

Water Harvesting

Create Your Own Sustainable Water
Supply

Brook Sarson
brook@h2o-me.com

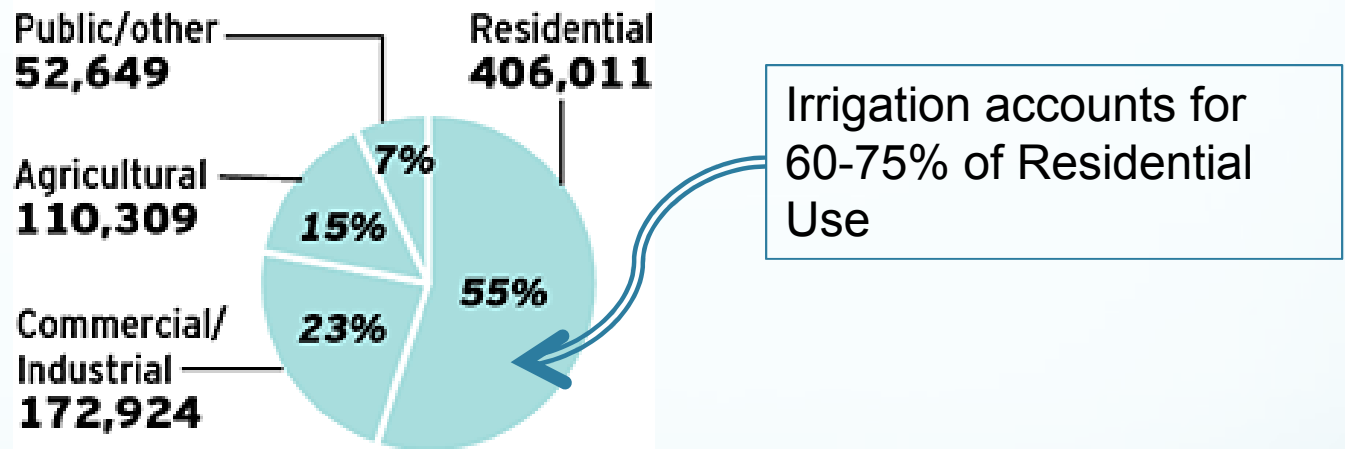


Where Does Our Water Come From?

- 10-20% is local rainfall captured in one of our reservoirs.
- 80-90% is imported via the Metropolitan Water District (MWD) of Southern California and the San Diego County Water Authority (CWA)
 - Northern California from the State Water Project
 - Water captured in reservoirs north of Sacramento and released through natural rivers and streams into the Sacramento-San Joaquin Delta. The 444 mile-long California Aqueduct then carries the water from south of the Delta to State Water Project contractors such as MWD.
 - Colorado River Aqueduct (CRA)
 - A 242 mile-long aqueduct brings Colorado River water from Lake Havasu to the southland
- The imported and local water is blended and transferred to treatment plants at Miramar, Alvarado, and Otay reservoirs via pipelines operated by CWA.

Who uses the water

Here is a breakdown of water consumption in the county in 2007, in acre-feet. One acre-foot is enough to serve two families for one year.



SOURCE: San Diego County Water Authority

AARON STECKELBERG / Union-Tribune

2007 average per capita was 185 gallons a day, excluding agriculture

Creating a Local Water Supply

- Harvest Rainwater
- Recycle greywater
- Reduce Water Use in the Home
 - Low Flow fixtures
 - Fix Leaks
- Landscaping
 - The nifty fifty (drought tolerant)
 - Natives
 - Xeriscape
 - Create Basins
 - Use Mulch
 - Redirect Storm Runoff into your landscape



Why Rainwater Harvesting?

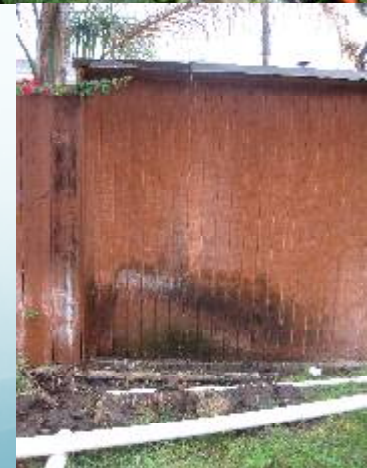
- Local Water Supply
- Reduces need for pumping groundwater
- Provides high-quality soft water that is low in mineral content
- Mitigates salt build up in soils
- Increases groundwater supply and improves quality of groundwater
 - Dilutes brackish water
- Reduces storm drain pollution
- Mitigates urban flooding and erosion
- Sustainable – rainwater collection is less expensive than desal and IPR
- Simple, low cost solutions

The Eight Principles of Successful Water Harvesting

1. Begin with long and thoughtful observation.
2. Start at the top (highpoint) of your watershed and work your way down.
3. Start small and simple.
4. Slow, spread, and infiltrate the flow of water.
5. Always plan an overflow route, and manage that overflow as a resource.
6. Maximize living and organic groundcover.
7. Maximize beneficial relationships and efficiency by “stacking functions.”
8. Continually reassess your system: the “feedback loop.”

Redirecting Storm Runoff

- Disconnect your downspout
- Optional: connect to rainwater storage
- Direct the water away from your foundation
- Use earthworks to provide opportunities for the water to soak into the soil
- Use mulch to hold the moisture in the soil
- Use compost to improve the soil absorption
- Use plants that can tolerate seasonal water



Estimated Runoff Efficiencies

90%	Smooth, impervious roof surfaces (metal, tile, built-up and asphalt shingle roof)
80%	Gravel roof and paved surfaces
60%	Treated soil
30%	Natural soil

Water Harvesting Earthworks

- Terrace
- French Drain
- Infiltration Basin
- Swale
- Mulch
- Hardscape Reduction, Permeable Paving
- Vegetation

Slow, spread, and infiltrate the flow of water.



Rainwater runoff can cause a problem or it can be seen as a resource to be captured.

Always plan an overflow route. Manage that overflow as a resource.



There are creative ways to use public spaces to harvest water and grow useful plants.

Hillside Earthworks (Swale)

- Used on sloped land to slow, spread, and infiltrate water (ex. Bioswale)
- Built perpendicular to the slope
- Soil from the excavated basin is heaped on the downhill slope to create a berm, or swale
- Cause as little disturbance as possible since the vegetation helps water infiltration
- Use a bunyip level to find the contour of the slope and create a basin that will hold water

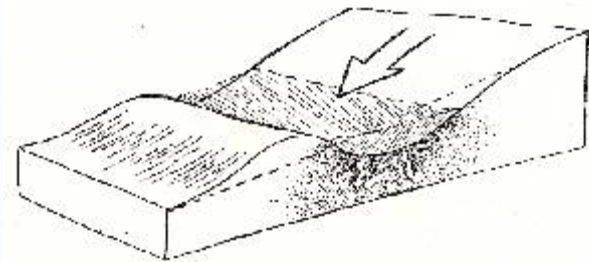


Fig. 3.2. A berm 'n basin holding runoff water and infiltrating it into the soil



Fig. 3.3. A contour berm doubling as a raised path

Tank Design from the Top Down

- ROOF SURFACE suitable for collecting quality rainwater.
 - Rainwater is slightly acidic
 - Test water collected to determine its content and appropriate filtration (if drinking)
- Fit Leaf Eater RAIN HEADS or other debris screen to downpipes to stop gutters blocking.
- Install WATER DIVERTER/S to prevent the first flush of most contaminated rainwater from entering the tank.
- Ensure the TANK SCREEN is installed at tank entry point to filter water and keep mosquitoes and pests out.
- Choose a WATER TANK. Consider annual rainfall, roof catchment area, water usage and costs involved/budget restrictions when determining its size.
- Direct OVERFLOW to additional storage or to earthworks. Ensure overflow has mosquito screens.



...Continued

- Optional: Utilize a TANK TOP UP system to automatically top-up the tank with mains water when water levels fall to a designated minimum level.
- Optional: Select a PUMP SYSTEM to distribute water for use inside or outside the home.
- Optional: RAINWATER FILTER. Fit a purpose designed rainwater filter after the pump to help reduce residual sediment, colour and odor.
- Optional: WATER LEVEL MONITOR. Install a level indicator to help monitor your water usage. Wireless systems are most convenient and display a reading inside the home.

Considerations

- Above ground systems
- Underground or partially underground tanks
- Delivery cost (is it local?)
- Space available
- Can you get it into the yard?
- Quantity desired
- Cost of the tank
- Cost of excavation or pad creation
- Aesthetics



Wet vs. Dry

- Wet System
 - Tanks are some distance from the house
 - Conveyance pipes are underground
 - Water finds its own level
 - Water remains in pipes, and they need to be mosquito proofed
- Dry System
 - Conveyance pipes feed water directly into tank via gravity
 - No standing water

Water Harvesting Calculations

- Possible Volume of Runoff from a Roof or Other Impervious Catchment Area:

catchment area (ft²) X rainfall (ft) X 7.48 gal/ ft³ =

maximum runoff (gal)

Ex: 450ft² X 10inches X 1ft/12 inches X 7.48 gal/ft³ = 2805 gallons

- Rough rule of thumb for calculating rainfall runoff volume on a catchment surface:

You can collect 600 gallons of water per inch of rain falling on 1,000 square feet of catchment surface.

Weight of Water Stored

- Stored water (gal) x 8.34lb/gal = weight of stored water (lb)
 - Example:
Can you move a full 55 gallon drum?
55 gallons x 8.34 lb/gallon = 458.7 lb

Calculating Water Pressure

- Height of water above its destination (ft) x water pressure per foot of heights (psi/ft) = passive water pressure (psi)
 - Every foot above destination develops 0.43 psi/ft
 - Example:
 - 8 foot tall tank
 - Veggie patch 6 inches below bottom of tank
 - A full tank is still 4 inches below the top due to overflow
 - 8.1 feet x 0.43 psi/ft = 3.48 psi
- Most drip irrigation requires at least 15 psi

Simple Rainwater Catchment



Large Rainwater Tanks and Systems



Local Example



What is *Greywater*?

- Greywater is any wastewater generated in the home,

except water from

- Toilets
- Kitchen Sinks
- Dishwashers
- Photo processing sinks



Why Use Graywater?

- Reduce Reliance on Municipal water source
- Less strain on septic tank or treatment plant
- Better treatment (topsoil is many times more effective than subsoil or treatment plant)
- Less energy and chemical use
- Groundwater recharge
- Plant growth
- Reclamation of otherwise wasted nutrients
- Increased awareness of and sensitivity to natural cycles

Using Graywater

- San Diego Information Bulletin 208
 - No permit required for clothes washer system which follows simple guidelines
 - Permit required for simple system including showers/baths/sinks outputting less than 250 gallons/week
 - Approx. \$550
 - San Diego Development Services Department
 - Plot Plan and Greywater System Plan
 - Complex systems require more permitting procedures.
- Arizona Greywater Guidelines

Elements of a Greywater System

- High Efficiency Fixtures
- Diverter Valve
- Mulch Basins
- Trees or plants that will respond favorably to regular watering with slightly higher sodium content. (eg. Not blueberries, or many natives)
- Greywater friendly Soaps

Greywater Complications

- Space—too close to neighbors or street
 - Greywater should not runoff or enter sewer
- No access to drain plumbing (slab, etc.)
- Soil either too permeable or not at all.
- Design your greywater system so no greywater-to human contact occurs before soil purification.
- GW must not contain pathogens such as from diapers or infectious garments
- Surface application of gray water is not used for irrigation of food plants, except for citrus and nut trees.
- Do not spray greywater since droplets can evaporate and leave pathogens suspended in air.
- See Arizona Greywater Guidelines for this and more

The “Perk Test”

- The rate at which water absorbs into the soil—the percolation or “perk” rate—is an important variable in greywater system design.
- High clay content generally means slow perk, which can further degrade if you add salt-laden GW. Rock can have slow or no perk. Very slow perk can lead to standing water and noxious smells.
- Sand is high perk, gravel more so.
 - Very fast perk can lead to groundwater contamination, though this is unlikely if there is a dense network of plant roots and mulch.

Determine resource availability



- Large top loader: 30-50 gal/load
- Front loader: 10-35 gal/load



One 10 minute shower at 2 gpm
(low flow showerhead): 20 gal/day

Say your family of 4 generates
 $4 \times 20 = 80$ gallons per day from the shower and
 $3 \times 10 = 30$ gallons per week or 4.3 gallons per
day from washing clothes,
For a total of 84 gallons per day.

Determining Soil Percolation

Soil infiltration rate, minutes/inch	Area needed, ft ² /gal/day
0-30	.4
30-45	.7
45-60	1.0
60-120	2.0

So for your high perk soil to absorb 84 gallons per day, we'd need a soil distribution area of:

$$84 \times 0.4 = 34 \text{ ft}^2$$

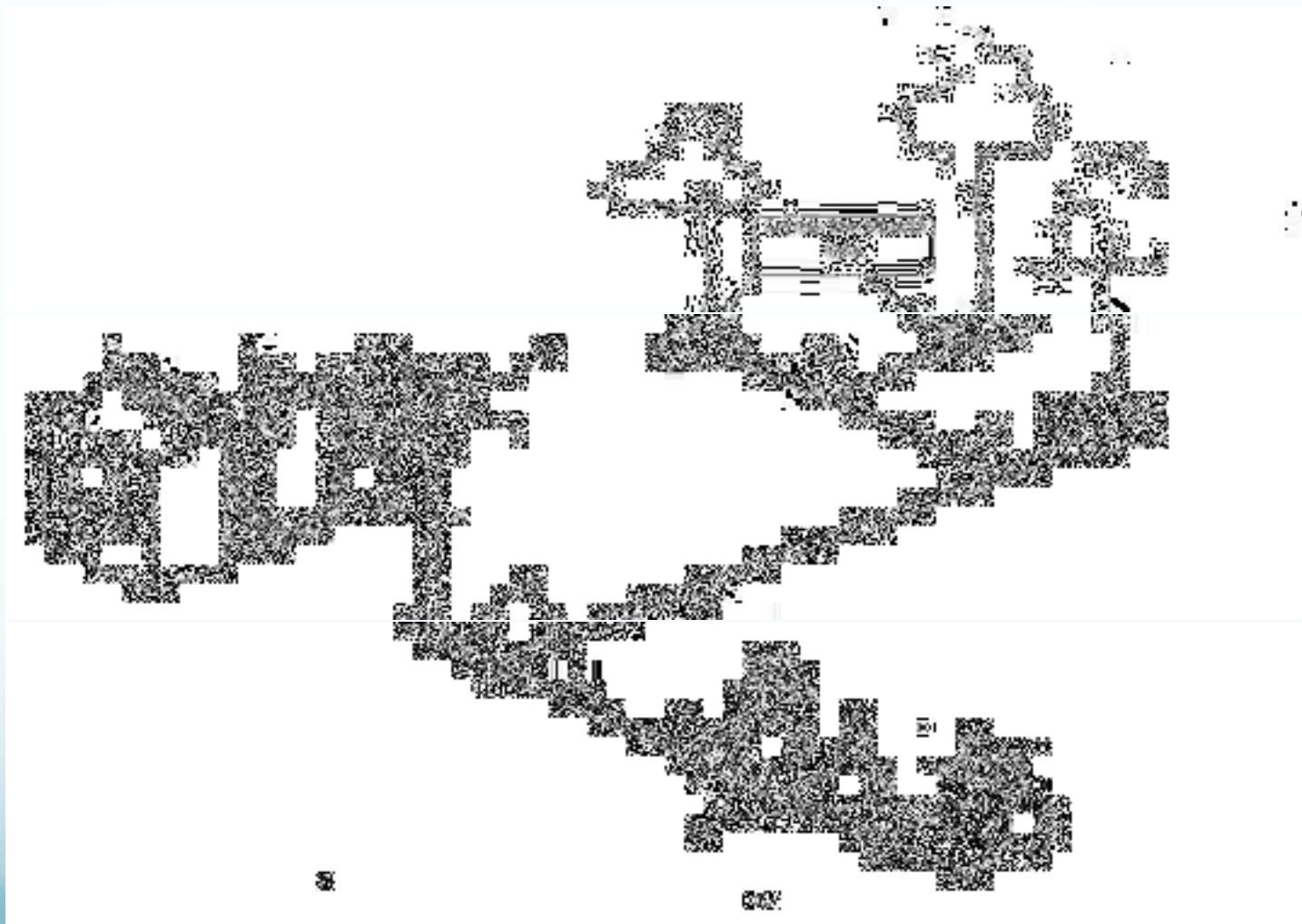
Simple: Using a Surge Tank

- Never store greywater for more than 24 hours
- Need a way to clean out the tank (removable lid)
- Keep out mosquitoes
- Filter the water with an easy-to-clean filter to keep from clogging exit point
- Tank needs an overflow directed back into the sewer
- You can hardwire this tank, or put on a simple garden hose

A simple system with a surge tank



Start Simple: Clothes Washer



A simple low-maintenance, low cost laundry greywater system



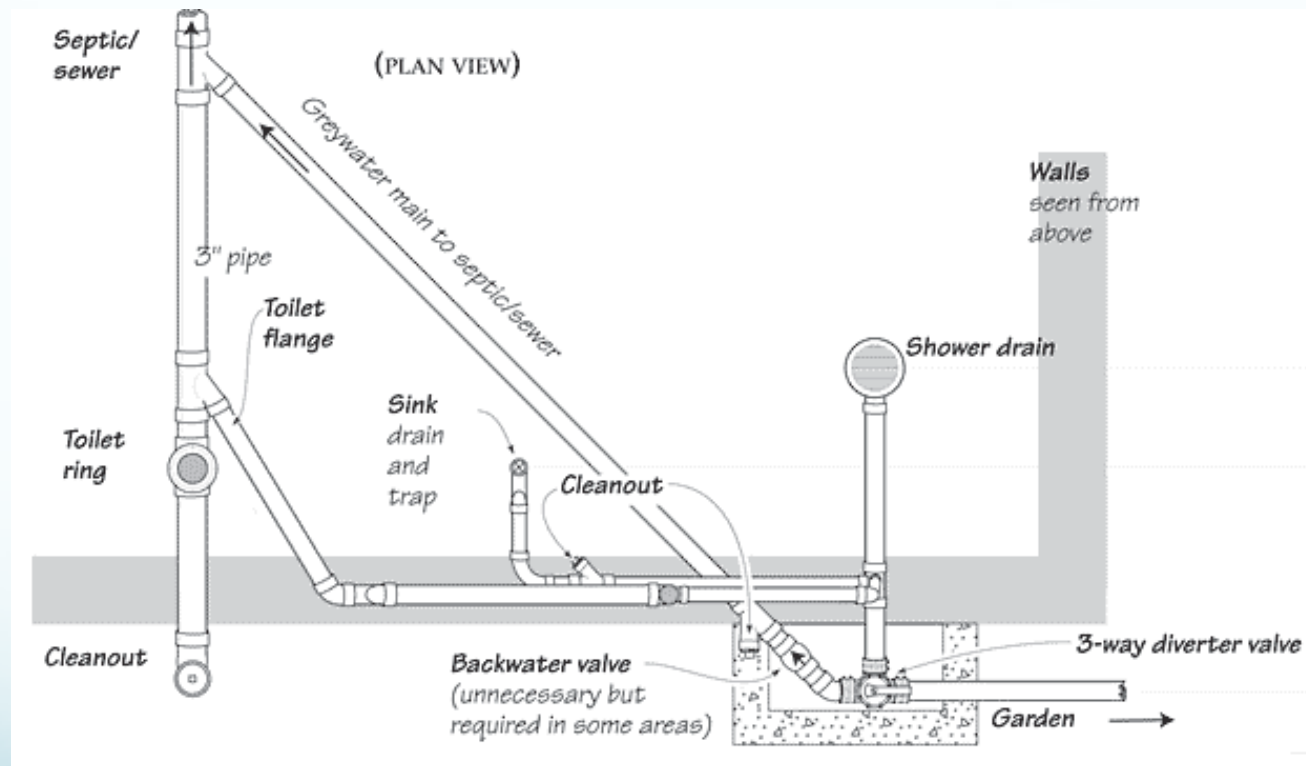
Basic Elements of a simple laundry system



Permitted Systems – Unincorporated SD

- Present a design layout to County of San Diego Department of Environmental Health (DEH) including how much water you are discharging, soil type, and discharge area. Also, how the water is retained onsite without pooling.
 - Plan check fee of \$396
 - Permit fee of \$343
- Then to the building department to approve plumbing modifications
- Then to the local water purveyor to discuss the need for the installation of a backflow protection device at the water meter.
 - Probably not needed for simple gravity fed system

Shower Plumbing (top down)



Gravity Fed Greywater System

- Install the Valve after the P-Trap to avoid pests and smells from entering your house
- You need $\frac{1}{4}$ inch drop per linear foot to keep water from pooling in the pipes
- How will you access the valve?
- You can split your water into several locations using a simple double-L plumbing fitting (branched drain)



Underground Infiltration Chamber



Before and After



Detergents

- Ingredients to EXCLUDE:
 - **sodium**
 - **borax**
 - **Bleach**
- **Phosphates – this is a fertilizing agent. Only harmful when built up in water ways**
- Read labels carefully.
- More information about soaps at:
<http://smartwatersavings.blogspot.com/2009/10/greywater-soaps.html>

Where to use Graywater

- Gray water should not be used on:
 - root vegetables or leafy green vegetables
 - sprayed directly on to any edible part of a plant
 - Watering lawns
- Ideal uses for graywater include fruit trees, ornamentals, berry/bean/tomato vines, roses
- Some natives including field sedge, canyon price giant rye, salvias, California fuchias, manzanita, toyon, blue elderberry, ironwood, torrey pine, monterey cypress, coyote brush, quail bush, coffeeberry

Learn More

- Water Harvesting Tour: Saturday, November 20 2:00 p.m.
 - Talmadge
 - Suggested \$5 donation
 - RSVP: brook@h2o-me.com
- Rain Barrel Making Workshop: Saturday, December 4 9:00 a.m. – 12:00 p.m.
 - City College
 - \$65 fee, \$5 donation goes to Seeds at the City farm
- Rainwater Tank Installation: Saturday, December 11 TBA
 - Roots Wild Willows Farm
 - Fee TBA
- Ocean Friendly Gardens, Surfrider Foundation

Resources

- www.h2o-me.com
- www.smartwatersavings.blogspot.com
- <http://www.sandiego.gov/water>
- <http://www.projectcleanwater.org>
- <http://www.sdcoastkeeper.org>
- <http://www.knowyourh2o.org>
- <http://www.thegarden.org>
- <http://www.bewaterwise.com>
- <http://www.h2ouse.org/>
- <http://www.sandiegotank.com/>
- <http://www.harvestingrainwater.com/>
- <http://www.rainharvest.com/shop/default.asp>
- www.tank-depot.com
- www.arcsa.org
- www.bushmanusa.com
- <http://oasisdesign.net/>
- brook@h2o-me.com
- Publications: Brad Lancaster, Rainwater Harvesting For Drylands
- Art Ludwig: Create an Oasis with Greywater