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CALIFORNIA-NEVADA SECTION AWWA V31 • N3 • Summer 2017

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When Things Go BOOM!

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We Want to Hear From YOU Feedback is the SOURCE feature that invites readers and members of the California and Nevada water communities to comment on the magazine and issues in the water and wastewater industries. Please email Penelope Grenoble at *pbg1747@sbcglobal.net.*

Solving the Riddle of Safe and Affordable Water

In SOURCE Winter 2017, I wrote about the challenges the State of California is grappling with regarding the 2014 legislation that guarantees every person in the state water that is safe, accessible, and affordable for basic human health and sanitation. The issue is highly relevant to AWWA and represents the kind of riddle that stirs the fires of a closet policy geek. (I confess that a PhD probably qualifies someone as a geek of the highest order--so here goes): The following are fundamental questions that California officials and stakeholders will have to resolve in order to deliver on the state's guarantee of safe, affordable and accessible water:

- How do we meet the needs of low-income communities?
- Who should put up the money and other resources that will be required to bring noncompliant drinking water systems into compliance, and more importantly, assure that they remain so?
- What lessons can be gleaned from current water industry operations and practices that can be used to inform future policy decisions at state and local levels so that our current predicament can be avoided or at least minimized?

I want to make clear to our constituents in the Nevada water community that I am not biased toward California and would wager (in true Nevada style) that the Silver State is also grappling with these challenges to some degree or another and likewise is every state in the nation. They hearken back to the founding purpose of AWWA and are central to the Association's mission. To date, AWWA has adopted 36 policy statements on important and timely issues and as with other policy actions, each was subjected to a grueling process of review, challenge, and editorial fine-tuning. The opening sentence of the policy statement on Financing, Accounting, and Rates states:

> *The American Water Works Association (AWWA) believes that the public can best be provided water and wastewater services by self-sustaining enterprises adequately financed with rates and charges based on sound utility accounting, management and financial principles.*

This is precisely what the majority of the U.S. population enjoys. But what happens when it is not the case and seemingly cannot be achieved? I believe the problem needs to be disassembled and tackled in a different way. Let's look closer at various aspects of this prickly situation and identify some of the steps that have been proposed or already set in motion.

1. *Pockets of poverty and low-income individuals within a sustainable public water system.* Assuming the water system is managed well, here the issue is affordability. As required by Assembly Bill 401 (2015), the State Water Resources Control Board (SWRCB) is investigating low-income rate assistance (LIRA) programs. These programs are common among energy utilities but less so with water. As I write, it is too early to tell what policy direction SWRCB will take, but it is almost certain to look for ways to "encourage," if not require, LIRA programs for many utilities, potentially piggybacking on programs already in place. From my perspective, support from CA-NV AWWA is desirable, but as they say, the devil will be in the details.
2. *Systems noncompliant with drinking water standards located adjacent to sustainable public water systems.* Here we find the dual issues of affordability and water quality. SWRCB has already slipped into a budget trailer bill the authority to initiate consolidation of such systems with a neighboring system capable of serving it. Some process safeguards are in place for the receiving entity, although the system managers and their customers may not support the indirect subsidy or cost-shifting that will occur as other ratepayers pick up the cost of bringing the failing system into compliance. (*See* SOURCE *Summer 2016, p. 22.*)

   It is possible that in a very few instances, it will make sense to consolidate multiple small systems into a new entity such as a community services district. While consolidation is fraught with difficulties, and not popular with many AWWA members, my view is that with appropriate financial support, such as State Revolving Fund (SRF) loans, and legal protections in place, it is the best available alternative.
3. *Geographically isolated noncompliant systems with low-income populations.* These conditions comprise the "mother of all compliance problems." Scanning a list of drinking water violations suggests that these systems are likely to be rural mobilehome parks and farm labor camps and some but not all, are mutual water companies. The SRF program (often with loan forgiveness) can cover capital expenditures for improvements such as treatment systems, pipe, and "appurtenant facilities." However, the tougher issue is operation and maintenance once these facilities are in place. The solution for systems

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CONTRIBUTORS

Bruno Bowles

Las Vegas Valley Water District Reboots Public Outreach 20

Bruno Bowles is Manager of the Springs Preserve in Las Vegas. His experience includes conservation and education with the City of Tacoma, managing education programs for Wolf Haven International, and working as a Nevada State Legislature lobbyist for the Southern Nevada Water Authority..

Susan Brownstein

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Susan Brownstein is an associate sanitary engineer at the California State Water Resources Control Board Division of Drinking Water in the Glendale (Los Angeles County) field office.

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Steven Garner is CA-NV AWWA Certification Manager. He is responsible for maintaining the six existing certification programs and the development of a new program for advanced water treatment operators.

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Amanda Hohner is an assistant professor in Civil and Environmental Engineering at Washington State University where her research focuses on watershed disturbances and the implications for source water quality and treatment. Fernando L. Rosario-Ortiz is an Associate Professor of Environmental Engineering at the University of Colorado-Boulder. His current research focuses on environmental photochemistry, impact of watershed perturbations on water quality and characterization of organic matter in varied environments.

Larry W. Lyford and Tommy Pearce

When Things Go Boom: VOCs and Ozone Destruction Units 16

Larry Lyford has been water treatment plant manager for Helix Water District for eight years. Before that he served as plant operations supervisor for nine years. He holds California Treatment 5 and Distributor 5 certifications. Tommy Pearce has worked in the water industry for the past nine years and is currently the plant operations supervisor for Helix Water District.

Ken Markison

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Ken Markison began his career at East Bay Municipal Utilities District as a utility labor in January 1986. For the past 17 years he has worked as a general pipe supervisor. He retired in May 2017, right after he complicated this article for SOURCE.

Jesse Pompa

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Jesse Pompa is a senior engineer at the Inland Empire Utilities Agency. He joined the agency in 2010 as a senior associate engineer with the Department of Planning and Environmental Compliance. He was the senior staff member for the battery energy storage project.

Brian Tarroja and David Feldman

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Brian Tarroja is a researcher in the UC Irvine Advanced Power and Energy Program and Department of Civil and Environmental Engineering focused on water-energy system interactions. David Feldman is Director of Water UCI. He specializes in water resources management and policy, global climate change policy, ethics and environmental decisions, adaptive management.

SOURCE

California-Nevada Section,
American Water Works Association
10435 Ashford Street
Rancho Cucamonga, CA 91730
Fax: (909) 481-4688 or (909) 291-2107
(909) 481-7200 | www.ca-nv-awwa.org

Mission Statement

To serve the regional water community with news and information about developments, regulations, technology and trends affecting CA-NV AWWA Section members and California and Nevada's water professionals.

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ADVERTISING SALES MANAGER
Kathleen Pishotta (888) 371-4933
EDITOR Penelope Grenoble
ART DIRECTOR Aude Cabaldon
TECHNICAL EDITOR Nicole Blute
COPY EDITOR Edward Richeson

Section Staff

EXECUTIVE DIRECTOR
Tim Worley
ASST. EXECUTIVE DIRECTOR/ FINANCE & ADMINISTRATION
Sita Ramakrishnan
DIRECTOR OF EVENTS AND MARKETING
Linda Contreras
MEMBERSHIP ENGAGEMENT MANAGER
Armando Apodaca
CERTIFICATION MANAGER
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EDUCATION MANAGER
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CERTIFICATION SPECIALIST
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EDUCATION SPECIALIST
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REGISTRATION/ACCOUNTING SPECIALIST
Shobhana Chickarmane
TRAINING COORDINATOR
Michelle Van Dommelen

2017 APEX® AWARDS FOR PUBLICATION EXCELLENCE

CA-NV AWWA IS PROUD TO ANNOUNCE that SOURCE magazine has won a 2017 APEX Award for Publication Excellence. Congratulations to Editor Penelope Grenoble, Art Director Aude Cabaldon, Technical Editor Nicole Blute, Copy Editor Edward Richeson and all of this year's authors, who contributed their time and expertise without compensation. Executive Director Tim Worley brought Grenoble onboard in 2013 when they collaborated on a redesign of the magazine. Since then, SOURCE has also been honored with three Maggie Award nominations by the Western Publications Association.

Cr6 @ 0.02µg/L—Back to the Drawing Board?

> *". . . the court is concerned that leaving the MCL in place will create an inexorable amount of momentum for the Department [SWRCB] to simply readopt 10 ppb without adequately considering its economic feasibility. For similar reasons, the court declines the Department's suggestion that it only invalidate the MCL for small water systems (those with less than 200 service connections), and that it leave the MCL in place for all other water systems."*
>
> —"Section 4" California Manufacturers and Technology Association and Solano County Taxpayers Association vs. State Water Resources Control Board.

On May 5, 2017, the Sacramento State Superior Court ordered the State Water Resources Control Board (SWRCB) to withdraw the current hexavalent chromium (Cr6) maximum contaminant level (MCL) and establish a new one in accordance with the California Safe Drinking Water Act, reconsidering the economic feasibility of compliance with particular attention to small water systems. Two weeks later, SWRCB chair Felicia Marcus assured the California water community that the board's review of the court decision would not be "a snap your fingers kind of thing."

In Spring 2013, USEPA Region 9 toxicologist Bruce Macler (then CA-NV AWWA chair elect) predicted that with California's Public Health (PHG) goal at 0.02µg/L, the forthcoming Cr6 MCL would likely be "much lower" than the state's 50 µg/L MCL for total chromium. In August 2013, the state released a proposed MCL of 0.010 mg/L, and the Section's Cr6 Technical Advisory Committee immediately expressed concern about lack of transparency in the cost-benefit analysis, incomplete data about Cr6 occurrence in water sources, and that individual community impacts might be artificially underestimated. The committee also noted that given that the cost of compliance would be beyond the financial ability of some small communities, state-supported funding would be needed. Similarly, an October 2013 technical study commissioned by CA-NV AWWA, the Association (AWWA), the Association of California Water Agencies and the California Water Association identified the economic feasibility of meeting the proposed MCL, especially for small water systems, as a major liability of the proposed regulation.

In SOURCE Winter 2014, Nicole Blute with Hazen and Sawyer, drafted a comparative review of currently available Cr6 Treatment options, including strong base anion exchange (SBA), weak base anion exchange (WBA) and reduction coagulation filtration (RCF). The material was based on work done by Blute, Issam Najm, Chad Seidel, Ying Wu and Jacqueline Rhoades for the City of Glendale. Blute

expanded her article in a webinar and four classroom seminars presented by CA-NV AWWA in January/February 2014.

In July 2014, SWRCB issued the MCL as proposed. Industry response was to request a reasonable timeframe for planning, design, and construction beyond the six months specified in the regulation. A year later, the state Senate unanimously passed SB 385, which specified a compliance date no later than January 1, 2020 and required utilities to submit a letter of intent to the Division of Drinking Water by March 1, 2016 and establish a formal compliance plan by June 30, 2016, including monitoring milestones. The bill was signed by Gov. Jerry Brown as an urgency statute.

In SOURCE Fall 2016, Blute and Steve Bigley, director of environmental services at Coachella Valley Water District (CVWD) with 30 percent of its wells impacted, described the district's $250 million compliance project (SBA and WBA and a central resin regeneration facility) to be financed with a low-interest State Revolving Fund loan, monies from its own drinking water reserve fund, and incremental rate increases that would almost double water rates over five years. CVWD broke ground on schedule, but in the next issue, Winter 2017, Bigley reported that CVWD was halting construction and initiating pilot testing of stannous chloride-assisted Cr6 removal, which if effective, would be "better for the community, better for the environment, and better for CVWD's ratepayers."

Where Are We Now?

Chad Seidel at Corona Environmental Consulting estimates that the majority of the systems impacted by the 2014 MCL have not yet initiated efforts toward compliance. The Indio Water Authority is one of a few public water systems with treatment in place—three anion exchange treatment sites in operation for a year. Coachella Utilities General Manager Scott Rogers estimates that the city has invested a half million dollars in initial SBA treatment design and stannous chloride-assisted treatment pilot testing, $300,000 of this from municipal funds. "The City of Coachella has a median household income of $43,000. Utilizing SBA treatment to comply with the current Cr6 MCL would double the percentage of a family's income needed to pay the water bill."

Another uncertainty is the California Office of Environmental Health Hazard Assessment's review of the state's 0.02 µg/liter Cr6 PHG initiated in 2016. Since 2011, when the PHG was established, several peer-reviewed studies have suggested that the cancer risk of ingesting Cr6 might be substantially less than previously thought.

For a complete Cr6 regulatory timeline see: *http://waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6timeline.shtml;* for the court ruling, go to *http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/chromium6/cmtajud.pdf.*

—Penelope Grenoble, SOURCE *Editor*

Drips and Droplets *columnist Rick Zimmer will be back next issue.*

The Rocky Road to Making Conservation a Way of Life

By Rosalie Thompson

THE WATER COMMUNITY WALKED AWAY FROM California's recent historic and prolonged drought a bit wiser about what it takes to balance supply and demand when supplies are limited. Across the state, conservation has become a fundamental building block in many water agencies' supply portfolios. While there is no doubt that conservation helps maximize the availability of treated produced, stored or imported supplies, it has become evident that there is no silver bullet to providing sustainable supplies. Effective long-term water supply planning requires an arsenal of options that must be responsive to, and reflective of, local and regional conditions.

Gov. Jerry Brown expressed his desire for sustainable conservation when he released The California Water Action Plan in January 2014. The plan is an approach to sustainable water management that reflects an "all-the-tools-in-the-toolbox-approach" for integrated water management to help address the state's climate and resource conditions. In addition to long-term water conservation, the tools include: production and use of recycled water; improved permitting to facilitate the increased production of seawater desalination and brackish water desalination and stormwater capture; expanded storage; improved habitat; and infrastructure for sustainable imported supplies.

On May 9, 2016, as California continued to slip further into its fifth consecutive year of drought, Gov. Brown issued Executive Order B-37-16, *Making Conservation a Way of Life*, addressing the severity of the cumulative dry conditions statewide. The order tasked the Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB) to develop a framework based on the following:

1. Develop urban water use targets for indoor, outdoor, and commercial, industrial, and institutional water use.
2. Develop reporting requirements to assess water savings.
3. Bolster drought contingency planning.

By August 2016, DWR and SWRCB had established an Urban Advisory Group and an Agricultural Advisory Group to provide stakeholder input for meeting the governor's objectives by the January 10, 2017 deadline required in the EO. DWR and SWRCB released an initial draft framework for stakeholder comments and provided revisions of the framework based upon the responses received. When the state agencies released their last working draft in November 2016, to provide a final opportunity for the water community to respond, there was general support for the overall objective of reporting and enforcement. However, the water community continued to argue for flexibility in establishing conservation targets, avoiding onerous reporting requirements, and preserving local flexibility in meeting water use efficiency targets.

On January 10, 2017, Gov. Brown released his proposed 2017-18 State Budget, in which *Making Conservation a Way of Life* was included as an important objective of the Governor's resources spending plan. This occurred while stakeholders (water agencies and municipalities, statewide water associations, and the NGO community including the National Resource Defense Council, Pacific Institute, and the Community Water Center) were still waiting for the release of the final draft of the implementation framework being developed by the state agencies.

In an effort to be prepared with an alternative option that reflects the water community's comments to previous framework drafts, the Regional Water Authority and the Irvine Ranch Water District worked collaboratively with the Association of California Water Agencies, the California Municipal Utilities Association, and their respective members in a three-month workgroup process to develop language for legislation that could be broadly supported by the water community. To ensure that the approach identified by the water community remained a part of the ongoing dialogue, and pending decisions in the Legislature and by the Brown Administration, the water community secured two legislative vehicles. The final work product is reflected in Assembly Bill 968 (AB 968), related to water efficiency target setting, and Assembly Bill 1654 (AB 1654), related to drought contingency planning and reporting. Both measures were introduced by Assembly Member Blanca Rubio (D-West Covina).

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CA-NV AWWA's Annual Spring Conference


Courtney Hernandez


Travis Powell


Tyler Judson

CA-NV AWWA's ANNUAL SPRING CONFERENCE IS OFTEN known as the "operators' conference" because it features the operator competitions, the Tops Op's Challenge and operator and service recognition. At this year's 2017 spring conference, CA-NV AWWA honored **Courtney Hernandez** of the Helix Water District with the *Treatment Operator Meritorious Service Award* and **Travis Powell**, also at Helix Water District, with the *Distribution Operator Meritorious Service Award*. **Tyler Judson** at Contract Operations, received the *Exemplary Operations Supervisor Award*. Congratulations to these three exemplary awardees.

Operator Competitions

Las Vegas Valley Water District's Silver State Tappers won first place in the *Men's Pipe Tapping Competition*, followed by **Los Angeles Department of Water and Power's TL Tappers**. The **City of Santa Ana's West Coast Tappers** were third. First place in *Women's Pipe Tapping* went to the **City of Sacramento's Sacramento Lady Tappers**. **Jaime Lozano**, **Ben Murdock** and **Casey Grijalva** from the **City of Brentwood** won first place in *Hydrant Hysteria*, followed by **Ramazon Sumovic** and **Arnold Herrera** from the **City of Sacramento**. Third went to **Jake Bryant** and **Jesse Martinez** from the **City of Huntington Beach**. (The Sacramento team went on to win second place in the national competition at AWWA's 2017 Annual and Conference and Exposition in Philadelphia).

The Sacramento Lady Tappers won first place in women's tapping. Members are Jolynn Conrad, Megan Mackay Megan Thomas, Roxanne Dilley (alternate), and Dave Boisa coach.


First place tapping champs from the Las Vegas Valley Water District, l-r: Larry Caufield, Mario Fernandez, Mark Luberts, Christian Pearson. The Silver State Tappers came in fourth in the national competition.

Jake Bryant, from **Huntington Beach** won *Meter Madness*. **Nick Hollon** from **Yorba Linda Water District** came in second and **Josh Madrid**, also **Yorba Linda Water District**, came in third. **Mark Poston** from the **City of Brentwood** was first in the *Hot Flare* competition, **Robert Gonzalez**, **City of Santa Ana**, was second, and **Enrique Reynoso**, also **City of Santa Ana**, was third.

James Gallegos and **Derek Cray** from the **Southern San Joaquin Irrigation District's** "Beauty and the Best" won the *2017 Top-Op's Challenge*. The **City of Napa's** "Floctologists" came in second and the **Sacramento Suburban Water District's** "Reservoir Dawgs" were third.

SOURCE congratulates all of this year's competition winners. Without you, the job wouldn't get done.

2017 Scholarship Winners Announced


Sonali Abraham


Alex Gong


Linh Kim


David Lim


Madeline Wiegel


Maria Katrina Mendoza

BRUCE MACLER, CHAIR OF THE CA-NV AWWA SCHOLARship Committee, has announced the winners of the 2016-17 undergraduate and graduate scholarships. This is the second year in a row that the Section has awarded scholarships under the new program designed to support students interested in careers in drinking water and wastewater. This year there were 51 candidates.

$5,000 Graduate Scholarships went to **Sonali Abraham**, a doctoral student in environmental science and engineering at UCLA, who received the Dr. Pankaj Parekh Memorial Scholarship, and **Alex Gong,** a master's student at California State University Fresno.

$2,500 Undergraduate Scholarships went to **Linh Kim** a student in chemistry and biochemistry at California State University Fullerton; **David Lim**, a student in the environmental science and management program at the University of California Davis; **Maria Katrina Mendoza** who is studying chemical engineering at California Polytechnic State University Pomona; and **Madeline Wiegel** in civil engineering at Loyola, Marymount University. The $1,000 One AWWA Operator Scholarship went to **Luis Estrada, Jr.**

Winners also receive complimentary student memberships in AWWA for the duration of their studies and have been invited to attend the CA-NV AWWA Annual Fall Conference to be acknowledged at the awards ceremony. Information on the CA-NV AWWA scholarship program is available at ca-nv-awwa.org. Applications for 2018 scholarships will be available in Fall 2017.

Congratulations to all the winners.

California Operator Certification Chief Talks AB 2890

By Steven Garner

Some things changed, others were modified.

IN JULY 2014, WHEN THE DIVISION OF DRINKING WATER WAS transferred from the California Department of Public Health (CDPH) to the State Water Resources Control Board (SWRCB), the Drinking Water Operator Certification Program (DWOCP) was transferred from CDPH to the SWRCB Division of Financial Administration. The Wastewater Operation Certification Program (WWOCP) was already administered under SWRCB, so both drinking water and wastewater operator certifications programs are now under the same roof. In February 2016, Assembly Bill 2890 (AB 2890) was introduced to better align the two programs and delete obsolete language. California Operator Certification Chief Annette Caraway discussed AB 2890 at CA-NV AWWA's 2017 Annual Spring Conference.

Asked if operators will be granted credit for education on environmental laws or requirements, Caraway indicated that each course or workshop will be granted credit on a case-by-case basis. Asked if she expected that the types of education that qualify for operator renewals will reviewed or revised, Caraway answered that changes are possible, again on a case-by-case basis. Questioned about experience credits for operators that manage both treatment and distribution operations, Caraway reported that shift supervisors may be permitted to submit additional hours of credit on a case by case basis when they manage both treatment and distribution systems. Caraway also noted that Drinking Water Operator certification applications for Grades 3-5 are being revisited, with updated applications perhaps issued by the end of 2017.

CHANGE	DESCRIPTION/RAMIFICATION
Deletes Operator-in-Training (OIT) language	The DWOCP has not utilized the OIT program since 2001. AB 2890 removed the OIT language from statutes. OIT language had previously been removed from the Operator Certification Regulations in 2001.
Deletes statutes on distribution grandfathering	AWWA grandfathering section deleted; past grandfathering was completed in December 2003.
Adds definitions	Adds a definition section to the Drinking Water statutes (Health and Safety Code), and amends the wastewater statutes (Water Code) for clarity and to make the definitions consistent with regulations.
Adds Administrative Civil Liabilities	Previous Health Code did not give the Office of Enforcement authority to fine operators, only Water systems.
Amends reciprocity provision	Allows operators certified by the United States, prescribed territories or tribal governments, or any unit thereof, to apply for certification through reciprocity.
Formal establishment of a Drinking Water (DW) Advisory Committee	Provides a structure for the 10-member DW Advisory Committee. Specifies membership, and requires approval by the State Water Board for each member
Allows for dual operator discount	Allows for a discount fee for the issuance of, and renewal of a drinking water certificate for those operators that also hold a wastewater certificate.
Uniformly applies 3-year renewal period	Effective January 1, 2017, all OIT and Grades I-V wastewater operator certificates and renewals will be issued for 3 years, instead of the current 2 years; drinking water treatment and distribution certificates are already valid for 3 years.
For-profit education will be accepted as of January 1, 2017	Previous regulations and Water Code allow for only non-profit education; AB 2890 removed "non-profit" from the Water Code; colleges and universities must be accredited by an organization recognized by the California Postsecondary Education Commission or U.S. Dept. of Education
Additional Advisory Committee member	New members must be employed as an operator at a water recycling treatment plant; the new position established as of January 1, 2017 comes with a 4 year term. The WWOCP requested nominations to fill the new position
Potential for amended fees	Dual operator discount offered for operators certified in both wastewater and drinking water (treatment and/or distribution); any proposed fee changes must be approved by the SWRCB; goal for recommended changes to the fees is Fall 2017.

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American Water Works Association
California-Nevada Section

When Things Go BOOM!

The Danger of VOCs for Ozone Destruct Units

By Larry W. Lyford and Tommy Pearce

Treatment plants with ozone systems, in particular intermediate ozone, should evaluate upstream chemicals. Adding chemicals containing VOCs upstream of the ozone process may result in hydrocarbon accumulation in the catalyst bed of the ODU, leading to a destructive failure. Raw waters containing hydrocarbons can have the same effect.

HELIX WATER DISTRICT'S (HELIX) R.M. LEVY WATER TREATMENT PLANT IS A 106 MILLION gallon a day (MGD) conventional treatment plant with intermediate ozone. The ozone system had been online since early 2002 with no significant issues. However, on July 13, 2011, a catastrophic explosion occurred in one of the plant's three ozone destruct units (ODUs) causing approximately $300,000 worth of damage to the ODU and the treatment plant. The force of the explosion would have resulted in critical injury or death had staff members been in the vicinity of the ODU at the time. Helix Water District staff and industry professionals had the challenge, and the responsibility, to determine the cause of the explosion, implement process changes, and develop future monitoring to ensure that similar issues never occur again.

The Treatment Plant and Processes

The R.M. Levy Water Treatment Plant is a conventional treatment plant built in 1965 and subsequently upgraded and expanded to its current 106 MGD capacity. For most of the year, it treats a blend of water from the Colorado River and the California State Water Project. This is typically augmented during the summer months by local surface water stored in nearby reservoirs. The local water is higher in organics and color than the imported water.

Past experience and significant testing have demonstrated that in addition to the normal coagulants of alum and cationic polymer, an anionic polymer is required as a flocculant aid to enhance particle removal in the filters. Prior to the explosion, the selection and use of an emulsified anionic polymer was driven by extensive testing, including jar and zeta tests. Helix began feeding anionic polymer, which was approved by NSF International for use in potable water treatment, in 2005, with no issues.

An Usual Situation

In 2011, a wet winter season resulted in increased quantities of water in the local reservoirs. This local water was of a poorer quality than in previous years and was more difficult to treat. Considerably higher doses of anionic polymer (more than twice the average of previous years) were required to achieve the desired finished water quality.

One week prior to the incident, staff (maintenance and electrical as well as operators) noticed a slight odor in the ODU area that they were unable to identify or determine its origin and which quickly disappeared. The afternoon of the incident, staff noticed the same odor in the ODU area (similar to acid or vinegar), but this time it was much stronger. They traced the origins of the odor to ODU #2 and rotated from ODU #2 to an alternate ODU to clarify whether the odor was coming from the ODU or possibly from the processed water. The odor diminished when the alternate ODU came online. Staff isolated ODU #2 the afternoon of July 13, 2011 by shutting off the inlet valve. Plans were made to trouble-shoot the affected unit the following day.

At approximately 4:40 PM, nearly two hours after being removed from service, ODU #2 exploded. Staff members immediately removed the ozone facility from service and contacted the equipment supplier, Ozonia, to request guidance. Several members of the Ozonia staff were at Helix within 36 hours to join an investigative team that included members of the Helix staff, Association of California Water Agencies Joint Powers Insurance Authority, and specialists from Chubb Group of Insurance Companies and Exponent Failure Analysis Associates (Exponent).

Investigation and Results

Initial investigations quickly ruled out a failure of the unit due to improper shutdown. This led the investigative team to consider that there had been some type of rapid internal over-pressurization of the catalyst vessel. To determine the source/cause of the over-pressurization, samples of the following were collected:

- Catalyst from the exploded ODU #2 and the two intact units.
- Residue found inside the catalyst vessels.
- Anionic polymer.
- Cationic polymer.

Catalyst samples from each unit were analyzed by Analyze, Inc. using thermal gravimetric analysis (TGA) and thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS) to determine what types of hydrocarbons, if any, were present. Although the catalyst from the intact units was essentially free of organic material, analysis of the catalyst from the exploded unit identified the presence of organics, including undecane, dodecane, branched hydrocarbons, and pyridine derivatives. The analysis of the organics is of particular interest in that undecane and dodecane are 11- and 12- carbon hydrocarbons, respectively, and were also found in the analysis of the volatiles in the sample headspace of the emulsified anionic polymer performed by S&N Lab using gas chromatography-mass spectrometry (GC-MS). In addition, the branched hydrocarbons were consistent with the hydrocarbons found during the analysis of the anionic polymer. GC-MS analysis on the cationic polymer showed undetectable volatile organic compound (VOC) levels.

The results of the two different analyses led the investigation team to conclude that the primary source of VOCs on the catalyst in the exploded ODU #2 was the emulsified anionic polymer.

The investigation also revealed an unusual amount of flaky and scaly corrosion of the stainless steel inside the catalyst vessels and the associated heaters and piping in the units of all three ODUs. The composition of the corrosion scale was determined using Proton Induced X-ray Emission (PIXE). The results were consistent with stainless steel corrosion possibly accelerated by higher than expected levels of bromine. One possible source of bromine was identified as volatile brominated hydrocarbons formed as a byproduct of chlorination. The hydrocarbons are also typical of those found in disinfection byproducts. (Helix's imported raw water is chlorinated in an effort to control quagga mussels.)

In reviewing operational data, staff noted that the exploded ODU #2 had been in service for the entire operating time that the anionic polymer was being used (91 days). This lack of rotation was identified as a contributing factor in the explosion because it increased loading of hydrocarbons on the catalyst bed, which with proper rotation (from seven to 10 days) would have been spread over the three individual units, reducing the cumulative impact and allowing additional time for VOC dissipation.

Expert analysis concluded that approximately three to six pounds of VOCs would have been sufficient fuel to create enough pressure to break the 32 3/8-inch bolts that attached the ODU lid to the vessel. Prior to the explosion, roughly 18,000 pounds of emulsified anionic polymer had been added to the plant flocculation process. The Material Safety Data Sheet for the emulsified anionic polymer product used indicates a VOC content of 26.2 percent. The VOC comes from a petroleum distillate used to keep the polyacrylamide in solution. Assuming that the VOC content of the total chemical was 26.2 percent and multiplying 18,000 pounds of total chemical used by 0.262 equaled 4,716 pounds available to possibly strip out and accumulate in the catalyst. Only 0.0642 percent of these 4,716 pounds was needed to accumulate in the catalyst to meet the minimum three pounds of fuel required for the explosion. Another way of looking at this is a dose of 0.33 mg/L multiplied by 26.2 percent VOC equals less than 100 parts per billion (ppb) of VOC available to strip out and absorb in the catalyst bed as fuel for the explosion. This finding clearly demonstrates that even a relatively small amount of VOCs detected in an ODU is worthy of further investigation and monitoring by water treatment plants with ozone systems.

Exponent investigators described the events as follows: ". . . initially, oxygen reacted with the VOCs on the catalyst surface sufficiently to form hot spots within the catalyst bed. These hot spots exceeded the VOCs thermal decomposition temperatures, which initiated an exothermic runaway decomposition/combustion reaction of the VOCs, resulting in the generation of a sufficient overpressure to cause the catastrophic explosion of the ODU."

The approximately 210 liters of available space occupied predominantly by oxygen in the catalyst vessel was not enough to support the full explosion. It is therefore theorized by the investigative experts that the catalyst material, primarily made of manganese oxide, decomposed and contributed oxygen to the reaction. This theory is supported by the fact that the samples of the catalyst showed lower Oact/Mn (a unit of measurement used by the catalyst supplier) ratios between the catalyst samples in the ODU #2 and the intact units, indicating oxygen in the catalyst material was consumed during the reaction.

Actions and Modifications

Over the course of a year and at a cost of $300,000 in insurance and in-house capital funds, Helix took several immediate and long-term steps to bring the ozone system back online:

1. Eliminated the source of the identified VOCs in the short term by discontinuing use of emulsified anionic polymer and changing source water blends so anionic polymer was not required.
2. Replaced the catalyst in one of the existing ODUs so the ozone system could be put back into service.
3. Sought out new forms of anionic polymer that contained no VOCs. Dry polymer was activated prior to testing of the headspace above the anionic polymer and found to be VOC free (<1 ppb). The dry polymer was then performance tested in a pilot test of a dry polymer feed system.
4. Selected, procured, and installed a dry feed system that performed at or above the previous emulsified feed system.
5. Replaced ODU #2. The Helix staff coordinated with Ozonia on design and modifications for a new ODU to replace the damaged unit.

Long-Term Monitoring

Plant Operator Courtney Hernandez uses the TVA 1000B VOC analyzer to measure the VOC levels of the ozone destruct unit headspace.

Treatment Plant maintenance staff inspects the ozone destruct unit vessel after removing the catalyst.

DUE TO THE SEVERITY OF THE ODU EXPLOSION, the Helix treatment plant staff determined that it now had a responsibility to continually monitor for VOC levels of the catalyst in each of the ozone destruct units. A monitoring program began in November 2013 using a system developed by the plant operations staff. Goals of the monitoring program included:

1. Determine normal and abnormal levels (parts per million) of VOCs present in the ODU headspace.
2. Identify constituents from source waters or plant treatment processes that impact the VOC levels in the ODU headspace.
3. Evaluate the effectiveness of the engineered controls installed on the ODUs.
4. Most importantly, ensure that Helix staff is safe and feels confident that there will not be a reoccurrence of this kind of incident.

6. Prepared and administered contracts for repairs to the damaged facilities and installation of the new ODU.

Engineering Controls

In addition to the process and operational changes that were made, multiple engineering controls were added to all of the ozone destruct units. To counteract corrosion and reduce the oxygen content within the catalyst vessel, a dry air purge was also installed. It works as follows: after an ODU shutdown, a solenoid valve injects an eight-CFM flow for 60 minutes. The dry air feed point is as close as possible to the upstream isolation valve. The dry air purge comes from the nitrogen feed system and is typically at a -130 degree Fahrenheit dew point. Advantages of this modification include reduction of moisture from a relative humidity of 37 percent down to four percent, lowering of the explosion potential by reducing the oxygen level from 100 percent to approximately 19.5 percent, and purging residual hydrocarbons. Sampling points were installed upstream and downstream to allow monitoring for VOCs and relative humidity. In addition:

- Temperature transmitters were installed in the catalyst vessel so temperature status can be monitored. If temperatures rise above alarm set points, indicating possible catalyst fouling from hydrocarbons, a shutdown and purge are initiated.
- To help prevent an ODU from running for an extended period of time, a SCADA alarm was added to initiate ODU rotation every week. Movable status signs ("Lead," "Lag," and "Standby") were attached to the control cabinet so ODU rotation is easily monitored by the plant staff.
- Over-pressurization of the catalyst vessel was a significant contributor to the level of destruction the explosion caused. In response, a pressure relief and access was created by welding a four-inch stainless steel pipe access to the top of the catalyst vessel lid. A four-inch stainless steel cap slips over the pipe to provide a seal during normal operation. A positive pressure of less than two pounds per square inch forces the cap off. This cap is easily removed, allowing sampling of the media for analysis to ensure that the catalyst meets the manufacturer standards and an additional sampling port for the VOC monitoring.

After renting and testing various types of VOC monitoring equipment and then performing extensive testing, the district purchased the TVA 1000B from Thermo Scientific for its flexibility and consistency in testing, ease of use and dual monitoring capabilities. The unit produces readings in parts per million (ppm), using a photoionization detector (PID) or flame ionization detector (FID). PID measures organic compounds using an ultraviolet (UV) lamp of a specific energy and ionization. Benefits of the PID include the ability to operate in a low oxygen environment and a high sensitivity to aromatics, unsaturated hydrocarbons and chlorinated hydrocarbons. FID measures organic compounds utilizing a flame produced by the combustion of hydrogen and air and includes the ability to operate in high humidity environments as well as a high sensitivity to hydrocarbon vapors, including methane.

The investigation of the explosion established the operational limits for VOCs in the headspace of the ODUs. This is important because it gives the staff a tangible number to evaluate data against and allows plant operators and the maintenance staff to have confidence that the levels the destruct units are operating at are below the operational limit. These values were established using a highly reactive hydrocarbon, (n-tetradecane) found in advanced testing, as a reference point because it had the lowest flammability limit (LFL) of all of the chemicals reported in testing of the ODU and catalyst, which is one percent volume. The maximum concentration allowable for Permit Required Confined Spaces, which is 10 percent of the LFL, was applied. Using 10 percent of the one percent of volume resulted in a very conservative operational ceiling of 1,000 parts per million (ppm).

Helix related the maximum operational limit to the Thermo Scientific TVA-1000B. Specifically, the highest response factors for the PID and FID were used to calculate the operating thresholds of 161 ppm for PID and 424 ppm for FID. These are very conservative values used to ensure that the VOC levels in the headspace of the ODUs are well below a potentially dangerous level. Staff was then able to develop standard operating procedures using these operational thresholds.

It was determined that the best methodology to measure the VOC levels of the ODU headspace was to incorporate testing into the weekly rotations of the ozone destruct units, which allowed equal run times on each of the ODUs for comparison. During the initial six months of monitoring, staff engaged in a variety of testing on various plant processes. It was decided that the most valuable data came from sampling the headspace of all three of the destruct units because staff was able to produce repeatable results in the area of highest concern. Once procedures were finalized, detailed instructions were developed and training was provided to the plant operators and maintenance staff. The training of staff is critical to ensure that data gathering is consistent over time.

Once the data is collected, it is combined with water quality and plant process data upstream of the ozone system. It is important to capture anything that could potentially impact the VOC readings from the ODU headspace. The data is then centralized to track and compare the test data, allowing staff to correlate the VOC readings with plant operations and processes. What was found was that PID and FID levels are well below the operational threshold. Also, VOC levels were not compounding and continuing to rise.

Testing the nitrogen purge was performed and the data evaluated. Staff tested two of the ODUs with the purge feature activated immediately after they had been shut down, then again after they had been purged with air for 60 minutes. As a control, one of the other two ODUs was also tested immediately after shutdown and again after 60 minutes without being purged with nitrogen. For the ODU subjected to the nitrogen purge, the VOC levels of the catalyst vessel headspace were consistently lower than the ODU that was not purged. Monthly testing from 2013 to 2014 produced an average of a 92 percent reduction in VOCs as measured by the PID and a 57 percent VOC reduction as measured by FID.

The explosion of the ozone destruct unit at Helix Water District's R.M. Levy Water Treatment Plant was an unprecedented event for the district and the water treatment industry. The Helix staff, equipment manufacturers, and industry experts worked together to determine the factors that caused the explosion. A thorough evaluation of water quality parameters and treatment chemicals along with engineering controls, operator SOPs, and process monitoring can greatly reduce the risk of a similar instance from occurring at another treatment or process facility with an ozone system. The responsibility of the Helix staff now is to share this information with as many ozone water treatment facilities as possible to prevent similar instances from ever occurring again.

For more information on the incident, the investigation, and development of long-term monitoring strategies, contact Larry Lyford: *Larry.Lyford@HELIXWATER.org.*

EDUCATION + ENTERTAINMENT:

LVVWD Reboots Public Outreach

By Bruno Bowles

180 acres in the shadow of the Las Vegas Strip, the Springs Preserve provides a unique platform for the Las Vegas Valley Water District.

ON THE NATIONAL REGISTER OF HISTORIC Places since 1978, the property ceased to be a productive source of water when the artesian springs, which gave the city it's name ("the meadows"), stopped flowing to the surface in the early 1960s, the result of extensive groundwater pumping. For decades the site languished, its centralized location coveted for commercial development, until expansion plans for a nearby freeway inspired Las Vegas Valley Water District (LVVWD) to consider how this important piece of community history might be preserved and made accessible to residents and visitors.

How It Happened

In the early 1990s, the LVVWD Board of Directors approved an organizational structure to oversee development and management of the site, which LVVWD now manages under the direction of the Springs Preserve Board of Trustees. The board in turn tasked the not-for-profit Springs Preserve Foundation, a cross-section of business and community leaders, to raise funds for construction and educational programming. In collaboration with business owners, historians, naturalists, and local elected leaders, LVVWD developed a concept for the property and facilitated construction.

Completed in 2007 at a cost of $234 million, the Springs Preserve operates on an annual budget of approximately $7.5 million. A portion of the operating funds is from direct contributions from LVVWD with the rest from general admission and special event ticket sales, membership dues, facilities rentals, retail and food and beverage sales, fundraising, and educational programing.

During design and construction, care was taken to assure that development of the site caused as little disruption to the natural

The Springs Preserve protects Las Vegas' natural and human history, provides a community gathering place, and as an active well field with three reservoirs (combined capacity: 40 million gallons), is a vital link in Southern Nevada's water distribution system.

environment as possible. For example, the main parking structure is built on top of one of the water reservoirs and its canopy is equipped with more than 2,200 photovoltaic arrays that supply power for the complex and give visitors a sense of the Preserve's commitment to sustainability the moment they arrive. A biofiltration wetland recycles water for reuse onsite. The eight-acre Botanical Garden collection includes more than 1,200 species of native and desert-adapted plants, many grown from seeds collected in the Las Vegas Valley, with most of the garden's native cacti and Yucca species salvaged from local land being developed.

The garden also hosts a sub-collection of the University of Nevada, Las Vegas Herbarium. Visitors can interact with dozens of butterfly species in the seasonal Butterfly Habitat and discover the plants that sustain them.

The garden also serves as an outdoor classroom, where visitors can learn about water-efficient plants, trees, and shrubs for home landscapes. Providing inspiration and ideas on landscape conversion, the Botanical Garden dovetails with Southern Nevada Water Authority conservation programs, including its Water Smart Landscapes Rebate program, which offers cash rebates for turf replacement.

The Education Connection

In fiscal year 2015-2016, more than 29,000 students from 1,086 classes at 301 Clark County School District schools participated in field trips to the Preserve. Teachers familiarize themselves with a 10-part "Teach the Teacher" video, which covers logistics and what to expect when visiting the complex's museums, exhibits, and the Preserve's trail system and Botanical Garden and helps align their visit with their class curriculum. The Preserve also offers a Teacher Field Trip Checklist to help field trips run smoothly and enable students to get the most from their visit.

In addition to school programs, free classes and workshops for the public are held each weekend with topics changing monthly, from desert gardening, drip irrigation instruction, energy conservation and solar options to "green" gourmet cooking and sustainable and nature-oriented crafts.

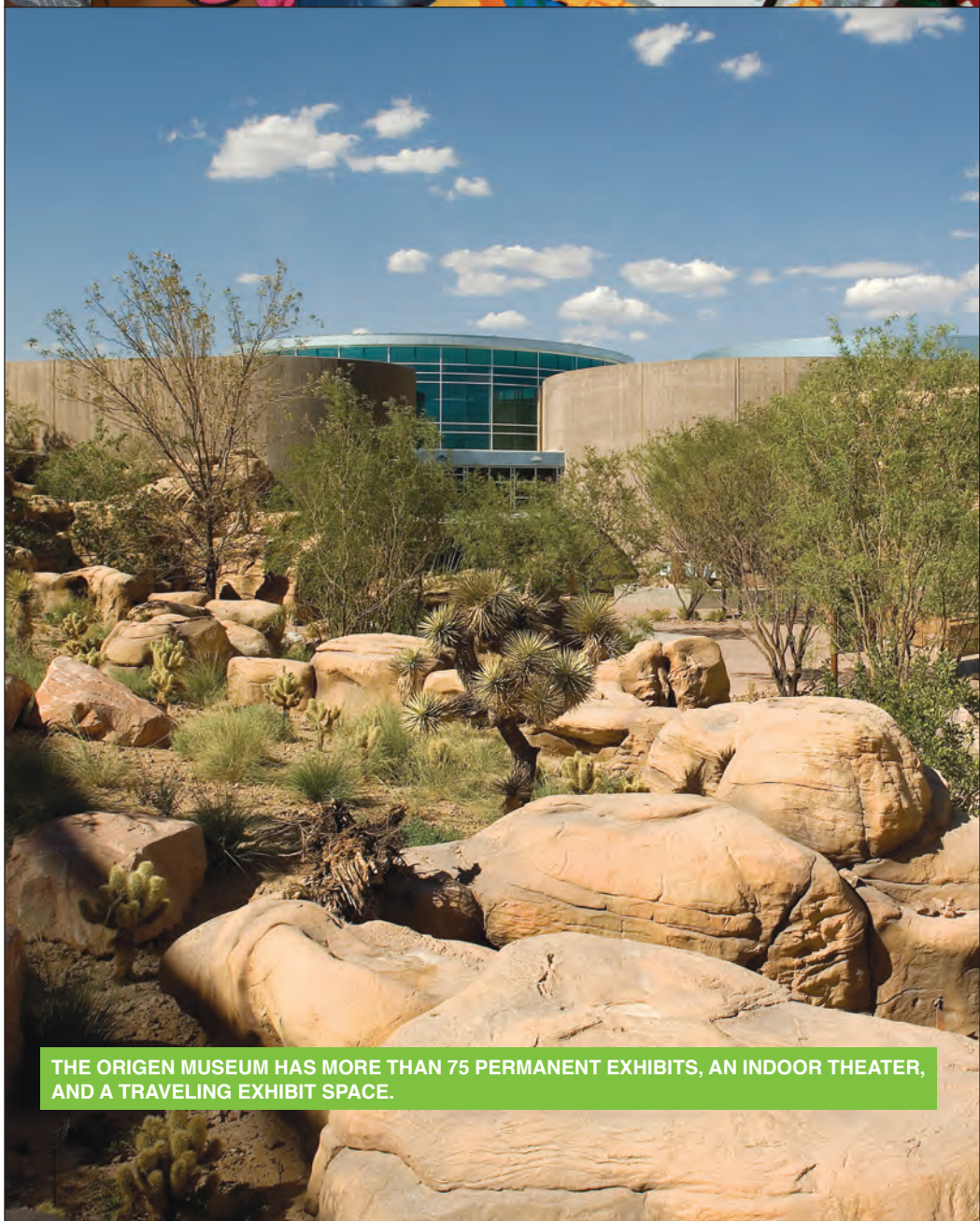
Getting Them Through the Gate

In addition to traditional outreach communication strategies such as bill stuffers and paid advertising, the Preserve leverages a robust presence on Twitter, Facebook, YouTube, Instagram, and Pinterest. Postings on Twitter and Facebook are dependent on programming and special events, while information is posted on Instagram from one to three times a week. The Preserve's YouTube videos promote events and exhibits, gardening and cooking tips, animal exhibits, and attractions, and a monthly e-newsletter reaches nearly 35,000 recipients of which some 13,000 are Springs Preserve members. Annual memberships are available for $25 for individuals and $60 for families, and currently there are 30,000 members. The Preserve's fundraising program includes annual donor packages ranging from $100 to $1,000, with benefits that include preferred parking at major events, free guests passes, and VIP invitations to exhibit and gallery openings. A tiered schedule includes separate admission prices for seniors, students, and active duty military. Discounted admission for Nevada residents gives locals a reason to keep coming back for special events (most with discounts for members) and touring exhibits.

Culture and History

The Preserve hosts more than 20 seasonal events and festivals annually celebrating the contributions of African Americans, Asians, Hawaiians and Pacific Islanders, and Hispanics to the regional culture. The Origen Museum (derived from "original" and "generations") is the historical focal point of the complex, with more than 75 permanent exhibits, an indoor theater, and a traveling exhibit space. *Dam, This is a Lot of Work*, provides a short documentary on Hoover Dam and a scaled recreation of the dam. The Big Spring Theater's Miracle in the Mojave, narrated by Martin Sheen, explores the natural history of the region and takes and in-depth look at the importance of water to its development.

THE PRESERVE FEATURES REGULAR PROGRAMS FOR FAMILIES AND KIDS AND OFFERS ANNUAL FAMILY MEMBERSHIPS. CURRENTLY THERE ARE 30,000 MEMBERS.



THE ORIGEN MUSEUM HAS MORE THAN 75 PERMANENT EXHIBITS, AN INDOOR THEATER, AND A TRAVELING EXHIBIT SPACE.

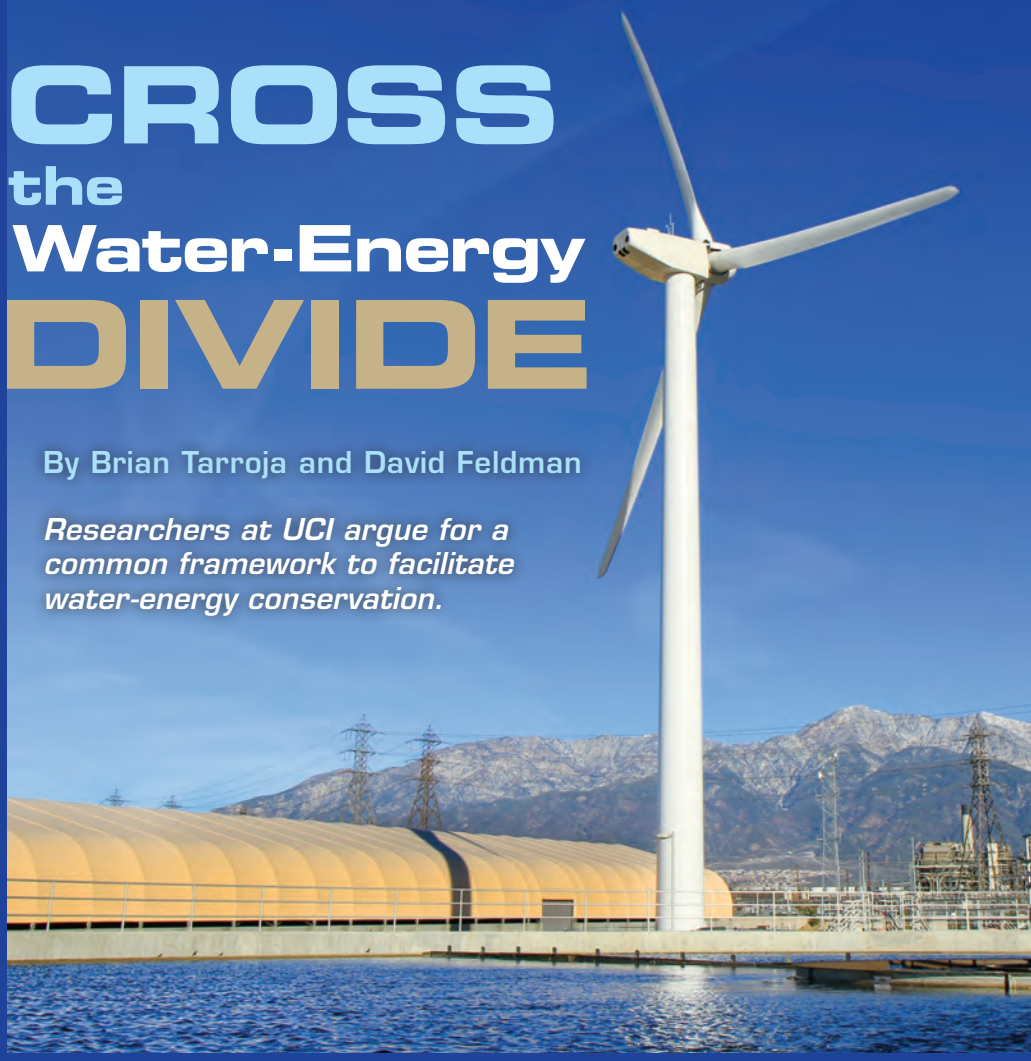
MORE THAN 29,000 STUDENTS FROM CLARK COUNTY SCHOOLS VISITED THE PRESERVE LAST YEAR. TEACHERS RECEIVE A "TEACH THE TEACHER" VIDEO ON LOGICS AND TIPS TO HELP ORIENT THEIR VISIT RUN SMOOTHLY.

SOLAR PANELS PROVIDE POWER TO THE COMPLEX AND GIVE VISITORS A SENSE OF THE PRESERVE'S COMMITMENT TO SUSTAINABILITY.

In the Desert Living Center, the NV Energy Foundation Sustainability Gallery provides visitors with tips on living an eco-friendly lifestyle, with interactive exhibits on recycling, composting, alternative energy, sustainable construction and water conservation and an entire house full of sustainable appliances, fixtures and décor. Boomtown 1905 is a historical streetscape with interactive exhibits housed in a recreated train depot, theater, mercantile and bank, and four original railroad cottages relocated from downtown Las Vegas and restored to original pre-1911 condition. Scheduled to open in fall 2017, *WaterWorks* features interactive exhibits that explore water resource use and management in Southern Nevada including water treatment and testing, distribution, drought and conservation, environmental initiatives and community supply projects.

For more information on the Springs Preserve and its role in public information and outreach, see *springspreserve.org*.

TIME to CROSS the Water-Energy DIVIDE



By Brian Tarroja and David Feldman

Researchers at UCI argue for a common framework to facilitate water-energy conservation.

PHOTOGRAPHS COURTESY OF INLAND EMPIRE UTILITIES AGENCY

TANGIBLE OBSTACLES need to be overcome to realize the potential benefits of integrated planning between the two sectors. For example, unlike the electricity sector, the water industry lacks the capability to "generate" water on demand and is wholly dependent upon the availability of its sources. And while new sources are being developed such as aquifer storage and recovery, groundwater recharge and indirect and direct potable reuse, these have to be instituted as the result of long-term plans and cannot be turned on or off instantaneously. Additionally, while statewide directives such as Gov. Jerry Brown's 2015 Executive Order B-29-15 may require utilities to lower overall consumption, currently water customers in California can't be legally compelled to adjust water use on demand.

Although many energy and water sector strategies that seek to achieve cost-effective risk reduction through investments of policy, management, and financial resources are relatively inexpensive, others will entail high capital costs. This is particularly true with climate change response alternatives. The water-energy nexus information base is growing, but modeling tools to evaluate long term interactions and feedbacks in the context of a changing climate require spatially explicit coupled modeling, which involves evaluating actions and activities in each sector in ways that can be translated between sectors in the same geographic region (e.g., how much energy is used to treat a certain volume of wastewater?) A 2015 joint U.S. Department of Energy and University of California Water-Energy Workshop at the University of California, Irvine identified specific elements needed to achieve cost-effective and mutually beneficial water-energy sector planning. These include:

- Robust understanding of integrated water-energy systems.
- Spatially and temporally compatible data from both the water and energy sectors.
- Standardized energy and water system operation data archives.
- Reduction of the logistical barriers to collaboration.
- Development of a business case for joint water-energy projects.

Understanding Integrated Water-Energy Systems: A Shared Systems Understanding

The overarching challenge identified in the 2016 report on the 2015 water-energy workshop was the need to understand how the impacts of technical or policy actions improve or degrade the performance of combined water-energy systems in meeting the goals of emissions reduction, climate protection resilience, and resource efficiency. Each of the aforementioned challenges need to be addressed to build understanding and inform the development of programs and projects that more effectively address the concerns of water and energy utilities and improve the performance of combined systems. One example of the tools and models that translate between electrical energy and water systems and improve decision-making is the California Public Utility Commission's water-energy cost-effectiveness calculator. The tool helps users estimate saved embedded energy from water savings and can assist regulators and utilities

quantifying the effectiveness of their efficiency programs. For example, a study by Navigant Inc. (*Water/Energy Cost-Effectiveness Analysis Final Report*) applied the water-energy cost effectiveness calculator to the 10 hydrologic regions of California to estimate the avoided cost of embedded investor-owned utility energy in water, avoided costs of water capacity, and the economic value of environmental benefits associated with reduced water use.

There is no doubt that our understanding of the interactions and feedback between the water and energy sectors will continually evolve as more visibility into the system is available through data and external forces. These external forces include, but are not limited to: 1) changes in the supply mix for water and electricity, where the sources of water and electricity supply are radically changed from historical mixes such as a transition to high utilization of renewable energy resources in the energy sector, or a transition to higher dependence on recycled water and desalination in the water sector; and 2) changes in operational paradigms such as transitioning from complete dependence on on-demand generation to include variable generation with energy storage or transitioning in the opposite direction in the water sector such as from complete dependence on variable supply and storage to include more on-demand sources such as desalination. Tools that link currently available databases such as California ISO's Open Access Same-time Information System (OASIS), which catalogues data on electric loads, generation, and economic bids in the electricity market for California utility regions in real time with emerging databases for common access could be developed. Such platforms can improve data accessibility, interoperability, quality and coverage, as well as inform the development of data standards. It is also important that these tools be kept current to reflect changes in systems and the scope at which they operate.

A shared systems understanding manifested by tangible tools tied together by solutions regarding visibility, data collection, identification of low-risk projects, and measurement and verification is key to the longevity of co-beneficial water-energy systems. What is needed

IEUA Takes the Lead in Energy Storage

By Jesse Pompa

The Inland Empire Utilities Agency is the first water agency in the country to incorporate battery storage in its energy portfolio, a move that reinforces its long-standing commitment to decrease dependence on the grid.

IN 2015, THE INLAND EMPIRE UTILITIES AGENCY (IEUA) partnered with Advanced Microgrid Solutions (AMS) with the goal of installing 4.0 MW (8.0 megawatt-hours) of state-of-the-art battery storage. Communicating with IEUA's existing renewable resources and utilizing sophisticated analytics, the batteries and associated software form a smart energy management system that integrates IEUA's six power generation sources, reduces energy costs, and provides control and visibility at levels that were previously unattainable.

The 4.0 MW of advanced energy storage to be installed at IEUA will be placed at six regional water recycling facilities and pump stations across its service area and save the agency five to 10 percent of its energy costs each year. The storage system will also help integrate IEUA's renewable resources, which include 3.5 MW of solar, 1 MW of wind and 2.8 MW of biofuel cell generation.

IEUA has long been committed to clean energy and environmental stewardship. Beginning with the construction of its headquarters buildings in 2003, IEUA became the first public building in the nation to be awarded a LEED platinum rating. In 2010, the agency installed the largest fuel cell system powered by renewable biogas in the world and reduced energy consumption by nearly 25 percent with aggressive energy efficiency measures including installation of submetering equipment. →

is a conceptual framework that describes and defines the relationship among the various elements that need to be addressed to establish co-beneficial water-energy systems on a utility and system basis. An example would be enhancing the cross connection between conservation certification and model scenarios. Currently, there are separate conservation certification programs in certain parts of the water and energy sectors. USEPA's Energy Star and WaterSense are two governmental examples, while the U.S Green Building Program's Leadership in Energy and Environmental Design (LEED) is an example of a private-sector developed effort. Neither set of systems fully embraces the complex interactions between energy and water systems. In order to better accommodate energy and water savings based on actual experiences, rather than merely benchmarked aspirations, data from actual experiences are needed. Such data can be provided by precision monitoring devices as well as by reports comparing forecasted demand with actual energy and water uses during peak demand periods. In effect, model scenarios and certification are connected in ways more useful to water-energy systems.

Compatible Data

The first step in determining the effects and potential benefits of joint water-energy projects is an understanding of the structure of the two respective sectors and their operational needs and constraints. Current disparities in the types of data collected by energy and water utilities, together with the fact that the markets for energy and water services tend to operate over geographic areas of varying size and time scales wherein demand and supply measurements vary greatly (e.g., kilowatt-hours versus gallons per day), make it difficult to explore how changes to one sector might affect the operations of the other.

At a minimum, energy sector data is collected hourly and is resolved spatially by substation within a utility's territory. This is based on the requirement that energy systems (particularly electricity), and the individual utilities that operate within these systems, must be managed on time scales that allow electric loads to be balanced and transmission and distribution infrastructure to remain stable. The challenge is further complicated by the introduction of such developments as distributed generation and microgrids (for resiliency and increased renewable resource uptake), which add to the diversity and resolution of data the energy sector collects.

In contrast, water sector data is collected on much longer time scales and over more aggregated spatial areas. To achieve a detailed understanding of how a change in water sector operations affects the energy sector, it is critical that water sector data collection provide transparency on temporal and spatial scales that are more compatible with (but not necessarily exactly the same as) data in the energy sector. The increased use of data collection devices such as advanced metering infrastructure (AMI) allows certain types of water data to be collected with the increased spatial resolution (such as individual water main flows) and increased temporal resolution typical of the energy sector. But the water sector will have to do more.

Standardized/Accessible Energy/Water Data Archive

In both the energy and water sectors, data on system operations is spread among disparate databases. In order for various stakeholders to evaluate the potential co-benefits of projects or regulations in an integrated water-energy system, data on system operations must be accessible to utilities, government agencies, researchers, and any relevant stakeholders seeking to be involved in these projects. Preferably, such an archive would be housed in a neutral third-party site such as a regional research university or other neutral entity. The compelling motive for utilities to contribute data and apply standards to this system is the legitimacy that would be accorded a third-party repository that is able to facilitate the diffusion of innovation on the one hand, with the ability to protect proprietary information on the other.

In accomplishing this, the two primary concerns of data privacy and data security must be addressed. Developing an accepted methodology for anonymizing data, and a secure architecture and central repository for anonymized datasets typified by the U.S. Department of Energy Buildings Performance Database would enable utilities, companies, researchers, and the public to leverage large data sets. Agreement will also be needed as to the types of data that are publicly released versus available by request.

In addition to accessibility, standardization of data types and their resolution will need to be implemented. Existing data in different databases contain different data types that may be measured differently and are not synchronized in terms of temporal resolution and data formatting. For example, electric system operational data (i.e., generation, load, transmission/distribution system power flows) are measured and stored at hourly timescales or shorter, whereas water system operational data (i.e., water supply, water demand, reservoir flows) are measured and stored at daily timescales or longer. As another example, certain utilities may collect detailed information on their system due to an extensive sensor network, enabling collection of data such as real-time power quality measurements in the electricity system or nodal pressure and flow measurements in the water system, while other utilities may not have the sensor capability to do so and therefore only store basic operational data. To address this, standards must be developed to specify the types of data to be collected for energy and water systems, the desired resolution, measurement method, and clear conversions between methods. This will help to expedite understanding of the data and develop a shared system-based understanding of integrated water-energy systems among various stakeholders.

Reducing Logistical Barriers to Collaboration

Because management of energy and water resources has typically been accomplished in separate institutional and regulatory environments, we lack a strong common history of institutional collaboration and working relationships between water and energy utilities operating in overlapping regions. Given that both sectors typically do not have departments or staff dedicated to understanding and facilitating water-energy collaboration, utility specific departments and contacts for collaborative projects are often unknown or nonexistent. Developing constructive inter-facility working relationship can be

facilitated through identifying co-beneficial low-risk and small-scale projects that demonstrate the benefits of collaboration and minimize potential risks that might seem associated with engagement. For example, Pacific Gas and Electric (PG&E) and a number of San Francisco Bay Area water utilities have collaborated on developing a high-efficiency clothes washer rebate program to bring together a number of preexisting, but only loosely coordinated efforts to enhance demand-side energy and water savings efforts. This is a relatively inexpensive and low-risk project.

Moreover, water and energy utilities typically lack a common understanding of each other's terminology as applied to their operational environments. Reliability may refer to different practical concepts in water and energy. For example, reliability in the context of water supply refers to storing sufficient quantities of water in reservoirs to weather potential dry seasons, whereas in the context of an electric utility it refers to having sufficient reserve generation capacity to survive a contingency event in the system or compensate for short- and long-term errors in demand and generation forecasting. This lack of an easily accessible and sharable knowledge base limits the ability to identify potential collaboration and assess potential co-benefits, which may in turn cause hesitation to engage in joint projects. A centralized, accessible information base that maps the organizational structure of water and energy utilities, the terminology of each sector, funding opportunities, and ongoing collaborations is needed.

Certification programs for energy and water-related product performance have been sound motivators for developing energy- and water-efficient products. However, current certification programs such as WaterSense and LEED (Leadership in Energy and Environmental Design) are not equally weighted between water and energy, have historically not included a verification component, and do not yet take into account systematic effects. Expanding these certification programs or developing new programs to take into account performance benefits in operation (in addition to projected performance at commissioning) and the indirect benefits of implementing an energy product/process on water or vice versa could play important roles in benchmarking

Background

IEUA covers 242 square miles, distributes imported water, and provides industrial/municipal wastewater collection and treatment services and other related utility services to more than 875,000 people through its nine member agencies. Responding to the fluctuating price of energy as well as more stringent air quality regulations, it has committed to energy independence from the grid during the peak energy use/pricing period of noon to 6:00 PM by 2020 or sooner. In 2008, it embarked on an ambitious campaign to ease grid demand through on-site renewable energy sources, utilizing onsite resources such as wastewater treatment infrastructure and nondeveloped land, to bring online sustainable self-generation technologies priced at a rate comparable to grid import costs.

This diverse renewable portfolio currently produces enough power to fulfill 50 percent of IEUA's peak electricity needs and was the product of public-private partnerships whereby third party energy developers designed and constructed power generating facilities at IEUA's water and wastewater treatment plants. IEUA purchases the power at a fixed rate according to an agreed-upon term ranging from 10 to 20 years. This structure has allowed IEUA to incorporate a diverse array of technologies into its facilities while minimizing capital expenditures, reducing its reliance on the grid, and stabilizing energy costs.

The Challenge

Although the multiple power generating systems have produced reliable, sustainable power since their inception, each system operates as a standalone. Because there is no communication between the individual systems, IEUA lacked the ability to control the distribution of power that the facilities generate. At times, renewable power generation has exceeded facility demand, with the unused energy exported to the grid. The energy storage system makes it possible to integrate multiple renewable power systems, control power distribution, and optimize the cost-effectiveness of power procurement. Stored power can be called on to meet demands of utility systems, shifting with peak power use.

For example, the impact of solar generated energy on grid consumption shifted the peak energy demand to early evening, when solar systems typically don't generate power. For large energy users with on-site solar generation such as IEUA, the battery storage system ensures that sustainable energy practices will continue to achieve savings, regardless of how peak pricing is structured. In addition to grid relief during normal operation, batteries are valuable to both parties during demand response events. Historically, when the energy utility would call upon large energy consumers to curb power usage due to demand on the grid, IEUA would shut off energy-intensive processes such as pumping or aeration. The battery storage system decreases the need to alter treatment processes while making it possible for grid managers to shift power IEUA would typically draw on to other customers.

What It Is and How It Works

The system is equipped with a learning algorithm that predicts individual facility power needs based on historical consumption data. Using this predictive tool, the storage system can determine optimum schedules for charging and discharging the batteries. Complex electrical utility tariff engines are incorporated to assess and optimize the cost savings achieved through battery operation.

In June 2016, IEUA's Regional Water Recycling Plant Number 5 (RP-5) was the first of the six IEUA facilities to complete construction of a battery storage system. A total of 1 megahertz (MWh) of Tesla batteries was successfully integrated into the facility's electrical profile, which includes a 1 MW solar plant and a 1.5 MW cogeneration engine fueled by anaerobically digested food waste. The facility also imports electricity to meet incremental power needs beyond the site's renewable generation capacity.

As with IEUA's previous power purchase agreements, the Agency's 10-year agreement with AMS was designed to minimize capital outlay, a critical component of the agency's operating philosophy of minimizing capital investment coupled →

and evaluating performance standards to better identify effective co-beneficial approaches.

Making the Case for Joint Water-Energy Projects

The economic cost structure and revenue sources for water and energy utilities vary widely. For energy utilities, revenue is based on the volume of energy sold and costs on a large variable component based on the volume of energy purchased from providers and a smaller fixed component encompassing infrastructure maintenance and updates. Efforts such as energy conservation decrease revenue but also decrease costs for an energy utility and are easier to justify financially. In contrast, water utility revenue can be fixed or based on the volume of water sold on an increasing or decreasing block basis. Because infrastructure maintenance and other service costs are largely fixed, and the variable component that scales with volume is smaller, conservation can decrease revenue while costs remain constant, which has led to decoupling sales from revenue to allow efficiency improvements while minimizing decreases in revenue.

Such sector differences need to be taken into account in the design of joint water-energy projects. An example of an effort to accommodate these sector differences, and to make possible sector collaboration, is afforded by the recent PG&E efforts to both evaluate and implement the formerly discussed water-energy cost calculator. Specifically, PG&E is evaluating how to precisely tailor this tool to individual zip codes in its operating area in an effort to calibrate the embedded energy for water supply within various hydrologic regions. Finding that these regions and the water agencies within them are not well-aligned with its own service area, PG&E is working with the California Public Utilities Commission to refine time-of-use and daily demand profiles in ways that are more useful to consumers, water providers, and its own operations. Alternatively, changes in business models in both sectors may need to be developed to establish a financial rationale for co-beneficial projects.

This lack of shared systems understanding and operational data can lead to uncertainty regarding benefits from joint water-energy programs. For example, while implementing a water conservation program may save water for a given water utility, the corresponding energy savings from reduced conveyance loads may occur to an energy utility whose territory does not overlap. Additionally, the scale of the monetary benefits may differ between energy and water savings. This type of uncertainty can hinder collaboration because of questions about distributing costs and benefits between the collaborating util-

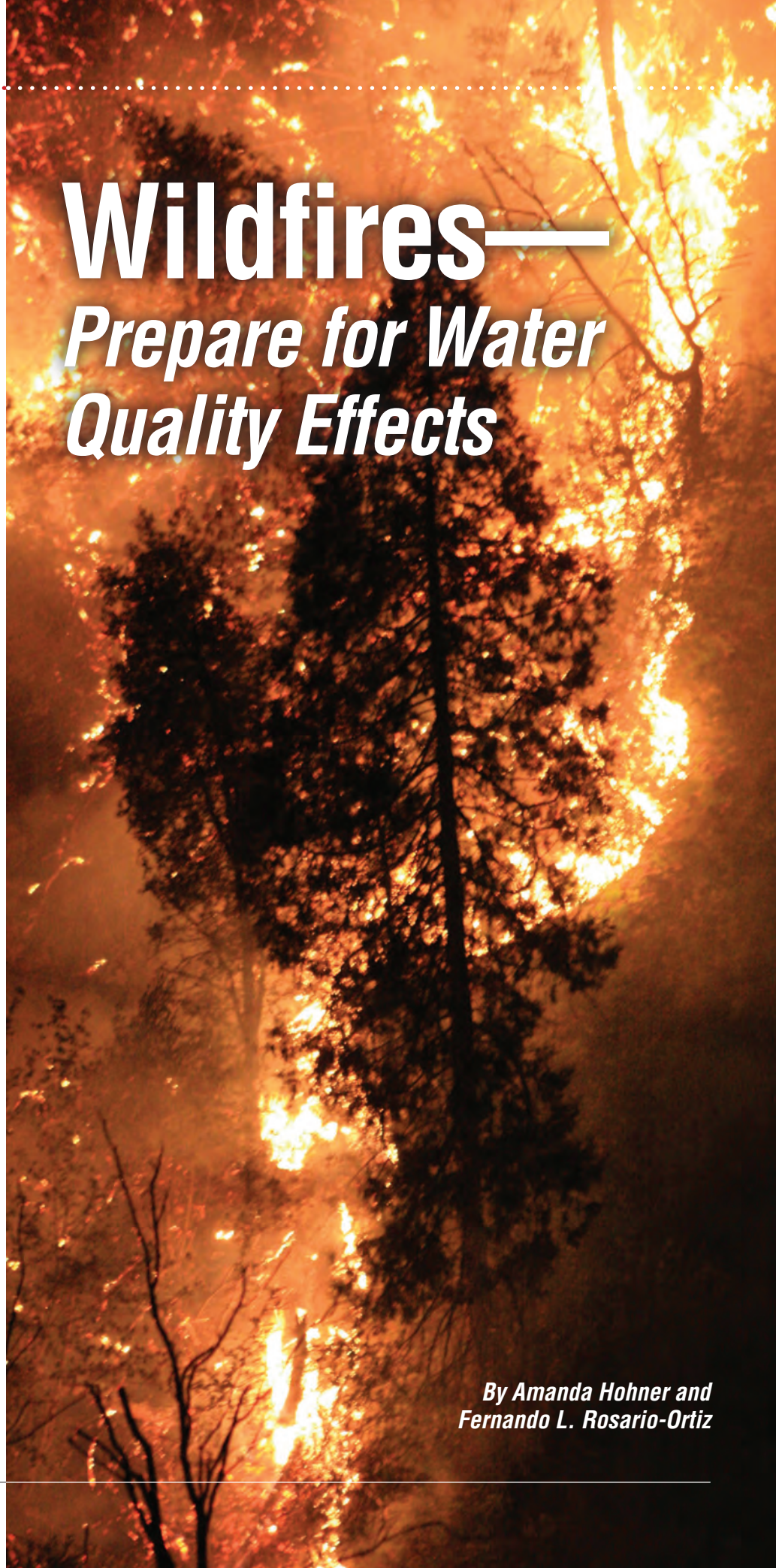
ities. To overcome this, water and energy utilities and other mediating stakeholders need to develop a common agreed-upon framework for how costs and benefits are allocated for given types of co-beneficial projects. This framework needs to be designed in a way that is equitable and also appropriate given differences in water and energy utility business models.

For more information, see: Brian Tarroja, Sandra Jenkins, Michael A. Berger, and Lifang Chiang. Capturing the Benefits of Integrated Resource Management for Water & Electricity Utilities and their Partners, United States Department of Energy and the University of California Irvine, May 2016, *https://energy.gov/epsa/downloads/capturing-benefits-integrated-resource-management-water-electricity-utilities-and*. For information on Water UCI's collaboration across schools, departments, and research centers see *water.uci.edu/*.

with ongoing reduced operational costs. The only costs during design and construction of the battery storage systems were associated with staff review and inspection. AMS covers the cost of installing, operating, and maintaining the storage systems. IEUA's fixed and performance-based costs are paid for as a portion of the energy savings. The fixed fees, approximately 50 percent of the expected savings, serve to recover installation costs and account for ongoing operating and maintenance costs. The remaining savings achieved by the system are split between IEUA and AMS, with IEUA receiving approximately 33 percent of the expected cost savings. The agreement also includes a minimum savings guarantee, which ensures that the project will always be a net benefit to the agency. IEUA expects to save between $55,000 and $230,000 annually from the project when the full 4 MW of battery storage is complete.

Since operation began, the RP-5 battery storage project has met or exceeded design expectations. Cost savings are in line with predictive models, and the battery has enhanced the site's sustainability by storing renewable power that would have otherwise been exported to the grid. In April 2017, the RP-5 battery storage project received a national award for Excellence in Environmental Engineering and Science from the American Academy of Environmental Engineers and Scientists in three separate categories: environmental sustainability, operations and management, and planning. The project further enables IEUA to protect its customers while addressing the link between water and the energy needed for processing and transport.

Wildfires—Prepare for Water Quality Effects



Climate change effects are increasing the frequency, intensity, duration and expanse of wildfires. Water utilities will do well to prepare for post-fire effects on water quality and treatment process performance.

THE THREAT OF WILDfires to water supplies has received increased attention as wildfire frequency, duration, and intensity continue to rise. In the western U.S., the forested watersheds that serve as sources of high quality water are susceptible to wildfire. Post-fire changes in water quality, specifically following rainstorm or runoff events, may impact treatment efficacy and potable water production. In many cases, such events may force treatment plants to shut down, reduce flow, deliver water of inferior quality, or fail to meet Safe Drinking Water Act regulations.

Operational Effects

While post-fire watershed responses vary, an anticipated increase in sediments during flow events will likely lead to an increase in chemical costs and sludge production as a result of treatment required to meet turbidity requirements and disinfection byproducts (DBP) maximum contaminant levels (MCLs). When preparing for treatment after a wildfire, water managers should prioritize turbidity and total organic carbon (TOC) concerns for their specific watershed and treatment system capacity to ensure regulatory compliance and delivery of drinking water to consumers. Wildfire hazard should be considered in water quantity management, and utilities would likely benefit from diversifying water sources and increasing water storage and treatment capacity.

A Case In Point

In 2012, the High Park Fire burned the Cache la Poudre watershed, which serves as a drinking water source for three northern Colorado communities, including the City of

By Amanda Hohner and Fernando L. Rosario-Ortiz

Fort Collins. At the University of Colorado, Boulder, we conducted multiple studies to characterize post-fire effects on water quality. In 2012, following the first four rainstorm events, the turbidity of the water reached >4200 Nephelometric Turbidity Units (NTU). During the subsequent year and a half, the source water turbidity, nitrogen, phosphorus, and TOC measured at the drinking water intake were of significantly higher concentrations compared with pre-wildfire water quality. These results were further supported by comparisons to an unburned reference site located upstream of the burned area.

The fire-affected water intake showed on average 0.7 parts per million (ppm) higher TOC than the reference site, 30 NTU higher average turbidity, and elevated nutrient concentrations (higher than 0.4 ppm). In addition, work published by our group and others suggests that the DBP formation of the natural organic matter (NOM) mobilized after a wildfire will likely increase due to elevated TOC (TOC being the analytical measurement of NOM concentrations.) The results also indicated enhanced formation of the nitrogen-based DBPs, haloacetonitriles (HANs). Although HANs are not currently regulated, these species are of significant concern due to their enhanced toxicity compared with regulated DBPs.

Quantifying the Effects

After the fire, the City of Fort Collins was able to switch exclusively to an alternate water source that was not affected by the wildfire. This change in water sources, which was in effect for more than 100 days, allowed the utility to avoid the most significant effects of the post-fire runoff. Unfortunately, depending on the wildfire and water source, many utilities may not have this option, and those directly dependent on watersheds should be prepared for the post-fire treatment response. To address the nature of potential challenges, we conducted bench-scale conventional treatment tests with the post-fire samples collected from the Cache la Poudre watershed. Generally, these samples were amenable to alum coagulation but required on average 10 milligrams per liter (mg/L) higher coagulant doses than the reference site to achieve similar TOC removal. Figure 1 presents a typical dose-response curve for the impacted and control sites, showing the effects of the wildfire on the impacted site treatability. Following rainstorms in the burn area, the effects of the wildfire were more pronounced and even higher alum doses were applied (e.g., >80 mg/L), with only marginal TOC removal in several instances. The treatment challenges are likely explained by the elevated raw water TOC and turbidity, which created increased alum demand. It should be noted, however, that some utilities may not have the ability to add more coagulant or may be limited by solids handling capacity.

To further evaluate impacts to treatment process performance, the water quality of post-fire runoff was simulated in the laboratory. We collected dark, charred wildfire-affected sediments from the burn area and leached them in baseline river water to mimic post-fire mobilization of the sediments to the river and water intake. The treatability of the samples was evaluated with conventional coagulation and additional unit processes, including powdered activated carbon (PAC), pre-oxidation, and biological filtration. Samples were analyzed for DBP formation before and after treatment. Results showed that to achieve desired finished water turbidity, higher coagulant doses would likely need to be applied, specifically if there is not a pre-sedimentation system in place. Similarly, sediment materials may leach organic matter, creating challenges for meeting DBP MCLs, unless operations are adjusted or additional unit processes, such as pre-ozonation, are added. Mobilization of sediments to source waters could lead to elevated nitrogen-based DBP precursors, which are generally not well removed by conventional coagulation. However, results from our study indicate additional treatment, such as pre-ozonation/coagulation/biofiltration, can effectively reduce HAN and chloropicrin formation. To complement our previous work, we took a laboratory-based approach to addressing the effects of forest floor heating during wildfires on water quality. We heated surface soil and litter samples from three watersheds in a furnace at 225° C and leached the materials to evaluate potential wildfire changes to water-soluble compounds. Heated and unheated (control) leachates were compared for treatability by conventional alum coagulation. The heated leachates consistently exhibited an overall poor response to coagulation, even at high coagulant doses (> 80 mgL). The adverse effect of heating on the treatability of the leachates might be explained by a lower molecular weight organic matter composition. Following treatment, all heated leachates exceeded DBP MCLs, whereas all control samples were below MCLs. Treated water nitrogenous DBP formation was also higher for the heated leachates, specifically chloropicrin. While our findings suggest an altered organic matter character, utilities may also experience an increase in influent TOC concentrations coupled with higher, or even extreme, sediment loads, resulting in compounding effects on water treatment.

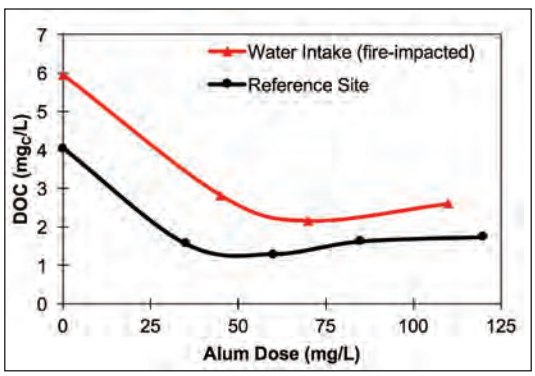


Figure 1. *Dose-response curve showing the response of both a control and fire impacted site.*

Potential Precautions

In preparing to address wildfire effects on water sources, water utilities should consider additional treatment processes, pre-sedimentation infrastructure, expanding storage and/or alternate water supplies. Efforts should also be undertaken to protect conveyance and treatment infrastructure by diverting or bypassing post-fire runoff or extending pre-sedimentation times. Expanding upstream monitoring to include early detection systems for rainstorms will better prepare utilities for shutting down pipelines or adjusting treatment operations. Extreme spikes in turbidity following rainstorms or runoff events, as well as sustained elevated turbidity loads during baseflow conditions, will strain filter run times and solids handling processes. Utilities may benefit from expanding turbidity design capacity in order to meet Surface Water Treatment Rule requirements and avoid shutting down operations.

For more information: the authors are currently working on a report for the Water Research Foundation, which funded Project #4590. In the meantime, readers can contact them directly for copies of published work on the subject: Fernando.rosario@colorado.edu>

Flying Pipes

Helicopter Delivery Saves Time and $$$

By Kenneth Markison

Faced with transporting two miles of replacement pipe around hairpin turns, a hard start date, and engaged homeowners, East Bay Municipal Utility District hired a helicopter.

THE EAST BAY MUNICIPAL UTILITY DISTRICT (EBMUD) serves high-quality drinking water to 1.4 million customers in California's Alameda and Contra Costa counties. The district maintains 4,200 miles of distribution pipelines in a seismically active, geographically complex service area. Nine crews replace 10-15 miles of pipe annually, However, the rate of replacement doesn't keep pace with nearly 700 water main breaks a year, and the district is currently aiming for an annual 40 miles of pipe replacement. The variety of soil types, sometimes steep foothill topography, and socioeconomic demographics in parts of the service area can pose additional challenges, in particular transporting pipe to work zones.

The Project

A two-mile section of pipe in the Berkeley-Oakland hills was identified for replacement because of the condition of the existing cast iron pipe, which was installed in the 1920s, the need for increased reliability, ease of maintenance, and fire flow. Due to the close proximity to the Hayward earthquake fault, 8- and 12-inch HDPE high-density polyethylene (HDPE) pipe was selected, primarily in 40-foot lengths, with some welded steel. The neighborhood is comprised of single-family homes served by narrow roads (14 feet wide) with hairpin turns. The area falls within the cities of Berkeley and Oakland and is near the campus of the University of California at Berkeley.

Prior to initiation of the project, EBMUD engaged in considerable public outreach to inform residents of what they could expect. Start and completion dates were agreed upon. Yet to be determined was the method of transporting the replacement pipe to the work site.

Options

Developing a new road, suggested by the city of Berkeley, with the support of local firefighting agencies, was quickly eliminated based on the delay and cost it would add to the project, in particular the cost of developing an environmental impact report. The field crew also considered pipe dollies, also known as pole dollies and used by electric utilities for transporting telephone poles. But these were difficult to locate and rent and were determined to be nonfunctional in this situation.

With the obvious strategies unworkable, the project supervisor ordered crews to begin cutting the replacement pipe into 20-foot segments that would

fit on 20-foot flatbed delivery trucks able to handle the road for transport to the worksite where the segments would be re-fused (as opposed to the 40-foot trailers that would typically be used). Liabilities of this approach included the expense of added labor and materials, the added time to cut and re-fuse the pipe, and the potential that the additional fused joints would compromise system integrity.

The Light Bulb Moment

As crews began cutting pipe to meet the project timeline, a third option presented itself—could a helicopter do the job? Lifting pipe from the staging area to the work zone in 20 minutes rather than delivering it over a period of weeks would allow EBMUD to reduce truck trips and labor hours as well as 30 workdays in neighborhood streets and save district ratepayers an estimated $250,000.

The idea was subjected to critical questions and myriad details needed to be considered and addressed. These included vendor procurement, FAA regulations, environmental compliance, issues of workplace health and safety, liability and risk- management issues, and public outreach challenges, including additional disturbance to a neighborhood that had already been primed to expect a certain kind of activity and designated start and completion dates.

The scope and extent of the helicopter lift was defined and presented to EBMUD internal stakeholders including operations management, the legal department, human resources, and public affairs, triggering a series of meetings and discussions as the clock ticked. Detailing the risk-to-benefit ratio was critical to achieving management approval but proved difficult as department heads posed questions and objections that needed to be addressed and resolved. FAA permit restrictions added additional challenges. For example, residents of two homes would have to vacate during the lift because of their exposure to rotor wash winds. The pipe drop-off site and an emergency landing site had to be located and designated. It was determined that the UC Berkeley soccer field was logical for emergency landings. This triggered repeated negotiations with university officials and eventually required shutdown of soccer practice. Arrangements also had to be made to control the work zone perimeter during flight operations. The EBMUD Public Affairs team provided support throughout by working closely with neighbors and briefing local city mayors, council members, and police and fire departments on the benefits of helicopter transport.

It's a Go

Once the internal approvals were secured, the date confirmed, and the vendor and the FAA permit approved, the countdown began. Now every last detail had to be checked and rechecked. Bundling the pipe to the proper weight load was critical. Balance and lifting slings had to be in place and ready to go. Tag rope lines were in-

stalled and taped to the pipe and readied for flight. The field superintendent held a final meeting with residents adjacent to the landing site to confirm that vacating during the lift was mandatory. To protect the pipe and avoid it sliding on the paved landing zone, used tires were placed as targets for landing. Traffic controls were put in place and *no parking* signs were posted. Ten trainees from the EBMUD Pipeline Training Academy handed out informational fliers and policed the flight path perimeter. Given the amount of public and media interest, members of EBMUD's Public Affairs team and security staff were detailed to the site and a press release issued. Last-minute contract details required review and signatures.

Employees at the staging area were divided into groups. A contact supervisor was assigned to each group, and safety was reviewed for each designated area. The helicopter arrived, the pilot held his mandatory FAA safety briefing, the sign-in sheet was completed, everyone took their places, and the lift began.

Success

In approximately four hours, at a cost of $18,275, the first helicopter lift (9/21/16) successfully transported 2,440 feet of 8- and 12-foot diameter HDPE pipe, all of which arrived in tact. The first lift involved 14 eight-minute round-trips and the helicopter landed four times to refuel, taking another 30 to 45 minutes. The pilot exercised a great deal of caution, taking his time feeling the wind and terrain. The second lift (4/27/17) involved 22 round-trips and delivered 4,400 feet of pipe. The second lift took much less time, in part because the pilot knew the flight path, terrain, and scope of work.

Cost comparisons between the two methods of pipe transport were based on un-bundling the new pipe in the yard, cutting the new pipe in half, rebundling, then transporting the pipe to the field site (which would have taken twice as much time using the smaller trucks required by the terrain), and the labor hours to weld and fuse the added joints.

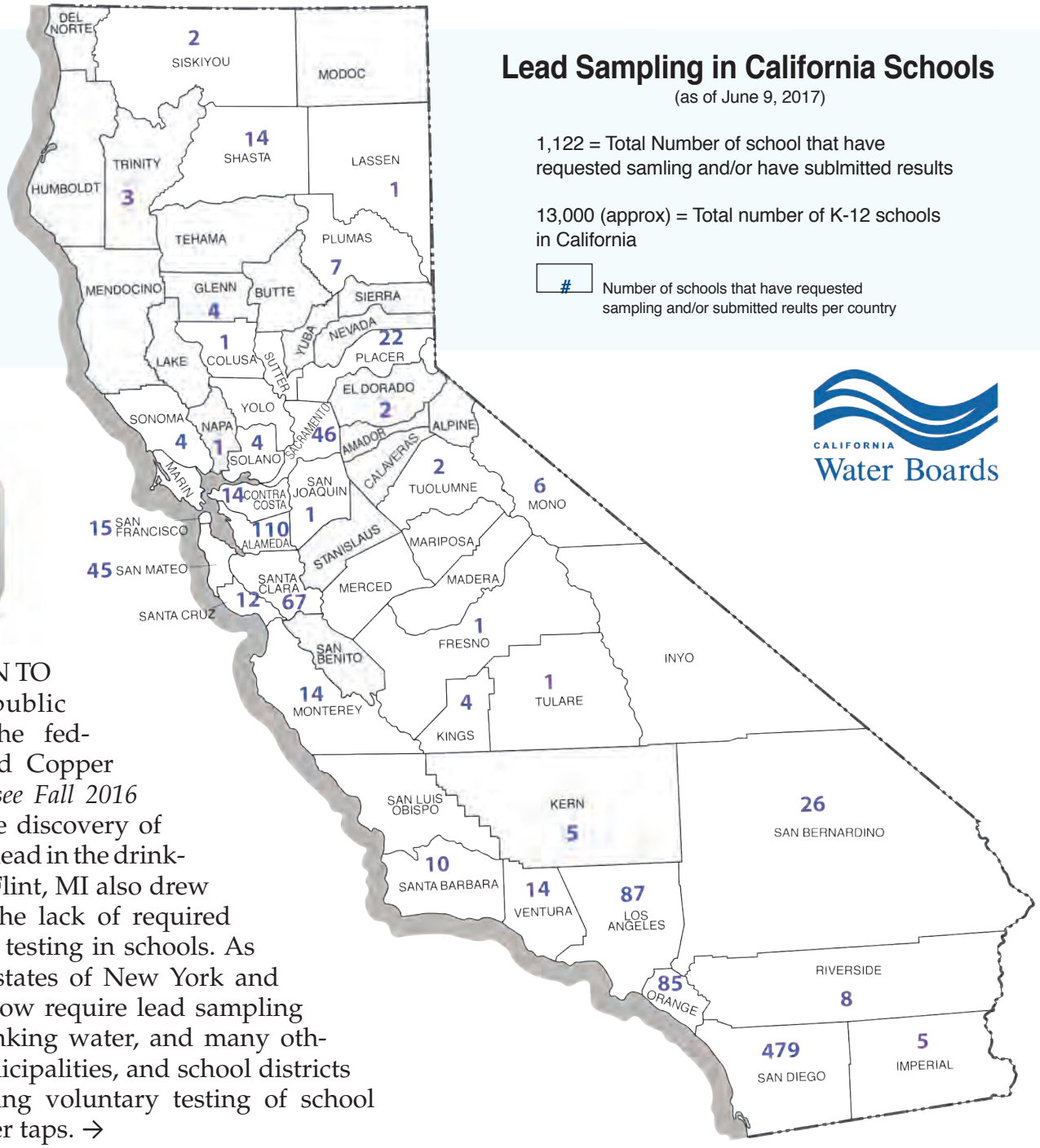
The expense for helicopter transport of 6,840 feet of pipe totaled $36,550, saving 60 workdays and labor that would have cost the district nearly $700,000. Despite initial management reservations, everyone agreed that saving the work days and thousands of dollars in actual costs more than compensated for the cost of renting the helicopter. Additionally, the lift generated positive media coverage and unprecedented social media engagement, drawing attention to the district's readiness to adopt innovative approaches for timely and cost-effective pipeline replacement.

Helicopter transport has become a new tool in the EBMUD toolbox. The district is now considering using helicopters for a variety of tasks such as transmission main surveillance, dam inspection, and delivery of pipe and materials to remote or difficult areas.

Measuring Lead in Schools—What's Required and What's Not

By Susan Brownstein

California's new requirement for lead sampling of drinking water in schools requires new roles and responsibilities for community water systems as well as a good-faith effort on the part of the drinking water community to implement an important first step in evaluating if and to what extent lead contamination is present in schoolchildren's drinking water.



IN ADDITION TO increased public interest in the federal Lead and Copper Rule (LCR) *(see Fall 2016 SOURCE)*, the discovery of high levels of lead in the drinking water in Flint, MI also drew attention to the lack of required water quality testing in schools. As a result, the states of New York and New Jersey now require lead sampling of school drinking water, and many other states, municipalities, and school districts are undertaking voluntary testing of school drinking water taps. →

Water systems are required to report in their annual CCRs how many schools requested sampling in the previous calendar year, but are not required to publish the results.

In January 2017, in response to a 2015 directive by California Gov. Jerry Brown, the State Water Resources Control Board Division of Drinking Water (DDW) issued permit amendments to community water systems with K-12 schools in their service area requiring these systems to provide free lead sampling and analysis at up to five tap locations to any public, private, or charter school that serves students in kindergarten through grade 12, providing that the school requests this testing. According to DDW Deputy Director Darrin Polhemus, the program's goal is "to help ensure that we continue to protect our most vulnerable populations."

What's Required

The sampling request must be made by the superintendent (or the equivalent) of the school district or the superintendent's authorized representative. Requests from charter schools and private schools must be made by a school official who is equivalent to a superintendent, such as a governing board or head of school. Principals, teachers, and parents are not authorized to request testing. Water systems are required to meet with school officials to develop a testing plan, perform the initial sampling and any required follow-up sampling, analyze the samples at a certified lab, and follow the data reporting procedures outlined in the permit amendment and guidance documents.

The permit amendment requires that the water system provide up to two rounds of follow-up testing at any of the original tap sampling locations that had an initial result over the lead action level of parts per billion, (ppb) plus one round of follow-up testing after the school takes corrective action such as replacing the fixture or installing a filter at any of the original tap sampling locations.

Water systems are required to report in their annual CCRs how many schools requested sampling in the previous calendar year, but are not required to publish the results. Additional requirements and extensive guidance are available at DDW's Lead Sampling of Drinking Water in California Schools website: *http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/leadsamplinginschools.shtml*

What's Not Required

Water systems are not required to inform schools of the testing program, although some water systems have voluntarily done so. According to Provision 7 of the permit amendment:

The water system shall communicate with the school after lead sampling and assist the school with the interpretation of laboratory results and provide information regarding potential corrective actions if a school has confirmed lead levels above 15 ppb. The water system is not responsible to pay for any maintenance or corrections needed at the school if elevated lead levels are found in the drinking water. The water system is not responsible for determining any corrective actions needed at the school.

Most school officials are not familiar with interpreting water quality data, let alone communicating such data to their stakeholders and deciding how to respond to the findings. The provision to report testing results ensures that water systems, with their decades of experience implementing the Lead and Copper Rule, will have at least one follow-up conversation with school officials after sampling. However, the amendment does not require water systems to design or implement any corrective action measures if a lead action level exceedance is found. Additionally water systems are not required to pay for or provide any technical assistance other than that associated with sampling the school's drinking water and analyzing and reporting the results.

Because DDW's regulatory authority extends only to public water systems and their distribution systems and appurtenances, the permit amendment does not specify any requirements for the schools themselves. California schools are not currently required to test their drinking water or to perform corrective action for any taps that are found to have lead action level exceedances. To help address this issue, it's anticipated that a new grant program from the State Water Resources Control Board will provide $9.5 million in funding to improve drinking water quality in public schools, including schools that identify lead action level exceedances through this testing program. See *http://www.waterboards.ca.gov/water_issues/programs/grants_loans/schools/.*

What's Next?

The initial investigation required by the permit amendment will help policymakers and politicians make informed decisions as they consider additional lead testing requirements at the local, state, and national levels. Future potential actions include California State Assembly Bill (AB 885), which would require water systems to conduct yearly testing of drinking water outlets at all public schools and provide reimbursement of the sampling costs by the state; (AB 746) which would require local educational agencies and community and public university boards to conduct yearly or triennial testing at all public schools and charter schools, including preschool locations and shut down any taps that exceed the lead action level; and possibly the long-awaited long-term revisions to the federal Lead and Copper Rule, which may include requirements for school sampling.

As of June 9, 2017, 1,122 California schools have either requested sampling or submitted sampling results, out of approximately 13,000 schools that are eligible for testing. Sampling requests by county are shown in Figure 1 on page 35 and are updated regularly on the DDW website. The permit amendment lapses on November 1, 2019.

For assistance in following the sampling or reporting instructions, email the DDW staff specialist for this program at *DDW-PLU@waterboards.ca.gov.*

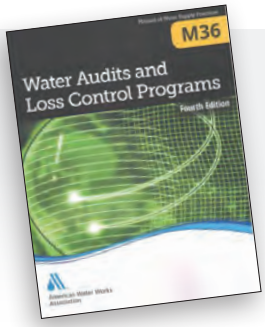
Finding Your Way to Audit Success

By Lucy Andrews

WATER AUDIT VALIDATION EXAMINES WATER AUDIT inputs, including instruments, databases, and analyses, to improve an audit's accuracy and document any persisting uncertainties. Water audit validation can be conducted at one of three progressive levels, each of which has distinct outcomes and corresponding engagement with water audit data and instruments. Level 1 water audit validation is an introductory review of audit data sources and results that is designed to accomplish three goals:

- Confirm the correct use of American Water Works Association M36 water audit methodology.
- Identify evident inaccuracies in water audit inputs and summary data.
- Verify that data validity grades accurately reflect utility practices.

Level 1 validation pursues these objectives through an interview between a water audit validator and the utility staff member who compiled the audit. Additional members of your staff may be involved as necessary to explain practices of data collection, data review, and instrument maintenance. It is important to understand that Level 1 water audit validation does not guarantee accurate results—you will have to pursue higher-level validation to truly understand accuracy—but it's a good place to start.



Confirm the correct use of American Water Works Association M36 water audit methodology.

Be Prepared

For water audit validation to be successful, the audit compiler must provide the following documents, without which your water audit can't be validated. It's important to remember: no supporting documents, no validation.

- Complete AWWA Free Water Audit Software.
- Volume from Own Sources volumes, disaggregated by month

and supply meter.

- Water Imported volumes, disaggregated by month and supply meter.
- Water Exported volumes, disaggregated by month and supply meter.
- Supply meter volumetric testing and calibration documentation, if such activities are conducted.
- Billed Metered Authorized Consumption volumes, disaggregated by month and rate code (e.g., customer class).

Although not required, additional supporting documents improve the rigor and efficiency of Level 1 validation, including:

- Customer Meter Inaccuracy derivation.
- Average Operating Pressure derivation.
- Customer Retail Unit Cost derivation.
- Variable Production Cost derivation.
- System schematic showing supply meter locations.

The Validation Session

Prior to your interview, the validator will review your documentation to develop an understanding of your utility and compile a list of initial questions. During the interview, the validator will discuss each input with your auditor and other utility staff members to understand what data and instruments informed the input, how data was handled to produce a single summary value, and how your utility collects information and maintains instrument performance. If the validator discovers any inputs

SB555 Updates

By Todd Thompson

The 2017 Spring Issue of **SOURCE** *acknowledged the work by CA-NV AWWA in the Water Loss Technical Assistance Program (TAP). The teamwork between the U.S. Environmental Protection Agency, State Water Resources Control Board (SWRCB), and the Department of Water Resources (DWR) shows that success happens when we work together. On that note, I appreciate the opportunity to update* **SOURCE** *readers on development of California's validated water loss regulations.*

What is DWR currently doing with water loss audits?

DWR is currently establishing regulations to satisfy Water Code Section 10608.34, created by Senate Bill 555 (2015). The statute requires DWR to establish rules on the conduct of standardized water loss audits consistent with AWWA's methodology (M36), minimum water loss audit validation requirements, and qualifications for professionals that perform water audit validations (WAVs). The statute also requires urban retail water suppliers to perform water loss audits of their systems, validate those audits, and submit them to DWR before October 1, 2017 and annually thereafter.

What will the regulations require?

Although as of this writing the regulations have not been finalized, they will specify the minimum standards for conducting water loss audits using Chapter 3 of the M36 manual and the minimum requirement for how water loss auditors must conduct a Level 1 validation. Also, WAV qualifications will most certainly be overseen by the California-Nevada Section of AWWA as a certificate program. Regulations will also specify standards for submitting water loss audit reports.

Should water utilities be concerned?

Reporting validated water loss audits by October 2017 should not be a concern for California utilities because they have submitted water loss audits with their 2015 Urban Water Management Plans. Many utilities also perform audits annually as part of the California Water Efficiency Partnership (formerly the California Urban Water Conservation Council). In addition, the CA-NV AWWA Water Loss TAP is preparing California utilities for this reporting.

What will DWR do with the data?

The state will use the data to assess the range and extent of distribution system water loss statewide. In 2020, the SWRCB will establish water performance standards using at least two years of water loss data, establishing performance standards based on that data, which will also be available to the public and interested parties.

What is the time frame?

The proposed regulations are currently being developed, with adoption nearing completion. The process began almost a year ago with stakeholder meetings, public comment input, and public hearings. The California Water Commission closed its second 15-day comment in early July and as of this writing was scheduled to present the proposed regulations to the California Water Commission on July 19, 2017.

Where can I learn more?

Visit DWR's website at ***water.ca.gov/wateruseefficiency/wlaudits.***

Todd Thompson is Senior Engineer, Water Resources, California Department of Water Resources.

or data validity grades that should be adjusted to improve your audit's accuracy, he or she will recommend and document these changes. Once all inputs and data validity grades have been systematically addressed, the interview will shift to a discussion of results. The validator will review the standard performance indicators produced by the water audit software to identify technically unfeasible outcomes such as negative real loss.

After Validation

After the interview, the validator will capture the process and outcomes in a Level 1 validation certificate. The validator will also comment on persisting sources of uncertainty and recommend further opportunities for data, instrument, and performance indicator validation. Typical higher-level validation activities include source meter volumetric testing, prorating billing data, customer meter testing, and field surveys of system pressure. Before pursuing a recommendation of more rigorous validation, you should assess the costs and benefits of the activity and explore how it would improve the accuracy of your water audit, not just the data validity score.

Tips for Success

- *Thoroughly document your water audit data sources and analyses.* In your validation interview you will need to describe the derivation of each water audit input and explain your operational practices as they relate to the data validity grades. You will not have the opportunity after the session to report back on questions you were unable to answer during the interview.
- *Compile and furnish required supporting documentation before your validation session.* If required documents are not provided at least three days in advance, your validation cannot occur.
- *Engage colleagues in the process of water audit compilation and validation.* Rarely can a single utility staff member speak to all the operational practices and data sources that a Level 1 validation explores. Building a water audit team that includes representatives from your operations, customer service, finance, engineering, and conservation departments makes water audit compilation more efficient and accurate and helps lead to a successful validation.
- *Use industry resources to compile your water audit; learn more about water loss control; plan a cost-effective water loss control program.* The Water Loss TAP website provides links to best-practice guidance, including CA-NV AWWA's own water audit manual. See *ca-nv-awwa.org/CANV/CNS/Water_Loss/CNS/Partnership_for_Saving_Water/collaborative.aspx.*

Lucy Andrews is Project Manager and Water Loss TAP Program Management Team Member, Water Systems Optimization.

Heads Up, Continued from page 11

In April 2017, the Brown Administration released its proposed budget trailer bill language for implementation of the EO and also released the final framework document. The trailer bill language was interpreted by the water community as going beyond the recommendations reflected in the regulatory agencies' final framework document. Assembly Member Laura Friedman (D-Glendale) incorporated the target-setting and drought contingency planning requirements included in the administration's trailer bill language in her AB 1668 and AB 1669 as a means of providing a pathway to continue the discussions in an open, transparent, and collaborative process (as opposed to an expedited budget process).

On April 25, 2017, all legislation within the Assembly related to water conservation policy, including AB 968, AB 1654, AB 1668, and AB 1669, was heard in the Assembly Water, Parks, and Wildlife Committee and passed to the Assembly Appropriations Committee without further amendment to leverage and encourage all stakeholders to identify a path forward to achieving broad consensus. To facilitate needed dialogue, the Assembly soon established a workgroup made up of Assembly legislators to work with stakeholders on identifying and developing potential areas of consensus. Members include: Assembly Members Friedman, Rubio, Shirley Weber (D-San Diego), James Gallagher (D-Yuba City), Anna Caballero (D-Salinas), Richard Bloom (D-Santa Monica), Frank Bigelow (R-O'Neals) and Brian Dahle (R-Bieber).

On a simultaneous track with the budget process, the respective Assembly and Senate budget committees rejected the Administration's trailer bill language. The legislature had expressed interest for the broader policy discussion to occur in more appropriate venues of the appropriate legislative policy and fiscal committees. However, in spite of these developments, the Governor's Office is also reaching out to stakeholders for feedback on potential refinements to its trailer bill proposal.

On May 26, 2017, the Assembly Appropriations Committee passed only three conservation bills. The objective is to continue dialogue and negotiations and develop a comprehensive package within the legislative process that addresses the issues of target-setting as well as drought contingency and planning. The three bills are: AB 1323 (Weber), which could potentially be the vehicle to address water use targets, and AB 1654 (Rubio) and AB 1668 (Friedman), both of which could potentially be the vehicles to address drought contingency planning and reporting.

Once the bills pass the Assembly Floor by the required house of origin deadline of June 2, the bills will be subjected to hearings in assigned policy and fiscal committees in the Senate in June or July. The hope is that the process will allow for a broadly agreed-upon compromise and language to be placed in the legislative vehicles before they reach the Governor's Office by the end of the legislative session in mid-September.

If you are interested in additional information or becoming involved in the process, please contact me, Rosie Thompson, at *rthompson@mwdh2o.com*.

Rosalie Thompson is an in-house state legislative representative for the Metropolitan Water District of Southern California. She served as a legislative staffer in the State Capitol for 13 years and is currently chair of CA-NV AWWA's Government Affairs Committee.

Executive Director

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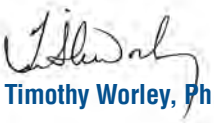
that lack a sufficient rate base, as well as the technical and managerial expertise, is the most elusive part of the riddle. SWRCB staff and consultants are currently researching options. My view is that the answer lies in breaking down the factors that contribute to the development of these kinds of situations.

To do this is to recognize that such conditions are the result of complex, underlying social and economic factors, some of which are related to the fact that the United States does not offer the kind of social safety net that other economically advanced countries have in place. In addressing itself to the human right to water, California has committed itself to the establishment of a very comprehensive safety net, which will require addressing multiple policy decisions. Either the income (wealth) of the population in these disadvantaged communities will have to increase to a self-sustaining level, or some other entity (perhaps government or a philanthropic enterprise) will have to assume the responsibility for operating a host of small water systems. Related questions abound, without an easy path forward:

- Should minimum wage levels be raised for farm workers?
- Should the state increase social and financial support for low-income elderly people?
- Where should the funds come from to cover small system O&M costs?
- Since the human right to water is a state policy, should the state cover the cost from the general fund?
- With safe drinking water a core AWWA principle, will the Association and its members overcome the natural resistance to adopting a fee or tax on well-managed utilities that come to the aid of failing ones?

It's obvious that there are no easy answers, but California seems destined to discover whether guaranteeing every citizen has access to safe, accessible, and affordable water is in fact a riddle without a solution, or whether, as has been the case with air pollution, auto emissions, and energy consumption, the state will once again deliver a breakthrough that will result in the establishment of a standard for the rest of the country?

Stay tuned, stay engaged, and help AWWA and the CA-NV Section make our views, and our voices, heard.



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