5 Things You Can Do to Mitigate the Consequences of Climate Change on Your City's Water Infrastructure

By Sandra DiMatteo, industry marketing director, water infrastructure, Bentley Systems

After decades of warning signs that climate change is happening, most people are now admitting that it is real, and it is not pretty. Droughts are getting dryer, and floods are getting wetter and more frequent. Water resources organizations are struggling to manage ongoing crises and prepare for future events. While you cannot do much to significantly alter climate, you can help your city to prepare to deal with the consequences and be more resilient.

Infrastructure remains one of the least technologically advanced sectors in the entire economy. A technological transformation of the industry has the potential to, among other things, help achieve sustainability and resilience goals against climate change, as well as improve the efficiency, safety, and quality of water infrastructure projects. Through new methods and new technologies, leading utilities are advancing the infrastructure on which society depends.

Here are five things that you can do now to mitigate the consequences of climate change on your city's water infrastructure.

1. **Develop a contingency plan for droughts.**

   Seasonal droughts are worsening each year. Amid constant demand to optimize water resources, you strive to maintain quality service and clean water supply to your community. One way to optimize investments and operations is to initiate a strategic hydraulic modeling project to understand how the supply system works and how to proactively address distribution network issues. During dry periods, your teams can develop a water contingency plan to reduce water production on the fragile source without affecting the people in the area.

   With advanced modeling and simulation, you can essentially create the foundation for a true digital twin of the municipality's macro water distribution and supply system. It is important to have a digital representation that accurately reflects the physical network operation so that in times of trouble, your teams can be prepared and in control. An open modeling application provides a crucial feedback loop between the operations and engineering teams. The operations team brings field problems that engineering teams can dynamically assess through digital models. Both teams can collaborate and decide on optimal solutions, bringing a quick response with minimal impact to customers, ensuring sustainable water supply and improving the environment and quality of life for the city's residents.

   Joinville, Brazil is a city that experiences seasonal droughts, but in recent years it has been experiencing some of the worst droughts in 30 years. Drought and water scarcity have a huge

social impact on people's lives. Access to water means dignity for the people in the community. A hydraulic model and a digital twin helped Companhia Águas de Joinville to evaluate how well the system was working, as well as simulate what could be done within the system to figure out the optimal solution. BBC StoryWorks produced a mini documentary film about the Joinville experience.

Image Link:

Image Caption: Companhia Águas de Joinville developed a contingency plan for droughts, recognizing that access to water means dignity for the people in the community. *Image courtesy of BBC StoryWorks.*

2. **Reduce nonrevenue water losses and waste to mitigate the effects of water scarcity.**

Water scarcity has the potential to affect more than half of the world's population by 2025. With a few simple steps, your organization can gain better visibility of their water distribution network assets, reduce waste in processes, and save millions of gallons of water annually.

First, optimize operational activities to prevent pipe bursts. By monitoring operations of the water supply system by leveraging a digital twin of the network, you can find and fix leaks faster and extend the operating life of infrastructure. This process saves resources required to keep the assets running safely and reliably. Including remote monitoring capabilities means fewer site visits and reduced fuel and labor costs.

Water digital twins bring together SCADA, GIS, hydraulic modeling, and customer information into a connected data environment to deliver cost-effective operations and maintenance strategies in real time. For the first time, engineering and operations can collaborate using the digital twin. While hydraulic models in the past were mainly used by

the engineering department, they can now be used easily for daily operations and maintenance. The advantage here is that with a cloud-based digital twin, real-time simulations of network events, such as pipe breaks, pump shutdowns, valves operations, water flows, and fires, can help to better understand and anticipate the impacts on service levels. With real-time hydraulic analysis of the network on-hand, operators can fill in the gaps between sensor data.

With visibility to the system's sensor data, boundary conditions, billing, and hydraulic modeling information in real-time, this living digital twin continuously monitors all infrastructure assets, including tanks, pumps, pipes, and valves. It provides at-a-glance visibility to key data points, including valve operational status, tank level, and input flow for each district metered area. This scalable environment provides utilities with access to critical system and individual asset performance to empower operations and maintenance with improved decision-making. The digital twin provides visibility into non-performing assets and anomalous network conditions. In addition, utilities you gain visibility into present, historic, and forecasted analysis of the performance of assets to uncover leaks in the network before they turn into a problem, and to proactively identify areas of improvement.

In Manaus, Brazil, AEGEA interated key data that was previously stored across different siloed systems into a single platform to improve leak detection, asset management decisions, and operational processes.

In Washington, D.C., a digital twin helps to reduce operational and capital expenditures and reduce nonrevenue water loss with improved visibility of data and analytics. With the sheer size of DC Water's network, the dynamic nature of operational unknowns and, at times, the physical unknowns can have a cascading effect on the delivery of reliable drinking water in a safe and resilient fashion. With an implemented digital twin, DC Water easily replicated data from their enterprise systems in a secure managed cloud application where they could organize and scrub the data in near real time. As a forward-looking utility that considers implementing a digital twin an essential business priority, DC Water knows that while data is crucial to the implementation, collaboration among stakeholders is key to success.

3. **Conduct flood risk assessments to mitigate effects from climate events on urban drainage systems.**

When flooding poses risks to residents, damages property and infrastructure, and disrupts urban services, hydraulic simulations can help engineers and operators to predict and better understand problems and create efficient solutions that increase the resilience of urban drainage systems. With a better understanding of surface flooding depth and velocity, flood hazards, and inundation times, it means proactive communication can be made to stakeholders.

Powerful tools for flood modeling and hydraulic analysis of overflowing stormwater systems are important to prepare for new challenges in water retention in both urban and city environments. With comprehensive visualizations, both engineers and non-engineers can make more informed decisions aimed at assuring service levels and improving stormwater collection network and asset performance.

Wastewater and stormwater condition assessment is a costly and constant activity for city workers. Intelligent and automated rapid condition assessments use machine learning to improve defect detection and labeling, improve data quality, accelerate inspection work, and reduce costs. Integration with the digital twin makes this data part of a systematic process that water and wastewater professionals use every day. The digital twin provides a federated source of actionable insights, including sewer condition assessment results. It puts valuable analytics and timely decision support at the fingertips of operations and maintenance to help them understand and proactively mitigate the impact on flows based on forecasted weather patterns, especially crucial during extreme weather events.

Urban drainage networks are intended to safely collect and convey sewage and stormwater, but the reality is that many existing systems have problem areas where the flow is not effectively contained. Digital tools help engineers to determine the extent to which undesirable overflows will spill, and also to understand the root causes of the problem. Paired with the automatic design algorithms that engineers have trusted for decades and the efficiency gains with the digital twin, these tools can be more effective than ever at helping to prioritize and fix systems to make them more resilient in the face of increasing extreme weather events.

In 2020, significant flooding along the Yangtze River killed 141 people and displaced 38 million more. For the city of Jiujiang, the disaster was the latest in a string of overflow and waterlogging incidents caused by accelerated urbanization, and officials initially could not determine how to prevent them. To better prepare for future flooding events and minimize disruption to city life, China Three Gorges Corporation directed Shanghai Investigation, Design & Research Institute (SIDRI) to create a hydraulic analysis system that can simulate a variety of water conditions in the city. To provide the information, the hydraulic analysis system would need to clearly display detailed data, plan flood control tasks, and pinpoint emergency events. Frequently updated hydraulic data needed to be easily accessible to shorten the time to dispatch emergency services. With the ability to predict potential waterlogging, officials can now identify and address critical drainage problems in advance. Real-time data overlaid onto the reality model allows the city to make emergency responses to flooding in a timely manner.

4. **Prepare for rapid response with dam safety monitoring.**

Dam failures can be catastrophic, so it is essential for dam owners and inspectors to implement tools that effectively and proactively reduce these risks to people and the environment. Unplanned rainfall events can wreak havoc with water resources and utility operations, leaving residents vulnerable to water supply disruption or worse. Dam safety programs supported by state-of-the-art monitoring systems are imperative to reduce risk imposed by storms. A self-sustaining dam safety monitoring system uses a network of sensors to monitor conditions including rainfall, pore pressure, deformation, reservoir lake level, and other metrics to provide automated site-specific insight into the performance of the dam and the water distribution system.

Real-time monitoring provides the right information at the right time for proactive risk management, safety, and predictive maintenance applications. Real-time monitoring of utilities can include environmental groundwater monitoring to improve the water quality of catchment areas, rivers, wetlands, and groundwater systems to assure a safe level of flood protection. Dam safety programs often include real-time condition monitoring applications that can include groundwater, flow, seepage, and slope stability during and after construction, or even rainfall and weather monitoring to minimize adverse environment impacts during and after construction.

In the case of Hurricane Ida, such data was used to establish alerts that triggered notifications that were autonomously sent to key engineers and authorities when thresholds or predefined warning limits were exceeded. A dam safety engineer on duty at the time was able to alert affected counties to conduct evacuations in a timely matter when multiple dam sites lost power. Through the use of real-time automated monitoring, the dam safety officer was able to react to rapidly deteriorating conditions that nearly reached overtopping conditions and maintain an enhanced safety response for the surrounding areas.

Read more about how going digital is necessary to support vital water resources here.

5. **Reduce carbon footprint and aim for net zero.**

One way to become carbon neutral by 2030 is to reduce energy consumption and carbon emissions. Energy use at a water or wastewater utility can be as much as 50% of the organization's total electricity consumption, second only to labor costs in most utilities' operating budgets. Water utilities are some of the largest users of electricity. Energy potentially represents the largest controllable operational expenditure in a utility, making it a perfect target to help minimize environmental impact. Digitizing the water supply network and implementing smart, energy-efficient pumping operations helps to achieve sustainability and eco-friendly goals without impacting service quality, such as water pressure or water

quality, for their customers. Hydraulic models can be used to instantiate energy savings by reducing energy waste and promote better efficiencies in operating a pumping system.

By optimizing the operation of pumping stations, you can lower fuel needs and reduce electricity usage. For example, you can automate operating times of your pumping stations while still guaranteeing consumer satisfaction in terms of water demands. The best way to automate the on/off pump switches is through a digital model, calibrated and simulated to accurately represent the water supply operations in real time.

Evides supplies the Netherlands' city of Rotterdam with clean and safe drinking water. They coupled the hydraulic model with an optimization algorithm using dynamic control scripting. They used the model to test, evaluate energy cost calculation, and automate the on/off switch points to optimize usage of the pumping stations for 110 million cubic meters of pumped water. Evides was able to save 33% in energy costs and reduce their carbon dioxide footprint by 942 tons. Energy costs savings of EUR 300,000 annually was achieved, reducing the carbon footprint and contributing towards sustainability company goals.

Advancing Utilities – It's About Time

Leading utilities are advancing their digitization to help achieve sustainability and resilience goals against climate change, as well as improve the efficiency, safety, and quality of water. Through new methods and new technologies, you can mitigate the consequences of climate change on your city's water infrastructure.

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