



## Who Can Catch the Rain?

**Never mind saving for a rainy day. How about saving for a dry one?**

According to Environment Canada, the forecast for 2004 is a drier than average spring and summer, wetter than average fall, and a drier winter.

Every time we build a new road, driveway or house, we disturb the natural rain collection areas that annually recharge our aquifers – and at the same time we add more “straws” sucking up those underground streams. Household water conservation is becoming crucial to sustaining our natural water supplies, and the use of alternative water sources such as rainwater is one effective water conservation technique. With the shortage of traditional water supplies, and the diminishing levels of the underground aquifers that feed the wells across western North America, including those on the Gulf Islands and the Sunshine Coast, many residents have returned to the ancient practice of harvesting rainwater. Who are these gatherers of rainwater?

- ◆ Gardeners who prefer rainwater for healthier plants.

- ◆ Rural and Island residents who need a sustainable water source for drinking and household use as an alternative or supplement to low volume wells that go dry in the summer, limited piped water supply, or poor quality well water.

- ◆ Those of us wanting an independent supply of water for fire and earthquake protection.

- ◆ Conservationists who strive for sustainable, efficient use of water resources.

Rainwater is a renewable, sustainable and quality water source for your cottage or home. It is soft, neutral in pH, and has no minerals to cause staining, pipe corrosion or smell. As well as being “nature’s watering agent” for gardening, disinfected, treated rainwater is an excellent water source for general household use – either on its own or as a supple-

ment to other water sources. Today, rainwater harvesting is popular in parts of Europe, Hawaii, and Japan, and mandatory in Bermuda, parts of Australia and New Zealand.

### What is A Rainwater Harvesting System?

A rainwater harvesting system catches the rainwater from the roof and gutters; transports the water through the downspouts and piping, and cleans it as much as possible before it enters the storage tank or cistern. A system can be as simple as capturing rain in a barrel for gardening or complex enough to include input from an architect, engineer, rainwater specialist, and filtration and water treatment specialist.

Catchment of rainwater for outdoor use is quite simple, but even for garden water, care needs to be taken

to reduce the amount of debris, i.e. pollen, bird droppings and organics that find their way to the storage tank. These organics can feed summer algae blooms in the tanks that negatively affect water quality and increase system maintenance.

Where rainwater is to be used inside the home, considerably more attention to collection techniques is necessary. This often includes debris catchment in the sealed transport piping, gravity filters and the use of a roof washer box. Final treatment of the rainwater will be discussed in the next issue of the *Watershed Sentinel*. An increased commitment to ongoing operation and maintenance is also required to ensure healthy, safe water.

A well-designed rainwater system will provide clean, safe water for your home or cottage.



1 inch of rain on 1 square foot of roof area produces 0.52 imperial gallons,

or 1 mm. of rain on 1 square metre of roof area produces 1 litre.

The wetter coastal climate and the Mediterranean climate (drier summers) of the Gulf Islands differ greatly in average rainfall amounts, and vary dramatically between different islands. For example a house with 1000 square feet of roof area in an area like Salt Spring Island would collect over 15,000 gallons in a year with average rainfall (assuming a 75% capture ratio).

## How Much Water Do I Need?

When calculating the amount of water you need, seriously consider what you want your system to do, and add conservation measures that fit your lifestyle. Calculate the total water use for the year. How many people? Is it a cabin or full time residence? Indoor use or gardening only? Many of the water districts in the Gulf Islands report use levels of 50-60 gallons per person per day (G/P/D) for fulltime resident households. Rainwater dependent users consider 40 G/P/D a maximum, and some are as low as 25-30 G/P/D. Cottage users are typically in this range.

Toilets and washing machines account for 1/2 of indoor water use. Low flush toilets (3 to 6 litres per flush), can lower indoor water use by as much as 15% and pay for themselves by reducing storage requirements. Other water-saving appliances include – dishwashers, washing machines, and composting toilets. Outdoor use can account for 1/2 of total summer usage. Selecting drought tolerant plants and setting up drip watering systems can reduce this by 50%.

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## How Much Rainwater Can I Collect?

The amount of water you can collect from your roof depends on three things:

- ◆ **Annual rainfall in your area.** Visit the Environment Canada website for monthly/yearly averages [www.climate.weatheroffice.ec.gc.ca/climateData/monthlydata\\_e.html](http://www.climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html).

- ◆ **Size of your roof - Measure** the area as the horizontal plane under the roof including overhangs

- ◆ **Proportion of the actual rainfall you can collect.** The collection efficiency ratio is based on factors such as evaporation loss from prevailing winds, tree cover, type of roofing, and the sizing of the pipes for storm events, etc. Well-designed systems capture 75-85% of total rainfall.

Total potential water capture can be calculated using the following simple formula:

## A Word about Design

Planning ahead and careful design of a rainwater harvesting system will improve your system and save money in the long run – especially for new construction.

The designer will be able to:

- ensure appropriate sizing of storage for your needs;
- allow for future adaptations as your needs grow;
- help you to catch a larger proportion of the available rainfall,
- ensure clean safe water, and
- reduce your future maintenance time and costs.

# TIPS FOR DESIGNING YOUR RAINWATER HARVESTING SYSTEM



## Roofing

Metal and tile roofs capture greater quantities and better quality water.

Asphalt shingles are adequate but collect less water in summer and are harder to keep clean.

Water collected from cedar roofs is acidic for plants and is impractical for indoor use.

Avoid such contamination sources as lead flashings.

## Gutters

One-piece, baked aluminum is standard and, for best results, should be installed with a slope to prevent ponding of water.

Gutter guard or debris free gutter systems are necessary where arbutus and maple trees are close by.

## Downspouts and Catchment Piping

Traditional aluminum down-spouts can be used in many cases to get the water down from the gutters.

Sealed PVC piping is often used close to the ground, and where the water needs to be transported horizontally. This piping must be sized for good flows, storm events, and easy cleaning.

Gravity flow to the cistern is ideal as it requires no power. Gravity flow to a surge tank and pumping to the cistern is a viable alternative where there is dependable hydro service.

## Filtration

Leaf traps and debris catchers are built into the catchment piping, and high capacity mesh filters can be installed to prevent most of the debris and organics from entering the storage tank.

## Roof Washers

For household water systems, a roof washer is used to reduce the airborne pollutants such as pulp mill smoke or organic material that collects on the roof or in the gutters. Roof washing refers to rejecting the first water that falls on the roof surface. Several US studies found that the first 0.5 mm of rainfall (from a metal roof) carries with it 80% of the contaminants. This helps ensure clear safe water that reduces the demand on the water treatment system. Roof washers are sized according to the footprint of the house.

## Storage

Water storage is the heart of a rainwater system – especially given our dry summers.

To determine your minimum water storage requirements combine your monthly demand with the monthly rainfall in your area and the size of your roof. Storage size must be sufficient to get you through the dry summer months. The dryer the summers, the larger the cistern! For example a 2 person, full time household in a dry area like Salt Spring Island would require 10,000 gallons of storage. This assumes an indoor water use level of 40 gallons per person per day, and a 2,000 sq. ft. roof collection area. For summer garden use, a 2,400 gallon tank would provide about 8,500 gallons of water in a typical summer. The similar figures for Bowen Island, with almost twice the rainfall, would be about 3,000 gallons of storage for a full time household and a 2,400 gallon tank would provide 12,000 gallons of summer garden water.

Storage cisterns take many forms. The most common are the above ground molded polyethylene tanks, from 300 gallons to 2500 gallons. For larger applications, the Rainwater Connection supplies and installs steel polypropylene-

**SUSTAINABLE LIVING**

lined cisterns 4,000-30,000 gallons that are made of culvert steel, structurally engineered, and easily transportable to most sites. The liner has a water potable rating. (NSF 61). These tanks can be partially buried, tucked away in the woods, or situated under decks. Other storage options include in-ground concrete cisterns, and ponds.

Don't forget to consider winterizing measures and specialized fittings for emergency water exits. Ensure good access for cleaning and avoid direct sunlight if possible.

**Water Disinfection and Treatment**

Treatment of rainwater is often simpler than treating water from wells or surface streams. Rainwater for indoor use requires a filtration and disinfection system to remove such things as parasites, bacteria, and virus from bird droppings, as well as insects, and wind blown materials that are carried onto the roof. Toxins leached from the roofing system can include heavy metals, petroleum products, algae, moulds, and yeast. (Note that many of these problems are also found in well water.) Filtration products can be found at [www.watertiger.net](http://www.watertiger.net). Look for Wilf Scheuer's article on Water Treatment in the next issue.



**RAINFALL AND WATER CATCHMENT VARIATIONS**

Location	Annual Precipitation	Summer Precipitation (June – Sept)	Annual Catchment (from a 1000 sq. ft. roof at 75%)	Summer Catchment (from a 1000 sq. ft. roof at 75%)
Saturna Island (Capmon)	33.1 inches (840 mm)	5.1 inches (130 mm)	12,900 gal.	2,000 gal.
Salt Spring Island	38.1 inches (975 mm)	4.9 inches (125 mm)	15,000 gal.	1,900 gal.
Cortes Island (Tiber Bay)	49.4 inches (1255 mm)	9.1 inches (230 mm)	19,700 gal.	3,550 gal.
Bowen Island	67.8 inches (1,700 mm)	9.8 inches (250 mm)	26,400 gal.	3,800 gal.

**NOTES:**

Precipitation averages are from Environment Canada records and range from 10 to 20 year periods. Catchment amounts in imperial gallons

**The Rainwater Connection**

The Rainwater Connection is committed to rainwater as an alternative source of high quality water for residential, agricultural, and industrial use. As well as designing and installing systems for private residences, Bob Burgess consults to government and the development community, and promotes the use of rainwater through public presentations and workshops. Visit our web site at [www.rainwaterconnection.com](http://www.rainwaterconnection.com) or e-mail [bburgess@pacificcoast.net](mailto:bburgess@pacificcoast.net)

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# To Catch the Rain (Part 2)

## Filtration and Treatment

by Wilf K. Scheuer

Rainwater collection can be a viable alternative to drilled wells for a potable water supply in the coastal area of BC. The entire west coast from Washington State – BC and up to Alaska is blessed with an abundance of precipitation from October to March. Collection and storage of rainwater is ideal in coastal areas as we rarely have to worry about freezing.

With proper planning of collection piping and storage capacity, sufficient rainwater can be harvested to supply water for a cabin or full time residence. Environment Canada has a comprehensive website at [www.msc-smc.ec.gc.ca](http://www.msc-smc.ec.gc.ca) which has a library of weather history for the entire country. You may access data showing average rainfall for your area by the day, month and year. A 1-inch rainfall over a 1500 square foot roof will yield a total of 780 imperial gallons of water. If your area receives 40 inches of rain a year, the gross rainfall potential for a 1500 sq. ft cabin is 31,200 gallons. The reality is that some of this water is lost to overflow, evaporation, operation of roof washers and filters. A carefully designed rainwater system will capture 75% of the rainfall received on the roof. Typical storage recommendations for cabins are from 3000 to 8000 gallons. For a full time residence 15,000 gallons of storage is required to assure sufficient reserve for the dry months

### The Ideal Design

The ideal rainwater collection system design starts with an overview of the house and site location. Rainwater is collected from the roof into a primary or flash tank with

a minimum size of 300 gallons. 500 gallons is recommended. The flash tank will typically be sized to hold all the water collected with a typical west coast storm event of at least 1 inch. The flash tank allows for the settling of heavy debris, can incorporate a skimmer to draw off floating pollen and should be easily accessible and cleanable. Include a 2 inch drain at the bottom of the flash tank to allow for easy cleanout. Ensure that the tank has a manhole for good access from the top for cleaning.

From the flash tank the water should flow by gravity (or by a transfer pump if required) into a Davnor BioSand filter that will remove debris, parasites, bacteria, algae, organics, suspended solids, and organic matter. A built-in flow control meters the water into the BioSand filter and gradually filters all the water as it passes from the flash tank into the clean water storage tank(s).

### Clean Rain, Fresh Water

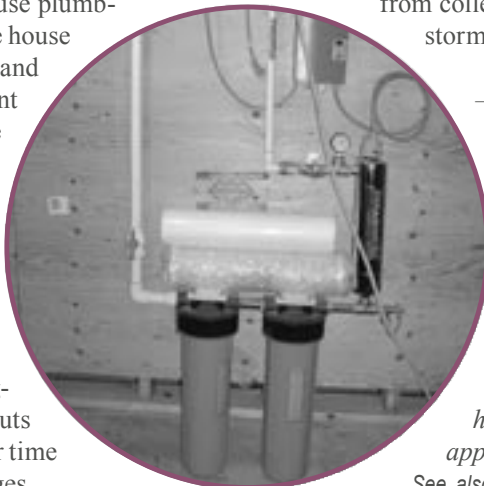
It is extremely important to eliminate as many pollutants from the rainwater as possible before it hits the storage tank. This will avoid growth of algae and bacteria in the tank and make your life much easier! (For rainwater we recommend the Model 240 Davnor BioSand filter priced at under \$1800, which comes with a mechanical float and clean-in-place system)

Depending on the size of the storage tank a circulation loop with filter and UV light can be used to keep the stored water fresh. A small air compressor (**low cost aquarium**

**bubbler kit with air-stone and tubing is under \$40 at Walmart**) is used to bubble air into the storage tank which helps to keep the water clear. The bubbler, filter and UV would typically run on a timer and is set to circulate to keep the growth of microorganisms under control in the tank.

Addition of bleach to 2 parts per million dilution (12 - tablespoons per 1000 gallons) also helps. Bleach should be added at least once a month. A pressure pump pulls water from the storage tank and into the house plumbing system. A final 4.5 x 20 inch whole house - dual gradient 25/01 - micron filter and Trojan UV light provide final treatment and disinfection for the water before it enters the house. An optional 4.5 x 20 inch carbon filter can also be used to polish the water and improve taste. The UV light and both carbon and sediment filters cost less than \$1000.

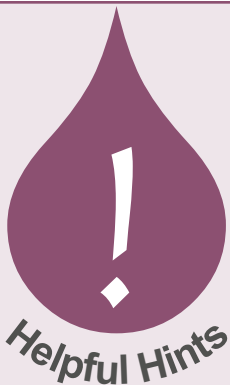
We recommend the Trojan UV Model D as it has a built in voltage regulator that can handle power brownouts and surges and has a digital readout for time used on the UV bulb and error messages.



A good approach is to utilize a team approach when designing and installing a rainwater system. The overall design should include input from the architect, builder, rainwater specialist, filtration specialist and plumbing contractor. A well designed rainwater system will provide sufficient high quality water for your home or cottage in areas where drilling a well is not possible or the groundwater is of poor quality. There is a certain satisfaction gained from collecting and using rainwater that makes a stormy day that much more enjoyable.

– *Wilf Scheuer is the president of both Tiger Purification Systems and Pro Star Mechanical. Tiger is involved in the sale, design and installation of large and small water purification systems on Vancouver Island and the Gulf Islands and has completed work for NASA at Kennedy Space Center. Wilf Scheuer has been working in the water industry for 35 years and has considerable experience in system applications and operation.*

See also *Who Can Catch the Rain?*, Part One of this series in the July/August 2004 *Watershed Sentinel*



◆ An inexpensive battery operated irrigation timer (**under \$60.00 at Home Hardware**) can be added to the circuit so that the water in the clean water storage tank can be easily circulated without additional pumps. Install a tee after the UV light that is installed after the pressure pump to the house, and route a ½ inch line back to the top of the storage tank. Set the irrigation timer to open twice a day for 2 – hours and the well pump will cycle on demand and circulate water from the tank and thru the UV light. The timer can be adjusted as desired.

◆ Specialty fittings such as roof washers, basket strainers, diverters, are used to remove debris from rainwater downspouts and piping. The actual piping should be sized for good flows and easy cleaning. 3 inch PVC is economical and will provide a good flow rate and resist plugging. Install clean-out fittings at changes of direction to aid cleaning. Dirt pockets with clean-outs are a good idea at the bottom of risers. Provide for a bypass or overflow to direct excess rainwater away from buildings and foundations in heavy storms when all tanks are full.

Some west coast storms can dump 4 inches per day!

◆ Avoid the temptation to shop for the least costly equipment when it comes to water purification products. The lowest price usually means the product will not be around in a few years and parts will be hard to obtain. Water purification equipment plays an important part in protecting your health and the approach should be to obtain top quality equipment and ensure you have a complete design with a multiple barrier approach.

◆ Service the system on a regular basis. It is important to keep the eavestroughs clean. They should be flushed out every month in the collection period.

◆ Avoid collecting rainwater in the pollen season in early spring – when the yellow goo sticks to your car windshield, remember it is also all over the roof! I personally like cleaning my eaves in a good downpour. With my trusty rain jacket on and hood up, I can quickly disconnect the collection system, clean out the debris and let mother nature flush out the residue prior to re-connection. Be careful on slippery roofs – a good idea is to attach some safety eyes to the structure and use a rope and safety harness. We are lucky that we do not have to worry about lightning in this area!

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← *Rainwater filtration continued*



Photos: Equipment installed for a new coastal home on Vancouver Island using a 15,000 gallon tank, a 2500 gallon in ground flash tank plus a second 1000 gallon flash tank that are pumped to a BioSand filter, and then up to the 15,000 gallon tank. Inside filters include sediment, carbon, UV, plus a small RO (reverse osmosis) unit for drinking water. The RO is set up for zero waste, all rinse water is re-used.

### Advantages of rainwater over well water

◆ Many wells on the Gulf Islands and coastal areas require treatment for removal of one or more of: hardness, iron, manganese, silt, and rotten egg gas (H<sub>2</sub>S). These problems require the installation of one or more filters such as: water softeners, multi-media filters, iron filters, and/or greensand filters. These filters are expensive and require constant maintenance. Rainwater is free of these problems.

◆ Well water in coastal areas can also contain high levels of heavy metals, boron, fluoride, and/or arsenic, which are directly hazardous to health and require additional expensive treatment technologies that include reverse osmosis and special resin filters. Disposal of backwash water can also present problems.

◆ Drilling wells and installing deep well pumps is an expensive proposition. Costs for drilling are \$15.00+ per foot. Wells can be anywhere from 200 to 500 feet deep. Costs for well drilling on Gulf Island areas can be many thousands of dollars with no guarantee of a good water supply. Homes that have wells with slow pump rates can incorporate rainwater storage for additional supply.

◆ Salt water intrusion from the ocean is a real problem for waterfront lots. Salt intrusion in well water can make the water unusable in dry months for some Gulf Islanders, the alternative is to install an expensive desalination RO unit. There is no salt in rainwater! A rainwater system with storage tanks can be used to provide water during the dry months. The stored rainwater will reduce dependence on well water or it can be mixed with well water to drop salt levels.

◆ Many Gulf Island wells have low water output with flow rates from 0.5 to 3 gallons per minute. This makes it difficult to maintain softeners and iron filters, as they require a higher flow rate for weekly backwash. Rainwater is soft and iron free!

◆ There is a trend to build off-grid cabins and homes. Rainwater collection can be set up so that pumps are not required and gravity BioSand filters are a good complement as they do not require power to operate.



**Considerations in designing a rainwater collection system**

**The Roof**

Calculate the area of the roof and rainfall levels. Calculate the amount of rainfall that can be collected. Evaluate the type of roof - is it metal, asphalt, cedar shakes, tile? Smooth surfaces retain less pollen and dirt, and are easier to maintain. A metal roof is the best choice, cedar roofs are the least suitable as they add tannins plus retain a lot of debris.



**Flow**

Review the design and placement of eaves troughs, downspouts and flashings to collection points. Plan piping for gravity flow to a flash tank and filter system. Grade eavestroughs so there are no flat spots to collect dirt. Avoid small downspouts.

**Roof debris and clean outs**

Allow for removal of roof debris which includes pollen, bird droppings, roofing materials, i.e. shedding from asphalt shingles, tannins from contact with cedar shakes, leaching from tar and metal roofs. Basket strainers, roof washers, and drain points are used to

remove debris. Filtration is required for tannins, metallic elements, and asphalt. Overhanging fir and cedar trees will drop large amounts of debris onto the roof which will plug the system. Overhanging trees should be removed or trimmed.

**Tank placement and size**

Verify the location of tanks and the maximum size that can be used. Plan for good access for cleaning and placement to allow for gravity flow. Avoid tank placement in direct sunlight if possible.



**Water Usage**

Calculate total water usage for the year – is it cabin or full time residence, how many people? In the city typical water usage is 60 gallons per day per person. For 2 people this would mean 43,800 gallons per year. With rainwater collection the usage must be reduced to a lower level of no more than 40 gallons per day per person. Conservation is required to avoid running dry in the summer months!

**Conservation ethic**

Adopt a water conservation ethic – shower together, forget the big soak in the tub every night, use water

conserving fixtures, re-cycle grey water for flushing toilets and watering plants, minimize waste by repairing leaks and dripping faucets.

**Filtration**

Filtration – rainwater requires a filtration and disinfection system to remove silt, dirt, macro living and dead organic matter, leaves, etc. Parasites, bacteria and virus from bird droppings, insects, and wind blown materials are carried onto the roof. Colour, taste, and odor from decaying organic matter rinsed off the roof can



foul the storage tanks. The filtration system must have multiple barriers. Note that many of these problems are also found in well water in addition to hardness and iron. Generally filtration of rainwater is a simpler task than well water filtration. Filtration products for rainwater systems can be found at [www.watertiger.net](http://www.watertiger.net) A multiple barrier system will include strainers and roof washer, settling tank, BioSand filter, bubbler and circulation system for the clean water tank, and a whole house fitter system with UV light disinfection unit for the final stage.

