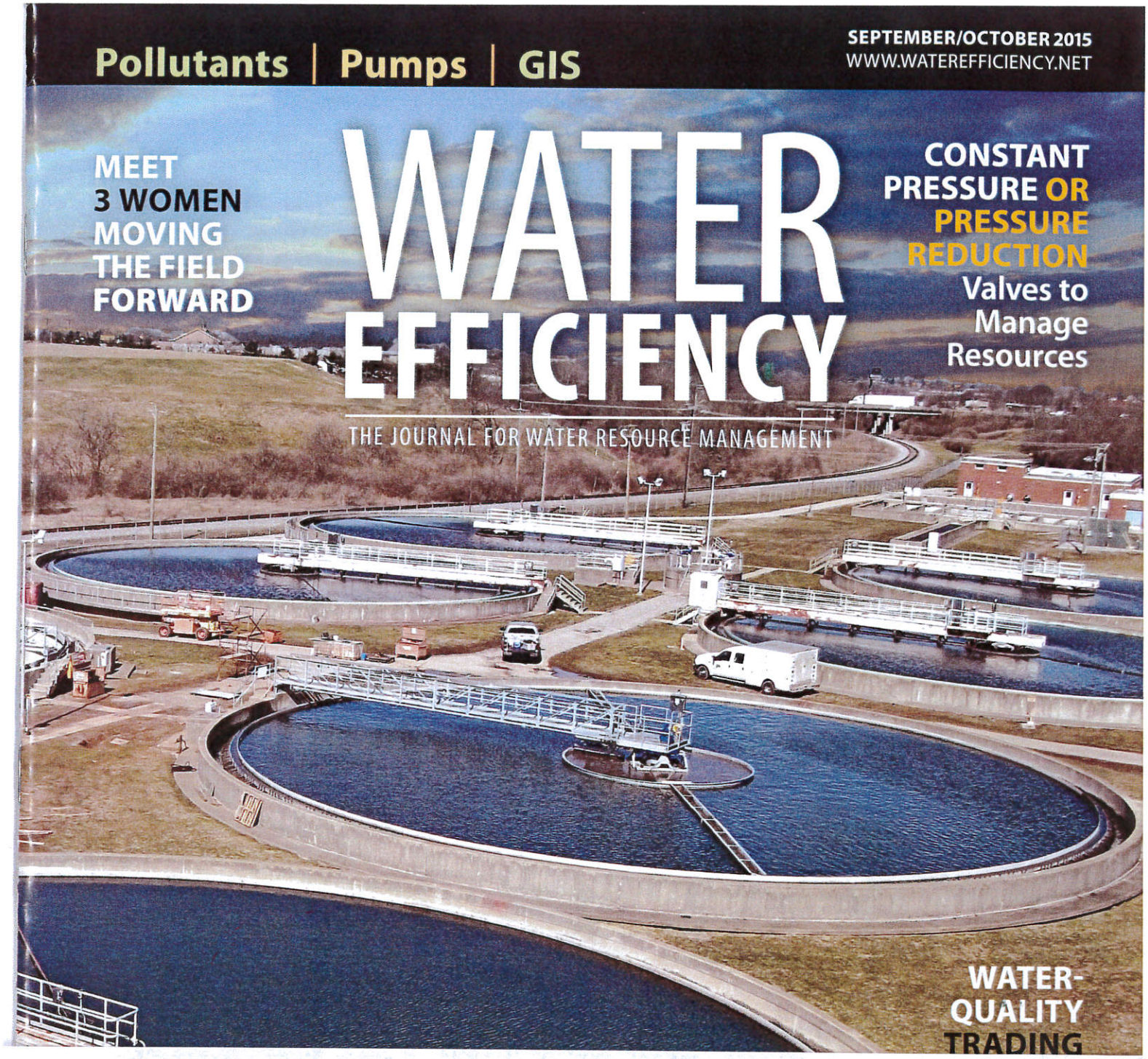

Saving Irrigation Water the Smart Way

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For four years, the state of California has experienced severe drought conditions, a situation predicted to continue "for the foreseeable future," according to Governor Jerry Brown's recent emergency proclamation, which calls for action from the State Water Resources Control Board and local water suppliers to "prevent waste and unreasonable use of water and to further promote conservation."

The snowpack in the Sierra Nevada has diminished to an all-time low and groundwater levels throughout California and some western states have dropped significantly, all of which contribute to a record-breaking drought that has left the landscape—and, in some areas, the humans and animals—parched.

Because voluntary compliance with conservation efforts resulted in only an 8.6% drop in water usage, according to the Los Angeles Times,* Brown issued an executive order that directed the State Water Resources Control Board to implement unprecedented water restrictions on water suppliers. His goal is a 25% reduction in potable urban usage (based on levels in 2013, the year before he declared a drought emergency) statewide through February 2016.

In order to achieve that goal, the State Water Resources Control Board followed up with rules that force cities to limit watering on public property to two days per week; implement water efficiency measures for commercial, industrial, and institutional users; prohibit irrigation with potable water of ornamental turf in public street medians; restrict runoff of potable water to adjacent properties, non-irrigated areas, walkways, roadways, parking lots, and structures; and prohibit irrigation with potable water outside newly constructed homes and buildings that is not delivered by drip or other water-saving systems. It also encourages homeowners to let their lawns die and imposes water-savings targets for the agencies and cities that supply water to California.

The focus is on reducing the amount of water used for lawns and other ornamental landscaping, which accounts for the biggest share of residential water use in California. Fines of up to $10,000 against cities or water districts that violate stateorders or fail to reach their target can be levied.

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Controlling the Panic

People are panicking, says Brandon Reitmeier, director of operations at Finley's Tree and Landcare, Inc. in Torrance, CA, but they shouldn't. "They're getting rebates for tearing out lawns, but you don't need to. This is cyclical; it gets better."

Until it does, he says Finley's can provide a low-cost solution to reduce water consumption by 20–30% without ripping out lawns. To do that, they're using two devices from Toro: spray head nozzles to better direct the water and smart controllers to determine the amount and timing of watering, based on weather. A more controlled spray generates less waste.

The weather-based irrigation controller with remote costs an average of $35–$50 per station, but rebates typically cover both material and labor costs. "We install at no cost because we

get the rebate for the precision nozzles," explains Reitmeier. He estimates that they can save the customer as much as 30% on the bill every month. "The customer gets the discount, we get the business, and the state gets conservation."

Finley's has been installing them since July 2014, after Toro contacted them about using precision nozzles for water conservation on irrigation projects. Since then, they've added so many new customers to their existing base of maintenance accounts, 95% of which are for commercial buildings and home owners associations (HOAs), that Reitmeier says they had to hire extra people.

They also formed the Water Efficiency Technology (WET) Team, a subdivision within their maintenance division dedicated to water conservation. The team has gathered each city's requirements, and researched water conservation alternatives for irrigation systems and the latest developments in technologies, as well as available rebates for implementing water conservation programs. "The technology is changing so fast," acknowledges Reitmeier, "but we're sticking with Toro. We understand it, the team knows it and we get support from Toro. Our proposals say we are backed by Toro."

The commitment often begins with a water audit. Reitmeier recalls one of their first customers worrying about the restriction. "We did a water survey on his property. Our proposal cost was $10,000, but with rebates, the net cost was only $4,300." Another proposal for a second customer in an inland location was $9,500, with a net cost of $6,000 after rebate.

In Culver City, where Finley's installed eight new controllers, both 12- and 24-station controllers with central computers mounted on the wall, the $4,795 proposed cost was reduced to just $800 after rebate. Noting that some companies make extra money by collecting the rebates from local water municipalities, Reitmeier says they pass the savings along to the customer.

The rebate isn't the only savings the customer gets. "Customers either need to reduce consumption [to comply with the mandate] or upgrade their system," explains Reitmeier. Often, they can achieve 30% reduction of water usage just by replacing the nozzles.

They need to. Reitmeier says enforcement is about to start in earnest, with some cities issuing fines, putting a governor on the meter or charging money for going over the limit to reach the desired reduction rate.

Educated Installation

Initial signs of violation include visible water use, overspray, and watering concrete. Those signs also indicate unbalanced distribution or improper use of technology. Inadequate distribution is the biggest problem, believes Ray Thengvall, owner of Frog Hollow Green Group Inc. in Angels Camp, CA. Irrigation systems "should have 70% average distribution, but most have 20 to 30%. The manufacturers have more sophisticated equipment, but 90% [of the customers] don't know how to use it, and don't know the plant requirements.

"Everybody knows something about irrigation, plants, and what's best for their yard," he continues, "but they're not looking at the health of the plant, leaf structure, bloom—just at the soil." He estimates that 90% of the people are over-watering, saturating the plants. Water should be 4–6 inches below ground to be most effective.

To determine how wet the soil is, Thengvall uses Toro's smart clocks with moisture sensors. But, he cautions, "you can't set them and leave. You must know your watering goals, runtime, and the evapotranspiration rate, and make adjustments accordingly."

He advises relying on a trusted installer who knows how to determine soil type and fertility, proper spacing of sprinkler heads, and plant requirements, as well as takes samples. "They must be knowledgeable."

Unfortunately, having just returned from the California Irrigation Association Conference for agricultural and horticultural use, Thengvall felt discouraged. "We have customers, but it's depressing. Even farmers over-water because they don't know how to use the technology. The problem is that people don't realize how they can save water with irrigation products and scheduling, so they're not taking advantage of smart technology. They need education."

Complicating the problem, as he sees it, is the water department, which "doesn't have the evapotranspiration rate every month. They just say 'water two times a week.'" Thengvall believes they're trying to simplify too much by replacing the need to monitor with a schedule. While watering correctly can lower the amount of water used, he says watering to a schedule can result in over-watering. "You can still flood."

Most systems are not installed with a working irrigation plan, he believes. Zones must be designated: shade under trees, hot zones, or low-water areas. "If you have mixed plants, you'll have different water requirements."

The plan should specify precipitation rate, distribution uniformity, and head spacing, as well as whether heads will be tilted or buried. Different nozzles require different spacing. If they aren't matched, it's impossible to achieve proper distribution. When set to manufacturer specifications and properly installed, Thengvell estimates that smart technology can provide average savings of 40–50% in water usage.

Ironically, he says the goal most of his customers shared before the drought was financial savings (people were fined $4,000–$5,000 for overuse): "They wanted an ROI." Now, despite rebates on the Toro smart clocks and grants that result in free smart technology, he says the driving force behind installing smart technology is for conservation.

Fortunately, says Thengvall, even with the new laws, it's "simple to conserve water and keep green, healthy turfs. You can save 25 to 40% from 2013 levels and still be green and healthy." In fact, he notes that some people use more water after removing their turf for financial incentives through improper water management. Others "just shut the water off. But how do we save it when the water comes back on when the drought is over? We need to stop the old way of watering to excess. People need to learn how to conserve and have green lawns."

To What Extent?

Uniform distribution is what Mike Moses, owner of Water Management Group, aims to provide his commercial customers. Old sprayers use a flood irrigation method; they double the water in some areas in order to cover all dry areas.

New precision nozzles from Toro provide 80% uniformity, have a 5-foot by 15-foot reach, and qualify for rebates. "High-efficiency nozzles provide uniformity similar to large rotors on a golf course," explains Moses. "They're a lot more efficient than a sprinkler head."

Even better, the Toro pressure-regulated spray heads reduce inlet pressure to 40 psi, the optimum pressure for a spray head, producing larger droplets that are more likely to hit the ground than the atomized mist produced by other systems, which evaporates before it ever reaches the ground. Some systems put out water more slowly and evenly. "Putting water out 40% more slowly reduces runoff," explains Moses.

While water rates are going up, budgets are not. Companies are told they have to conserve, continues Moses. In response, some are collecting rebates for retrofits. Others are removing grass, and getting paid to do so. So many have taken advantage of incentives, Moses says the municipal water district cut rebates from a per-square-feet calculation to a cap of $25,000 for commercial properties, and $6,000 for residential.

But when cities target 35% reduction, Moses calls it "water elimination, not conservation" and says that such severe restrictions "make rebates on weather-based controllers obsolete." Weather-based controllers work on a deficit, he explains, citing an algorithm that corresponds to 1/10 inches of water. "If we can't water [because of a mandate], it creates another deficit." That merely doubles the amount of watering the next day, he says. "It won't eliminate any water."

The only way to keep up with the changing rules is to turn off the weather-based format and water strictly on the new schedule. "People want to be green, but they need an ROI," realizes Moses. "This is a business decision. Why install it if you can't water at all? Are we doing water conservation or elimination?"

What a Drip

The two-day-a-week mandate also stipulates 10-minute maximum watering periods. For

those using drip irrigation, the schedule could be problematic. Bill Millward with Netafim says, "This hurts." In past drought periods, drip was exempt, but it's unclear if that applies under current regulations. "Some products put down water slowly to maximize absorption," he says.

Calculations for water use in California list the efficiency of devices: drip ranks 90% versus 55% for sprinklers. "Drip goes to the roots," explains Millward. "No water in the air means no water to evaporate. You get uniform distribution." You also get water conservation.

With some estimates claiming one-year reserve left in the California reservoir, groundwater has become a big debate and groundwater contamination is a big issue. "The new mandate says water can't leave the site—no runoff," says Millward.

This law changed how property is graded. It is also changing how irrigation is performed. Applying too much water causes damage. Runoff degrades concrete and asphalt, creates mold on windows, destroys fences, and promotes root growth that can lift concrete.

"Everyone is scrambling for water," states Millward. He mentions another mandate that requires new construction projects to use smart controllers instead of conventional sprinklers. Fortunately, because there are so many rebates for smart controllers, he says end users essentially get them for free.

If the rebate isn't enough incentive, the additional savings might be. "The biggest line item is water," he discloses. Explaining that $100,000 per year for an HOA landscaping budget in California is low, he says cost is a "big incentive" for them to conserve. Not only do they spend less money on water, they can also avoid fines for over-watering, as well as the cost of having to re-slurry parking lots due to water damage and the disruption of business during construction.

But a poorly installed drip system results in poor irrigation. Signs of a bad irrigation system are inconsistency and lack of uniform watering. "It must be installed correctly," says Millward. "We get a lot of calls about drip."

Approximately 95% of Netafim's business consists of agricultural, commercial, urban ag, nursery, greenhouse, and residential landscape customers. One large-scale project is a new development in Chino Hills, CA, called Villa Borba. The project includes a park, streetscape, model homes, and habitat restoration over a large, sloping area.

In the HOA and common areas of this residential development, Netafim Techline CV, Netafim NLC-100D controllers with two-wire technology, as well as weatherstations and hydrometers (master valve/flow sensor) are used to conserve water.

"We look at ease of use in the products we use," says Dawn Rourke, landscape designer for Architerra Design Group, which completed the Villa Borba project. Efficiency is also important. It's the company's standard practice not to use overhead sprays. "We get water savings of 25 to 50% with a drip line." Trees were outfitted with individual valves per their water needs. "It's more efficient and causes less over-watering."

Injecting a Little Green Into the Situation

Landscape design in the western portions of the country is changing. The percentage of turf for residential applications has dropped to 30; in commercial applications, it's being eliminated entirely in many cases.

"For every square foot of turf torn out, you can get up to $4 rebate," says Netafim's Millward. "The rebates are so significant, companies do the work for free and keep the rebate." Because the rebates are so large, they can often cover the cost of re-landscaping with low-water use landscape plants. He refers to a golf course in Rancho Santa Fe near San Diego that removed 700,000 square feet of turf, got $1.7 million in rebates from the water district, and put their landscaping back in for $1.3 million.

One new product keeps turf green without violating water restrictions. Aqua Cents Water Management injects liquefied water-absorbing polymers at high pressure under the sod. Able to retain 400 times their weight in water, the non-toxic ingredients retain moisture at the roots. Lawns require 40–50% less watering.

"We are getting many calls and meeting with many cities, school districts and residential/commercial customers who are seeking an alternative," says Aqua Cents' Shelia DeLany. She observes that numerous commercial and residential customers have invested a lot of money in landscaping and don't want to remove their plantings. In addition, she notes, schools and parks, as well as larger apartment communities and HOAs, have "essential turf" used for sports, recreation and relaxation, or to provide a sense of community.

Turf has many benefits: it provides relaxation, cooling, and dust control, and can help prevent runoff, increase property values, and improve carbon sequestration. Aqua Cents offers property owners an option to "drought-proof" their lawns without the need to remove turf or go to greater expense to re-landscape or change irrigation systems.

Austin Eriksson, sustainability program manager with California State University–Northridge (CSU–Northridge), made one of the calls Aqua Cents received. In addition to complying with all state and local water restriction mandates, the college's conservation goals for the 23 campuses under one chancellor are 10% reduction by 2016 and 20% reduction by 2020.

After seeing the success of the product at CSU–Fresno, Eriksson wanted to set up a pilot at his school. "We were already working on reducing water usage," he begins, explaining that they removed turf in non-athletic spaces and replaced it with drought-tolerant native plants and decomposed granite paths with benches. But they wanted to keep turf on an athletic field—and keep it green.

The proposal from Aqua Cents promised a 50% reduction in irrigation after the agricultural-grade hydro gel was injected under the sod. "In two weeks, we saw 60 to 70% reduction," relates Eriksson.

In March 2015, Aqua Cents injected a 3.5-acre soccer field on the CSU Northridge campus. They worked with the management team to gradually reduce irrigation. By May, the school's irrigation schedule reached 40 minutes per week, as compared with 120 minutes the year before.

They water less than before—less than with the weather-based smart technology they had been using. "We connected to the local weather station, using data to develop a schedule based on plant type and weather," he elaborates. That schedule called for watering three days a week in winter, four days a week in summer.

Twelve weeks later, Eriksson describes it as a "straight-forward product" and a "very easy system." Expected to last five to seven years, the product "acts like a sponge under the root zone, training the roots to dig deeper for water," describes Eriksson. He doesn't anticipate having to do another application, which will help his budget since he estimates a five-year return on investment (ROI). "[ROI is] not something we look at," he says, explaining that "water is cheap" and conservation is their goal.

The savings he's interested in are water, and, as the first in the area to try this technology, he is submitting his numbers to the LA Department of Water and Power to validate its effectiveness so they can adopt a plan for rebates and incentives. Although the program is still in its early stages, Eriksson remains confident. "We know we're moving down the right path."

Government Green

With the drought and the Governor's mandates for 25–35% water savings, DeLany says property owners are faced with options: let their turf/lawns go brown and face re-landscape costs when the drought subsides, along with the risk of losing trees and shrubs; invest in re-landscaping/xeriscaping/desert landscaping—and in irrigation retrofits/upgrades to support them; or use Aqua Cents at costs in the range of $0.30–$0.35 per square foot to save 50% on water use for a sustained period of five to seven years.

Last year, Manco Abbott watered the turf at a government building it manages in Fresno three times a day for 20–25 minutes to keep the lawn green. Built in 2003, it features a green turf that requires water, explains Robin Adcock, building manager/energy and sustainability coordinator, who adds that they were "looking for a resolution. We're doing whatever we can to cut back; the problem is, lawns require water."

Fresno allows watering two days a week, but Adcock says they cut back to one day a week because the drought is so bad that some people have run out of well water already in this agricultural region in California's central valley. And yet, she says, they were reluctant to let the lawn die. "Urban blight. We were searching for something to propagate curb appeal."

After seeing how bad the green spray looked, Adcock says they considered artificial turf, but it was "very costly," $63,000 versus $5,000 for the Aqua Cents hydro gel at the 23,600-square-foot government building, and because it has to be laid with sand or ground-up rubber to hold it in place, it generates heat.

Happy with the choice of Aqua Cents, Adcock says despite having little rain, they still have a green lawn. By reducing runtime 59% (over 322,000 gallons per month), they have achieved 43% saving in inches of water. "Our water bill in April was $6.97."

However, financial savings was not of primary concern. "With the size of the property, savings are not as significant," says Adcock. "The benefits are staying within the restrictions, having

green turf, and runtime savings." With the summer heat, she says they've increased the schedule to two days a week, but only once a day.

Still, she says it's cost-effective, although she had to convince the building's owner to do it because "it's not a one-year payback since the water bill is not big. The benefit is an attractive property. When our owner saw the lawns, he thought they were artificial because they're so thick and lush."

Shortly after they finished the project, the city reduced watering to two days a week. The building's green lawn attracted attention. In fact, it attracted official attention. After an official from the city's water department took notes on the property's green lawn, they put up a sign to notify visitors that they were compliant with the water restrictions and their lawn is green, thanks to the hydrogel.

Another benefit of the technology is that it saves money on re-seeding and fertilizer. It's also long-lasting. "We'll have to replace it in five to seven years—maybe," speculates Adcock. She anticipates Manco Abbott using it on more commercial properties this year.

Wet and Wild: The Future of Water

While Aqua Cents recently completed third-party independent research trials and a fourth-year field trial to verify its claim of reducing watering by 50%, Aqua Engineering Inc., in Ft. Collins, CO, develops and tests protocols to ensure the end user gets equipment that does what is promised, says Doug Macdonald, vice president.

Aqua Engineering is an irrigation engineering firm specializing in water-conserving irrigation system design and management. Sustainable landscape projects for golf courses, parks, sports fields, and other areas have included cost-effective systems that contribute to aesthetic solutions in the shifting realm of restrictions and mandates.

A large portion of their market is in the desert southwest—Arizona and Nevada—which is serviced by the Colorado River. Because the headwaters of the Colorado River are 60% below historical average, according to Aqua Engineering's Robert Beccard, it hurts many states. "What's happening in California is affecting the entire industry," states Macdonald. Other states have similar issues, including water rights issues that preclude rainwater capture.

To combat some of these common issues, Macdonald says they are working on a program using smart water application technology to harvest, store, maintain the quality of, pump, and reuse water onsite. "There's an ongoing trend toward capture and reuse of water onsite, or at least locally, versus distribution from purveyors." Deteriorating infrastructure is one of the drivers.

Conservation is another. Systems, particularly in the southwest, capture rainwater and condensate from air conditioners—"lost" water. Other sources include snowmelt, ditch water, runoff, process water, treated effluent, stormwater, rainwater, foundation water pumped, and graywater.

Depending on local laws, harvesting and reusing water that usually leaves the site is an "up and coming" idea, says Beccard. "Net zero water is a concept, parallel with solar panels to be energy-neutral. With water, you want to capture it onsite and use just what's needed."

The idea is to "close the loop" of the water system by capturing and using onsite as much of your water supply as feasible. Beccard mentions a microbrewery in Colorado that is serving as a test site for this idea. "They've been conscientious about interior water usage for years; now they are looking at irrigation, too."

Aqua Engineering has other ideas about water conservation, such as irrigating with graywater to reduce the impact on potable water infrastructure; encouraging a paradigm shift in the quality and type of acceptable plantings to include more native plants; letting lawns go brown (dormant) by restricting irrigation to sports fields and parks; urging urban farms that replace turf with gardens; suggesting drip irrigation; and using drones to determine the effectiveness of irrigation.

A group in Boulder embarked on a study to evaluate the use of drones for water management. They could be a cost-effective way to inspect for over-watering, proper nozzle spacing, and damage without a lot of manpower needed.

"The issue is where can they be used?" ponders Macdonald. While they are already being used on agricultural fields to monitor crop irrigation, he's not sure how it translates to examining turf in parks and golf courses within city limits.

Another form of smart technology on the horizon is a black box that incorporates water management into overall building management. "The technology is not proven yet," cautions Beccard, but if successful, it could eliminate a separate control system for outdoor water, integrating control into the building energy management system.

Other trends in smart irrigation include a move from weather-based control systems to wireless soil- and moisture-based control systems.

When advanced irrigation systems are combined with use of raw, well or graywater, which Colorado residents did in response to a three-day water restriction in the early 2000s, Beccard

believes these mandated water restrictions could backfire. "It's not well-thought-out. Instead, it penalizes people who have been managing their resources."

"There's no straightforward way to look at irrigation systems," reasons Macdonald, adding that any system must be used correctly or it's not effective. "It has to be managed right." **WE**

**According to the latest figures released by the Board, Californians reduced water use by 3.6% in March, as compared with March 2013. February saw a 2.8% reduction, January a 7.3% reduction, and last December a 22% drop.*
