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FROM THE EDITOR

By Kevin Westerling
Chief Editor, editor@wateronline.com

Securing Smart Water

The digital transformation of utilities is necessary and inevitable but also innately vulnerable to bad actors. It's time to discuss prioritizing cybersecurity.

With the rise of digital technologies (showcased throughout this edition of *Water Innovations*), cyber threats have become a growing concern for water and wastewater utilities, yet federal rules for cybersecurity measures remain elusive. States like New York are starting to fill the regulatory void, providing potential blueprints for others, while individual utilities would be wise to protect themselves — as best they can — even without a mandate. But what does that initiative and investment look like?

In the following Q&A, I discuss these and other issues with Kayne McGladrey, IEEE senior member and field CISO at Hyperproof, who has more than 20 years of experience in building effective cybersecurity programs for organizations of all types, including Fortune 500 and Global 100 companies. But today Kayne is keen on water, addressing the developments, needs, and requirements regarding cybersecurity for those who steward the nation's critical infrastructure.

Kayne McGladrey
IEEE Senior Member,
Field CISO at Hyperproof

New York State recently proposed new cybersecurity regulations for water and wastewater utilities. Assuming no changes after public review, what would the rules require?

New York's regulations create a two-tier compliance structure based on the population served, with systems serving over 3,300 people facing annual vulnerability assessments, formal cybersecurity programs, and 24-hour incident reporting requirements. For larger utilities serving over 50,000 people, additional obligations include appointing dedicated cybersecurity executives and implementing comprehensive network monitoring with logging capabilities. Beyond these core requirements, all covered systems must develop incident response plans and provide cybersecurity training for certified operators, though utilities with completely air-gapped systems remain exempt from compliance. The state has set implementation timelines of January 2026 for IT systems and January 2027 for operational technology systems.

What are your thoughts on the merits or importance of the regulations?

These regulations address a gap in protection for infrastructure that directly impacts public health and safety; last year, the EPA's Office of Inspector General found that 97 U.S. drinking water systems already have important or high-risk cybersecurity vulnerabilities affecting over 26 million people. Water systems have historically operated with minimal cybersecurity oversight, despite serving millions of people who depend on reliable, clean water delivery. The phased approach and grant funding demonstrate an understanding that compliance requires both time and financial support, particularly for smaller utilities with limited resources. Most importantly, the regulations create accountability through mandatory reporting and designated leadership roles, transforming cybersecurity from an optional consideration into a business requirement.

Aren't such measures, or some cybersecurity measures, needed everywhere? Are we on that path?

States are stepping into the regulatory void left by federal agencies after the EPA's cybersecurity regulations were withdrawn due to industry lawsuits and court rulings, with New York setting a precedent that other states may follow based on their own risk assessments and political priorities. The approach makes sense because water systems are locally operated but face globally coordinated threats, requiring local accountability with standardized protection frameworks. In my experience, industry sectors rarely adopt comprehensive security measures without

substantial regulatory or contractual pressure, despite business benefits. Financial services and healthcare are examples of this pattern, where regulatory requirements drove widespread security improvements that voluntary guidance never achieved.

What about the cost of cybersecurity implementation?

State estimates show annual costs ranging from $150,000 for smaller systems to $5 million for larger utilities, with the $2.5 million grant program covering only a fraction of total implementation expenses. The remaining costs will likely transfer to ratepayers or taxpayers, but this represents a small fraction of the economic impact from a disruptive attack on water infrastructure. Smart utilities will phase implementation over the compliance timeline, prioritizing high-impact, low-cost controls first, such as multifactor authentication and replacing default passwords that EPA inspections found at over 70% of water utilities. Budget discussions should frame these costs as insurance premiums rather than technology expenses, protecting against service disruptions that could cost millions per day.

What types of threats and ongoing cyber risks do utilities face, and what are the potential impacts?

Water utilities face sophisticated threat actors, including ransomware groups that use infostealer attack chains with malware. I've seen utilities struggle with vulnerabilities in human machine interfaces that allow unauthorized system access and supply chain compromises that expose utilities as unintended victims. The financial consequences can be severe — service disruptions can cost over $100 million per day in lost revenue, while contamination incidents create liability exposure that could functionally end the operations of smaller utilities. With reports of electrical grid attack surfaces expanding daily, the evidence shows that IT-operational technology convergence allows attackers to move from administrative systems into water treatment controls, potentially affecting public health.

AI and machine learning are taking digital capabilities further, and fast! How do we continue to evolve while remaining protected from bad actors?

Start with security by design principles when implementing AI systems, treating them as high-value assets that require the same protection as operational control systems. The nuclear energy sector's early AI adoption demonstrates both the potential benefits and risks, as utilities integrate AI for cost optimization while potentially expanding their attack surface. Organizations should implement AI governance frameworks that include security reviews for new AI deployments, data protection for training sets, and monitoring for AI system manipulation by threat actors. Utilities should focus first on building security expertise within their organization rather than relying solely on AI vendors, because utilities understand their operational risks better than any external provider. ■

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101 Gibraltar Road, Suite 100
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PH: (215) 675-1800
Email: info@wateronline.com
Website: www.wateronline.com

Converging Challenges, Unified Solutions: How Three Overlapping Trends Are Shaping Public Water

With the right help, coping with workforce upheaval, the digital transition, and asset management can be an opportunity.

By Isaac Pellerin

The public water sector is undergoing a profound transformation driven by three powerful and interconnected trends: the digital transition and rise of AI, the increasing urgency of asset management, and dramatic changes in the workforce, including the looming vacuum of experienced personnel known as the "silver tsunami." Together, these trends are redefining how utilities operate, make decisions, and prepare for the future. Understanding their interrelationships is key to crafting solutions that create resiliency and stability for systems of all sizes.

The Digital Transition And The Rise Of AI

The digital transformation has arrived in the water sector. Where utilities once relied on paper records, manual readings, and reactive maintenance, many now embrace digital platforms, sensors, and analytics to optimize operations and extend the life of infrastructure. This trend is getting a big lift from federal and state regulations and increased public awareness of water quality. New PFAS and lead line removal regulations mandate that information be stored, submitted, and available to the public digitally, and the availability of state revolving funds (SRFs) and grants is increasingly tied to utilities' ability to submit digital information.

The role of AI and machine learning is expanding in the areas of non-revenue-water leak detection, lead pipe identification, predictive maintenance, energy optimization, and asset condition monitoring. These tools can analyze massive data sets and identify patterns in hours, minutes, or seconds — work that would take people days or weeks to complete (and for some tasks, the work is simply beyond human capacity). With AI, utilities can predict equipment failures, optimize chemical dosing, and respond more swiftly to emergencies.

The digital transition in public water is not just about technology; its success depends on a utility's culture, governance, and training. Implementing digital tools requires new skillsets in data analysis, cybersecurity, and change management. It also demands a shift in mindset, from reactive problem-solving to proactive planning and continuous improvement.

Asset Management: A Strategic Imperative

Large chunks of the U.S. water infrastructure are old and getting older, and the need for effective asset management has never been greater. Treatment facilities installed decades ago are increasingly prone to failure, with costly consequences for public health, service reliability, and the environment.

Historically, many utilities operated on a "run to failure" model, replacing infrastructure only when it broke. That approach is no longer sustainable, especially as climate change, supply chain disruptions, and stricter regulations increase the risks and costs of unexpected failures. But upgrading or replacing equipment because "the calendar says so" is financially wasteful. Asset management identifies the strike point between the extreme strategies of running to failure and replacing before necessary.

With asset management, utilities can reap enormous savings by getting the most value from the assets already in service. Savings within reach include extending the life of equipment, ensuring regulatory compliance, deferring construction costs, reducing energy consumption, avoiding the cost of over-protecting assets, minimizing downtime, and reducing the risk and impacts of a severe weather event.

The drinking water sector received a C- in the *2025 Report Card for America's Infrastructure*[1], released every four years by the American Society of Civil Engineers (ASCE). This report noted that about 30% of utilities have implemented an asset management plan, and about half are currently deploying one. To raise the grade, the ASCE recommends continued investment in asset management plan development and implementation.

The Silver Tsunami And The Changing Water Workforce

A throbbing refrain pulsing under the digital transition and asset management trends is dramatic change in the workforce. The "silver tsunami" is cresting, with an estimated third of the sector's operators, engineers, and managers at or close to retirement, when many are taking with them decades of institutional knowledge. Additionally, replacement workers need very different skills than their retiring counterparts.

The challenges of this broad trend include understaffed utilities, the loss of expertise, and training that must be overhauled in lockstep with the digital transition. New employees must be proficient not only in water system operations, but also in navigating digital platforms, managing data, and thinking strategically about infrastructure investments.

The workforce crisis also presents the opportunity to recruit a new generation of workers who are tech-savvy, sustainability-minded, and eager to make a difference. To take advantage, however, utilities will need mentors and knowledge transfer strategies.

How These Trends Interact

These three trends are deeply interconnected and not evolving in isolation. Effective asset management depends on good data, which is collected, maintained, and interpreted through digital tools. Condition assessments are tied to GIS mapping systems, work orders are tracked in cloud-based platforms, and dashboards help visualize risk across an entire service area. High-quality asset data also feeds into AI and predictive analytics, making the digital transition a prerequisite of both effective asset management and AI. These tools must be used by a skilled workforce with appropriate training.

Meanwhile, as workers retire, their institutional knowledge must be captured and translated into digital systems and asset inventories to prevent that knowledge from also retiring. In addition to sensors and software, AI requires human expertise to configure, interpret, and act on AI's recommendations. This requires a workforce that is digitally savvy, and this workforce will expect up-to-date systems and tools, creating a feedback loop between technology adoption and talent attraction.

These trends are part of a shared progression toward smarter, more adaptive, and more resilient water systems. Advances in one area enable innovation in another, while gaps in one area can hinder gains in others. Successful utilities are taking a holistic approach, integrating strategies for digital and AI tools, asset management, and workforce development into a unified plan.

Challenges For Small Systems

The large majority of public water systems are hindered in their ability to quickly or efficiently achieve a digital migration, take advantage of AI, or deploy a system-wide asset management system due to manpower resource constraints, siloed data systems, small budgets, and a lack of staff comfort with new technology. Raising rates on customers is rarely an option, further restricting utilities' flexibility.

While these challenging trends offer significant opportunities to improve resiliency and future-proof operations, it's not easy for small and rural water systems to capitalize on them because they face steep barriers to implementation. Digital tools, while increasingly accessible, still require investment, IT support, and training that small systems often lack. Asset management plans, GIS mapping, and predictive analytics may feel out of reach without outside assistance.

How Utilities Are Getting Help

Companies like 120Water exist to help customers navigate these challenges in ways that make utilities stronger and more operationally sustainable. Utilities and engineering firms are using specially designed tools and services to manage compliance, identify risk points, and otherwise reduce the operational burden resulting from these industry trends.

For example, a water system with about 27,000 mostly residential connections in South Carolina leveraged AI in its response to the U.S. EPA's Lead and Copper Rule Revisions (LCRR). The utility used predictive modeling to determine the service line type of Lead Status Unknown lines, starting with verified information gleaned from potholing a representative sample of lines. This data was added to existing records data to generate predictions about the likelihood of a lead service line at each address. Guided by these predictions, the utility was able to schedule select digs that further updated the model so that it learned and improved its predictions, an approach that is much less expensive than excavating every service line.

In a growing number of states — including Indiana, Georgia, Arizona, Delaware, and Rhode Island — regulators have standardized the way utilities collect and submit service line data. This streamlined approach improves the quality and consistency of submissions, enabling both utilities and regulators to have meaningful, constructive conversations about a utility's service line profile. By pooling participation across multiple utilities, the model delivers cost-effective access to advanced digital tools.

Regarding workforce upheaval, 120Water's platform meets the expectations of young staffers by making information easily accessible and highly visual. For the South Carolina utility, the platform's interactive map feature and its ability to help the operational team visualize its goals has been particularly motivating. The lead and copper coordinator likened the interface to a "heat map" that becomes less crowded as Lead Status Unknown lines are eliminated, a satisfying interaction that has helped the team keep focus and stay on task.

Turning Threats Into Opportunities

These water industry megatrends are daunting, but with the right help, they can be a golden opportunity for utilities to achieve a state in which operational staff is not always having to play catch-up. Proper tools can help utilities grow from these challenges in ways that will benefit them and their customers for generations. ■

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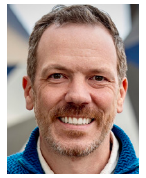
1. American Society of Civil Engineers. "Drinking Water Infrastructure." *2025 Report Card for America's Infrastructure*, American Society of Civil Engineers, published March 25, 2025. Accessed July 22, 2025. https://infrastructurereportcard.org/cat-item/drinking-water-infrastructure/

About The Author



Isaac Pellerin is 120Water's SVP of corporate strategy and has invested nearly two decades into building organizations and data-driven technologies that impact local communities. Pellerin has a never-ending curiosity to understand how technology impacts people's work and produces good for the communities they serve. He sees the complexity of drinking water regulations as an opportunity to align the value of 120Water's platform with the needs of the water workforce today and grow with the needs of the future.

A Comprehensive Guide To Phosphate Feed System Design For Drinking Water Applications

Phosphate dosing systems are critical for corrosion control, and increasingly important under the mandate of Lead and Copper Rule Improvements.

By Keval Satra, Rajeev Kamalampet, Varenya Mehta, and Mahith Nadella

Phosphate-based chemical treatment is a proven strategy in drinking water systems for both corrosion control and sequestration of metals such as iron and manganese. The addition of phosphate plays a key role in helping water systems comply with drinking water regulatory standards. The U.S. EPA has emphasized corrosion control as a critical measure to reduce lead and copper release into drinking water under the Lead and Copper Rule Improvements (LCRI), which were issued in October 2024.

There are two main types of phosphates used in water treatment:

1. **Orthophosphates:** Contain one unit of PO_4, acting as a corrosion inhibitor by forming a protective microscopic film or stable metal-phosphate coating (anodic film) on pipe surfaces, thereby preventing the release of lead and copper into drinking water.

2. **Polyphosphates:** Contain multiple PO_4 units chained together and act as sequestering agents, binding with bivalent metal ions such as iron (Fe^{2+}), manganese (Mn^{2+}), and calcium (Ca^{2+}) to prevent scale formation and aesthetic issues caused by iron and manganese.

Blended phosphate (orthophosphate + polyphosphate) offers the combined benefits of corrosion control and sequestration.

Chemical Selection Guidelines

Water Treatment Goal	Recommended Treatment
Corrosion Control (Lead/Copper)	Orthophosphate
Iron/Manganese < SMCL *	Polyphosphate
Iron/Manganese > SMCL *	Oxidation (chemical or aeration) + Filtration
Multiple Treatment Goals	Blended Phosphate

*Note: The SMCL (Secondary Maximum Contaminant Level) established by the U.S. EPA is 0.30 mg/L for iron and 0.05 mg/L for manganese.

Water Quality Considerations

To determine the appropriate phosphate type and dosage, water systems should perform a comprehensive water quality analysis, including the following parameters:

- pH
- Temperature
- Conductivity
- Dissolved inorganic carbon (DIC)
- Total dissolved solids (TDS)
- Calcium and magnesium hardness
- Alkalinity
- Iron and manganese concentrations

In addition, water stability indices such as the Langelier Saturation Index (LSI), Calcium Carbonate Precipitation Potential (CCPP), and Ryznar Stability Index (RSI) should be calculated to assess potential scaling and corrosion tendencies, helping with selection of an appropriate phosphate blend.

Dosage Consideration

1. Corrosion Control: The typical target orthophosphate dose is 0.5 - 2.0 mg/L as PO_4.
2. Sequestering Iron and Manganese: The typical industry practice often involves using a target polyphosphate dose (as PO_4) based on a 2:1 ratio for Fe2+ concentration and 5:1 ratio for Mn2+ concentration.

Pilot or bench-scale testing is recommended to establish phosphate dosing requirements based on water quality and treatment goals.

Polyphosphates may revert to orthophosphates depending on water temperature and residence times in the distribution system. Therefore, a slightly higher dosage of polyphosphate is often recommended to account for this reversion. A water age of two to three days is generally acceptable, as polyphosphate reversion can accelerate after three to five days of residence time.

Many chemical suppliers provide proprietary blends of orthophosphate and polyphosphate (referred to as blended phosphate), each with varying concentrations and ratios. It is crucial for system designers to consult product-specific information from suppliers to accurately calculate the appropriate dosage rates. Designers should also ensure the feed system is properly sized to deliver the target concentrations of orthophosphate, polyphosphate, or blended phosphate, tailored to the system's specific treatment goals. Variation in water quality characteristics and flows require adjustments to the phosphate dosage to maintain effectiveness and achieve desired treatment goals. Furthermore, it is recommended to conduct periodic monitoring of phosphate concentrations and related water quality parameters to ensure that treatment objectives are consistently achieved.

Recommended System Components For Phosphate Storage And Feed System

1. Chemical Storage
   Chemical storage is typically sized to hold a 30-day supply based on treatment design dosage demand; however, some regulatory agencies may require only a 15-day storage capacity. Chemical storage tanks for phosphate systems are generally made from phosphate-compatible materials such as high-density polyethylene (HDPE), medium-density polyethylene (MDPE), cross-linked polyethylene (XLPE), fiberglass-reinforced plastic (FRP), stainless steel (SS), or glass or epoxy-lined steel. Depending on the chemical usage rate and delivery schedule, phosphate feed systems may include bulk tanks, day tanks, or both. Bulk tanks are typically used when storage requirements range in the thousands of gallons. When large bulk tanks are installed, day tanks are often used downstream to hold a smaller, controlled volume of the chemical, thereby reducing the risk of accidental overfeeding or large spills. As an alternate solution, systems may skip day tanks by providing appropriate controls, instrumentation, and procedures. Intermediate bulk containers (IBCs or totes) may be used when the chemical consumption rate is low, offering a more practical and space-efficient storage solution.

2. Containment
   Containment or secondary containment for chemical storage is a safety measure designed to capture and contain chemicals in the event of a primary tank's failure or leak. Common secondary containment methods include double-walled storage tanks or an external containment structure. EPA regulations require that secondary containment systems be sized to hold at least 110% of the largest tank within the containment area. However, it is recommended to comply with and adhere to applicable local or state regulations for secondary containment sizing, as these requirements may vary by jurisdiction or application.

3. Building
   Phosphate storage and feed systems are recommended to be located indoors in a temperature-controlled environment (i.e., building), as phosphate can become viscous and start freezing at temperatures below 38°F. Buildings provide essential protection from weather conditions such as rain, snow, and extreme heat, helping to maintain chemical stability and prolong equipment life. In addition, housing the feed system indoors simplifies design, installation, and maintenance. These buildings are typically constructed using pre-engineered materials such as fiberglass-reinforced plastic (FRP), precast concrete, concrete masonry unit (CMU) block, or metal building systems. Buildings should include a well-designed truck unloading area to ensure the safe transfer of chemicals from delivery trucks to the feed system's bulk storage tank. Buildings must include appropriate lighting and HVAC systems that comply with applicable codes for the jurisdiction.

Depending on the treatment objective, phosphate may be injected either into basins or directly into pipelines.

4. Chemical Feed System
   Pre-assembled, skid-mounted feed systems are commonly used in phosphate treatment applications. A typical phosphate feed skid includes a peristaltic or diaphragm metering pump, calibration column, a pulsation dampener, suction and discharge isolation valves, inlet Y-strainers, a discharge pressure relief valve, a check valve, discharge flow meters or sensors, pressure gauges, and a pump control panel. These systems are typically configured with at least one duty pump and one standby or shelf spare pump to ensure full redundancy.
   Alternatively, a custom-built feed system can be used in place of a pre-assembled skid system for phosphate treatment applications. When designing a custom system, it is important to include all necessary equipment and instrumentation, shown in the page 12 schematic, to ensure proper functionality and reliability.

5. Chemical Feed Piping
   Chemical feed piping or tubing is routed from the metering pumps to the chemical injection point. Whenever feasible, it is recommended to minimize the length of piping by positioning the chemical feed and storage equipment as close to the application point as possible. For piping, Schedule 80 PVC or CPVC is recommended due to its durability and chemical compatibility with phosphate feed systems. For tubing, clear PVC, white polyethylene, or thermoplastic elastomer tubing is commonly utilized for flexible connections and visibility of chemical flow. In outdoor applications exposed to sunlight, it is recommended to use materials with UV inhibitors or to apply a protective coating to enhance the longevity of the

piping. Additionally, consider freeze protection measures (insulation or heat tracing) if the location experiences freezing weather conditions.

6. Chemical Injection
Depending on the treatment objective, phosphate may be injected either into basins or directly into pipelines. When added to basins, phosphate is typically dripped from the top of the tank or injected through quills installed in the side walls, with some form of mixing provided to ensure proper dispersion. For pipeline injection, chemical injection quills are used to deliver the phosphate to the center of the flow stream, promoting even distribution. To further enhance mixing, an inline static mixer can be installed downstream of the injection point. Injection quills are generally designed to be retractable for ease of maintenance and are equipped with backflow prevention mechanisms to ensure safe operation. For added redundancy, systems can incorporate dual injection ports at the application point.

7. Controls
Controls for phosphate storage and feed systems include instruments and equipment required to monitor, regulate, and automate the chemical dosing.
   a. Instrumentation and Equipment
      i. Level sensors are installed on storage tanks to monitor chemical levels and activate alarms in the event of low (empty) or high (overflow) conditions.
      ii. Flow meters or flow sensors are used to measure chemical flow to the application points and can be integrated with control systems to automate dosing based on flow rate.
      iii. Pressure gauges or pressure transmitters are placed on the suction and discharge lines of metering pumps to help identify issues such as clogs, leaks, or pump failures.
      iv. Variable frequency drives (VFDs) are utilized to control metering pump speeds, enabling precise, variable-rate chemical dosing based on process requirements.
   b. Automation
   The operation of the phosphate feed system can be fully automated with a programmable logic controller (PLC) using the feedback signals from the field instrumentation.

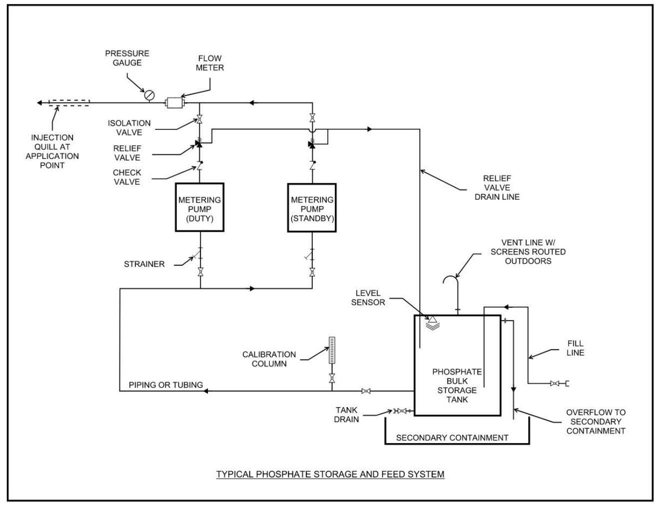
8. Ancillary Considerations
   a. Power
   If continuous operation of the phosphate system is critical, provisions for emergency backup power, such as a generator, should be included in the design. Additionally, an uninterruptible power supply (UPS) is recommended for the PLC and control systems to maintain functionality and prevent data loss during power interruptions.

   b. Emergency Eyewash and Safety Shower
   An emergency eyewash and safety shower should be installed near areas where phosphate chemicals are stored or handled. The number and exact placement of these safety stations should comply with applicable local, state, and federal safety regulations.

Location Of Phosphate Chemical Injection

The location of chemical injection depends on the treatment goal (corrosion control vs. sequestration), the type of source water (groundwater vs. surface water), and the treatment process at the water treatment plant. Generally, for the sequestration of iron and manganese in ground water application, phosphate should be injected upstream of the oxidation process (e.g., chlorination or aeration). A general rule of thumb is that a separation of 1' per 1" pipe diameter should be maintained ahead of the chlorine injection point. For corrosion control, phosphate is typically injected into the finished water leaving the treatment plant, upstream of the secondary disinfection residual injection point (chlorine or chloramine).

Typical Process Schematic For Phosphate Feed System



Ancillary Considerations Related To Phosphate Feed Systems

Biological Activity in the Distribution System

Phosphate is one of the limiting nutrients for microbial growth; therefore, excessive dosing can lead to biological growth. This is critical for water systems that maintain a chloramine residual (monochloramine) and utilize phosphate treatment, as there is an increased risk of biological activity within the water distribution system, which can lead to negative water quality issues such as reduced disinfectant residuals and taste and odor problems. To manage this, public water systems can implement periodic free chlorine conversions (also referred to as chlorine burn) for two to three weeks, typically twice a year, to suppress biological growth.

Increased Load to Wastewater Treatment Plants

Phosphates used in drinking water treatment ultimately contribute to increased phosphate loading in the sanitary sewer collection and treatment system. This can place an additional burden on wastewater treatment plants (WWTPs), particularly those required to meet stringent effluent total phosphorus (TP) limits under their environmental discharge permits.

Aesthetic Impacts and Metal Taste

Phosphate treatment does not remove iron or manganese from the water. Instead, it keeps these metals in soluble form, thereby preventing precipitation that would otherwise cause discolored water and staining. However, since iron and manganese remain in solution, their presence may still affect the taste of the water, often imparting a metallic flavor.

Water Quality Monitoring

To monitor and adjust dosage and residuals, water quality parameters such as orthophosphate and total phosphate are periodically measured in both raw and finished water. Orthophosphate is measured directly using the Ascorbic Acid Method (e.g., Standard Method 4500-P E or EPA 365.1), which detects reactive phosphate without digestion. Total phosphate measurement requires an initial digestion step (typically using acid persulfate) to convert all phosphorus forms, including polyphosphates and organics, into orthophosphate, which is then measured using the same colorimetric method. Both results are typically reported in mg/L as PO_4 or as P. Subtracting the orthophosphate concentration from the total phosphate provides an approximate estimate of the polyphosphate concentration for drinking water application.

With the increasing emphasis on corrosion control under the LCRI, phosphate dosing systems are a critical investment in protecting public health.

Cost of Treatment

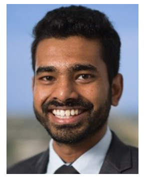
The cost of treatment is a critical factor in the design and selection of a phosphate feed system to achieve the desired treatment goal. Operational costs include chemical purchases, feed system maintenance, and water quality monitoring. Additionally, systems with complex water chemistry or extensive distribution networks may require higher chemical dosing, resulting in increased annual expenditures. The need for additional treatment at the WWTP to meet TP limits should also be considered. Therefore, utilities are encouraged to evaluate the long-term financial implications during the planning and selection of phosphate treatment strategies.

Conclusions

Designing a phosphate feed system for drinking water involves a careful balance of chemical selection based on treatment goals, water quality characteristics, equipment sizing, optimized design of system components, and regulatory compliance. With the increasing emphasis on corrosion control under the LCRI, phosphate dosing systems are a critical investment in protecting public health. In conclusion, utilities must carefully evaluate their phosphate treatment strategies, considering both immediate and long-term financial and environmental implications. ■

About The Authors

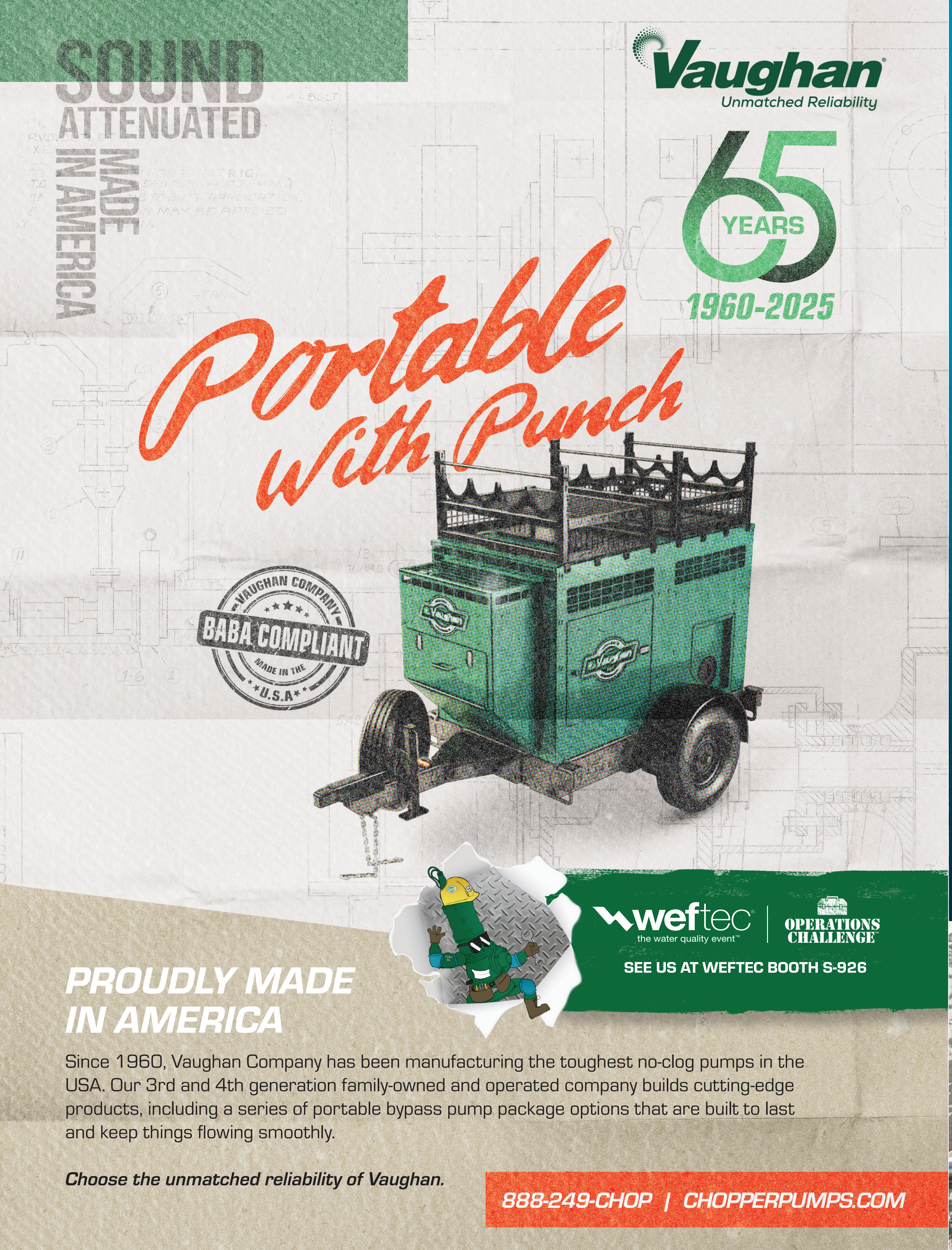
Keval Satra, PE, is a project manager and associate at HR Green, Inc., based in the Houston office. He has 10 years of experience in water and wastewater treatment and conveyance projects for municipal clients. Satra holds a master's degree in Civil Engineering from Texas A&M University and a BS in Civil Engineering from Veermata Jijabai Technological Institute (VJTI), India. He actively contributes to the water industry through his involvement in several volunteering and technical committees with both the Water Environment Association of Texas (WEAT) and the Water Environment Federation (WEF).



Mahith Nadella, PE, ENV SP, serves as a project engineer at Civitas Engineering Group, Inc., where he is engaged in diverse projects related to municipal water/wastewater treatment, collection, and conveyance. He earned a master's degree in Civil Engineering from Texas A&M University. Aside from his professional role, Nadella actively participates in various professional organizations, such as AWWA and WEF, contributing to the engineering community. He is currently serving as the vice president for the Southeast Chapter of Texas AWWA Section.

Varenya Mehta is a water engineer at Civitas Engineering Group, Inc., with over eight years of experience in water and wastewater planning, quality, and modeling. He earned his master's degree in Civil & Environmental Engineering from the University of Illinois at Urbana-Champaign. Mehta currently serves as the Chair of the Texas AWWA Water Quality & Technology Division and has been actively involved with the Southeast Texas AWWA (SETAWWA) Chapter. In 2024, he served as President of the American Society of Indian Engineers & Architects (ASIE) and is a recipient of multiple honors, including Young Engineer of the Year (ASIE and SETAWWA) and the Texas AWWA Maverick Award.

Rajeev Kamalampet, PE, is a licensed Environmental Engineer in Texas, with seven years of experience in water treatment facilities design, construction, startup, and commissioning. He earned his master's degree in Civil & Environmental Engineering from Texas A&M University, College Station.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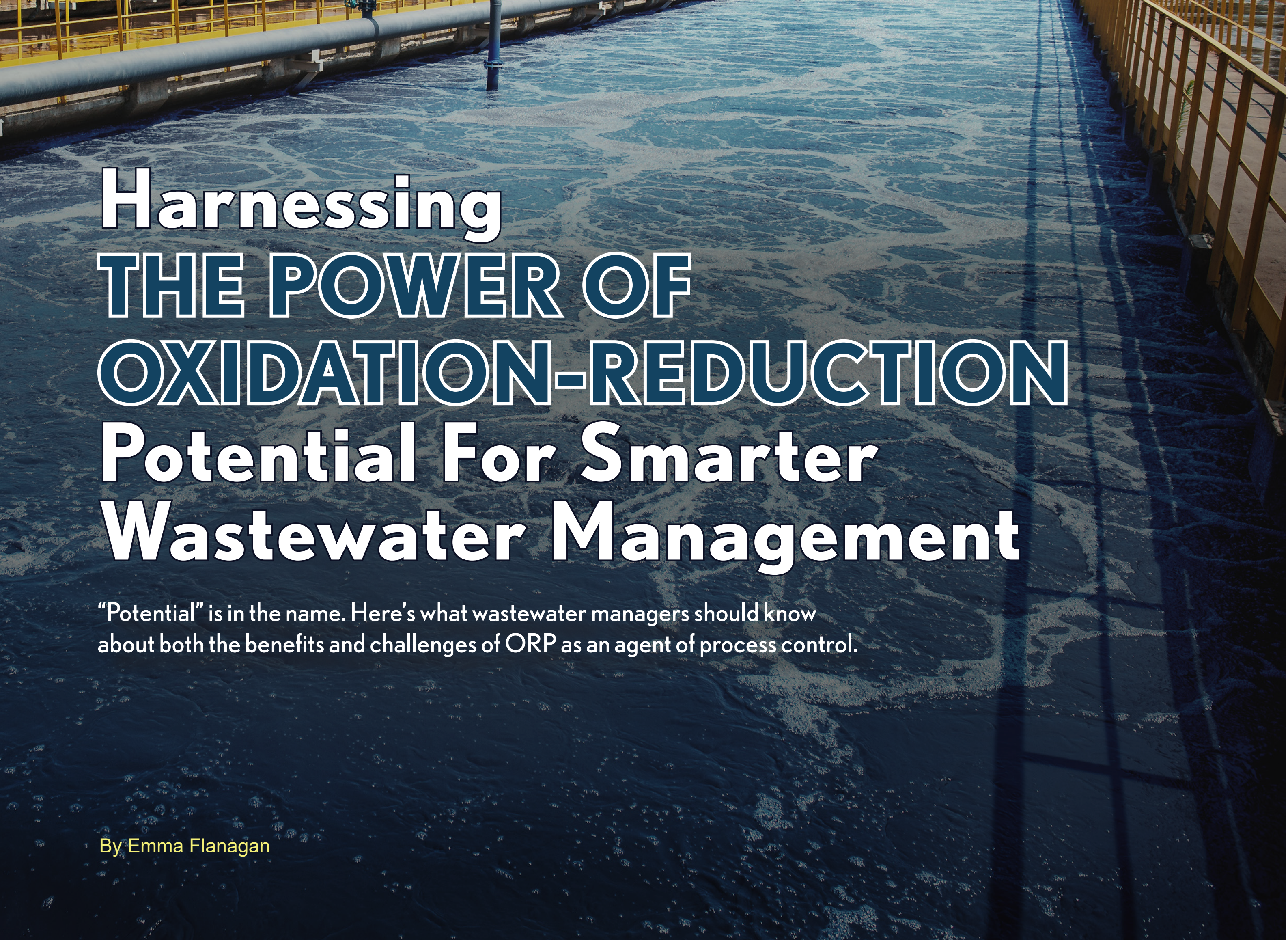


Harnessing THE POWER OF OXIDATION-REDUCTION Potential For Smarter Wastewater Management

"Potential" is in the name. Here's what wastewater managers should know about both the benefits and challenges of ORP as an agent of process control.

By Emma Flanagan

In today's rapidly evolving water resource management landscape, wastewater treatment facilities are under unprecedented pressure to improve operational efficiency, reduce chemical consumption, and meet tightening environmental regulations. One powerful, yet underutilized, tool in this effort is oxidation-reduction potential (ORP) — a real-time, integrative metric that enables more intelligent control of redox-based chemical and biological processes.

A Real-Time Indicator Of Chemical And Biological States

ORP, measured in millivolts (mV), reflects the balance between oxidizing and reducing substances in a water system. High ORP values typically indicate an oxidative environment conducive to aerobic processes, disinfection, and the breakdown of organic matter. Conversely, low or negative ORP values correspond to reducing conditions, which support processes like denitrification, sulfate reduction, and methanogenesis.

ORP provides operators with an instantaneous snapshot of the system's redox state, allowing for real-time process adjustments without relying solely on laboratory analysis. This makes it an invaluable tool for optimizing treatment efficiency, microbial health, and system stability.

Expanding Applications Of ORP In Wastewater Treatment

Initially used primarily in industrial settings, ORP is now widely adopted in municipal wastewater treatment plants. Its applications span across all major biological treatment stages: carbon removal, nitrification, denitrification, anaerobic digestion, and biological phosphorus removal.

> In an era where sustainability and efficiency are no longer optional, ORP offers a compelling return on investment.

In aerobic systems such as activated sludge basins and trickling filters, maintaining ORP values between +300 and +400 mV supports the activity of aerobic bacteria, which are responsible for the oxidation of organic matter and ammonium. During nitrification, keeping ORP above +50 mV helps prevent nitrite accumulation and ensures complete conversion to nitrate.

In anoxic zones, facultative bacteria such as *Escherichia coli* switch to using nitrate as an electron acceptor when oxygen is absent. Here, ORP values typically range from +100 to -50 mV. Operators can use real-time ORP data to detect the completion of denitrification, which allows for more efficient nitrate removal and energy savings by preventing unnecessary aeration.

Anaerobic digesters, which host methanogenic archaea, require strictly reducing environments. ORP values below -300 mV — ideally around -330 mV — are necessary for optimal methane production and volatile solids reduction. Managing ORP in these systems enhances gas yields and reduces issues related to odor and sludge instability.

Biological phosphorus removal involves alternating anaerobic and aerobic conditions. In the anaerobic phase, phosphorus-accumulating organisms (PAOs) release phosphorus and uptake volatile fatty acids, a process best maintained at ORP values below 0 mV. In the subsequent aerobic phase, ORP between +25 and +250 mV supports the uptake of phosphorus into biomass.

ORP is also a critical tool in odor and corrosion control. Maintaining ORP above -50 mV in sewer lines and holding tanks helps prevent the formation of hydrogen sulfide (H_2S), a major contributor to odor issues and infrastructure corrosion.

Performance Benchmarks And Case Evidence

The effectiveness of ORP-based process control is well-supported by empirical studies and case applications.

A U.S. municipal wastewater plant implemented ORP monitoring in its anaerobic digesters and achieved a 15% increase in methane production, along with a 40% decrease in hydrogen sulfide emissions. Another facility, managing an aerobic activated sludge system, used ORP to modulate aeration dynamically. This resulted in a 25% reduction in energy use while maintaining effluent quality within permit limits.

In Germany, a municipal facility employing enhanced biological phosphorus removal integrated ORP into its control strategy. The optimized transition between anaerobic and aerobic phases led to a 20% improvement in phosphorus-removal efficiency and significantly reduced chemical-phosphate binders.

Integrating ORP For Process Control

Real-time ORP monitoring provides an affordable and actionable indicator of biological activity. Unlike isolated parameters such as pH or dissolved oxygen (DO), ORP integrates the cumulative impact of multiple factors — including oxygen levels, temperature, and microbial metabolism — into a single, holistic measurement. This makes it especially valuable in treatment systems where chemical and biological interactions are complex and dynamic.

Operators can use ORP to fine-tune aeration intensity, adjust chemical dosing, and detect process upsets sooner. In many cases, ORP data allow for a shift from fixed setpoints to dynamic, demand-based control strategies. For example, rather than maintaining a fixed DO concentration, plants can modulate aeration based on ORP to meet microbial oxygen demand while minimizing energy waste.

Practical Considerations And Limitations

Although ORP is a powerful process control metric, it is not without challenges. Readings are influenced by various factors such as pH, salinity, and the presence of multiple redox-active species. As such, ORP values must be interpreted in the context of the specific treatment stage and system configuration.

Successful implementation requires regular probe calibration, system-specific setpoints, and integration with other sensors and supervisory control systems. When deployed thoughtfully, however, ORP becomes an indispensable component of intelligent, automated wastewater operations.

The Future Of ORP In Smart Water Management

As utilities increasingly adopt automation and digital transformation, ORP is becoming a foundational element of data-driven water treatment. Its compatibility with modern SCADA systems and its ability to serve as a proxy for multiple process indicators make it well-suited to support real-time decision-making and predictive control.

In an era where sustainability and efficiency are no longer optional, ORP offers a compelling return on investment. By enhancing microbial process control, reducing chemical and energy consumption, and preventing odor and corrosion, it positions wastewater treatment plants to operate more effectively and responsibly.

Conclusion

Oxidation-reduction potential is far more than a laboratory curiosity; it is a practical, real-time metric that connects microbial activity, chemical reactivity, and system performance. With proper calibration and system integration, ORP monitoring empowers operators to make faster, smarter decisions across all stages of wastewater treatment.

By shifting from reactive to proactive control, plants can not only meet regulatory targets but also lower operational costs and environmental impacts. In the pursuit of smarter, cleaner, and more sustainable wastewater management, ORP is a tool whose time has come. ■

About The Author

Emma Flanagan is the CEO/CTO of Envirocleen, LLC, an Illinois water treatment consulting company, manufacturer, and distributor of mineral oxychloride advanced oxidation reagent and quantum disinfection technologies. Email: info@envirocleen.com

SMARTER PUMPS, LOWER EMISSIONS:

The Digital Reinvention Of San Jose Water

Pumps are power-hungry and thus expensive to run, but San Jose Water shows how data-driven technologies and strategies can bring the cost down for utilities.

By Gary Wong

San Jose Water (SJW) is a key player in the San Francisco Bay Area, bringing fresh water to over one million California residents every single day.

In a mission to optimize its performance, the investor-owned provider launched an ambitious operations control and data initiative designed to reduce energy costs, lower carbon emissions, and unlock the full potential of its assets.

SJW operates a complex distribution network, comprising over 100 pressure zones, ranging from a handful of service connections to tens of thousands.

Monitoring its 84 stations for groundwater extraction and inter-zone pumping — as well as 229 booster pumps and 89 groundwater wells — has proven to be a large-scale challenge.

Conserving Power

Energy consumption continues to be a top focus for SJW. Pump operations account for over 90% of the utility's annual energy costs. Yet, until recently, SJW lacked the data transparency to survey and optimize this usage effectively.

To address this blind spot, the utility set out to build a centralized data infrastructure capable of aggregating and analyzing operational and asset data in real time.

In tandem, the organization set a target to slash greenhouse gas emissions by 50% by 2030.

From Silos To Real-Time Success

From the start, SJW's main pain point was a lack of operational visibility. Data was scattered across isolated systems, and real-time pump performance couldn't be easily monitored. Maintenance was reactive, which meant repairs were often costly and disruptive. Operators couldn't reliably track asset lifecycles, and downtime was frequent.

It was also a challenge to decide which pumps to operate throughout the day. With energy rates rising as much as 30% during peak hours, it was imperative to use pumps when they were the most affordable to operate.

The utility originally prioritized pumps based on the results of field-efficiency tests, which offered static information and were time-consuming and costly to perform. SJW conducted field tests infrequently, so the test results could be two to five years old.

Ethan Smith; EIT, capital planning, San Jose Water; summarizes the challenge: "We looked at improving our operating efficiency, reducing electrical costs, and lowering our carbon footprint at the same time. We also wanted to move toward more condition-based maintenance rather than reactive maintenance."

The breakthrough came with the adoption of a centralized data platform, anchored by the AVEVA PI system. The solution combined data from flow meters, pressure monitors, and level sensors, as well as SCADA and HMI systems.

This setup enabled SJW to organize data hierarchically — from stations to individual assets, such as well pumps and tanks — providing a complete and contextual view of operations.

Defining Pump KPIs And Acting Early To Detect Issues

To make sense of the flood of new data, SJW worked with Casne Engineering to develop key performance indicators (KPIs) for pumps leveraging context and system templates on the data.

These metrics define how pumps should perform under ideal conditions, allowing SJW to detect underperforming equipment in real time and act before minor issues cascade into system failures.

With energy rates rising as much as 30% during peak hours, it was imperative to use pumps when they were the most affordable to operate.

Today, operators receive alerts when a pump deviates from its KPI targets or nears the end of its service interval. As a matter of course, maintenance is proactive, targeted, and informed.

Real-time dashboards also reveal the operating cost per million gallons of water. This data is then updated automatically as electricity prices fluctuate. When a low tank triggers a pump activation, the system evaluates current rates and selects the most energy-efficient option.

Toward A Smarter Future

The results have been transformative. SJW identified a 5% overcharge from its electric utility, tracing it back across 12 months. With this data in hand, the utility recovered the excess charges and renegotiated its rates. This adjustment alone means SJW now saves hundreds of thousands of dollars annually.

And that's not all. By ensuring that pumps operate during off-peak hours, energy consumption decreased by 30%, resulting in even more cost savings. Greenhouse gas emissions have fallen by 206 tons annually, putting the utility on track to meet its 2030 climate target.

Now that the company has brought its data into a centralized location where it can view and measure asset performance against KPIs, it's making plans to take the system to the next stage. SJW is currently adopting a system for enterprise asset management and plans to integrate the enterprise-asset-management (EAM) solution to further improve its asset-management capabilities.

In summary, SJW's ambitious real-time data infrastructure initiative has transformed its everyday operations, cut costs, and positioned the utility on a clear path toward a sustainable and efficient future. ■

About The Author

Gary Wong is the global segment leader of power, utilities, and infrastructure at AVEVA, a leader in real-time, industrial, performance intelligence. He leads its global power, water, smart cities, facilities, and transportation businesses and has 25 years of extensive international experience providing sustainable, strategic, and cost-effective digital solutions. Wong is also the chairman emeritus of the Smart Water Networks Forum (SWAN) Americas Alliance.

Common Misconceptions Are Keeping Lakes "Sick"

Long-held misconceptions about lake management fuel the intensity and recurrence of harmful algal blooms.

By Dave Shackleton

Harmful algal blooms (HABs) are an escalating concern for both recreational and municipal water bodies. Driven primarily by nutrient enrichment and rising temperatures, HABs — caused by toxin-producing cyanobacteria — pose a significant threat to lake health, public safety, and water infrastructure.

Cyanobacteria are highly adaptable organisms that thrive in stagnant, nutrient-rich, and warm environments. As these conditions become more common, blooms are appearing earlier in the season, lasting longer, and covering larger surface areas. In many regions, what were once sporadic or seasonal events are now near-permanent features of the aquatic landscape.

Moreover, recent blooms are demonstrating higher concentrations of cyanotoxins, increasing the risk to human and animal health. These more toxic and widespread blooms place additional strain on drinking water treatment systems, raise public safety concerns, and complicate lake management strategies.

Without long-term strategies focused on prevention and ecological balance, the risks to both environmental and public health will continue to intensify.

Commonly held misconceptions about how to manage algae blooms are effectively keeping lakes "sick" by facilitating the dominance of cyanobacteria and accelerating the deterioration of the lake's ecosystem.

These challenges range from a long-held belief that chemical interventions are an effective solution, as well as misconceptions about the root causes of HABs, and even confusion over the metrics used to assess lake health.

These misconceptions highlight the true root causes, such as hypoxia, sediment accumulation, and nutrient recycling, and promote more effective, natural, chemical-free management strategies.

MISCONCEPTION: Chemical Applications Effectively Control HABs

The most common conventional approaches to addressing invasive weeds and algae blooms typically rely on the use of treatment chemicals.

However, biocides (herbicides and algaecides) as well as chemicals designed to reduce phosphorus levels accelerate the deterioration of the reservoir's ecosystem while increasing the frequency and intensity of HAB events.

Algaecides

Algaecides are chemicals specifically formulated to kill algae, including cyanobacteria. While effective, the side effects of the process are what keep lakes sick. In fact, over time, the use of algaecides accelerates the onset of toxic HABs and intensifies them.

Algaecides, specifically, have been proven to be more effective against beneficial algae than against toxic cyanobacteria.

By killing algae and cyanobacteria cells, toxins are released that lead to the destruction of more beneficial organisms. The dead algae cells also sink to the sediment and, as they decompose, recycle nutrients to fuel more algae blooms. This decomposition causes oxygen to be consumed in the water, leading to hypoxic conditions, or "dead zones," where aquatic life cannot survive.

Over time, the continued application of algaecides causes compounds — the sediment-nutrient stockpile at the bottom of a lake that are recycled to feed more algae blooms and shift the profile of the phytoplankton towards more and more cyanobacteria.

Herbicides

Herbicides are applied to manage invasive or nuisance aquatic weeds growing in the nutrient-rich sediment. Like algae, dead weeds sink to the sediment and decompose, contributing to oxygen depletion and fueling more algae blooms.

Other secondary effects of herbicides include habitat loss and ecosystem imbalance. They can even pose risks to human and wildlife health, especially in drinking or recreation waters.

Alum And Other Phosphorus Precipitants

Alum and other phosphorus precipitants are chemical agents used to reduce the levels of total phosphorus (TP).

Alum, short for aluminum sulfate, is the most used of these compounds. Other precipitants, such as ferric chloride or ferric sulfate (iron-based), and calcium compounds like lime, function similarly by chemically binding phosphorus and precipitating it out of the water, down into the sediment.

The logic is reasonable: Take phosphorus out of the water that cyanobacteria use as a nutrient source.

Precipitants deposit phosphorus into sediment. When sediment is hypoxic, the microbiology changes and recycling of nutrients accelerates. Beneficial algae cannot access them there, because they can only float passively near the surface. Cyanobacteria can control their buoyancy and descend to the sediment to use those nutrients, so precipitating phosphorus into the sediment helps cyanobacteria become even more dominant over time.

In short, lake management reports that tout the killing of algae with algaecides and weeds with herbicides are not telling the whole story.

"[C]hemical and physical methods either dampen the effects of a bloom or shorten the bloom, but do not prevent the bloom," says Wayne Carmichael, PhD, a prominent expert in aquatic toxicology, known for his work on toxic cyanobacteria. He adds that the net effect is often only a temporary improvement of lake conditions for a few weeks or months.

MISCONCEPTION: There Are No Visible Algae Blooms And Aquatic Life Is Evident, So The Lake Must Be Healthy

A common misconception in lake monitoring is the reliance on surface-level measurements of dissolved oxygen to assess overall water quality.

While surface readings may appear normal, they provide no indication of the oxygen conditions at depth where the most serious problems originate. Hypoxia, or low oxygen levels, begins in the deeper layers of a lake due to decomposition of organic matter, which causes sediment-nutrient accumulation. These conditions go undetected when monitoring is limited to the upper water column.

As a result, stakeholders may develop a false sense of security, unaware that the lower strata are highly hypoxic — an environment that supports internal nutrient recycling and fuels the proliferation of HABs.

Other indicators, such as evidence of aquatic life, can be misleading.

If fish are being caught only in the upper levels of the lake, it may be because the deeper waters are hypoxic and all the fish are being forced up to shallower water that is still oxygenated, making them easier to catch.

MISCONCEPTION: Nutrient Inflows Are The Primary Problem

A common misconception in lake management is the belief that nutrient inflows from the watershed are the primary issue, and therefore, financial and operational resources should be concentrated exclusively on mitigating these external sources.

These external sources of nitrogen and phosphorus include agricultural runoff, sewage, stormwater, septic systems, groundwater, and atmospheric deposition that run into the lake.

That issue likely passed decades ago. In many lakes, it is the internal sources that contribute more nitrogen and phosphorus to algae blooms. The threat is from the decades of accumulated phosphorus and nitrogen stored in the organic sediment.

These act like a high-risk "time bomb" that is released under low-oxygen or stratified conditions, particularly during warmer months.

Lake Honeoye, one of the Finger Lakes in upstate New York, is a textbook example. Despite significant and expensive efforts to eliminate nutrient inflows from its watershed, persistent HABs worsen every year.

When the lake's deep-water oxygen levels drop below 1.0 mg/L, sediment-bound phosphorus is released into the water column. This internal recycling becomes a self-sustaining driver of eutrophication and recurring HABs.

MISCONCEPTION: A Good Trophic State Index Score Means The Lake Is Healthy

For the past five decades, the Trophic State Index (TSI) has served as a standardized eutrophication assessment, but it has significant limitations and redundancies.

The traditional TSI, which was developed in the 1970s by Robert E. Carlson to quantify nutrient-driven productivity in lakes and reservoirs, only measures and correlates symptoms and gives little indication of conditions at depth, which is where the root causes of the problems play out.

The narrow emphasis on symptoms has led to many misguided lake management practices. This includes reactive, short-term actions such as the use of algaecides and phosphorus precipitants that temporarily improve TSI scores but ultimately worsen the underlying causes and hasten the development of HABs.

A more effective approach to assessing lake health involves quantifying the volume of hypoxic water to evaluate the extent of oxygen-depleted zones within the reservoir, combined with continuous phytoplankton monitoring to track the balance between beneficial algae and harmful cyanobacteria.

These factors can be systematically monitored using the Reservoir Risk Assessment and Tracking System (RRATS), which consolidates the data into a streamlined Reservoir Risk Index score.

This score provides a clear and actionable indicator of a reservoir's current risk status. Only with this foundational understanding can lake managers effectively prioritize interventions, allocate resources strategically, and implement early risk mitigation measures.

From Misconceptions To Meaningful Solutions

Decades of misconceptions have led to lake management strategies that often treat symptoms rather than root causes. As a result, many lakes continue to decline despite costly and well-intentioned interventions. Misguided reliance on chemical treatments, surface-level oxygen readings, and outdated metrics has created a cycle of temporary improvements followed by worsening conditions.

By addressing the true root causes of water quality decline — such as sediment-bound nutrient release and oxygen depletion — lake managers can move beyond reactive, short-term fixes. With a more holistic and preventative approach, supported by better data and monitoring tools, the path to healthier, more resilient lakes becomes not only clearer but also achievable. ■

About The Author

Dave Shackleton is the president of Clean-Flo International, a U.S.-based leader in biological water management solutions for lakes, reservoirs, rivers, and wastewater treatment facilities.

INTEROPERABILITY UNLOCKED:

How Connected Systems Will Power Water's Future

The full potential of smart water infrastructure is within reach — if our digital systems work together and share critical data.

By Dr. Frank Schlaeger

Over the past decade, the water sector has made huge strides towards digital transformation. From smart meters and advanced leak detection to AI-powered forecasting and real-time monitoring, utilities have access to more data, tools, and technologies than ever before.

Yet for many, the full promise of smart water networks remains out of reach. Why? Because many of these systems don't yet talk to each other.

Interoperability — the ability for different technologies, devices, and platforms to seamlessly share and use data — is the missing link in delivering truly smart and responsive water infrastructure.

Without it, utilities are left juggling isolated systems, unable to realize the efficiencies, resilience, and customer benefits that a connected network should provide.

The Foundation Of A Smart Water Network

At its heart, smart water infrastructure is about visibility and control. Sensors track flow rates, pressure, water quality, and reservoir levels. Forecasting tools provide insight into future supply and demand. Customer metering systems feed back on consumption patterns.

> **Without a clear strategy for data sharing and interoperability, the full potential of smart systems remains untapped.**

In theory, bringing all this information together should allow utilities to optimize their operations in real time. But these advantages depend on one crucial factor: The data generated across the network must be easily shared, combined, and analyzed.

When devices use proprietary protocols or when platforms are built as closed ecosystems, this becomes difficult or even impossible. The result is a patchwork of isolated systems that fall short of delivering the holistic, data-driven decision-making that defines a smart network.

What's Holding Us Back?

There are several reasons why interoperability remains a challenge in the water sector.

First is the legacy of existing infrastructure. Many utilities operate equipment and systems installed long before the idea of a smart network took hold. SCADA systems and telemetry devices were often designed to work in isolation or within specific vendor ecosystems. Integrating these with modern, open systems can be technically complex, not to mention costly.

Second is the diversity of technology suppliers. The water industry works with a wide range of vendors, each offering their own solutions, often with unique data formats or communication protocols. While this diversity drives innovation, it can also create fragmentation. Without shared standards, integrating these different technologies can become a significant barrier.

Third is organizational culture and structure. Utilities are complex organizations, and data can sit in silos between departments. The wastewater team, for example, may use different tools and platforms than the drinking water team, with limited integration (or even conversation) between the two.

Without a clear strategy for data sharing and interoperability, the full potential of smart systems remains untapped.

The Cost Of Fragmentation

The consequences of poor interoperability go beyond inconvenience. They can have real operational and financial impacts.

When systems can't share data easily, utilities lose time and insight. Operators may have to manually transfer data among platforms or rely on incomplete information to make critical decisions.

In emergency situations (such as responding to a major leak, flood event, or contamination incident), that delay can affect both service quality and public safety.

A lack of integration also increases the total cost of ownership. Utilities may end up duplicating monitoring equipment or investing in middleware just to get basic systems talking. A major challenge with evolving technologies is that the cost and complexity of integrating new devices and platforms increase, unless interoperability is prioritized from the start.

Towards A Connected Future

The good news is that the industry is increasingly recognizing the importance of interoperability and progress is being made.

Many technology providers are adopting open standards and protocols, making it easier for their systems to work alongside others. Examples include widespread support for MQTT, OPC UA, and other communication standards that enable data-sharing across platforms. Utilities themselves are starting to specify interoperability as a core requirement in procurement, pushing suppliers to design with openness in mind.

Collaborative initiatives, including those driven by industry bodies and regulators, are helping to define common data models and integration frameworks. These efforts not only make technical integration easier but also support a more competitive, innovative supplier ecosystem by leveling the playing field.

There is also growing interest in cloud-native platforms that act as central hubs for data from across the network. These platforms can bring together information from diverse sources (legacy systems, modern IoT sensors, external data feeds) and provide operators with a unified view of their infrastructure.

Crucially, they offer scalability, thus helping utilities future-proof their networks as technology continues to evolve.

> **The vision for smart water infrastructure is compelling: networks that can self-optimize, detect, and respond to issues before they become problems, and deliver better service at lower cost.**

The Human Factor

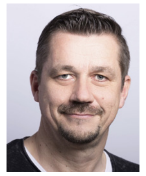
Of course, achieving interoperability isn't just about technology. It requires leadership and collaboration. Utilities need to develop clear data strategies that prioritize integration and openness, breaking down internal silos and encouraging teams to work together.

Suppliers need to recognize that their customers increasingly value openness and long-term flexibility over lock-in. Regulators can play a role by encouraging or even mandating data-sharing practices that support resilience and efficiency.

The vision for smart water infrastructure is compelling: networks that can self-optimize, detect, and respond to issues before they become problems, and deliver better service at lower cost. But we won't get there if we build systems that operate in isolation. Interoperability is the key that will unlock the true potential of digital transformation in the water sector.

By embracing open standards and prioritizing data integration, we can build smarter, more resilient water networks and ultimately deliver greater value to the people we serve. ■

About The Author



Dr. Frank Schlaeger is the head of enterprise solutions for the HydroMet Business Unit at KISTERS, with over 20 years of management experience. He has led major international projects across Europe, Asia, North America, and Australia and has been a key figure in the technical development of water quality modules within the WISKI software suite. Dr. Schlaeger holds a doctorate from RWTH Aachen University, where he specialized in water resources management and water quality simulation.