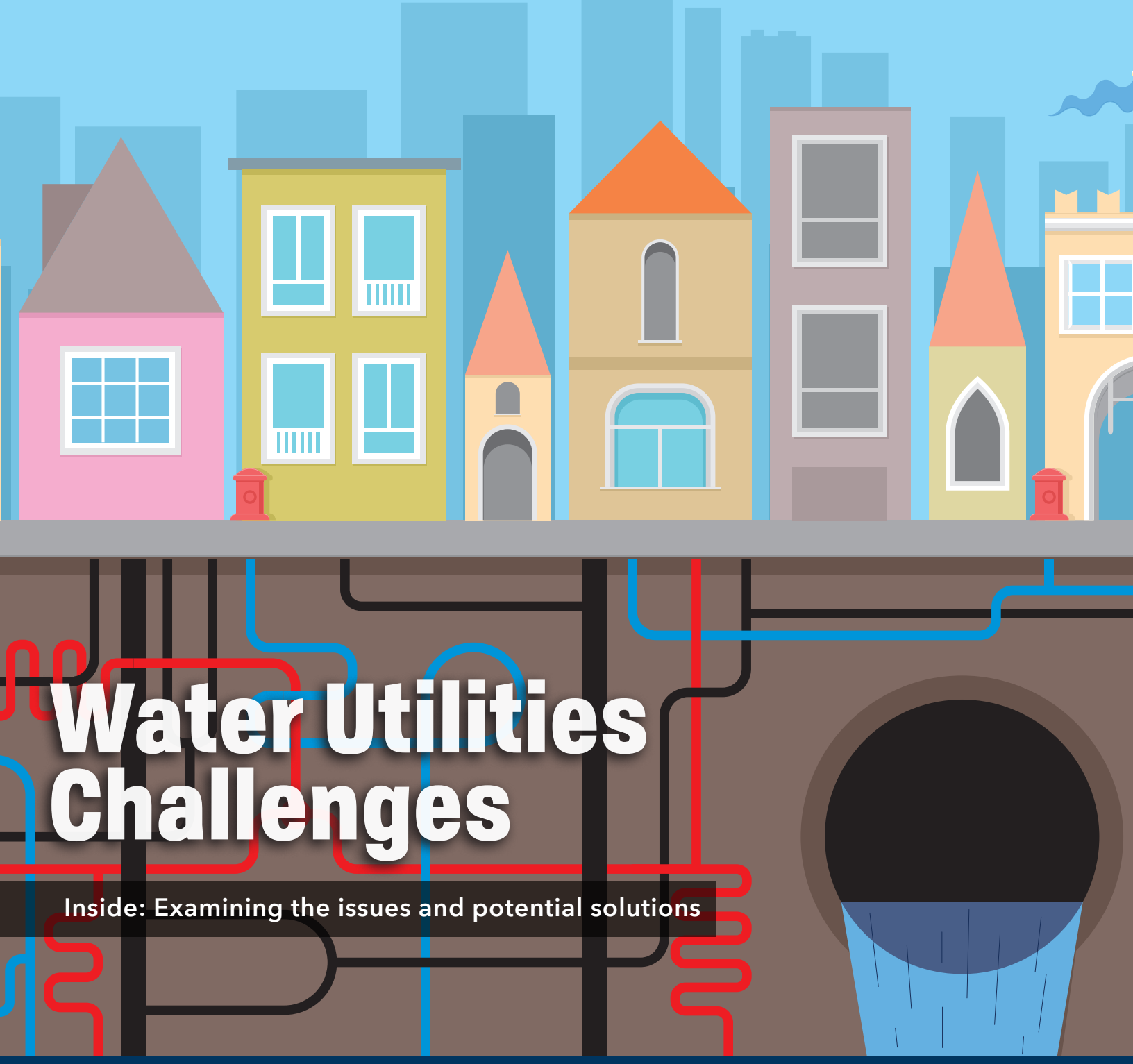
tx H$_2$O

A Publication of the Texas Water Resources Institute

Summer 2019



Water Utilities Challenges

Inside: Examining the issues and potential solutions

Texas A&M AgriLife Research | Texas A&M AgriLife Extension Service | Texas A&M University College of Agriculture and Life Sciences

Working to make every drop count

We have all seen the headlines and heard the talking points regarding the state of infrastructure across the United States, and, in particular, how our water resource infrastructure has been in decline for years. These include the constant references to the water crisis in Flint, Michigan, which seems to have become the face of the declining state of our municipal water infrastructure across the nation, or how increasing populations, combined with the increasing frequency and severity of droughts, will lead to communities running out of water supplies at some point in the future.

Many national organizations have highlighted the state of the nation's infrastructure. The American Society of Civil Engineers' Infrastructure Report Card (infrastructurereportcard.org/) depicts a dire state of our nation's water resources infrastructure, giving it an average grade of D. The RAND Corporation's report (rand.org/pubs/research_reports/RR1739.html) gives a less dire depiction, indicating that there are some problem areas, but overall our nation's water infrastructure is not in a state of precipitous decline. The American Water Works Association's State of the Water Industry analysis (awwa.org/Professional-Development/Utility-Managers/State-of-the-Water-Industry) indicates that there are some increasing challenges for municipal water managers in the coming years.

Many times the talking points seem to focus only on the technological challenges associated with providing adequate and safe drinking water supplies for our nation's communities — or what we often refer to as the pumps, pipes and filters. But when we focus solely on technological approaches to address our water infrastructure needs, we tend to forget that we also need an educated workforce to operate our water supply systems; we need mechanisms to finance the construction, operation and maintenance of these systems; and we need to engage the people who ultimately pay for this infrastructure, so that water delivered to their homes and businesses is trusted as safe and reliable.

This issue of *txH2O* examines the diverse challenges that need addressing to ensure that our future municipal water supplies are safe and reliable and how these challenges are addressed through a combination of educational, social, financial, technological and governance approaches.

As always, please join us in "making every drop count."

John C. Tracy, Ph.D.
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On the cover:
Municipal water utilities have diverse challenges, ranging from infrastructure to workforce to financing needs.
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Texas Water Resources Institute
make every drop count

Volume 13, number 2, Summer 2019

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*Facts and figures information from the [1]Texas Section of American Society of Civil Engineers, [2]U.S. Government Accountability Office, [3]American Water Works Association, [4]Texas Water Development Board, [5]U.S. Environmental Protection Agency, [6]Texas Commission on Environmental Quality, [7]David Sedlak, University of California, Berkeley in *The Trend*, an annual analysis published by the Pew Charitable Trusts.

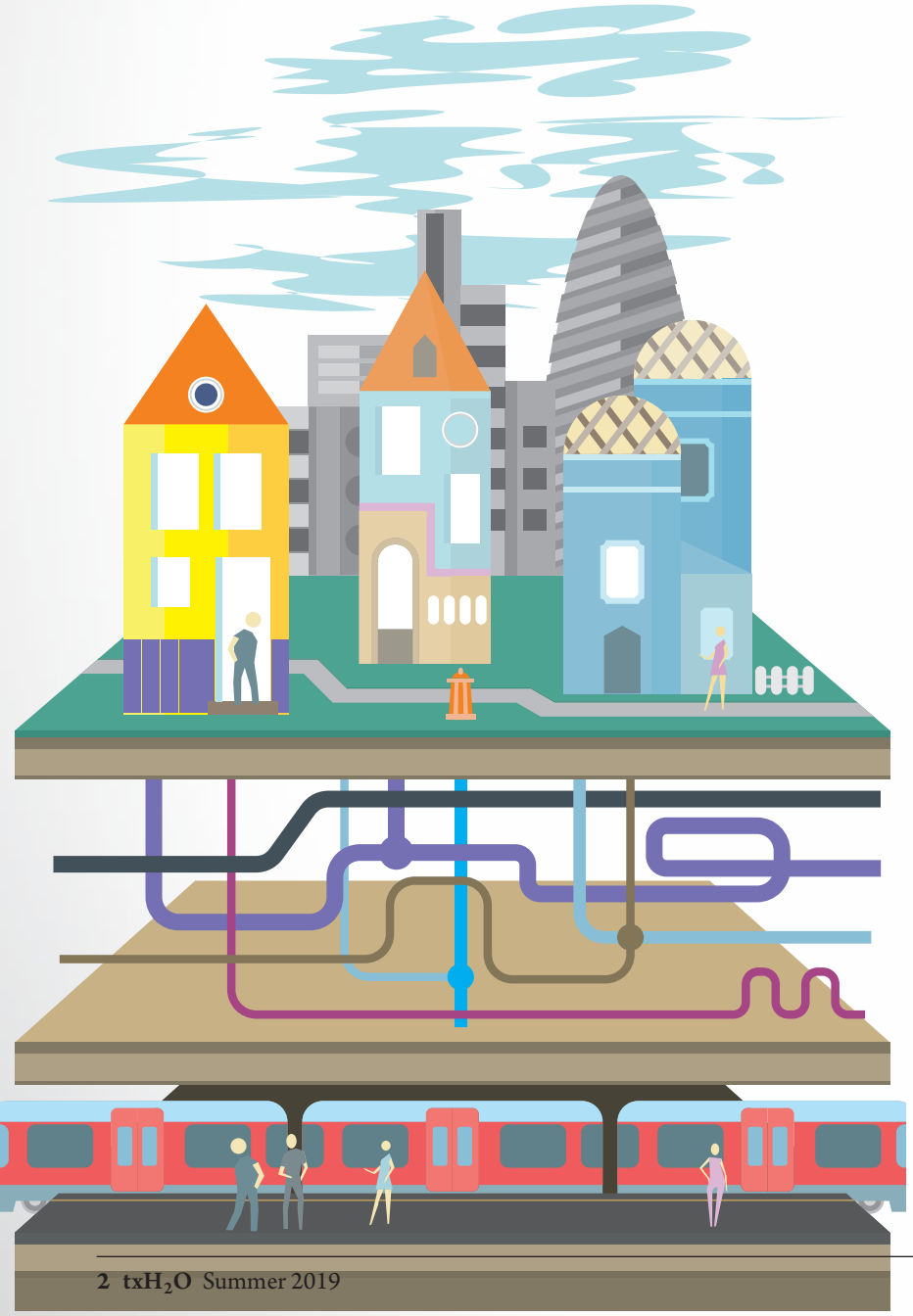
txH$_2$O *is published two times a year by the Texas Water Resources Institute (TWRI), which is part of Texas A&M AgriLife Research, the Texas A&M AgriLife Extension Service and the Texas A&M University College of Agriculture and Life Sciences. TWRI is funded in part by the U.S. Geological Survey and authorized by the Water Resources Research Act. To subscribe to* txH$_2$O or Conservation Matters, *TWRI's monthly email newsletter, visit* twri.tamu.edu/publications

Story by Sarah Richardson

10 CHALLENGES OF WATER UTILITIES

Aging infrastructure, financing top the list

Renewal and replacement of aging water and wastewater infrastructure is a top issue facing the water industry today. Photo by Shutterstock.



One million miles of pipes deliver drinking water across the country, according to the American Society of Civil Engineers' (ASCE) 2017 Report Card for America's Infrastructure, and many of those pipes are in need of modern-day upgrades.

Some water utility systems still have pipes that were installed in the 1800s; most are from the early- to mid-20th century and have a 75-100 year lifespan.

Pipes connect everything within the water infrastructure, supplying 42 billion gallons of water a day in the United States. Water infrastructure can include reservoirs, pump stations and treatment plants, in addition to the many different sizes of pipes such as water mains, sewage lines and storm drains.

Dorothy Young, Texas Commission on Environmental Quality program specialist, said the list of challenges that Texas water utilities face is as varied as the systems.

The challenges

1. *Aging infrastructure*

The American Water Works Association (AWWA)'s 2018 survey of water industry professionals lists renewal and replacement of aging water and wastewater infrastructure as the top issue facing the water industry.

Dr. Ali Mostafavi, assistant professor in Texas A&M University's Zachry Department of Civil and Environmental Engineering and director of the Urban Resilience, Networks and Informatics Lab, said all aging infrastructure is a national challenge, but particularly water infrastructure.

With water infrastructure, Mostafavi said municipalities and utilities are having to upgrade very old systems including underground water distribution, levees, reservoirs and flood channels.

"In high magnitude events, there is the risk of aging systems failing, like we saw during Hurricane Harvey," he said.

2. *Leaking pipes*

Young said water loss from leaking pipes is one of the biggest challenges that water utilities encounter.

According to ASCE, 6 billion gallons of treated water are lost every day in the United States due to leaking pipes, and an estimated 240,000 water main breaks occur each year.

"Water loss is a big problem," Young said. "Not only are you losing water, you're losing money. And there is always the risk of contamination when you've got leaks in your line."

3. *Financing improvements*

Financing capital improvements is another issue water utilities face, specifically in small and rural systems.

Young said because populations are smaller within these systems, they generate less revenue compared to larger utilities, but some utilities also pride themselves on keeping the rates low.

"Often times, a lot of rural water systems have artificially low rates," Young said. The profits made from charging these low rates may not be enough to cover expenses for day-to-day operations or emergency accounts.

"That's a tough issue for a lot of little communities and can get a lot of systems in trouble," she said. "Then they can't pay their operators, buy their chemicals, pay their lab fees and make the repairs they need to."

4. *The value of water*

Public understanding of the value of water systems, services and resources has been listed in the AWWA report's top five water industry concerns for several years in a row.

Young said many people don't understand what water is worth, and that rates need to cover the cost of producing water.

However, according to AWWA's 2018 report, 68 percent of the water industry professionals surveyed believe residential customers would react negatively or very negatively to a rate increase.

"People seem to be willing to pay a whole lot more for cable TV than for water," Young said, "but water is essential."

5. *Long-term water supply*

Long-term water supply availability was also one of the top issues on AWWA's list.

The population of Texas is expected to increase more than 70 percent between 2020 and 2070, from 29.5 million to 51 million. Its municipal water demands are projected to grow from 5.2 million acre-feet per year in 2020 to 8.4 million acre-feet in 2070, according to Texas Water Development Board's (TWDB) 2017 state water plan.

6. *Water contamination*

Young said some systems may be exposed to natural contaminants.

"There are well-run water systems, but the groundwater may have naturally occurring arsenic or fluoride or radionuclides, and those are very expensive to treat," she said.

Water contamination issues are sometimes the result of aging pipes that contain lead or copper. Contamination can also occur because of bacteria or flood waters causing sewer overflow or salt water intrusion.

7. *Retirement and talent attraction, retention*

Many water utility workers are expected to retire, creating the need to attract and retain new workers. The Bureau of Labor Statistics estimated that 8.2 percent of existing water operators will need to be replaced annually between 2016 and 2026. (For more, see "Water, but no workers," page 6.)

8. *Population fluctuation*

Although Texas' population is predicted to increase in the next 50 years, not all areas of Texas are growing, and rural counties are losing residents to metropolitan areas.

Mostafavi said water systems will have less customers in areas with shrinking populations, "and, therefore, their revenue base goes down, and then they have less funding for upgrading already less functional aging systems. That's a huge challenge."

Additionally, where there is more population growth, Mostafavi said that aging infrastructure doesn't have the capacity to absorb that growth. "Cities with high population growth will have a higher revenue base, but the renewal of the system will be tricky because you cannot replace the entire water distribution system in a short period of time," he said. ⇨

Texas has $8.76 billion in drinking water infrastructure needs over the next 20 years. [1]

Water utilities are using sensors and artificial intelligence to predict infrastructure failures. Photo by Shutterstock.

An estimated 240,000 water main breaks occur each year in the United States. [1]

9. Implementing innovative technology

Using innovative technology can improve the performance of water systems and the relations between the water utility and customer.

In the AWWA report, water industry professionals cited economics as the biggest barrier to innovation at their utility, followed by regulatory constraints and risk concerns.

10. Infrastructure resiliency and emergency preparedness

Mostafavi said Texas communities need to address how to make their water utility systems more resilient, especially during natural disasters and changes in weather patterns.

"I think resiliency is very relevant to Texas when you have increasing patterns of extreme events like

Hurricane Harvey," he said. "We saw how many communities received boil water notices because of the flooding, and that is because of the aging pipelines and the infiltration of the flood water into the water distribution system, and that's concerning."

Solving challenges

The needs of each water utility vary; solutions are not one-size-fits-all.

Mostafavi said he is investigating using innovative infrastructure to improve the performance of water systems in growing or shrinking cities.

For some cities, Mostafavi said a dual distribution system could be a viable solution.

"If a city has an old system and an increasing population, why not use the old system for nonpotable water and build a new system for potable water use?" he said.

On the other hand, he said shrinking cities may need to decommission parts of their systems and operate under a smaller user base.

Improving efficiency

Innovation and technology, as well as asset management, can play a big role in the success and efficiency of water utilities.

To better understand water systems' underground conditions, Mostafavi said water utilities could use sensors and artificial intelligence to predict infrastructure failures and make more informed decisions.

"We don't want to build the same pipelines that we used to build 40, 50, 60 years ago," Mostafavi said. "The issue is that if the pipeline system is already very old, we cannot install sensors on it. So that's part of the reason for a smart renewal of infrastructure."

Some cities' pipeline systems are more advanced, with asset management systems that periodically evaluate their pipe conditions, Mostafavi said. Systems can receive more location-specific data about pipe conditions by sending robots into pipelines and water mains to inspect them.

"We need to have a good understanding of the situation," he said. "If we can deploy smart technology, we will be able to have better decision-making and be more proactive rather than reactive."

Because of funding issues, Mostafavi said most of the cities he has investigated only replace pipes when they burst, instead of replacing them proactively. "Even for areas where pipe condition data is available, if water systems don't have the funding, renewal would be delayed," he said.

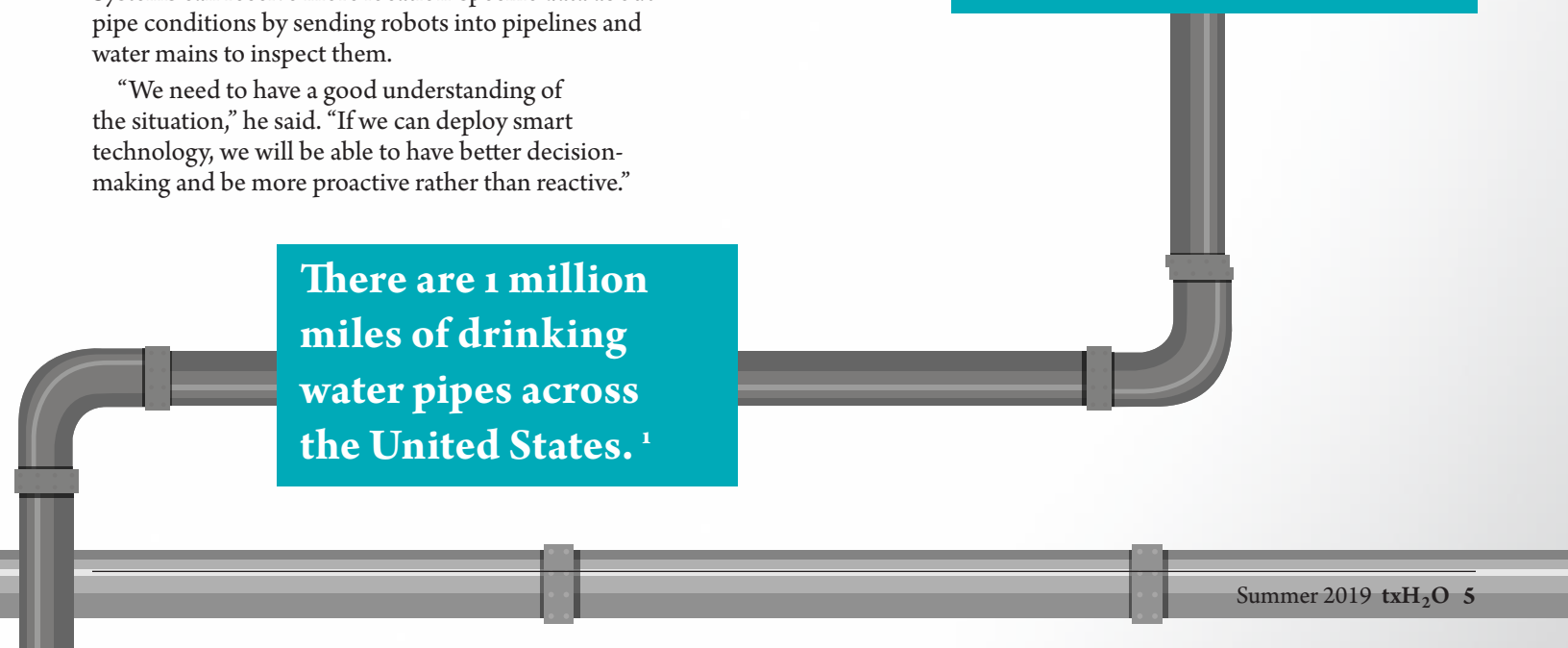
Mostafavi's research has shown that delays can increase the lifecycle cost of water infrastructure systems tremendously.

Another key point in planning the future of smart urban water systems, he said, is for water utilities to always account for the dependencies that their systems have on other systems.

"What systems upstream and downstream do water systems rely on, and what systems rely on water supply? What would systems like the hospital do if the water quality is less than standard? Thinking about how these systems are interdependent is required for planning urban water infrastructure," Mostafavi said. "This will require a change of mindset by the utilities and municipalities to have more cooperative system planning, especially for improved resiliency."

6 billion gallons of treated water is lost every day in the United States, due to leaking pipes. [1]

There are 1 million miles of drinking water pipes across the United States. [1]



Story by Bianca Calderon

Texas A&M Engineering Extension Service holds water and wastewater training schools for all water utility and environmental professionals as well as operators and technicians. Photo by Shutterstock.

Water, but No Workers

Higher education systems are looking to help fill the water, wastewater industry workforce gap

The water and wastewater industry is seeing a decline in workers throughout the nation. To help fill the gap in the Texas' workforce, Texas A&M University-San Antonio (A&M-SA) and Texas A&M Engineering Extension Service (TEEX), an agency of the Texas A&M University System, have created educational pathways to work toward closing the workforce gap.

What's the concern?

According to Dr. Rudolph Rosen, director of A&M-SA Institute for Water Resources Science and Technology, the need to replace workers in the water and wastewater workforce will increase over the next 10 years.

At a series of industrywide water security planning forums in 2015 and 2016, Rosen said Texas water experts from business, industry, government, academia, research and the investment community expressed concerns about a coming wave of retirements and attrition accompanied by inadequate recruitment to the water workforce.

The Bureau of Labor Statistics has projected that 8.2 percent of existing water operators will need to be replaced annually between 2016 and 2026.

"Forum participants also identified another major issue: the general failure of post-secondary educational institutions to supply workforce-ready graduates for Texas' evolving urban and rural water sectors," Rosen said.

Not enough workers are being properly trained for specific advanced treatment technologies and regulatory requirements, meaning they are unable to advance in the workforce.

Dr. Walter Den, A&M-SA professor of water resources science and technology, said without the correct licenses and education, individuals are limited on how far they can move up within the industry.

Small water utilities in rural areas may be hit the hardest by the decreasing workforce.

Rosen said while Texas may be doing better than many states, the challenge of keeping workers in small rural utilities will be more difficult as the labor market for water workers tightens.

"Finding individuals trained to work in water systems can be challenging," he said. "So we believe recruiting water degree students from rural communities will help develop a water workforce with the training and desire to support water treatment needs throughout all of Texas."

Filling the gap with education

A&M-SA is helping expand the water workforce by creating a bachelor's and master's degree program through the Water Resources Science and Technology Program. The Texas A&M University System Board of Regents approved the degree-conferring program in 2015.

Den said the degree program was designed to fill the workforce gap and fulfill the needs of different workers in the water industry.

Beginning in the fall of 2019, pending final approval by the Southern Association of Colleges and Schools Commission on Colleges, students who are interested in getting a Master of Science degree specifically geared toward the water industry will be able to do so.

Additionally, beginning in the fall 2020, undergraduate students can earn a Bachelor of Science in water resources science and technology. Another option, currently in the approval process, is the Bachelor of Applied Arts and Sciences degree, designed for students who already have an associate degree. These programs will give students the tools necessary to work in the water or wastewater workforce.

Den said the Bachelor of Science program will have 40 percent technical courses, 40 percent policy courses and 20 percent management courses, all from the water industry perspective.

He encouraged undergraduate students who want to go to school prior to the beginning of the program to major in biology. Students studying biology at A&M-SA are able to take water resources courses along with other core curriculum classes. Once the degree is officially offered, those students will be able to transfer swiftly into the water resources degree.

Den explained that over time, individuals in the workforce have gotten stuck on the work ladder because they only had licenses that were job-specific. Creating these degrees will allow workers the opportunity to receive degrees and have the chance to climb that work ladder. ⇨

8.2 percent of existing water operators will need to be replaced annually between 2016 and 2026. [2]

Den said the two bachelor's degrees are intended for students with no prior work experience in the industry. But they would also be a good fit for those with industry training who would like to complete a college degree.

Den said all degree programs will provide internship opportunities with local partners, offering students the prospect of gaining valuable practical skills through experiential learning and research.

Distance learning

Allowing water utility and wastewater workers to get their education through distance learning, whether through TEEX or A&M-SA-community college collaboration, is another way to counteract the decline.

Throughout the year, TEEX holds water and wastewater training schools for all water utility and environmental professionals as well as operators and technicians. The schools can provide the training hours necessary for obtaining professional licenses required by the Texas Commission on Environmental Quality. There are also courses available online for training, such as Public Water System Security that provides a better understanding of how to recognize and assess potential security issues related to water and wastewater plants.

As part of the Water Industry Professional Recognition Program, TEEX offers certificate programs for both water and wastewater operators and professionals.

The water industry will continue to require professionals be properly trained in the latest technologies to ensure safe water quality. Den said A&M-SA hopes to be a model for other universities and community colleges that want to start their own water programs.

The degree program offered at Texas A&M University-San Antonio will provide internship opportunities with local partners, offering students the prospect of gaining valuable practical skills through experiential learning and research. Photo from Texas Aquatic Science, Texas A&M University Press. Courtesy of the Harte Research Institute for Gulf of Mexico Studies, TAMU-Corpus Christi.

Results from a 2018 water industry survey indicated that aging workforce and anticipated retirements was the No. 7 issue facing the water industry. [3]

Story by Sarah Richardson

Arlington Water Utilities is about 65 percent finished with replacing its water meters with advanced metering infrastructure (AMI) (pictured). Photo courtesy of Arlington Water Utilities.

GIVING WATER AN UPGRADE

Automation technologies give water utilities cost-, water-saving data

Do you live in a smart city?

Smart cities use different types of electronic sensors and technology to collect data, allowing the more efficient management of assets and resources.

One city department in particular can benefit from these efficiency-improving tools: the water department.

Using smart technology such as automated water meters and robots with lasers is making life easier for residents and water utilities, saving them water, money and time.

Digitizing meter readings

In the cities of Lubbock and Arlington, the water utilities are installing advanced metering infrastructure (AMI), replacing meters read manually once a month with digital meters that can record water consumption data as often as every hour or more often in some cases.

Instead of a meter reader visiting each home, the AMI system transmits readings throughout the day over a secure radio network to the water utilities, providing them with data about the customer's water consumption.

Customers in cities where AMI has been installed can access digital readings of their meters online to monitor their water use.

In Lubbock, Aubrey Spear, director of water utilities, said the city is scheduled to install 90,000 AMIs over the next year, combining its water and electric utility meters.

"There will be separate data coming in, both from the customers' electric meter and from the water meter," he said.

The Lubbock Water Department crew replace manually read water meters with advanced metering infrastructure (AMI). Photo courtesy of Lubbock Water Department.

With AMI, Spear said there there will be a data point for every hour of every day, instead of one data point every 30 days, as with the manually read meters. "You've got 24 data points per day, and you're talking about a lot more information that we will be able to use to help our customers," he said.

Because manual meters are only read once a month, Spear said customers occasionally complain when their water bill unexpectedly increases — usually the first sign of an unknown leak.

Once the AMI system is installed, Spear said the utility will be able to know if more water is being used than usual and send customers notifications to check their home for leaks. "It should save a lot of money for the customer and water for us," he said.

The Texas Water Development Board loans acoustical leak detection and ultrasonic flow meter-testing equipment to help utilities identify leaks and determine flow rates. [4]

Additionally, if customers call with questions about their water bill, the utility can use the water consumption reports, or profiles, to pinpoint issues. The profiles will show patterns in water use that are outside of the recommended water conservation restrictions and allow the utility to make water- and money-saving suggestions.

"I think that profiles will help us with our relationship with the customers so that they are not doubting what is going on with their water bill," Spear said. "The AMI technology can help us be more proactive with our decisions and have more solid data to make those decisions with."

Walter "Buzz" Pishkur, director emeritus at Arlington Water Utilities, said Arlington is now in year six of its transition to AMI. "We're about 65 percent changed out, so we are well on our way to being fully AMI water metering," he said.

"We have also implemented new technology in the customer service and field operations departments," Pishkur said. "All of our crews have handheld devices, and our work orders are now handled digitally, giving us instantaneous access to account information and accelerating service delivery."

Enhancing water conservation

In some cases, AMI can be combined with other technology, making them more effective together.

Pishkur said combining AMI data with district metering, or the amount of water distributed out into the district, helps locate areas where leaks may be occurring. The hourly AMI readings are compared to the district metering.

"It helps us focus our leak detection personnel on areas that indicate a higher potential for having a leakage, optimizing limited resources," he said.

In Lubbock, Spear said the conversion to AMI will also allow other technologies to piggyback onto the data collection devices. Permanent acoustical correlating technology, a type of leak detection system, is placed in water valve boxes or on fire hydrants, sending sound waves through nearby water distribution pipes.

"These devices send data back through the radio collectors in the system, allowing us to detect unusual sound patterns that would indicate a pipeline has a leak even before the pipe bursts," he said.

If a pipe does burst, Spear said the data would give a more precise leak location, preventing the loss of so much water.

This leak detection equipment can also perform condition assessments on transmission lines that are suspected of developing leaking conditions.

Pishkur said leak detection is just one piece of water conservation in Arlington.

"It's a combination of AMI metering, full-time leak detection, district metering, focused main replacement and a comprehensive valve maintenance program," he said.

This combination of efforts leads to a reduction in water loss while avoiding unplanned repairs and reducing service outages for residents.

"In less than five years Arlington has reduced its lost water by nearly 50 percent," he said. "It's data, data, data. Our goal of comprehensive water conservation has been achieved by taking accurate data and turning it into useful information."

Spear said Lubbock has made great strides in its water conservation efforts as well, delaying the need for new water supply projects by at least 10 years.

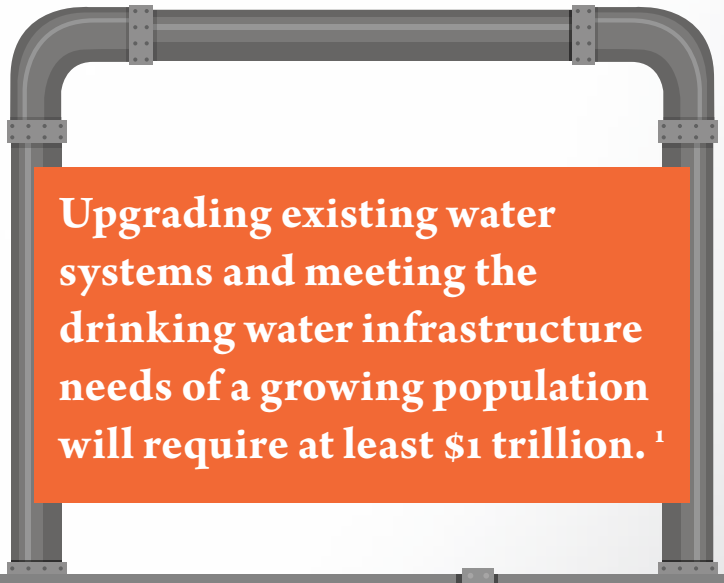
"We're like all other cities," he said. "You've got to look out for your new supplies of water, but you also have to take care of your aging infrastructure."

Managing water utility assets

With aging infrastructure, both Spear and Pishkur said knowing the condition of water lines and valves, or asset management, is extremely important.

At the same time Lubbock's water department is integrating AMI, Spear said it is adding an asset management system and doing some condition assessments using different technologies.

"We don't have a cohesive citywide asset management system that will help us manage existing assets and come up with some good proactive replacement programs, so that's in the process this year," he said.



Upgrading existing water systems and meeting the drinking water infrastructure needs of a growing population will require at least $1 trillion. [1]

"Some of our large transportation or transmission lines, even though they were built back in the 1950s, are still intact and in really good shape," Spear said. "But there are certain portions that detection technology can say 'Look, here's an area of concern,' and you can go in there and decide how you want to replace or repair that one location rather than taking out miles of pipe."

Pishkur said pipe assessment and a comprehensive valve maintenance program have many benefits.

"It is estimated that up to 50 percent of all the valves in a water distribution system are either not findable or not operable," he said. "What that means is whenever you need to have shut-offs, you have to shut off larger areas and it takes longer to achieve a shutdown for repairs. This results in disrupting more residents for a longer amount of time and losing more water due to the time delays."

Partnering with the University of Texas at Arlington's Center for Underground Infrastructure Research and Education, Arlington Water Utilities used robot technology to evaluate all the city's large-diameter pipes in its wastewater system.

Traditionally, Pishkur said entire sections of pipe would be replaced when a significant failure or pavement replacement occurred. "We now know that a majority of the pipe being replaced may still have many years of useful life, but we never knew which segments until now," he said.

"With this robot, not only do we have a picture, but now we know the condition of every segment of large diameter pipe in our system," Pishkur said. "The robot's laser can evaluate the pipe structure above the waterline, and with the robot's sonar capability, we can actually see the pipe condition below the waterline, which we have never been able to do with a camera. We can also see any debris that's building up there that may be limiting the pipe capacity."

The robots help not only with preventative maintenance but also with identifying pipe replacement project scopes.

"We had a 66-inch sewer line, which carried approximately 60 percent of all the flow in Arlington, and it failed. So we had a catastrophic event," Pishkur said. "In the past, we would have made an emergency repair and replaced the entire pipe section. Instead, we put the robot in that pipe and found out that out of 17,000 feet of 66-inch pipe, we only needed to replace about 1,100 feet."

By knowing which segment of pipe was actually damaged, Pishkur said a potentially $20 million project turned into a $3 million project.

"What we're finding is that 80 to 90 percent of the pipes that we were replacing didn't need to be replaced," Pishkur said. "So now we can do five or six more projects with the same dollars, which has a significant positive impact on our ability to make the piping system more dependable without expending more funds."

Pishkur said the adoption of this technology has helped the utility spend its dollars in the right place at the right time, accomplishing many more projects and addressing many more issues.

"With the valve maintenance, AMI, district metering, robotic pipe assessment and full-time leak detection, we have achieved tremendous reductions in both operating and spending," he said.

"Data is influencing everything we are doing. We just had to have the courage to adopt the technology that allows us to be better," Pishkur said. "You've got to be willing to change what you're doing when you have better data. Technology has and will continue to enhance our ability to provide better service to our residents while improving the skills of our employees."

Arlington Water Utilities crew deploys a robotic device for examining large diameter sanitary sewer lines. Photo courtesy of Arlington Water Utilities.

Story by Kathy Wythe

Engineer + Conservationist

Kathleen Jackson combines passion and profession in her work at TWDB

When Kathleen Jackson was first appointed to the three-member Texas Water Development Board (TWDB), she asked her three adult children — sixth-generation Texans — what they thought people across Texas most wanted to know about water.

"They just want to know that everything is going to be okay," Jackson recalled them responding.

Making sure that Texas water "is going to be okay" now and in the future is how Jackson has spent her time since first being appointed by then Gov. Rick Perry in 2014 and reappointed by Gov. Greg Abbott in 2017.

She travels all across the state, presenting and talking to Texans about the importance of water in Texas and how TWDB can assist communities in ensuring they have water for the future.

"It's not just about sharing the resources of the agency, but it's also about getting their (community leaders) thoughts and ideas and understanding what their challenges are, what the opportunities are and learning about what's going on in the community," she said, "because quite frankly, they're going to need water to meet their goals and objectives."

As an engineer, Jackson believes it is particularly important to engage with the engineering community because "they are the boots on the ground" for helping communities move forward with addressing aging infrastructure or building out new projects.

Path to the board

Jackson's path to serving as the engineer on the board began in Beaumont, Texas.

After graduating from North Carolina State University with degrees in chemical engineering and pulp and paper science and technology — the first woman to graduate with that degree — the Pensacola, Florida native moved to Beaumont, first to work at a paper company, then for Mobil (now ExxonMobil). Jackson held several engineering positions at the Beaumont refinery in the engineering design, operations, technical service and environmental departments. ⇨

Kathleen Jackson has served as a Texas Water Development Board member since 2014. Photo by Kathy Wythe, TWRI.

The Lower Bois d'Arc Lake will be the first major reservoir built in Texas in nearly 30 years.

It was through her work in environmental stewardship that Jackson gained an understanding of the value of water.

As part of a regional initiative, Jackson worked with Dr. Ruth Patrick, a renowned scientist with the Academy of Natural Sciences of Philadelphia (now the Academy of Natural Sciences of Drexel University), to conduct a biological survey of the Neches River to evaluate the health of the estuary. She also served on the board of the Lower Neches Valley Authority, one of the river authorities created by the state.

Jackson also developed a passion about agriculture after meeting her late husband, Tom, a fifth-generation Texan rice farmer and cattle rancher, in Beaumont. Jackson said her husband would tell her, "We make the perfect couple because people have to have food and they have to have energy."

Because of her enthusiasm for environmental stewardship and engagement in the community, the oil and gas company eventually appointed Jackson its public and government affairs manager.

"I was very fortunate in that I was able to use the background I had and the education I had to make a contribution," she said, adding that during this time at the refinery she worked on some strategic initiatives.

Jackson worked with local educators in support of the Texas Reading Initiative, and then Gov. George W. Bush appointed her to the Governor's Focus on Reading Task Force. She also worked with a consortium in Southeast Texas to develop the Southeast Texas Alerting Network, a communications network that enables people to know and understand what is happening very quickly during emergencies.

The Luce Bayou Interbasin Transfer Project, currently the largest water infrastructure project being constructed in the United States, will move water from the Trinity River to Lake Houston.

Using her engineering background

She said her engineering degree and background served her well in the different positions she has held through the years.

"What I found over time is that engineers can do lots of things, having that good, strong technical background," she said. "Engineers are trained to be problem-solvers, to execute to a process and to ask the question, how do we measure success?"

When the opportunity arose in 2014 to become one of the three TWDB board members, Jackson accepted.

At the time she joined the board, the state was still grappling with the repercussions of the 2011 drought, Texas' driest year on record. To address some of these issues, the Texas Legislature had created the State Water Implementation Fund for Texas (SWIFT), which Texas voters approved with a constitutional amendment in November 2013. SWIFT enabled the one-time investment of $2 billion from the state's Rainy Day Fund to finance low-cost loans for projects in the state water plan.

"I believe the intent of the Legislature in establishing SWIFT was to incentivize communities to invest now and move big water supply projects forward," she said.

As she traveled around Texas, talking to Texas water leaders, she asked them how they thought success could be measured to show the state is making a difference and achieving its goals.

"What they shared was, 'We have a lot of big water supply projects that right now are just treading water. If we see those start to move forward, then we believe that would be a good indicator that we're being successful,'" she said.

Jackson cited several large water supply projects that have since benefited from SWIFT funding. The Tarrant Regional Water District and Dallas Water Utilities Integrated Pipeline Project will transmit water from East Texas to both water entities. Another project, the Lower Bois d'Arc Lake, will be the first major reservoir built in Texas in nearly 30 years, and the Luce Bayou Interbasin Transfer Project, currently the largest water infrastructure project being constructed in the United States,

will move water from the Trinity River to Lake Houston to help meet the growing water needs of the Houston area.

The agency hoped SWIFT would increase focus on water infrastructure projects and communities using TWDB's other loan programs, such as the Clean and Drinking Water State Revolving Funds.

For the most part, Jackson said, TWDB has seen communities using the agency's resources and funding programs more, particularly to upgrade their aging infrastructure.

Implementing these projects begins at the local level, Jackson said, so a key component to success is local leadership communicating the value of water and helping its residents understand that the community needs to invest in upgrading its infrastructure.

"We believe local communities know best," she said, adding that as in the state water plan's regional water planning process, implementation is a bottom-up process.

"You can have the money, and you can have the technology. But it's up to the local community leadership to take the bull by the horns and move these projects forward."

One of the things Jackson noticed traveling around Texas and talking to city staff is that larger cities not only participate in the regional water planning process, but they also are able to successfully manage their assets to address their future water supply needs. Smaller communities also participate in the water planning process but don't necessarily have those asset management plans, which, Jackson said, are "so important for success."

To address this issue, TWDB, with input from the Texas Commission on Environmental Quality, is piloting an asset management program for six small communities. Consulting engineers are working with each community to develop asset management plans with specific deliverables, such as documenting up-to-date utility maps, equipment information and operating procedures.

"It's not just about the steel and the pipe," Jackson said, about identifying the assets. "It's also about investing in the resources those communities need to promote efficient and reliable long-term operations.

"If a small community is out of water, then Texas is out of water," she said. "So a lot of what we've done in the last five years is really look at what can we do to assist small and rural communities."

Flood planning, post Harvey

The day after Hurricane Harvey, Jackson flew over Beaumont in a helicopter and saw first-hand the devastation and flooding to her own community. She said the natural question any community that's experienced a major flood has is, "What can we do to prevent this from happening again?" The answer, Jackson said, is, "We want to be prepared."

The first step for the state to be prepared for future flooding begins with planning and investing in the "absolute best data and best information," she said, including improved mapping, modeling and weather data, and identifying mitigation efforts, both structural and nonstructural.

TWDB has been very successful in water planning because the planning is data driven and science based, Jackson said, and it makes sense to draw on that same approach for flood planning.

"The better the data, the better the science; the better the science, the better the policy," she said. "We need to make sure that we get the best data that we can and utilize science, so that as we move forward, we have the information that communities need to make the best risk-based decisions."

Perhaps prompted by Harvey and Texas' susceptibility to weather extremes, building resiliency for the state's water infrastructure is also on people's minds. Jackson said Gov. Abbott calls it "future-proofing our state."

"We don't really know what's coming, but we ought to be building out our infrastructure to be resilient, so when things happen, we are prepared and able to respond, and we have the resiliency already built in," she said.

A dream come true

Reflecting on the path that brought her to the board, Jackson said she recognizes that all her experiences have been interrelated.

"Along the way, you learn a lot from everyone," she said, seeming invigorated by the challenges the position presents.

And she is glad she took her children's advice to "go for it," calling her position on the board "a dream come true."

"It's my hope that I can take everything that people invested in me and everything that I've been able to learn and make a meaningful contribution to help communities across our state make sure they have the water they need so that our children and our children's children have a future."

Consolidation of smaller utilities is one way to address both financial and workforce issues, according to experts. Photo by iStock

Story by Sarah Richardson and Kathy Wythe

WEARING MULTIPLE HATS

Smaller utilities encounter numerous challenges

Almost 6,000 Texas public water utility systems serve populations of 3,000 or smaller. Supplying around 3.2 million people with water, they encounter unique, important challenges that their larger counterparts don't necessarily face.

Many of these challenges come down to economies of scale. Smaller utilities struggle with having enough revenue to fund infrastructure upgrades and other capital improvements and hiring or keeping adequate qualified staff, experts said.

Dr. Manny Teodoro, associate professor in Texas A&M's Department of Political Science, said a utility that serves a million people and has a staff of thousands is very different from a utility that serves 5,000 people and has a staff of a dozen. And those utilities are different from utilities that serve fewer than 1,000 customers and have a part-time staff.

"All utilities face these challenges, but the smaller the utility, the bigger the problem, the bigger the challenge," he said.

Dorothy Young, program specialist with the Texas Commission of Environmental Quality (TCEQ), agreed.

"With smaller water systems, it's a matter of running it like a business, having the funds and the planning and keeping on a path of compliance," Young said. "They don't have the same budget. They don't have the same resources as larger systems or access to workforces or funding.

"And, a lot of times, the mayor may run a store and is also the operator. They wear lots of different hats and are pulled in different directions."

Young said not having the needed revenue for operations is a challenge for many smaller communities.

"They see their neighbors, and the neighbors might not seem very well off," she said. "They don't want to burden their neighbors with higher water rates, but in the end they probably need to review and maybe raise rates more often."

Recruiting workers

Most smaller utilities have more difficulty recruiting and keeping the highly trained, specialized operators needed in the water industry today. (See "Water, no workers," page 6.)

"Large utilities can hire specialized operators depending on the kind of plant they have," Young said. "They can have more backup; they've got more revenue coming in; and so it's just easier to do."

Teodoro agreed that larger utilities have an advantage over smaller ones when recruiting staff. He said there are some places in Texas, particularly in South and West Texas, where utilities can't find qualified water and sewer operators at any price.

"It's not that local government can't raise the money; it's that those people don't exist," he said.

Many water utilities have transitioned from a low-tech industry to one that is technology-driven and require their workers to be trained in the newest technologies.

"The level of regulatory demand and the new kind of challenges to water quality from different kinds of contaminants makes everything much more complicated," Teodoro said.

Young said TCEQ's staff encourages small water systems to look to their own community for possible workers.

"Particularly where there is the lure of the oil field with higher paying jobs in nearby towns that might pay a lot more, we try to encourage home-grown operators," Young said. "When you've got people who want to stay in the town, we suggest talking to them about getting trained."

Consolidating small systems

Dr. Robert Greer, assistant professor in Texas A&M University's Bush School of Government and Public Service, said Texas has a very fragmented system of water utilities, ranging from city-owned utilities to more than 1,000 special districts, such as municipal utility districts and irrigation districts. Smaller districts' ability to generate revenue to fund their operations is limited, with some able to raise revenue with property taxes, but most relying on revenue generated from water and wastewater services.

"If you were to draw the perfect sort of efficient system to deliver water, it wouldn't include so many different districts that have different interests and different financial and political capacities," Greer said.

Both Teodoro and Greer said that coordination between surrounding entities or consolidation of smaller utilities is one way to address both financial and workforce issues, but both bring their own challenges.

"When you have a limited geographic area or limited consumer base that is the sole source of your revenue, you don't have the ability or the financial capacity sometimes to take on these really large multi-million dollar projects, such as replacing all the pipes or installing new treatment facilities," Greer said. "Because we have sort of neglected infrastructure for so long, we end up with districts where even if they recognize the need to invest in new infrastructure, they don't have the capacity to do so. They don't have the revenue streams that they need to then issue the debt or take on these large projects."

The choices for the smaller utilities, Greer believes, are for them to coordinate with surrounding districts with a collaborative agreement or for the state to provide state dollars.

Teodoro also thinks the consolidation and regionalization of small systems may help.

He said consolidation could be done by combining two or more adjacent utilities.

"But sometimes that's not possible or not practical," Teodoro said. "And in that case, it's still preferable to have small systems unified under a single organization because you can provide the organizational economies of scale."

Greer said he has also looked at how those special districts operate organizationally. Often, he said, the smaller utilities or districts are networking and sharing contractors for specific, needed tasks, such as engineering, legal work or financial advice.

Consolidation would be complicated, Teodoro said, not only because of governmental issues but also because of the tremendous amount of emotions and identity that are part of local water systems.

"A lot of folks think of their water system the same way they think about their local football team or their basketball team," Teodoro said. "Asking a community to take their name off the local water tower is like asking Paris to give up the Eiffel Tower."

There are 7,012 public water systems in Texas, serving a population of 28,249,222. Almost 6,000 of these systems serve populations of 3,000 or smaller.[6]

Up-to-date infrastructure aids water quality

In both their research, Greer and Teodoro have found that the fiscal capacity of districts to raise revenue affects their ability not only to invest in infrastructure but also to solve environmental or health-related water quality issues.

Greer examined some of the more than 500 special districts in the Houston area responsible for delivering drinking water to determine some of the institutional capacity-type issues that arise with heavily fragmented systems.

Because smaller districts in lower income areas have pressure to keep water rates low and they don't have the means to invest in infrastructure, Greer said they receive multiple fines for not meeting standards for clean drinking water.

"Rich districts are able to invest more in infrastructure and, therefore, have fewer EPA violations; poorer districts are not able to invest and, therefore, have higher frequencies of EPA health violations," Greer said of the expected results of his study.

"There are different areas of Houston where that's a challenge," Greer said. "We want to be able to highlight that this is an issue going on right in our own backyard and something that we need to be aware of."

Teodoro and Dr. David Switzer, a former Texas A&M doctoral student now at the University of Missouri, conducted a national study that discovered compliance to EPA's Safe Drinking Water Act (SDWA) is also tied to human capital.

"When a utility has the size and resources to take advantage of human capital resources in its labor pool, compliance with the more technically difficult aspects of SDWA regulations improves," Teodoro said.

Resources for smaller utilities

There are resources available to help smaller water utilities with their different challenges.

The Texas Water Infrastructure Coordination Committee (TWICC) was formed about eight years ago to provide funding and other assistance to water and wastewater systems. Young said TWICC is an umbrella organization of different entities — funding, regulatory and nonprofits — that organized voluntarily to help entities with their water and wastewater projects.

(Left) Small water utilities sometimes struggle with having enough revenue to fund infrastructure upgrades and other capital improvements. Photo courtesy of Texas Commission on Environmental Quality.

(Right) The Texas Commission on Environmental Quality offers free on-site financial, managerial and technical assistance to help public water and wastewater systems comply with regulations and address issues such as water loss and planning. Photo courtesy of Texas Commission on Environmental Quality.

The Texas Water Infrastructure Coordination Committee provides assistance to water and wastewater systems in Texas.[6]

In her position with TCEQ, Young is involved in the Capacity Development Program, which supports water systems through technical assessments and managerial and financial assistance.

The agency offers free on-site financial, managerial and technical (FMT) assistance to help public water and wastewater systems comply with regulations and address issues such as water loss and planning. Free technical training workshops are also available to public water systems. TCEQ contracts with experienced water and wastewater professionals to help provide this assistance and training. FMT assistance can also help systems determine whether consolidation with a neighbor or larger utility is feasible.

"TCEQ has been providing free on-site assistance for a long time, and the program keeps growing," Young said.

TCEQ also has the Texas Optimization Program for Surface Water Treatment Plants. Originally created with the intent for TCEQ staff to help existing water systems optimize their operations, Joel Klumpp, manager of TCEQ's plans and technical review section, said the program has expanded to also offer advanced technical assistance, including problem-solving.

"Now the Texas Optimization Program is deployed not just to achieve optimization but also to provide technical assistance to a water system that perhaps doesn't have the technical resources of its own or the ability to hire someone to help with some technical issues," he said.

The Texas Water Development Board (TWDB) is piloting a one-year asset management program specifically to help smaller utilities.

Jessica Zuba, TWDB's deputy executive administrator for water supply and infrastructure, said TWDB is steering six small utilities through the process of asset management. The agency paired each utility with a consulting engineer to examine its system to determine needs and help the utility prepare a plan for going forward.

"We have some entities in the state that don't know where existing facilities are because they weren't mapped or there's just been so much turnover that no one's familiar with where lines are," she said.

Depending on the success of the pilot program, Zuba said it could become a permanent part of TWDB's programs.

Story by Kathy Wythe

INVESTING IN H_2O

Water utilities balance financial, social, political challenges

A growing population combined with aging infrastructure and new water treatment technologies are challenges water utilities all across the country face. Many times resolving those concerns comes down to money.

Intertwined into the financial challenge, though, are the social and political consequences of raising the needed revenue. How do water utilities balance the need for revenue while keeping water affordable?

Funding new, replacing old infrastructure

According to the American Water Works Association's 2018 State of the Water Industry report, financing for capital improvements is the No. 2 issue facing the water industry with replacing aging infrastructure topping the list. Texas water experts agree.

Dr. Robert Greer, assistant professor in Texas A&M University's Bush School of Government and Public Service, said one of the main reasons funding infrastructure is such a challenge for water utilities is because they are the primary entities responsible for paying for the infrastructure.

"In the United States, it disproportionately falls on state and mostly local governments to identify what infrastructure requirements are needed, both for new construction and maintenance of existing infrastructure, and to develop ways to finance those projects," Greer said.

There are limited funds through the federal government to pay for infrastructure. For instance, the Water Infrastructure Finance and Innovation Act provides long-term, low-cost supplemental loans for regionally and nationally significant projects, according to the U.S. Environmental Protection Agency's (EPA) website.

The Texas Water Development Board (TWDB) offers a few grants and several loan programs for water utilities to help finance their projects. For example, the Drinking Water State Revolving Fund, funded by EPA with matching state dollars, provides low-cost financial assistance for planning, acquisition, design and construction of water infrastructure, and the Rural Water Assistance Fund helps small rural utilities obtain low-cost financing for water and wastewater projects. The State Water Implementation Fund for Texas, or SWIFT, provides low-interest loans for projects in the state water plan. As of February 2019, TWDB had made more than 5,145 financial commitments for approximately $27.8 billion since the agency's inception in 1957, according to TWDB's website.

Jessica Zuba, TWDB's deputy executive administrator for water supply and infrastructure, said the advantage of water utilities coming to TWDB is that those entities get the benefit of the state's AAA bond rating, saving them money.

"The water utilities are getting a better interest rate than they would have gotten had they gone out to the market themselves and sold bonds," Zuba said. "With our state revolving fund programs, we partner with EPA, and those programs allow us to offer even further subsidized interest rates." ⇨

Replacing aging infrastructure is a need for water utilities, both large and small. Photo by iStock.

Revenue volatility: Planning for that rainy (or dry) day

Revenue volatility, or the lack of revenue stability, is another challenge for water utilities.

Some water utilities can issue bonds to pay for capital improvements, and some water districts have property tax authority where some of the taxes can be used to pay for improvements. But for the most part, water utilities pay for these capital improvement projects through revenue from the sale of water and wastewater fees.

Zuba said one of the bigger issues TWDB is seeing is how entities are trying to update their aging infrastructure and how that fits into their current rate structure or how they communicate to their constituents about rates if they have to raise them, particularly if rates have been static for a while.

Most Texas utilities use the inclining block rate, where the more water customers use, the more they pay. This type of rate structure tends to help customers conserve water but can also decrease revenue.

Dr. Manny Teodoro, associate professor in Texas A&M's Department of Political Science, said some utilities managers are reluctant to rely on inclining block rates because they worry about reduced revenue if customers are more efficient with their water use.

For example, extreme drought and rainfall both can potentially reduce water utilities' revenue because people use less water during both of these weather events, and utilities have to manage for these uncertain environmental factors and the loss of revenue while their costs may remain fixed.

Utilities have to pay for the infrastructure, Greer said, whether "it's rain or shine with a flood or drought."

For water districts and utilities with taxing authority, Greer said those taxes can be used to offset total reliance on the fees from delivering water or wastewater services.

"If the district is solely relying on fees from the sale of water to fund all of its operations and fund all of its infrastructure, then it's under increased or higher levels of pressure and more fiscal constraints," he said.

Greer said he and some colleagues looked at mandatory water restrictions and the correlation to revenues during the 2011 drought. What they found was that entities that had greater fiscal capacity — meaning they had more revenue and lower levels of debt — were faster to implement these mandatory restrictions.

"Those that had reduced fiscal capacity — lower revenues and higher levels of debt — were slower to implement these mandatory restrictions," he said.

"We need to create ways that will allow utility managers to manage that financial risk," said Teodoro of this revenue volatility. "Ideally what we would like to do is have every utility keep big financial reserves so that it can manage those things."

When water sales are up, the utility would save the money; when sales are down, it would draw that money out to operate the utility.

"It is not that simple though," Teodoro said. "The reason it's not that simple is that elected officials do not like it when utilities are sitting on enormous financial reserves. Ultimately, the problem is political. It's not about the finances, it's about the politics."

Affordability program versus rate structure

Raising rates might be a burden to the lower income customers, so many cities offer assistance or affordability programs.

For example, the San Antonio Water System offers an assistance program, Uplift, which provides access to 14 different initiatives to help with paying monthly water bills, including an option that offers disabled

In 2018 the Drinking Water State Revolving Fund committed $2.8 billion in drinking water infrastructure loans and refinancing and disbursed $2.5 billion for drinking water infrastructure.[5]

veterans a payment extension on their monthly bill. El Paso Water collaborates with Amistad, a non-profit agency, to offer an assistance program, AguaCares, for customers over 65, facing financial hardship and at risk of being disconnected from water service.

While not against assistance programs, Teodoro said he believes keeping rates affordable for residents who use very conservative amounts of water is the first and more sensible approach to addressing affordability.

He relates the problem of unaffordable water to a disease.

"If you think about the problem of unaffordable water as a disease, then the assistance program is like therapy; it's like taking a drug or getting an operation," he said. "Addressing affordability through rate structures is like an immunization program, an inoculation."

Vaccines are the most cost-effective way of preventing a disease, and low rates are the most cost-effective way of making water affordable, he said.

Sponsoring affordability programs involves tremendous effort and administration for both the customer and the utility and comes with some barriers. Teodoro said customers have to be aware of and apply for the program and the utility has to administer it and deliver the benefit, either by bill reduction or direct cash payment. The program periodically has to be audited.

"Even in the best of circumstances, these programs are only going to reach maybe 80 to 85 percent of the eligible population," Teodoro said. "And in a lot of cases they are going to reach a lot fewer than that."

Instead, Teodoro said, if the utility keeps the price for basic indoor water use — the water needed for cooking, cleaning, drinking and sanitation — low, it becomes affordable for everyone.

"I'm not suggesting to keep rates low across the board," he said. "I'm saying that the price of water for residential use at a very conservative level ought to be affordable. Water rates for high volumes of water use — especially during periods of peak demand — should be higher."

Teodoro said a common narrative is that conservation and efficiency come into conflict with affordability.

"There's this idea that we have to charge a lot of money for water so people will use it efficiently," he said. "But if we do that, that's bad for affordability. I don't think those two goals are really in conflict. If you price things properly and keep prices low for essential use and high for discretionary use, you can achieve both efficiency and affordability at the same time."

The need for communication

When it comes to raising rates to fund new projects, the experts agreed that communicating the value and price of water, not only to the customers but also to local politicians, is key to acceptance.

"I think one common misconception is who the average person thinks is supplying their water," Greer said, adding that most think they get their water from the city. "It may be the city, but there's a good chance it's not the city but a special district that overlaps with city boundaries."

When water rates go up, people might get angry at the city, but it may not actually be the city raising those rates, he said.

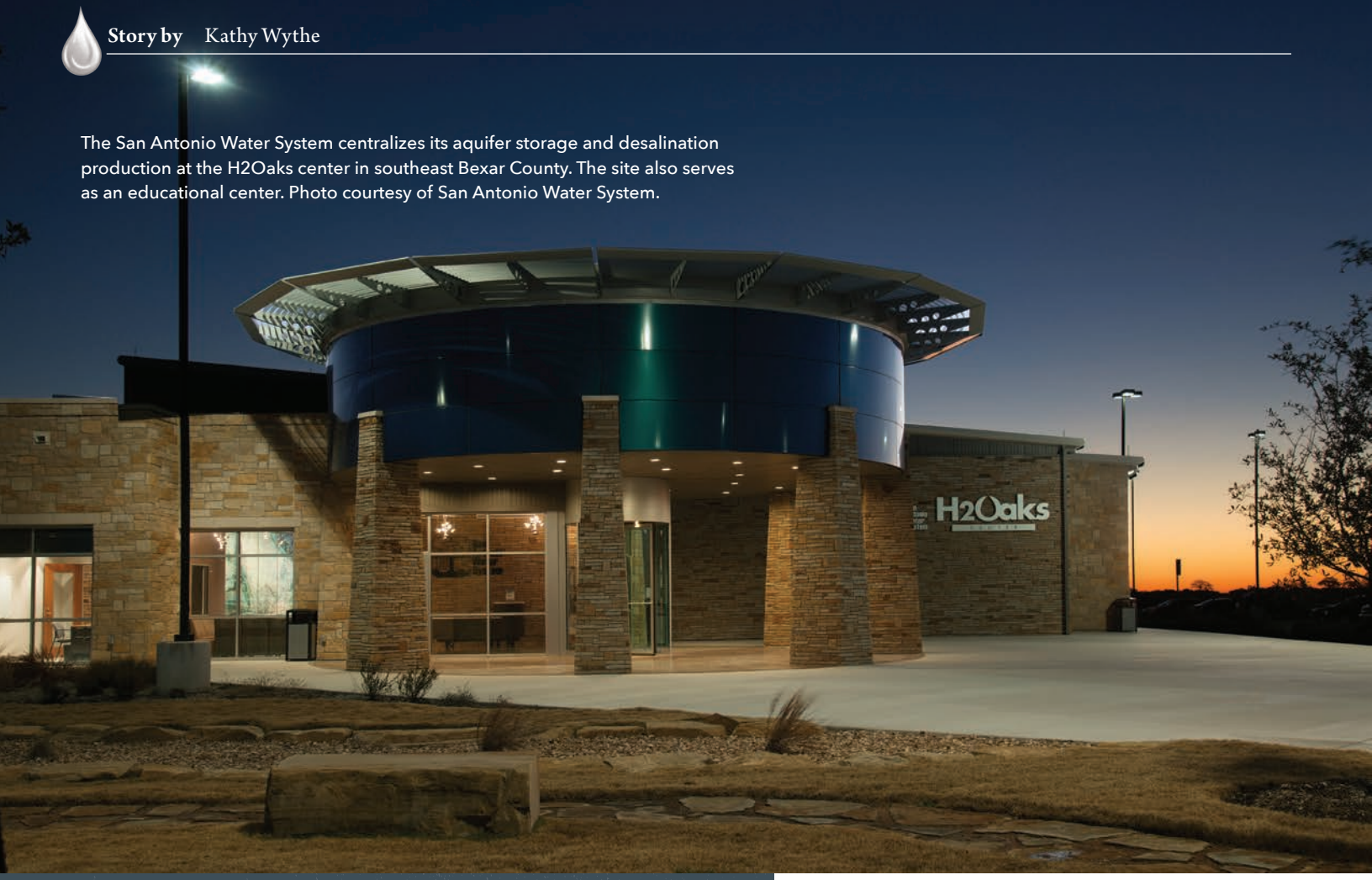
Teodoro said the best utility managers manage up. "They manage the relationship with their elected officials so that their elected officials understand what they're doing. They don't just show up when they want a rate increase."

Teodoro said having adequate and affordable drinking water and sanitation is the very definition of human development.

"If you ask most people, they recognize water and sewer systems are the most important things that we have," he said. "It's incumbent upon the folks in the water sector and folks like me to explain it and come up with creative solutions," he said. "I think there are solutions. There are things that we can do; it is just going to take some creativity. We have to make it a priority."

As of February 2019, the Texas Water Development Board had made more than 5,145 financial commitments for approximately $27.8 billion since the agency's inception in 1957.[4]

Story by Kathy Wythe



The San Antonio Water System centralizes its aquifer storage and desalination production at the H2Oaks center in southeast Bexar County. The site also serves as an educational center. Photo courtesy of San Antonio Water System.

Diversifying Water Portfolios

Two Texas water utilities use 'out-of-the-box' strategies to ensure future supplies

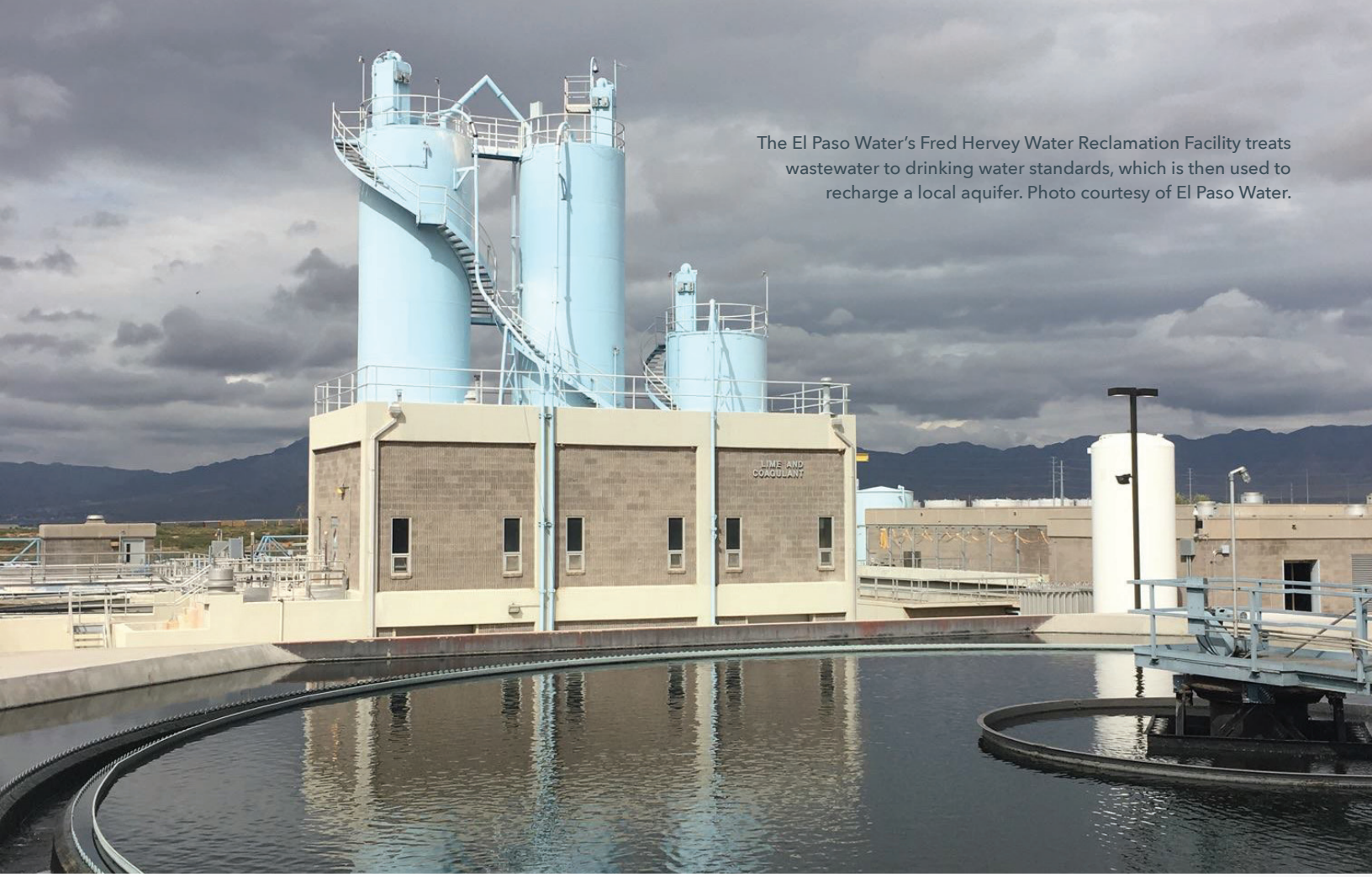
Two Texas water utilities, in cities miles apart and geographically different, rely on similar and diversified water management strategies to supply enough water to their growing populations.

El Paso, at the furthest western tip of Texas situated in the Chihuahuan Desert, began in the early 20th century to diversify its water portfolio. San Antonio, in south-central Texas, wasn't faced with the need to expand until 20 years ago, when its sole source of water, the Edwards Aquifer, became regulated with limits to its withdrawal.

Both are known in the water world as leaders in innovation strategies and aggressive conservation.

San Antonio: game-changing strategies

For years, the Edwards Aquifer, one of the most productive aquifers in the United States, supplied San Antonio residents with their water. Once the aquifer became regulated by the Edwards Aquifer Authority, the San Antonio Water System (SAWS) began looking for new water sources to reduce its reliance on the Edwards. While the aquifer is still the utility's main source, providing 80 percent of its water in 2018, the utility now draws water from eight sources through 15 different projects.



The El Paso Water's Fred Hervey Water Reclamation Facility treats wastewater to drinking water standards, which is then used to recharge a local aquifer. Photo courtesy of El Paso Water.

New sources include surface water from Medina Lake, Lake Dunlap and Canyon Lake and groundwater from the Trinity Carrizo and Lower Wilcox aquifers.

SAWS also uses reclaimed water to further reduce its dependence on the Edwards. In 2001, SAWS completed the first phase of its purple pipe system to recycle treated wastewater for irrigation and industrial uses.

SAWS' purple pipe system is the largest direct reuse system in the country, according to Darren Thompson, SAWS director of water resources. "It has the capacity to deliver about 25,000 acre-feet (8.146 billion gallons) a year to our customers," he said.

Thompson said transitioning golf courses and industries from using potable, or drinking, water to using recycled water maximizes SAWS' use of drinking water. "We didn't want to use potable water on golf courses," he said.

In most years, SAWS doesn't use all its permitted water from the Edwards and saves this water to use during dry summers or droughts. The utility stores the excess water in the Carrizo Aquifer in south Bexar County through a process called aquifer storage and recovery (ASR). SAWS' ASR facility is the largest groundwater-based facility in the nation.

During the record-breaking drought between 2011 and 2014, SAWS recovered more than 50,000 acre-feet (16.202 billion gallons) of stored Edwards water, according to its website.

It also operates a desalination plant, treating brackish, or salty, water from the Lower Wilcox Aquifer through reverse osmosis. The plant has the capacity to produce about 12 million gallons of drinking water a day. ⇨

The San Antonio Water System recovered more than 50,000 acre-feet of stored Edwards Aquifer water during the 2011-2014 drought.

(Top) Through its partner, Garney Construction, the San Antonio Water System is running 140 miles of pipe from Burleson County to San Antonio as part of its Vista Ridge project.

(Bottom) The San Antonio Water System staff uses a flexible robot that travels through smaller water mains detecting leaks through internal pressure anomalies, helping the utility save water. Photos courtesy of San Antonio Water System.

The newest addition to SAWS' portfolio will come online in April 2020. The Vista Ridge Pipeline project, a public-private partnership, is a 142-mile pipeline that will transfer 50,000 acre-feet (16.202 billion gallons) of groundwater a year from the Simsboro and Carrizo aquifers in Burleson County to SAWS.

Calling the Vista Ridge project a "real game changer," Thompson said it will provide the largest amount of non-Edwards water in SAWS' portfolio. "In the past we have developed water sources locally within Bexar County and adjacent counties before reaching out within the region," he said. "When Vista Ridge comes online, it will ensure water security into the 2040s."

Each of the different water management strategies, Thompson said, fits a need and has a reason to be developed.

He likened the utility's diversification strategy to someone planning for retirement and diversifying their investments. "You want to make sure each one of those investments fits a need," he said. "You don't want to have everything in one basket. Some of SAWS water sources are more susceptible to drought, and some sources are very stable and dependable."

Thompson said the regulation of the Edwards in the 1990s actually turned out to be advantageous to SAWS. "If the Edwards Aquifer was never regulated, then those out-of-the box activities might not have happened or not happen as early," he said. "When you go from an unlimited source of water to one that is regulated and you don't have enough of it to meet future demands, you tend to get very creative and maximize what you do have."

El Paso: proactively prepared

El Paso Water also prides itself on its range of different water supplies and its water reuse.

Currently, 40 percent of its drinking water supply comes from the Rio Grande, with 55 percent from Hueco Bolson and Mesilla Bolson aquifers and 5 percent from desalination. However, it is how the utility is using — and reusing — the water that makes it one of the most progressive water utilities in the country.

"Because we live in the desert and because we are limited in water supply, we have always had to diversify, and that began decades ago," said Christina Montoya, El Paso Water's communications and marketing manager. "Our strategy is not waiting until we have to do something; it's diversifying and being proactive."

As early as 1963, El Paso Water operated a wastewater treatment plant that took effluent, or

The Vista Ridge Pipeline project will transfer 50,000 acre-feet of groundwater a year from aquifers in Burleson County to the San Antonio Water System.

(Left) The Kay Bailey Hutchison Desalination Plant uses reverse osmosis to treat brackish groundwater pumped from the Hueco Bolson to produce drinking water. Photos courtesy of El Paso Water Utilities.

(Right) Research is conducted at El Paso Water's Advanced Water Purification Pilot Facility in 2016. Photos courtesy of El Paso Water Utilities.

treated wastewater, and distributed the nonpotable water to a local golf course for irrigation. Today, the utility operates four wastewater reclamation plants and supplies about 5.83 million gallons of reclaimed water a day to golf courses, sports fields, construction sites and others. Currently, 32 percent of El Paso Water's reclaimed water is used for irrigation, 33 percent for industrial processes, 34 percent for aquifer recharge and a small percent for construction.

El Paso Water's Fred Hervey Plant also treats wastewater to drinking water quality standards, and about 30 billion gallons of the reclaimed water has been recharged into the Hueco Bolson.

El Paso Water's smallest but most famous supply of water comes from the Kay Bailey Hutchison Desalination Plant, the world's largest inland desalination plant. It opened in 2007 as a joint project of the utility and U.S. Army's Fort Bliss. It treats brackish groundwater pumped from the Hueco Bolson by reverse osmosis to produce drinking water. The plant has the capacity to produce 27.5 million gallons of freshwater a day, increasing El Paso Water's freshwater production by approximately 25 percent, according to the utility.

In 2017, El Paso Water began a partnership with Enviro Water Minerals, which plans to recover minerals discharged in wastewater from the desalination plant. The company will separate the waste concentrate into high-purity, industrial-grade mineral products. Water extracted from the process will be returned to El Paso Water and will increase water production at the desalination plant by more than 2 million gallons a day at full capacity.

The utility has already piloted direct potable reuse that brings treated wastewater up to drinking water standards and then returns it directly into the drinking water distribution system. It plans to put its Advanced Water Purification Facility online within the next five years, according to Gilbert Trejo, El Paso Water's chief technical officer.

"That is really the next logical step in our water reuse program," Trejo said.

Trejo said the facility will be the first pipe-to-pipe system in the nation. Other communities have sent treated wastewater through a purification process, only to treat it again in a surface water facility before it enters the distribution system.

"I think it's very exciting for El Pasoans to know that what we're doing here in El Paso is going to change the water industry," Trejo said. "The water community knows and understands that these treatment processes treat the water and produce very high quality water. It's a matter of which community is going to be the first one to have absolute trust in its water utility and in the water to drink it. And that's what we're about to do here in El Paso."

Aggressive conservation

Both utilities have aggressive conservation programs that help extend the life of the other water sources. ⇨

El Paso Water supplies about 5.83 million gallons of reclaimed water a day to golf courses, sports fields, construction sites and others.

Karen Guz, SAWS director of conservation, said SAWS relies on three strategies: education and outreach, reasonable regulation and incentives for the utility's conservation program.

"The mix of programs offered has evolved over the years as we have completed some efforts such as eliminating high-flow plumbing fixtures," Guz said. "Today the utility has a wide range of programs to help residential and commercial customers be water efficient."

SAWS incentives include residential outdoor and commercial rebates, such as WaterSaver Coupons to help customers transform their grass landscapes to resilient designs that match their individual tastes and home styles.

Both utilities have ordinances that restrict landscape watering during certain times; SAWS' is tied to the water levels in the Edwards; El Paso Water has a year-round watering schedule with restrictions on what days residents can water, and from April 1 to September 30, what time of day they can water.

Since the 1980s, El Paso Water customers have reduced per-person water consumption by 35 percent, according to its website. This savings was accomplished through a combination of conservation programs that emphasized educational outreach to schools, incentives to change how customers use water and enforcement to ensure compliance with the city conservation ordinance.

Communication, education keys to success

While both utilities have similar and diversified strategies, they also have similar governmental organization and philosophies that have helped them succeed.

Both SAWS and El Paso Water have their own board and operate independently from their respective cities.

Connecting with the community through education and communication is a priority for both utilities.

Guz said the utility has been out in the community and in schools for decades.

"The impact was brought home to SAWS recently when we realized our newest conservation planner was introduced to water efficiency ethics through our school-aged programs years ago," she said.

Montoya said El Paso Water has also communicated to its customers about the reasons for diversification and the need to add nontraditional water supply sources, such as the desalination plant.

"We've always talked to our customers about the need to diversify living in a desert," Montoya said, "so we'd have their support."

As the plans started on the Advanced Water Purification Facility, Montoya said the utility immediately started communicating with its customers. It conducted a survey to find out how its customers felt about this new water source.

"We were very pleasantly surprised that about 84 percent of those surveyed were okay with accepting that type of a new water supply," she said, adding that the more people knew about the technology and understood the process, the more the project's acceptance grew.

Montoya said El Paso Water adds diversified solutions to its portfolio to make sure that if one water supply is not available, it will be able to supplement with another source.

"For example, in 2013, when we had the drought and our river water supply went from 40 percent to probably about 5 percent, we had to really use the desalination plant at high capacity and pump a lot of our wells," she said. "Because we have those alternate sources, we were able to keep meeting demand."

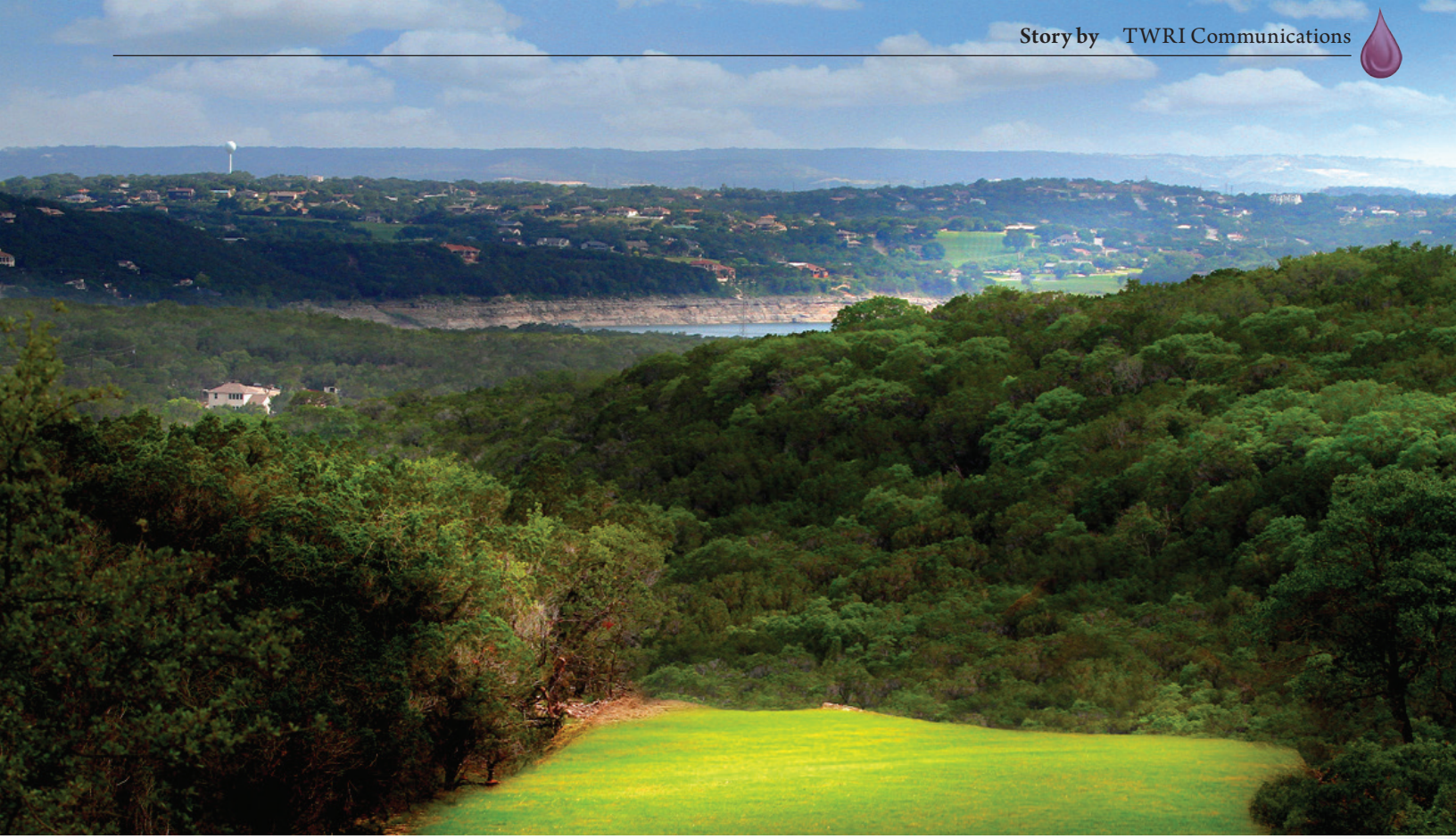
Anne Hayden, SAWS communications manager, said San Antonio had to face the challenges of water issues much earlier than most areas in other parts of the country.

"In the early 1990s, when our only source of water at the time was becoming heavily regulated, there was some shock about what we would have to do," she said. "But as a result, we were able to implement education and conservation programs, incentives and ordinances to create a conservation ethics in San Antonio, so now it is really in our blood."

Transparency is also a key to success. "The more the community knows and the more we show them, the more confident they are that we can provide them with clean and sustainable water now and in the future," Thompson said.

The Kay Bailey Hutchison Desalination Plant has the capacity to produce 27.5 million gallons of freshwater a day.

Story by TWRI Communications



CREATING A SPLASH

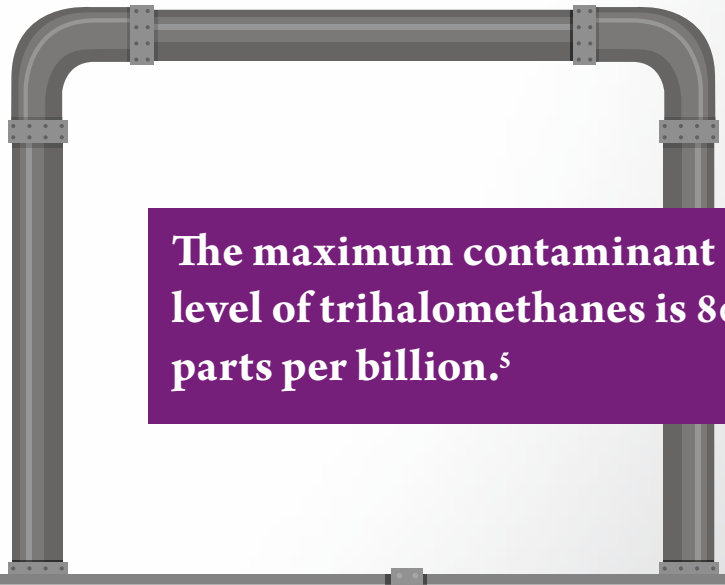
City solves water problem, wins award

The city of Lago Vista recently won a 2019 Texas Environmental Excellence Award in the technical/technology category for its ground storage tank and total trihalomethanes removal project. Photo courtesy of the city of Lago Vista.

Until 2009, a small city in the Texas Hill Country was faced with a large water problem. It found a way to solve the challenge, winning one of Texas' highest environmental awards along the way.

Lago Vista was regularly buying twice as much water as it delivered to its customers from the Lower Colorado River Authority, partially due to flushing high levels of total trihalomethanes (TTHMs), a group of potentially carcinogenic contaminants, out of its ground storage tanks and distribution system. The city lost approximately 2.1 million gallons of water a year flushing its ground storage tanks.

Through an innovative ground storage tank and TTHM removal project along with distribution system improvements, the city has now reduced its TTHM levels and decreased its water loss by 50 percent. ⇨



The maximum contaminant level of trihalomethanes is 80 parts per billion.[5]

The city created a splash pump with spray heads. When water from the spray heads splashes down on the water in the tank, the impact dissipates the total trihalomethanes. Photo courtesy of the city of Lago Vista.

For its efforts, Lago Vista won the 2019 Texas Environmental Excellence Award (TEEA) in the technical/technology category for its ground storage tank and TTHMs removal project. TEEA, an annual Texas Commission on Environmental Quality awards program, honors achievements in environmental preservation and protection. Since 1993, the program has honored more than 250 successful environmental projects and efforts.

Regulated by the U.S. Environmental Protection Agency (EPA), TTHMs are odorless, gaseous byproducts of the chlorine used to disinfect drinking water.

Because of Lago Vista's low population density, the city's water is used slowly, causing the water to stay sitting in storage tanks longer than it would in more population-dense cities. When the water sits unmoving for too long, TTHM levels can increase.

Dave Stewart, Lago Vista's capital improvement manager and inspector, said that prior to 2008, the city was flushing its tanks up to seven times a year to keep the TTHMs in the stored water below the EPA-mandated maximum contaminant level.

"Everybody thinks that chlorine is the most dangerous gas in the water industry," Stewart said. "That's not true. Trihalomethanes are the most dangerous because you can't smell or taste them and, therefore, can unknowingly consume them."

To combat the TTHM problem, Stewart and his team created a splash pump with a 1-inch discharge and two spray heads, which evolved into the current pump with a 2-inch discharge and six spray heads. Water from the spray heads splashes down on the water in the tank, and the impact of the water droplets on the water's surface dissipates the TTHM gas, Stewart said.

The city also added floating, fused high-density polyethylene (HDPE) pipe tank mixers, which ensure a constant turnover of the water in the tanks. This helps reduce TTHM levels by eliminating dead zones in the tanks, Stewart said.

After making these changes, the city saw drastic reductions in the presence of TTHMs — from 175 milligrams per liter to 40 — in the water distribution system. Stewart said the city's TTHM level is now just half of the maximum EPA containment level of 80 milligrams per liter that can be present in a water distribution system. Lower TTHM levels also means less water is lost because tank flushing is not necessary.

The revamped storage tanks aren't the only factors that have helped reduce water loss. The city also began abandoning the use of legacy conventional pipes, which are prone to leaking, in favor of HDPE pipes. About 35 percent of the city's water distribution pipes are now made of HDPE, meaning that they are monolithic from valve to valve and don't let water leak at fused pipe joints. HDPE pipes are easy to work with, Stewart said, and save time, money and water.

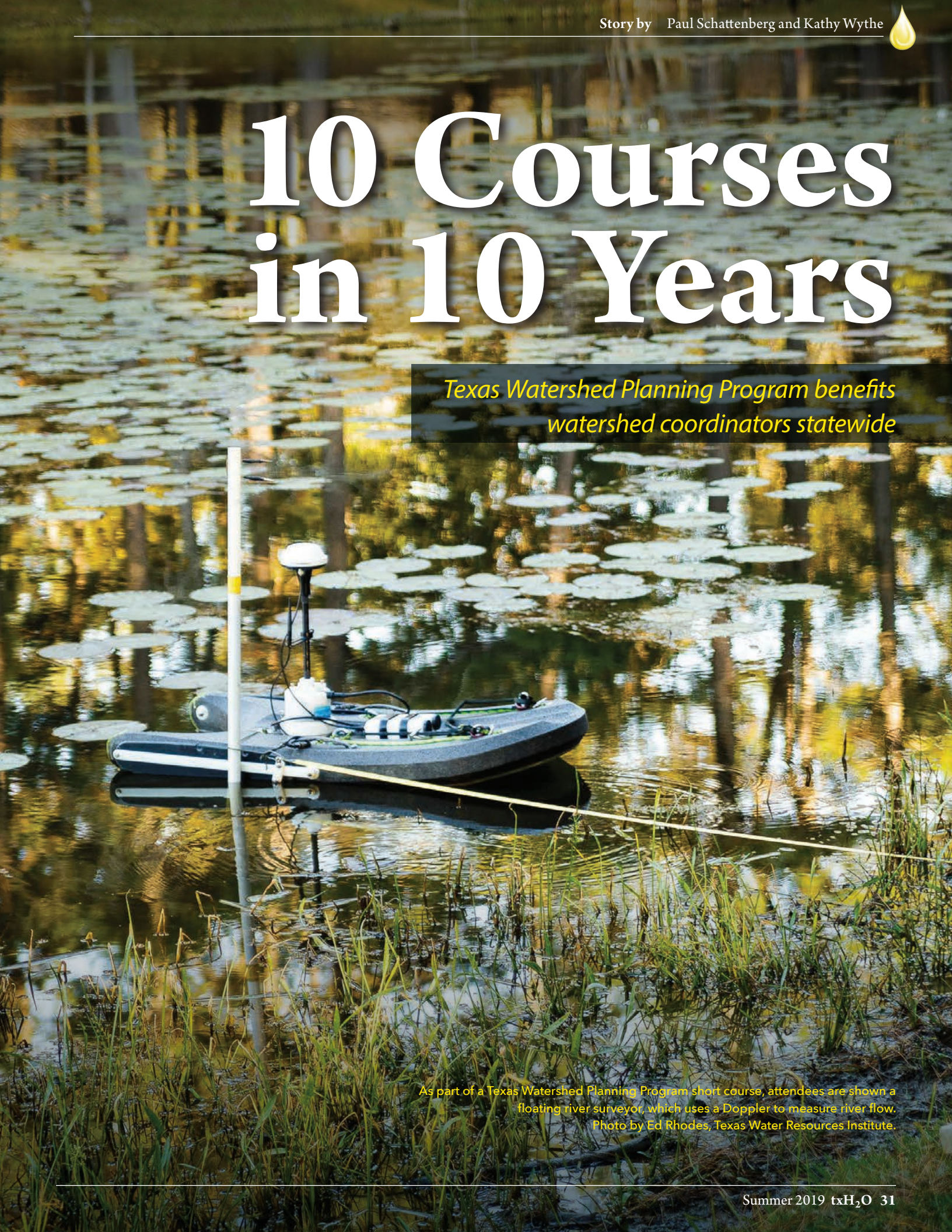
Before implementing the ground storage tank and TTHM removal project, Stewart said the city was unable to keep water in the tanks for more than four weeks without needing to flush out the high levels of TTHMs that developed during the warmer months.

"Now we don't have to flush the tanks in the summer anymore. In fact, we haven't flushed any tanks at all since we put the tanks mixers and the splash pumps in the tanks," Stewart said. "It is a 100 percent completely successful project."

Story by Paul Schattenberg and Kathy Wythe

10 Courses in 10 Years

Texas Watershed Planning Program benefits watershed coordinators statewide



As part of a Texas Watershed Planning Program short course, attendees are shown a floating river surveyor, which uses a Doppler to measure river flow. Photo by Ed Rhodes, Texas Water Resources Institute.

Dr. Lucas Gregory demonstrates equipment used in assessing water quality during one of the Texas Watershed Planning Program short courses. Photo by Ed Rhodes, Texas Water Resources Institute.

In 2008, Dickie Clary from the small Central Texas town of Hamilton attended the first Texas Watershed Planning Short Course at the Mayan Dude Ranch in Bandera, Texas. The 4 1/2 day course, hosted by the Texas Water Resources Institute (TWRI), provided Clary and other attendees essential information for managing water quality throughout the state.

Ten years and 10 courses later, more than 300 watershed coordinators and other water professionals have attended and benefited from the course.

"Our short course, part of the Texas Watershed Planning program, provides needed training and sustainable proactive approaches to managing water quality throughout the state to watershed coordinators and other water resources professionals," said Dr. Lucas Gregory, senior research scientist and quality assurance officer for TWRI.

"This is the only watershed planning short course in the state or, in fact, in the nation," Gregory said. "So far, we have educated almost every watershed coordinator in Texas."

While not a watershed coordinator, Clary, a Hamilton County Commissioner and landowner, believed he had a stake in water quality in his county. He said it was important for him to learn as much about surface water quality as possible, so he could represent the views and concerns of Hamilton County citizens.

"The short course helped me learn the basics about surface water quality issues and provided useful knowledge about how watershed planning can be an effective tool in solving water quality impairments in local watersheds," he said of attending the 2008 course. "Through the course, I developed an understanding of surface water quality vocabulary and the various state and federal agencies that have a direct impact on regulations and implementation plans related to surface water quality issues."

Gregory said the multi-day short course provides guidance on stakeholder coordination, education and outreach.

"We strive to make sure the program meets the U.S. Environmental Protection Agency (EPA)'s nine key elements of a watershed protection plan, ensure accurate data collection and analysis and provide the necessary tools for plan development," he said.

He said helping ensure proposed protection plans meet EPA requirements is necessary to have watershed protection plans approved and secure Clean Water Act funding.

"This training gives water professional the tools they need to develop a plan they can use to conserve and protect the state's water resources," he said. "Having these plans in place can go a long way toward making sure we are prepared to handle the state's ever-increasing population and other future challenges."

TWRI has partnered with numerous other entities to present the short course throughout the 10 years, including Texas A&M AgriLife Extension Service, Texas A&M AgriLife Research, Texas State Soil and Water Conservation Board, Texas Commission on Environmental Quality, EPA and the Texas Institute for Applied Environmental Research.

Mike Bira, EPA Region 6 environmental scientist and frequent presenter at the short course, said EPA strongly supports watershed-based planning through the states' nonpoint source (NPS) management programs.

Under the Clean Water Act Section 319, states, territories and tribes receive grant money to support NPS programs such as watershed-based planning and education.

"The NPS program is the most efficient way to protect and restore our nation's surface waters when they are impacted by NPS pollution," Bira said.

The short course is one of several courses the Texas Watershed Planning Program offers to watershed coordinators and other water professionals in Texas.

Gregory said because the program's goals are to ensure watershed protection efforts are adequately implemented and to improve water quality restoration efforts statewide, TWRI is always considering additional courses designed to increase watershed professionals' expertise.

Over the past 10 years, Gregory said, the program also has hosted 19 biannual Texas Watershed Coordinator Roundtables and 31 additional courses. The roundtables, usually held twice a year, provide a forum for dialogue between watershed coordinators, facilitate interactive solutions to common watershed issues faced throughout the state and add to the fundamental knowledge conveyed at the short courses.

He said topics at the additional trainings include watershed modeling, using social media to connect with stakeholders, fundamentals of developing a water quality monitoring plan and urban best management practices for watershed planning.

"During the 2018 fiscal year, we conducted two roundtables — one in Austin and one in College Station," he said. "We also organized the first week-long Texas Watershed Planning Short Course in Navasota and coordinated four different watershed trainings for professionals in Austin, Lewisville and College Station."

The Texas Watershed Planning Program is currently funded through a Clean Water Act nonpoint source grant provided by the Texas State Soil and Water Conservation Board and EPA.

During a Texas Watershed Coordinator Roundtable, attendees split into groups to discuss challenges that face watershed managers today and potential solutions. Photo by Ed Rhodes, Texas Water Resources Institute.

It has received Clean Water Act funding through the Texas Commission on Environmental Quality in previous years.

Clary, who currently serves as charter member of the planning and advisory committees for both the Leon River and Lampasas River watershed protection plans, said the short course was one of the most beneficial training events that he has ever attended. He has also attended several roundtables.

"It helped pave the way for a much broader understanding of various surface water quality issues," Clary said, "and has undoubtedly helped me be more productive and successful in developing and advancing water quality programs that affect the citizens of Hamilton County and perhaps others across Texas."

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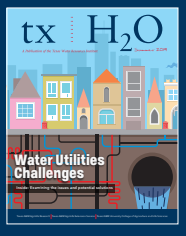

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