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The two strongest themes for 2017 appear to be finding the right people for the job and filling in the gaps of knowledge. Many perennial topic areas come into clear focus when viewed through these twin lenses.

The first and most-noteworthy are the effect last November's U.S. election will have on the water sector. From new cabinet members to changing legislative leadership to new perspectives and goals being touted by the incoming administration, these changes have the potential to affect the water sector greatly. See our take on p. 19.

Nutrients also will figure prominently this year. The U.S. Environmental Protection Agency will seek to develop a more complete picture of nutrient removal practices and capabilities throughout the U.S. This work will take the form of a national survey, but first the agency is working with stakeholders at all levels to ensure the project can be as useful as possible. See the latest information on p. 20.

Also related to nutrients, Illinois has emerged as a leader in asking water utilities to prepare plans for how to remove more nutrients now as well as in the future. These extra information-seeking requirements are intended to help identify opportunities to get the most benefit for the dollars spent. See what the state is doing on p. 22.

Drought, energy, and resilience are three topics that round out this section. Each of these articles (pp. 24, 26, and 27, respectively.) examine a wide range of perspectives and projects that are under way. In each case, we detail how collaboration and seeking to understand different perspectives have paved the way for progress. For the most part, the needed technologies and processes exist, they just need innovators to combine them in the proper situation to achieve the desired goals.

Vote tally

Considering potential changes with the new administration

After more than a year of primaries, debates, town hall meetings, and finally a presidential election, Republican candidate Donald J. Trump was elected the next President of the United States of America. Key electoral vote support came from battleground states including Florida, Pennsylvania, Wisconsin, Michigan, and North Carolina.

The election also resulted in republicans remaining in control of the U.S. Senate, as well as the U.S. House of Representatives.

Once inaugurated on Jan. 20, 2017, President Trump will officially nominate, for Senate approval, leaders of all federal departments and agencies. This cabinet will include a new U.S. Environmental Protection Agency (EPA) Administrator, as well as several Assistant administrators, including one for the Office of Water.

Presidential priorities

According to the Dec. 5, 2016, *Washington Post* article, "Here Are the Names of People Whose Names Have Been Floated for Trump's Cabinet," Trump has vowed to "refocus" EPA on its core goal of ensuring clean air and water, rather than more recent efforts to fight climate change and move toward cleaner energy sources.

Trump also has vowed to fight to prevent drinking water contamination issues such as the situation in Flint, Mich. He called these types of cases "real environmental challenges."

The new EPA administrator also would be responsible for enacting Trump's aggressive deregulatory push. On the campaign trail, Trump pledged to roll back all of President Obama's climate agenda. This includes the Clean Power Plan, which limits carbon dioxide from power plants.

As mentioned, Trump said that the Clean Water Rule – known as the Waters of the United States rule – would be undone and all existing regulations would be reviewed for potential changes or repeal. However, most recently he met with climate change champion, former Vice President Al Gore, who said there is potential for common ground in the future following the meeting.

Trump nominates Pruitt for EPA

At press time, President-elect Trump has confirmed his plan to nominate Oklahoma Attorney General Scott Pruitt for the role of U.S. EPA Administrator. The EPA administrator oversees the 15,000-employee agency that writes and enforces regulations on air pollution, water pollution, climate change, land

contamination, and more.

Scott Pruitt is known as a top challenger of President Obama's environmental agenda – and specifically is at the forefront of lawsuits challenging EPA regulations on carbon emissions and water pollution. Pruitt has been a leading critic of the aforementioned Clean Water Rule. He also is a leading critic of climate change.

Pruitt began his career as a private lawyer before spending 8 years in the Oklahoma Senate where he served as GOP whip and assistant floor leader at different times during his tenure.

Congressional changes

Also, over the next several months, congressional committee chairmanships and memberships will be assigned. For the water sector, key committees in the House include

- the Committee on Appropriations (specifically, the Energy and Water Development and the Interior and Environment Subcommittees),
- the Natural Resources Committee, and
- the Transportation and Infrastructure Committee (specifically, the Water Resources and Environment Subcommittee).

Rep. Bob Gibbs (R-OH) is term-limited as the chairman of the Water Resources Subcommittee. His replacement will be made in the coming months to lead what is expected to be a busy legislative agenda for the subcommittee in 2017.

The key Senate committees include

- the Committee on Appropriations (specifically, the Energy and Water Development Subcommittee and the Interior and Environment Subcommittee),
- the Energy and Natural Resources Committee, and
- the Environment and Public Works Committee.

Sen. Jim Inhofe (R-OK) also is term-limited and is stepping down as chairman of the Environment and Public Works Committee. He is likely to be replaced by Sen. John Barrasso (R-WY).

Sen. Barbara Boxer (D-CA), the ranking member is retiring and potential replacements include Sen. Tom Carper (D-DE), Sen. Ben Cardin (D-MD), and Sen. Sheldon Whitehouse (D-RI).

Transition communication

On Dec. 7, WEF sent a letter to President-Elect Donald Trump providing recommendations for water sector priorities for the next administration. Specifically, WEF addressed water sector challenges related to aging water infrastructure, research and development, workforce development, stormwater, affordability, and resource recovery and the energy–water nexus. In the letter WEF pledged to provide reliable and expert input to the next administration to help solve the nation's water challenges.

Read the letter at www.wef.org/advocacy/legislative-affairs.

– Amy Kathman, Steve Dye, and Claudio Ternieden, *WE&T*

Engage with your newly elected leaders

Water Advocates

Join the WEF Water Advocate program to form a network of water professionals in every state and community, in every congressional district, to get the word out about the value of water and steps needed to protect it. Visit www.wef.org/water-advocates.

2017 National Water Policy Forum

Participate in the 2017 National Water Policy Forum, Fly-in, and Expo on March 21 and 22, in Washington, D.C. Held in conjunction with Water Week, this event attracts water professionals from across the U.S. to hear congressional speakers, attend policy briefings, visit Capitol Hill, and participate in roundtable dialogues with key policymakers and experts on important regulatory and policy matters. Visit www.wef.org/waterweek.

EPA to survey WRRFs about nutrient practices

Baseline data on nutrient removal would help set more realistic and achievable reduction targets

The U.S. Environmental Protection Agency (EPA) is initiating a national study focused on nutrient removal and secondary technologies at water resource recovery facilities (WRRFs). The goals of EPA's multiyear, multiphase study are to establish a statistically representative, nationwide baseline for nutrient discharge and removal and to characterize operation and management practices that result in improved nutrient reduction.

As a first stage of this study, EPA will collect basic information from all facilities nationwide through a voluntary questionnaire, to be sent out later this year. Making the questionnaire voluntary is a change from the agency's earlier plans

to make the questionnaire mandatory. According to EPA, the collected data will be used to identify statistically representative types of treatment trains at WRRFs in parts of the country where temperature and other influent characteristics are expected to change the percentage of total nitrogen and total phosphorus removed by the facilities.

"The questionnaire will ask for basic facility information that is not currently available in other databases, but should not require facilities to collect additional data," said EPA spokesperson Monica Lee. "The information will be used to generate a comprehensive and nearly complete population of publicly owned treatment works (POTWs) not found in any other database."

EPA then will use the questionnaire responses to focus on collecting more detailed information from a subset of facilities of different sizes in different geographic regions, including facilities that have optimized procedures for nutrient removal. Eventually, the agency plans to collect paired influent and effluent samples from a representative subset of facilities to understand nutrient removal at optimized and unoptimized WRRFs.

In some areas of the U.S., according to EPA, it has been shown that nutrient reductions can be achieved without major capital investments, but rather by optimizing operations and maintenance. "In order to provide states and utilities with enough information to adopt these practices more widely, baseline information is needed on nutrient removal at secondary treatment plants across varying geographic regions and treatment trains with and without optimized operations and maintenance," Lee said.

EPA envisions that many other entities would benefit from the information collected from both the basic questionnaire and the more detailed phases of the study.

"For example, POTWs could use the information for peer-to-peer mentoring and sharing best practices for nutrient removal within the industry," Lee said. "State permitting authorities can use estimated nutrient loads from POTWs when developing accurate TMDLs [total maximum daily loads] or watershed plans, including point and nonpoint source tradeoff analyses."

Additionally, federal agencies can use baseline nutrient loads for modeling to inform and enhance river basin plans, while academics and contractors can use the information to identify good candidate facilities for optimization and site-specific studies, Lee said.

A lack of data

EPA's long-term study is anticipated to help fill a void related to the lack of available nationwide data on nutrient control practices at WRRFs. Currently, when developing waterbody and watershed plans, regulatory entities rely on estimates from WRRFs in terms of nutrient removal capabilities as well as the overall contribution of nutrients to U.S. waters from these facilities. However, according to EPA, estimates on nutrient discharges are outdated – by as many as 50 years in some cases – and often were provided before facilities integrated the process controls that many use today.

"Moreover, these estimates do not reflect variable attributes such as differential plant loadings or temperature effects," Lee said.

Current databases that are available

How can WRRFs get more involved?

EPA encourages all WRRFs to participate by responding to the questionnaire when it is sent out later this year.

In developing the questionnaire, EPA is working with the Water Environment Federation (Alexandria, Va.), the Water Environment & Reuse Foundation (Alexandria, Va.), the National Association of Clean Water Agencies (Washington, D.C.), the National Rural Water Association (Duncan, Okla.), the Association of Clean Water Administrators (Washington, D.C.), and the Environmental Council of States (Washington, D.C.). WRRFs interested in getting involved with questionnaire development can work through one of these associations and can also consult the study website at www.epa.gov/eg/national-study-nutrient-removal-and-secondary-technologies#webinars.

Here are some additional ways to ensure EPA develops a meaningful and useful questionnaire, and administers it successfully.

EPA published its current list of facilities in the Sept. 19 *Federal Register* notice for the draft questionnaire. Although the public comment period for the notice has closed, this list is available in the docket for the notice at www.regulations.gov, Docket Number EPA-HQ-OW-2016-0404. WRRF employees can ensure their facility, and any other facilities with which they are familiar, are on the mailing list with accurate address information.

Before the questionnaire is administered, EPA will reach out to facilities and will host a series of webinars to walk through the questionnaire and its format, which is intended to be electronic.

After it addresses any concerns, EPA will send the questionnaire to facilities, most likely in the second half of 2017. Responding to the questionnaire accurately, and encouraging peers to participate, is the best way to ensure that EPA collects useful information.

– Jeff Gunderson, *WE&T*

– such as EPA's Integrated Compliance Information System database and the Clean Watersheds Needs Survey database – do not contain the level of detail on treatment processes or coverage of small- and medium-sized plants needed to develop a baseline of nutrient removal capabilities, Lee said. "For example, basic nutrient discharge information and paired influent and effluent data from POTWs with secondary treatment are generally not available in any database."

Claudio Ternieden, director of government affairs at the Water Environment Federation (Alexandria, Va.), said EPA's survey would provide the needed statistically representative data for determining how far nutrient control limits could be reasonably pushed. "The EPA is lacking thoroughly in concrete data as to the technology performance that currently exists at secondary facilities for removing nutrients," Ternieden said. "Comprehensive data at this level would effectively provide an understanding of what facilities can realistically be expected to accomplish."

Importantly, this information could enable EPA to determine if a facility is doing everything it can, given the resources and technology available to it, Ternieden said. "Ultimately, this would help establish goals within a permit that are achievable."

– Jeff Gunderson, *WE&T*

Nutrients in Illinois

Loss reduction through stakeholder planning

Nathan Davis

It's no secret that excess nutrients within natural aquatic systems are an on-going concern across the country. This is especially true in the Mississippi River Basin and requires action from multiple states.

Illinois has recognized the importance of managing nutrients to mitigate the potential on local and national water quality, and has undertaken efforts over the last decade to control the loss of nitrate–nitrogen and total phosphorus into Illinois waterbodies. These efforts have led to comprehensive state nutrient loss reduction strategy that includes two new special conditions for some Illinois facilities to complete.

Illinois efforts and accomplishments to date

Illinois has adopted numerical water quality criteria for total phosphorus for lakes and a narrative standard to prevent discharges from causing unnatural plant and algae growth within streams. In addition, Illinois adopted numerical effluent phosphorus limitations for all discharges from point sources to lakes, and effluent limitations for all water resource recovery facilities (WRRFs) with flows greater than 3785 m^3/d (1 mgd) that undergo an expansion.

Illinois has also seen many volunteer planning efforts within specific watersheds. These efforts typically are comprised of clean water utilities, environmentalists, and water quality experts who work together to identify water quality issues and needs basinwide. These efforts have a history of successfully prioritizing projects based upon the maximum benefits provided per finding utilized. Recognizing this fact, the

Maximizing the use of existing wastewater treatment structures is a consideration when addressing phosphorus requirements. In Salem, Ill., an existing tank was elevated and repurposed as an anaerobic reactor. CMT

Illinois Environmental Protection Agency (IEPA) has encouraged stakeholders to participate in watershed groups and even allowed flexibility when crafting National Pollutant Discharge Elimination System (NPDES) permit language to address stream impairments within these areas.

Heeding a national call to action

The U.S. Environmental Protection Agency established the Gulf of Mexico Hypoxia task force in 1997 to study the hypoxic zone and its causes and to coordinate action to reduce its severity and effects. The task force published an action plan in 2001, and a revised plan in 2008. Recognizing the scope of the problem, the 2008 report called on 12 of the states within the Mississippi River Basin to develop and implement plans to provide a minimum target reduction of 45% of the nutrients load exiting their states.

Heeding this call to action, Illinois assembled a diverse group of stakeholders, including point source dischargers, environmental groups, agricultural leaders, regulators, and others to serve on a policy working group. This group was charged with collaborating on the development of a statewide strategy to build upon existing efforts, and the latest science and technology, to provide a long-term reduction in the nutrients entering Illinois waterways.

The Illinois Nutrient Loss Reduction Strategy was prepared with the primary goals of reducing the annual loading of nitrate–nitrogen and total phosphorus to the Mississippi River in accordance to the 2008 Gulf Hypoxia Plan. The strategy also addresses the effects of nutrients on local water quality. The final 2015 strategy includes the following key components:

- Build upon existing regulatory and voluntary efforts.
- Prioritize watersheds for nutrient loss reduction efforts.
- Establish a council charged with coordinating water quality monitoring efforts.
- Convene a nutrient science advisory committee to develop scientifically defensible numerical nutrient criteria for Illinois waters.
- Create the Urban Storm Water Council to reduce nonpoint source loading through improvements to state stormwater programs.
- Develop strategies for improved collaboration among stakeholders.
- Establish the Agricultural Water Quality Partnership Forum for outreach and education.
- Develop a process for regular review and revision, including continued meetings by the policy working group.

New special conditions for Illinois WRRFs

The nutrient reduction loss strategy does not immediately impose new discharge requirements for nutrients. It does, however, highlight the likelihood of new regulatory requirements on top of the current existing standards.

The nutrient science advisory committee was formed shortly after the publication of the final strategy, and is expected to present their recommendations for numerical nutrient water quality standards in Illinois in late 2017. In addition, there is the possibility of a modification to the current point source effluent standards as the collaboration among stakeholders continues.

As a recommendation of the strategy,

Illinois adopted numerical effluent phosphorus limitations for all point sources discharges to lakes, and effluent limitations for all water resource recovery facilities with flows greater than 3785 m³/d (1 mgd) that undergo an expansion, such as the Spring Creek Plant operated by the Sangamon County Water Reclamation District. CMT

two new special conditions are being included during NPDES permit renewals for all facilities larger than 3785 m^3/d (1 mgd). These conditions require permit holders

- to prepare phosphorus removal optimization plans and
- to conduct feasibly planning in anticipation of future changes to their existing phosphorus limits.

The optimization plans are being required to ensure that sufficient steps are being undertaken to reduce nutrients discharge with existing infrastructure. The plans focus on means of implementing source reductions of phosphorus loading to facilities and methods for increasing the level of phosphorus removal by the facilities.

The influent sources of phosphorus, such as industrial or commercial users, should be identified, and a plan developed to reduce significant contributions. This can be accomplished through a combination of pretreatment program tools or encouragement of best management practices. The plans should include an examination of the existing facilities at the WRRF and evaluate opportunities to provide a greater level of nutrient treatment within the existing footprint without undertaking major facility upgrades. This should include operational changes and low-cost modifications to the existing facilities.

The feasibly studies are being required to ensure that permit holders proactively plan and prepare for future phosphorus limits. The studies will examine effluent phosphorus limitations of 1 mg/L, 0.5 mg/L, and 0.1 mg/L. The studies should identify the capital and operational costs for providing each of these three levels of phosphorus removal on a monthly average, seasonal average, and an annual average basis.

The preparation of these plans provides both the clean water utility and IEPA with an appreciation for what improvements will be required, the required time for implementation, and total costs for meeting any future proposed permit limits.

Illinois has taken a big step forward in improving the quality of its water by addressing excessive nutrients. By engaging all of the stakeholders, water professionals have obtained a more balanced view of the issue, one that considers all sources of nutrients and identifies the best opportunities for mitigation.

Nathan Davis *is a senior water resources engineer with Crawford, Murphy & Tilly, Engineers & Consultants (Springfield, Ill.).*

Fighting drought on several fronts

Diversified water supplies can help better cope with water limitations

Challenges related to water stress have mainly concerned arid and drought-prone regions, but based on recent trends in climate variability, population growth, and intensifying global water demand, the struggles of ensuring water supply are becoming more widespread. These concerns are placing greater significance on sustainable water management approaches that can reduce water scarcity risks and contribute to more reliable water supplies.

A prime example of how supply distributions have spurred actions to develop more resilient water systems is California, where persistent dry conditions have caused one of the most severe multiyear droughts in the state's history. Now 5 years long, California's water crisis, which includes the lowest ever-recorded snowpack in 2015, spurred Governor Jerry Brown that year to issue an executive order mandating a 25% reduction in the amount of water consumed statewide in urban areas.

Although water supply conditions improved in 2016, November data from the U.S. Drought Monitor still showed that extreme to exceptional drought remained deeply entrenched across 43% of the state.

With the threat of drought conditions continuing into 2017 and beyond, California has placed greater emphasis on making regions and communities more self-reliant through the pursuit of diversified water supplies.

"Diversification will play a huge role in the future of California's water system, but it's important that it be done in a non-prescriptive way – depending on the region, the most viable options can be very different," said Newsha Ajami, director of Urban Water Policy with Stanford University's Water in the West.

In developing regional water management strategies, Ajami said municipalities and water utilities should prioritize solutions that incorporate an integrated approach. "By managing water resources in a more holistic and collaborative way, we can maximize our opportunities and better control costs," she said.

Examples of different initiatives in California that reflect an integrated and sustainable methodology to managing water supplies are currently under way.

Economic model helps cope with water scarcity

As a future mechanism to help conserve freshwater supplies and maximize water reuse opportunities, researchers at the University of California (Riverside) have developed an

economic model that demonstrates how flexible wastewater treatment processes can be optimized to produce cost-effective irrigation water. These flexible processes blend varying levels of treated effluent to meet and surpass various water quality requirements.

In the study, "Wastewater Reuse for Agriculture: Development of a Regional Water Reuse Decision-Support Model (RWRM) for Cost-Effective Irrigation Sources," researchers Kurt Schwabe, David Jassby, and Quynh Tran found that blending effluent from various treatment processes could produce water with nutrients that are beneficial to specific crops, thus reducing fertilizer costs and increasing the affordability of recycled wastewater.

Such a framework could help ease stress on groundwater and surface water sources, which are relied on heavily for crop irrigation water in California, according to Jassby. He is an assistant professor of chemical and environmental engineering. "Although irrigation demand in California is roughly seven times larger than the amount of municipal wastewater produced, that demand could still be reduced by allocating treated wastewater to certain high-value crops grown at the rural–urban interface such as turfgrass, citrus, avocado, and grapevines," Jassby said.

Using reclaimed wastewater for irrigation – particularly on golf courses – already is practiced regularly in California and other arid states, but because of the limited treatment of that water, salinity-related problems can be a reoccurring issue.

"Golf courses that irrigate with treated wastewater will often end up with elevated levels of accumulated salt in the soils, requiring periodic flushing with potable water," Jassby said.

Because of the typical high salt concentrations in treated effluent, the researchers emphasized desalination in specifying the technologies and treatment trains associated with their model. "The idea is to desalinate a small portion of the wastewater and then blend it with secondary effluent," Jassby said. "And, by adjusting the blending ratio, water can be engineered with appropriate nutrient compositions that are matched to specific crop demands at a minimum cost."

Following completion of their study, the researchers are now working with colleagues in Israel toward applying their framework to a regional water supply model.

"The next phase is to see how our research can help water districts evaluate the consequences of different infrastructure projects and better develop water supply strategies based on rising demands over time," said Schwabe, a professor of environmental economics and policy. "We will also consider further lower-cost opportunities to blend certain types of effluent with other water sources, which could help the lower costs of meeting regional water supply needs."

Stormwater capture augments supply

To help bolster the Los Angeles region's water supply and add more resiliency against drought-related risks, the City of Los Angeles recently broke ground on an aquifer recharge facility expansion that will double the amount of stormwater that can be captured at the Tujunga Spreading Grounds. This facility is a 61-ha (150-ac) parcel of permeable soil in the San Fernando Valley that connects to the San Fernando Groundwater Basin.

The $29 million expansion project will enhance the storage and conveyance capacity of the spreading basins. It will include construction of new diversion gates and intake structures to allow the spreading grounds to capture more channel flows.

"The purpose of the project is to both equip the facility to hold higher flood-flow volumes and improve the rate at which water can percolate into the ground," said Marty Adams, senior assistant general manager of the water system with the Los Angeles Department of Water and Power. "Based on climate studies, we expect future storms to be shorter and higher-intensity. As such, the ability to capture more instantaneous water from extreme rain events becomes a very important aspect."

By reconfiguring the spreading basins for enhanced replenishment of the San Fernando Groundwater Basin, the project aims to augment the region's most valuable local water asset that is relied on as a primary source for potable supply, according to Adams. "If we are going to prepare our region for future droughts and reduce our reliance on imported water, more focus needs to be placed on developing water resources locally," he said.

Tailored water reuse

In El Segundo, Calif., the Edward C. Little Water Recycling Facility, which is owned and operated by the West Basin Municipal Water District (Carson, Calif.), helps bolster the region's water supply reliability by producing approximately 282,000 m^3/d (62 mgd) of recycled water. The facility is the only one of its kind to convert secondary wastewater effluent into five different types of tailored recycled water qualities that are utilized for specific end uses.

The "designer" types of water produced include tertiary water for industrial and irrigation uses, nitrified water for cooling towers, pure reverse osmosis (RO) water for low-pressure boiler feed water, ultrapure RO water for high-pressure boiler feed water, and softened RO water that is injected into the West Coast Groundwater Barrier to protect local well water supplies against seawater intrusion.

The recycling facility is a key pillar of West Basin's Water Reliability 2020 program, which is designed to shift water supplies to more locally controlled and reliable sources of water.

– Jeff Gunderson, *WE&T*

Plotting a course through the tangled maze of energy and water

Experts address energy efficiency and generation from multiple perspectives

Managing energy wisely always has been important to the water sector. Recently, though, the discussion has intensified beyond reducing energy use to reaching full energy neutrality and even energy production while treating wastewater.

The paths to reach this new goal vary among water sector professionals, but one conclusion for optimizing energy efficiency crosses all boundaries: success will require collaborative energy.

Bringing the right people together is the key element of minimizing energy use, achieving energy neutrality, or even producing energy in the water sector. The examples below show a range of what some have done already and new opportunities that exist to balance the larger water and energy equation.

Water, energy, and food

At WEFTEC® 2016, the Plenary Session 102, Industrial Water and the Water/Energy/Food Nexus, brought together panelists from government, industry, and academia to discuss the intersection of these vital areas. Without proper interaction and collaboration, these areas risk destabilizing each other.

Kathleen Hogan, deputy assistant secretary for the U.S. Department of Energy (DOE), provided details on many DOE-supported energy projects to address water resources.

Hogan grouped the projects into three categories:

- clean water production technologies;
- energy efficiency in wastewater treatment; and
- reduction of water demands from industry, targeting manufacturers, water resource recovery facilities, and industrial facilities.

The same idea ran through all three groupings – in Hogan's words, DOE is "looking to be very strong partners in this space."

For example, Hogan described the 3-year Better Building Wastewater Infrastructure Project. Under this accelerator project, nearly 75 water resource recovery facilities are setting long-term targets to improve energy efficiency by 30% or more, developing sustainable infrastructure plans, and assembling a package of energy conservation and resource recovery methods as well as a concrete financing model.

Rabi H. Mohtar, professor of agricultural engineering at Texas A&M University (College Station), posed the question, "What's new in the water/energy/food nexus?"

His answer reflected the sentiments of the other panelists – that coordination and collaboration are essential. "It's very important to realize that we need all of these pillars moving forward. It is all of the above," Mohtar said. "…The message here is that 'interdisciplinarity' can only exist if you have strong disciplines, and we need the strong pillars of energy, food, and water to build a sustainable platform."

Amanda Brock, founder and CEO of Water Standard (Houston), summed up the nexus simply: "While water is a pillar, it also is what everything projects around. Because without water, there is no energy, there is no food. Without water, we die."

She added that securing water sources in a rapidly changing environment is a key concern. The four main sources are

- rivers, lakes, and groundwater;
- conservation;
- reuse; and
- desalination.

Finding the balance in allocating this finite resource among energy, food, and other needs requires an understanding of the true distribution of uses among different sectors.

She described how perceived usage of water by the oil and gas industries often is over represented in the media when compared with how much water they actually use. For example, Brock cited studies that estimate 9 years of hydraulic fracturing water use to be 946 billion L (250 billion gal) – less than 1 day of consumptive water use in the U.S., she said.

Snehal Desai, global business director for Dow Water & Process Solutions (Midland, Mich.), provided the final voice on the panel. He concluded the discussion with a viewpoint from the industrial sector. He described efforts to reuse water multiple times within a facility for various purposes.

Desai also commented on the complexity and scope of the entire water/energy/food nexus. He warned against trying to figure out the broad strokes too fully before smaller pieces are put into place. "If you make it small enough, it's manageable. It's when we think we're going to do a national water policy that our heads explode," Desai said.

"We will get there, but it's going to be a series of small programs from around the country that get the bigger picture painted."

Next level perspective

When dealing specifically with municipal wastewater, Bruce E. Rittmann, director of the Swette Center for Environmental Biotechnology at Arizona State University (Tempe), is encouraging wastewater

professionals to "graduate" from thinking about wastewater to thinking about its inherent resources. Chief among these is energy.

Rittman presided over the annual WEFTEC Scientist's Luncheon, hosted by the Association of Environmental Engineering and Science Professors (AEESP; Washington, D.C.) and the Water Environment Federation (Alexandria, Va.). His presentation was titled "From Treatment to Resource."

He advocated rethinking treatment systems with the use of the effluent in mind. He also described the activated sludge process as "an expensive way to squander valuable resources."

As an alternative, he suggested choosing processes that treat water only to the degree needed for its next intended use. Choosing not to remove some contaminants can defer a tremendous amount of energy use.

For example, domestic wastewater can be converted to liquid fertilizer (with the bonus of irrigation water) or for some industrial uses while avoiding the processes needed to remove nutrients.

He described being able to more readily use established processes, such as methanogenesis, that can extract energy while treating water. This improvement comes by leveraging newer technologies, such as staged anaerobic fluidized membrane bioreactors (SAF-MBRs), to make these processes more achievable.

The idea of customizing the treatment of water to its end use varies vastly from the idea of removing pollutants from water to release it to the environment, he said. The processes and technologies needed to make great strides are either available today or developing, he said.

The real challenge, according to Rittman: "You have to change minds and develop the markets."

Changing the culture

Getting one utility to take steps to optimize energy usage is good. Getting several to do it is better. Having that group work through the process together and on similar schedules can reap even greater benefits.

Layne McWilliam from Cascade Energy (Portland, Ore.) shared the value his program has found in grouping several utilities together into a cohort to encourage energy savings programs. Multiple facilities of different sizes form each cohort. They create peer relationships that promote knowledge sharing and offer opportunities to test ideas and validate results.

McWilliam presented his perspective in Technical Session No. 317, The Upward Trend: Optimizing Energy from Net Neutral to Net Positive, at WEFTEC 2016.

He advocated reaching beyond the traditional confines of wastewater treatment to also find lessons from the drinking water and energy management sectors. The training walks facilities through team assembly, policy adoption, baselining, facility analysis, and implementation. The onsite work gives the cohort members time to think about these changes, as well as to receive coaching, while removed from the everyday demands of their facilities.

Tracking the results from the implemented changes builds the framework, skills, and confidence for lasting cultural change and successful energy management over the long-term.

This sort of wastewater energy coaching "boldly goes where traditional electric utility energy audits fear to tread," McWilliam writes in his paper.

Finding the right partners

The consistent message throughout these different water–energy perspectives is the importance of continuing collaboration and innovation. Technology is not the main challenge, though it certainly does add complexity – the real challenge is gaining consensus around a project to choose which path to follow.

– Steve Spicer, *WE&T*

Building a stronger, faster, more nimble utility

Wastewater professionals discuss how the sector can have a more resilient future despite obstacles

The wastewater sector is dealing with an ever-evolving world, requiring utilities to be resilient and adaptable. Not only do they have to prepare for natural disasters and purchase or refurbish equipment to meet stricter regulations, they also face the challenges of climate change and the threat of bioterrorism.

Several experts at WEFTEC® 2016 in New Orleans shared how utilities can better prepare for the future and respond to these diverse challenges internally while conveying cohesive but informative messages to the public at large.

Changing your response with the climate

Drought, heavy rains, and climate change are forcing utilities and regions to rethink how they prepare for and respond to their environment.

Don Vandertulip of WateReusEngineers (San Antonio, Texas) noted during Technical

Session No. 411, Public Health in the Headlines, that the drought in California is unprecedented. There has been a drought in Texas from 2011 through 2014, he said. There are still areas in north Texas that are going through drought such as Wichita Falls, and state climatologist warn temps will only get warmer with evaporation from existing waterbodies, he said.

These droughts are pushing some utilities to adopt direct potable reuse (DPR) practices. Vandertulip said currently, there are two places in U.S. doing DPR: Big Springs, Texas, and Wichita Falls, which is now switching back to indirect potable reuse due to rainfall. The city of Brownwood, Texas, had approved the first direct-to-pipe potable reuse in the U.S., Vandertulip said, but after flooding due to heavy rains, the city put this plan on hold.

Climate change prep work

During Technical Session No. 320, Urban Resiliency Planning: Are You Ready?, Alan Zelenka, director of energy services at Kennedy/Jenks Consultants (San Francisco), explained weather extremes will only get worse.

"We've got droughts, higher temps, flooding, and forest fires. And if that doesn't depress you enough, it is increasing thanks to climate change," Zelenka said.

He said these factors increase utilities' risks and costs.

"Dealing with our risks and our costs in an effective way is what climate change resiliency is all about," he said.

Zelenka said cities like San Francisco, Los Angeles, and Portland, Ore./Maine, have added climate change adaptation to their resiliency plans. For example, he said, when San Francisco put together the capital improvement plan and analysis of a tunnel that will transport water, the city factored in sea-level rise due to climate change. This changed the design height of the underground tunnel accordingly.

"But medium-to-small utilities typically don't do [resiliency plans] due to staff and resource constraints," Zelenka said. They are more focused on permit requirements. They also face the challenge of lack of available funding and lack of political will to support these improvements, he said.

But preparing for climate change will give utilities lower costs in the long run. Proper planning can pay for itself in less than a year, in some cases, Zelenka said. And, he added, it will be more expensive to retrofit later.

Utilities also should be aware that some grant funding applications, bond ratings, and insurance coverage now require climate change preparation plans, he said.

The U.S. Environmental Protection Agency (EPA) is offering an additional tool to assist utilities with climate change preparation. That online portal will "provide local leaders in the nation's 40,000 communities with information and tools to increase resilience to climate change," according to an Oct. 6 EPA news release. The Adaption Resource Center (ARC-X) provides users with information designed specifically for their needs, location, and "particular issues of concern to them."

"ARC-X is a powerful new tool that can help local governments continue deliver reliable, cost-effective services even as the climate changes," said former EPA Administrator Gina McCarthy.

Preparing for the worst-case

Not all climatic events are slowly evolving like droughts and climate change. Some are natural disasters that require plans at the ready. Japan has dealt with a multitude of natural disasters – from flooding from heavy rainfall to earthquakes and tsunamis. Japan's many utilities have learned to prepare and improve their response to these events after decades of trial and error, many of which were detailed during Technical Session No. 520, Insights from Recent Natural Disasters in Japan.

Tomoyuki Inoue of the Japan Institute of Wastewater Engineering and Technology, detailed how some water resource recovery facilities and pump stations in Japan have systematically modified their structures because of tsunamis. They have prepared for these natural disasters by waterproofing structures against highest tsunami levels. This includes modifying doors, window shutters, and exit hatches; installing barriers against floating objects (cars, for example); and developing evacuation maps that are circulated among facility staff. These evacuation maps even include the location of airlift points.

Getting public buy-in

Yuki Fujita of the Tokyo Metropolitan Government's Bureau of Sewerage, discussed "Tokyo Amesh," the city's rainfall radar system. The system includes two radars spaced 50 km apart that help alert the public about high rainfall and where major flooding may occur. The radar also enables the city's utility system to use pumping stations more precisely.

Yamato Nakamura of the Sewer Construction Division for the city of Yokohama spoke next. Nakamura shared how the city constructed and spread the word about a temporary toilet system they decided to use instead of traditional toilets due to frequent earthquakes.

Conventional toilets are highly vulnerable to these quakes and are more likely to malfunction, Nakamura explained.

The earthquake-proof toilets are mainly installed in local schools. The public can maintain and operate these toilets themselves. The toilets are built on ground-level, use semi-pure water, can be used for up to 150 days by up to 500 people before they must be emptied, Nakamura said.

Yokohama has constructed the public toilets in 109 locations and may install more.

The public communications campaign for the toilets included drills, educational videos that explain how to set up and use the temporary

toilets, and signboards with QR codes to show where the toilets are located, Nakamura said.

The problem with nutrients

Nutrient runoff and subsequent algal blooms in major waterways also must be handled.

During Technical Session No. 324, Leadership in Action: Public Confidence in Utilities, Bill Stowe, CEO and general manager of Des Moines Water Works, said that Iowa has seen a 15% increase in impaired waterways in the past few years. Part of the reason is increased nutrient runoff, something that the wastewater sector is trying to curtail.

"The state has the world's largest denitrification facility, which is kind of like bragging 'I'm the largest chain smoker in the world,'" Stowe said.

He said his utility uses ion exchange to denitrify wastewater but it's cheaper to remove the nitrogen upstream. This is why Des Moines Water Works took the bold step to curtail runoff by suing point source agricultural polluters.

"In Iowa, discharge from farms is completely unregulated," he said. "But regulations and public health are closely aligned. I'm glad that when I land at Louis Armstrong [Airport in New Orleans], there are regulations on the pilots and air traffic controllers. … Regulators serve a purpose."

Being prepared and transparent

Water supply contamination seems to be the threat that gets the most media attention. Resilient utilities must have not only a fast responses, but also a methodical one. Technical Session No. 201, Bioterrorism, dealt with these topics.

John Petito, assistant commissioner of the Bureau of Wastewater Treatment at the New York City Department of Environmental Protection (DEP), shared that the agency has had two examples of biocontamination events within the past 20 years – one anthrax scare and the 2014 Ebola outbreak. DEP discovered that "transparency and communication are key elements," he said.

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Naoko Munakata, a project engineer with the Los Angeles County Sanitation District, said to prepare for similar threats at other facilities, utilities should ask themselves a series of questions, such as:

- What are the transmission risks to workers/public?
- "How do we protect people?
- How will it affect operations?

Munakata said practical concerns also can affect threat response. Things like how efforts will be coordinated within a utility and with partners, and whether there are regulations or financial issues afoot.

Besides bioterrorism, WEFTEC presenters also explored lead contamination in water. In Technical Session No. 411, Leonard Casson, assistant professor of civil and environmental engineering at University of Pittsburgh, shared the most recent incidences of lead found in drinking water in the U.S. He cited Washington, D.C. (2001 to 2014), Pittsburgh (2013 to 2015), and Flint, Mich. (2014 to present).

The Flint crisis first came to the attention of William Rhoads, a graduate research assistant at Virginia Polytechnic Institute and State University (Blacksburg), when a mother asked the university to test her home's water. She asked after children in the household began losing hair and not meeting developmental milestones.

Rhoads found lead levels of 1300 ppb – the highest level allowed by the federal law is 15 ppb, he said.

University researchers continued to collect samples from other Flint households and confirmed similar alarmingly high levels of lead. In fact, one in five homes in the City of Flint showed lead contamination, Rhoads said.

Utilities have to embrace being honest with their customers, said George Hawkins, general manager of DC Water. Hawkins spoke at the aforementioned Leadership in Action session.

"Being open and transparent is important," he said. DC Water now publishes an online map that shows a record of services, disclosing where lead service lines are located.

"We're showing we're worrying about this with you," he said. "We're on your side."

– LaShell Stratton-Childers, *WE&T*