

WATER CONSERVATION PAPER

Intro

As seen in the Water Online (www.wateronline.com) newsletter.

Water is becoming rare in the future. Against this backdrop, it is clear how important it is to man and industry to have an efficient, high-capacity potable water supply and to have eco-friendly wastewater treatment for the planet as well as for the development of entire regions.

Population Growth Drives Water Demand

Water Scarcity Impacts Energy Generation

Public Health Depends On Clean Water

Water is the most important future market worldwide.

We must act now because...

Healthy and livable communities need clean and adequate freshwater

Ecosystems can experience abrupt, nonlinear change! When a particular ecosystem component crosses a threshold it sparks accelerated change that reverberates throughout the system.

Human activity is reducing the resilience of many natural systems and increasing the possibility of crossing ecological thresholds. Although science can confidently say that ecological thresholds exist, it is extremely difficult to predict at what point they will be crossed and whether the subsequent effects will be reversible. We must take a proactive, precautionary approach to foster the resilience of our freshwater ecosystems and avoid crossing ecological thresholds.

PREP

Collecting Rainwater

Environmental trends come and go, but one that seems to be taking hold is the surprisingly simple practice of rainwater collection for harvesting and reuse and rainwater gardens for aquifer recharge. The challenge with impervious surfaces in nearly any development including roofs, roadways, paved paths, and driveways is dealing with the volume of runoff they create. These can increase runoff up to 300 percent in some residential and suburban developments. In urban and commercial developments, the increase in stormwater runoff can be as much as 1000 percent. Fortunately there are potential benefits; this concentrated water can be collected and stored for multiple uses.

Wikipedia has defined Rainwater Harvesting as “the accumulating and storing, of rainwater for reuse, before it reaches the aquifer.” Rainwater harvesting has many uses such as providing water for drinking (potable water) and non-potable uses such as irrigation of lawns, landscape, golf courses, gardens, toilet flushing, car and equipment washing and livestock operations.

Rainwater harvesting may be the new, trendy “green” thing to do and water conservation is somewhat of a media darling these days but as is the case with most trends, the increase in adoption of

rainwater capture and reuse strategies is largely driven by economics. Residential and commercial property owners in the United States and Canada have generally been blessed with low water rates and are accustomed to opening the faucet, irrigating landscaping, flushing toilets, and other high water use activities without the worry of calculating the financial implications. However, inexpensive, bountiful water is becoming a thing of the past in many areas, including N. Calif. Higher water rates and surcharges for excess water usage and extensive local and regional droughts have stressed water supplies. This has caused heavy users to consider alternative sources of water, particularly for non-potable uses.

In the arid west, water conservation has long been on the radar screen. Mark Twain is given credit back in the 1800's for the quote: "Whiskey is for drinking; water is for fighting over." Now, this mindset is moving Eastas homeowners, commercial developers, and building owners are becoming better educated and eco-conscious about water usage and conservation. In most cases, water from rooftops is very inexpensive because it doesn't have to be collected, sent to a centralized treatment facility to be treated to drinking water standards, then pumped through a network of leaky pipes back into circulation for customer use at an exorbitant fee. Roof runoff can be easily reused for non-potable needs resulting in cost efficiencies and a lower potable water usage footprint.

In general, rainwater harvesting will have applicability in any region of the country when nonpotable indoor and outdoor demands can be met using rainwater as a supply. These uses constitute a significant water demand and consume a high percentage of potable water. The substitution of rainwater for potable water in appropriate applications is appealing to consumers because of the cost savings that result from lower water bills. When residential and nonresidential properties use potable water for outdoor irrigation, for instance, they are **not only paying for the cost of the drinking water used, but also a cost for wastewater treatment for water** that does not then enter the sewer system or flow to a treatment plant.

Roof types

If rainwater is used as a potable drinking water supply, treatment for the water becomes necessary. The untreated, captured water is not of drinking water quality because some roof materials are toxic and the roof may contain bird droppings or residues from local industrial operations. **Asphalt and wood shingles** are treated with potentially toxic chemicals, while not suitable for potable, indoors or pond water, these roofs **are very suitable for landscaping**. Potable systems are gaining popularity in arid climates and while some of the same principles apply, additional equipment for filtration and treatment of the captured water is essential. Treatment is not necessary for rainwater collected for residential irrigation; however non-potable indoor, pets and commercial uses do require some level of treatment such as ultraviolet disinfection, ozone treatment or filtration of volatile deposits.

Rainwater Harvesting Systems

The harvesting of rainwater is nothing new; it has been conducted for thousands of years, however it is reaching a whole new scale due to the innovation and ingenuity of the systems now available in the marketplace. Large and small systems are both effective and similar in configuration, if not in scale. There are many products available that can be scaled for typical rainwater harvesting systems. The basic concept is to route the roof drainage to a holding tank(s). After separating and discarding the first roof washing, the remaining water drains

directly into the tank(s), which can be above grade or below, and have a pump, or drain via gravity from a spigot in the tank.

The sizing of the system depends upon the application, the desired usage, and local climate conditions, the amount of rainfall received and the length of the irrigation season. In cases where a homeowner wishes to irrigate flowers, landscaping, or a vegetable garden, a smaller tank in the 300-500 gallon range may suffice. This size tank can be placed above grade (or below) and a pump may not be necessary. In the case where the homeowner wants to irrigate their lawn then tanks in the 1000-3000 gallon range are common. In commercial applications, multiple connected large tanks can be used with pump mechanisms and filtration. Large, multiple tank systems are in most cases installed below grade. There are many website tools available to assist a homeowner in sizing their rainwater harvesting system. Generally speaking, the size of the storage tank should be big enough to meet the daily water requirement for the intended use throughout the dry season (this varies geographically) and the roof or catchment area should be large enough to fill the tank. Most Americans use between 50 and 70 gallons of water per day for routine household activities. The amount of rain or pond water needed for irrigation is site specific due to the range of potential plant materials and varying climates.

There are a number of manufacturers that offer rainwater catchment products and systems, which provide efficient and affordable options for commercial and residential systems. Hobbyists wishing to do these changes can find many used items at much cheaper prices.

System Components

The number and style of tank and the associated piping, pumps, filtration systems are case specific and the selection of the system components truly depends on the system size and the end use of the collected water. When a homeowner or builder needs a larger storage volume, additional tanks can be installed side-by-side.

Other smaller-scale systems that are readily available for non-potable rainwater collection include rain barrels and rainwater pillows. In both cases the principal is the same however these systems are ideal for individual homes or smaller systems with gutter and downspout configurations

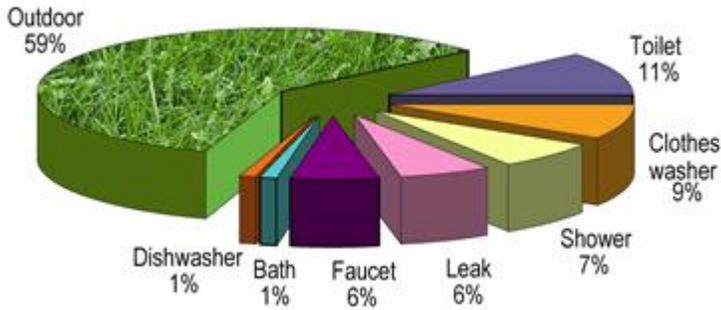
Water Saving Ideas for residential water use (including pond water supply & disposal thoughts)

Saving water starts with you! Simple adjustments can save you money.

Remember leaks can account for a lot of water waste inside an average single family home, so be sure to repair them right away! For help with water efficiency, *call your local water service to schedule a free Waterwise house call*

Now that the weather is starting to warm up, focus on saving water outside your home.

Residential Average Water Use



Source: American Water Works Association Research Foundation, End Uses of Water

FOR OUTDOOR AREAS

Even without a pond, more than 1/2 of our water is used outside and most of that for watering the landscape.

September and October is the time to cut back on your irrigation.

The easiest way to save water is to reduce the length of time you irrigate. When the weather is cooling down reduce irrigation to 2 or 3 days a week. If you see runoff in the gutter, turn down the rate or the length of time you irrigate.

We recommend reducing the number of watering days and/or the number of minutes from your summer watering schedule. Typically during September, plants need only about 75% of the water that they do during peak summer in July; in October, they need only about 50% of peak water use. See the table below for typical monthly percentages compared to July for the Stanford area. Sprinklers can be turned off in the winter months, for areas that are exposed to rain.

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul |
|-------|-----|------|-----|-----|-----|-----|-----|
| | 10% | 15 | 25 | 50 | 80 | 95 | 100 |
| Aug | 80% | Sep | Oct | Nov | Dec | | |
| | | 75 % | 50 | 30 | 5% | | |

Typical Monthly Percentage Comparison of Landscape Water Need Using July as Basis – Using 5 year Average (2008-2012) for the Stanford Area Season

Do not let the water run while washing your car. Install an adjustable spray nozzle on your hose. Clean your car using a bucket and sponge, then spray the car down to rinse it.

Alternatively, consider taking it to a commercial car wash that recycles its water.

Let your lawn go dormant (brown) during the winter. Dormant grass only needs to be watered every three to four weeks, less if it rains.

Apply water only as fast as the soil can absorb it. Split your watering time into shorter periods to allow for better absorption. Water your plants deeply but less frequently to encourage deep root growth and drought tolerance. If walking across the lawn leaves footprints (grass blades don't spring back up), then it is time to water.

Minimize evaporation by watering during the early morning hours when temperatures are cooler and winds are lighter. Don't water your lawn on windy days when most of the water blows away or evaporate.

Plant [water-wise plant species](#) reduce lawn sizes and substitute with low water use ground covers. Consider using the [California Fescue](#) or other climate appropriate bunchgrasses where grass is desired.

Avoid planting grass in areas that are hard to water, such as steep inclines and isolated strips along sidewalks and driveways. Group plants with the same watering needs together to avoid overwatering some while under-watering others. Use a layer of organic [mulch](#) on the surface of your planting beds to minimize weed growth that competes for water.

Use [drip irrigation](#) for shrubs and trees to apply water directly to the roots—where it's needed.

Use sprinklers that deliver big drops of water close to the ground. Smaller drops/ mist often evaporate before hitting the ground.

Periodically check your sprinkler system for leaking valves and broken/misadjusted heads.

Adjust your watering schedule each month to match seasonal weather conditions and landscape requirements. (See monthly chart, above!)

Install a rain sensor on your irrigation controller so your system won't run when it's raining. Learn [how to set your controller](#) properly. (Few people understand how to water different areas!)

Lacking a moisture sensor on your watering system, shut off your irrigation controller during rain events or if sprinklers are malfunctioning.

Water the landscape using the water being dumped from the pond

Use a broom to clean the driveway or sidewalk.

Know where your master water shut-off valve is located. Were a pipe to burst, this could save lots of water and prevent damage.

Use your water meter to check for leaks. Water meters are usually located near the roadway at the front of the property. To check for leaks turn off all faucets and water using appliances on your property, then note the needle's position on your water meter dial. Do not use any water for approximately 15-30 minutes then check the needle's position again. If the position has changed, you may have a leak. Many newer meters also have a small "tattle tale" triangle that spins when water is being used. If this is spinning while all water is turned off on the property, you may have a leak as well.

When checking for leaks, remember to check garden hose fittings. They are the most common leaks in the garden!

Pond water conservation

Use a pool cover to keep your pool clean, reduce chemical use and prevent water loss through evaporation. Check for pool leaks. Make sure your swimming pools, fountains and ponds are equipped with recirculating pumps.

Dump water changes to landscape

Using pond water to water the landscape eliminates the impact of the pond. Untreated pond water, with nutrients, is a very healthy source for the plants.

I usually install a hose bib at the outlet of the pump and have connected a drip line to the front yard and water the front with pond water. (A very easy installation and the plants love it!)

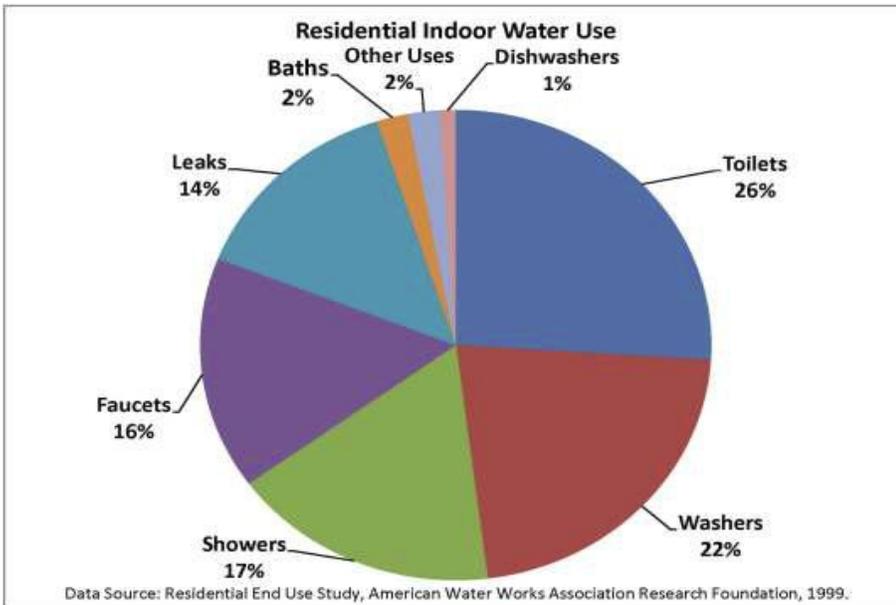
For high TDS sources (most of the East Bay), determine water TDS of tap and change water before the pond water TDs is twice the tap water!

For people who like to try different ideas, distilled water for return to pond may be feasible using a few solar cells for power to operate a still.

Evap rate w/solar pv is 1lb/kw/H

RO is normally wasteful in both water and electricity! If the waste water is used for irrigation, water is not wasted. However, ROs normally use high pressure pumps which consume more power than our recirculating pumps.

Water saving thoughts for the home's interior



In the Laundry & Bathrooms...

Turn off the water while brushing your teeth and shaving.

Take advantage of the rebates and replace all inefficient toilets and clothes washing machines. New toilet design has resolved poor flushing problems!

toilets

Check your toilets for leaks. Drop a little food coloring or leak tablet into your toilet tank. Wait a few minutes. If color shows up in your bowl (without flushing), you have a leak. The most common toilet problem is due to worn out flappers. For in-depth toilet repair instructions, visit the [East Bay MUD water saving tips](#).

Install a high efficiency toilet, new toilet models use as little as 0.80 gallons per flush. An in-depth look at the different high efficiency models is available at <http://>. Consider buying a dual-flush toilet (fig. 6). It has two flush options: a half-flush for liquid waste and a full-flush for solid waste.

Flush the toilet only when necessary; don't use it as a waste basket.

Spend less time in the shower; try to limit your showers to five minutes or less and turn the water off while you apply soap.

Time your shower and keep it under 5 minutes and save up to 1,000 gallons per month. While you wait for hot water, collect the running water and use it to water plants.

Improvements

Install water-saving shower heads or flow restrictors. Santa Clara County residents can get free water saving devices from the [Santa Clara Valley Water District \(SCVWD\)](#) or find inexpensive, easy-to-install devices at your local hardware or plumbing store.

There are kits that transfer **hot water to the cold water** line at the most remote faucet and run the low temperature 'hot water' into the cold water line until the hot water heats up.

Install small water heater at remote faucet to eliminate running the hot water until it heats up.

Use the [WaterSense® label](#) as a guide when purchasing toilets, sink faucets, urinals and showerheads. Take advantage of [rebates](#) for purchasing water-efficient/Energy Star laundry machines.

FOR KITCHEN & LAUNDRY

Fill the kitchen sink with water to wash and rinse dishes.

Scrape dishes rather than rinsing. Newer dishwashers don't require pre rinsing.

When washing dishes by hand, don't let the water run. Fill one basin with wash water and the other with rinse water.

.When using your dishwasher or laundry machine run only full loads or adjust settings.

Dishwashers typically use less water than washing dishes by hand.

Use the garbage disposal sparingly. Instead, compost vegetable food waste, or throw them in the garbage, and save gallons every time.

Collect the water you use while rinsing fruit and vegetables. Use it to water house plants.

Install water-saving [aerators](#) on all of your faucets.

Store a pitcher of water in the refrigerator for drinking, so you won't have to run the faucet to get a cold glass of water!

Designate one glass for your drinking water each day, or refill a water bottle

Water Wise Rebates

Prerequisite you need to complete a Water Wise house call before you can participate in the landscape rebate.

*High Efficiency Toilet Rebate – visit our website for more information at;
(http://lbre.stanford.edu/sem/water_conservation)*

*Clothes Washing Machine Rebate – for more information visit:
<http://www.valleywater.org/programs/waterconservation.aspx>*

Rain Gardens

In addition to collecting rainwater for reuse as a potable or non potable resource, many communities are moving away from traditional stormwater retention ponds and infiltration systems to rain gardens. These systems serve the purpose of collecting stormwater runoff onsite but also provide a community a beautification option that features water loving plants and landscape while allowing rainwater to be returned to the aquifer for recharge near the point of origin.

Rain gardening on a small and community-wide scale is a hot item in landscape design and is becoming popular with municipalities as a way to reduce challenges with managing stormwater runoff. This form of

gardening not only looks great and creates habitats for birds, beneficial insects and butterflies for a community but also brings people together toward solving community-wide stormwater problems created by impervious surfaces such as rooftops, drives, and roadways.

Most rain gardening incorporates native plants that are tolerant of local climactic fluctuations including natural wet and dry cycles. They use stormwater to nurture the planting but do not retain a permanent pool of water or incorporate major water or wetland features. In fact, most rain gardens drain within 24 hours, which is a substantial benefit, as they do not encourage mosquito breeding common with standing water situations. Another benefit is that because they are designed to drain within 24 hours, they can capture rainwater from successive storms without being overwhelmed.

Rainwater Collection in Action: High-Efficiency Rainwater Collection and Reuse System at the Charlottesville Waldorf School, Charlottesville, Virginia

When the Charlottesville Waldorf School (CWS) in Charlottesville, Virginia began its expansion project, the original focus was on designing the new facilities with very high-energy efficiency, low water use options and “green” building materials. A library, music and arts building and a large covered pavilion were all part of the 2010 expansion. Fortunately for CWS, local donors approached the architect and expansion directors with the offer of funding a rainwater collection system for toilet flushing and irrigation as an additional sustainability feature and educational tool for CWS. With the project already underway, engineers, architects, contractors, and the school were challenged to design a very cost efficient rainwater system, which could fit seamlessly within the current project design parameters. In addition, the team needed to go back to Albemarle County for approvals specific to the rainwater system.

Working in close collaboration on the design details with the County permit reviewers, plumbing inspectors and project engineers, Aqua Nova Engineering designed a cost efficient system that collects rainwater from about 9,500 square feet of standing seam metal roof on the new Music and Arts building and outdoor pavilion for non-potable uses at the school. The downspouts are connected to two transfer pipes that flow into filter screens. Clean water flows through the screens and into the storage tank, while dirt and debris are directed to the stormwater biofilter. Water is pumped out of the tank by a ½ HP submersible turbine pump and through two-stage filtration system. A UV disinfection unit is installed after the filters to provide fully disinfected water. The filtered and disinfected rainwater is used for toilet flushing in the building and watering of gardens and landscaping.

Conclusion

There are a number of manufacturers that offer rainwater catchment products and systems, which provide efficient and affordable options for commercial and residential systems. The system that is best for you really depends on the geographic and climactic factors in your area, how much water you intend to collect, how you plan to use the water and the type of installation that will fit best within the confines of your property or development. In any case, the key point to keep in mind is that the closer we return the water we use or that is delivered to us by nature to the point of origin, the better our aquifers can manage future use. And, the more we reuse the resources we have, the better we conserve them and protect the environment in which we live. There are a number of ways to save water...

Saving water is easy when you think about it. To see how water wise you are around your home, choose the practice that best describes your water use habits and ideas and we can talk about them.

For additional water saving tips, visit:

- <http://wateruseitwisely.com/100-ways-to-conserve/>

- http://lbre.stanford.edu/sem/water_tips

- AquaticEco

Pentaries <http://search.pentairaes.com/search#w=Search%20entire%20store%20here>

<http://www.sandiego.gov/water/pdf/waterwisegardening.pdf>