

# Chapter 2: The Basics of Cistern Systems

Every roof-reliant landscaper needs to have an understanding of how to collect water from a roof and how to divert this water to landscape plants or to a cistern for storage. This chapter provides an introduction to rooftop rainwater harvesting and gives an overview of both types of cistern systems—aboveground (the water tank sits at ground level) and below-ground (the water tank is buried underground). The terms and cistern system components introduced in this chapter are further described in detail in Chapter 8, Water Conveyance, and Chapter 9, Water Storage.

Rainwater harvesting systems are usually divided into two main types: simple (also commonly known as “passive”) and complex (also known as “active”). In a simple rooftop rainwater harvesting system, precipitation is captured from a roof and diverted directly to plants in the landscape. (Figure 2-1 shows an example of this simple approach.) Note that in this simple system, rainwater hits the surface of a roof and is gravity-fed downward. The water collected off the roof is diverted by gutters and downspouts, which then deliver the water to the area of landscape plants. Except for some land contouring to direct the flow of water on the ground and encourage the water to settle near the planted vegetation, no attempt is made to store the rainwater for future use.

A complex rainwater harvesting system includes a storage tank for some or all of the water collected.

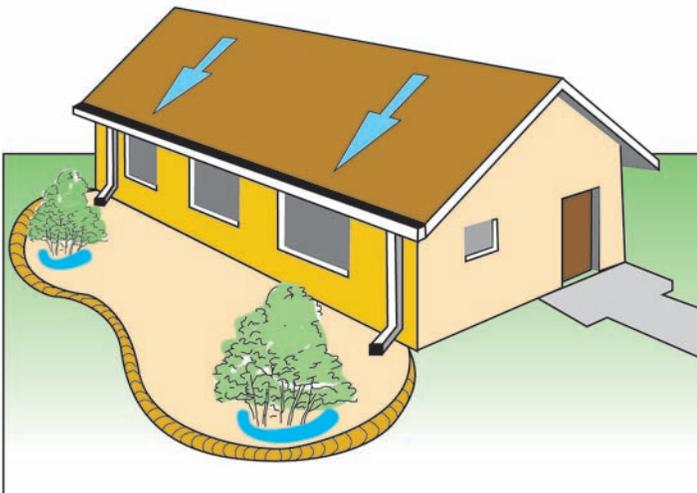


Figure 2-1: A simple (“passive”) rainwater harvesting system, with no water storage.

Therefore, a true roof-reliant system as defined in this manual is a complex rainwater harvesting system because it requires a storage tank so that the water can be used at a later time. The ability to store water greatly increases the number and variety of plants that can be grown in a roof-reliant landscape because it provides a water source between natural rainfall events. When widely installed and used throughout New Mexico, rooftop water harvesting systems that include cisterns have the potential to significantly reduce the use of potable water for landscape irrigation.

## An Introduction to Water Storage

Although it is accurate to say that a cistern is a water storage tank, the term cistern, as used in this manual, is much more than a container. In roof-reliant landscaping, a cistern denotes a functioning water-storage system, not simply the shape and the material that make up the water tank’s walls. A cistern system includes the storage tank and its relationship and connection to each of its constituent parts.

The complexity of cistern systems vary widely from aboveground systems that distribute collected water via standard, manually operated garden hoses to underground systems that use the latest technology to automatically distribute water to

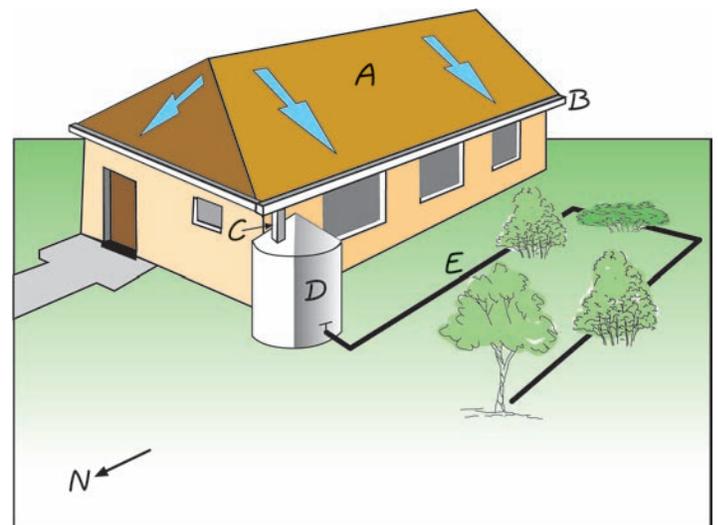


Figure 2-2: A complex (“active”) rainwater harvesting system includes water storage. Shown here are: collection (A), conveyance (B and C), storage (D) and distribution (E).

landscape plants using an intricate network of drip irrigation components. Regardless of the precise form of your system's anatomy, your roof-reliant cistern system will perform four basic functions: collection, conveyance, storage and distribution. (See Figure 2-2 on page 14).

Roofs are particularly well suited as water collection surfaces. The sloped surfaces of roofs efficiently use the force of gravity to direct rainwater downward. (Even so-called flat roofs are slightly sloped.) Water collected off a roof is relatively clean and healthy when used for **irrigation purposes only**.

In roof-reliant landscaping, conveyance systems move roof water from precipitation collection surfaces to cisterns. In a basic water collection system, a downspout or canale funnels water directly into an aboveground rainbarrel or cistern for storage. In the more complicated system presented in Figure 2-4a and 2-4b on pages 16 and 17, the water in the conveyance system must pass through gutters, downspouts, a leaf screen, a first-flush device, a sediment trap and conveyance piping before it is delivered to the cistern. The distribution of cistern water to the root zones of plants is the final act of water harvesting.

Although collecting, conveying and storing roof water is often referred to as rainwater harvesting, the entire function of harvesting is not completed until the water has been effectively distributed.

### From Rainbarrels to Cisterns

As the storage capacity of rainwater harvesting systems grows, their complexity and cost also grow. In modest systems, storage tanks can consist of rainbarrels that can be purchased at retail stores and landscape supply outlets. When simple rainbarrels do not provide adequate water storage, rainbarrels can be connected together with pipes to provide more storage capacity. In more ambitious systems, larger tanks designed for water storage can be purchased and delivered onsite. Sometimes storage tanks are built onsite to precise specifications.

For the most part, this manual concentrates on larger rainwater harvesting systems that include large aboveground or below-ground cisterns. Because of their size and scope, these larger cistern systems require detailed planning, careful design of the cistern system as well as the finished landscape, skilled labor to assist with installation, and

*(continued on page 18)*



Figure 2-3: An example of an aboveground cistern system storage tank with a solar-powered pump.

### A Sample Below-Ground Cistern System (Part 1), Figure 2-4a

An underground cistern system is much more than a buried water tank. In order to function properly, a rainwater harvesting system with an underground cistern must efficiently collect water from a roof, filter dirt and debris from the water, and convey clean water to the cistern for storage. The stored water will then be available for landscape use when needed.

Together, Figures 2-4a and 2-4b depict the first three functions of a rainwater harvesting system—collection, conveyance and storage. The roof of the house depicted in Figure 2-4a is the collection surface, from which rainwater flows into the gutter that runs along the roofline. This

illustration depicts four types of filtering devices. A gutter guard (1) is a simple device that is placed in, or sometimes over, a gutter that filters out large debris such as leaves. A leaf screen (2) is similar to a gutter guard in that it filters out leaves and large debris. A first-flush diverter (3) is a length of capped pipe that captures the first water that is conveyed off the roof. This first-flush of water typically contains the most debris. After the first-flush pipe fills up with water, debris and sediment, any additional water flows through the connected pipe and downward toward the cistern. A sediment trap with a removable filter (4) is a device that separates sediment from water. The sediment settles at the bottom of the trap, allowing clean water to flow through.

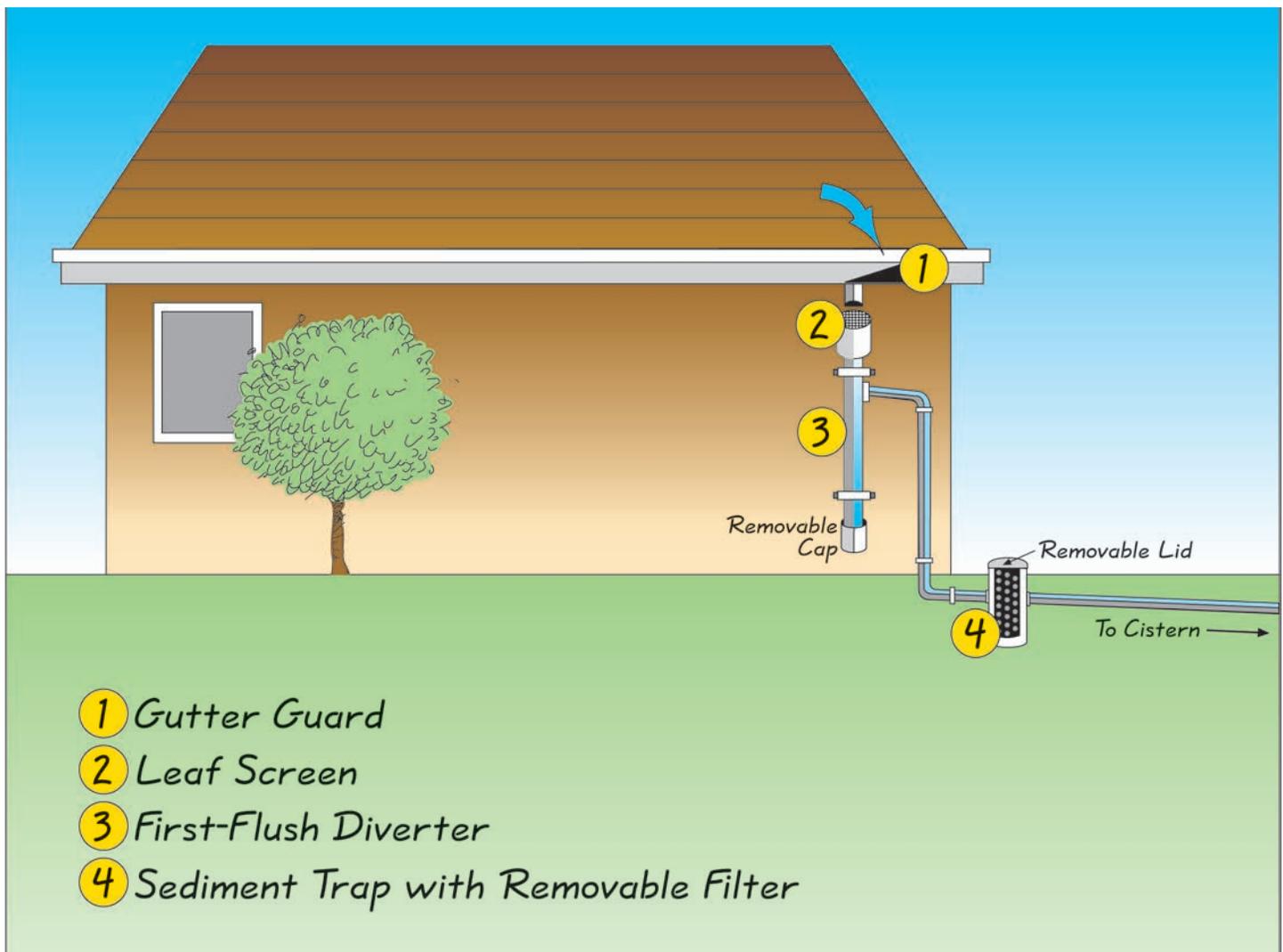


Figure 2-4a: A complex conveyance system moves water from a roof through water filtering devices.

NOTE: A typical rainwater harvesting system would not have all four of the filters depicted in this illustration. A common approach would be to have either a gutter guard or a leaf screen and either a first-flush diverter or a sediment trap.

### A Sample Below-Ground Cistern System (Part 2), Figure 2-4b

After passing through the filters, water flows through underground conveyance pipe to the cistern. The cistern depicted in Figure 2-4b is a commonly available unit made of molded plastic. An underground cistern tank has a serviceway that allows access to the inside of the cistern and its associated components. (These components will be covered in detail in Chapter 9.)

An important feature of every cistern tank is an overflow pipe. Even in arid climates such as those found in New Mexico, large storm events can result in a volume of harvested rainwater beyond that which the storage tank can hold. The overflow pipe directs excess water away from structures and toward landscape plants, a swale or a French drain. With careful planning, even the water harvested from an unusually large storm can be safely and effectively managed.

Not depicted in this illustration is the final stage of rainwater harvesting, distribution. See Chapter 10 for a complete discussion of distributing water to the landscape.

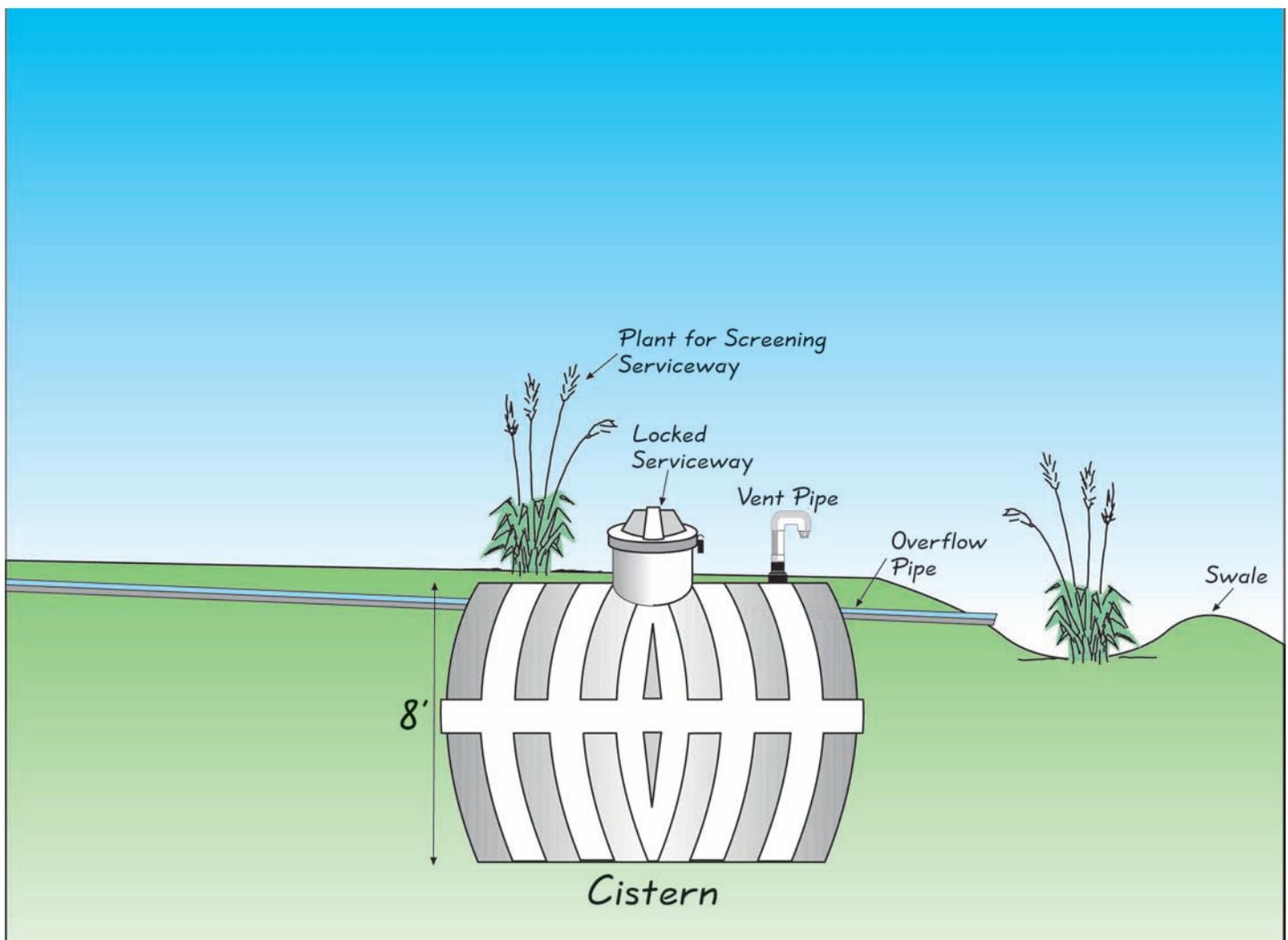


Figure 2-4b: After passing through filters (as shown on previous page), water is conveyed to an underground cistern for storage.

compliance with any local building codes and applicable regulations. All of these steps must proceed in a logical order to ensure the success and the cost-efficiency of the project. Mistakes can be costly, dangerous and wasteful, but the benefits of a well-designed system are enormous.

Figure 2-5 shows a design overview of a large roof-reliant underground cistern system. Water is harvested off of the roof via canales, which feed water into inground drain boxes. Branching off and away from the house is the underground conveyance piping leading to an underground cistern. Also shown are a sediment trap,

pumphouse, a buried conduit line running electricity for the cistern system and an overflow pipe<sup>4</sup>.

In roof-reliant landscaping, water travels through the cistern system, and given a thoughtful plan, a successful installation and occasional maintenance, this water can help establish an oasis in any desert.

<sup>4</sup> "Overflow" refers to the discharge of water that pours out of a cistern whenever the tank is full and a precipitation event is occurring. Legally, every cistern system needs to control this kind of runoff, such that the overflow pipe never increases the level of water and/or sediment that runs off of your property. This runoff, if properly controlled, provides an additional benefit due to an increased quantity of water directed toward newly planted, recently established, or existing native plant material.

## Site Plan

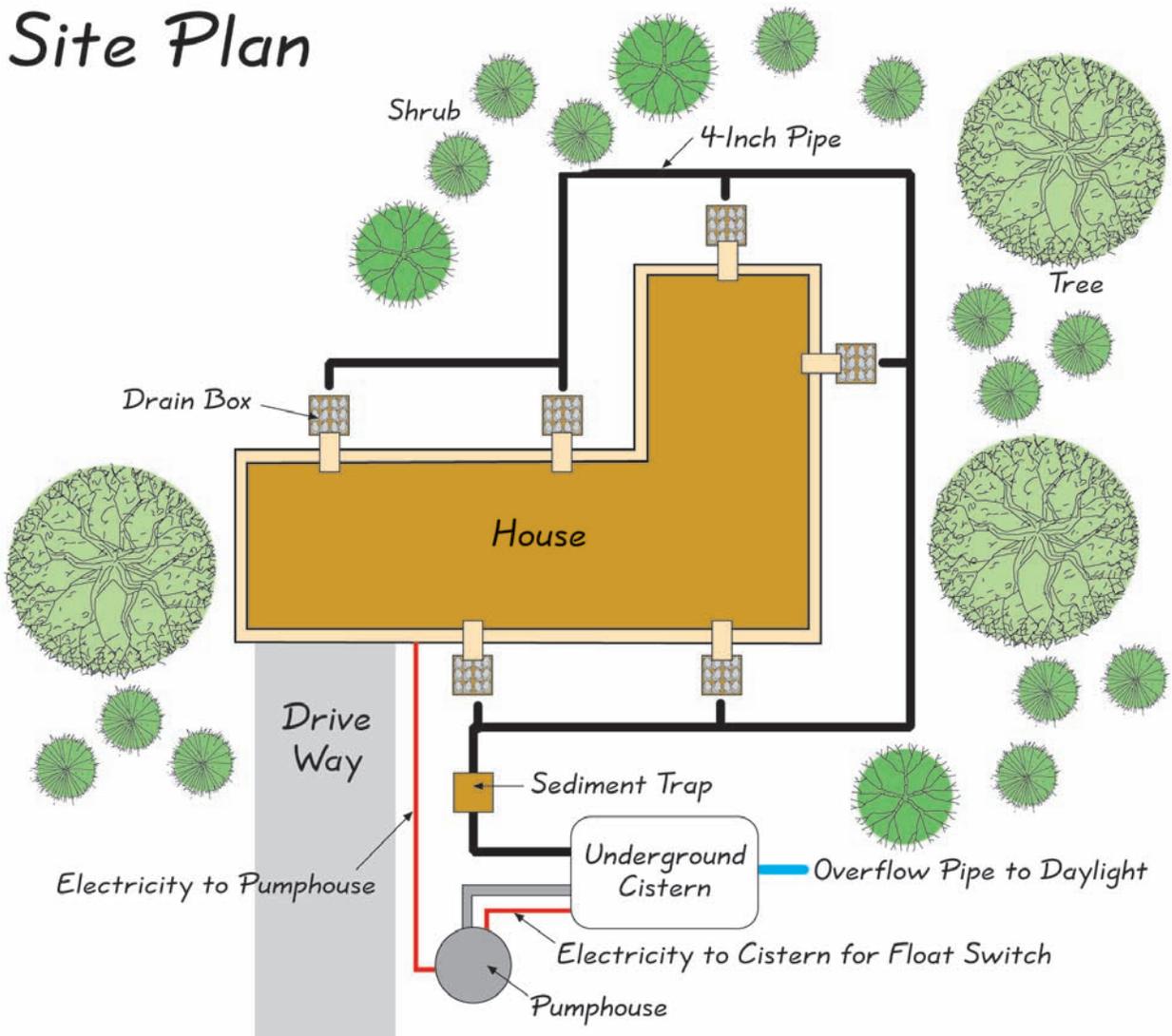


Figure 2-5: An overview of a roof-reliant rainwater harvesting system (water distribution not shown). Conveyance pipes and electrical conduit lines are buried, according to code.