



# Use of Graywater in Urban Landscapes

Janet Hartin and Ben Faber

UC Cooperative Extension



## Definition and Overview

The use of graywater to irrigate landscape plants is increasing throughout the United States, particularly in California and other arid states. In the United States, "graywater" most often refers to wastewater that originates from residential clothes washers, bathtubs, showers, and sinks, and it excludes wastewater generated from kitchen sinks, dishwashers, and toilets (black water).

In California, under Health and Safety Code § 17922.12, graywater is defined as "untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. Graywater includes, but is not limited to, wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers."

As of August 2009, a permit is no longer required for the installation of the following single-family or two-family residential graywater irrigation systems if other conditions under section 1603A1.1 of the Department of Housing and Community Development (HCD) are met:

- a simple clothes washing graywater system as long as it does not require cutting of the existing plumbing piping
- a single-fixture system that collects graywater from one plumbing fixture.

All other systems require a construction permit prior to erection, retrofitting, construction and installation as stated in the actual code. The full text of these standards can be viewed at the California Department of Housing and Community Development (HCD) Division of Codes and Standards website, <http://www.hcd.ca.gov/codes>. Because these regulations may change at any time, always check with HCD and local enforcement agencies before developing plans for or installing a graywater system. Cities and counties can impose stricter guidelines than the state, so homeowners interested in installing graywater systems should contact their local jurisdiction for specific regulations concerning graywater handling and use.

Laundry-to-landscape graywater systems are relatively simple to install and are inexpensive. The hose exiting the clothes washing machine is attached to a valve that separates graywater from water destined for the sewer. The graywater is diverted through a 1-inch main irrigation line with ½-inch tubing outlets placed throughout the landscape terminating in a valve box set in what is termed a "mulch basin" that surrounds plants being watered (see below). The washing machine pump distributes water directly to

the landscape with no filter. A vacuum break or backflow prevention device may also be needed. Keep in mind that salt-free and boron-free liquid laundry detergents should be used for irrigating the landscape. In addition, chlorine bleach should be avoided.

All laundry-to-landscape systems not requiring a permit are required to:

- be equipped to direct flow back to the sewer (e.g., a three-way valve).
- have valves and direction of graywater flow clearly labeled.
- supply graywater to landscape plantings only on the homeowner's property.
- include an operation and maintenance manual.
- discharge graywater underneath a 2-inch cover of mulch, plastic shield, or stone covering.

Systems must not:

- use water contaminated by diapers and human waste.
- contain hazardous chemicals from oily rags, photolabs, car pasts, etc.
- create pooling of standing water or an open tub.
- create water pollution through runoff or deep percolation of graywater into ground and surface waters.
- include a pump (other than a washing machine internal pump).
- connect to any potable water supply.
- affect or alter electrical, plumbing, mechanical, or structural components of the home.

Mulch basins receive and distribute graywater to plant root zones and are constructed by removing several inches of soil and replacing it with coarse organic mulch. These basins are established in bed areas or near plants so that the graywater reaches plant root systems. They need to be sized correctly to prevent surface ponding. Sizing depends mainly on soil texture (sandy loam, clay loam, etc.). Graywater percolates quickly through sandy soil, requiring minimal mulch. In slower-percolating clay loam soil, a larger mulch basin is required around the valve box to prevent graywater pondage. Large wood chip mulch is more durable and longer lasting than smaller wood chip mulches or shredded fiber.

Applying graywater through a drip irrigation system is not generally recommended. Drip emitters can quickly clog with hair and other graywater products and requires a filter and regular filter cleaning. A drip system for this use also requires a backflow preventer to ensure that potable water is not contaminated and a pump and controllers to assure that water flows through the emitters. These systems are expensive and require regular maintenance.

### **Benefits and Risks**

Using graywater to irrigate landscape plants can conserve water and electricity and reduce water bills by recycling water otherwise destined for a wastewater treatment plant. Since an estimated 30 to 50% of home water use produces graywater, significant savings can be realized by reusing this source of

nonpotable water to irrigate landscape plants. A typical household (2.6 people) produces an average of 90 gallons of graywater each day. While most graywater systems will not supply enough irrigation water to irrigate an entire traditionally landscaped yard, most can supply one-half to 3/4 of the water required by a drip-irrigated water-efficient landscape with limited or no turf.

The potential risks should be carefully evaluated before deciding whether to install a graywater recycling system. Graywater varies substantially in quality and potential risks from site to site. Many household cleaning products, as well as many shampoos, soaps, and detergents, contain dyes, bleach, chlorine, sodium, boron, and phosphate, which can pose significant human and environmental health concerns and can injure and even kill plants at high dosages over a short period or smaller dosages over a longer period.

### **Impact of Graywater on Human Health**

Because of the recent changes regarding graywater reuse under California and other state statutes, research pertaining to the long-term impacts and risks of graywater reuse on human health, plant health, soil chemistry, and ground and surface water quality is very limited. A review of current research-based information follows.

Research examining the microbial constituency of graywater indicates that direct contact with graywater can pose a health risk to humans. Pathogens can enter graywater through food sources in the kitchen, which is why use of graywater generated from kitchen sinks and dishwashers is not recommended. Also, because pathogens can enter graywater through fecal matter, avoid water contaminated by dirty diapers. Pathogens posing the greatest concern in graywater include bacteria such as enterotoxigenic *Escherichia coli*, *Salmonella* spp., *Shigella* spp., *Vibrio cholera*, *Campylobacter* spp., and *Legionella* spp.; protozoans such as *Giardia* spp. and *Cryptosporidium* spp.; and viruses such as enteroviruses, hepatitis A, rotavirus, and Norwalk virus.

Graywater should not be applied directly to edible plant parts or root crops. To be safe, it should be applied only to nonedible ornamental plants. Avoid splashing graywater on neighboring edible plants. Graywater should not be applied through sprinkler systems, since droplets containing harmful microbes can become suspended in the air and breathed.

### **Impact of Graywater on Soil Chemistry and Water Quality**

Limited research exists that addresses the fate of microorganisms found in graywater and their impact on indigenous soil microorganisms, soil chemistry, and water quality. Infiltration through soil, rock, and other materials that serve as filters can significantly diminish the threat of water pollution from graywater use. Unfiltered graywater accumulating in surface water and graywater seepage into nearby wells can diminish water quality.

## **Impact of Graywater on Plant Health**

Because graywater is often rich in nutrients required for plant growth, ornamental plants may benefit from its use. However, numerous studies indicate that graywater may contain significant levels of sodium and other salts harmful to plants, particularly from powdered laundry detergents. Since ornamental plants vary dramatically in their sensitivity to potentially harmful salts found in graywater, care must be taken when plants are irrigated with graywater that is high in salts, particularly over a long-term basis. In general, evergreen trees are more salt sensitive than deciduous trees. Very little is known regarding the impact of graywater use on annual bedding plants. More research is needed on the impact of graywater on plant health since the chemical composition of graywater is different than that of treated wastewater and surfactants are widely used in household cleaning products.

Regardless of what graywater system is chosen, the following precautions should always be taken:

- Carefully label all valves and pipes associated with your graywater system and prevent backflow.
  - Do not store graywater more than 24 hours.
  - Wear gloves and do not come into direct contact with graywater.
  - Do not let graywater pool or run off of the soil surface or come into contact with well water.
  - Do not irrigate edibles with groundwater or allow it to splash on neighboring edible plants.
  - Do not irrigate turfgrass or ground cover areas with graywater, since potentially harmful microorganisms can remain on the surface.
  - Do not use graywater contaminated with human waste, infectious disease organisms, grease, paint residue, gasoline, solvents, or other chemicals found in household and industrial products.
  - Keep the graywater system simple and avoid systems requiring heavy upkeep and maintenance.
- Contact a professional with experience designing and installing graywater systems if you lack the specific knowledge or time to undertake the project yourself.

## **Bibliography**

- Roesner, L, Y. Qian, M. Criswell, M. Stromberger, and S. Klein. 2006. Final report: Long-term effects of landscape irrigation using graywater: Literature review and synthesis. Alexandria, VA: Water Environment Research Foundation. WREF website, [http://www.urbanwater.colostate.edu/A1\\_Published\\_Report\\_03CTS18CO.pdf](http://www.urbanwater.colostate.edu/A1_Published_Report_03CTS18CO.pdf)
- State of California Graywater Code. [http://www.hcd.ca.gov/codes/shl/Preface\\_ET\\_Emergency\\_Graywater.pdf](http://www.hcd.ca.gov/codes/shl/Preface_ET_Emergency_Graywater.pdf)
- Wu, L., and L. Dodge. 2005. Landscape plant salt tolerance guide for recycled water irrigation. Slosson Research Endowment for Ornamental Horticulture, University of California, Davis, Department of Plant Sciences website, <http://slosson.ucdavis.edu/files/66355.pdf>.