Commercial Complexities

By Mike Warren

Considerations for commercial rainwater harvesting applications

Over the past five years, the topic of rainwater harvesting has become prevalent everywhere we look. Many articles on this subject begin with an introduction about rainwater harvesting not being a new concept because systems have been around since before the ancient Greeks. They then cover the basics, from where water can be captured to its various applications. Storage tanks, pumps and filters are typically mentioned, but sometimes without specific details. This is for good reason: Rainwater harvesting systems, especially commercial-sized ones, can be complex.

Rainwater harvesting systems are designed to turn owners/operators into purveyors of their own non-potable water supplies. A complex system with fully automated capabilities for water harvesting and distribution would be impossible to discuss in great detail in one article, so this article will focus on two important aspects: backup water and how it affects system design and operation, and how catchment surfaces affect water quality.

This water, harvested from a surface that combines green roof, pavers and EPDM, is colored even after filtration, meaning it is best suited for irrigation.

Backup Water: When & Where

Backup water refers to the integration of a reliable, consistent water source into a rainwater harvesting system. This can be from city supply, well water or even partially treated effluent water.

Two of the most common applications for harvested rainwater today are landscape irrigation and toilet flushing. With each application, designers must ask one simple question: What happens if the rainwater runs out?

In the case of landscape irrigation, if plantings are drought tolerant, long periods without water are acceptable. If tens of thousands of dollars in landscaping and plantings are at stake, however, an integrated backup water supply may be necessary.

The decision to integrate backup water is more apparent when considering a toilet flushing application. If there is no backup water supply, a building's restrooms will become unavailable during drought. For businesses, schools and universities, it is not an option to send people away because their facilities are not functional.

The two options for incorporating backup water into a rainwater harvesting system are to plumb it to the storage tank supply (in this article, we will assume it is from a city supply) or to plumb it directly to the water distribution system.

In the first option, a valve opens when the storage tank level is low, allowing city water to enter the tank. The pump, in turn, supplies water to the distribution system without interruption. Make sure that the level controls on the rainwater harvesting system do not open the valve and allow the city water to fill the storage tank to full capacity. Be sure to maintain a low level in the storage tank—just enough for proper pump operation—and leave adequate room to harvest the next rainfall event.

In the second option, when plumbing the backup water directly to the water distribution system, city flow and pressure operate the system when the storage tank is empty. This essentially bypasses the rainwater harvesting system when the harvested water supply is unavailable.

In each case, a potable water source is being connected with a non-potable source. In every state in the U.S., backflow prevention is required.

Consider this example of a 2,000-student high school. A backup water supply from the city would be required for this type of application. The system utilizes a submersible pump to send water from the rainwater tank to the toilets in the building; when the tank level is low, a valve on the city water supply opens and allows city water into the storage tank. The level controls are set properly so as to fill the tank to minimum adequate capacity with city water. Everything is functioning normally as designed.

One day during the school week, the pump itself fails due to a bad mechanical seal and cannot operate. The system still has water in the storage tank, but no way to send it to the toilets. Given this application, the pump station would need to be designed with a second 100%-capacity redundant pump, motor and controls that could take over automatically should the first pump fail. If this were a landscape irrigation example, the landscape and plantings might survive for a short duration while the pump and motor were being repaired.

For the second option, in which the city water is plumbed directly to the water distribution system, a second 100%-capacity redundant pump, motor and controls would not be necessary. The operational sequence of the system could be configured so that the automatic valve on the downstream side of the pump station would allow city water to be used whenever the pump is disabled. This could occur on low tank level, any other system alarm or even a power failure. In each case, city water pressure could satisfy the demand, and the pump station could be repaired without an interruption of service to the building tenants.

When and where a backup water supply is used has an effect on the pump system design, and ultimately cost.

Water Quality & Roof Material

The type of surface with which rainwater comes in contact affects water quality. It is best to filter the rainwater before allowing it to enter the storage tank, thus keeping out organics that decompose over time. A rainwater filter installed upstream of the storage tank is the most common method.

A good rainwater filter has a stainless steel screen with a micron rating of about 350. These filters require only gravity to operate, and can be installed above or below ground. A screen filter removes suspended solids from the water, but not dissolved solids. There are some rainwater harvesting systems that can contain dissolved solids, but these are much harder to remove from rainwater. Examples are salt from a parking lot or tannins from a green roof.

The water pictured at right is a sample taken from a large warehouse facility in Kentucky with an ethylene propylene diene monomer (EPDM) rubber roof. It was filtered to 350 µ prior to entering the storage tank, and 5 µ after the pump station. The water is clear and free from any foul odor. Portions of the EPDM roof are older and do make their way into the drainage system, but are mostly kept out of the storage tank by the 350-µ rainwater filter.

The water shown on page 16, a sample taken from a surface that is a combination of green roof, permeable pavers and EPDM, exhibits the presence of tannins. These are dissolved into the water from the plant material

This water, harvested from a facility with an EPDM rubber roof and then filtered, is ideal for toilet flushing because it is clear and odor free.

and/or soil media on the green roof and have made the water a tea color. The sample shown is taken after 350-µ rainwater filters and a 5-µ discharge filter. Five microns is 0.0002 in., or about the size of a red blood cell. Even though the water is filtered to 5 µ and there are no solids that settle out of the sample if it is left still for an extended period of time, the color of the water may not be desirable to the owner/operator.

This is where application once again comes into play. If this water is sent to a drip irrigation system, it is unlikely anyone would notice the color. If the water is sent to toilets inside a building, however, the color might create a negative impression and be unacceptable. For this reason, it is a good idea to only recommend a hard surface rooftop when harvesting rainwater for toilet flushing applications.

Summary

We hope that this article has furthered your understanding of backup water integration—when it is necessary, how it affects price and the number of pumps on a system, and how needs vary across applications. We also looked at which surfaces harvested rainwater can be captured from and how the resulting water quality can affect user perception and satisfaction.

There are many other complexities to rainwater harvesting systems, but the consistent delivery of quality non-potable water is a challenge that designers of successful rainwater harvesting systems must understand. *wqp*

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