Try a gravity flow water system

By Don Fallick

Backwoods homesteaders usually need to develop their own sources of water for drinking, cooking, washing, sanitation, and irrigation. The traditional solution in the U.S. is the deep well. Even where surface water is available, health codes usually ban development of such water for household use. This makes sense for drinking water, but most of the water used on a homestead is not consumed directly by human beings, and can be safely used for irrigation, watering livestock, and bathing. Cooking and drinking water accounts for only a small percentage of all the water used. Why then go to the expense and trouble of extracting more of it than necessary from deep in the earth if it is available on the surface?

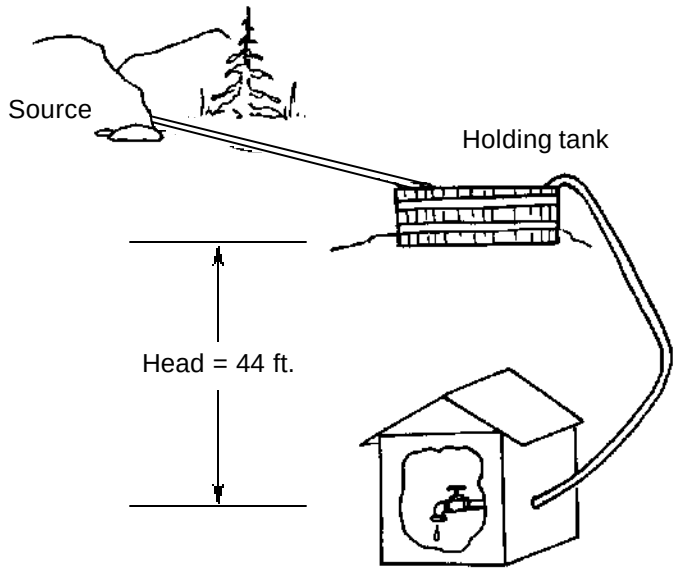
Water sources

Gravity flow systems include all systems where water pressure is primarily provided by gravity, regardless of the actual source of the water. Nevertheless, some sources lend themselves to gravity-powered delivery. Water from streams, ponds, springs, and artesian wells can be used directly, or can be stored in a settling basin or cistern before entering the system.

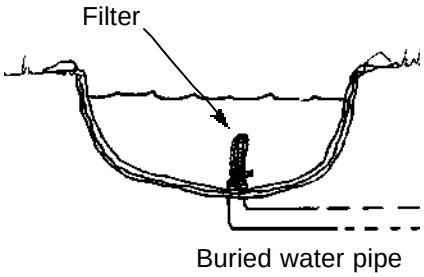
This allows for settling out of silt, mud and trash, and helps equalize pressure in the pipes. Water in small streams tends to flow in surges, which can affect the function of sprinklers and other appliances. Springs and artesian wells are really just ways of tapping into underground streams, and they suffer from the same problem.

Tapping a spring

You may have a spring on your property—a place where water seeps from the ground or from a hillside. To tap it, remove the dirt until you have exposed bare rock, with water seeping from a crack. Enlarge the crack with a sledge hammer and star drill, until you can get a steel pipe into the crack. Then *carefully* drive the pipe in until you get a steady flow from the pipe. *Don't drive the pipe any farther.* The underground stream feeding the spring may be quite small. If you punch a hole through the other side of it with your pipe, you may lose all the water as the stream finds a new channel.



A gravity flow water system.
Pressure = Head / 2.2 = 44 / 2.2 = 20 psi.



A simple holding tank: a bowl-shaped hole in the ground, lined with six or eight mil plastic sheeting. You can line the hole with cardboard or old carpeting to protect the plastic.

A lone pine or serviceberry bush growing on a hillside can be an indicator of an invisible spring, since both require lots of water and have short roots. Check this out by dowsing or other means, though. Tree roots can get through crevices in rocks that pipes will never penetrate.

An artesian well, or tapped spring, can be piped directly into any gravity flow system, or can be filtered or run into a settling basin, or holding tank.

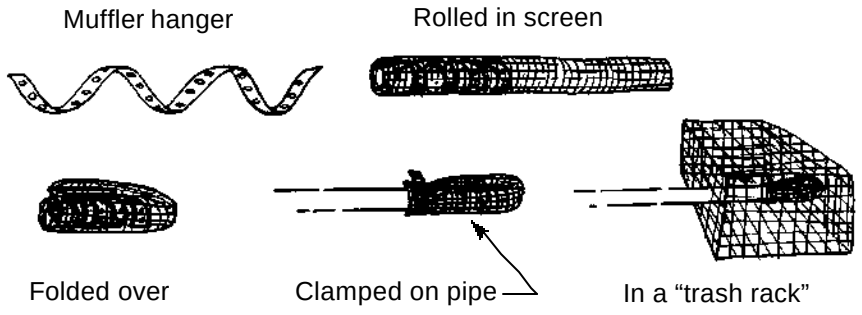
Holding tanks

These can be commercial metal or plastic water tanks, or they can be made from livestock watering tanks. They can also be made from ferro-cement in any shape or size, and can last for years. But the cheapest, and perhaps simplest, holding tank is just a bowl-shaped hole in the ground, lined with plastic sheeting. Pierce the plastic at the bottom for the outlet pipe, which should stick up six to eight inches, to allow for silt and mud accumulating in the bottom. Pull a generous amount of plastic up around the pipe, and fasten it to the pipe with

silicone glue and two hose clamps. It's always a good idea to attach a small filter, to keep out bugs and dirt.

I make my filters from a two-foot-long piece of galvanized steel, muffler-hanging tape—the kind with holes punched in it. It's rust resistant and available cheaply in any auto parts store. Coil the tape around a dowel or broomstick, then stretch the coil into a rough cylinder about an inch in diameter and eight inches long. Place the cylinder on an 18" square of nylon window screen, with the end in one corner of the screen, and roll the cylinder up in the screen, forming a screen tube with a metal helix in one half of it. Fold the empty screen over, closing off one end of the filter. Then clamp the whole thing onto the end of the pipe with a hose clamp. If your pipe is black "poly" irrigation pipe, it may not be stiff enough to clamp the filter to. If this is the case, insert an ordinary, straight connector into the pipe before installing the filter.

The rolled and folded-over screen makes a filter with very small holes, yet provides enough total open area to avoid restricting the water flow. The muffler-hanging tape keeps the screen cylinder from collapsing. It will last for years.



An intake filter

Pressure

In a pure gravity flow system, the pressure at point of use can be calculated by dividing the head (vertical distance between the intake and outlet) by 2.2. For example, if the source is 44 feet above your faucet, water pressure in the faucet will be 20 psi (pounds per square inch). Most appliances are designed to operate on standard city pressure of about 35 psi. To achieve this pressure, the head would have to be 77 feet. Since few of us are lucky enough to have a water source 70 to 100 feet above us, most gravity flow systems are also low-pressure systems.

For most applications, we can make up for low pressure by using large diameter pipes. A 1" pipe has a cross-sectional area four times as large as a typical ½" domestic supply pipe, so my 1" bathtub supply pipe at 5 psi delivers a flow, in gallons per minute, equal to a standard faucet at 20 psi.

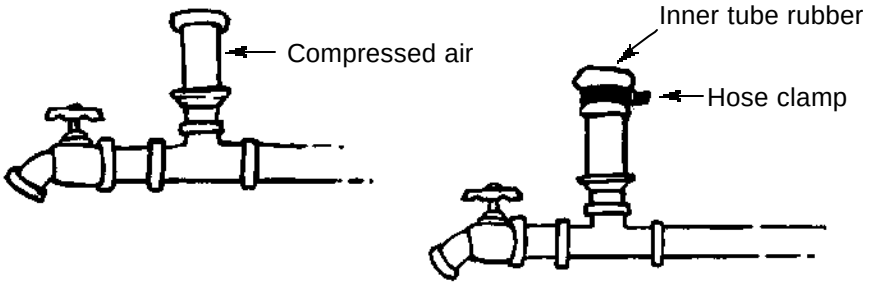
Two applications where this does not work well are tankless water heaters and pulse pressure water sprinklers. Users of both have complained that even brands claiming to operate on low pressure, don't. My experience with sprinklers is that some of the cheapest ones work fine on low pressure, while some of the most expensive "name brands" don't. Unless you can afford to experiment, get a guarantee from your dealer before purchasing any water-using appliance.

Water hammer

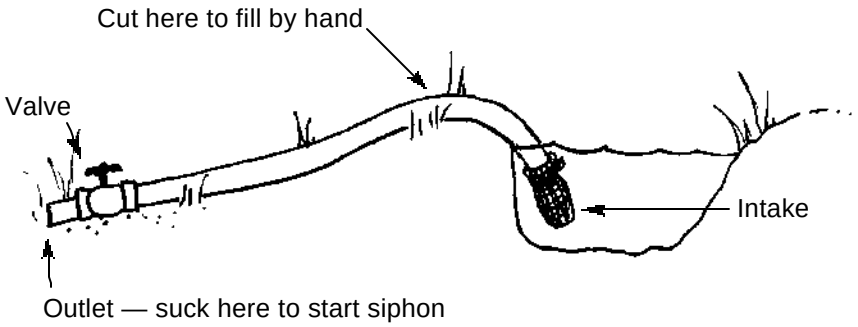
The pressure equation can work the other way, too. My neighbor has a water source ¼ mile away from his house, with a head of 150 feet. The 70 psi this generates was constantly blowing his pipe joints apart. Whenever he shut off a faucet, the shock waves created in the pipes (called "*water hammer*") would pop the nearest joint.

Water hammer can be eliminated by a commercial (and expensive) water hammer eliminator, or by a cheap, homemade variety. Eliminators work by using some elastic substance to relieve the instantaneous shock caused by the sudden stoppage of water under pressure. If you do not have a low pressure system, you'll need an eliminator as close as possible to each faucet or valve. Commercial ones use springs and/or compressed air. Homemade ones use compressed air or rubber.

To make a water hammer eliminator, place a tee in the water line on the supply side, as close as possible to the faucet. Using flanges or adapters, attach an 18"-long pipe, about twice the diameter of the supply pipe, to the



Water hammer eliminators



Siphon

vertical arm of the tee. For the compressed air version, this vertical tube is capped off, leaving it full of air. Air is compressible (water is not), so the air will absorb the shock wave when the water is shut off. Eventually the air will be absorbed by the water and will need to be replaced. For the rubber version, stretch a piece of inner tube rubber over the end of the vertical tube and fasten it on with a hose clamp. The rubber will eventually deteriorate and start to leak. The commercial ones last forever. Take your pick.

Streams and ponds

Taking water out of a stream or pond involves special considerations. Stream and pond water is dirty! Leaves and twigs, bugs, silt and mud are often present. Removing them requires more than just a pipe with a filter on the end. Streams also produce greatly varying water flow.

A small dam of rocks and mud, perhaps protected with sheet plastic weighted down with more rocks and mud, can provide a small catch basin to even out much of the flow variation. Placing the inlet midway between the surface and the bottom helps eliminate clogging with leaves, while allowing for settlement of silt. Even just a porous dam of rocks can raise the water level enough.

To trap sticks and wet leaves, enclose the filter in a "trash rack" made of rabbit wire, an old birdcage, recycled refrigerator rack, etc. Make sure you can get to it easily, as it'll need frequent cleaning in autumn, and anytime it is windy.

One advantage of using a stream is that you can "bury" your pipes in the running water to keep them from freezing. We have found that our 900 feet of 1" pipe won't freeze until the temperature gets down to 20° F., if we keep a faucet dripping at night. Running the pipes in the stream lets us extend our "running water" season by as much as a month and a half.

Floods

If your stream freezes in the winter and thaws in spring, or is subject to *any* chance of flooding, you'll need to secure your pipes against washing away. You can weight them down with rocks, to keep them away from cold air, but even rocks heavy enough to crush most "poly" pipes will be easily swept away by a small flood.

Tying a stout rope between the filter and a sturdy tree may hold the pipe against a fair flood, but the rope will break when hit by a moving boulder or a large chunk of wood. The trick is to tie the pipe to a large, yet still springy, branch. The branch can give enough to keep the rope from snapping, yet be strong enough to hold against the flood.

Of course, nothing will hold a pipe against a really big flood. If your stream is going to freeze anyway, it may be best to remove the pipes from the stream and drain them. I weave my drained pipes along the top of a fence, where they'll be up high enough to avoid getting stepped on by foraging deer. This means I have to re-lay my pipes every spring, but it's better than having to replace them every spring.

Siphons

Whether you run your outlet pipe through a dam or not, the pipe is going to have to come out of the streambed somewhere. When it does, the water in the pipe has to flow uphill briefly. You can make it do this by establishing a siphon. As long as the bottom end (outlet) of the pipe is lower than the top end (inlet), and there are no air leaks in the pipe, the falling water in the lower part of the pipe will pull water uphill from the source.

The most common ways of establishing a siphon are sucking on the pipe, filling the lower part of the pipe by hand, and running the pipe downstream far enough to push the water over the bank. This last method, called a reverse siphon, is generally the easiest to use. Sucking on the pipe is the hardest. Most people can't develop enough suction to lift water more than

Reverse siphon

two or three feet. If you have to suck on the pipe, make sure there are no burrs on the end to cut your tongue. By sticking your tongue in the end of the pipe while taking a new breath, you can increase your "draw" by a foot or two. If this is not sufficient, you may have to fill the lower portion of the pipe by hand.

Hand-filling a long pipe is tedious at best. Separate the pipe near the high point, plug the outlet or turn off a valve there, and pour water in, using a funnel. Pour slowly, to allow the air in the pipe to escape. A gallon of water will fill 20 feet of 1" pipe. If you have several hundred feet of pipe to fill, you could be pouring water for quite awhile.

A better way is to run the full length of the pipe down the streambed, until the water is flowing in the pipe. Cap off the bottom end, or better yet, install a valve there, and move the pipe where you want. If you've kept the pipe airtight, and the delivery end is below the intake end, the water should flow.

Another way is to run the pipe down the streambed until it reaches a point where the bank is lower than the intake end of the pipe. At this point, there will be enough pressure to force the water up and over the bank in a reverse siphon. If there's an important reason to bring the pipe out of the stream close to the upstream end, you can establish a reverse siphon, then move the pipe to cross the bank where you wish. In moving the pipe, take care not to kink it. Kinks that have not created a hole in the pipe can sometimes be straightened with a pair of pump pliers, such as Channel-Loks. If this does not work, you'll have to cut the kink out and rejoin the pieces with a connector. Be sure the connection is airtight. Any air leak will ruin the siphon.

Putting a shut-off valve in the line at the bottom is more than just handy. Sure, you can pull the pipe out of the creek at the top if you need to work on the plumbing, but you'll then have to re-establish the siphon. One-inch gate valves may seem expensive when you price them in the store, but they seem much cheaper when you're squatting in cold water, sucking on a pipe. D

Horseshoe Crabs

Horseshoe crabs grappling,
Along the tidal shore
Of the brook near Adams' Point
Locked in a prehistoric embrace
Smaller male relentlessly gripping behind
Bubbles rise from vents
Chinks in the armor
And long moments of coupled stillness

She digs into the soft sand near the edge.
It is a day-long embrace
In the silty, sunny water.
A nice day for it.
Other couples drift by
On the incoming tide
Down through the grass-lined meadow
Past the little boat house.
Solitary, spiny types
Committed just for now.

Patricia Soule
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