



# Use of Graywater in Urban Landscapes in California

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- b. Untreated wastewater uncontaminated by toilet discharge or other contaminants
- c. Treated wastewater
- d. Only water from a washing machine

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More specifically, under CA 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 Wastewater From:

- Bathtubs, showers, bathroom basins
- Clothes washers



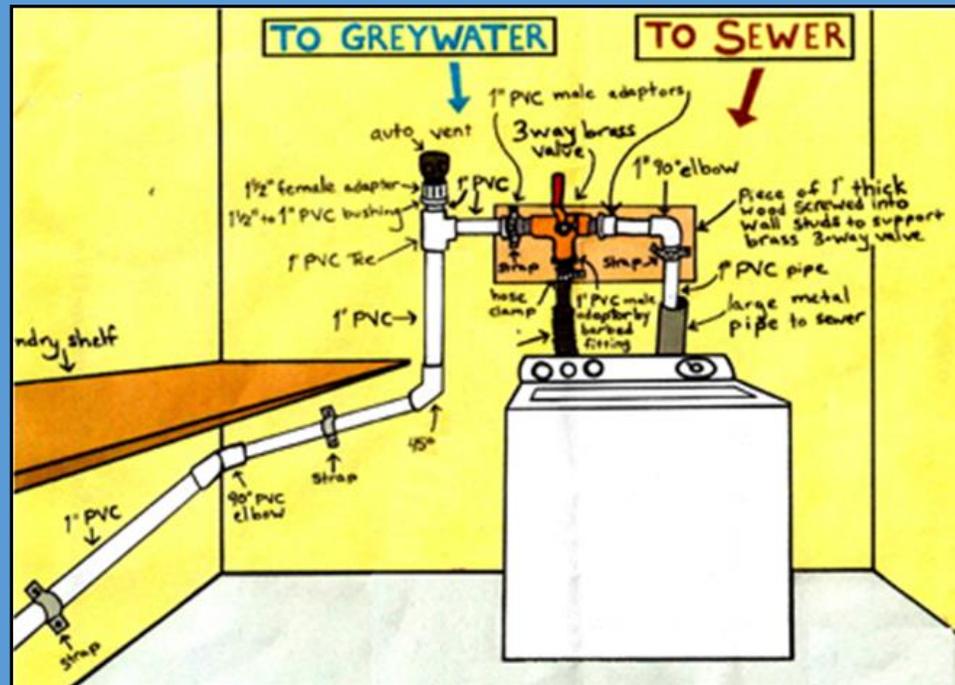
# Graywater Does Not Include Wastewater From:

- Kitchen sinks
- Dishwashers

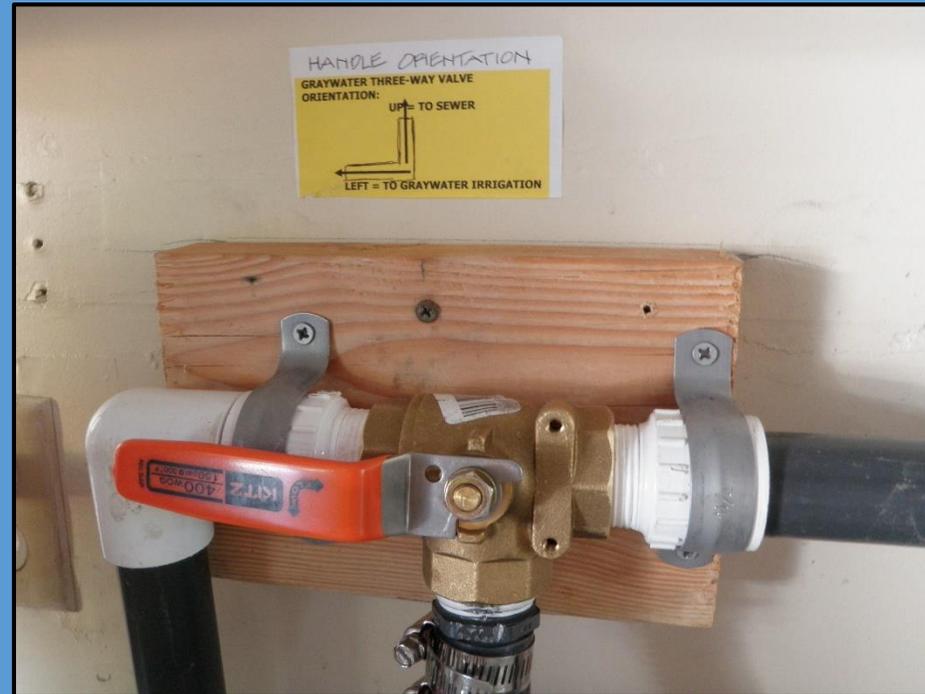


The use of graywater (also spelled greywater, grey water and gray water) to irrigate landscape plants is increasing throughout the United States, particularly in California and other arid states. Municipalities are rapidly amending their codes to encourage the use of home graywater systems.

A construction permit is no longer required for the installation of a single-family or two-family residential graywater irrigation system from a washing machine to an outdoor irrigation or disposal field as long as it does not alter the household plumbing.



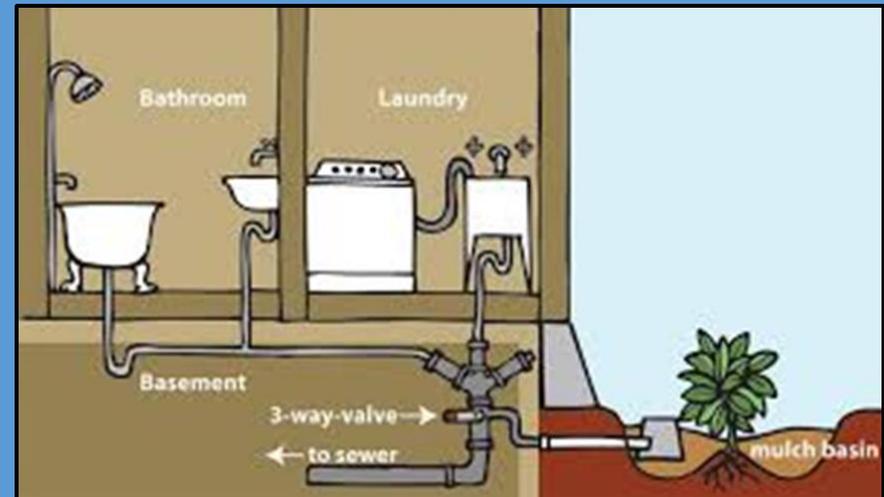
# How Do Laundry to Landscape Systems Work?

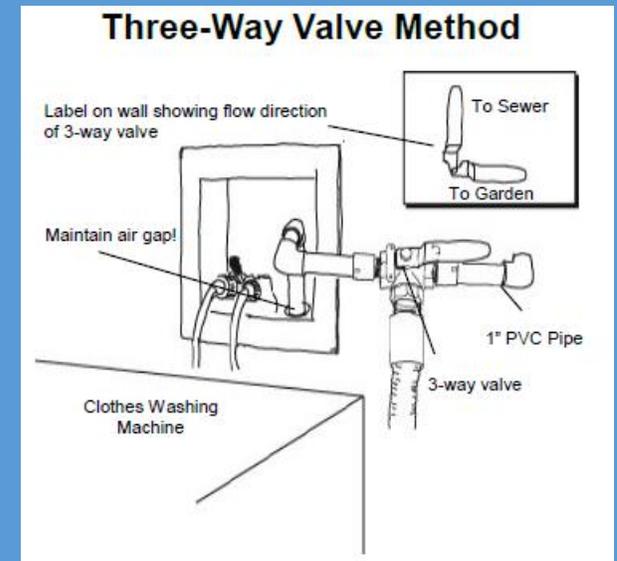
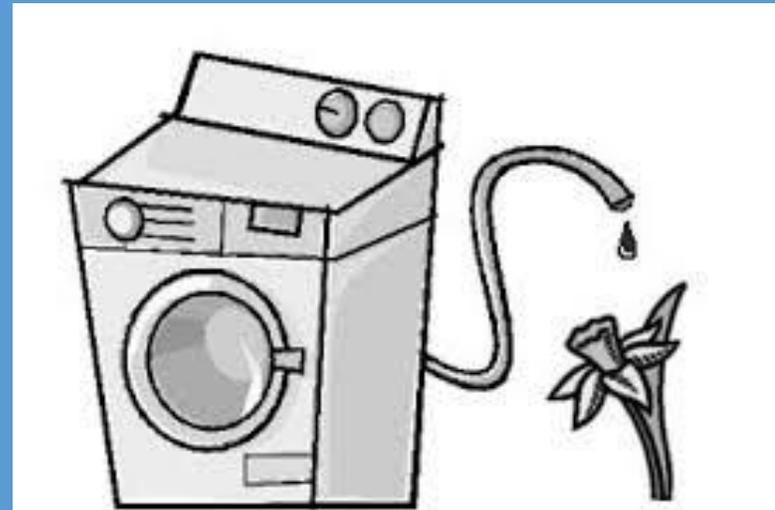
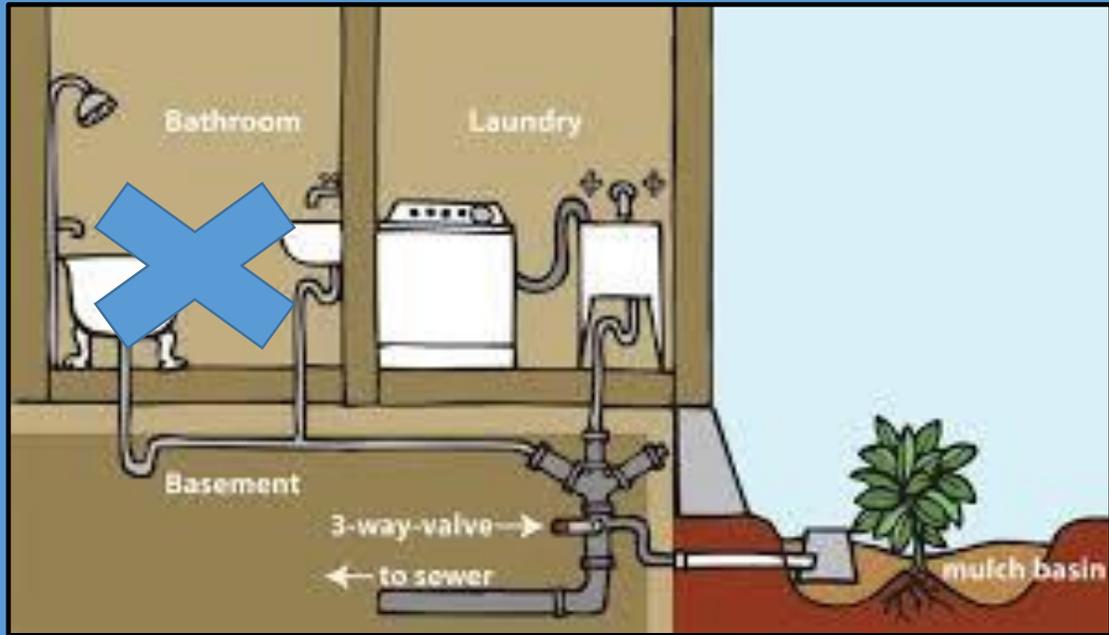


The hose exiting the clothes washing machine is attached to a valve that separates graywater from water destined for the sewer.

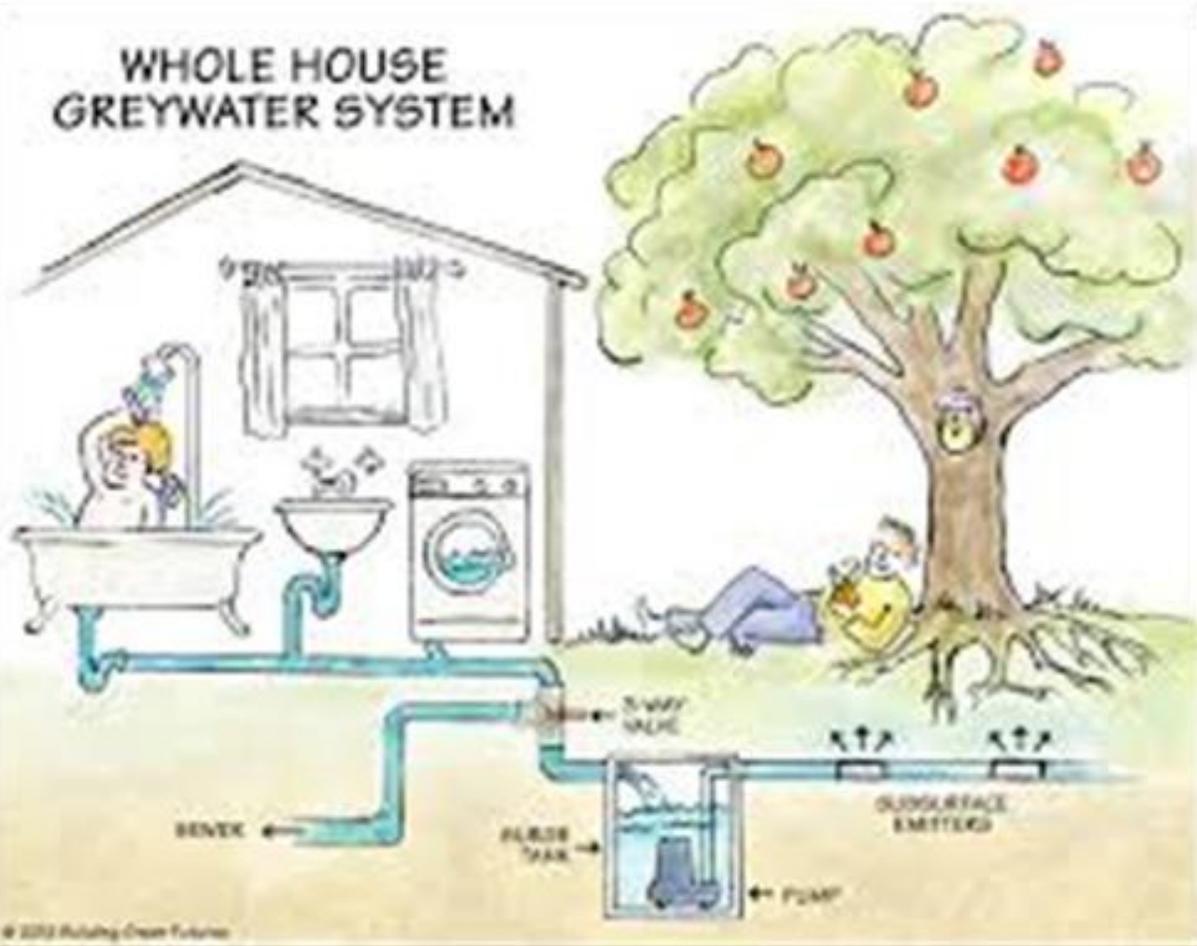
# All Graywater Systems Aside from Laundry to Landscape Require a Construction Permit

- Simple systems serving a one or two family dwelling discharging no more than 250 gallons of water per day
- Complex systems discharging more than 250 gallons of water per day





# WHOLE HOUSE GREYWATER SYSTEM



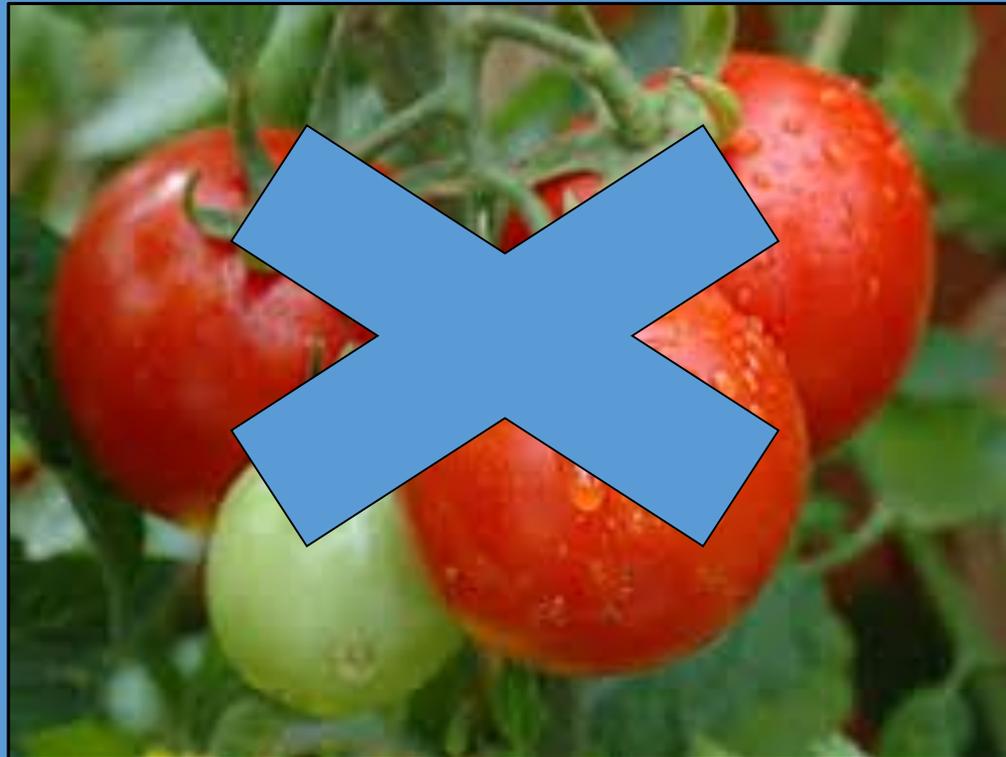
# Which are Good Choices for Irrigating with Graywater Systems?







Due to Low But Potential Health Risks, Graywater  
Should Not be Used to Irrigate - or Come into  
Contact With - Edible Plants.

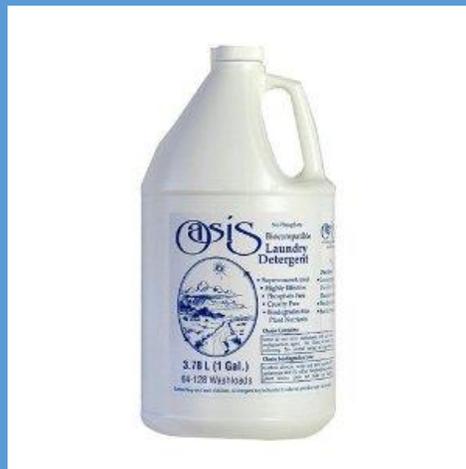


# What Kinds of Laundry Products Should Be Used?

- Liquid detergents rather than powders
- Hydrogen peroxide bleaches rather than chlorine-based

# Graywater Friendly Detergents:

- Oasis Liquid Laundry Detergent
- Trader Joe's
- Ecos Free and Clear



# How Much Graywater Can be Generated?

- Between 10 and 25 gallons per washing machine load is generated from a horizontal drum machine (side loader)
- About 40 gallons per washer load is generated from a top loader.



# When Would Directing Water to the Sewer Be Warranted?

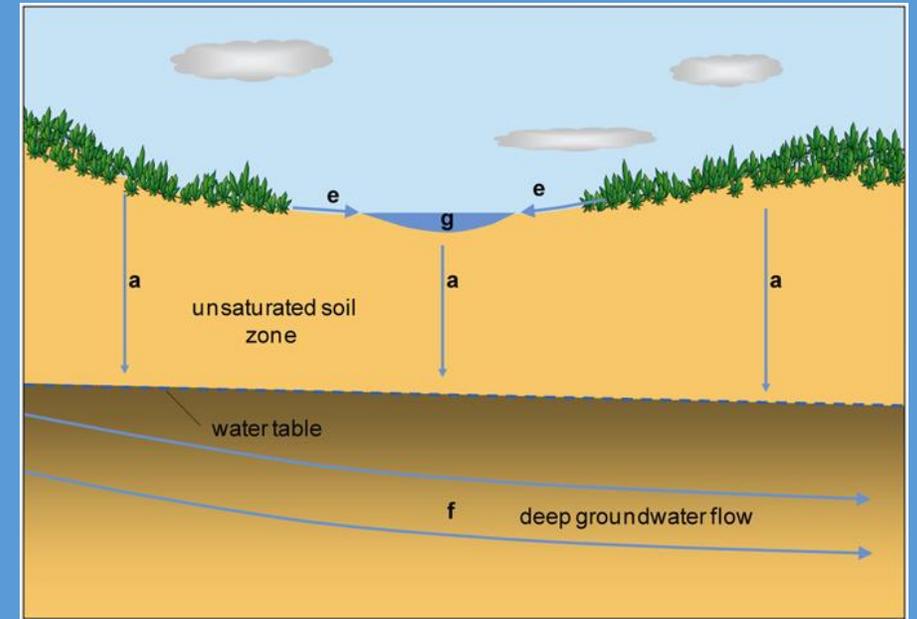
- a. When diapers and oil/grease are laundered
- b. When powder detergents or bleach are used
- c. When a heavy rainfall occurs
- d. When your quota of graywater is used up
- e. All of the above

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# Other Times You Should you Divert Graywater to the Sewer

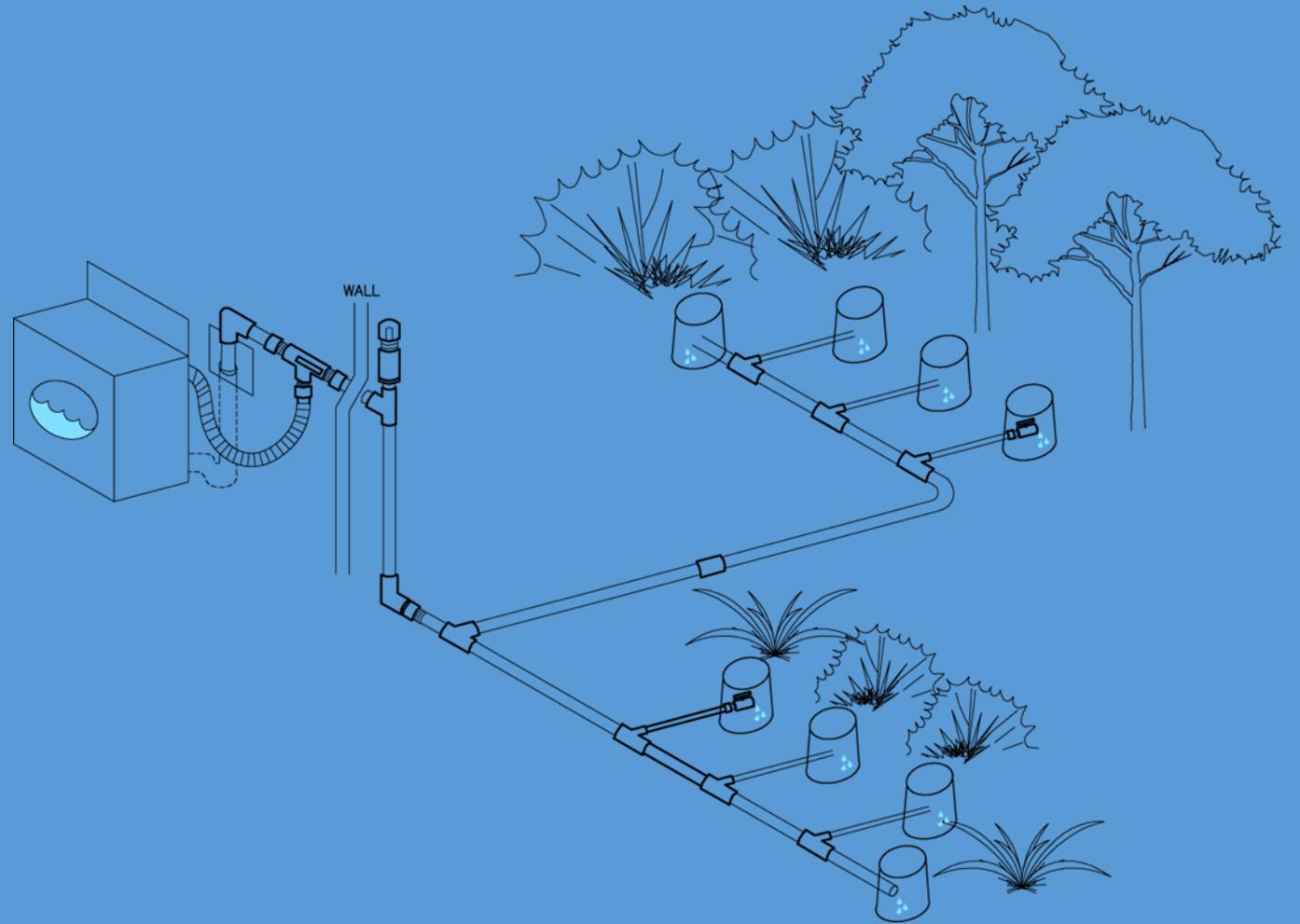
- If irrigation is not needed
- Anytime the water table rises within 3 feet of graywater
- Anytime the water isn't draining well and you see pooling or runoff in the landscape



# Many Laundry to Landscape Systems Discharge Water into Mulch Basins



# Water is Delivered to Plants Growing in Mulch Basins



- Graywater is often released in mulch basins constructed by replacing several inches of soil with coarse organic mulch
- These systems work well for irrigating flower beds and small ornamentals
- However, basins constructed within the drip line of mature trees are not recommended and can result in injury to established roots and unstable and unsafe trees

## Piping to Landscape Must Be:

- 1.5 feet from buildings and property lines
- 100 feet from wells, creeks and storm drains
- Piped around obstacles—go under, around, remove, or cut a strip from hardscapes (e.g. patios or walkways)

# Topography and Graywater Use

- Irrigate via gravity to flat areas of your landscape (or the closest downhill area to the washer). Do not extend beyond 50 ft to avoid too much wear and tear on washing machine pump.
- Yards with gentle downward slopes are easiest to irrigate with 'Laundry to Landscape' systems.
- In a flat yard, distribution should be within 50 feet of the washing machine.
- If the site has a significant downward slope consider using tubing that curves.

# Number of Distribution Points

- Top-loading machines can irrigate up to 12 mulch basins
- Front-loading machines can irrigate up to eight mulch basins

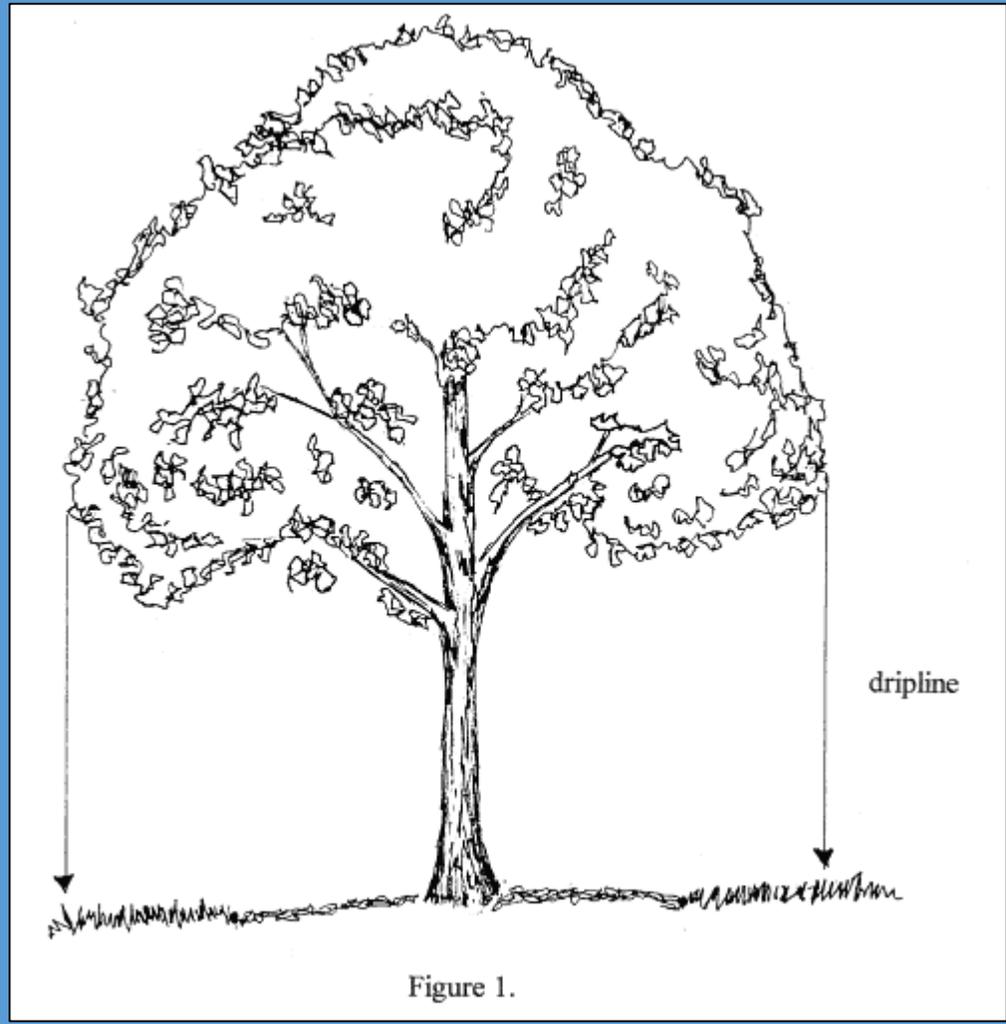
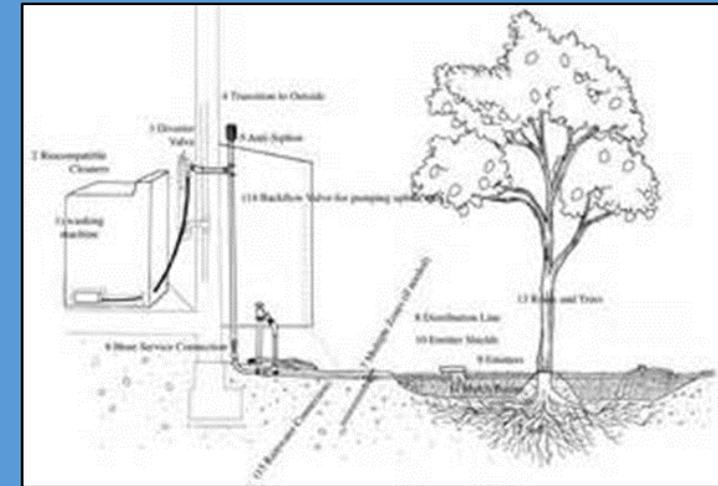


Figure 1.

# Mulch Basins that Cut into Tree Roots are Never Recommended



# Girdling and Circling Roots

- Trees can be stressed and even killed by circling roots
- Stressed roots transport less water and nutrients to above-ground portions of the tree
- Often, circling roots slowly weaken trees over many years

# Circled Roots



# Potential Result of Circled Roots



# High Quality Root System



Make Sure Mulch and Other Organic Materials are Free of Weed Seeds, Diseases, and Insects



# Potential Pathogens in Graywater Systems That Can Harm Humans

- *E. coli*
- *Salmonella* spp.
- *Giardia* spp.
- Enteroviruses

Graywater shall not contain hazardous chemicals derived from activities such as cleaning car parts, washing greasy or oily rags, or disposing of waste solutions from home photo labs or similar hobbyist or home occupational activities.

# What Do Soil (Textures)Types Have to Do With Graywater Application?

- a. A lot because clay soils hold less water than sandier ones
- b. A lot because clay soils hold more water than sandier ones
- c. Nothing as long as you apply the graywater directly to the plant using an overhead system
- d. Nothing

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# Know Your Soil Texture (Type)

**Table 16A-2 Design Criteria of Six Typical Soils**

<i>Type of Soil</i>	<i>Square Feet</i>	<i>Gallons</i>	<i>Square Meters</i>	<i>Liters</i>
	<i>Minimum square feet of irrigation/leaching area per 100 gallons of estimated graywater discharge per day</i>	<i>Maximum absorption capacity in gallons per square foot of irrigation/leaching area for a 24-hour period</i>	<i>Minimum square meters of irrigation/leaching area per liter of estimated graywater discharge per day</i>	<i>Maximum absorption capacity in liters per square meter of irrigation/leaching area for a 24-hour period</i>
<i>Coarse sand or gravel</i>	20	5.0	0.005	203.7
<i>Fine sand</i>	25	4.0	0.006	162.9
<i>Sandy loam</i>	40	2.5	0.010	101.8
<i>Sandy clay</i>	60	1.7	0.015	69.2
<i>Clay with considerable sand or gravel</i>	90	1.1	0.022	44.8
<i>Clay with small amounts of sand or gravel</i>	120	0.8	0.030	32.6



# Use the 'Feel' Test



Dry

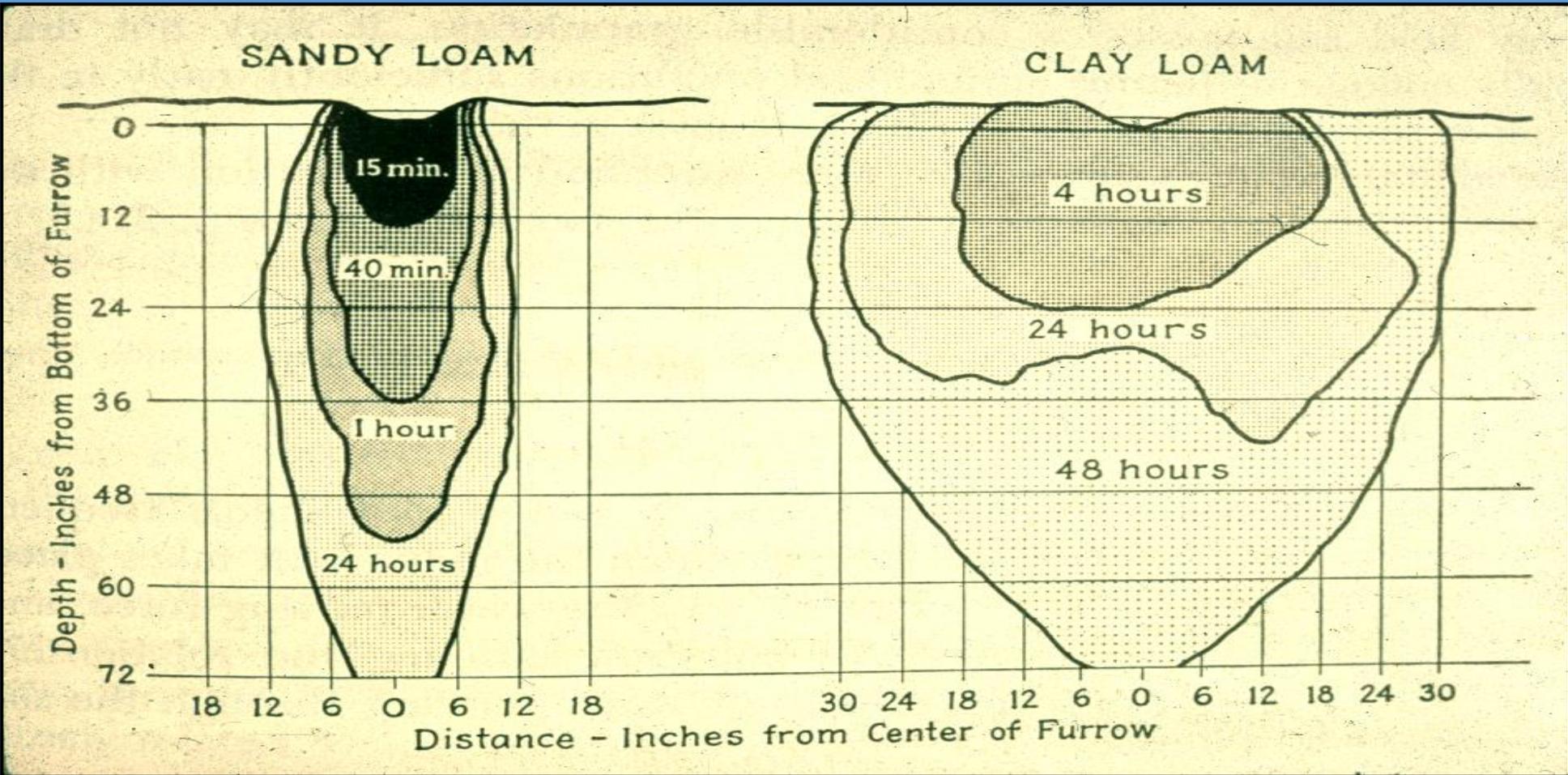


Medium



Wet

# Determine Soil Water Holding Capacity



# Depths to Irrigate

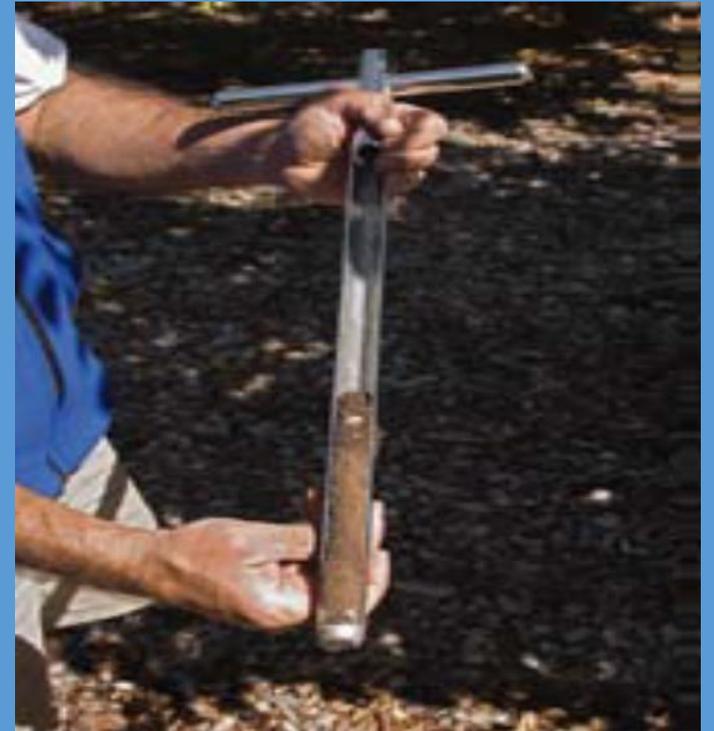
Turf - 8 To 12 In.

Shrubs - Small: 1 Ft.

- Large: 2 Ft.

Trees - Small: 2 Ft.

- Large: 3 Ft.



Recently transplanted plants are at greatest risk of drought damage due to potential root loss.



# How Many Trees Can be Watered with a Graywater System?

- a. It depends on the water demand of the tree
- b. It depends on the amount of graywater available
- c. It depends on the season
- d. 2-12 trees in Inland Valleys and more along coast
- e. All of the above

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# Water Use Of Trees in Gallons (at Luxury Consumption)

<b>Climate</b>	<b>Relative Water Requirement of Tree/Shrub (July)</b>	<b>50 square foot canopy</b>	<b>100 square foot canopy</b>	<b>200 square foot canopy</b>
Coastal (historical evapotranspiration = 1 inch/week)	Low	10	19	38
	Medium	16	31	62
	High	25	50	100
Inland (historical evapotranspiration = 2 inches/week)	Low	19	38	76
	Medium	31	62	124
	High	50	100	200
Desert (historical evapotranspiration = 3 inches/week)	Low	28	57	114
	Medium	47	93	186
	High	75	150	300

Another easy way to estimate maximum tree water needs is to divide the sq footage of the tree canopy by 4. This approximates the gallons per week the plant needs. For example, a tree with a canopy of 80 sq. ft. would need about 20 gal/week ( $80/4$ ).

## A Typical Medium-sized tree in San Francisco Requires Approximately 10 to 20 Gallons of Water per Week During the Summer.

- On average, graywater from one laundry load from a front-loading machine (approximately 20 gallons) can irrigate one to two trees per week
  - Graywater from a top loader (approximately 40 gallons) could irrigate three to four trees per week.

# What About Salt Damage? (sodium, potassium, calcium)

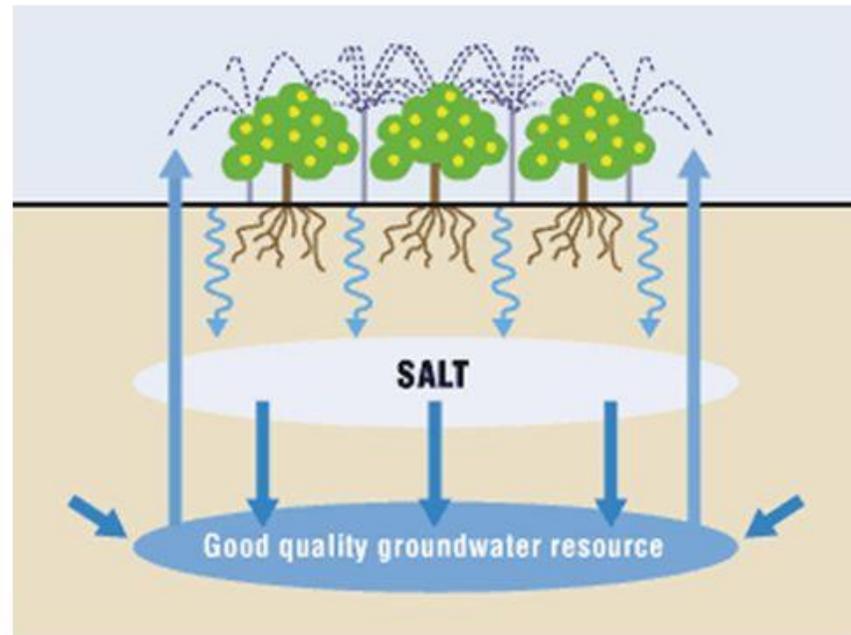


# The following Products Should Be Avoided Because they Can Harm Soil and Plants

- Sodium-containing compounds
- Boron, borax, or borate
- Peroxygen, petroleum distillate or alkyl benzene
- Chlorine bleach (use hydrogen peroxide bleach instead)
- Water softeners that use sodium chloride (potassium chloride is okay)
- Antibacterials (some are incompatible with naturally occurring soil and water bacteria)

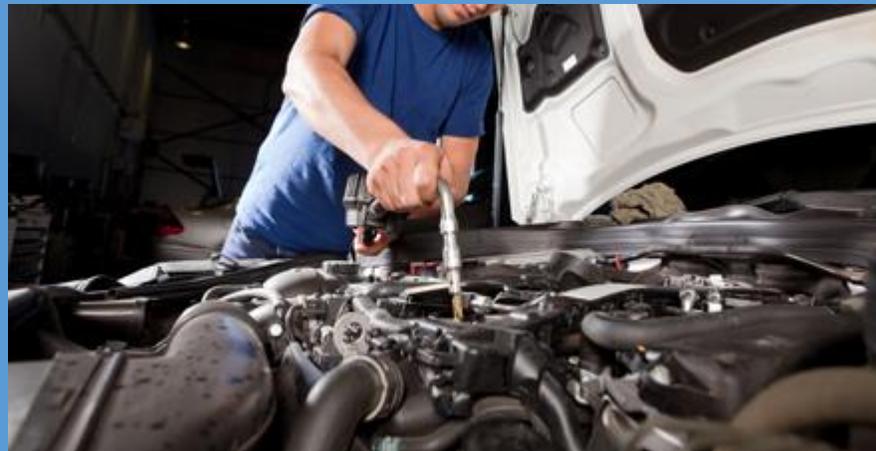
# Salinization of Irrigated Soil

- ✦ Irrigation water soaks through the soil area where the plant roots grow, adding to the existing water.
- ✦ The additional irrigation water causes the underground water-table to rise, bringing salt to the surface.
- ✦ When the irrigated area dries & the underground water table recedes, salt is left on the surface soil.
- ✦ Each time the area is irrigated this salinity process is repeated.



**ALL IRRIGATION WATER CONTAINS SOME DISSOLVED SALTS.**

Graywater should not contain dirty diapers, hair dye, hazardous chemicals on clothes used for cleaning car parts, greasy or oily rags, or waste solutions from home photo labs or other hobbies or activities.



Hydrogen peroxide bleach is twice as expensive and half as effective as chlorine, but ecologically superior for plants and soils in a grey water system.



# Brown Margins Signify Salt Damage



UC Statewide IPM Program  
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# High Levels of Sodium



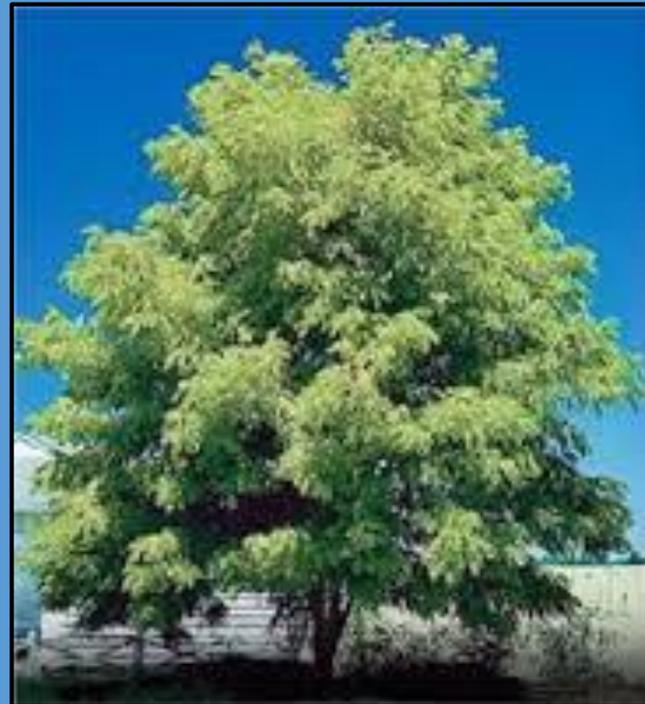
# A Few Very Salt-Sensitive Plants

- Crape myrtle
- Plum
- Apple
- Pear
- Desert Willow



# A Few Salt-Tolerant Plants

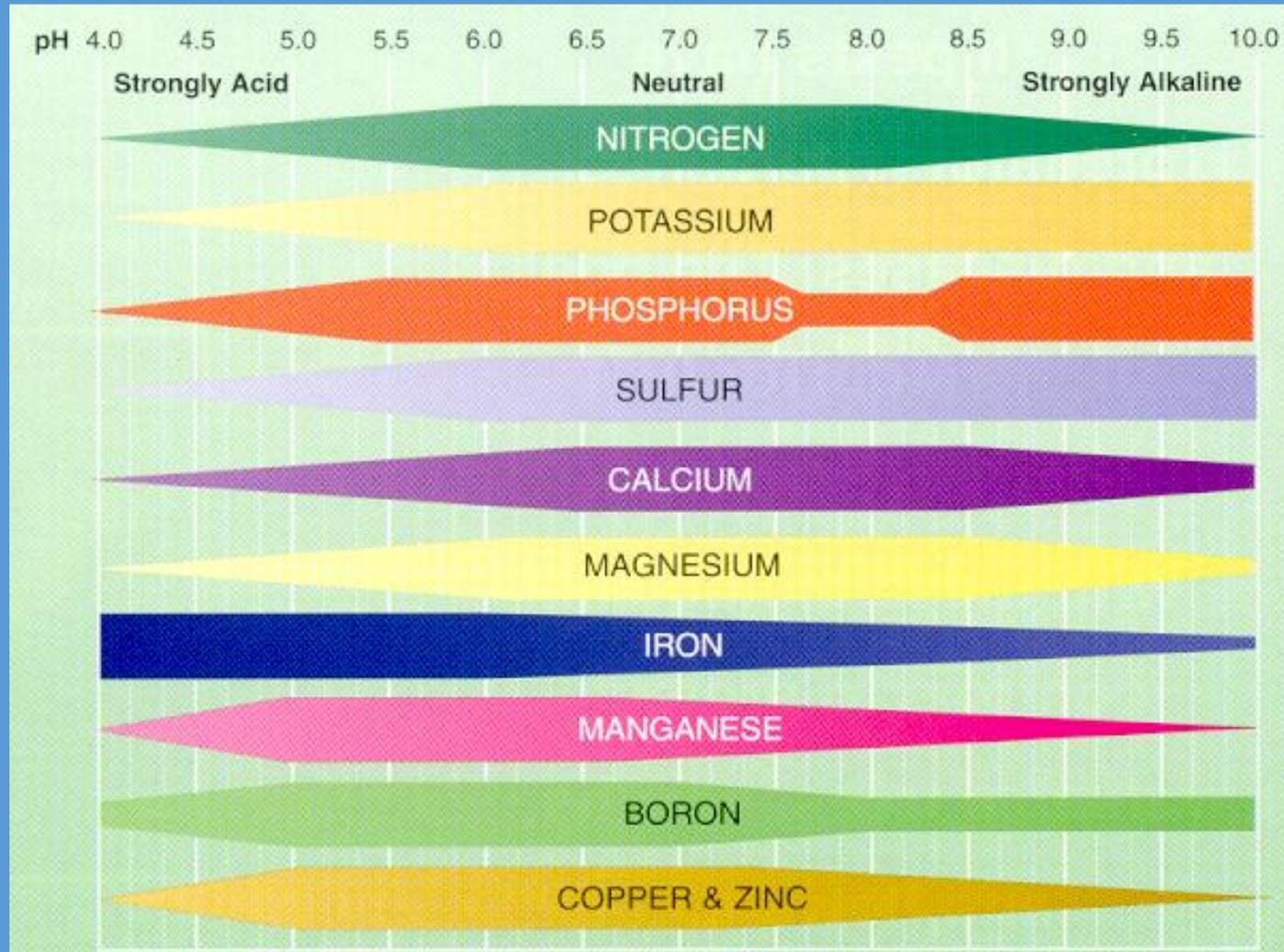
- Honey locust
- Honey Mesquite
- Chilean mesquite
- Salt Cedar
- Salt grass



# This Website Lists Salt Tolerances of Several Plants

<http://ucanr.org/sites/sjcoeh/files/98902.pdf>

# pH and Nutrient Uptake



# Iron vs. Nitrogen Deficiency



# Leach Salts Below Plant Roots with Clean Water



# Affordable Housing Project in Los Angeles (Casa Domingues) Irrigated with a Large, Complex Graywater System





# And Beautifying Your Landscape..... *The Sustainable Way!*



# Resources

UC ANR Graywater Publication (new!):

<http://anrcatalog.ucanr.edu/Details.aspx?itemNo=8536>

San Francisco Graywater Design Manual:

<http://www.sfwater.org/modules/showdocument.aspx?documentid=55>

Oasis Design Graywater Information Site:

<http://www.oasisdesign.net/greywater>

Greywater Action: For a Sustainable Water Culture:

<http://www.greywateraction.org>

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# Thank You!

## Questions?

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