater Treatment System is a natural system that can be used for both on-site greywater and blackwater recycling. Filtered wastewater from a standard septic system is collected and then time dosed (pumped slowly) to percolate through a peat filter media; the treated effluent emerges as a “clear innocuous liquid,” according to the company. The treated water can be used to irrigate lawns, ornamental trees, and shrubs. Other advantages of this system come with leach field preservation and a reduced need for leach field area, allowing the construction of a septic system in challenging locations, such as too small a lot for the house size, poor percolating soils, or close to lakes and streams. 800.787.2356. www.bnm-us.com. Circle xxx.



▲ **PONTOS.** The AquaCycle provides a four-phase water treatment with UV light disinfection. The recycled water conforms to European Directive 76/160EWG for Recreational Water. Unfortunately, this most advanced of greywater systems built in Germany by Masco subsidiary Hansgrohe, will not be available in the U.S. Citing an uncertain regulatory landscape, along with the absence of a proven nationally recognized performance standard related to on-site greywater, the company announced March 1 that plans to bring the Pontos AquaCycle technology to North America have been put on “indefinite hiatus.” . 678.762.6942. www.hansgrohe-int.com/int_en/86083.htm. Circle xxx.



▲ **SLOAN.** The Aqus point-of-use greywater system collects water from bathroom sinks and reuses it for toilet flushing. The drainage water is routed through a sanitizing and filtration system, and then collects in a storage reservoir under the sink; upon flushing, the water is pumped to the flush tank. According to the company, the system can reduce metered water usage in a two-person household by about 10 to 20 gallons a day—or approximately 5,000 gallons a year. 502.550.1506. www.sloanvalve.com. Circle xxx.

ornamental trees and shrubs. All jurisdictions prohibit the storage of raw greywater; after 24 to 48 hours of fermentation it becomes septic blackwater. This lack of storage limits the practical application of untreated greywater as production and consumption do not always match. But a raw greywater system can cost under \$300 in materials to plumb, so consequently many thousands of simple washer-machine-to-watering-can systems exist, some legal, most not.

Filtered Greywater. At once practical and moderate in cost (\$1,500 to \$3,000), a filtered greywater system represents the most popular option. Filtered systems can use pumps to distribute water through drip irrigation for watering ornamental and, in some areas, edible plants. No jurisdiction allows the use of filtered but untreated greywater indoors, nor the aerial spraying of greywater, such as lawn sprinklers.

At the low end, filtering methods include a simple skimmer, similar to that used for a pool, and a fine sand filter. More sophisticated systems employ multi-stage coarse-to-fine media (screen) filters, and even biological filters that incorporate contaminate-scrubbing vegetation. The simpler systems are generally used for deep root watering, or sometimes gravity-fed irrigation. The removal of fine particles in the multi-stage filtered systems allows the filtered greywater to run through pumps and drip irrigation without clogging.

Although legal for drip system irrigation in some areas, the filters do not remove fecal matter, so users should be aware of the risk when watering edible plants, such as lettuce, which could transmit disease. The filters need periodic cleaning, and the frequency and intensity of maintenance required should figure prominently when considering a system; if the homeowner cannot maintain it properly, it will not work.

Treated Greywater. In order to store and recycle greywater for use in toilets, the greywater has to be filtered and treated. Many different treatment methods exist and prices range from a few hundred dollars for a small, single-fixture point-of-use application, such as Sloan’s Aqus System, to pricey, multi-stage in-home treatment plants that

cost \$8,000 or more and can feed multiple fixtures, such as the German Aquacycle system by Pontos.

Greywater treatment methods vary, but usually consist of a two-stage, coarse-to-fine filter that removes particles, followed by a chemical disinfectant (think chlorine tablets) or a biological (aerobic) treatment, and pass through ultraviolet light. The treated water is stored in a gas-tight container and pump-fed to toilet tanks to be used on demand. If there is not sufficient greywater stored, most systems have automatic valves with backflow preventers to make up the shortfall with fresh water. When there’s too much greywater, most systems have overflow valves that allow the excess to discharge into the sewage system. Although some systems clean water to potable levels, no jurisdiction in the United States allows the use of site-treated water for anything other than toilets. Public treatment plants are monitored by the EPA; there’s no way to know if homeowners run their home-based treatment plants to the standards of a municipal sewer.

GREYWATER PLUMBING

Before we can recycle greywater, it has to be kept separate from its foul-smelling sibling, blackwater—the highly contaminated and more difficult to treat wastewater that issues from toilets and kitchen sinks. “The concept of separation sounds simple, and it is,” says Ron Flax of Rodwin Architecture in Boulder, Colo., “but it requires planning.” Flax knows, because he was project manager on the hyper-ecological Edge House, which featured Boulder’s first permitted greywater recycling system.

Just like all sewage disposal, greywater piping is gravity fed and requires a downhill route to the point of treatment or stub-out. “This can mean having to build extra-wide plumbing walls to accommodate a double sewage line,” explains Flax, especially when multiple greywater sources have to be combined. Greywater sewer lines require their own venting as well.

The sewer side of the equation requires no special type of pipe. But reclaimed greywater headed for reuse—especially when in the



▲ **NUBIAN WATER SYSTEMS.** The company manufactures and installs high-end greywater treatment systems for single-family, multifamily, and commercial applications. Its residential system, the Nubian GT600, meets requirements for indoor reuse (where allowed) and for above-ground sprinklers. A four-stage treatment process, including coarse-through-fine filtration, adsorption media, biological treatment, and UV-light disinfection completes the treatment process before the treated water is stored for recycling. Nubian is headquartered in Australia and provides service in Western United States. www.nubian.com.au. Circle xxx.



▲ **WATER LEGACY.** Designed to service the typical four- to six-person household, the WL-55, installed at the Edge House in Boulder, Colo., is a mid-range, three-stage treatment process that includes coarse-to-fine filtration, hydrogen peroxide (H₂O₂), and UV-light disinfection. The WL-55 is fully automatic and requires no operator intervention. Its filter requires maintenance only once a year. 303.587.9147. www.waterlegacy.com. Circle xxx.

home—must flow through clearly marked purple pipe, as specified by both the Uniform and International Plumbing Codes (UPC and IPC). Many PEX manufacturers nowadays offer a purple pipe labeled “non-potable.” But when Flax installed the first greywater system in Boulder, “We couldn’t find purple pipe, we had to paint it by hand, and affix ‘non-potable water’ labels to the full length of every pipe.”

On the treatment end, you will find many engineered greywater systems for sale, but the features of an individual system may not comply with the specific requirements of your area. Generally the requirements include a sealed, gas-tight reservoir of 50 gallons or more. The reservoir will have to have a valve that clears the greywater into the sewer system automatically if left standing for 72 hours, and the reservoir will require its own vent. You will have to provide makeup potable water to keep the system functioning even when there’s no greywater available. The makeup water will require its own backflow preventer to keep greywater from being drawn back into the freshwater supply.

Mike Vale, who designed and built the Water Legacy Greywater Treatment System installed at the Edge House in Boulder, says one of the reoccurring errors in greywater installation is not providing space for the water heater-size treatment appliance. “Allow plenty of room around the treatment tank, so you can easily get to it for servicing,” says Vale, who now manufactures and sells the Water Legacy system nationwide. Recycling tanks are located in the same utility closets where water heaters may go, in basements, laundry rooms, or even garages or outdoors in warm climates.

When specifying a greywater recycling system, it pays to check with the building department first to make sure the system you intend to use meets local requirements. Then carefully blueprint the plumbing tree, forestalling hours of skull-peeling, head-scratching problems at the jobsite.

REGIONAL RULES AND REGULATIONS

The greywater sources you can legally recycle vary by jurisdiction, but Florida’s

regulations typify the usual assortment: bathtubs, showers, lavatories, clothes washers, and laundry sinks. All together, these represent about 40% of the water waste discharged in the average home, according to EPA estimates.

Drought-stricken areas, such as California and Arizona, have recently jumped head-first into greywater permitting, and, in some cases, even provide tax credit incentives for homeowners to install the systems. Since June 2010, Tucson has required builders to plan for and stub-out greywater plumbing for future hookup.

The most aggressive states encouraging greywater recycling include Arizona, California, New Mexico, and Texas. But even traditionally conservative areas, such as Nebraska, have rolled out the gray carpet. Georgia’s statewide plumbing code adopted in 2009 permits the use of filtered and disinfected greywater for toilet, urinal, and subsurface irrigation.

WATER CENTS

Unlike many high-end energy-saving measures, which can provide handsome dividends, the payback for indoor-quality greywater treatment discourages many from making the investment. Even the least expensive systems, such as the point-of-use Aquos from Sloan that costs as little as \$300, may require a five- to 10-year payback at a water-savings rate of \$20 to \$30 per year.

In the U.S., combined water and sewer bills average about 2 cents a gallon, or less than 0.5% of household income, according to the EPA. Because of the protected payback, sometimes beyond the lifespan of the greywater system itself, many people installing water recycling measures do it for purely environmental reasons. But for those with large irrigation needs, or with private sewage disposal systems, it can make financial sense.

In drought-prone areas such as California and Arizona, where landscape watering can represent nearly 70% of a household’s consumption, according to a 2010 study commissioned by the California Homebuilding Foundation, low-tech, outdoor-only greywater recycling systems



▲ **CLIVUS MULTRUM.** The Clivus Greywater System includes a Greywater Dosing Basin as the collection point for all of a home's greywater. Made of rigid plastic, it contains level switches and an effluent pump or gravity siphon (where sufficient slope is available). When an amount of greywater sufficient to create a 1 ½-inch flooding dose within the irrigation chamber has collected in the dosing basin, the pump (or gravity siphon) engages. Because the irrigation chamber is flooded throughout its length, water and nutrients are carried evenly to surrounding plants. 800.425.4887. www.clivusmultrum.com. Circle xxx.

make good economic sense, especially when punitive over-consumption fees go into effect. Payback varies by usage, with high-consumption homes such as those with orchards or large yards obtaining ROI in as short as three to five years.

For those on private disposal systems, the reduction in effluent from diverting greywater from leach lines also can make it possible to build on a lot otherwise too small for a standard septic system. In fact, some systems exist that treat combined black and greywater for subsurface irrigation, such as the Puraflo Wastewater Treatment System.

For now, greywater in the U.S. is still in its beta-test phase. Like early solar panels, greywater recycling systems have to prove themselves before they become a standard branch in the garden-variety plumbing tree.

But costs are slowly coming down, and just like alternative energy, municipal subsidies are helping the industry inch forward. In some areas, such as San Francisco, permissive regulations allow homeowners to install the smallest, simplest, and least costly systems without a permit. In most cases, these systems are also the ones that make the most economic sense.

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To view diagrams of greywater systems and to see images of the Edge House,