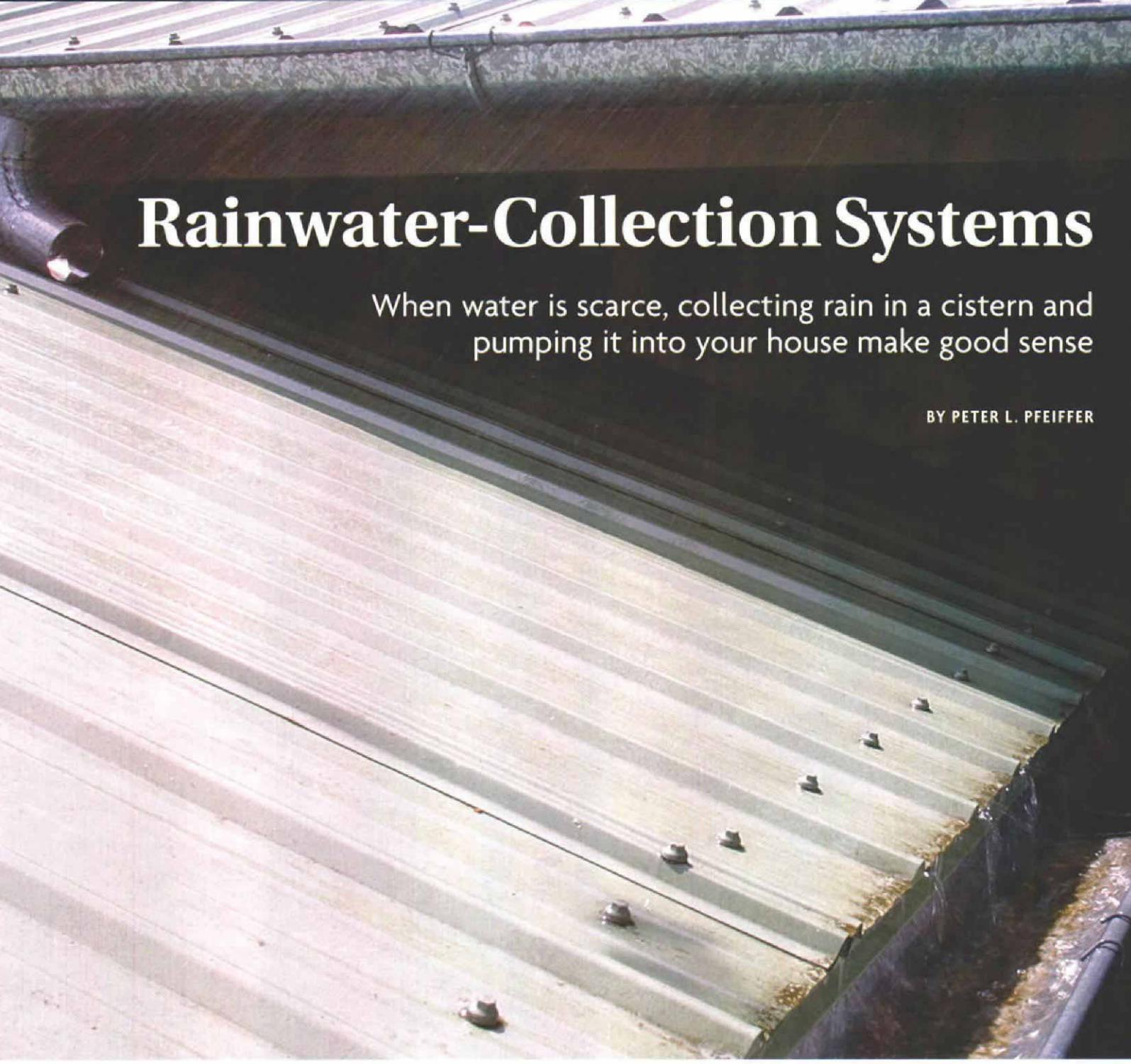


Rainwater-Collection Systems

When water is scarce, collecting rain in a cistern and pumping it into your house make good sense

BY PETER L. PFEIFFER

Stop for a moment. How many times today have you opened a tap to let fresh water pour out without giving it a second thought? If you're like most folks, you've probably taken a shower, brushed your teeth or filled a drinking glass, not to mention flushed the toilet or run the dishwasher.

But for many of us, especially in the Sunbelt, clean, fresh water is fast becoming a scarce commodity. As the population grows, more and more homes are being built in outlying areas. At most of these homes, domestic water comes from wells that draw from overtaxed underground aquifers. These same homes often rely on septic systems that percolate effluent into the same aquifer that quenches our thirst. It's especially problematic in this area where health-department standards vary widely and where the fractured limestone beneath the topsoil makes an ineffective filter.

A collection system starts with a good collection surface

My architectural firm has been designing and building rainwater-collection systems for more than 12 years. Most of these systems are installed with no backup supply, such as a well or city water, but are fitted with oversize storage instead. (A family of four needs 3000 gal. to 4000 gal. of water per month, and I try to size systems to hold at least ten months' supply.) Over the years, these systems have evolved so that they can be built with reasonably priced off-the-shelf products, and when installed properly, these systems require minimal routine maintenance.

The first part of the collection system is the collection surface, and the roof on just about

any structure, whether it's a house, a pole barn or a garage, works well (drawing p. 87). The smoother and less porous the collection surface, the less filtering of water is required. I recommend unpainted-metal roofing, such as Galvalume Plus.

Galvalume Plus is sheet metal coated with zinc and aluminum. It holds up better to deterioration from the elements than the older G-90 galvanized coatings, and it is priced competitively. Galvalume Plus has a protective acrylic coating instead of oil, which is commonly used on other types of metal roofing. So water from the first few heavy rainfalls doesn't need to be discarded as would be the case with oily coatings. Painted metal roofs, especially dark colors and even when factory-applied, eventually oxidize and create more stuff to be filtered out of water.

Composition shingles, clay tiles and concrete tiles are rougher and more porous than metal roofing. Consequently, they tend to collect dirt and harbor mildew, ultimately adding to filtering requirements. I'm especially wary of composition shingles because they are hydrocarbon-based products. Composition shingles also tend to shed their surface granules into gutters, which can clog a filter system quickly.

Gutters and downspouts deliver collected water

The next task is moving collected water to its storage tank, or cistern. Gutters and downspouts are the first step in this process (photo facing page). A good, reasonably priced gutter for rainwater collection is the large (6 in. wide) seamless aluminum variety with 5-in. downspouts. The maximum run of gutter should not exceed 50 ft. for each downspout. Large-dimension gutters and downspouts have a much larger carrying capacity to collect every drop of those gully-washer rainstorms.

Aluminum gutters and downspouts are relatively inexpensive, and they won't rust the way galvanized gutters tend to. However, half-round gutters made of copper or Galvalume are my favorites. They have a nice look, and the curved bottom keeps them clean. Debris doesn't build up in them the way it tends to in a flat-bottom gutter.

Downspouts should be sized to provide 1 sq. in. of cross-section area for every 100 sq. ft. of roof that they serve. So a 5-in. by 5-in. downspout should safely handle about 2500 sq. ft. of roof area. I don't recommend leaf strainers or cover screens over the gutter where downspouts connect because they tend to create leaf dams. Instead, oversize gutters and downspouts allow debris to be flushed. Debris is then collected for dis-

Why collect rainwater?

Those of us without rainwater-collection systems probably get our drinking water either from a well or from a municipal water supply. In many areas, the aquifers that feed our wells are fast becoming polluted with nitrates from lawn fertilizers as well as septic systems.

Municipal sources aren't much better. If not fed by wells, cities usually get their water from lakes or rivers. These lakes and rivers are fed by polluted runoff, which comes from paved areas covered with oil and chemical byproducts from internal combustion, as well as runoff from overfertilized lawns. City water systems usually pickle the water with large quantities of chlorine and other chemicals to make it safe to drink.

Before it hits the ground, rainwater is clean distilled water. So rainwater collected from a relatively clean surface, such as a metal roof, is captured before it becomes contaminated by contact with the ground or pavement. Here in Austin, Texas, which boasts a pretty good municipal water system, collected rainwater has one-quarter the amount of typically measured contaminants.

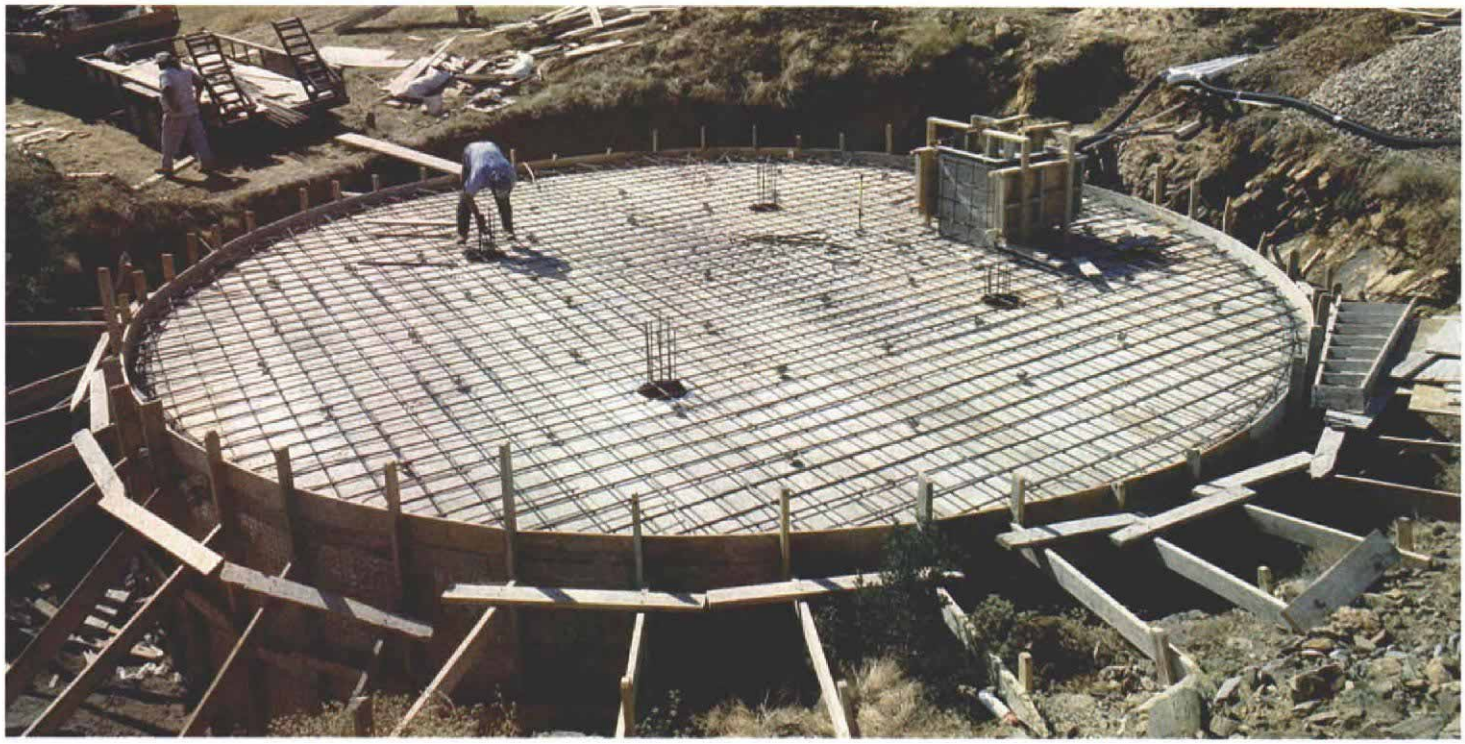
In the Austin area, collected rainwater is also about 1/20 as hard as typical well water. This softness makes rainwater a more aggressive cleaning agent; soft water does not contain minerals that can clog appliances.

As an added benefit, food and drinks taste better when they are prepared with clean, nonchlorinated water from a rainwater-collection system. And humans aren't the only beneficiaries of collected rainwater. Plants also grow better with rainwater, which is slightly acidic and tends to balance the pH of our slightly basic soils.

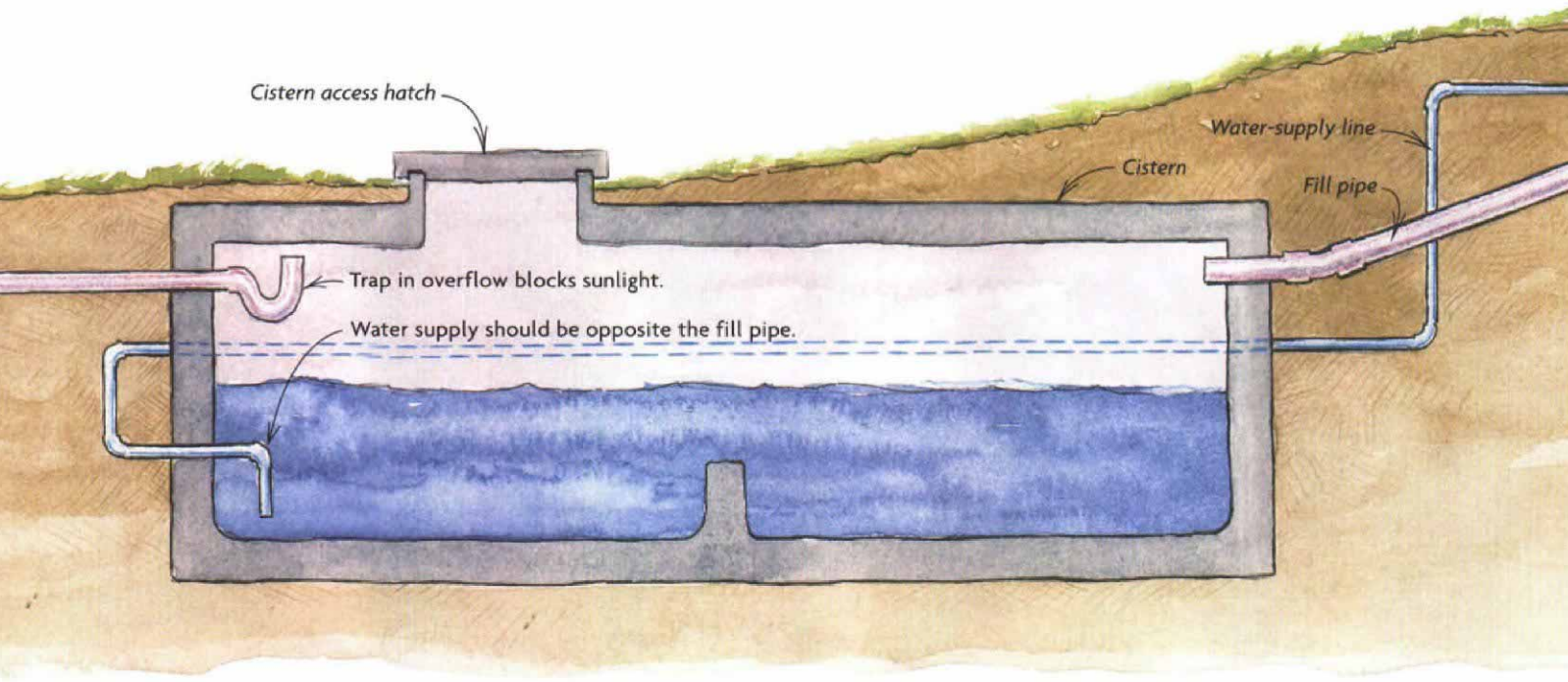
–P.L.P.



Two clean alternatives to city water. The water in the glass is rainwater from a cistern, the cover of which is visible in the background. Filtered rainwater is many times cleaner than city water, and drinking too much of it won't give you a hangover.



Putting the lid on 37,500 gal. A reinforced-concrete lid is ready to be poured on top of this in-ground concrete cistern that will hold up to 37,500 gal. of rainwater, enough to keep a family of four supplied for ten months.



posal at a roofwasher, or prefilter, which I'll discuss later.

To carry water to the cistern, I recommend 4-in. schedule-40 PVC pipe. Plastic sewer pipe should not be used because it can be crushed. All pipe sections should be connected with watertight, cemented joints.

This pipe should be installed at a minimum slope of 5 in. per 100 ft. of run, but a greater slope of ¼ in. per ft. is preferred. To minimize the chance of clogging pipes, any change of direction in horizontal-pipe runs should not exceed 45°. We always include an ample number of clean-outs in the pipe just in case. Clean-outs should be installed at every location where a downspout feeds into a collector pipe and at any place where the collector pipe makes a sharp bend.

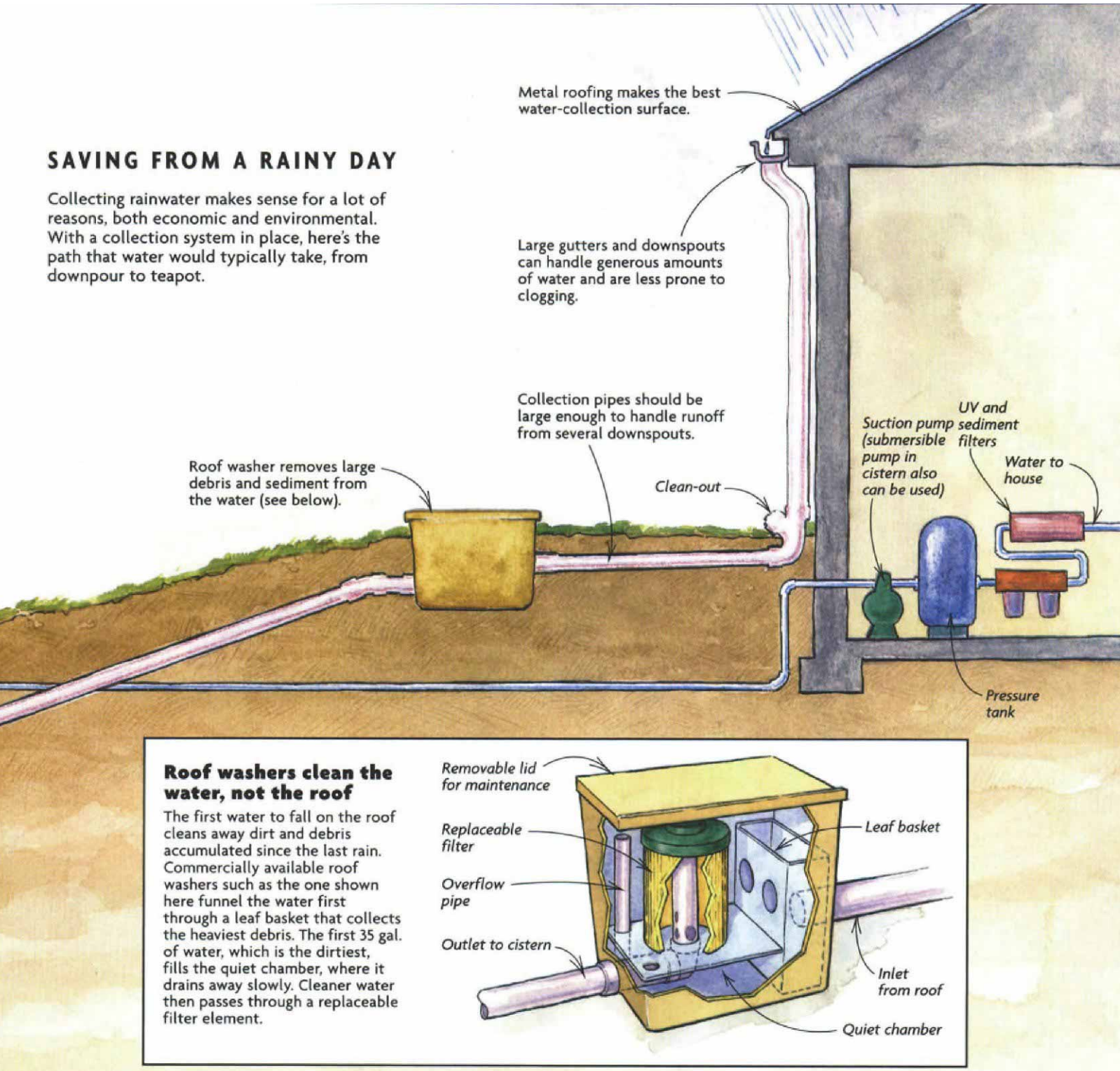
Rainwater takes a bath

The next stop on the rainwater's journey is the roofwasher, a device that filters the water before it gets to the cistern. I've seen roof washers built from scratch, but building one is expensive and time consuming. Instead, we use a product made by The Water Filtration Company (waterfiltrationcompany.com; 800-733-6953) of Marietta, Ohio. Their roofwashers outperform anything I've ever seen built on site and cost about $600. Multiple roofwashers can be hooked up in parallel to handle larger roof-debris loads. The sizing and number of roofwashers in a sys-

Photo this page: Peter L. Pfeiffer. Drawings: Dan Thornton.

SAVING FROM A RAINY DAY

Collecting rainwater makes sense for a lot of reasons, both economic and environmental. With a collection system in place, here's the path that water would typically take, from downpour to teapot.



Roof washers clean the water, not the roof

The first water to fall on the roof cleans away dirt and debris accumulated since the last rain. Commercially available roof washers such as the one shown here funnel the water first through a leaf basket that collects the heaviest debris. The first 35 gal. of water, which is the dirtiest, fills the quiet chamber, where it drains away slowly. Cleaner water then passes through a replaceable filter element.

tern depends not only on the area of the roof but also on the amount of debris that is likely to land on the roof from nearby trees.

Here's how a roof washer works. Between rains, some dirt and debris collect on every roof. The first rain that hits the roof takes most of this stuff with it. Inside the roof washer, this water enters a leaf basket (inset drawing above), where any heavy debris such as leaves or twigs settles out. From the leaf basket, the first 35 gal. of water (the dirtiest) enters what is called a quiet chamber, which is separated from the rest of the roof washer by a baffle.

None of the water from the quiet chamber ever makes it to the cistern. Instead, that quiet-chamber water slowly drains out of the chamber through weep holes that have been drilled in the roof washer's overflow pipe. After the quiet chamber is full, the cleaner rainwater entering the roof washer passes through a cleanable, replaceable filter element. This filtered water is what finally fills the cistern.

Make sure the cistern is big enough

A cistern is a large storage tank that can be either aboveground or below ground. Cisterns can be made from a variety of materials. Aboveground tanks are usually fiberglass (bottom photo, p. 88) and typically range in capacity from 250 gal. to 10,000 gal. Several tanks can be plumbed in series to provide ad-



Next stop, your drinking glass. A submersible pump in the cistern sends water first to the pressure tank (far right in photo). The water then runs through a sediment filter (bottom center) and is purified in a UV-filter (top center).



Aboveground tanks need a roof. Fiberglass tanks installed aboveground can be used for water storage, but a roof is needed to keep fiberglass from breaking down in the sunlight. Water does not stay as cool as with in-ground tanks.

ditional storage. Concrete cisterns built in the ground (photo p. 86) can easily have storage of 30,000 gal. to 40,000 gal. or more.

I usually don't recommend aboveground fiberglass tanks unless the storage required is fairly small. They are hard to hide or blend into the landscape, and water tends to warm up, not desirable when you're looking for a cool drink at the tap. The sun's ultraviolet light breaks down fiberglass, so these tanks should be placed under a protective roof.

When costs are added up, fiberglass storage tanks end up saving little compared with below-ground concrete cisterns. In our area, most swimming-pool contractors can use shotcrete to build a concrete cistern for around $20,000 to $30,000, or 75¢ per gal. stored. After the tank is finished, a cover is formed and poured on top. Cistern covers are supported by columns inside the tank and are 8 in. to 12 in. of reinforced concrete.

Concrete cisterns have benefits besides cost and large capacity. First, drinking water stays cooler below ground. Concrete cisterns also can be hidden due to their relatively shallow (5 ft. to 6 ft.) overall depth, so their tops can be landscaped or even serve as putting greens (photos facing page). Underground cisterns have also been used as tornado shelters. You might get wet, but at least you're alive.

One feature we've begun incorporating into our concrete cisterns is a center dividing wall 2 ft. to 4 ft. tall. Each side of the cistern can then be drained off separately, allowing one side to be cleaned or repaired while a supply of water remains on the other side.

Making rainwater fit to drink

Water is usually pumped from the cistern with a 1-hp to 2-hp submersible pump at the cistern. Coupled with a 44-gal. pressure tank, enough water pressure can be produced for a typical household. The tank and pump are the same used in a well-water system except for the fact that the collection system requires a smaller pump. A suction pump can be used instead of a submersible pump if the cistern is within 50 ft. of the pump and pressure tank and if the cistern is not more than 15 ft. to 20 ft. downhill from the pump.

When stored water is pumped from the cistern, it has to be filtered a second time before it's okay to drink (top photo). This second filtering occurs after the water has been pumped and pressurized. Here, water passes through a standard sediment filter, usually one with a 30-micron element. The water next passes though a UV-filter, which kills any bacteria and leaves water ready to drink. We use a UV-filter called Mighty Pure (Atlantic Ultraviolet; 631-273-0500; ultraviolet.com).

Bottom photo this page: Peter L. Pfeiffer



Mighty Pure filter systems cost $500 to $600 depending on their size, and they need to be replaced annually or more often depending on the volume of water used.

Collecting water calls for trade-offs

If you're serious about water collection, the first big design trade-off is roof configuration. The simpler the roof design, the easier it is to run gutters and downspouts. Simple roofs also tend to collect less debris.

The second big trade-off is placement of the cistern. Finding free space in your yard for a tank 25 ft. to 35 ft. in dia. and 6 ft. deep may not be easy. However, most stand-alone water-collection systems are built for houses in the country, where space usually isn't a big issue.

Landscaping can be one of the biggest points of water consumption for a house, so we encourage xeriscaping, or landscaping with indigenous plants that need minimal watering (putting greens notwithstanding). And last, rainwater-collection systems need a small amount of routine maintenance. Gutters, downspouts and pipes have to be kept clear of clogs, and roof washers should cleaned regularly. If roof washers are properly maintained, the cistern itself should need cleaning only every five to eight years. □

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Photos by Roe A. Osborn, except where noted.



A big hole in one. **The large flat cover of a cistern can be topped off with a patio or even a putting green (top photo). However, most cisterns are buried beneath the landscape with only the access hatch showing (bottom photo). Here, the owner and his dog use a long dipstick to check the water level in the 50,000-gal. cistern below the open hatch.**

Top photo this page: Peter L. Pfeiffer