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FROM THE EDITOR

By Kevin Westerling
Chief Editor, editor@wateronline.com

Celebrating **50 Years** Of (Mostly) Clean Water

October 18, 1972, the day the Clean Water Act became law, was undeniably a pivotal moment for the state of water quality in America. From where we stand now, 50 years later, it's hard to imagine a time when polluters were dumping contaminants freely into environmental waters — enough to set a river on fire!

Many readers will remember the image of Ohio's Cuyahoga River ablaze on the cover of *Time* magazine in 1969 and the resulting impact. Soon after, in 1970, the U.S. EPA was created and the first Earth Day was celebrated. Two years later, Congress enacted the Clean Water Act (CWA), which was a renaming of the Federal Water Pollution Control Act of 1948 following the sweeping set of amendments that updated it.

The six key 1972 amendments described in bold below (via EPA.gov) are accompanied by some recent themes that come to mind — mine at least — related to each one, giving current context to the CWA's stated goals.

Amendment 1: Established the basic structure for regulating pollutant discharges into the waters of the United States.

"Waters of the United States" has been fought over since the Obama administration introduced the "WOTUS" rule in 2015, seeking to expand federal regulatory oversight to systems "connected" to navigable waters, such as streams and wetlands. During the Trump administration, the rule was suspended, repealed, and replaced, but the replacement rule was thrown out in court. Now called the Clean Water Rule, the Biden administration has promised to return the rule to WOTUS circa 2015.

Amendment 2: Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.

PFAS weren't known as contaminants in 1972, but they are found far and wide in 2022. The same can be said for microplastics. While the EPA's authority "to implement pollution control programs such as setting wastewater standards for industry" has obviously improved water quality — no more rivers on fire — industrial processes have still polluted the environment in less obvious but extremely pervasive ways.

Amendment 3: Maintained existing requirements to set water quality standards for all contaminants in surface waters.

Unfortunately, when I think of surface waters and water quality today, an image of harmful algal blooms appears — HABs, for short — so named because of the toxic cyanobacteria within them that can kill fish and other aquatic species, even pets, and have serious deleterious effects in humans. The questions of where and how to adequately prevent, control, and ultimately remediate HABs continue to plague municipalities.

Amendment 4: Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.

"Navigable waters" reminds me of *County of Maui v. Hawai'i Wildlife Fund*, which Earthjustice described as the "Clean Water Case of the Century." The 2020 verdict established that point-source discharges "into navigable waters, *or when the discharge reaches the same result through roughly similar means*" [emphasis mine], can be regulated under the Clean Water Act. The "similar means" in the case against the County of Maui was through groundwater, establishing that this is no buffer to regulatory relief.

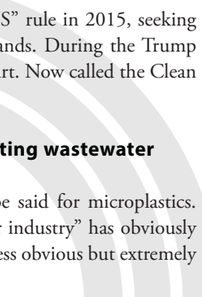
Amendment 5: Funded the construction of sewage treatment plants under the construction grants program.

The 1972 amendment that provided funding for construction of wastewater treatment facilities is 50 years old, which means that many are now far beyond useful life. Infrastructure renewal got a boost with the recent *Infrastructure Investment and Jobs Act (IIJA)*, but the needs still outweigh funds.

Amendment 6: Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

While I can't speak to what lawmakers and the nascent environmental movement were specifically wary of back then, today's nonpoint source pollution issues seem largely due to agricultural runoff — a main cause of HABs — and stormwater management, including the prevention of sewer overflows.

Fifty years of great progress, but water work is never done! ■



GETTING THE MOST FROM YOUR PUMP STATION WITH **COMPUTATIONAL FLUID DYNAMICS**

Carollo has developed computational fluid dynamics (CFD) modeling approaches and methods to evaluate and optimize pump intake hydraulics, embracing an industry trend that improves the efficiency, affordability, and reliability of water/wastewater infrastructure projects.

By Ed Wicklein

For good reason, CFD modeling is being employed ever more frequently in the water sector — for smaller facilities that typically are not physically modeled due to cost relative to the project budget; for optimizing designs prior to physical modeling; and for facilities when results are needed rapidly. Using CFD modeling minimizes costs and risks while enabling verification of complex designs.

The Hydraulic Institute, a consortium of pump manufacturers, engineering designers, and end users, has agreed on generally acceptable flow conditions that the wet well geometry needs to deliver to a pump, and has provided guidance on facility layout and hydraulic conditions. Traditionally, scale physical models have been used to verify or optimize the hydraulics of larger facilities (pump systems starting at 10,000 gallons per minute [gpm] or higher, depending on system geometry). However, these models can have limitations, including the time it takes to build them, production costs, and space constraints for maintaining a model through design and construction of a project, which can take up to several years.

Many Carollo projects involve dynamic pumps, which move large volumes of water by converting input kinetic energy to liquid flow. The equipment is certified by the manufacturers to deliver a specified flow and head before it is incorporated into designs. The pump's rated pump flow and head are based on fairly optimal flow conditions. With that in mind, it is imperative to deliver water to the pump with balanced velocity, minimal rotation, low turbulence, and minimal vortex activity for long-term reliable operation.

Case Study #1: Self-Cleaning Headworks Pump Station

The recently constructed city of San Leandro, CA, influent pump station is a 27-MGD facility that has six total submersible pumps in parallel, self-cleaning trench-style wet wells with three pumps in each. CFD modeling evaluated and optimized the system hydraulics by testing a range of flows and pump operating conditions. The model showed a uniform velocity entering the pumps, but high swirl and turbulence (almost 2 times and 1.3 times greater than recommended, respectively) and excessive vortex formation, which can be seen in Figure 1. The model was used to test geometric modifications such as fillets and a center flow splitter. Wet well modifications reduced the maximum swirl by 75%, lowered the turbulence levels, and reduced vortex formation.

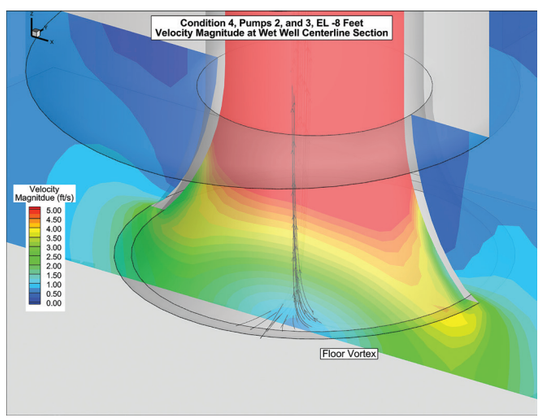


Figure 1

Additionally, the model was used to simulate a self-cleaning cycle to evaluate the performance, as shown in Figure 2. The results showed that the upstream portion of the wet well scoured, while the hydraulic jump entrained lighter material, maintaining sufficient submergence on the downstream pump.

Case Study #2: Custom Pump Retrofit Saves Time And Money Replacing 48 Pumps

Process improvements at the Sacramento Regional County Sanitation District (SRCSD), CA, treatment plant required changes to the return activated sludge (RAS) pumping, including both higher flow and head. As highlighted in Figure 3, the RAS pumps were in open bottom cans adjacent to the secondary clarifiers. Since the piping was in place for the 24 existing clarifiers, the design goal was to reuse the existing cans, thereby saving significant construction effort.

A CFD model was used early in the design process to identify likely hydraulic conditions in the open bottom can pumping system. Overall, the CFD model showed that the intake hydraulics were acceptable with the proposed larger pumps in the existing cans. The velocity distribution on the system centerline plane is shown in Figure 4. Although flow separation was observed entering the can, the velocity was mostly uniform when it reached the pumps. Figure 5 shows a possible vortex that may develop near the pump inlet. The CFD model also found slightly elevated turbulence levels entering the pumps.

Given the overall size and complexity of the project, a scale physical model was also prepared to verify the CFD model results. The physical model verified the hydraulic conditions identified in the CFD model, such as higher, but acceptable, turbulence and intermittent vortex formation from the can wall, shown in Figure 6. Based on the results of the CFD modeling and physical modeling, the facility was upgraded with new pumps that are currently installed and in operation.

Summary And Conclusions

CFD modeling is frequently used to evaluate and improve the layout and geometry of new and retrofitted pump stations. Carollo has successfully used this tool for verification and/or improvement of many pump stations, enhancing our understanding of both the modeling approach as well as the analysis of results. ■

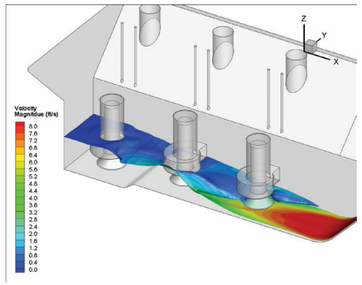


Figure 2

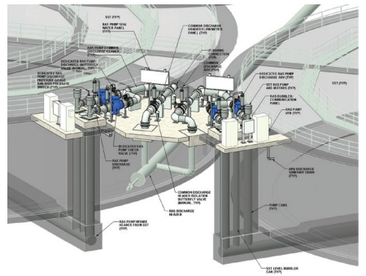


Figure 3

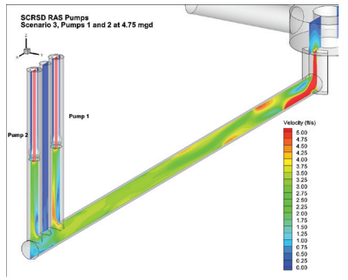


Figure 4

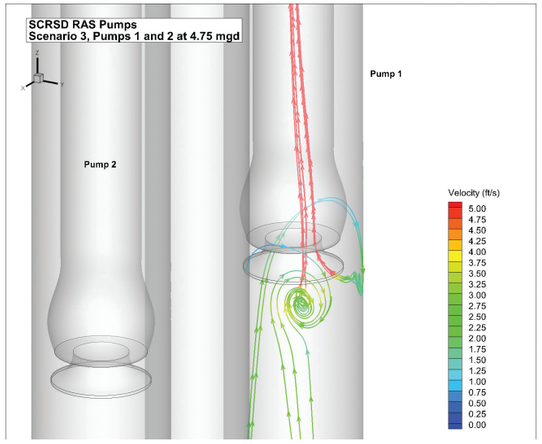
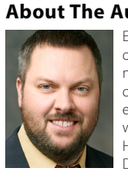


Figure 5

Figure 6

About The Author



Ed Wicklein, principal technologist at Carollo Engineers, has 23 years of experience in design and analysis of hydraulic facilities using numerical models. He has conducted thousands of CFD studies of municipal facilities, including many pump intake hydraulic evaluations, as well as detailed modeling of most of the major water and wastewater treatment components and processes. He is an active member of the Hydraulic Institute Pump Intake Design Committee and the lead or co-author of four chapters of the International Water Association book *CFD Modeling for Wastewater Treatment Processes*.

6 STEPS UTILITIES CAN TAKE TO IMPROVE CYBERSECURITY

By Mark Carde

Cybercrime is on the rise, and the utility industry has become an increasingly common target. The energy sector plays a critical role in the U.S. infrastructure, and unexpected events such as water or gas shortages, severe weather, and rolling blackouts can give cybercriminals ample opportunity to wreak havoc on energy providers and the communities or government agencies they serve.

A recent report[1] found that 94% of global critical infrastructure organizations (e.g., utility providers[2] and government agencies) face difficulties when implementing cyber-threat detection protocols, multi-factor authentication, and protection and rapid response strategies. In fact, only 37% of U.S. critical infrastructure organizations are utilizing multi-factor authentication, and a mere 29% have implemented zero-trust architecture.[3]

U.S.-based organizations are no exception. Last year, the FBI received 847,376 complaints[4] of suspected cybercrime, reaching losses of around $6.9 billion.

How Can Utility Providers Protect Themselves?

There are six main ways that utilities can safeguard themselves from unwanted cyberattacks:

1. **Promote and implement security education and awareness within your organization through regular training and protocols.**

According to the IBM Cyber Security Intelligence Index Report, 95% of cybersecurity incidents resulted in part due to human error.[5] Phishing emails and smishing[6] text messages have dramatically evolved. They now appear more convincing and authentic than before. Even social media platform Snapchat unwittingly fell victim to a phishing[7] attack in 2016.

Hackers are upping their game and using more creative ways to access sensitive data. That's why all employees and personnel should understand how to identify and prevent cybersecurity incidents.

2. **Learn how to identify and report email or text message scams.**

Cybercriminals often use email and text messages to gain access to a company's digital infrastructure or data.

According to the Federal Trade Commission (FTC),[8] these messages often appear to be sent by a trusted organization or business, such as a bank, social media platform, online payment app, or even credit card company. The sender may claim they've noticed unusual activity linked to an individual's banking account, include a fraudulent invoice, or request identity verification.

By training employees to approach text or email messages from third parties with a healthy amount of skepticism, utility companies can avoid data breaches, ransomware attacks, disruptions, and more.

According to the IBM *Cyber Security Intelligence Index Report*, 95% of cybersecurity incidents resulted in part due to human error.

3. **Use strong passwords.**

Teaching employees how to implement strong passwords is the first line of defense against cybercrime. Passwords should include a random combination of letters, numbers, and characters. Employees should also be told to refrain from sharing their account passwords with anyone else.

4. **Implement multi-factor authentication.**

Multi-factor authentication[9] requires users to verify their credentials using additional layers of security. This multi-tiered approach adds additional protection to any device, online network, or database. Even if a nefarious third party breaches the first authentication request, it's unlikely that they'll successfully gain access to the second. Multi-factor authentication typically asks users to provide answers to personal questions, but entering a second or third password here can add further protection to one's account.

5. **Implement standard tools and technologies that can protect your utility from unwanted cyberattacks.**

Because non-U.S.-based hackers often target American businesses, it may be helpful for utilities to block traffic from countries or locations in which they don't conduct business or offer services. Some cybersecurity experts believe that the biggest digital threats[10] stem from Russia or China, so prohibiting traffic from these areas could help protect your utility from unwanted threats.

Working with remote employees also presents unique challenges. Make sure that *all* connected devices are managed by your utility. Block unknown devices and ensure that any employees who log in are who they say they are. Certain tools and applications allow remote employees to validate their identities, whether using unique codes or other identifiers like their fingerprints.

It's also important to adopt a standard — whether it's protocols set forth by the National Institute of Standards and Technology (NIST),[11] ISO, or the PCI Security Standards Council. Implementing processes, controls, and procedures will establish a solid framework. Although these policies may evolve due to changing threats and technology, they create a strong foundation that will protect your utility. These protocols will also guide teams that need direction, helping them move forward productively.

6. **Update and modernize Internet of Things (IoT) devices.**

The more devices you use, the more risk you take on. This is especially true in the areas of distribution and generation for water, gas, and electric providers. These utilities use many devices that reduce workload and streamline meter readings. All of them are typically network-enabled, making them vulnerable to unwanted third-party access.

Make sure to keep a detailed inventory of all devices. It's also critical to keep these devices updated and replace them with newer equipment when necessary. Failing to do so can lead to disaster. If hackers infiltrate a network-connected device, they could increase gas or chemical flow in a certain area, causing an explosion that has the potential to harm communities.

Conclusion

New and evolving cybersecurity threats have the potential to cause significant damage to utilities and the communities they serve. How can utilities protect themselves?

Training employees to identify phishing and smishing messages, implementing security measures, and updating network-enabled devices can keep utility providers safe from falling victim to cyberattacks. ■

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A DECADE OF PROGRESS AND SHIFTING CONCERNS IN THE U.S. WATER INDUSTRY

Although the water industry has a reputation for being slow to change, the past 10 years provide evidence to the contrary.

By the Black & Veatch Insights Group

When Black & Veatch released its first water report in 2012, fading infrastructure, an aging workforce, and financial obstacles were top-of-mind concerns for the leaders in the nation's water industry. Ten years later — though the drivers of these forces largely have changed — the sector still grapples with them. The biggest difference? They're now complicated — and in some ways eased — by the increasing influences of digitalization and resilience.

As the tangled threats of an aging workforce, budget constraints, extreme weather events, and deteriorating assets push against the newer influences of the increasing reliance on and protection of digital systems and a front-and-center focus on sustainability and resilience, burgeoning opportunities flood the water industry.

Amid this changing landscape, water utilities find themselves perfectly poised to take on major transitions in how and even why they operate. As they mitigate both long-standing and newly developed challenges, U.S. water utilities are opening up to new tools, practices, and motivations. Overall, the sector finds itself using data and technology to do more with less as it navigates changing workforce and environmental, social, and governmental (ESG) considerations and funding opportunities.

Converging Concerns And Financial Inputs

Comparing results of Black & Veatch's survey of more than 300 U.S. water industry stakeholders for the 2022 water report to the company's similar polling from 2012 demonstrates an industry at once evolving rapidly yet unable to outrun some enduring challenges.

As with each year the survey has been conducted, the 2022 outreach began with a call to identify the industry's pressing issues. To little surprise, aging infrastructure topped the list, as it did in 2012. The second largest challenge in 2022 — hiring of qualified staff — wasn't an option in the 2012 survey. This, along with issues around the industry's aging workforce (also rising in the survey from seventh to fourth), underscores the significant strain to develop and retain human capital resources.

Despite its drop in concern over time, funding remains a major headwind for industry leaders. Though the federal government is coordinating support for the water industry, especially for contaminant removal and infrastructure upgrades, industry need will continue to outweigh current investment, at least in the near term. The Biden administration has offered a lifeline in the Infrastructure Investment and Jobs Act (IIJA) that earmarks $82.5 billion for critical water investments, with the largest portions allocated to improving safe drinking water and sanitation. These commitments will help revitalize aging infrastructure but will only get the ball rolling on the numbingly large number of necessary improvements.

Because of the availability of new funding, managing capital and operational costs dropped in concern over the past decade, yet they remain within the top 10 of the ranked issues affecting the industry. Another element of costs — justifying capital costs — comes in prominently in the sixth spot. This points to a difficult conclusion regarding the decade's progress: Issues may not necessarily be changing, but they're multiplying. Long-standing concerns remain at the forefront, while new and developing obstacles emerge to grab mindshare.

Though federal funding will aid the industry, continuing investment and concentrated effort will be required to revitalize the water sector and stimulate its long-term success. But finances are only a portion of the issue. As the water industry progresses, it also grapples with finding solutions that cannot simply be bought.

From your perspective, what are the most challenging issues facing the water, wastewater, and stormwater industry today?

Source: Black & Veatch

	Rank	
	2022	2012
Aging water and wastewater infrastructure	1st	1st
Hiring of qualified staff	2nd	—
Increasing/expanding regulation	3rd	5th
Aging workforce	4th	7th
Funding or availability of capital	5th	3rd
Justifying CIPs and/or rate requirements	6th	—
Managing capital costs	7th	2nd
Water conservation	8th	11th
System resilience	9th	—
Managing operational costs	10th	4th/7th*
Treatment technology	13th	6th
Information technology	14th	9th

— A dash indicates the answer wasn't included in 2012

* Managing energy costs and Chemical cost asked in 2021

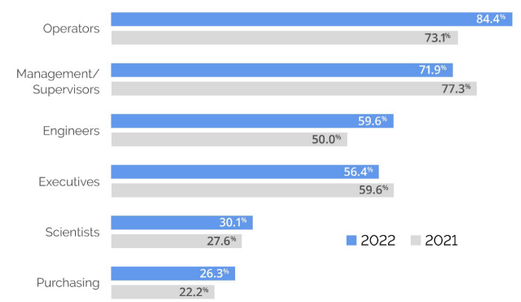
Staffing Instability

The modern water industry is definitely a worker's market. As the "Great Resignation" era and an aging water industry workforce intertwine to place demand for workers at an all-time high, hiring qualified staff has become such a worry that it's taken the second highest spot on the list in 2022. By comparison, it ranked 14th in Black & Veatch's 2017 survey results.

As workers age out, retire, and pivot careers, the workforce to replace them is dwindling rapidly. While digitalization stands to remove some of the burden on those who remain, much of the stress falls upon field roles that cannot yet be automated. When survey respondents were asked which roles are impacted most by the changing workforce, operators and managers stood out as the top two.

For each of the following job categories, how significant will the impact of employee retirements be over the next five years? *(Select one per row)*

Source: Black & Veatch



Which is the main challenge for improving asset management in your organization? *(Select one)*

Source: Black & Veatch

50.6%
Developing the required systems and processes needed to improve asset management

17.6%
Too much data without quality information for decision making

16.5%
Defining what asset management is and communicating it to the workforce

11.8%
Lack of asset management capabilities in the workforce

3.5%
Getting senior management buy-in to improve asset management

The Water Industry In The Information Age

As the water industry's top challenges heavily influence the plans, projects, and projections the industry is creating, the information age offers significant tools in the realms of digitalization and data collection, many of which were underutilized or undeveloped a decade ago.

In 2022, data collection for any business is widely accepted and often prioritized, though barriers to effective interpretation and use remain, especially in utility industries. Nearly seven in 10 respondents to Black & Veatch's latest survey reported they collect "lots" of data, although 41% admit they are not leveraging it effectively — many companies are data rich but information poor.

When asked what they found to be the main challenge for improving asset management, nearly one-fifth — 18% — of respondents selected "too much data without quality information for decision-making," while "developing the required systems and processes" — which nowadays often includes data collection and management — was the highest concern.

Where data collection once was underappreciated, we now collect so much information that we overwhelm ourselves. With heaps of unorganized but plentiful data at our disposal, we falter in the task of making it useful. To ensure the data collected are deployed as an advantageous asset, utilities must create master plans for data analysis, extrapolate long-term trends, and glean actionable items from the revelations it offered.

The tools to do so are plentiful and are making it easier than ever for even the most tech-averse individuals to capitalize on data. With data dashboards and business intelligence, utilities can now organize and display meaningful statistics in an interactive format that can easily be manipulated for various metrics and results, giving simple, data-driven insights. Digital twins — virtual models of assets that can run simulations of various possible scenarios to determine outcomes and mitigation strategies — also offer interactive, meaningful interpretation of collected data.

New Tools For New Tasks

Though the past 10 years have seen the water industry challenged by new obstacles, the decade has also yielded new and exciting tools to combat them. Though respondents to Black & Veatch's survey find workforce availability and resilience concerns to be higher priority than before, digitalization and data collection offer a myriad of methods to lessen the impacts.

Digitalizing systems opens a wealth of potential for data collection and analysis, which can be used to deepen understanding of almost anything, to predict or anticipate potential failings in assets, and to drive enhanced decision-making processes. For many utilities, the ability to track long-term trends with data has unlocked significant benefits for boosting efficiency, mitigating water loss, and strengthening system resilience. Data collection and digital systems can even mitigate workforce availability issues by automating processes and boosting efficiency, thereby decreasing overall workload.

Though the enduring and arising challenges the water industry faces can seem monumental at times, a long-term view of the past decade gives hope by illustrating an industry that is actively adopting new practices and technologies to evolve. Though time has brought new challenges, it has also brought many ways for utilities to rise to them, should they so choose. ■

About The Author

Black & Veatch is a 100% employee-owned global engineering, procurement, consulting, and construction company with a more than 100-year record of innovation in sustainable infrastructure.

Delivering Digital Water — *ARE WE THERE YET?*

The water industry's greatest technology trend is also one with scattershot levels of adoption, but that can change with proper understanding of the purpose for and pathway toward Digital Water.

By Oliver Grievson

Digital Water, Water 4.0, or smart water — whatever you want to call it — has been a concept that has been around for many years. While speaking on smart wastewater networks at a conference around six or seven years ago, an audience member challenged, "But we've been talking about smart wastewater networks for 10 years now, and we still haven't delivered many."

This is, of course, the truth about Digital Water. It is something that we've struggled with, to grasp its concept and tangibility, because the benefits of Digital Water are not very well known, and the opinion of most is that "Digital Water" is a buzzword for the latest technology. In some regards, people are right in saying that and there are a lot of water companies that will pick up the latest fad in technological innovations, run with it for a few years, and then get bored of it or discover an even newer technology that gets adopted instead. It's the attraction of pretty, shiny things that look good but deliver only some of what they promise.

For those who truly are ready, the first step in any Digital Water journey is about the people — it's about stakeholder engagement, from the CEO of the water company to the operator on the ground.

For the past few years, within the water industry, I have heard artificial intelligence (AI) being hailed as the future, with proclamations that we can use AI to solve this problem or that problem without much of a clue as to what AI can actually do. This is half the problem with Digital Water — most people don't realize that it's a collection of tools utilized to get the best out of a dataset to glean insight on what's happening within a real-world scenario.

What Is Digital Water?

If you have a room with a hundred people in it, then you will probably get a hundred different answers. To me, Digital Water is using the many forms of data that all water companies collect to gain insight into and situational awareness of a system's performance. The system can be a wastewater collection network or an entire wastewater treatment system, or it can be the entire anthropogenic water cycle (although the scale of this is somewhat daunting).

The water industry has always suffered from the DRIP (data rich, information poor) phenomenon. It can be argued that there is data poverty as well, depending on the data quality and how a company looks after its data sources (mainly its instruments). What companies usually fail to do — as they simply don't have time — is to use the many forms of data and bring them together to gain insight. For example, I've conducted investigations into why a treatment works is receiving too much flow for the number of people that it's thought to serve. In these investigations, you tend to look at your data sources to see if they are right, usually finding that one of them is wrong or out of date. The conclusion of the investigation typically results in instrument error due to incorrect setup, a steady increase in population served without anyone knowing, or some sort of infiltration into the network. By looking at the flow data alone and understanding the system, you can understand what's happening, whether attributable to a cracked pipe, a faulty instrument, or lack of communication with planning authorities. All these investigations were manual tasks with costly resolutions. But what if all that could be done automatically? Wouldn't this be a value case of actually using the data that is already collected?

What Are The Steps To Achieving Digital Water?

I've heard that it doesn't matter where you start with Digital Water — the important thing is that you start. But I disagree.

Realistically, Digital Water is a mixture of policies, people, and — yes — technology. For me, the start of any Digital Water process is understanding all the informational requirements you may need within the business, as opposed to the standard thinking of "we want everything." The organizations that say this are somewhat immature in their approaches and aren't ready. For those who truly are ready, the first step in any Digital Water journey is about the people — it's about stakeholder engagement, from the CEO of the water company to the operator on the ground. It's about understanding the operational and engineering needs of the organization.

To illustrate, the CEO of the organization will want relatively high-level data about how the company is performing. Is it doing what it was meant to, or will there be a knock on the door by a regulator with the potential for a big fine? The CEO also wants to know how the business is performing financially and whether the board and shareholders are going to be content. If we trickle this down to the manager of a water treatment plant, they're going to want to know what asset might fail that could prevent them from producing enough water to keep their customers happy. If we trickle down even further to the operators on the front line of the business, they're going to want to know how an individual treatment plant is performing and what the next priority is on their list to manage or fire-fight.

And, of course, the information that is given must be absolutely correct — and thus, the source of data has to be correct, too. There is a world full of efficiencies available to water operators, so mining the data they collect has huge value to it. This value is largely untapped.

Once the stakeholder engagement piece is done, a water operator can get more advanced and use the digital tools that are available. An example is the "digital twin" adopted in Valencia, Spain, which is arguably one of the most advanced digital twins for water in the world. This was built up by ensuring that the model it was based upon was correct and that the monitoring was correct as well. Once it was put into practice, problems were exposed related to a lack of depth of data or a lack of calibration in the model. This resulted in a fine-tuning state, going back and forth between instrumentation and model to get things right for the first uses of the digital twin. As more functionality was added, it also added to the complexity. In the end, real-time insight into the performance of the water distribution network became possible, with the ability to forecast what would happen in the future if certain steps were taken. This is Digital Water.

We have, however, only started on this journey as an industry, and there will be many practicalities to iron out. It will take a lot more discussion, so do join me at the IWA Digital Water Summit in Bilbao (https://digitalwatersummit.org), from November 30 to December 2, 2022, to expand on Digital Water in much greater detail. ■

About The Author

Oliver Grievson is the technical lead at Z-Tech Control Systems, executive director of Water Industry Process Automation & Control, and chairman of the Sensors for Water Interest Group. He is a fellow of the International Water Association as well as the chair of their Digital Water Programme. He has 25 years of experience within the water industry in both the U.K. and abroad, working in everything from municipal operations to engineering design, acting as a technical and operational specialist. His specialties include wastewater operations, instrumentation, and Digital Water.

When Decentralized Wastewater Is The Wise Choice

Centralized wastewater treatment systems have been the dominant – and extremely effective – choice for pollution control historically, but onsite could prove right in many cases today.

By Dennis Hallahan

Communities face extensive challenges that strain infrastructure and budgets, including population density, commercial growth, traffic, and schooling. One of the most basic community responsibilities is public health. Considering wastewater treatment as a critical public health responsibility, community leaders must incorporate forward thinking that anticipates population density, commercial development, and the age of existing wastewater treatment facilities and systems, and incorporate future wastewater volumes and treatment strategies as part of a master plan. When this does not happen, pollution from wastewater can result in stressed or impaired local waterways, water source or well damage, and negative outlooks for tourism or commercial fisheries. These impacts often catalyze the development of new regulations or treatment limits that either restrict or allow community and commercial growth and enhancements.

When addressing wastewater challenges, communities have several options to consider, including installing a centralized sewer system, extending an existing centralized treatment system by upgrading the treatment plant for additional capacity, or looking to new technology and approaches such as decentralized treatment systems.

A decentralized wastewater treatment (DWT) solution can be the wise choice. DWT is where groundwater is extracted, consumed, treated onsite, and returned close to its point of origin to recharge the local aquifer. Today, DWT systems can treat to the same level as centralized systems and can handle larger flows, with some systems in excess of 1 million gallons per day.

New DWT technologies that use natural approaches are less land-intensive, more cost-effective, and provide effective long-term treatment that can help a community working to create development best practices. The DWT approach can offer a solution for engineers and developers to obtain a code-compliant system for sites with difficult soils, tough terrain, or large recreational and commercial developments in environmentally sensitive areas. With the addition of comprehensive available performance data, DWT systems are increasingly popular with local health officials.

With a decentralized approach, the same treatment technologies utilized by large-scale wastewater treatment plants are available for smaller flows as well. This includes membrane bioreactors (MBR), which have become popular in the last decade. And the community or owner/developer does not have to be at the mercy of the sewer district requiring sewer extensions, nor do they have to wait years for the wastewater treatment plant to be upgraded to have capacity so they can move forward with their project.

Once the darling of communities for wastewater treatment, centralized sewers are now recognized as a primary contributor to the discharge-to-surface-water problems plaguing towns and cities. Centralized treatment has also been to blame for much of the urban sprawl and the resulting loss of community identity that regularly follows the sewer solution.

The centralized approach to wastewater treatment involves collection, treatment, and discharge, typically as a point source. Unfortunately, the collection system can have inflow and infiltration (I&I) from stormwater or groundwater entering the system. This is the case whether the collection system is old or new. When this happens, the collection system's capacity can be exceeded, leading to a combined sewer overflow (CSO), thus discharging untreated waste directly to a receiving body.

How Does A Community Evaluate What Direction To Take?

Community needs and challenges vary greatly. Here are eight key questions for communities to consider in order to make wise decisions.

1. ***What is the future vision for our community?*** Sewers offer opportunity for community expansion and business growth, such as high-rise hotels and increased housing density. In some communities, allowing for growth is the goal; however, along with that can come increased traffic, traffic lights at each intersection, strip malls, and a loss of community character. Community planning is at the core of determining not only the five-, 10-, and 20-year vision, but also in selecting the best sustainable wastewater treatment plan.

2. ***What do we anticipate our future wastewater treatment capacity needs to be?*** With DWT, a community can focus on only treating the areas of town that have the greatest need and phasing in other treatment over time. It allows for lower design flows, smaller dispersal areas, and therefore lower costs. With this approach, the financial burden is placed on those properties where issues are seen or anticipated, not across the board. Centralized sewers do not always offer functional and selective capability.

Combined sewer overflows (CSOs) are still common 50 years after the passage of the Clean Water Act. These allow direct discharge of untreated effluent, causing significant health and environmental impacts.

3. ***What current wastewater treatment challenges exist?*** Community officials need to accurately assess current community wastewater treatment challenges. Leaking sewers, under-capacity systems, underfunding, watershed issues, groundwater pollution, and regulatory non-compliance all need to be documented. Once that assessment is in place, residents need to be informed about community challenges and provided with detailed information to review, including proposed solutions, associated costs, and short- and long-term impacts. Thorough assessments and proper education will garner public support for needed improvements.

4. ***Will the proposed solution address existing pollution concerns?*** In most cases when a community is considering a wastewater system upgrade, a pollution concern has been identified and the community may be under orders from the state regulatory agency to address the issue. Sewering a whole town to address a small fraction of the residents may not make economic sense. Be sure that all the alternatives have been reviewed by experts in the areas of technology under consideration and that options are not disregarded without proper vetting.

5. ***When does a new system need to be operational?*** Rushing into system construction prior to thorough review is never the solution. Getting a new solution up and running requires careful planning and budgeting, whether for individual DWT systems or larger community systems. Costs can vary widely depending on the regulatory requirements and the specific technology. And depending on the issue(s) being addressed, compliance to regulations can be challenging and require expert knowledge and experience.

6. ***What wastewater treatment options are available?*** There are a lot of specific technologies available, but the primary choice is between a decentralized or a centralized treatment solution — or a melding of the two, which has gained favor in many communities. When evaluating the options, it's important for the community to employ an expert in each model; otherwise, the solution selected may be biased toward only one of the options.

7. ***What are the short- and long-term costs?*** Short-term costs to consider for any new treatment system approach include system design, land acquisition, permitting, legal considerations, and construction. Long-term costs include ongoing maintenance, operations, and management, which are often overlooked as a factor when considering options. Also, licensed operators, sampling, power, billing structure, district vehicles such as specialized trucks, and specialized equipment are all cost considerations for the long haul.

   Decentralized treatment can offer many cost advantages, including smaller design flows, reduced treatment and disposal areas, lower energy consumption, reduced ongoing maintenance, and less regulation related to soil dispersal when compared to heavily regulated single-point discharge to a water body.

8. ***Will the system being considered require professional management?*** This was previously mentioned, but it is a factor that should be fully explored and estimated as part of many new wastewater treatment approaches that are at a scale to handle the anticipated flows to sustain community growth. Often, professional management will be mandated

A community drainfield system serves a residential housing project.

A high-flow, small-footprint sand filter will treat to a very high level with a surface discharge. This system is completely passive and requires minimal O&M.

by regulatory officials. This is a good thing, as it can improve system effectiveness for the long term and provide more extensive monitoring of the system ongoing.

Some DWT Solutions To Consider

Community and Commercial Systems — Community or cluster systems are a sustainable option that can be effectively monitored and managed by independent contractors, developers, or existing utilities. They are cost-effective and can easily be hidden and landscaped to integrate into open-space viewsheds. Product and design advances provide improved decentralized treatment in commercial and community systems, including streamlined collection and increased storage capacity to meet peak flows.

Repair and replacement standards, codes, and regulations differ by state and province. Upgrades and replacements can take many forms and there are many solutions available. If there is room on the site, an advanced treatment system (ATS) can be installed with a disposal field. Many types of treatment systems are available, and the approved ATS varies per regulations. For small, undersized, tight lots, it may be best to install septic tank effluent pumping (STEP) systems to convey the effluent to a site with available area and good soil conditions and is located away from the sensitive water body. The point is that the options are varied and understanding the area and the individual sites within it is the only way to make the best recommendation.

On sites with adequate space, the application of engineered wetlands can result in substantial O&M cost savings, especially for systems that have to operate over long periods of time. Engineered wetlands are unique from other treatment processes in that they employ vegetation as part of the treatment process and require very little energy input.

Individual Systems — Onsite septic systems come in many sizes and design configurations, including trench and bed designs, sand filters, and mound systems. The introduction of highly adaptable plastic chambers has expanded the possibilities for specialized system designs and treatment needs. Highly adaptable and effective, chambers can be a key element in septic systems, evapotranspiration beds, community (cluster) systems, constructed wetlands, and large-scale wastewater treatment plants.

Combined Decentralized And Centralized Treatment Solutions

Municipal Wastewater Treatment Plant Extensions — Providing cost-effective and ecologically sound wastewater treatment when the treatment plant is at capacity and growth is strong is a challenge faced by engineers who design municipal treatment systems. Extending the life of municipal wastewater treatment facilities by adding an auxiliary disposal field or other plant extension to provide effective treatment in communitywide wastewater treatment systems is an example of where centralized and natural treatment systems work in concert.

Conclusion

The decentralized wastewater industry has come a long way and the future looks bright. Various treatment technologies that were once only available for large-scale systems are now effectively being used for smaller systems, and designers and installers have become more educated. Rules and regulations have improved and the all-important O&M void is being filled by qualified professionals. The design decisions are ultimately the responsibility of the community, and the appropriate solution may incorporate a combination of technologies. The goal is to provide a system that will perform well for the customer, meet regulatory treatment levels to be code-compliant, and protect public health and the environment. ■

About The Author

Dennis Hallahan (dhallahan@infiltratorwater.com) has more than 30 years of experience with onsite wastewater treatment system design and construction. Currently technical director at Infiltrator Water Technologies, he is responsible for technology transfer between Infiltrator and the regulatory and design communities, and consults on product research and testing for universities and private consultants. Dennis received his MS in civil engineering from the University of Connecticut and his BS in civil engineering from the University of Vermont. He is a registered professional engineer in Connecticut and holds several patents for onsite wastewater products.

Digital Transformation Drives CUSTOMER SATISFACTION, IMPROVED PROCESSES

Digital payment platforms improve the efficiency of collections and related labor practices, but their greatest benefit may be enhancing utility-customer relations.

By Sara Faied

Water rates have increased 43% over the last decade[1] across U.S. cities, signaling a growing financial burden in this sector. The data show that the surge in water prices currently outpaces other household utility services such as power and gas, at an average of 4.2% per year. Price increases do not bode well for utility companies that ostensibly feel the impact of increased late and unpaid water bills.

It's not just water. All utility companies are mired in inefficiencies, reinforcing late and delinquent payments, reduced employee productivity, and a reliance on manual operations. For these providers, time is of the essence. According to Accenture,[2] utilities have just *10 minutes* of customers' attention annually, meaning providers have about 60 seconds a month to achieve a top-quality experience.

The Road To Customer Success

The importance of strategic billing and payments ranks highest among significant touchpoints[3] along the customer journey, proving that digital payments are no longer simply a welcome convenience but a foundational element toward maximizing sustainable value. Proprietary research finds that 43%[4] of consumers prefer online payment as their method of choice. Yet water, electricity, and gas providers continue to lag behind other industries in this area. Growing competitive, regulatory, and stakeholder pressures all challenge utilities to prioritize customer experience and secure their trust.

While not quite on par with industries such as e-commerce or ride-sharing apps, utility companies have plenty of opportunities to improve customers' engagement via digital channels. Customer-centricity is especially valuable during market volatility and inflation, and decreased physical touchpoints challenge sentiment toward utility companies and their processes.

Delivering digital payment options is not only a crowd pleaser among payers — a recent survey shows that 79%[5] of customers prefer to make a payment through a digital channel, whether online (43%), on a mobile device (34%), or via text messaging (2%). For utilities, digital accelerates collections, reduces late and delinquent payments, and boosts customer satisfaction; but first, these organizations must strategically implement these offerings.

Real-World Validation

When the population served by the Bona Vista Water District of Utah[6] grew at a higher and faster rate than the state's average, the utility was challenged to keep up. The utility hired additional

While not quite on par with industries such as e-commerce or ride-sharing apps, utility companies have plenty of opportunities to improve customers' engagement via digital channels.

customer service staff to respond to increased payment-related visits and calls. Employees were stressed and overwhelmed, especially toward the end of the month when payments were due and a few weeks later when mid-month shutoffs were expected due to nonpayment. Increased numbers of phone calls and walk-ins limited insight into enrollment numbers, outdated user experience on both the front and back end, and an inability to scale using existing hosted electronic bill payment and presentment (EBPP) platforms (which frequently had technical problems) led to untenable frustration for both the utility's customers and its employees.

The district explored various options and settled on a digital payment and customer engagement solution — InvoiceCloud — to transform and improve collection processes as well as efficiently troubleshoot customer issues.

The new solution came with a number of features to improve ease of use and self-service for customers and utility staff alike, including:

- Multichannel payment options, such as pay-by-text.
- Quick access to statements without needing to log in to an account.
- Cloud-hosted technology that reduces server issues and keeps the payment solution continuously updated.
- A robust reporting functionality for a detailed view of all payment details.

The new customer engagement and payment solution integrated directly within Bona Vista's existing IT system, allowing the utility to keep pace with customer demand during the transition and scale as needed without additional integrations.

In just six months, Bona Vista saw the following results:

- Increased e-payment adoption by 75%.
- Expanded paperless enrollment by 63%.
- Reduced payment-related calls by 20%, allowing employees to prioritize high-value projects, improving their productivity and satisfaction.

Best Practices

Where to start? Check out three best practices for utilities at the top of their digital game and encourage adoption numbers:

1. Make it easy for people who have traditionally not used online payment methods to embrace the transition:
   - Mirror details of the paper bill, clearly identifying due dates so customers can feel confident knowing they're in the right place.
   - Include notes in bill inserts with more information.
   - Provide reminders to encourage on-time payments.

2. Prioritize communication with payers, especially those who struggle to make payments:
   - A personalized touch makes people feel comfortable and allows more human interaction.
   - Provide a target date, whether that's a potential payment date or to check in again.

3. Invest in enhanced security:
   - To reassure customers that their information is safe and to keep online payment adoption rates up, be sure to offer a secure payment platform.
   - Ensure the solution is cloud-based and both PCI Level 1 and Nacha compliant.

Experience continues to pervade as a top priority: Gartner confirms that customer experience drives over 66%[7] of customer loyalty — more than price and brand combined — and this is true for almost every industry. With a more engaging and innovative approach to billing and payments (and other processes), water providers can shift from simply a commodity provider to a significant contributor toward improving communities, a benefit that serves everyone. ■

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