Rainwater Harvesting

More Than Just A Drop in the Bucket

By Sarah Lawson

Rainwater harvesting is an ancient and effective water conservation practice. Unfortunately, in modern times "rainwater harvesting" has often become associated with a mosquito-laden barrel in the backyard, lined with last year's leaves and a resident frog or two.

The potential of rainwater harvesting systems is so much more. With proper design, these systems can transform a waste product (stormwater) into a valuable resource. Bringing rainwater harvesting into the commercial and residential mainstream will require increasing awareness of possible uses of rainwater, improved regulatory guidance and a greater understanding of all the potential environmental benefits of stormwater management. Rainwater harvesting systems are also a perfect opportunity for coordination of services and design among the civil engineer, the plumbing engineer and the mechanical engineer (the butcher, the baker and the candlestick maker).

Harvested rainwater is often thought of only as an irrigation supply, but it can also be used indoors to meet non-potable water demands (and is approved in some localities for potable use). According to the Alliance for Water Efficiency, restrooms, landscape and cooling and heating account for 87% of the water use in schools and 89% of the water use in office buildings (domestic use is included with restrooms in the reported figures for office buildings). Even if half of the restroom/domestic use requires potable water (handwashing, etc), the majority of water use at schools and office buildings is non-potable. The EPA's guidance document, "Managing Wet Weather with Green Infrastructure: Municipal Handbook: Rainwater Harvesting Policies," identifies non-potable indoor water uses as toilets, urinals, laundry and cooling towers.

Using harvested rainwater for water closets and urinals will be only part of the story at the Wellmark Blue Cross-Blue Shield headquarters now under construction in Des Moines, Iowa. Cisterns at this site will collect rainwater and condensate from the HVAC system to supply toilets and urinals and to be used for irrigation. During warmer months, when the demand for irrigation is highest, the water supply from the HVAC system condensate will also be highest. The cisterns are integrated into the site stormwater management plan, which offsets a portion of the initial cost of rainwater harvesting. This project is a prime example of the benefits of collaborative design. Imagine the potential waste if the plumbing engineer designed a rainwater harvesting system, the civil engineer designed an underground detention system and the HVAC engineer designed a system to handle condensate.

In an article entitled, "President's Viewpoint - the Need for Green Schools" in *NEA Today*, National Education Association president Dennis Van Roekel stated, "Green schools are also a great teaching tool. If we want children to learn that human beings have a responsibility to be good stewards of natural resources, we have to teach them by example."

At Burton School in Grand Rapids, Mich., rainwater from 11,000 square feet of roof is filtered and directed to a 10,000-gallon belowground storage tank, then used to flush 12 water closets. A water meter in the corridor lets students see how much water the system has saved. Based on daily rainfall data from Grand Rapids, if the school was used year round, this system could supply approximately 150,000 gallons of water per year.

Paula Leatherman, CPD from ProgressiveAE, who designed the rainwater harvesting system at Burton School, describes the process, saying, "Grand Rapids Public Schools

A high capacity vortex filter in action during construction of the Burton School. This pre-tank filter diverts the "first flush" and prevents debris from entering the tank. A single filter can treat roof areas up to 33,000 square feet. (Photo courtesy of Paula Leatherman.)

has made a commitment to sustainability for its facilities, and their last several projects have earned LEED® certification. During the Burton Elementary School project planning stage, administrators and designers discussed the different elements that would be appropriate for LEED points for this project. One way to acquire additional points for LEED is to use a non-potable water source to satisfy the building water needs. The concept of a rainwater harvesting system was researched. The district's director of facilities expressed a deep interest in an educational approach to the aspect of rainwater harvesting, and so the groundwork was set for the system.

"Not only does the system help recognize a 52% total building water savings (according to LEED templates) but it also provides an educational tool that involves the students in the importance of preserving our natural resources. The design integrated a visual metering system located in a corridor display case where the kids are able to track the water savings. This was one of the first rainwater harvesting systems in the city of Grand Rapids, and the first to utilize the system as an educational tool. Reusing rainwater for building needs is a viable direction in the construction industry, and we are exploring opportunities to implement similar systems in a variety of building types."

At Western Virginia Regional Jail in Salem, Va., which opened on March 9, 2009, a look at the whole site led to innovative design and increased energy efficiency. Water demands inside the facility outweigh the available rainwater supply, so harvested rainwater is used only for laundry. Because the laundry use is localized in one section of the building, the pumping and piping demands are decreased. However, the real energy savings occur with pre-heating of the rainwater for laundry. Water used to cool the pumps from the vacuum-assisted waste system enters a heat exchanger and pre-heats rainwater before it is pumped to the laundry. This 264,000-square-foot facility will be the first LEED-certified jail in the region.

Rainwater harvesting is often used just to earn LEED points through irrigation but can be a part of stormwater management and innovative design, in addition to water efficiency.

The potential impact of rainwater harvesting is staggering. According to the U.S. Census, the United States had almost 12 million more housing units in 2007 than in 2000. Assuming an average footprint of 1,500 square feet for each of these housing units and an average of 30 inches per year of precipitation, if all of these new housing units had rainwater harvesting systems, they could collect about 234 billion gallons of water per year, more than enough water to supply the entire city of Los Angeles. These rainwater harvesting systems would also mean that there would be 234 billion gallons less of runoff into lakes, rivers and streams or into stormwater treatment facilities. Based on information from the Stormwater Manager's Resource Center, 234 billion gallons of residential runoff will carry about 390 tons of phosphorus, 2,150 tons of nitrogen and 97,770 tons of sediment. While these nutrients and sediment are crucial for plant growth on land, they can wreak havoc in lakes and estuaries, causing algal blooms and fish kills.

The environmental benefits of rainwater harvesting even extend to energy use. According to the EPA, approximately 3% of energy use in the U.S. goes to drinking water and wastewater treatment. By using non-potable water, which requires less treatment, for non-potable uses and by greatly decreasing the distance that water is transported, rainwater harvesting provides an energy-efficient alternative to traditional water systems. Rainwater harvesting even reduces strain on an aging water supply infrastructure.

These calculations are only for new residential development. Imagine how much greater the impact could be if commercial development was included. While rainwater harvesting is an old technology, the opportunities for innovation are by no means exhausted. Starting with a basic, established, system design to preserve the quality of the rainwater, the possibilities of producing a green solution are vast. Rainwater harvesting should continue advancing far beyond the leaf-filled barrel to becoming an integral part of whole-site water management. ■

Rainwater storage at the Western Virginia Regional Jail is stored in four 30,000-gallon belowground fiberglass storage tanks. Storage tank selection can be tailored to the site.

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