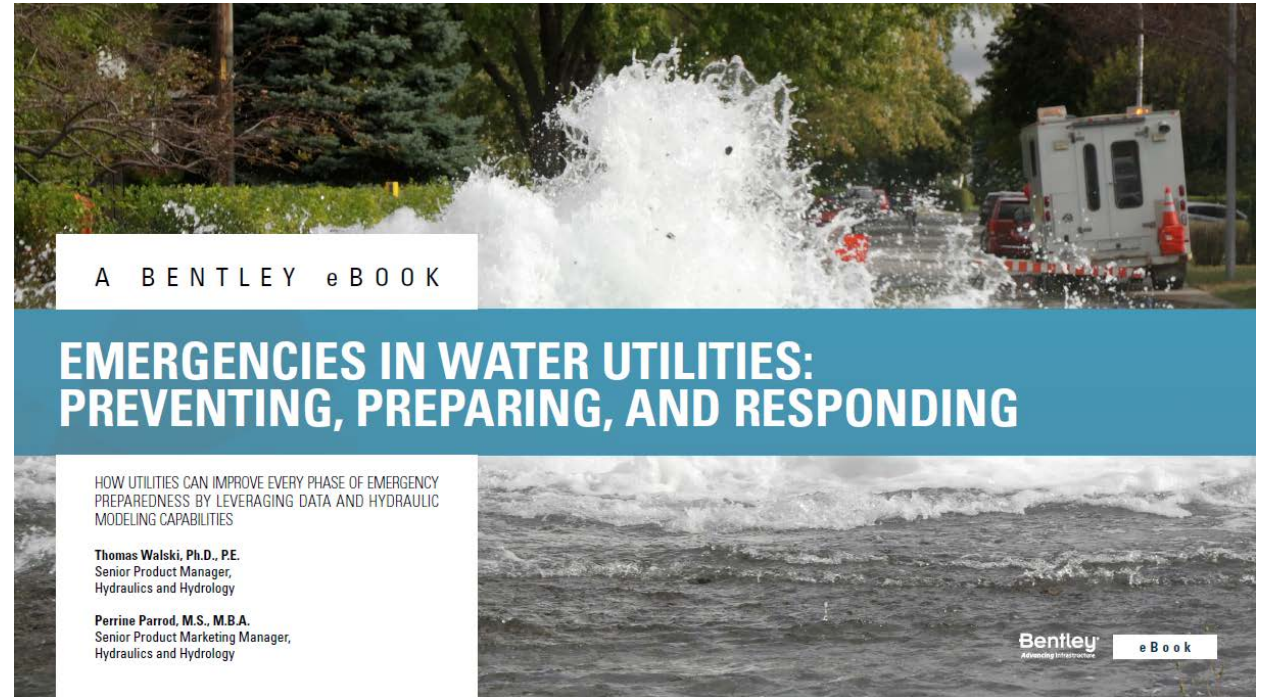




EMERGENCIES IN WATER UTILITIES: PREVENTING, PREPARING, AND RESPONDING



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EMERGENCIES IN WATER UTILITIES: PREVENTING, PREPARING, AND RESPONDING

HOW UTILITIES CAN IMPROVE EVERY PHASE OF EMERGENCY PREPAREDNESS BY LEVERAGING DATA AND HYDRAULIC MODELING CAPABILITIES

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INTRODUCTION

When an event threatens the continuous and safe supply of potable water, utilities must be prepared to respond quickly and effectively to ensure population health. Through the use of hydraulic modeling, utilities are able to prevent some emergencies and be better prepared to respond when other emergencies inevitably occur.

A water utility's operations department typically relies on a supervisory control and data acquisition (SCADA) system to monitor what is currently occurring in the water system. When operations professionals rely uniquely on SCADA data, however, it is impossible to interpolate between measured points or see into the future.

An integrated SCADA-hydraulic model is able to forecast what will happen in the water system when an out of the ordinary event occurs. This integrated system can not only provide an accurate and clear understanding of how the current system behaves, but it can also simulate various alternatives to identify the optimum emergency response.

Most water utilities already have a hydraulic model of their system that they use for planning and design. Starting from that point, constructing a real-time model for use in operations is not difficult.

This eBook reviews use cases where a calibrated hydraulic model can help utilities prevent, be better prepared for, and respond faster to emergencies.



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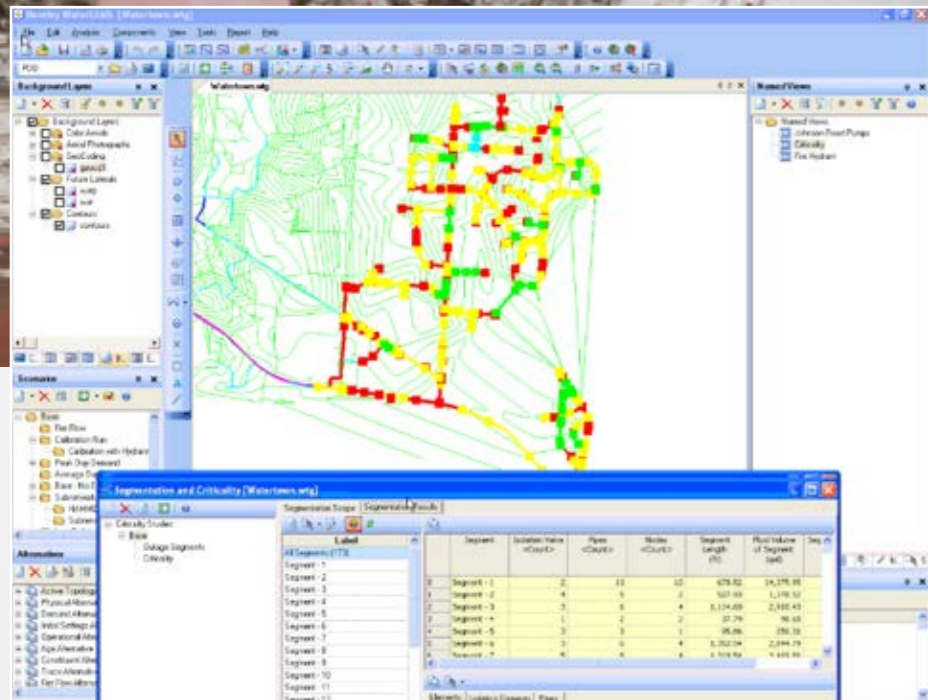
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WaterGEMS identifies the most critical elements. System performance is determined per shutdown of segments.

VULNERABILITIES

Before preparing for an emergency response plan, it is good maintenance practice to prioritize pipe and asset renewals in order to mitigate the risk of infrastructure failure. Hydraulic modeling will help find the pipes and facilities that are the most vulnerable.

A criticality analysis in water modeling software provides modelers with capabilities to identify the most critical elements. By simulating the impact of shutting down each individual segment of the water system, engineers can determine the impact on performance across the entire system.

Criticality analysis results can then be fed into a hydraulic modeling capability that optimizes the replacement and rehabilitation of distribution network pipes.

Hydraulic modeling helps ensure long-term system reliability by decreasing pipe breaks, leakage, lost revenues, and outages, and ensuring adequate capacity. With a proactive pipe renewal program, infrastructure failure is less likely, however because the water system cannot be reliable at 100 percent, water utilities with a renewal program still need to be prepared to manage emergencies.

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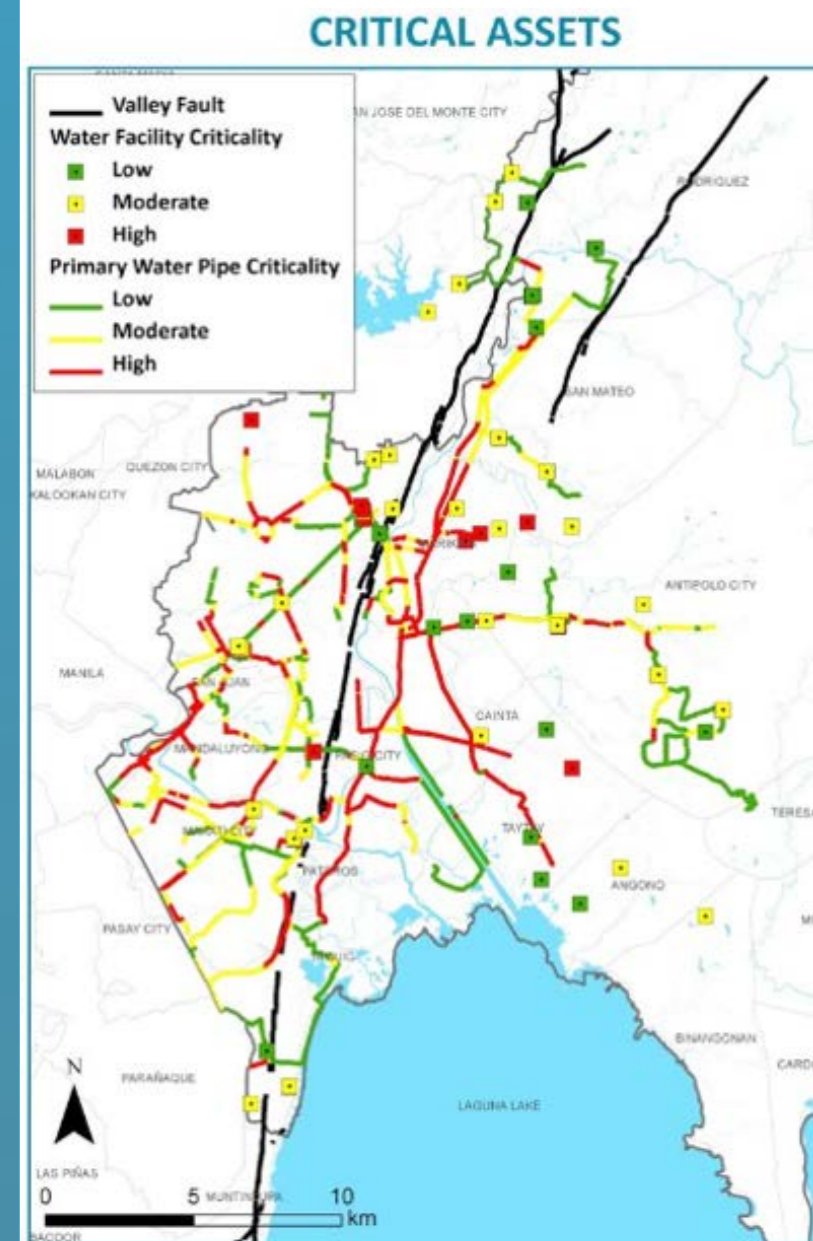
USER CASE

MANILA WATER IDENTIFIES VULNERABLE ASSETS

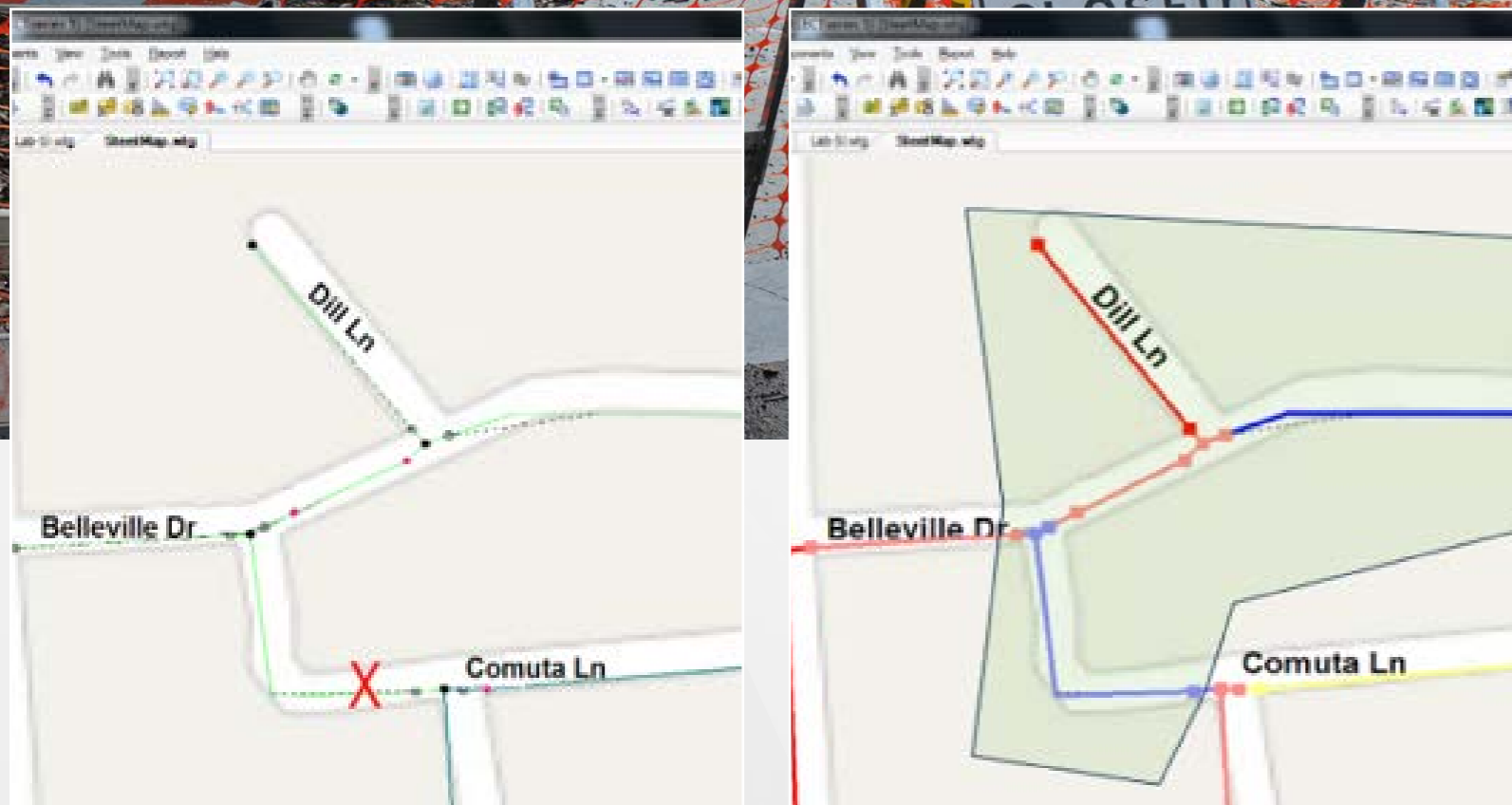
Perched on the Pacific Ring of Fire, the Philippines is always threatened by devastating earthquakes, volcanic eruptions, and typhoons. To ensure a reliable water supply for its 6 million customers in the event of disaster, Manila Water Company, Inc. prepared a resiliency and mitigation masterplan for its water and wastewater service area, covering the east zone of Metro Manila and Rizal Province.

WaterGEMS' criticality analysis helped to prioritize the rehabilitation of facilities. WaterGEMS illustrated what happens if one or more interconnected systems shut down and which facilities would cause the most harm if operating at less than full capacity.

The results helped Manila Water prioritize facilities requiring resiliency measures to minimize damage and facilities needing contingency plans in case of loss. These measures could limit property damage and business interruption to USD 380 million versus USD 520 million without such measures.



Facility and pipe criticality map



USER CASE

HATCH MOTT MACDONALD PREPARES PLAN TO MANAGE SHUTDOWNS FOR DC WATER

DC Water provides 100 million gallons of water per day to 600,000 people in the U.S. capital. As part of a capital improvements program (CIP), a main transmission artery known as the Cross Town Tunnel had to be taken out of service for rehabilitation. Hatch Mott MacDonald performed hydraulic analyses to identify alternative supply sources and forecast potential outages during the 13,200-foot, 84-inch diameter tunnel shutdown.

Criticality analysis with WaterGEMS allowed Hatch Mott MacDonald to run scenarios for 475 transmission main outages and 72 capital improvement projects ongoing during the tunnel closure. The analysis identified 26 scenarios that could result in unacceptable service levels. Two projects were recommended for rescheduling, which enabled DC Water to develop emergency response and contingency plans.

The emergency main break results, on the left, show three major concern areas (dash lines). The CIP map, on the right, shows the projects occurring during shutdown and highlights the two projects that should not happen at the same time as the shutdown.

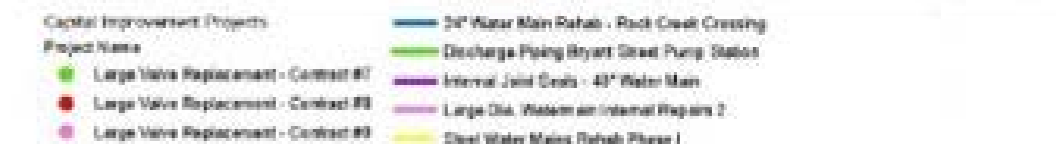
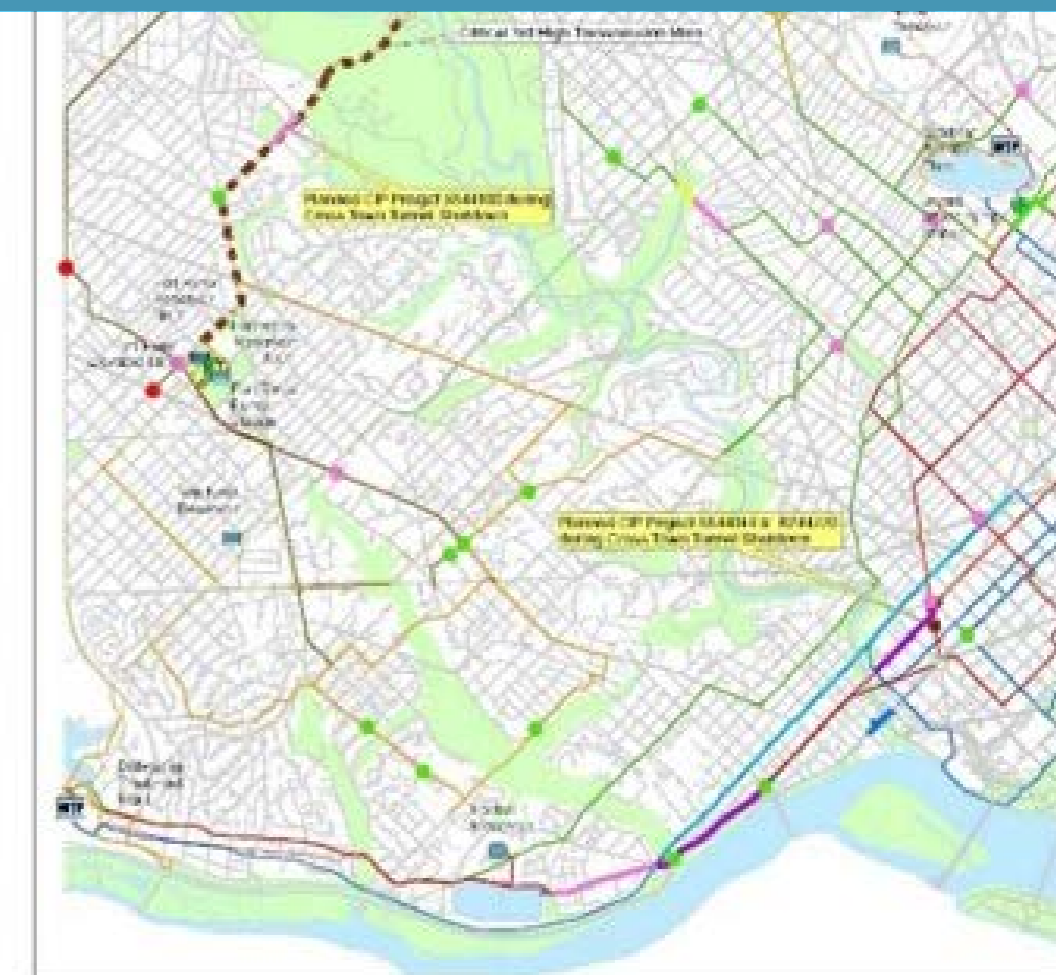
SHUTDOWNS

Shutdowns can happen for various reasons, from maintenance reasons such as repairing a leaky pipe, to unplanned events like a pipe break. In analyzing pipe shutdowns, a shutdown does not correspond exactly to taking a single pipe out of service. Instead, a shutdown removes a distribution system segment, which is bounded by valves, from service. Modeling a shutdown should take into consideration the exact locations of valves.

Let's consider the emergency shutdown to repair a pipe break at the X (see above left screenshot).

With a hydraulic model such as WaterGEMS, modelers can easily close the blue colored pipe in Comuta Lane. However, because of valving at the intersection of Belleville Drive and Comuta Lane, all the customers in the green box would be out of water, not just those served directly by the pipe with the X.

In complex networks, a shutdown map, similar to the one on the above right screenshot, can be provided to operators.





[Download Detailed Case Study ▶](#)

USER CASE

SABESP LIMITS POWER OUTAGES EFFECTS TO CUSTOMERS

When the Jardim da Conquista pump station shut down due to power failures, approximately 240,000 people in São Paulo, Brazil, remained without water overnight until Sabesp restarted the pumps the next day. To solve this problem, Sabesp performed modeling with Bentley's WaterCAD that simulated the hydraulic conditions. By understanding the operation of the entire system, the company was able to define a cost-effective solution.

Construction of a new reservoir with an oversized volume provided sufficient autonomy to ensure water supply until the morning after a power outage. WaterCAD determined existing operating conditions, tested new pump setups, and determined how long the pumps would take to fill the new reservoir. The total project cost was BRL 20,000, and with resulting savings of BRL 1.1 million, the return on investment was 55 times the project cost.

Water supply system in risk area

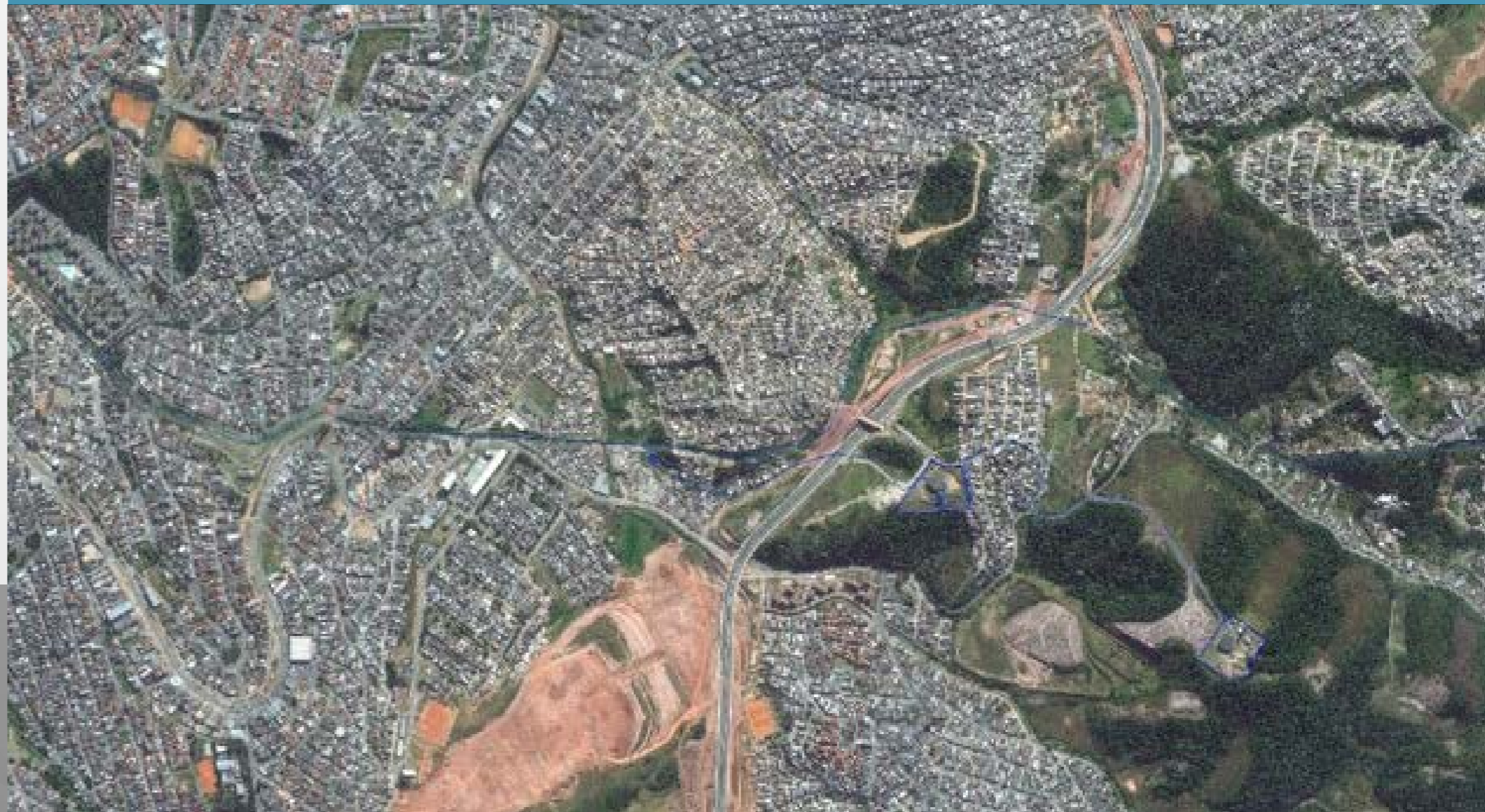
POWER OUTAGES

Power outages can severely impact the pumping capacity of a water system. Given the amount of water in storage at the start of the outage and the capacity of backup power, the operator can use the hydraulic model to estimate when the supply will run out and which portion of the distribution system will feel the impacts first.

If the power outage is isolated to a fraction of the pumping stations in the system, modifications in the operations of the other pump stations can minimize the adverse impacts. The model can be used to estimate the effectiveness of this type of strategy.

If the outage is sufficiently long such that tanks may drain, more drastic measures may be taken, such as turning on backup wells, moving in portable generators, or opening interconnections with neighboring utilities.

The effectiveness of each of these measures can be evaluated with the model. If they will not prevent loss of pressure, the model can indicate the neighborhoods that will lose pressure and areas where water tankers or bottled water can be deployed for the most benefit.





Navigate the network and map elements that satisfy (or not) fire flow constraints using WaterGEMS.

FIRES

Depending on the size of the fire and the capacity of the distribution system, fire demands can have a serious impact on the performance of the system. Limitations in pumping and piping capacity can impair firefighters. However, there are some modifications in system operation that can increase fire flows. The most obvious alteration is overriding normal control settings and turning on additional pumps.

Providing additional sources of water by opening connections with neighboring district metered areas (DMAs), pressure zones, or neighboring water systems may significantly improve fire flows. A hydraulic model can give a quantitative estimate of the additional flow available for the fire from these sources.

Preventing water from leaving the pressure zone with the fire by temporarily turning off pumps to higher zones or closing pressure reducing valves (PRVs) to lower zones can also make more water available for the fire if those zones have storage.



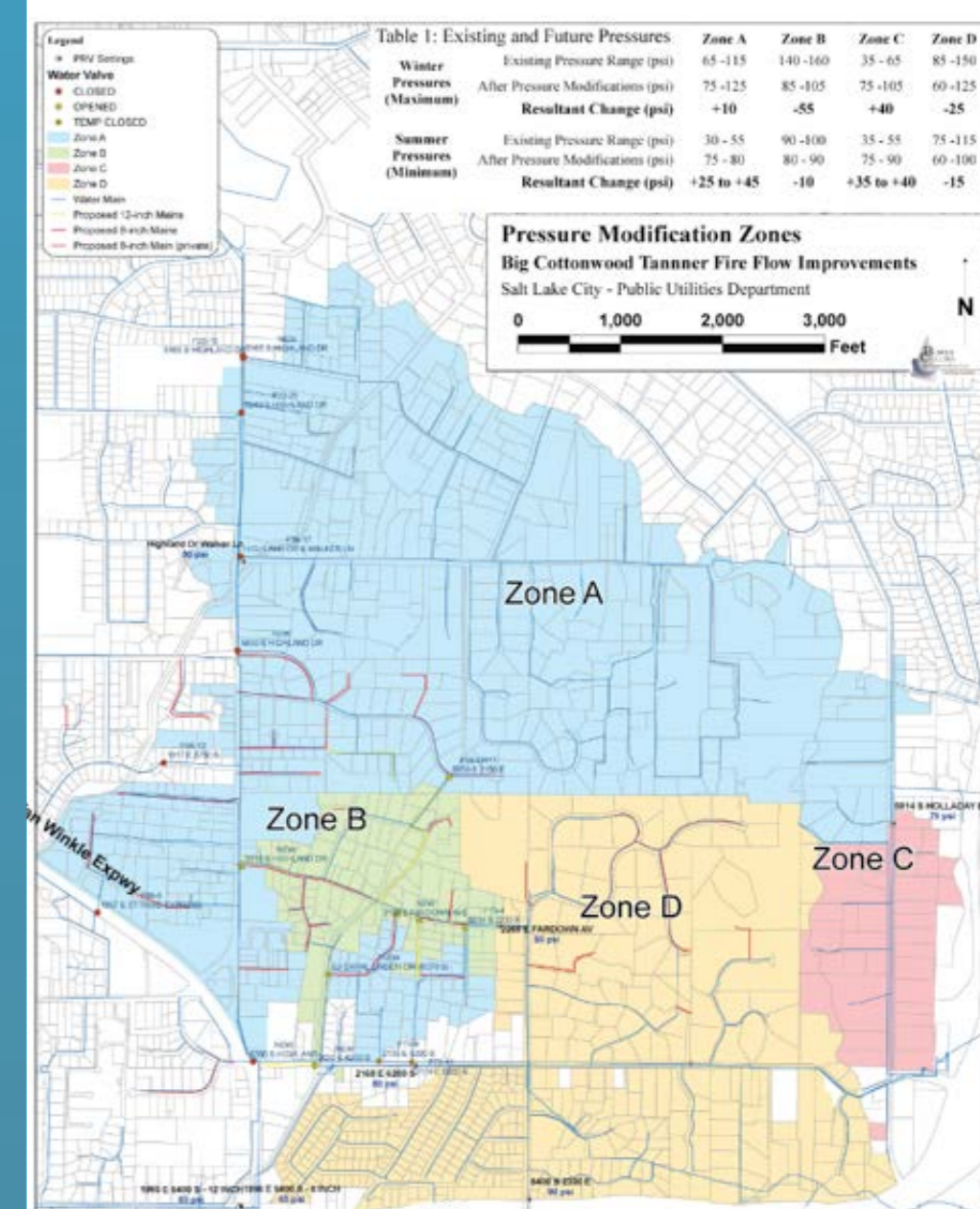
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USER CASE

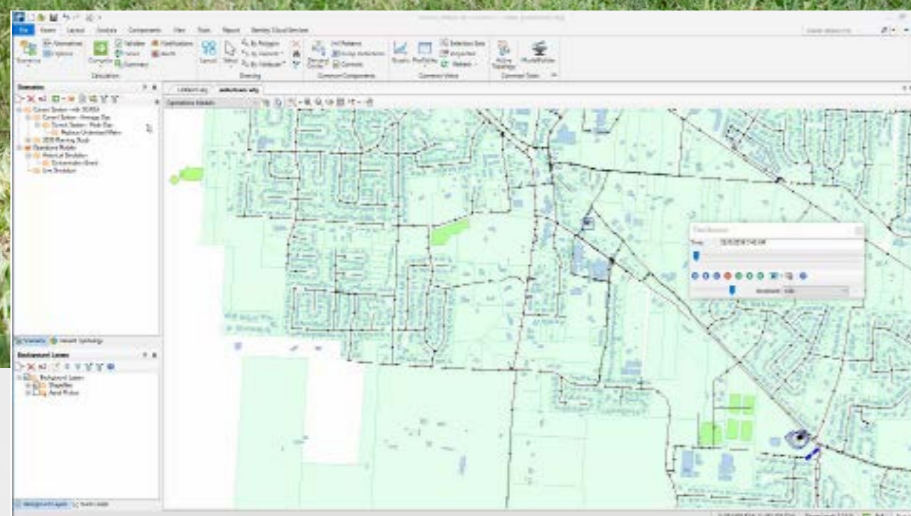
SALT LAKE CITY IMPROVES FIRE FLOW PLANNING

Water service in some areas of Salt Lake City, Utah, is provided via historic agreements with private mutual irrigation companies. Pipelines in these areas have fallen behind current fire flow service requirements. This USD 9.5 million project included a study to evaluate distribution system improvements to meet requirements and develop a prioritized plan for completing them.

WaterGEMS was used to determine which pipes were the best candidates for replacement to meet current fire flow requirements and to develop a model for the best placement for control valves—and the settings for those valves—as well as the boundaries for the new pressure zones. The performance of the distribution system was evaluated against four criteria: system delivery pressure, different fire flow capacity depending on the area, fire hydrant size, and fire hydrant coverage. WaterGEMS helped the city boost the available fire flow to the area and provide a higher pressure for many customers, increasing customer satisfaction.



Pressure modification zones – Big Cottonwood Tanner Fire Flow Improvements.



[Click to watch the WaterGEMS video.](#)

CONTAMINATION

When planning a response to a contamination, it is crucial that water utilities be able to visualize where contaminated water may travel through the system and assess this contamination spread from various sources.

The impacts of contamination can be minimized if the system is flushed by opening hydrants, but it is important to flush at the location of the contaminant plume. If the wrong hydrant is flushed it can discharge good water and spread the plume. If a reasonable estimate of the initial position of the contaminant plume is available, the model can identify where it will be located at later times in order to tell the operator which hydrants to flow.

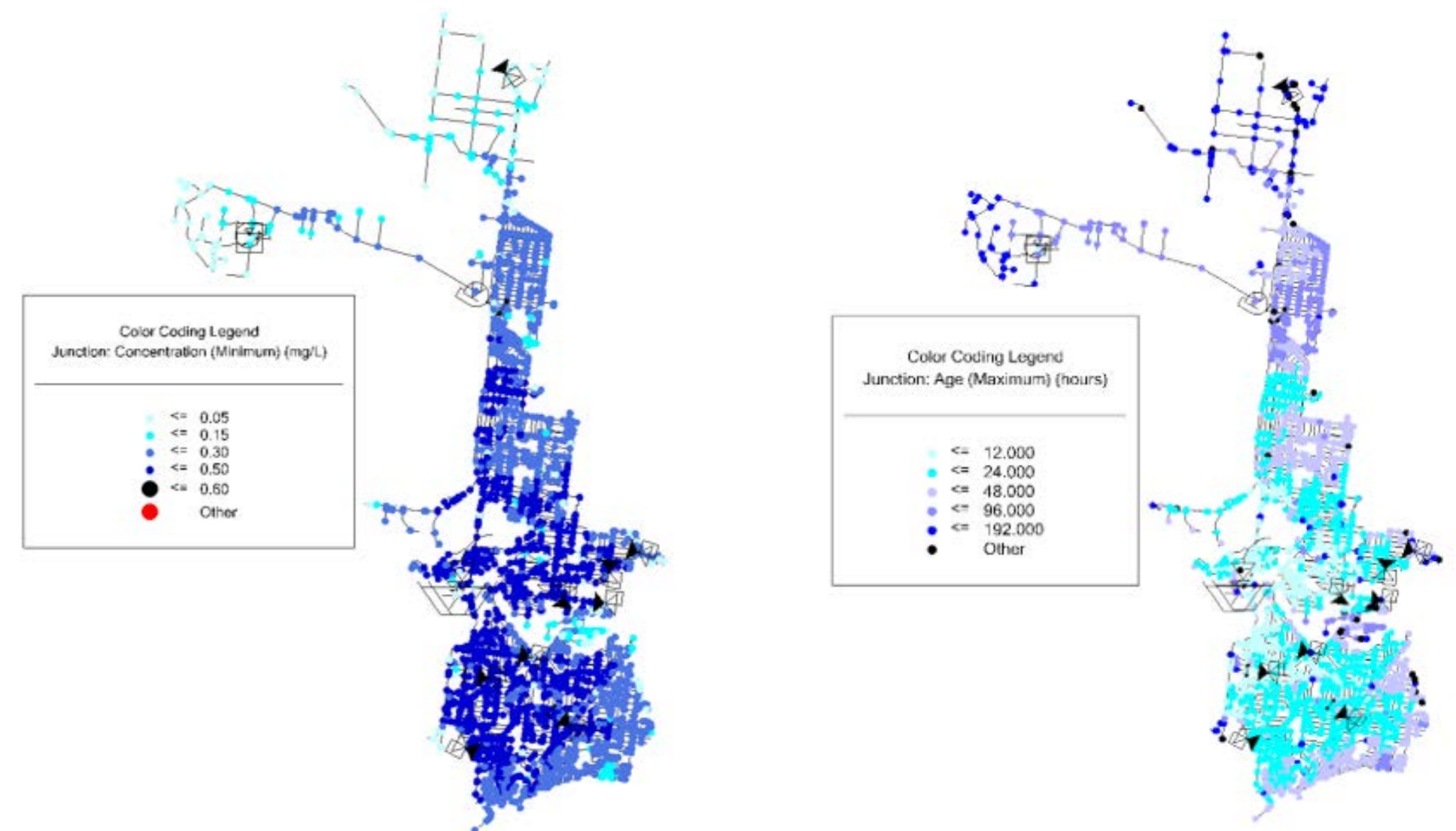
USER CASE

BARWON WATER ELIMINATES WATER QUALITY ISSUES

Barwon Water serves an 8,100-square-kilometer area in Victoria, Australia. Maintaining a high-quality water supply to all customers involves understanding the intricacies of the water supply network. This project modeled chlorine residuals throughout the distribution system via the development of chlorine decay rates to create a calibrated model that then was used to analyze and optimize the chlorine residuals throughout the network.

The primary objective of the water-quality modeling was to establish a pilot project in this area to determine the viability of establishing water-quality models for planning and operational analyses. On this project in Geelong, Barwon Water used WaterGEMS to model alternate scenarios, which reduced the risk of implementing a weaker solution, through the ability to analyze the performance of the system under varying conditions.

Constituent rate and water age analyzed and color-coded in WaterGEMS





LEARN MORE

To learn more about how WaterGEMS can help you, or to discuss your organization and projects, [complete this online form](#).

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