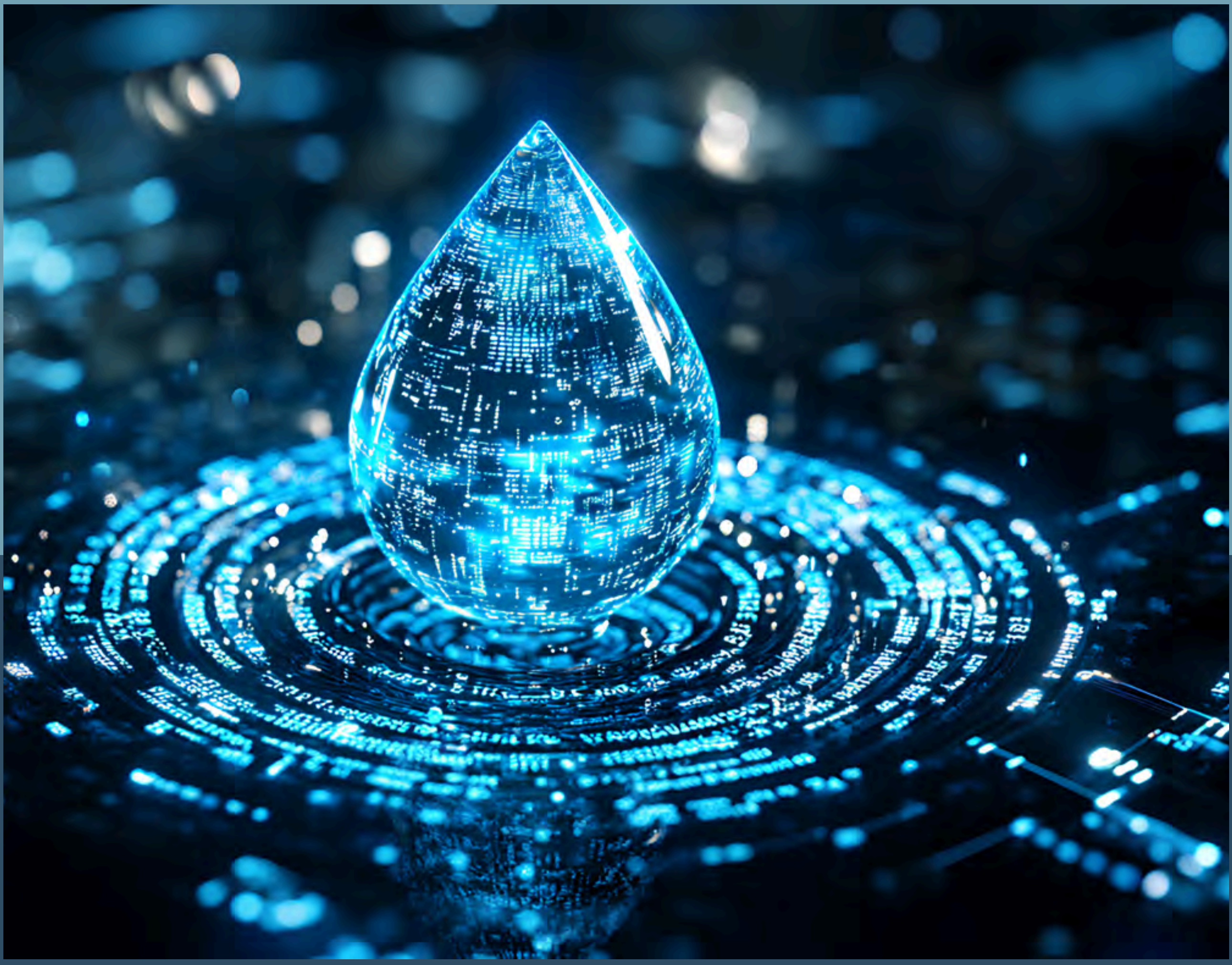
AI for Water: Periodic Review of Examples in Action

Version 1.0



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The Water Center
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Acronyms

AI..........Artificial intelligence
ALF..........Anomaly leak finder
AMI..........Advanced metering infrastructure
AMR..........Advanced meter reading
DL..........Deep Learning
PC3..........Project Controls Cubed
SWNM..........Smart Watershed Network Management
SGMA..........Sustainable Groundwater Management Act
TNC..........The Nature Conservancy

Executive Summary

As water systems across the U.S. increasingly face challenges like aging infrastructure, workforce development, climate change impacts, and rising costs, innovative solutions like artificial intelligence (AI) tools can help support these systems. AI is already being used for a variety of objectives across the water sector, including permitting assistance, predictive maintenance, demand forecasting, and leak detection. However, some water systems, especially those with fewer resources, have not yet implemented these tools at their organizations, potentially missing an opportunity to solve problems and improve services.

To help such systems better understand where, why, and how to implement AI tools, this report examines current and emerging AI applications in the water sector. It focuses on four purposes for which many utilities use AI: (1) to reduce the time needed to complete projects and tasks; (2) to improve operational efficiency; (3) to support planning of large-scale projects; and (4) to enhance decision making that affects communities. The report also highlights key AI tools used to achieve these aims, like digital twins, machine learning, natural language processing, and smart monitoring systems, as well as examples of cases in which utilities have successfully implemented them.

The Water Center at Penn plans to use these findings to support pilot projects, educational programs, and resources that help utilities navigate the transition to AI-enabled water management.

Introduction

A growing number of industries are using artificial intelligence (AI) to drive new applications, spur innovation, and solve problems. The water sector–a field facing challenges such as high retirement rates, aging infrastructure, rising costs, and climate change–is one such industry increasing its AI use to address needs. With high-quality data and responsible implementation, AI can help water utilities improve operations, reduce costs, and deliver better service to their customers.

This document is intended to help water system managers and operators better understand how AI tools and digital solutions can be used in their systems by learning from industry peers. Because the AI landscape is changing rapidly, this document is not intended to be exhaustive. Rather, it provides a snapshot of some AI tools and applications used in the water sector. As such, it will be updated periodically as technologies and use cases continue to evolve. The examples included are intended to illustrate potential applications and do not constitute an endorsement by The Water Center at Penn.

AI That Saves Time

AI tools can be particularly useful and easy to implement for administrative tasks that are time-consuming but do not require complex decision making. Many water utilities have already begun using AI for these types of tasks. Examples include email routing, internal chatbots, and permit drafting. Cutting down time spent on these tasks can allow employees to focus on more thought-intensive work. AI can help utilities address administrative workloads without requiring them to overhaul core operations.

Email Routing

One PA public water utility serving 116,000 customers has begun implementing AI to assist with reviewing and routing emails. The utility uses an AI product from Y Meadows, a tech company with products built to handle administrative tasks. Using natural language processing, this product can read through emails and send them to the appropriate department for review. Management uses a dashboard designed by Y Meadows to monitor how emails are being processed and ensure they are routed correctly.

Internal Employee Chatbots

Cognistx is a chatbot available for employees to pull information from documents such as operating procedures, workflows, or training presentations. Employees can prompt the chatbot for internal utility information, saving time and energy. Pennsylvania utilities have also implemented a call evaluation and sentiment analysis tool from ASC Technologies. This tool pulls recordings from calls randomly throughout the week to evaluate customer satisfaction and tone of voice from both the employee and customer. Management can view this data on a dashboard to review and improve customer service and experience.

Permit Drafting

PermitPro is an AI risk management framework designed to protect agencies from operational, legal, and compliance exposure. The platform is designed to assist with drafting permits, reviewing applications, completing site analyses, and securing cloud architecture. According to PermitPro, regulators using the platform can reduce their drafting time by 90%, shrinking the average amount of staff time from 15-25 hours to just 10-15 minutes. To encourage human oversight and decision making, the platform also readily allows for staff input. PermitPro is already being implemented at the regulatory level in multiple jurisdictions.

AI That Improves Operations

AI tools can help water operations be more proactive rather than reactive. For example, they can be used to optimize wastewater treatment chemical dosing by analyzing real-time sensor data. This approach prevents over-dosing and reduces chemical consumption. AI can also be used to help manage and design projects and upgrades at treatment facilities.

Predictive Maintenance

Aquaspec is an AI platform built specifically for critical, everyday water utility operations. This platform provides continuous forecasts for water demand and capacity, equipment performance and degradation, compliance risk before violations occur, treatment requirements and water quality parameters, and energy and chemical usage trends. Aquaspec has already been implemented in communities across the country ranging from smaller utilities (<1000 population) to larger ones (using up to 22 million gallons/day). Utilities primarily use this platform for preparation and predictive measures.

Digital twins, or computer models of real-world products, processes, facilities, or systems, can help strengthen infrastructure safety, security, and sustainability as risks from storm surge events increase due to climate change. Using AI and digital twin modeling provides a reference point for physical structures to help reduce project costs and failures. For example, Seattle City Light created a digital twin of their Diablo Dam to help identify maintenance and repair needs. This process combined engineering, architecture, and construction data to keep the dam safe and ensure its longevity.

Figure 1. A digital twin of the Diablo Dam. From Bentley Systems.

Digital twins can also be used to detect and analyze operational issues. For example, Singapore's National Water Agency, PUB, collaborated with Bentley to develop an integrated Anomaly Leak Finder (ALF) solution. The tool uses hydrologic models and AI to generate a digital twin to model and predict flows and pressures, track the health status of different zones, and detect and localize various anomaly events, such as water main breaks and hidden leaks. In the first three months of use, two operational leaks were identified and managed using this network, reducing costs and improving the network's resilience and sustainability.

Chemical Dosing and Treatment Optimization

AI is also being applied commercially at wastewater treatment facilities across the United States. For example, the engineering firm Jacobs employs data scientists who work directly with treatment plants to develop AI-driven solutions tailored to their operational needs. At two facilities, these efforts resulted in chemical usage reductions of 10–30%. At one site, machine learning models were used to optimize the application of sodium hypochlorite for disinfection and bisulfite for chlorine removal. By improving dosing strategies, the facility was able to maintain regulatory compliance while reducing the risk of excessive chlorine residuals. The AI system also provided recommendations for adjusting operational setpoints, which enabled operators to decrease aeration-related energy consumption without compromising treatment performance.

Veolia is another company utilizing AI to optimize industrial water treatment. With Hubgrade, their smart monitoring and digital services platform, Veolia has introduced PlantExpert to provide recommendations on chemical dosing. The application draws on demand information to recommend to operators what to adjust and by how much. This model pulls historical water analysis data and patterns across the Veolia network to help identify trends and recommend adjustments that improve efficiency and consistency.

AI That Improves Planning

AI is being used by municipalities and utility companies to monitor their water distribution system, manage aging infrastructure, strategically plan projects, and model watersheds. These services are often more efficient than traditional monitoring methods and can provide utilities with additional insights to support planning and decision making.

Demand Forecasting

Upstream Tech provides science-backed software for land and water management. Their two products, Lens and Hydroforecast, provide remote monitoring and forecasting tools for communities. For example, communities can use these products to track flooding events, agricultural runoff, erosion, and water quality to help better manage their watersheds when natural events occur. By providing improved forecasting capabilities, these tools allow communities to better prepare for and respond to changing water conditions.

Asset Management

Water Works Metrology offers water management technology that helps municipalities and utilities monitor, maintain, and optimize their water distribution networks. Their services include advanced metering infrastructure (AMI), automated meter reading (AMR), leak detection systems, pressure monitoring, and automated flushing programs. These technologies have been adopted by utilities nationwide to improve system efficiency and reduce water loss.

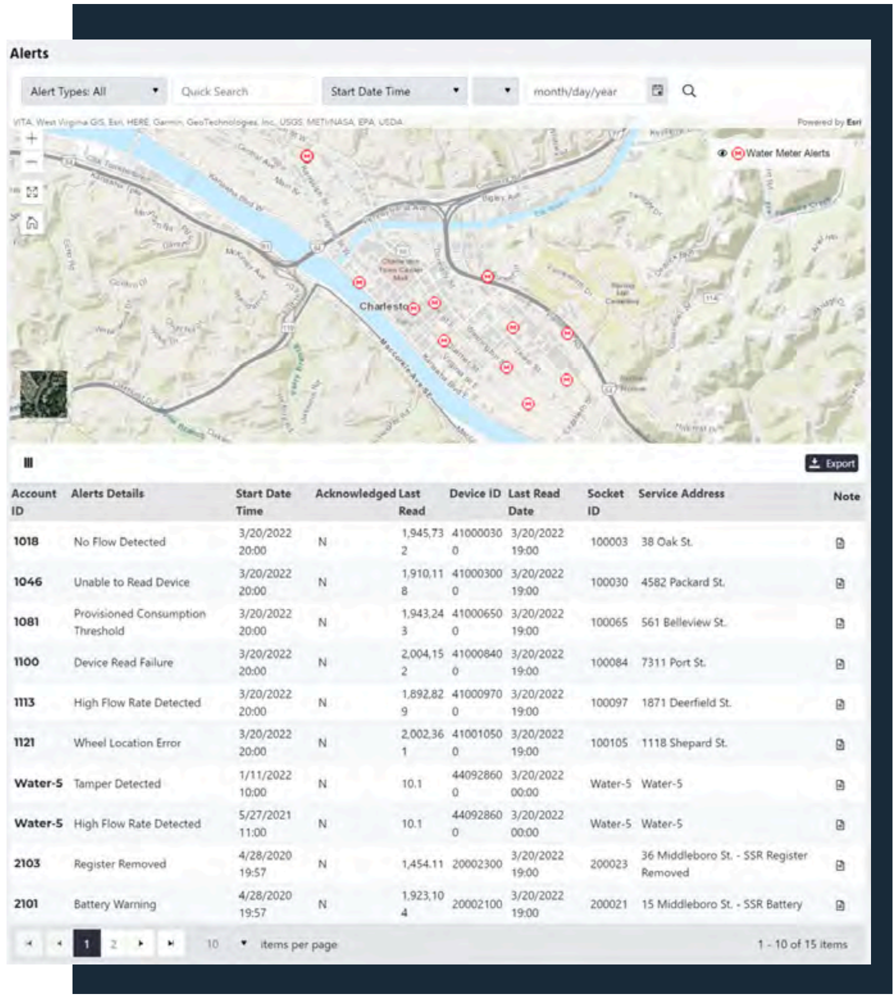

Figure 2. A sample AMI dashboard for utilities using Sentryx, Water Works Metrology's AMI product line. From Water Works Metrology.

Another example of using AI for asset management comes from Mueller Water Products' EchoShore-TX permanent leak detection system. The system combines acoustic sensing technology, wireless communication through AT&T connectivity, and user-friendly data dashboards to provide continuous, cost-effective monitoring. In one arid water district, 13 permanent acoustic sensors have been installed along approximately three miles of aging pipeline to help detect and address leaks more efficiently. In a region where water resources are limited and water loss occurs through aging small-diameter service lines, the technology's ability to monitor critical pipelines and identify leaks has helped protect and bolster the utility's available water supply.

Watershed Modeling

The Nature Conservancy (TNC) has launched Brightstorm, a project using technology to rethink stormwater management in collaboration with corporate and government partners. Brightstorm's "Smart Watershed Network Management" (SWNM) approach uses sensors, data analytics, modeling, and automated control devices to improve the performance of existing stormwater infrastructure. Through real-time water quality monitoring, adaptive flow management for flood mitigation, and predictive forecasting, SWNM helps communities better anticipate stormwater impacts and make more informed management decisions. Indian River Lagoon, a critical ecosystem off the coast of Florida threatened by stormwater pollution, is one such community benefitting from this tool.

To better plan for flood responses, Autodesk released a tool called InfoDrainage2025. This machine learning-enabled tool enables stormwater drain designers to create predictive flood maps. Using pattern recognition from extensive training data, the tool predicts surface water behavior, including potential ponding locations, flow directions, and water accumulation zones.

Treatment Plant Design Assistance

Digital twins can be used to better manage large-scale construction projects. For example, Sacramento Regional County Sanitation (Regional San) contracted Project Controls Cubed (PC3) to manage the planning, scheduling, and cost of a project to upgrade their Regional Wastewater Treatment Plant using a digital twin. The project, known as EchoWater, consisted of 22 individual engineering projects to upgrade the plant's existing infrastructure, including an upgrade of the plant's ammonia and nitrogen removal process. To manage all of the projects simultaneously, PC3 created a digital twin of the facility that was fully synced with every aspect of the site using Bentley's iTwin tool. With the use of Bentley's digital construction platform, the team was able to anticipate and mitigate potential risks, schedule performance, and reduce the project's cost from $2.1 to $1.7 billion. These cost savings were used to fund Regional San's Harvest Water program, providing recycled water to agricultural lands and existing habitats in southern Sacramento County.

To accelerate the early-stage engineering designs for water and wastewater treatment plants, Autodesk has partnered with Transcend, a generative software company. Transcend Design Generator streamlines and accelerates the traditionally time-intensive initial design concept process. By automating aspects of this process, the product allows engineers to evaluate options more quickly and supports the development of treatment plants.

AI That Improves Public Decision Making

Another high-impact opportunity for AI deployment in the water sector is supporting faster and more informed community decision making. AI tools can be used to track policies, assess the water impact of data center projects, and inform the community about climate-related issues.

Water Impact Tools

Transparency on local water impact is crucial for responsible and equitable development and management of data centers. WaterMark, a free citation-backed tool for hyperscale data center siting, helps support this transparency by giving the general public the ability to quantify local water impacts from data centers. WaterMark assesses water impacts by calculating direct water consumption (scope 1 water use), community impact context, municipal water supply impact, watershed stress allocation, and power generation impact (scope 2 water use). The tool also uses a site risk index to score parcels on water stress, Scope 2 grid water intensity, aquifer recharge, and utility constraint. This tool is not only beneficial for the general public, but also for regulators, local governments, and developers seeking to quantify community water impacts.

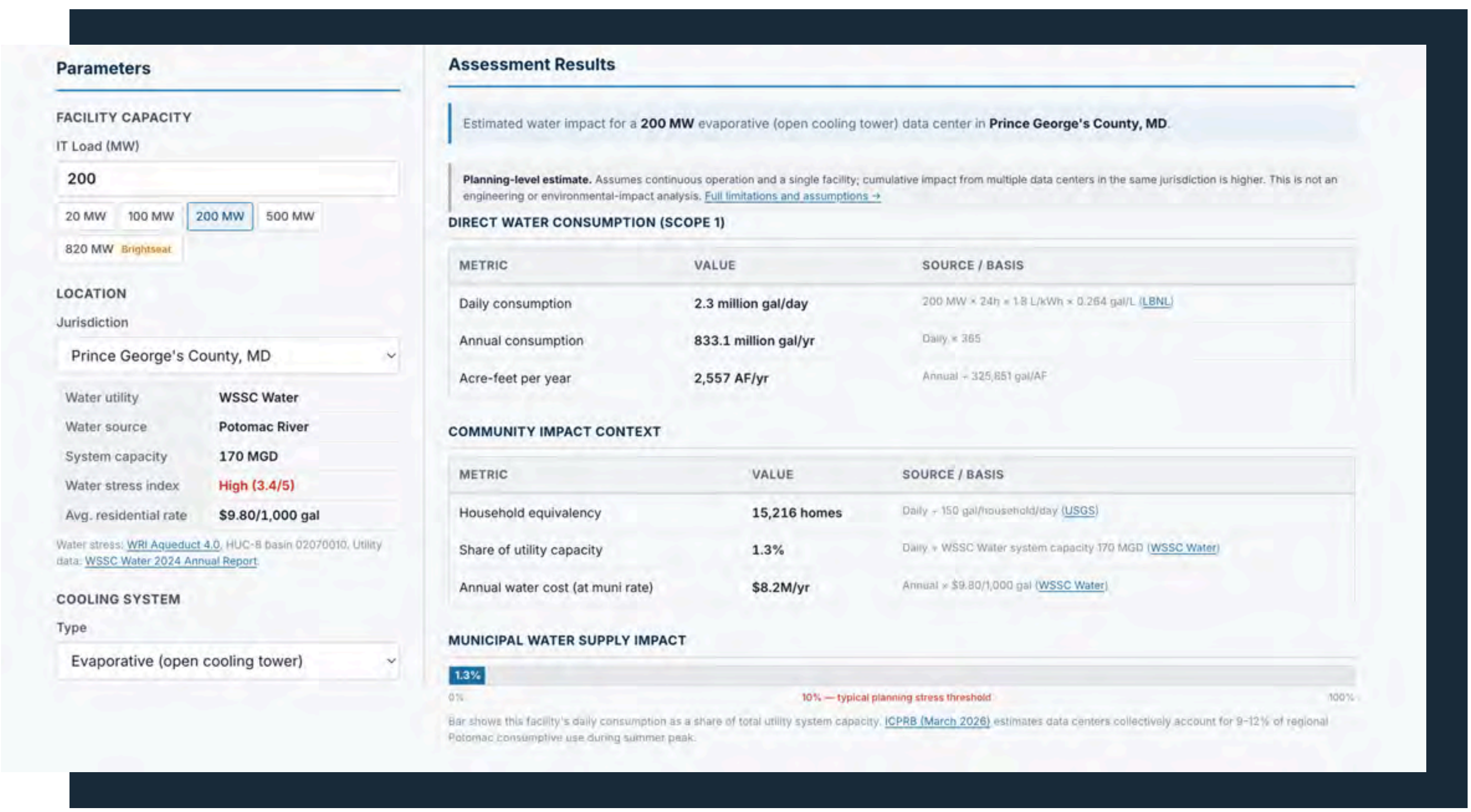

Figure 3. A sample water and siting risk assessment for a data center project. From WaterMark.

Policy Tracking

Key infrastructure, pricing, and regulatory decisions made during public meetings are often only documented in meeting minutes, which can be brief and delayed. This leaves a gap in available knowledge for industry leaders. WaterOne.ai is bridging this gap using AI systems to track Sustainable Groundwater Management Act (SGMA) implementation across California by attending public meetings, analyzing their outcomes, and delivering customized intelligence outputs. Their free and open SGMA database allows users to access summaries from agency, utility, and municipality board meetings across the state by listening to or reading the information.

They have also released Datacenter Watch, a platform that uses a similar process to increase publicly available information on siting and permitting of and community opposition to data centers. Both of these platforms are subscription only. These platforms can be especially impactful in California, where water resources are already limited and additional demand can further exacerbate them.

Digital Public Infrastructure

Researchers at the Indian Institute of Technology Delhi have designed CoRE Stack (Commoning for Resilience and Equity), a digital public infrastructure product for communities to engage directly with the environment. This infrastructure consists of datasets, algorithm pipelines, and user-facing tools that can be used by rural communities and other stakeholders to improve the sustainability and resilience of their local landscapes.

Community members can use this platform to identify local land uses to analyze drought impacts, cropping intensity and patterns, groundwater stress, feasibility of water structures, and social response to natural resource management. The main goal of this project is to place communities at the forefront of local environmental data management and improve resiliency to climate change. This tool is already guiding landscape action in over 1,000 villages, led on the ground by more than 20 civil society organizations.

Although CoRE Stack uses machine learning, AI, hydrology simulations, and other data-driven algorithms internally, a key philosophy of "more participation, less AI" guides all implementation on the ground. The developers aim to use the technology to catalyze and accelerate community participation in landscape-level decision making rather than automate decisions or reduce community agency.

Emerging Applications

While this example does not represent all emerging technologies and applications of AI in the water sector, it is intended to provide an overview of such tools that may shape the future of water management.

Detection of Lead-Based Pipes

Various real-world challenges make it difficult to determine service line material classification, and as such, the process can be time-consuming, expensive, and impractical. To address this, researchers at Drexel University have designed a sensing system to identify lead-based water pipes using stress acoustic waves and deep learning (DL), a type of AI machine learning. The method, which does not require access to the homeowner's property, uses Piezoelectric sensors to detect vibrations on the surface of surrounding soil. The combination of ultrasonic stress wave propagation technology and DL offers a promising approach for detecting lead-based pipes, with blind testing resulting in an 83% success rate. So far, this technology has been applied to nearly 250 houses across 20 U.S. cities for field testing on real service lines. The tool has the opportunity for more widespread implementation as utilities work to identify and replace lead service lines under the EPA's Lead and Copper Rule Improvements. Philadelphia has between 20,000 and 25,000 service lines that need to be replaced under this rule, making it a possible candidate for this technology.

Strategies for Implementing AI

During his keynote address at The Water Center's 2026 Spring Water Policy Forum, Water for AI: Policy at the Speed of Technology, former New York City Department of Environmental Protection Commissioner Rohit Aggarwala gave insight into how utilities can, should, and will use AI. His remarks highlighted a phased approach for utilities looking to adopt AI while balancing operational benefits, risk management, and public trust. Key recommendations from his address are summarized below.

- Utilities should begin implementing AI in the most obvious and low-risk areas such as customer service chatbots, employee handbook chatbots, or presentations to elected officials about ongoing work. Because these services pull from existing information systems, they are easy to implement. While their impact is relatively low, they can help utilities build familiarity with AI and establish practices for responsible implementation.

- Then, utilities can move on to implementing AI in other ways. Examples include using automated meter data to better predict leaks and warn customers, prioritizing work assignments, improving revenue collections, and speeding up procurement and legal review. Utilities should proceed with caution if they decide to implement AI in difficult, sensitive areas like treatment plant automation, key engineering projects and regulatory strategy.

- Before, during, and after implementation, utilities must clearly communicate what AI is being used for. This helps build public confidence, which is crucial given widespread public concern about this rapidly evolving technology.

By implementing AI incrementally, learning from early successes, and maintaining transparency with employees and the public, utilities can maximize the benefits of AI while minimizing potential risks and resistance to adoption.

Conclusion

This use case review demonstrates that many promising applications of AI have already been successfully implemented in the water sector. However, while some utilities are successfully using AI for asset management, administrative needs, and predictive modeling, significant barriers remain, particularly for small and medium-sized utilities. Limited staff capacity, resources, and data management capabilities can make it more difficult to adopt AI solutions. Ensuring that utilities of all sizes have access to the resources, training, and support needed to implement AI will be critical for an equitable and sustainable transformation of the sector.

Various tools show promise in expanding the role of AI in the water sector for purposes such as identifying lead service lines, mapping disaster relief, tracking local water policy, and analyzing impacts of data centers. Insights from existing and emerging technologies emphasize the importance of building accessible data systems, training programs, and collaborative networks that allow utilities of all sizes to experiment with and adopt AI tools. Moving forward, The Water Center at Penn plans to use these findings to guide pilot projects and develop educational resources for utilities. By learning from cross-sector innovations, The Water Center will help advance responsible AI adoption across the water sector, ensuring that these technologies support more reliable, sustainable, and resilient water systems.

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