Chapter 10: Water Distribution

Particular attention must be paid to the distribution component of every cistern system because this final part of the process of rooftop rainwater harvesting is typically responsible for more water waste than the other three components (collection, conveyance and storage) combined. For example, when a pressurized pipe cracks 24" below grade, it will often go unnoticed until large quantities of water have already been wasted. Likewise, when a pump or automatic irrigation system gets stuck in the "ON" position, it doesn't take long for a full cistern to become empty. And if you get distracted and forget to turn off a hose running in your garden, your entire cistern could be drained in a short period of time.

The distribution of harvested water can be divided into two basic processes: the pumping of and delivery of water. Most conventional cistern systems require a pump to provide hydraulic lift and either a garden hose or a drip irrigation system to deliver water to the root zones of plants. Distribution systems can be manually operated, or they can be easily automated for an additional cost.

This chapter provides an overview of the components and functions of typical rainwater harvesting distribution systems.

Conventional Distribution Systems

In conventional distribution systems, water is lifted from the cistern by one of two types of electric pumps—a sump pump or an inline pump. After it is lifted out of the cistern, water is then typically delivered to the root zones of the plant material via two different irrigation techniques—hose watering and/or drip irrigation.

Sump Pumps

Sump pump systems are the least expensive kind of electric pumping systems available. Sump pumps must be submerged in water in order to work. A simple sump pump can be purchased for under $100 and be easily connected to a garden hose.

Note that the pump is kept slightly off of the bottom of the tank to prevent the intake of sediment and, therefore to reduce the frequency of having to clean, repair or replace the pump. The greatest expense associated with these types of systems is usually the hiring of a licensed electrician to connect the pump to the electricity in your home and to provide a safe and convenient ON/OFF switch. Another expense is the installation of a frost-free hydrant (also known as a hose bib), which does not require a licensed plumber or irrigator as long as the cistern is not connected to other water systems such as a private well or a local utility company.

All systems should provide relatively easy access to the cistern's serviceway so that your pump can be easily monitored, maintained, repaired and/or replaced. Inside the cistern, the sump pump should be attached to a cable, wire, rope or chain that can be used to remove the pump for such purposes.

Figure 10-1: A sump pump must be submerged in water in order to work.

Figure 10-2. Sample inline pumphouse with spin filter manifold

Inline Pumps

At minimum, inline pump systems require an inline pump and a pump house. The pump house protects the pump from the elements as well as from vandals and/or thieves. Pump houses are typically located underground (Figure 10-2), but they can also be constructed aboveground in a separate structure.

Like sump pumps, inline pumps can distribute water to plants by connecting directly into a garden hose. As with sump pump systems, in order to effectively run drip irrigation with an inline pump system a separate pressure tank is typically needed. However, one of the simplest inline pump systems features a small pressure tank built into the pump, which can be used for some drip irrigation applications.

Many inline pumps have a drain for winterization in the fall and a priming hole for start-up in the spring. The depth and slope of your pressurized lines will dictate whether you will need to drain or prime your pump.

One of the main advantages of having an inline pump is that the pump is easily accessible if it malfunctions. However, a leaky inline pump can flood an entire pump house quickly if an overflow pipe to daylight is not provided in the pumphouse.

Two Irrigation Methods

Typically, sump pumps supply the pressurized water necessary for hose watering, while inline pumps provide the water pressure needed for drip irrigation (and/or time-efficient hose watering).

Drip Irrigation

Drip irrigation (commonly known as "drip") directs water right to where plants need it—at their root zones. Using a network of poly-propylene tubing, drip irrigation releases a slow trickle of water through properly placed emitters. As long as this type of irrigation system is properly installed, closely monitored and efficiently maintained, drip is a highly efficient water-delivery method. Drip emitters are often located under mulch, so, with a drip system, very little water is lost due to evaporation. *In most cases, drip irrigation is the preferred form of landscape irrigation in New Mexico.*

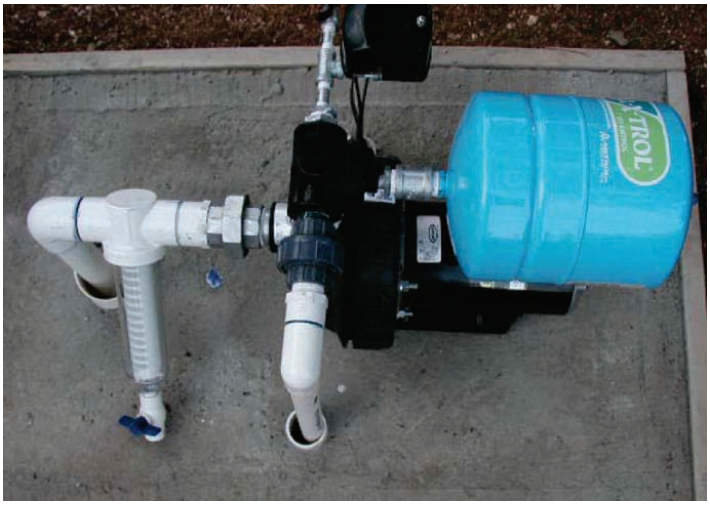

Figure 10-3: Inline pump and system controls with pressure tank

Figure 10-4: Drip emitters deliver water to plant root zones with very little waste.

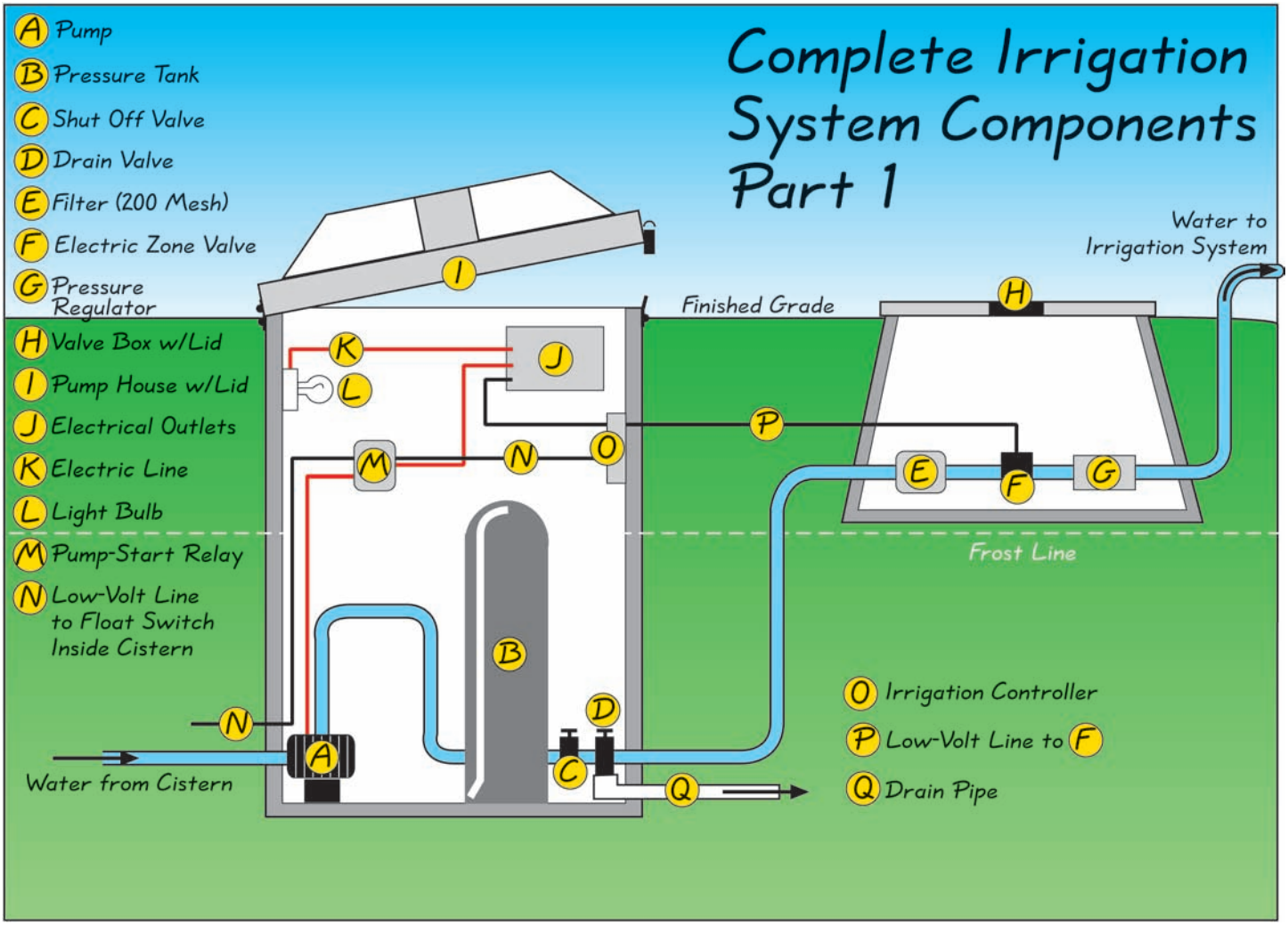

Figure 10-5: The components of a complete drip irrigation system. (Also see next page.)

For a more detailed and comprehensive discussion of drip irrigation, refer to *Low Volume Irrigation—Design and Installation Guide* published by the Albuquerque Bernalillo County Water Utility Authority (and available online from the Office of the State Engineer).

Cistern-related drip irrigation systems generally begin right after the pump lifts water from the cistern into the main water-delivery pipe. The first component that connects to this pipe is typically a pressure tank, which calls for water from your pump whenever water pressure in your system drops below a predetermined level. The pressure tank is an important item because drip irrigation requires reasonably constant water pressure in order to function effectively. For most systems, 15 to 30 PSI is a good pressure-tank setting. For most roof-reliant landscapes, an inexpensive six-gallon pressure tank is all that is necessary.

An inline filter is then connected to the main delivery line (labeled E in Figure 10-5). This small, inexpensive item, is a critical part of any cistern-related irrigation system. A standard drip irrigation filter in the 150 - 200 mesh range (i.e., between 100 to 75 microns) should be sufficient as long as the filter is regularly monitored and cleaned once a month. During the design and installation of your system, make sure you provide enough "elbow room" so changing and cleaning your filter(s) can be accomplished with relative ease.

Next in line is a small item called a pressure regulator, labeled G in Figure 10-5. The main role of a pressure regulator is to prevent water

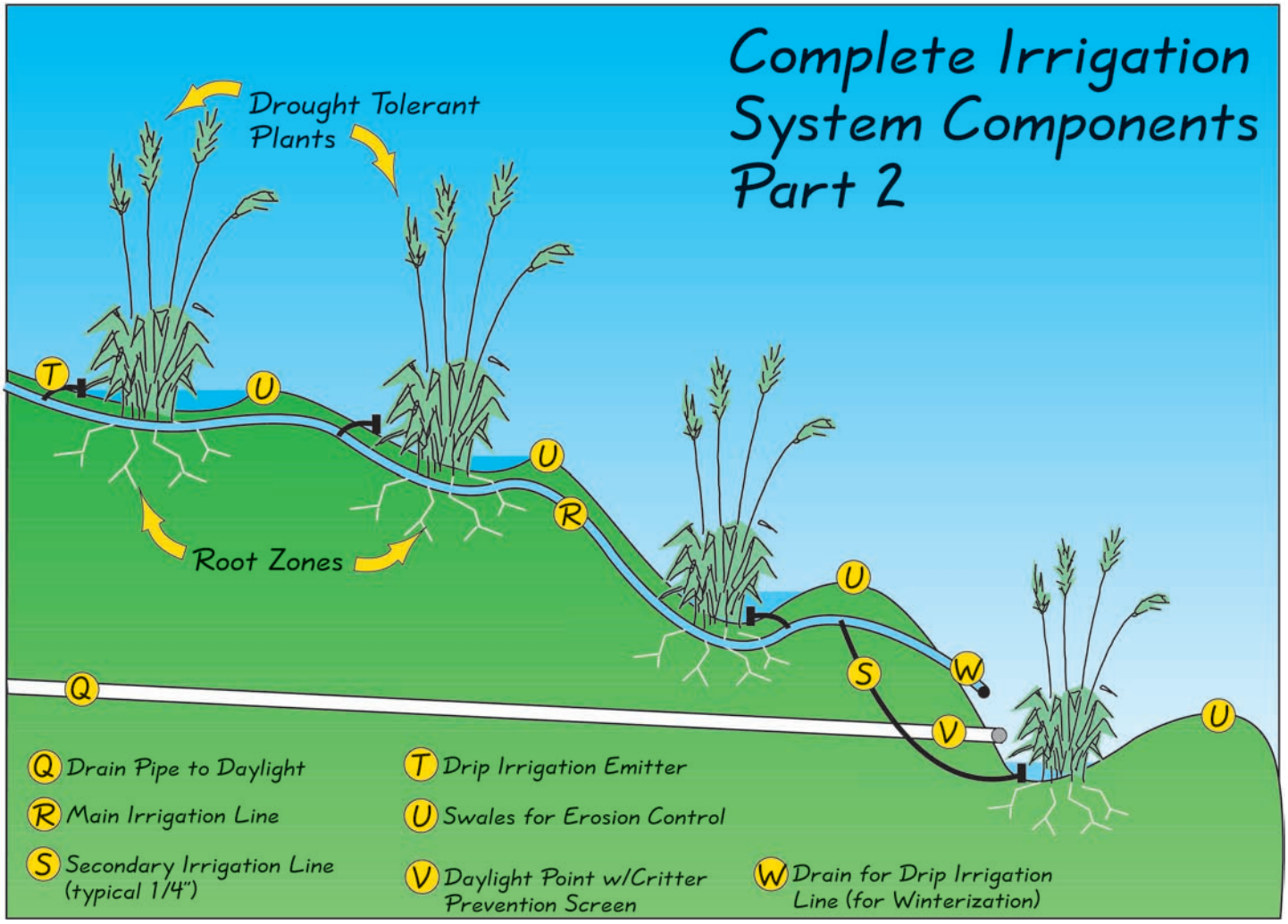

Figure 10-5 (Part 2): The components of a complete drip irrigation system.

pressure from getting too high in your system's delivery tubes.

If your system includes a frost-proof pump house or a self-draining sump pump, it makes sense at this juncture to install a frost-free hydrant, even if you plan to use drip irrigation exclusively. Frost-free hydrants can be used to water during warm, dry winters and they can be used to spot water in the summer. However, be sure to clearly identify your frost-free hydrant as a source of non-potable water and consider locking the handle. (NOTE: Purple is the Universal Plumbing Code's (UPC) color for indicating nonpotable water sources.)

This is often a good point at which to create a place for your system to drain. Most systems need to be drained before the first frost in the fall. The drain and its valve should be located at a lower elevation than all of the components that you wish to empty.

From this point, the distribution pipe will attach to an irrigation valve box (also called a manifold box). Such boxes are installed with their tops flush with grade. Inside you should have one valve for each irrigation zone.

Unless your system is manually operated, each valve will also be attached to a solenoid that is connected, with low voltage wire, to an irrigation controller. Separate watering zones are recommended for trees, shrubs and perennials, because each type of plant prefers a different watering schedule.

Figure 10-6: An irrigation controller can be programmed to automatically turn each zone of your irrigation system on and off.

After the valve box, delivery pipes are typically converted from rigid PVC pipe to flexible polypropylene tubing. Such tubing typically ranges in diameter from 1/2 to one inch. It can be buried under the soil, but, for ease of access, irrigation tubing is typically tacked to the surface of the soil with landscape staples and covered only by mulch.

Although an irrigation controller is technically an optional item, it is highly recommended to include a controller to automatically turn your drip system on and off. Irrigation controllers range from battery operated one-zone timers to high-tech clocks that offer a wide range of programming options, including controlling your irrigation system from a computer in the house (or halfway around the globe via the internet). An irrigation controller is worth the cost because of the time that it saves you from having to manually run zones from the valve box.

Another optional item is a digital water level meter. These devices provide you with a percentage of water in your cistern. Although some types can be tricky to calibrate when the tank is empty, digital level readers can be installed by the do-it-yourselfer.

Hose watering

On the other side of the distribution spectrum is conventional hose watering, which requires nothing more than an ON/OFF valve, a frost-free hydrant connected to a pump and someone willing to move a hose. A nozzle should be added to control the flow rate of water through the hose.

If you are considering watering with a hose, make sure you check your landscape design for ways that make this chore easier. Especially on steep sites, you can reduce watering time and effort by grouping your plants so that several can be watered efficiently with each hose placement. This can be accomplished by properly grading densely planted garden beds and also by placing the most water-thirsty plants closest to your spigot locations. With grading that effectively uses gravity, a hose watering system can leave much of the work to nature. Even if you are very committed to using drip irrigation, it is beneficial to also install a frost-free hydrant for spot watering with a hose.

Advantages and Disadvantages of Hose Watering

The best part about a hose watering system is the low cost of installation. There are no multiple valves, tubing, emitters, stakes or any other components of drip irrigation. There are also no trenches to dig and no water lines to cover up with mulch or soil. Hose watering includes, quite simply, a hydrant or valve at the point of hydraulic lift, a hose and a spray nozzle.

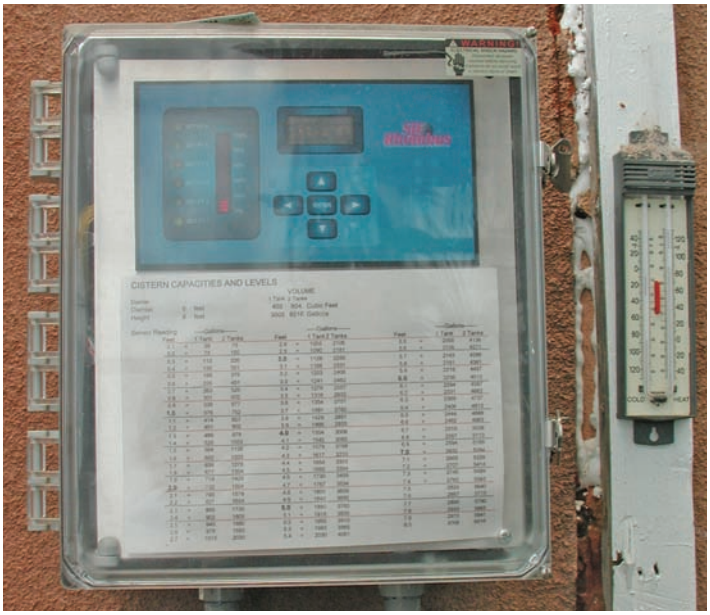

Figure 10-7: A digital water level meter indicates how much water is in the cistern.

The most difficult part of hose watering is that the watering needs to be done regularly, carefully and consistently until your plants are well-established. Many people simply do not have the time for hose watering by hand, so they often decide to spend the extra money for drip irrigation with its inherent precision and automation.

Low-Cost Distribution Alternatives

The vast majority of roof-reliant landscape designers will choose an electric pump to move water from the cistern to the distribution system. However, if the budget for your roof-reliant landscaping system is tight, here are two low-cost distribution alternatives that you may want to consider:

Hand Pump Systems

Hand pumps are traditional, manually powered devices that lift water often from a relatively shallow depth. Normally, such systems also include a watering can or bucket that gets filled up underneath the hand pump's spigot. This water is then hauled (or siphoned off) and poured onto the mulch covering the topsoil above the root zones of your plant material.

Hand pumps range in price from under $30 to about $300. Because licensed electricians and plumbers are not required for the installation of a hand-pump system, the actual cost for the installation of such systems is very low.

Hand pumps do not use any electricity, allowing you to eliminate this cost from your monthly expenses. In addition, hand pumps are not complex and therefore the long-term costs of maintenance for such systems are relatively low in comparison to conventional distribution systems.

There are a number of drawbacks associated with hand-pump, or manually powered, systems. For most people, the amount of time and physical energy necessary to pump and distribute harvested water throughout any given landscape is too much work. It is also not practical to connect a hand pump to a drip irrigation system.

Pump-Free Systems

The pump-free alternative is an option that only works in rare circumstances. Your property will need a sufficient slope and a landscape designed specifically for watering to occur using the force of gravity.

For every foot of increased elevation, the pressure in an irrigation tube increases by 0.433 PSI. The minimum pressure for drip irrigation to function properly is between 10 and 15 PSI, which means your plants need to be 25 to 35 feet below your cistern for gravity-fed drip irrigation to function as per the manufacturer's recommendations.

Just as you cannot have a pump-free system without the proper site, you can't have a pump-free system without the right person to run it. Pump-free systems take patience, a good memory and the ability to be available for a number of brief moments of time throughout the property's watering cycle.

Figure 10-8: A hand pump is an old-fashioned device that requires no electricity to operate—just human muscle power.