Story by Katie Heinrich

MAROON & GREEN

New Texas A&M buildings conserve energy, water and money

The Agriculture and Life Sciences Complex at Texas A&M University features four 9,000-gallon rainwater harvesting cisterns. Photo by Leslie Lee, Texas Water Resources Institute.

Over the past three years, Texas A&M University has built six new buildings across campus that employ water harvesting and reuse systems. These new facilities are not only essential to the success of their colleges and departments, but are also playing a vital role in fulfilling one of the state's dire needs — water conservation.

By integrating rainwater harvesting (RWH) and air-conditioner (AC) condensate reuse methods into new campus buildings, along with implementing other resource-efficient initiatives, Texas A&M is continuing to improve conservation and sustainability on the College Station campus.

RWH involves the capture of rainwater. AC condensate reuse collects condensate that forms on air conditioning coils. These reuse technologies are used for landscape irrigation on campus, said Texas A&M Architect Lilia Gonzales.

Successes of campus conservation

Jim Riley, executive director of Texas A&M's Utilities & Energy Services Department, said the largest sector of Texas A&M's water consumption — more than 35 percent — comes from water evaporation at Texas A&M's four utility plants. The consumption occurs in the plant cooling towers

and is a direct result of evaporative cooling used to absorb heat from most of the buildings on campus.

"When you have 19 million square feet of air-conditioned space to keep cool on a hot summer day, there will be more than 4 million gallons of water evaporated from all of the cooling towers in the four utility plants on campus," Riley said.

Landscape irrigation around campus makes up another 30 percent of Texas A&M's water use. All other domestic uses, such as water used in residence halls, for food preparation and in laboratories, account for another one-third of total consumption.

The university has its own water wells and manages its own water production, transmission, treatment, distribution and quality control and operates separately from the Bryan and College Station water systems. The university has seven water wells, which can produce up to 14 million gallons per day, he said.

A typical city does not have either the challenge or the reliability and efficiency that Texas A&M has with cooling and heating hundreds of buildings from central production facilities. A city's water consumption is driven by residential and commercial customers, with some industrial use, Riley said.

"Most cities have a higher percentage of residential use, which includes a lot of irrigation, but they do not have the large cooling towers, chillers, boilers and power generation equipment like we do here at Texas A&M," he said.

Although the university has grown significantly in square feet through the years, it has actually lowered its water consumption. Since 2000, Texas A&M has reduced its water consumption by more than 30 percent, Riley said.

Riley credits the reduction to four areas: correcting operation leaks and inefficiencies, improving thermal efficiency in the utility plants to reduce evaporative cooling, enhancing building design standards, and switching to automated irrigation systems.

"Over the last several years, instead of rejecting the heat to the atmosphere, we use the energy much more efficiently in the utility plants and buildings for heating hot water and in other uses," he said. "We have become more thermally efficient, so we don't have to evaporate as much water."

State regulations

Recent state regulations require the installation of water-efficient systems such as RWH and AC condensate reuse. Since September 2011, Texas Water Conservation Standards, administered by the State Energy Conservation Office, have been mandatory for all new state-funded buildings or state-funded major renovation projects, including those at state-supported institutions of higher education. These standards include requirements for RWH, reclaimed water, recycled water and AC condensate reuse.

Construction of any new state-funded building larger than 10,000 square feet requires approval from the State Energy Conservation Office, based on completion of a water compliance certification form documenting that an appropriate water recovery and storage system will be installed.

Campus landscape irrigation

Texas A&M's water wells are used to irrigate most of the campus landscape, but the six buildings built with RWH/AC condensate capture collect water in a cistern and use it to irrigate the surrounding landscape through a conventional sprinkler system.

"Rain and condensate water use makes good sense because it saves on groundwater consumption," Riley said. "Because rainwater and condensate are both pure, they do not have the salt and hardness that other water sources have. This makes them better than groundwater for watering the landscape as the water is almost like distilled water; it's that clean."

Logistics of AC condensate capture

While landscape irrigation conservation is a plus, AC condensate reuse provides a unique indoor conservation system that can collect more water than most may think.

Gonzales said facilities with large cooling demands can best take advantage of condensate reuse.

Condensate recovery systems work as follows: Air contains a certain amount of water vapor, or humidity. When warm air runs across chilled water coils in the air-conditioning system, the air cools and water condensation forms on the coils, much like water droplets on a glass of iced tea. This condensation is then collected and routed to a cistern either above or below ground, Riley said. In the new campus buildings, most air handlers in the air-conditioning system have a condensate drain that runs from the coils into a cistern, where the condensate is combined with collected rainwater. The condensate and rainwater are stored in the cistern and used during drier weather for landscaping and irrigation. ⇨

Designing a RWH system

Gonzales said RWH systems typically use gutters and downspouts to channel water from the roof to the cistern. Other components such as first-flush diverters and roof washers remove debris and other contaminants before the rainwater reaches the cisterns. Cisterns can be installed above or below ground and can be made of materials such as corrugated steel, concrete or fiberglass. The water can be gravity-fed or pumped for irrigation use.

When designing a RWH system, Gonzales said the first step is deciding on the intended use of the collected water. Estimating the amount of water needed for that use comes second. The next step is calculating whether enough water will be collected, based on rainfall totals and on the catchment surface area. The last step is determining whether an above- or below-ground cistern would be best, factoring in the available space, aesthetics, materials and costs.

Campus rain gardens also collect rainwater. The water percolates down through gravel or rocks, being filtered and cleaned in the process, and then is stored in the cistern.

Incorporating RWH/AC condensate reuse

Riley said RWH and AC condensate capture methods are easily implemented; once the cistern is designed and properly constructed, redirecting the roof drains into it is rather simple.

Gonzales said the earlier the capture methods are incorporated into a new building's design process, the more efficient and cost-effective the systems will be. It may also make sense to design these systems for existing buildings, depending on the complexity of the proposed design, she said. Although Texas A&M has no plans to adapt and install RWH technology into existing buildings, Gonzales said such a project would depend on cost and availability of funds.

Justifying the cost

"With a lot of things, economics tend to drive the decisions — if you are going to put in a cistern, roof drain and condensate recovery and harvesting system, there is going to be a cost to do it," Riley said. "You are going to have to justify that expense."

Riley said one challenge for Texas A&M in implementing water recovery systems is the very low rate the university charges its customers for water. The Texas A&M Utilities & Energy Services Department operates and maintains its own water system at less than $1.90 per thousand gallons of water use.

Riley said public utilities or city water municipalities typically charge between $2.50 and $5.00 per 1,000 gallons, so the university benefits from having lower rates.

But, Riley points out, "the higher the water rate that is paid, the better the economic payback is for installing water harvesting or reuse systems."

"The biggest consideration of these reuse methods is economically driven," Riley said. "Hopefully, the environment and conservation of resources is also considered. You want to make good use of water, but economics tend to be the driver. You have to be able to justify the expense of adding new water harvesting or reuse systems."

Although the payback for installing new water-saving systems at Texas A&M may take longer than average because university water rates are low, the university and Utilities & Energy Services are continually evaluating water harvesting and reuse opportunities, to create a more sustainable environment and reduce the use of groundwater.

For more information, visit *txH2O* online at twri.tamu.edu/txH2O.

Texas A&M University's buildings with RWH/AC condensate technology:

1. **The Agriculture and Life Sciences Complex**
   4 X 9,000-gallon cisterns
   40,000-gallon cistern
2. **Mitchell Physics Building**
   60,000-gallon cistern
3. **Arts and Humanities Building**
   20,000-gallon cistern
4. **Interdisciplinary Life Sciences Building**
   30,000-gallon cistern
5. **Memorial Student Center**
   26,000-gallon cistern
6. **Emerging Technologies and Economic Development Interdisciplinary Building**
   145,679-gallon cistern

Total water cistern storage:
over 350,000 gallons of water