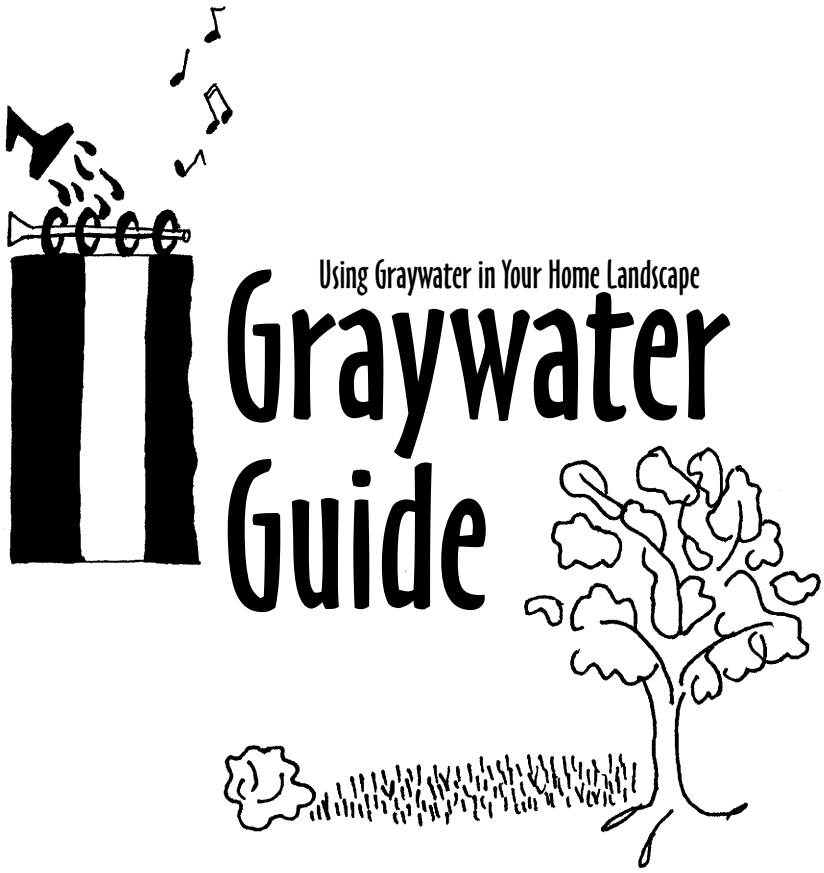

Using Graywater in Your Home Landscape

Graywater Guide

Pete Wilson
Governor
State of California

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Graywater is untreated household waste water which has not come into contact with toilet waste.

Includes: used water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs.

Does not include: waste water from kitchen sinks, dishwashers, or laundry water from soiled diapers.

(from California Graywater Standards)

Thanks to the Urban Water Research Association of Australia for their contribution of four illustrations from their publication, *Domestic Greywater Reuse: Overseas Practice and its Applicability to Australia.*

Foreword

California's Graywater Standards are now part of the State Plumbing Code, making it legal to use graywater everywhere in California. These standards were developed and adopted in response to Assembly Bill 3518, the Graywater Systems for Single Family Residences Act of 1992.

This Guide was prepared to help homeowners and landscape and plumbing contractors understand the Graywater Standards and to help them design, install and maintain graywater systems.

Carlos Madrid
Chief, Division of Local Assistance

Table Of Contents

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Why Use Graywater?

Are you tired of watching your bathing and laundry water go down the drain when it could be put to good use on your landscape? Now it is safe and legal to reuse that "graywater" and this guide shows you how.

In addition to conserving water and probably reducing your water and sewer bills, you will also be "drought-proofing" your landscape by using graywater. Since more than half of your indoor water can be reused as graywater, during shortages, when outdoor watering may be restricted, you will have a constant source of water. With landscapes valued at between 5 percent and 10 percent of the value of a home, this back-up supply of water may be an important economic insurance policy for you. Furthermore, the nutrients in graywater may be beneficial to your plants.

The seven steps to follow to put graywater to use in your landscape are:

1. Investigate the permit process
2. Prepare a plan
3. Design the graywater system
4. Submit the plan for review and approval
5. Install the system
6. Arrange for system inspection and approval
7. Use, monitor and maintain the system

If you decide not to do some of the steps yourself, you can hire a landscape contractor to install the irrigation system or a plumbing contractor to install the plumbing. They will follow this same process.

To better illustrate how to install a residential graywater system, this guide features the Brown family. In examples throughout the text, this family of four follows the seven steps.

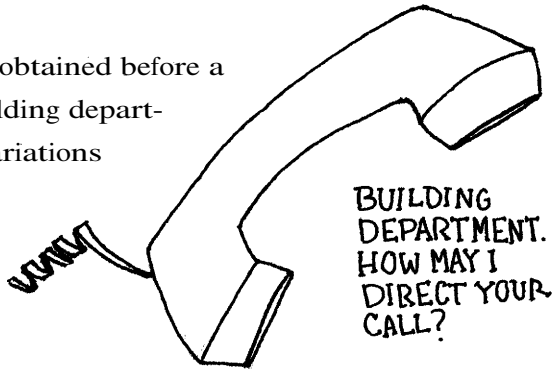
The Seven Steps

The following seven steps will help you plan, design, install, and maintain your graywater system.

1. Investigate the Permit Process

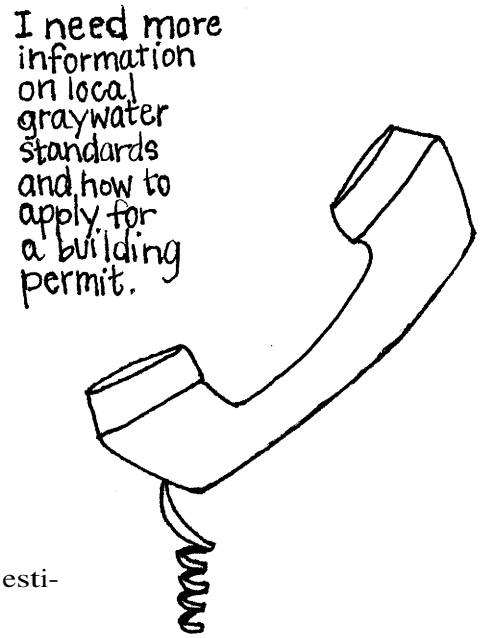
Information in this guide is based on the California Graywater Standards. In the appendix, you will find a copy of Title 24, Part 5, of the California Administrative Code, GRAYWATER SYSTEMS FOR SINGLE FAMILY DWELLINGS, commonly called the California Graywater Standards (Appendix **J**). These are the official rules for using graywater in California.

The Standards require that a building permit be obtained before a graywater system is installed. Check with your local building department for information on their permit process and any variations made to the Graywater Standards before you proceed.



2. Prepare the Plan

Is a graywater system for you? By first learning approximately how much graywater your family will produce and how much landscape you can irrigate with it, you will be better able to decide. Determining whether your soil is suitable for a graywater system is another primary consideration. Once you have decided that a graywater system is in your future, the next step is to draw a plan and design your system.



Estimate the Amount of Graywater Your Family Will Produce

The number of plumbing fixtures which you connect to the graywater system will determine how much graywater is available for irrigation use. See the section entitled "Plumbing System: Pipes and Valves" page 8 for more information about accessing plumbing fixtures.

The Graywater Standards use the following procedure to estimate your daily graywater flow:

(1) Calculate the number of occupants of your home as follows:

First Bedroom	2 occupants
Each additional bedroom	1 occupant

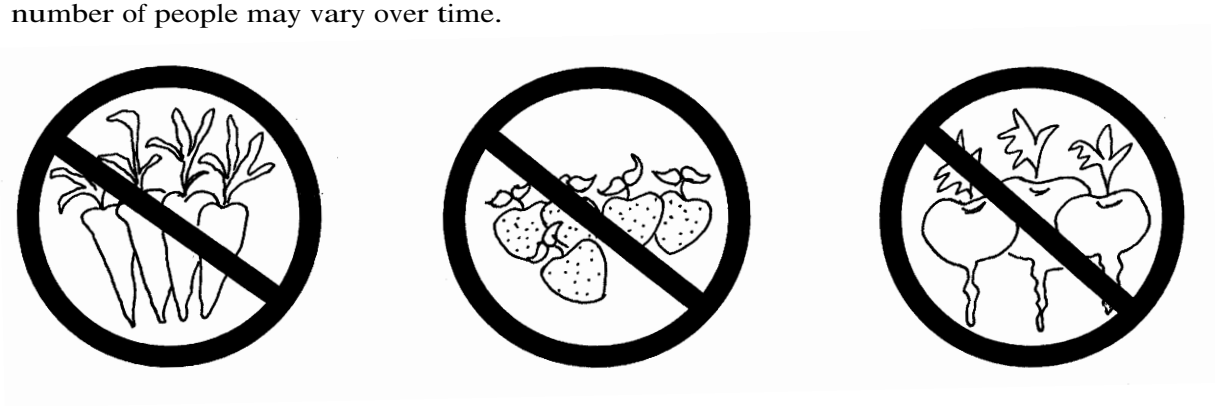
(2) Estimated daily graywater flows for each occupant are:

Showers, bathtubs and wash basins (total)	25 Gal./Day/Occupant
Clothes washer	15 Gal./Day/Occupant

(3) Multiply the number of occupants by the estimated graywater flow.

Example: The Brown family has a three bedroom house so the system must be designed for a minimum of four people. If all fixtures are connected, then each occupant is assumed to produce 40 gallons of graywater per day, resulting in a total of 160 gallons each day.

The reason graywater flow is based upon the number of bedrooms rather than the actual number of people is that the number of bedrooms will remain constant, while the number of people may vary over time.



Estimate the Amount of Landscape You Can Irrigate

Graywater is distributed subsurface and will efficiently maintain lawns, fruit trees, flowers, shrubs and groundcovers. It can be used to irrigate all plants at your home except vegetable gardens.

You do not need to do the following calculation as part of the permit process, but it will help you determine just how much landscape your graywater will irrigate and how many plumbing fixtures you may want to hook up to the system. On page 6, you will find specific information about determining the minimum required irrigated area.

You can estimate either the square footage of the landscape or the number of plants which can be irrigated. Generally, estimating the square footage is more useful for lawn areas and subsurface drip irrigation systems while estimating the number of plants would be more useful for trees and shrubs irrigated by a mini-leachfield system.

Use this formula to estimate the square footage of the landscape to be irrigated:

$$LA = \frac{GW}{ET \times PF \times 0.62}$$

where:

LA = landscaped area (square feet)

GW = estimated graywater produced (gallons per week)

ET = evapotranspiration* (inches per week)

PF = plant factor

0.62 = conversion factor (from inches of ET to gallons per week)

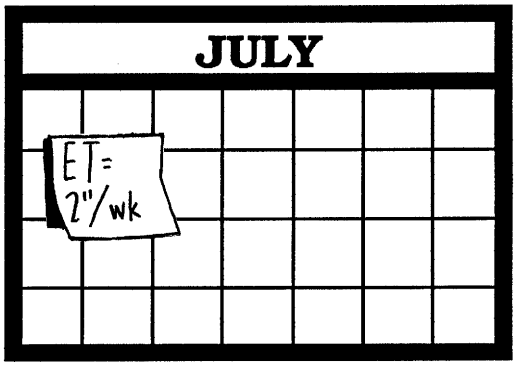
*Evapotranspiration is the amount of water lost through evaporation (E) from the soil and transpiration (T) from the plant. (This formula does not account for irrigation efficiency. If your irrigation system does not distribute water evenly, extra water will need to be applied.)

Example: If the Brown family living in Sacramento produces 160 gallons of graywater per day, how much lawn can be irrigated with that graywater? (160 x 7 days = 1120 gallons per week)

$$LA = \frac{1120}{2 \times .8 \times 0.62}$$

LA = 1129 square feet

Since Sacramento has an ET of 2 inches per week in July (the peak irrigation month in most areas of California), the Brown family can irrigate 1129 square feet of lawn with the available graywater.



If the landscape includes less water thirsty plants, more than twice as much square footage can be irrigated. For specific information about evapotranspiration and estimating landscape water needs, see University of California Leaflet 21493, *Estimating Water Requirements of Landscape Plantings*, and *U.C. Water Use Classification of Landscape Species*. These publications can be obtained through your county cooperative extension office. Also, in the appendix, you will find a list of evapotranspiration rates for the month of July for selected sites in California.

An alternative to considering the square footage of the landscape is to estimate the number of plants that can be irrigated with this 1120 gallons of graywater per week. Here is a look-up chart to help you determine approximately how much water an individual tree or shrub will need for one week during July:

Climate	Relative Water Need of Plant (Plant Factor)	Gallons Per Week		
		200 SQ FT CANOPY	100 SQ FT CANOPY	50 SQ FT CANOPY
Coastal	low water using (0.3)	38	19	10
(ET=1in/wk)	medium water using (0.5)	62	31	16
	high water using (0.8)	100	50	25
Inland	low water using (0.3)	76	38	19
(ET=2in/wk)	medium water using (0.5)	124	62	31
	high water using (0.8)	200	100	50
Desert	low water using (0.3)	114	57	28
(ET=3in/wk)	medium water using (0.5)	186	93	47
	high water using (0.8)	300	150	75

[The gallons per week calculation for this chart was determined with the following formula: Gallons per week = ET x plant factor x area x .62 (conversion factor.)(This formula does not account for irrigation efficiency. If your irrigation system does not distribute water evenly, extra water will need to be applied.)]

Example: The 1120 gallons of graywater per week produced by the Brown family in Sacramento could irrigate:

8 young fruit trees:	8 x 50 = 400 gallons	(high water using, 50 foot canopy)
8 medium-sized shade trees:	8 x 62 = 496	(medium water using, 100 foot canopy)
7 large shrubs:	7 x 31 = 217	(medium water using, 50 foot canopy)
total:	1113 gallons per week	

The number of gallons of water per week a plant needs will vary from season to season, plant to plant, and site to site, but this will give you a general idea about the number of plants you can successfully irrigate in July with your graywater.

Irrigation needs of the landscape may be greater than the total available graywater. So, even if the system includes the shower, tub and clothes washer, some supplemental water would be necessary during the hot summer months. Contrarily, the amount of available graywater may be greater than the amount you can use on the landscape. In that case, you can reduce the number of plumbing fixtures connected to the graywater system.

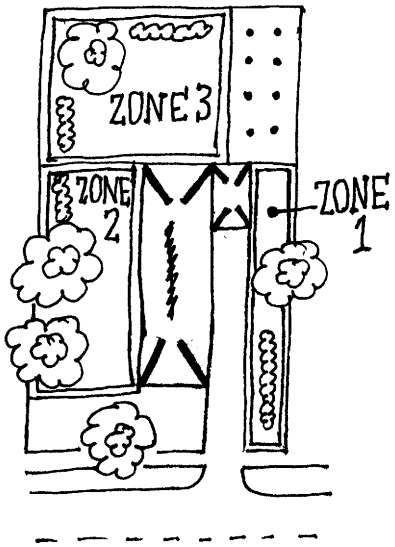
Gather Soil and Ground Water Data

Determine the soil types and ground water level on your property. The local building department will probably provide this information or allow you to use Table J-2 of the Graywater Standards. If this information is not available, consult with the local building department about the approved soil testing method. They may require that you hire a

qualified professional to conduct a percolation test, or may allow you to do it. Usually you would be required to dig test holes in close proximity to any proposed irrigation area and conduct a percolation test. The U.C. Cooperative Extension Office, the county agricultural agent or a local geologist, soil scientist or college instructor will be able to assist with soil type identification and characteristics. The United States Department of Agriculture Soil Conservation Service publishes a Soil Survey of every county which may be helpful for this purpose.

Draw a Plot Plan

A plot plan of your property should be drawn to scale and may be required to include dimensions, lot lines, direction and approximate slope of the surface. The location of retaining walls, drainage channels, water supply lines, wells, paved areas, and structures should be included. If you have a septic tank, show the location of your sewage disposal system and the required 100 percent expansion area. Provide information on the number of bedrooms and which plumbing fixtures will be connected to the proposed graywater system. Finally, indicate the landscape area that you plan to irrigate with graywater.



Determine the Size of the Irrigated Area

Above, you learned how to estimate the amount of landscape you can irrigate based on the graywater produced and the water needs of the plants. Now you need to determine the minimum size of the irrigation field required, based on soil type. With either a subsurface drip or mini-leachfield system, at least two irrigation zones are required and each must irrigate enough area to distribute all the graywater produced daily without surfacing.

For sub-surface drip irrigation systems, Table J-3 of the Graywater Standards is used to determine the number of emitters required. The emitters must be at least 14 inches apart in any direction.

Example: The Brown family produces 160 gallons of graywater per day and irrigates plants in a sandy loam soil. Based on Table J-3, the minimum number of emitters per gallons per day of graywater production is .7 x 160 = 112 emitters. With at least 14 inches between each emitter, the total irrigation area for one zone would be 112 emitters x 14 inches / 12 inches (to get square feet) = 130 square feet. The Browns would need 130 x 2 = 260 square feet for the minimum of two irrigation zones required by the Graywater Standards to safely distribute their graywater without surfacing.

As we discovered earlier, the Browns could irrigate up to 1129 square feet of lawn with 160 gallons of graywater per day. Therefore, they can design their system to irrigate over four times the minimum irrigated area in this case and still maintain a healthy landscape.

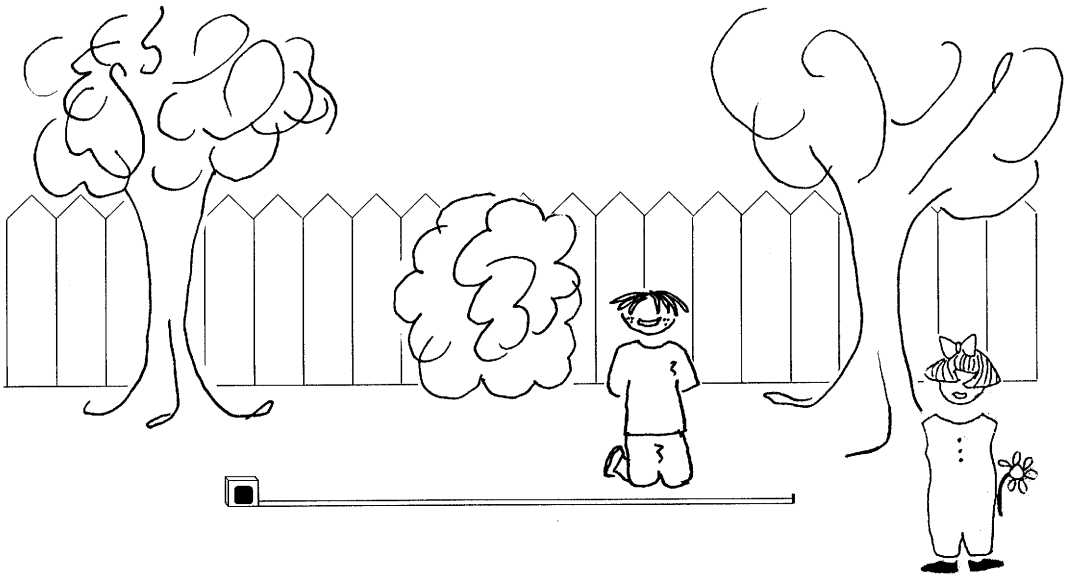
If the mini-leachfield irrigation system is used, the required square footage is determined from Table J-2 of the Graywater Standards.

Example: The Brown family produces 160 gallons of graywater per day and is irrigating a sandy loam soil. Based on Table J-2, the minimum square feet of irrigation area for a mini-leach field system would be 40 square feet per 100 gallons, (160/100=1.6)1.6 x 40 = 64 square feet. The Browns would need two irrigation zones, each 64 square feet in size, a total size of 128 square feet.

The Browns want to install a 100-foot line with a trench that is 8 inches wide to irrigate the 8 fruit trees and 7 large shrubs along the perimeter of their yard. Then, they want to install an 80 foot line with a trench that is 1 foot wide to irrigate 8 mature shade trees. To calculate the area of the mini-leachfield irrigation field, the length of the line as well as the width of the trench must be considered. Therefore, the total area of the irrigation field would be 66 square feet (100 ft. length x .66 ft. width) + 80 square feet (80 ft. length times 1 ft. width) = 146 square feet. Since 146 square feet is greater than the minimum required irrigated area for a mini-leachfield (128 square feet), and since each zone is greater than the required 64 square feet, the Browns meet the minimum irrigated area requirement.

Determine Location of the Graywater System

Once you know the size of the irrigation field, based on the soil and plant needs, you can decide where to put it. Table J-1 in the Graywater Standards establishes distances that the surge tank and irrigation field have to be from various features, such as buildings, septic tanks, and the domestic water line. In addition, your system must be designed so that no irrigation point is within five vertical feet of the highest known seasonal ground water.



3. Design the Graywater System

The next step is to determine the different components of your graywater system and prepare a description of the system itself. Included will be a determination of the irrigated area and details of the graywater system. This construction plan includes a description of the complete installation including methods and materials.

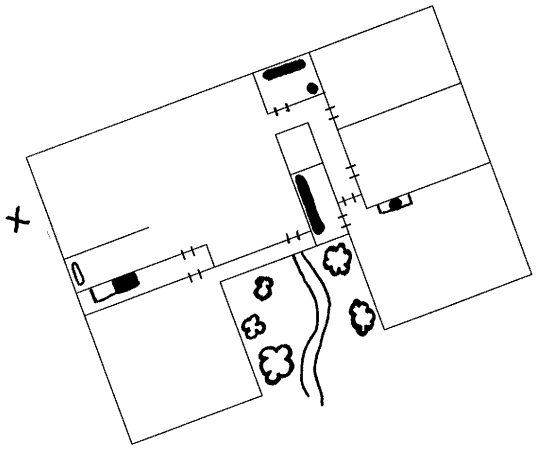
A graywater system usually consists of:

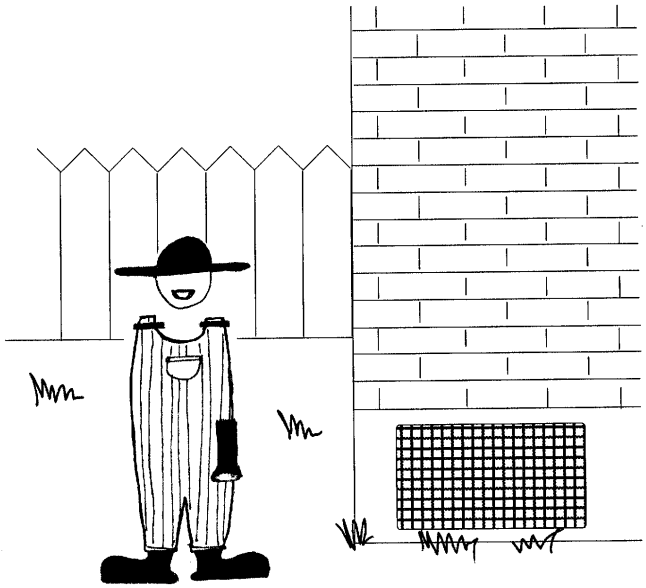
Plumbing System made up of pipes and valves to bring the graywater out of the house
Surge tank to temporarily hold large drain flows from washing machines or bathtubs
Filter to remove particles which could clog the irrigation system
Pump to move the water from the surge tank to the irrigation field
Irrigation System to move the water to the plants

It may be helpful to refer to Figure 1 in the Graywater Standards to get a sense of the overall layout of a graywater system. Then continue reading this section which describes the different parts needed to assemble your system. In your plan, all of the parts of your graywater system must be identified as to the manufacturer.

Plumbing System: Pipes and Valves

The plumbing fixtures which can be used easily in a graywater system depend on the building's foundation. If your home is built on a slab foundation, most drain pipes are buried beneath the concrete slab and the graywater from the bath and shower are unusable without expensive remodeling. However, if your washing machine is located near an outside wall or in the garage, the water is easily usable.



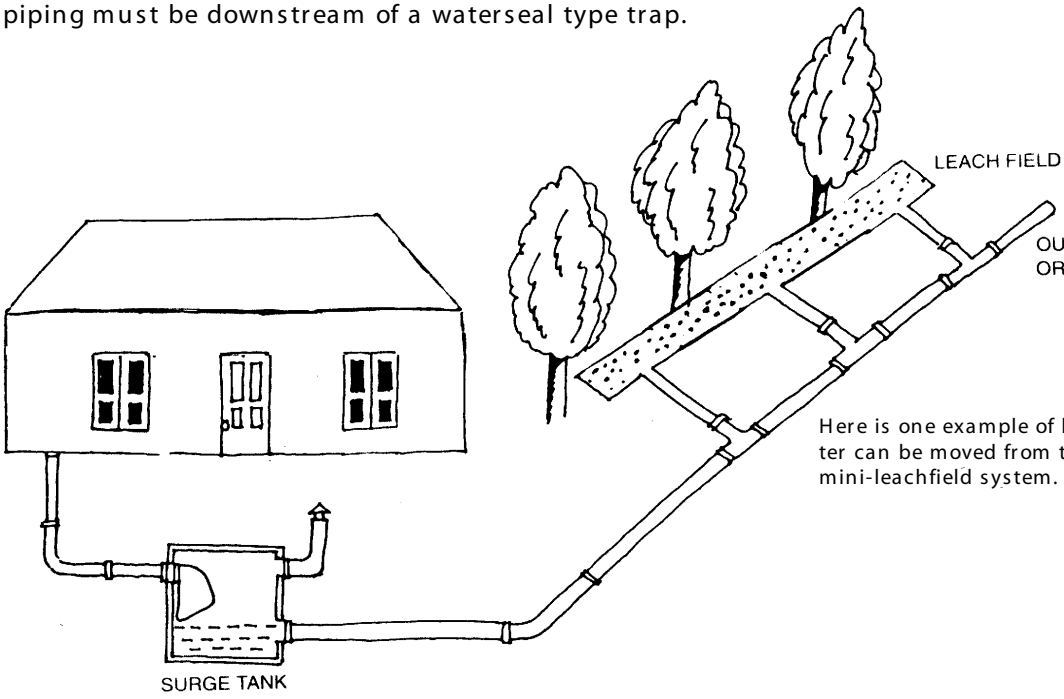


If your home is built on a raised foundation, the drain pipes are generally accessible from the crawl space. Before you enter the crawl space, draw a floor plan of your house, noting the location of the shower, bath, washing machine, and bathroom sinks. Under the house, identify which drain lines serve which fixtures and decide which ones you would like

to include in your system. The more fixtures included in the graywater collection system, the more graywater you will have, but the more plumbing changes you will have to make. If you are remodeling your home, this is a great time to access the plumbing and install a graywater system.

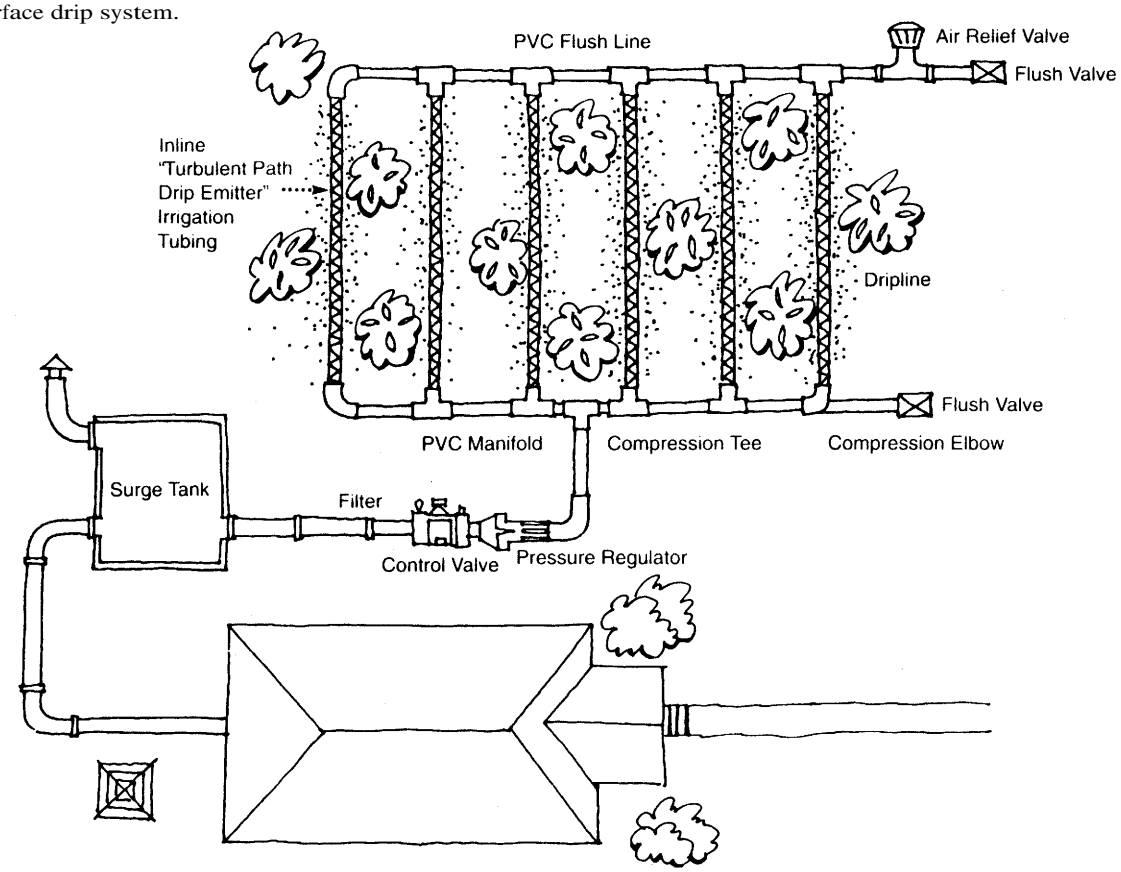
The Graywater Standards require that all graywater piping be marked "Danger-Unsafe Water." This is usually done by wrapping the pipe with purple tape, which is available at most irrigation supply stores. You can install graywater plumbing to a new house for future graywater use even though you are not quite ready to install the irrigation system. This capped off, preliminary plumbing, often referred to as "stub-out plumbing," is allowed in the Graywater Standards as long as it is properly marked.

All valves in the plumbing system must be readily accessible, and backwater valves must be installed on surge tank drain connections to sanitary drains or sewers. Finally, piping must be downstream of a waterseal type trap.



Here is one example of how graywater can be moved from the home to a mini-leachfield system.

This illustration shows a typical hook up from the home to a subsurface drip system.



Surge Tank

Where a graywater pipe exits the home's foundation, it is routed to a surge tank. The tank can be located near the house or, if the line is run underground, nearer the irrigation area. The tank must be solid, durable, watertight when filled, and protected from corrosion. The tank must be vented and have a locking gasketed lid. It must be anchored on dry, level, compacted soil or on a three-inch concrete slab. The capacity of the tank and "GRAYWATER IRRIGATION SYSTEM, DANGER- UNSAFE WATER" must be permanently marked on the tank. The tank drain and overflow gravity drain must be permanently connected to the sewer line or septic tank. The drain and overflow pipes must not be less in diameter than the inlet pipe.

Filter

For subsurface drip irrigation systems, a 140 mesh (115 micron) one inch filter with a capacity of 25 gallons per minute is required. A mesh size of 140 means that a screen has 140 openings per square inch. The size of the openings are 115 microns (a micron is equal to one-thousandth of a millimeter) each, which is equivalent in measure to a 140 mesh.

Pump

If all of the plants you wish to irrigate with graywater are below the building's drain lines, then the graywater system and irrigation lines could use gravity to distribute the water. If any of the plants you wish to irrigate with graywater are higher than the surge tank or the building's drain lines you will need a small, inexpensive pump to lift the water to the plants. A pump will increase the cost of the system slightly .

To pick the right size pump you must know:

1. the 'head' (the total lift measured in feet from the pump to the highest point in the landscape) of your system;
2. the distance from the tank to the furthest point you wish to irrigate; and
3. the maximum discharge rate of all your graywater sources.

For both distance and head, the pump's specifications must show a gallon-per-hour (gph) or gallon-per-minute (gpm) rate. Make sure that the rating is at least 10 gpm at the head you will be using. Try to get a pump that does not need water cooling so that all the water can be pumped out of the tank. Buy a pump that meets or exceeds your needs. Check the manufacturer's specifications.

Irrigation System

The Graywater Standards allow for two kinds of irrigation systems to be used for graywater: sub-surface drip irrigation or mini-leach fields.

Subsurface Drip Irrigation System

Here is a description of the various parts of a subsurface drip irrigation system:

Emitters: The minimum flow path of the emitters is 1200 microns (the holes can be no smaller than 1200 thousandths of a millimeter in size). The coefficient of manufacturing variation (Cv) can be no more than 7 percent. Cv is a method of describing how evenly the emitters apply water at the time they come from the factory. According to the American Society of Agricultural Engineers, good emitters have a Cv of 5 percent or less, average emitters are between 5 and 10 percent, and marginal emitters are between 10 and 15 percent. Emitters must be recommended for subsurface and graywater use and demonstrate resistance to root intrusion.
(To determine the emitter ratings of various products, check with your local building department or order a copy of the Irrigation Equipment Performance Report, *Drip Emitters and Micro-Sprinklers*, from the Center For Irrigation Technology, California State University, 5730 N. Chestnut Ave., Fresno, CA 93740-0018, (209) 278-2066.)

Supply lines: PVC class 200 pipe or better and schedule 40 fittings must be used

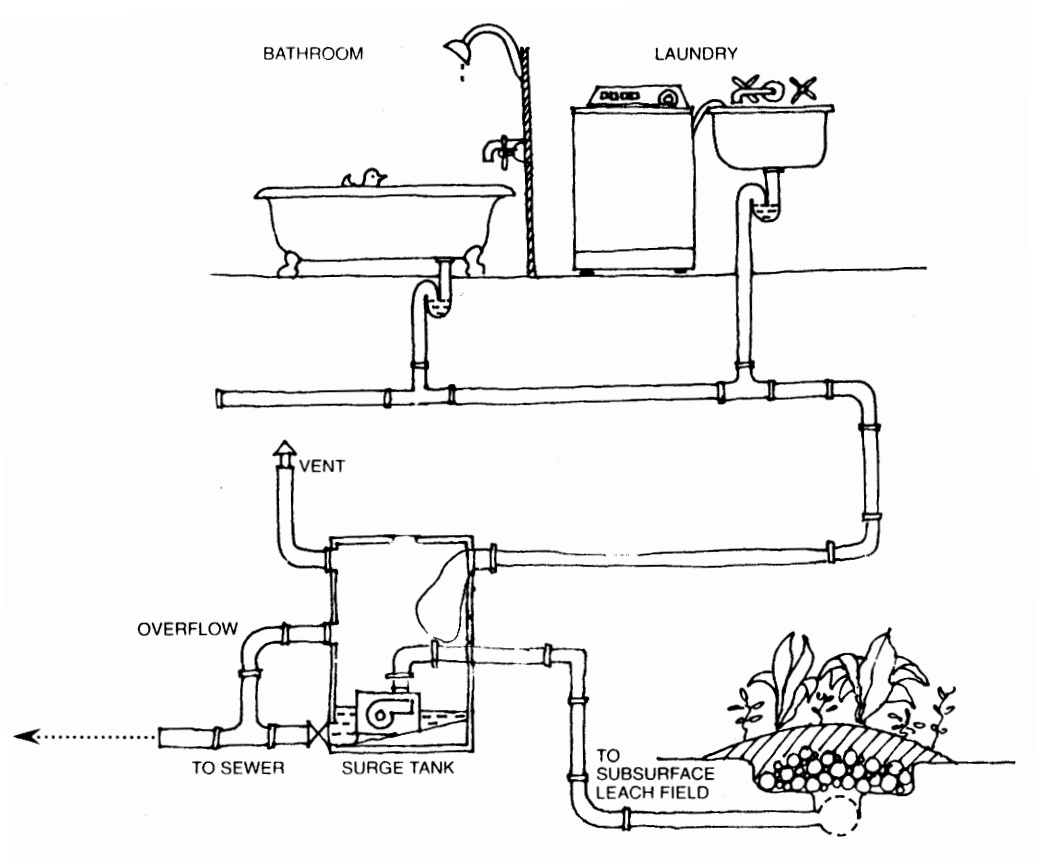
for all supply lines. Joints, when properly glued, will be inspected and pressure tested at 40 psi and must remain drip tight for 5 minutes. All supply lines must be buried at least 8 inches deep.

Drip lines: Poly or flexible PVC tubing shall be used for drip lines which must be buried at least 9 inches deep.

Pressure reducing valve: Where pressure at the discharge side of the pump exceeds 20 pounds per square inch (psi) a pressure reducing valve must be used to maintain pressure no greater than 20 psi downstream from the pump and before any emission device.

Valves, switches, timers, and other controllers: These devices are used, as appropriate, to rotate the distribution of graywater between irrigation zones and to schedule the irrigations.

Automatic flush valve/vacuum breaker: These devices are required to prevent back syphonage of water and soil.

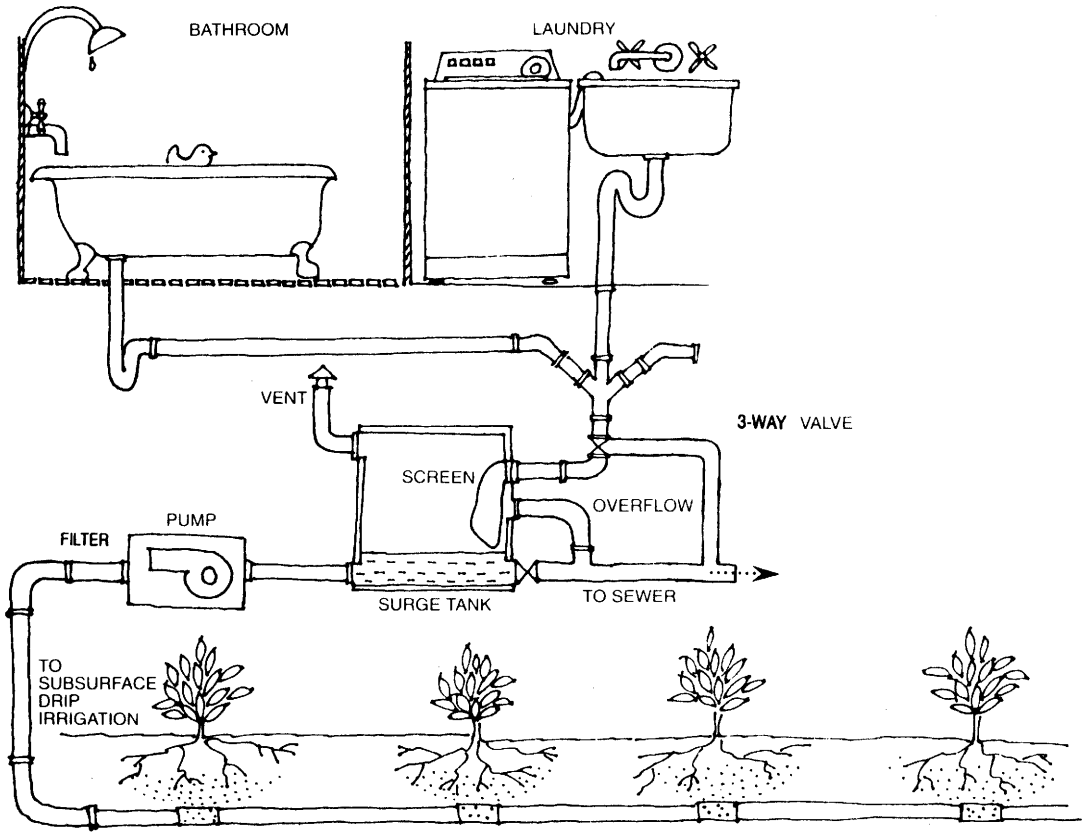


Mini-Leachfield System

The dimension specifications of the mini-leachfield are found in the Graywater Standards, Section J-11 (b) (3). Here is a description of the various parts of a mini-leachfield system:

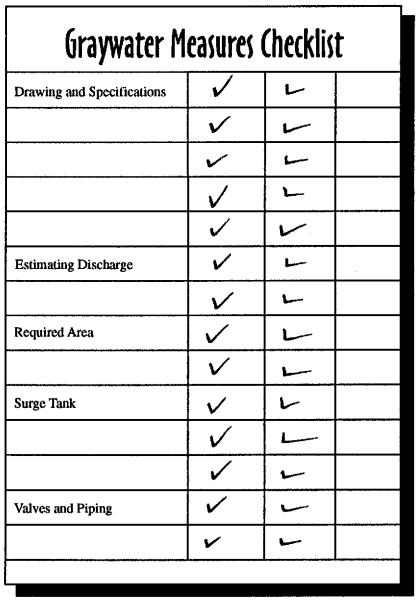
Perforated pipe: The pipes must be a minimum 3-inch diameter, constructed of perforated high density, polyethylene, ABS, or PVC pipe, or other approved material. The maximum length is 100 feet; minimum spacing between lines is 4 feet; and the maximum grade is 3 inches per 100 feet.

Filter material: A clean stone, gravel, or similar material, sized between 3/4 and 2-1/2 inches, must be used. This filter material is then covered with landscape filter fabric or similar porous material before being covered with earth. Do not backfill the trench until after it has been inspected.



4. Submit the Plan for Review and Approval

Once you have completed the application form, plot plan, construction plan, and soil and ground water determinations, submit them to the building department. Staff will review your submittal to insure that you are in compliance with the Graywater Standards. Most likely, they will have a form listing the provisions of the Graywater Standards and will check off each item as they determine it conforms with the regulations. In the Appendix you will find a sample Graywater Measures Checklist on page 31. Once your submittal is approved, you may begin installation of your graywater system. Remember that the building inspector will want to inspect your system before you cover the subsurface drip irrigation lines or backfill the mini-leachfield trenches.



Graywater Measures Checklist			
Drawing and Specifications	✓	✓	
	✓	✓	
	✓	✓	
	✓	✓	
	✓	✓	
Estimating Discharge	✓	✓	
	✓	✓	
Required Area	✓	✓	
	✓	✓	
Surge Tank	✓	✓	
	✓	✓	
	✓	✓	
Valves and Piping	✓	✓	
	✓	✓	

5. Install the System

Purchase the Equipment

Your construction plan includes a description of the materials to be used for the graywater system. This will form the basis of your "shopping list." On the following page is a shopping list for the system the Brown Family plans to install.

In most cases, the plumbing parts, pump and tank can be purchased at your local plumbing supply store. Look in the Yellow Pages under "Plumbing Fixtures, Parts, and Supplies, Retail." The Yellow Pages also has listings for "Pumps-Dealers" and "Tanks-Fiber Glass, Plastic, Etc," or "Tanks-Metal" if your first stop does not have all the parts you need.

"Irrigation Systems and Equipment" is the heading to look under for the components of the subsurface drip irrigation system. The pipes for a mini-leachfield system can be purchased from a plumbing supply store and the gravel filter material can be found at a "Sand and Gravel" company, listed as such in the Yellow Pages.

There are some specialty sign companies that produce the warning labels such as "GRAYWATER IRRIGATION SYSTEM-DANGER-UNSAFE WATER," needed for your graywater system.

Parts and Approximate Costs for the Brown Family Graywater System*

Parts	Approximate Cost ($)	
washing machine hook-up		
connection parts	20	
three-way diverter valve	28	
pipe to sewer	4	
pipe to tank	4	
sanitary tee	3	
shower/bath hook-up		
connection parts	15	
pipe to tank	4	
bends	15	
fittings	15	
vent	13	
Total: Plumbing Parts		**$121**
55 gallon tank with lid	101	
vent	13	
inlet pipe	4	
overflow pipe	4	
drain pipe	4	
backwater valve	4	
water seal type trap	3	
emergency drain ball valve	28	
tank adapters ($20 each, one for each pipe)	60	
union	12	
Total: Tank Parts		**$233**
Total: Pump		**$150**
AND		
Subsurface Drip Irrigation System		
filter 140 mesh one-inch 25 gal/min	25	
pipe: PVC class 200	12	
fittings: schedule 40	15	
drip lines: 112 emitters	46	
valves ($25 each)	50	
automatic flush valve ($2 each)	4	
controller	50	
switches	32	
pressure reducing valve	15	
compression T's	4	
Total: Drip Parts		**$253**
OR		
Mini-leachfield		
solid pipe	50	
perforated pipe: 180 ft.	70	
gravel, 18 in /130'/1' = 7 yds.	70	
landscape filter fabric	40	
Total: Leachfield Parts		**$230**
GRAND TOTAL: DRIP		**$757**
GRAND TOTAL: LEACHFIELD		**$734**

*Cost for permit fees, rental equipment, professional installation, and maintenance not included.

Install the Plumbing System

Modifying drain lines usually requires extensive plumbing knowledge and skills; seeking professional assistance is recommended. This guide does not provide basic plumbing instructions. If you are a do-it-yourselfer, the staff at a retail plumbing store, plumbing books at the library, or friends may be able to provide you with the plumbing information you will need for most of the plumbing work associated with a graywater system.

The drain pipes in homes built before 1970 are generally cast iron, while those built since 1970 will probably be plastic. The tools required to make the necessary plumbing changes will usually include: a hacksaw, tape measure, flashlight, hammer, pipe wrenches (metal pipes only), and screw drivers. An electric drill and a hole saw may be necessary to provide access holes through walls. If you do not have the necessary tools, most rental companies rent these tools inexpensively. Be careful not to connect any part of the graywater system piping to the existing water supply system.

In order to clearly identify graywater pipes, all graywater lines must be continuously marked along the entire length of the pipe with a warning label. Identification of graywater pipes is important to avoid the possibility of cross-connecting graywater pipes with fresh water supply lines. This is for your protection as well as for the protection of future occupants of your home who may be unaware of the exact location of the graywater plumbing and is especially important with graywater pipes that resemble standard freshwater supply pipes.

Install the Subsurface Drip Irrigation System

Once again, this guide provides a brief overview of the installation process, not basic landscape irrigation instructions. You can call the local chapter of the California Landscape Contractor's Association or their state office at (916) 448-2522 for a list of qualified referrals to install subsurface drip irrigation systems.

If you decide to do it yourself, first, gather all the parts you have determined will be needed for your system. There are special tools for digging the trenches for the drip lines, or you can do it with an ordinary shovel. After the trenches are dug, it is recommended that you install the main valve, filter, and pressure regulator first. Next, install of the main PVC lines and finally the drip lines. Once the system is fully installed, test it for leaks. Don't cover the system until it is inspected and approved.

Install the Mini-Leachfield System

To create a mini-leachfield, dig a trench along the dripline (the outer edge of the foliage) and fill it with gravel to within nine inches of the surface. Be sure to cover the gravel with a landscape filter fabric or similar material before filling the trench with soil. If soil is able to infiltrate down into the gravel, the mini-leach field will quickly clog and the water will be forced to the surface.

6. System Inspection and Approval

Once all the plumbing is connected, the tank in place, and the irrigation system in the ground (but uncovered), arrange to have a building inspector come out for the final inspection and approval. The inspector will be checking that the surge tank remains watertight as the tank is filled with water; that all the lines remain watertight during a pressure test; and that the other measures listed on the Graywater Measures Checklist in the appendix meet the Graywater Standards.

7. Using, Monitoring and Maintaining the System

Protect Health

If a member of a household is ill, graywater may carry infectious bacteria or viruses. However, in order for the graywater to make another person ill it would be necessary for that person to drink or otherwise consume the contaminated graywater. As long as a person does not drink the graywater or irrigate vegetables with graywater and then eat them unwashed, graywater is safe.

The Graywater Standards require that graywater not surface and that human contact with graywater be avoided. Graywater systems designed, installed, and maintained in accordance with the standards present minimal risk to public health. The California Department of Health Services participated actively in the development of these standards to insure the protection of public health.

When graywater is used, always follow these rules :

Don't drink or play in graywater.
Don't mix potable (drinking) water with graywater.
Don't allow anything that may be eaten to come into contact with graywater.
Don't allow graywater to pond on the surface or run off the property.

Select Garden-Friendly Soaps

The chemical and biological composition of graywater varies greatly, based on numerous factors, including the original quality of the water coming to your home, the personal habits of the family members, which plumbing fixtures are connected to the system, and the soaps used. Since the type of detergent you select is one major factor that you can control, the use of garden-friendly soaps can contribute significantly to better quality graywater.

Most hand and dish soaps and shampoos will not damage plants at low residential concentrations. Laundry detergents, on the other hand, need to be selected carefully. Sodium and boron are chemicals that can have a negative effect on landscapes. Powdered detergents and soaps include "filler" ingredients (not essential to clothes cleaning) which are usually some compound of sodium. Liquid soaps contain few fillers, thus less sodium.

A few soaps are now being formulated for use with graywater systems. Cleaners and laundry soaps you may wish to **avoid** are:

bleaches or softeners (send graywater to sewer when used)
detergents that advertise whitening, softening and enzymatic powers
detergents with ingredients which include:
  boron, borax, or chlorine, or bleach
  peroxygen or sodium perborate
  petroleum distillate or alkylbenzene
  sodium trypochlorite

Often the labeling on detergents is incomplete. The University of Arizona Office of Arid Lands Studies (with the sponsorship of Tucson Water) tested the composition of many common detergents for sodium, boron, phosphate, alkalinity, and conductivity. High alkalinity often indicates a high level of sodium. Conductivity is the measure of all dissolved salts in the water. The higher the concentration of salts and minerals, the greater the potential for adverse impacts on the soil and plants. Phosphates are good for plant growth, but the detergent form may not always be usable by the plants. The Office of Arid Lands Studies suggests that you select detergents with the lowest levels of alkalinity, conductivity, boron, and sodium. This information is included in the Appendix.

Generally, once people begin to use graywater, they think more carefully about what they put down the drain. Some cleaning products are toxic to plants, people and the environment and should not be used. Products designed to open clogged drains or clean porcelain without scrubbing **must** be sent to the sewer or replaced with alternative products or boiling water and elbow grease.

Also, home water softeners often use a solution that contains high levels of sodium chloride that may have a negative effect on soils. Avoid using softened water as graywater when possible.

Keep Soils Healthy

Sodium, potassium and calcium are alkaline chemicals. Because of the presence of these chemicals in laundry detergent, graywater use tends to raise alkalinity of the soil. Slightly alkaline soils will support many garden plants. Even most acid-soil loving plants will be happy with slightly alkaline soils that are generously amended with organic matter. The pH of an acid soil is 6.9 or lower while that of an alkaline soil is 7.1 or higher. If a simple pH test indicates that the pH reading is over 8.0, the pH should be reduced. This can be accomplished by adding agricultural sulfur or an acidifying fertilizer such as ammonium sulfate.

Problems with water infiltration may be due to a sodium build up in the soil. Soil

analyzed by a soil lab is the only way to verify excess sodium. Depending upon the severity of the problem, you can usually correct it by adding agricultural gypsum and/or organic matter to the soil.

A sandy, well-drained soil will be less affected by the application of graywater than a poorly drained clay soil. Sometimes graywater may degrade the structure of a clay soil by making it stickier and less loamy. The soil's physical condition also may be affected by high sodium. To correct these problems and keep soil healthy, once again, till in organic matter.

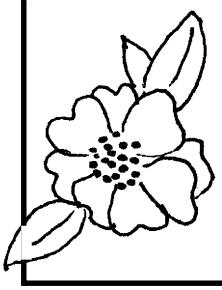
The salts that might build up from the use of graywater will only be a problem if they are not leached away periodically by heavy rains. If winter rains are light, occasionally leach the soil with fresh water.

Grow Healthy Plants

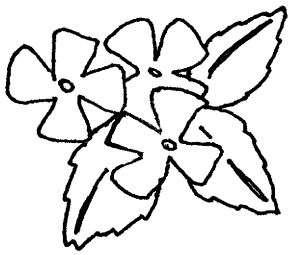
The application of too much water, of any kind, too frequently will result in saturated soils, and an invitation to plant disease. Generally, plants are healthier when the soil is allowed to dry out between irrigations.

A very small percentage of plants may be damaged by graywater, most of these are listed below. Too much sodium or chlorine could result in leaf burn, chlorosis (yellow leaves), and twig die back. Boron can be toxic to plants at levels only slightly greater than is required for good plant growth. Symptoms of boron toxicity include leaf tip and margin burn, leaf cupping, chlorosis, branch die back, premature leaf drop, and reduced growth.

Shade loving and acid loving plants do not like graywater. Their native habitats are forested areas where acid soils predominate. Here are some plants that are not suitable for the alkaline conditions often associated with graywater irrigation:

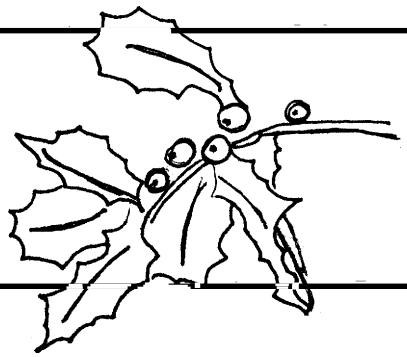


- Rhododendrons
- Bleeding Hearts
- Oxalis (Wood Sorrel)
- Hydrangeas
- Azaleas
- Violets
- Impatiens
- Begonias
- Ferns
- Foxgloves
- Gardenias
- Philodendrons
- Camellias
- Primroses



Other plants that are especially susceptible to high sodium, and chloride which may be present in graywater are:

- Crape Myrtle
- Redwoods
- Star Jasmine
- Holly
- Deodar Cedar



Plants that would probably do well with graywater irrigation are:

Oleander	Italian Stone l
Bougainvillea	Purple Hopsec
Fan & Date Palms	Oaks
Rose	Arizona Cypre
Rosemary	Cottonwood
Agapanthus	Olive
Bermuda Grass	Ice Plant
Honeysuckle	many native p
Australian Tea Tree	Juniper

Monitor and Maintain the System

If you have someone else install your graywater system, the installer will provide an operation and maintenance manual. That person will recommend such practices as checking the pump, filters, main lines, and other lines to keep your system in top condition.

It is important to check your system on a regular basis, every week or so, to see that graywater is not surfacing, that the plants and soils are healthy, and that the equipment is working properly.

The pump is an important part of the graywater system. Read the pump's instruction guide carefully. Adjust the pump's float switch to turn on as early as possible to avoid an overflowing tank. Be sure to connect the grounded, three-pronged cord supplied with the pump to an approved Ground Fault Intercept outlet. The pump runs off standard house current, so special wiring is not necessary.

A pump should not be run without a check-valve, which is installed between the pump and the first irrigation point. The check-valve allows water to pass in only one direction--toward the landscape, and not back into the tank. Without a check-valve, water draining back into the tank would activate the pump and the pump would run continuously.

The main concern people have with drip irrigation systems is the possible clogging of the emitters, preventing the flow of water to the plants. With properly selected and maintained filtration and occasional flushing of the subsurface drip irrigation system, most problems with emitter clogging can be avoided. If clogging does occur, simple chemical solutions can be used to clear the emitters.

The 3-way diverter valve (or washing machine "Y" valve) which was installed as part of the graywater system allows the graywater to be sent back to the sewer/septic line when rain has saturated the soil. Turning the graywater system off during the rainy season will help keep the soil healthy because the rain will leach away any soap buildup. The diverter valve is also employed to send water with caustic cleaners or strong bleaches to the sewer/septic line.

Appendix

APPENDIX J

Graywater Systems for Single-family Dwellings

J 1 Graywater Systems (General)

(a) The provisions of this Appendix shall apply to the construction, alteration and repair of graywater systems for subsurface landscape irrigation. Installations shall be allowed only in single-family dwellings. The system shall have no connection to any potable water system and shall not result in any surfacing of the graywater. Except as otherwise provided for in this Appendix, the provisions of the Uniform Plumbing Code *(U.P.C.) shall be applicable to graywater installations.*

(b) The type of system shall be determined on the basis of location, soil type and ground water level and shall be designed to accept all graywater connected to the system from the residential building. The system shall discharge into subsurface irrigation fields and may include surge tank(s) and appurtenances, as required by the Administrative Authority.

(c) No graywater system, or part thereof, shall be located on any lot other than the lot which is the site of the building or structure which discharges the graywater; nor shall any graywater system or part thereof be located at any point having less than the minimum distances indicated in Table J-1.

(d) No permit for any graywater system shall be issued until a plot plan with appropriate data satisfactory to the Administrative Authority has been submitted and approved. When there is insufficient lot area or inappropriate soil conditions for adequate absorption of the graywater, as determined by the Administrative Authority, no graywater system shall be permitted. The Administrative Authority is a city or county.

(e) No permit shall be issued for a graywater system which would adversely impact a geologically sensitive area, as determined by the Administrative Authority.

(f) Private sewage disposal systems existing or to be constructed on the premises shall comply with Appendix I of this Code or applicable local ordinance. When abandoning underground tanks, Section 1119 of the U.P.C. shall apply. Also, appropriate clearances from graywater systems shall be maintained as provided in Table J-1. The capacity of the private sewage disposal system, including required future areas, shall not be decreased by the existence or proposed installation of a graywater system servicing the premises.

(g) Installers of graywater systems shall provide an operation and maintenance manual, acceptable to the Administrative Authority, to the owner of each system. Graywater systems require regular or periodic maintenance.

(h) The Administrative Authority shall provide the applicant a copy of this Appendix.

J 2 Definitions

Graywater is untreated household waste water which has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. It shall not include waste water from kitchen sinks, dishwashers or laundry water from soiled diapers.

Surfacing of graywater means the ponding, running off or other release of graywater from the land surface.

J 3 Permit

It shall be unlawful for any person to construct, install or alter, or cause to be constructed, installed or altered, any graywater system in a building or on a premises without first obtaining a permit to do such work from the Administrative Authority.

J 4 Drawings and Specifications

The Administrative Authority may require any or all of the following information to be included with or in the plot plan before a permit is issued for a graywater system:

(a) Plot plan drawn to scale completely dimensioned, showing lot lines and structures, direction and approximate slope of surface, location of all present or proposed retaining walls, drainage channels, water supply lines, wells, paved areas and structures on the plot, number of bedrooms and plumbing fixtures in each structure, location of private sewage disposal system and 100 percent expansion area or building sewer connecting to public sewer, and location of the proposed graywater system.

(b) Details of construction necessary to ensure compliance with the requirements of this Appendix together with a full description of the complete installation, including installation methods, construction and materials as required by the Administrative Authority.

(c) A log of soil formations and ground water level as determined by test holes dug in close proximity to any proposed irrigation area, together with a statement of water absorption characteristics of the soil at the proposed site as determined by approved percolation tests. In lieu of

percolation tests, the Administrative Authority may allow the use of Table J-2, an infiltration rate designated by the Administrative Authority, or an infiltration rate determined by a test approved by the Administrative Authority.

J 5 Inspection and Testing

(a) Inspection

(1) All applicable provisions of this Appendix and of Section 318 of the U.P.C. shall be complied with.

(2) System components shall be properly identified as to manufacturer.

(3) Surge tanks shall be installed on dry, level, well-compacted soil if in a drywell, or on a level, 3-inch concrete slab or equivalent, if above ground.

(4) Surge tanks shall be anchored against overturning.

(5) If the irrigation design is predicated on soil tests, the irrigation field shall be installed at the same location and depth as the tested area.

(6) Installation shall conform with the equipment and installation methods identified in the approved plans.

(7) Graywater stub-out plumbing may be allowed for future connection prior to the installation of irrigation lines and landscaping. Stub-out shall be permanently marked GRAYWATER STUB-OUT, DANGER—UNSAFE WATER.

(b) Testing

(1) Surge tanks shall be filled with water to the overflow line prior to and during inspection. All seams and joints shall be left exposed and the tank shall remain watertight.

(2) A flow test shall be performed through the system to the point of graywater irrigation. All lines and components shall be watertight.

J 6 Procedure for Estimating Graywater Discharge

The Administrative Authority may utilize the graywater discharge procedure listed below, water use records, or calculations of local daily per person interior water use:

(a) The number of occupants of each dwelling unit shall be calculated as follows:

First bedroom	*2 occupants*
Each additional bedroom	*1 occupant*

(b) The estimated graywater flows for each occupant shall be calculated as follows:

Showers, bathtubs and wash basins	*25 GPD/occupant*
Laundry	*15 GPD/occupant*

(c) The total number of occupants shall be multiplied by the applicable estimated graywater discharge as provided above and the type of fixtures connected to the graywater system.

J 7 Required Area of Subsurface Irrigation

Each irrigation zone shall have a minimum effective irrigation area for the type of soil and infiltration rate to distribute all graywater produced daily, pursuant to Section J-6, without surfacing. The required irrigation area shall be based on the estimated graywater discharge, pursuant to Section J-6 of this Appendix, size of surge tank, or a method determined by the Administrative Authority. Each proposed graywater system shall include at least two irrigation zones and each irrigation zone shall be in compliance with the provisions of this Section.

If the mini-leachfield irrigation system is used, the required square footage shall be determined from Table J-2, or equivalent, for the type of soil found in the excavation. The area of the irrigation field shall be equal to the aggregate length of the perforated pipe sections within the irrigation zone times the width of the proposed mini-leachfield trench.

No irrigation point shall be within 5 vertical feet of highest known seasonal groundwater nor where graywater may contaminate the ground water or ocean water. The applicant shall supply evidence of ground water depth to the satisfaction of the Administrative Authority.

J 8 Determination of Irrigation Capacity

(a) In order to determine the absorption quantities of questionable soils other than those listed in Table J-2, the proposed site may be subjected to percolation tests acceptable to the Administrative Authority or determined by the Administrative Authority.

(b) When a percolation test is required, no mini-leachfield system or subsurface drip irrigation system shall be permitted if the test shows the absorption capacity of the soil is less than 60 minutes/inch or more rapid than five minutes/inch, unless otherwise permitted by the Administrative Authority.

(c) The irrigation field size may be computed from Table J-2, or determined by the Administrative Authority or a designee of the Administrative Authority.

J 9 Surge Tank Construction (Figures 1, 2, 3 and 4)

(a) Plans for surge tanks shall be submitted to the Administrative Authority for approval. The plans shall show the data required by the Administrative Authority and may include dimensions, structural calculations, and bracing details.

(b) Surge tanks shall be constructed of solid, durable materials, not subject to excessive corrosion or decay, and shall be watertight.

(c) Surge tanks shall be vented as required by Chapter 5 of this Code and shall have a locking, gasketed access opening, or approved equivalent, to allow for inspection and cleaning.

(d) Surge tanks shall have the rated capacity permanently marked on the unit. In addition, GRAYWATER IRRIGATION SYSTEM, DANGER—UNSAFE WATER shall be permanently marked on the surge tank.

(e) Surge tanks installed above ground shall have a drain and overflow, separate from the line connecting the tank with the irrigation fields. The drain and overflow shall have a permanent connection to a sewer or to a septic tank, and shall be protected against sewer line backflow by a backwater valve. The overflow shall not be equipped with a shut-off valve.

(f) The overflow and drain pipes shall not be less in diameter than the inlet pipe. The vent size shall be based on the total graywater fixture units, as outlined in U.P.C. Table 4-3 or local equivalent. Unions or equally effective fittings shall be provided for all piping connected to the surge tank.

(g) Surge tanks shall be structurally designed to withstand anticipated loads. Surge tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot when the tank is designed for underground installation.

(h) Surge tanks may be installed below ground in a dry well on compacted soil, or buried if the tank design is approved by the Administrative Authority. The system shall be designed so that the tank overflow will gravity drain to a sanitary sewer line or septic tank. The tank must be protected against sewer line backflow by a backwater valve.

(i) Materials

(1) Surge tanks shall meet nationally recognized standards for nonpotable water and shall be approved by the Administrative Authority.

(2) Steel surge tanks shall be protected from corrosion, both externally and internally, by an approved coating or by other acceptable means.

J 10 Valves and Piping (Figures 1, 2, 3 and 4)

Graywater piping discharging into a surge tank or having a direct connection to a sanitary drain or sewer piping shall be downstream of an approved waterseal-type trap(s). If no such trap(s) exists, an approved vented running trap shall be installed upstream of the connection to protect the building from any possible waste or sewer gases. All graywater piping shall be marked or shall have a continuous tape marked with the words DANGER—UNSAFE WATER. All valves, including the three-way valve, shall be readily accessible and shall be approved by the Administrative Authority. A backwater valve, installed pursuant to this Code, shall be provided on all surge tank drain connections to the sanitary drain or sewer piping.

J 11 Irrigation Field Construction

The Administrative Authority may permit subsurface drip irrigation, mini-leachfield or other equivalent irrigation methods which discharge graywater in a manner which ensures that the graywater does not surface. Design standards for subsurface drip irrigation systems and mini-leachfield irrigation systems follow:

(a) Standards for a subsurface drip irrigation system are:

(1) Minimum 140 mesh (115 micron) 1-inch filter with a capacity of 25 gallons per minute, or equivalent, filtration shall be used. The filter backwash and flush discharge shall be caught, contained and disposed of to the sewer system, septic tank or, with approval of the Administrative Authority, a separate mini-leachfield sized to accept all the backwash and flush discharge water. Filter backwash water and flush water shall not be used for any purpose. Sanitary procedures shall be followed when handling filter backwash and flush discharge or graywater.

(2) Emitters shall have a minimum flow path of 1,200 microns and shall have a coefficient of manufacturing variation (Cv) of no more than 7 percent. Irrigation system design shall be such that emitter flow variation shall not exceed ± 10 percent. Emitters shall be recommended by the manufacturer for subsurface use and graywater use, and shall have demonstrated resistance to root intrusion. For emitter ratings, refer to Irrigation Equipment Performance Report, Drip Emitters and Micro-Sprinklers, Center for Irrigation Technolo-

gy, California State University, 5730 N. Chestnut Avenue, Fresno, California 93740-0018.

(3) Each irrigation zone shall be designed to include no less than the number of emitters specified in Table J-3, or through a procedure designated by the Administrative Authority. Minimum spacing between emitters is 14 inches in any direction.

(4) The system design shall provide user controls, such as valves, switches, timers and other controllers, as appropriate, to rotate the distribution of graywater between irrigation zones.

(5) All drip irrigation supply lines shall be PVC Class 200 pipe or better and Schedule 40 fittings. All joints shall be properly glued, inspected and pressure tested at 40 psi, and shown to be drip tight for five minutes, before burial. All supply lines will be buried at least 8 inches deep. Drip feeder lines can be poly or flexible PVC tubing and shall be covered to a minimum depth of 9 inches.

(6) Where pressure at the discharge side of the pump exceeds 20 psi, a pressure-reducing valve able to maintain downstream pressure no greater than 20 psi shall be installed downstream from the pump and before any emission device.

(7) Each irrigation zone shall include an automatic flush valve/vacuum breaker to prevent back siphonage of water and soil.

(b) Standards for the mini-leachfield system are (Figure 5):

(1) Perforated sections shall be a minimum 3-inch diameter and shall be constructed of perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that sufficient openings are available for distribution of the graywater into the trench area. Material, construction and perforation of the piping shall be in compliance with the appropriate absorption field drainage piping standards and shall be approved by the Administrative Authority.

(2) Clean stone, gravel or similar filter material acceptable to the Administrative Authority, and varying in size between $^3/_4$ inch to $2^1/_2$ inches shall be placed in the trench to the depth and grade required by this Section. Perforated sections shall be laid on the filter material in an approved manner. The perforated sections shall then be covered with filter material to the minimum depth required by this Section. The filter material shall then be covered with landscape filter fabric or similar porous material to prevent closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspections and acceptance.

(3) Irrigation fields shall be constructed as follows:

	Minimum	Maximum
Number of drain lines per irrigation zone	1	—
Length of each perforated line	—	100 feet
Bottom width of trench	6 inches	18 inches
Total depth of trench	17 inches	18 inches
Spacing of lines, center to center	4 feet	—
Depth of earth cover of lines	9 inches	—
Depth of filter material cover of lines	2 inches	—
Depth of filter material beneath lines	3 inches	—
Grade of perforated lines	level	3 inches/100 feet

J 12 Special Provisions

(a) Other collection and distribution systems may be approved by the Administrative Authority as allowed by Section 201 of the U.P.C.

(b) Nothing contained in this Appendix shall be construed to prevent the Administrative Authority from requiring compliance with stricter requirements than those contained herein, where such stricter requirements are essential in maintaining safe and sanitary conditions or from prohibiting graywater systems.

J 13 Health and Safety

(a) Graywater may contain fecal matter as a result of bathing and/or washing of diapers and undergarments. Water containing fecal matter, if swallowed, can cause illness in a susceptible person.

(b) Graywater shall not include laundry water from soiled diapers.

(c) Graywater shall not be applied above the land surface or allowed to surface and shall not be discharged directly into or reach any storm sewer system or any water of the United States.

(d) Graywater shall be not be contacted by humans, except as required to maintain the graywater treatment and distribution system.

(e) Graywater shall not be used for vegetable gardens.

Table J-1 Location of Graywater System

Minimum Horizontal Distance From	Surge Tank (feet)	Irrigation Field (feet)
Buildings or structures[1]	5[2]	8[3]
Property line adjoining private property	5	5
Water supply wells[4]	50	100
Streams and lakes[4]	50	50
Seepage pits or cesspools	5	5
Disposal field and 100 percent expansion area	5	4[5]
Septic tank	0	5[6]
On-site domestic water service line	5	5[7]
Pressure public water main	10	10[8]
Water ditches	50	50

NOTES: When mini-leach fields are installed in sloping ground, the minimum horizontal distance between any part of the distribution system and ground surface shall be 15 feet.

[1]Including porches and steps, whether covered or uncovered, but does not include carports, covered walks, driveways and similar structures.

[2]The distance may be reduced to 0 feet for aboveground tanks if approved by the Administrative Authority.

[3]The distance may be reduced to 2 feet, with a water barrier, by the Administrative Authority, upon consideration of the soil expansion index.

[4]Where special hazards are involved, the distance may be increased by the Administrative Authority.

[5]Applies to the mini-leachfield type system only. Plus 2 feet for each additional foot of depth in excess of 1 foot below the bottom of the drain line.

[6]Applies to mini-leachfield-type system only.

[7]A 2-foot separation is required for subsurface drip systems.

[8]For parallel construction or for crossings, approval by the Administrative Authority shall be required.

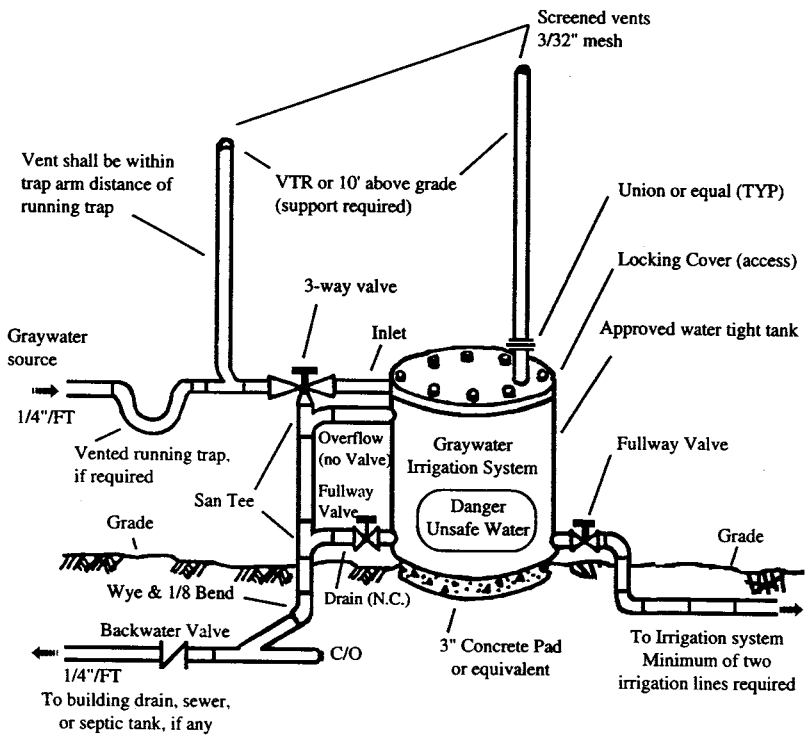
Table J-2 Mini-Leachfield Design Criteria of Six Typical Soils

Type of Soil	Minimum sq. ft. of irrigation area per 100 gallons of estimated graywater discharge per day	Maximum absorption capacity, minutes per inch, of irrigation area for a 24-hour period
1. Coarse sand or gravel	20	5
2. Fine sand	25	12
3. Sandy loam	40	18
4. Sandy clay	60	24
5. Clay with considerable sand or gravel	90	48
6. Clay with small amount of sand or gravel	120	60

Table J-3 Subsurface Drip Design Criteria of Six Typical Soils

Type of Soil	Maximum emitter discharge (gal/day)	Minimum number of emitters per gpd of graywater production
1. Sand	1.8	0.6
2. Sandy loam	1.4	0.7
3. Loam	1.2	0.9
4. Clay loam	0.9	1.1
5. Silty clay	0.6	1.6
6. Clay	0.5	2.0

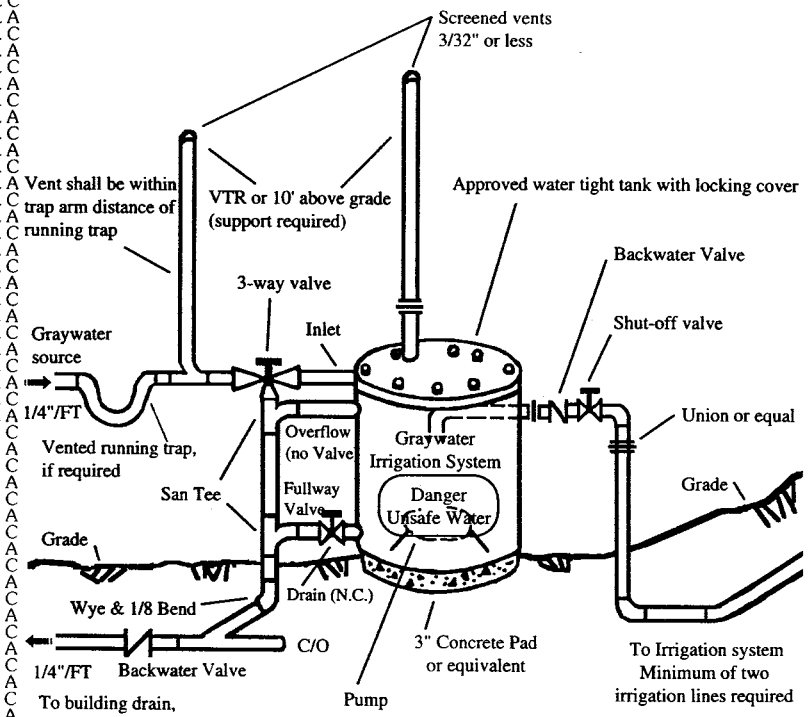
Use the daily graywater flow calculated in Section J-6 to determine the number of emitters per line.



Abbreviations

C/O	Cleanout
N.C.	Normally Closed
VTR	Vent Thru Roof

Figure 1—Graywater System Single Tank—Gravity (conceptual)



Abbreviations

C/O	Cleanout
N.C.	Normally Closed
VTR	Vent Thru Roof

Figure 2—Graywater System Single Tank—Pumped (conceptual)

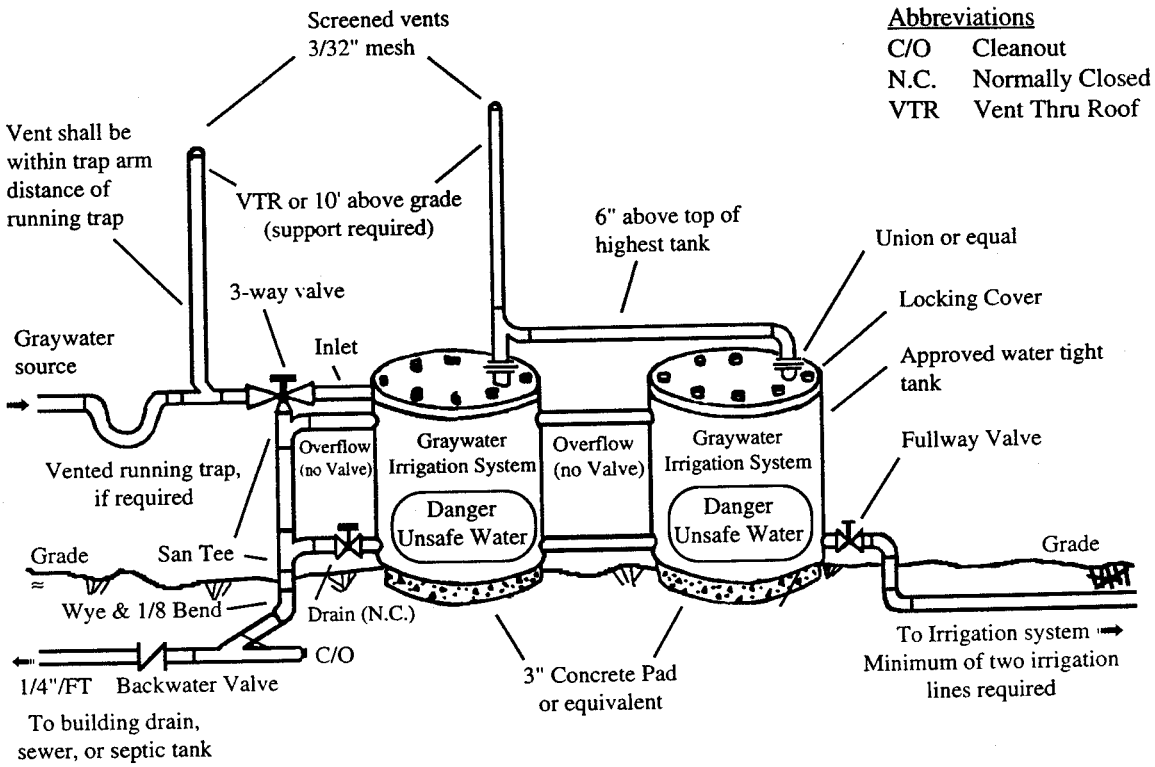


Figure 3—Graywater System Multiple Tank (conceptual)

FIGURE 3

224.13

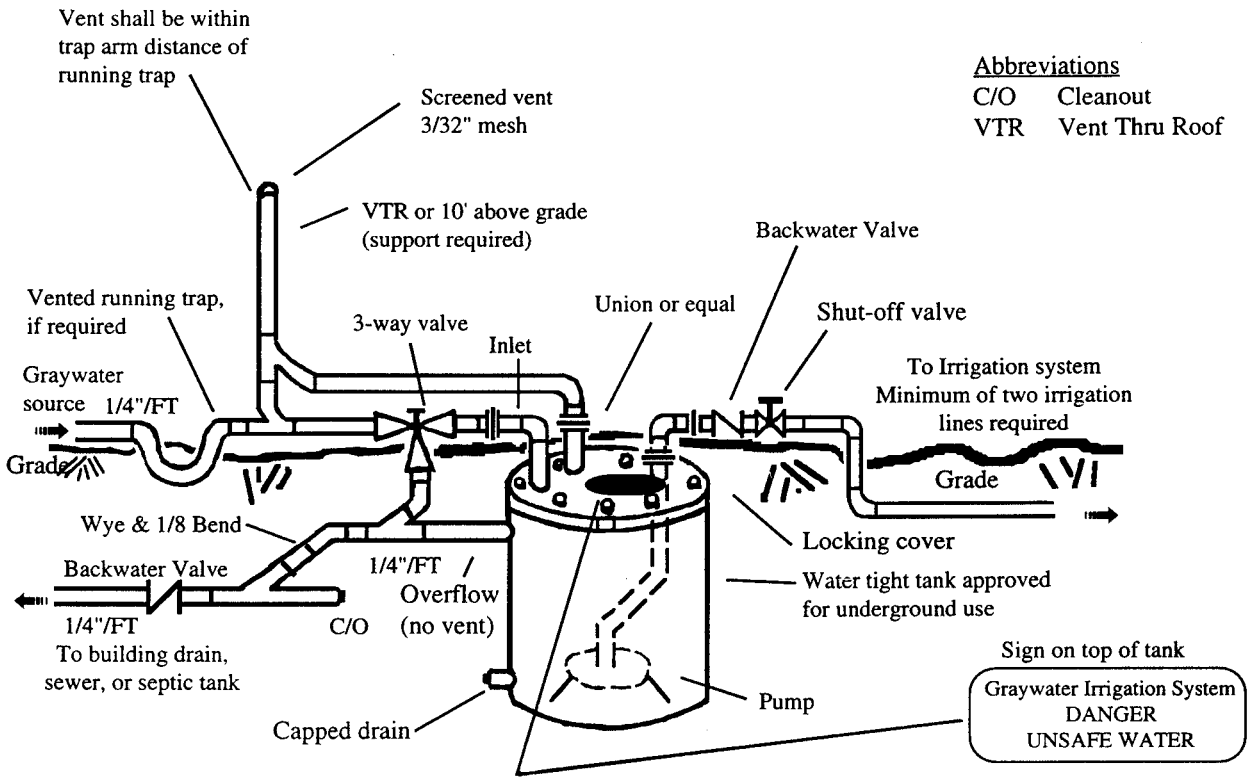


Figure 4—Graywater System Underground Tank (conceptual)

FIGURE 4

224.14

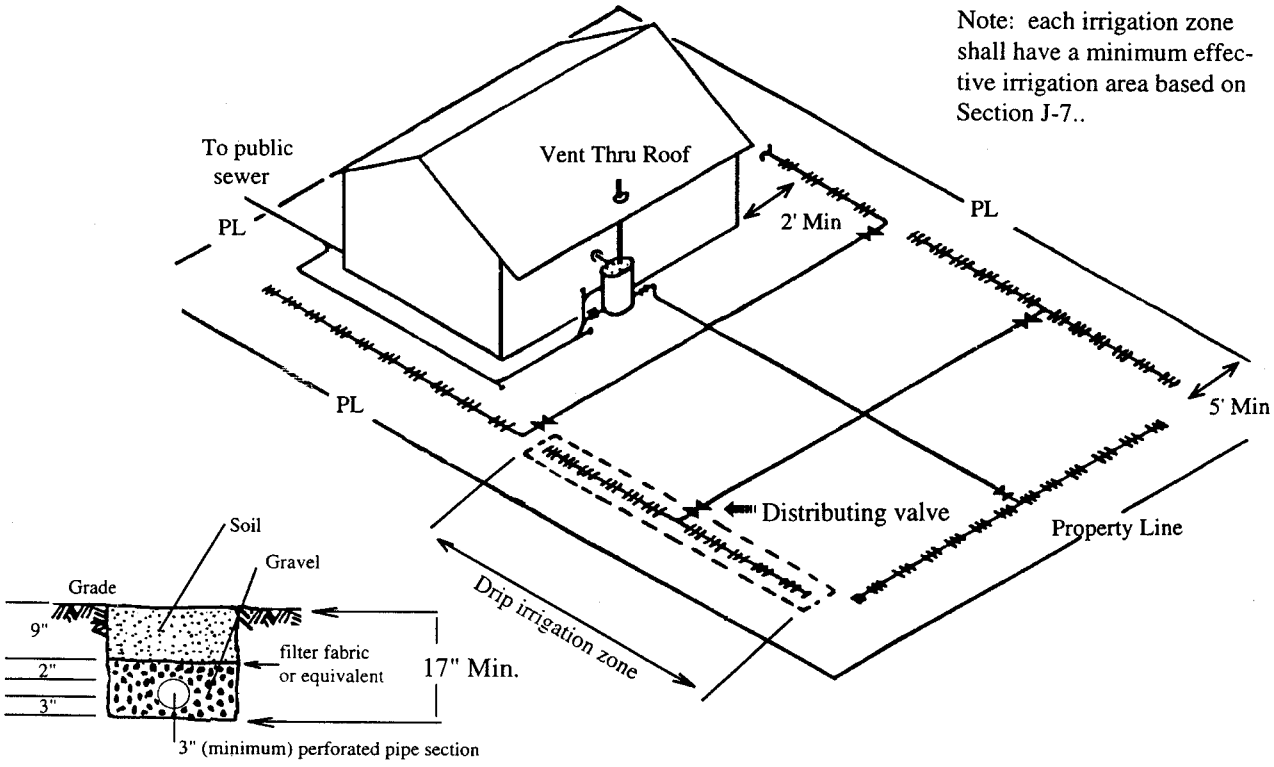


Figure 5—Graywater System Irrigation Layout (conceptual)

Graywater Measures Checklist

Description	Designer	Plan Checker	Inspector
Drawings and Specifications (J-4)			
(J-4, a) plot plan drawn to scale showing:			
lot lines and structure			
direction and approximate slope of surface			
location of retaining walls, drainage channels, water supply lines, wells			
location of paved areas and structures			
location of sewage disposal system and 100% expansion area			
location of graywater system (Table J-1 lists required distances)			
number of bedrooms and plumbing fixtures			
(J-4, b) details of contruction: installation, construction, and materials			
(J-4, c) log of soil formations, ground water level, water absorption of soil			
(J-7) no irrigation point within 5 ft. of highest known seasonal groundwater			
Estimating Graywater Discharge (J-6)			
bedroom #1 (2 occupants)			
additional bedrooms (1 occupant)			
showers, tubs, wash basins: 25 GPD/occupant			
laundry: 15 GPD/occupant			
Required Area (J-7)			
at least two irrigation zones			
each zone to distribute all graywater produced daily without surfacing			
meets Table J-2 design criteria of mini-leachfield OR			
meets Table J-2 design criteria for subsurface drip systems			
Surge Tanks (J-9)			
solid, durable material, watertight when filled, protected from corrosion			
(J-5, a) anchored on dry, level, compacted soil or 3 inch concrete slab			
meets standards for non-potable water			
vented with locking gasketed access opening			
capacity permanently marked on tank			
"GRAYWATER IRRIGATION SYSTEM, DANGER-UNSAFE WATER" permanently marked on tank			
drain and overflow permanently connected to sewer or septic tank			
Valves and Piping (J-10)			
piping downstream of waterseal type trap			
piping marked "DANGER-UNSAFE WATER"			
all valves readily accessible			
backwater valves on all surge tank drain connections to sanitary drain or sewer			
(J-5, a) stub-out plumbing permanently marked			

Graywater Measures Checklist

Description	Designer	Plan Checker	Inspector
Subsurface drip irrigation systems (J-11, a)			
minimu m 140 mesh (115 micron) one inch filter, with a 25 gpm capacity			
filter back-wash to the sewer system or septic tank			
emitter flow path of 1200 microns			
cv no more than 7%, flow variation no more than 10%			
emitters resistant to root intrusion (see CIT list)			
number of emitters determined from Table J-3, minimum spacing 14 inches			
supply lines of PVC class 200 pipe or better and schedule 40 fittings, when			
pressure tested at 40 psi, drip-tight for 5 minutes			
supply lines 8 inches deep, feeder lines (poly or flexible PVC) 9 inches deep			
downstream pressure does not exceed 20 psi (pounds per square inch)			
each irrigation zone has automatic flush valve/vacuum breaker			
Mini-leachfield systems (J-11, b)			
perforated lines minimum 3 inches diameter			
high density polyethylene pipe, perforated ABS pipe, or perforated PVC pipe			
maximum length of perofrated line- 100 feet			
maximum grade- 3 inches/100 feet			
minimum spacing- 4 feet			
earth cover of lines at least 9 inches			
clean stone or gravel filter material from 3/4 to 2 1/2 inch size in trench 3 inch			
deep beneath lines and 2 inches above			
filter fabric covers filter material			
Inspection (J-5, a)			
system components identified as to manufacturer			
irrigation field installed at same location as soil test, if required			
installation conforms with approved plans			
Testing (J-5, b)			
surge tank remains watertight as tank is filled with water			
flow test shows all lines and componints remain watertight			

What Can I Irrigate?

Greywater can be used to irrigate fruit trees, groundcovers and ornamental trees and shrubs. Salt-tolerant plants such as oleander, bermuda grass, date palms, and native desert plants are well-suited to irrigation with greywater. Avoid using greywater on plants that prefer acid conditions, such as:

Ash	Foxglove	Philodendron	Hydrangea	Camellia
Azalea	Gardenia	Primrose	Oxalis	Xylosma
Begonia	Hibiscus	Rhododendron	Violet	Fern
Dicentra	Impatiens			

Sandy soils are less vulnerable to damage than clay soils because they drain better. In very low rainfall areas, apply fresh water occasionally to leach out accumulated salts. Be aware that some harmful effects are not always visible immediately and may take one or two years to appear. In any case, you should always pay attention to the health of the plants being irrigated and discontinue using greywater if signs of stress are observed.

About The Study

All the detergents and related clothes-washing products were purchased in Tucson during May, 1992. The amounts used were based on the manufacturers' recommended levels for a cool- to warm-water wash in a top-loading machine. Distilled water was used as a source to minimize the effect of widely-varying salt and mineral levels in tap water. The list is presented in alphabetical order and is intended as a basis for comparison only. No endorsement of any product is intended.

This study was based in part on research conducted by the Pima County Extension Service, and was prepared by the Office of Arid Lands Studies, in cooperation with the Soil, Water and Plant Analysis Laboratory, University of Arizona, and sponsored by Tucson Water.

For more information...

on legal requirements to operate a greywater system,
contact Pima County Department of Environmental Quality at **740-3340**
or Arizona Dept. of Environmental Quality in Tucson at **628-6733**
or call **1-800-234-5677, ext. 4667.**

on greywater systems or water conservation, call Tucson Water at **791-4331.**

tucson water

City of Tucson TDD number (Telecommunication Device for the Deaf) **791-2639**

GREYWATER AND YOUR DETERGENT

This pamphlet is intended for those conservation-minded people who would like to use washing machine water (greywater) to irrigate their landscapes. **However, the use of greywater and operation of greywater systems are carefully regulated by the Pima County Department of Environmental Quality and the Arizona Department of Environmental Quality.** Contact the Pima County Department of Environmental Quality at **740-3340** for requirements and regulations regarding permits for the construction, operation, and maintenance of greywater systems and use of greywater.

If you plan to use washing machine water to irrigate, you should be aware of the elements present in this water which may affect your plants or soils. Detergents and other clothes-washing products use a variety of chemicals to aid in cleansing. Some of these ingredients can be harmful to your plants. Because labeling on detergent and other clothes-washing products is often incomplete, a study was conducted to evaluate some critical product characteristics which may adversely affect the landscape, including alkalinity, boron, conductivity, sodium, and phosphate.

Alkalinity

Alkalinity refers to the relative amounts of alkaline chemicals in a solution. Sodium, potassium, and calcium are alkaline chemicals; they often are combined with carbonates, sulfates, or chlorides. Plants do not tolerate high concentrations of alkali salts.

Boron

Boron is considered a plant micronutrient, required in only very, very small amounts. Most soils provide adequate amounts of this chemical. Concentrations only slightly higher than those considered beneficial can cause severe injury or death to plants.

Conductivity

Conductivity is a simple measure of the amount of dissolved chemicals in a solution. These chemicals can be beneficial or harmful. The higher the conductivity, the more dissolved salts and minerals are present. In general, the higher the concentration of dissolved salts and minerals in the water, the greater the potential for adverse affects on the environment and plant health.

Sodium

Sodium can act as a plant poison by reducing the plant's ability to take up water from the soil. Too much sodium can destroy the structure of clay soils, making them slick and greasy by removing air spaces and thus preventing good drainage. Once a clay soil is damaged by sodium, it can be very difficult to restore it to a viable condition.

Phosphate

Phosphate is a plant food and is added to soil as a fertilizer. Soils in the Tucson area are typically low in phosphate; thus, there may be some benefit to plants if phosphate is present in greywater. This should not be relied upon, however, since many forms of phosphate are not readily usable by plants and soils.

Is Biodegradable Better?

The word biodegradable means that a complex chemical is broken down into simpler components through biological action. Do not be confused by the word biodegradable, which often is used to imply environmentally safe. Harmful chemicals as well as beneficial ones may be biodegradable.

A Note About Chlorine

Although chlorine in bleach and detergents is generally expended in the washing process, some may be left in the greywater that reaches plants. Chlorine should not be used in the garden because it may substitute for similar nutrients, blocking normal metabolic processes. The addition of chlorine to water used for irrigation should be kept to a minimum .Choose your detergent and clothes-washing products keeping in mind that it is better for your plants and soils to have a low alkalinity, boron, conductivity, and sodium content in the water. Personal preference may affect your choice of products, since higher levels of these constituents may add to their cleansing ability.

Product Name	P or L	Conductivity	Alkalinity	Sodium	Boron	Phosphate
Ajax Ultra	P	1130	219	292	0.040	11.2
Alfa Kleen	L	25.6	16.8	3.71	<<	<<<
All	P	2030	659	492	0.10	NT
All Regular	L	116	29.8	39.3	<<	<<<
Amway	P	939	310	227	<<	4.00
Ariel Ultra	P	1020	247	280	0.030	10.8
Arm and Hammer	P	2450	1160	572	<<	<<<
Bold	L	46.7	68.6	9.74	<<	<<<
Bonnie Hubbard Ultra	P	1560	617	377	0.036	<<<
Calgon Water Softener	P	1290	345	359	<<	22.9
Cheer Free	L	307	80.3	94.7	<<	<<<
Cheer Ultr	P	710	149	171	0.076	<<<
Chlorox 2	P	2880	1430	672	11.2	<<<
Dash	P	1060	482	238	2.14	<<<
Dreft Ultra	P	737	328	189	9.75	<<<
Downy Fabric Softener	L	6.37	NT	<	<<	<<<
Ecovcover	L	132	63.7	24.3	<<	<<<
ERA Plus	L	102	15.3	26.3	<<	<<<
Fab Ultra	P	1140	199	443	<<	21.7
Fab 1-Shot	Pkt	501	09	109	<<	5.26
Fresh Start	P	510	106	132	0.026	8.28
Gain Ultra	P	792	300	180	0.058	<<<
Greenmark	P	1690	568	395	<<	1.67
Ivory Snow	P	258	219	70.8	<<	NT
Oasis	L	89.6	16.2	<	<<	<<<
Oxydol Ultra	P	1030	501	272	11.3	<<<
Par All Temperature	P	2350	431	529	0.049	2.67
Purex Ultra	P	1010	278	231	<<	<<<
Sears Plus	P	2500	1200	635	<<	<<<
Shaklee	L	19.0	12.1	6.48	<<	<<<
Shaklee Basic L	P	1030	285	230	<<	<<<
Snuggle Fabric Softener	L	2.60	NT	<	<<	<<<
Sun Ultra	P	1490	653	335	<<	1.58
Surf Ultra	P	989	302	249	<<	13.7
Tide with Bleach	L	329	58.3	95.0	2.30	<<<
Tide Regular	L	291	61.2	93.8	0.030	<<<
Tide Ultra	P	959	236	243	0.098	10.7
Valu Time	P	1650	460	371	0.034	1.79
White King	P	266	165	74.0	1.83	NT
White Magic Ultra	P	1140	194	273	0.035	18.5
Wisk Advanced Action	L	221	72.4	56.8	7.41	<<<
Wisk Power Scoop	P	1160	360	319	<<	9.77
Woolite	P	1040	22.3	239	0.17	<<<
Yes	L	42.5	10.3	6.40	<<	<<<
Tap Water	n/a	317	118	42.7	0.042	<<<
Distilled/Deionized Water	n/a	2.03	3.78	<	<<	<<<

Legend: P: Powder L: Liquid
<: Less than the sodium detection limit of 1.0 mg/l.
<<: Less than the boron detectionlimit of 0.025 mg/l.
<<<: Less than the phosphate detection limit of 1.2 mg/l.
NT: Testing of sample not possible.

Historical Evapotranspiration Values in Inches for July

North Central Coast	monthly	weekly
Novato	5.9	1.3
San Francisco	4.5	1.0
Concord	7.0	1.6
San Jose	6.5	1.5
Monterey	4.3	1.0
San Luis Obispo	4.6	1.0
South Coastal		
Santa Barbara	5.5	1.3
Ventura	5.5	1.3
Los Angeles	6.6	1.5
Laguna Beach	4.9	1.1
San Diego	4.6	1.0
Central Valley		
Auburn	8.3	1.9
Sacramento	8.4	1.9
Modesto/Stockton	8.1	1.8
Fresno	8.4	1.9
Baskersfield	8.5	1.9
Redding	8.5	1.9
South Inland		
San Fernando	7.3	1.7
Pasadena	7.1	1.6
Riverside	7.9	1.8
Ramona	7.3	1.7
San Bernardino	7.9	1.8
High Desert		
Palmdale	9.9	2.3
Lancaster	11.0	2.5
Victorville	11.2	2.5
Bishop	7.4	1.7
Independence	9.8	2.2
Low Desert		
Palm Springs	11.6	2.6
Coachella	12.3	2.8
Needles	12.8	2.9
El Centro	11.6	2.6