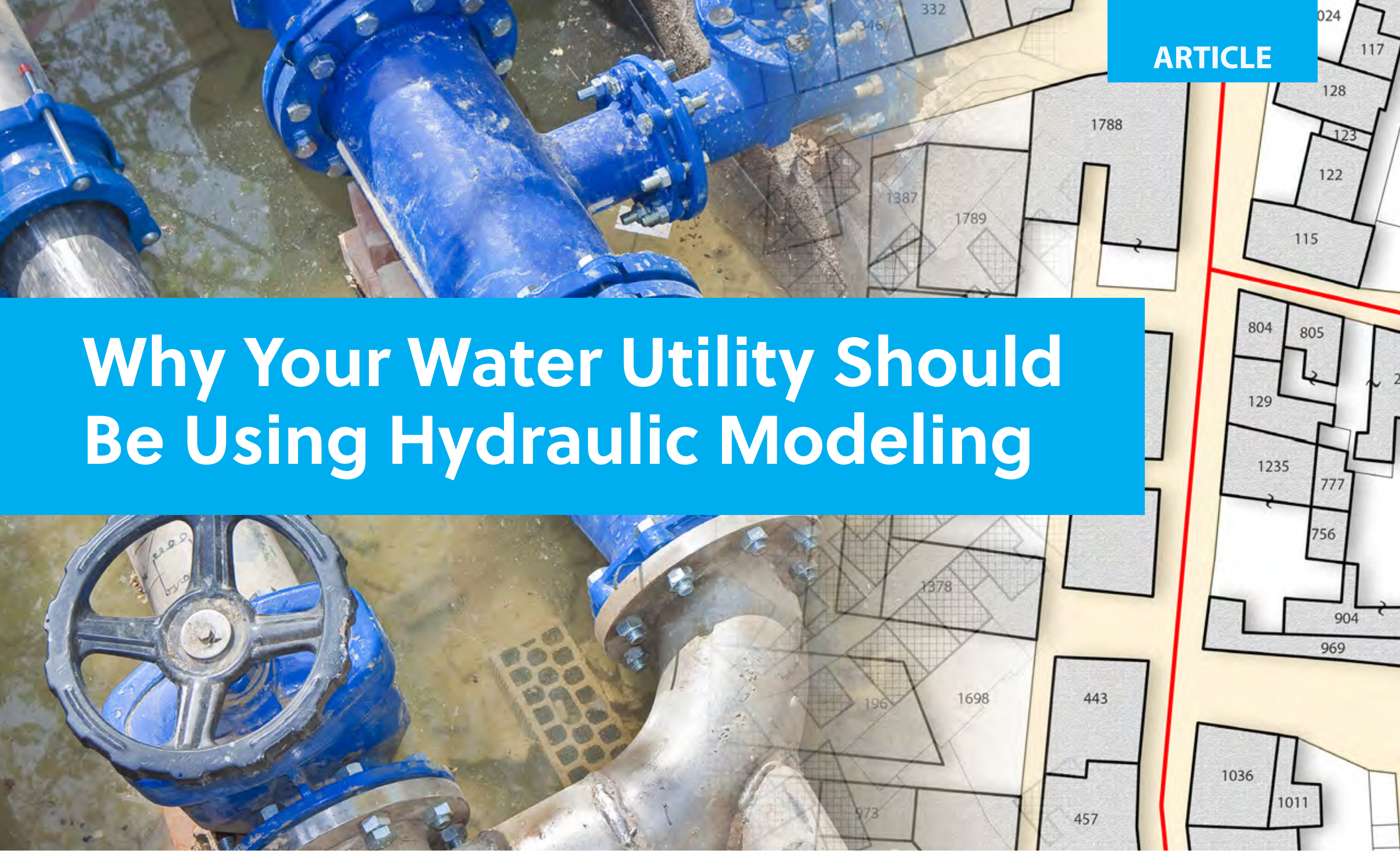
ARTICLE

Why Your Water Utility Should Be Using Hydraulic Modeling



Water utilities strive to ensure consistent and high-quality water service to growing populations, all while constrained by limited financial and labor resources. These challenges, combined with sustainability pressures, mean water utilities must do everything possible to keep their systems running at peak efficiency.

Many tools exist that water utilities can use to keep increasingly complex distribution systems performing optimally. One of the most useful but often underutilized tools is hydraulic modeling. While many water utilities have pen-and-paper or CAD diagrams of the distribution network from when the system was first built, these systems change over time. The models gradually become outdated and updating them can be difficult and time-consuming.

Hydraulic modeling changes all this. It can provide information about the performance of the system, which allows utilities to realize a vast range of benefits.

The Value Proposition Of Hydraulic Modeling

Improving customer experience. Drops in pressure and/or water quality can cause numerous problems, particularly unhappy customers. Utilities then must work backward to find the problem while under the gun to quickly restore service. Sometimes this results in a temporary or partial solution, which will only need to be serviced again. Hydraulic monitoring allows for regular, ongoing analysis of the water network, which lets water utilities proactively respond to network deterioration and demand variations before these changes begin to trouble the customers (Figures 1 and 2). A hydraulic engineer with a balanced hydraulic model can make recommendations like adjusting valves, scheduling pumps for balance supply pressure, and other necessary changes for maintaining supply standards.

Improving system performance. Beyond solving or preempting problems, hydraulic models can be used to optimize system performance. For example, utilities can analyze pump stations to discern when and how often to run certain pumps to maximize fluid output while minimizing energy usage. It can also be used to examine how pumping and pressure change over a period of time or in specific scenarios, such as when a fire hydrant is opened or after a rainstorm, etc.

Leak pre-localization. Finding leaks typically requires workers to walk the length of a section looking for evidence of leakage or wait for consumers to report issues that have made it to the surface. Usually this occurs after the leak has been occurring for quite some time. Combining sensors with a digital hydraulic model can help identify potential leaks before they become an expensive problem. An analysis of pressure, usage, and other patterns, combined with pipe age and similar factors, can isolate specific sections of the water distribution network that are likely to begin –– or which may have already begun –– leaking.

Infrastructure replacement planning. No matter how well-designed and built a system is, over time, parts and equipment will need to be replaced or modified. The hydraulic model allows the utility to plan

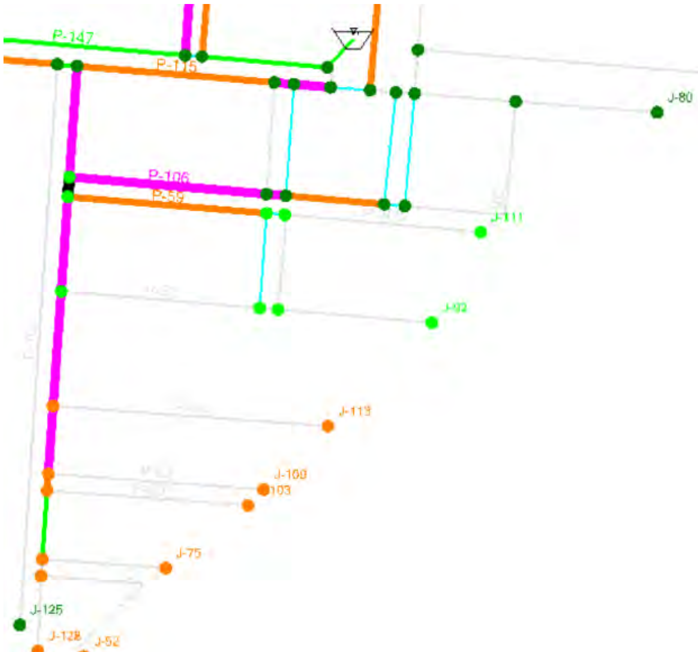


Photo courtesy of Itron

Figure 1. This hydraulic model shows homes that are beginning to see a drop in pressure (orange nodes). The pipeline highlighted in magenta shows a bottleneck that may be causing this. From here, the operator can simulate a replacement of the magenta pipe with a larger-diameter or, optionally, a parallel pipe.

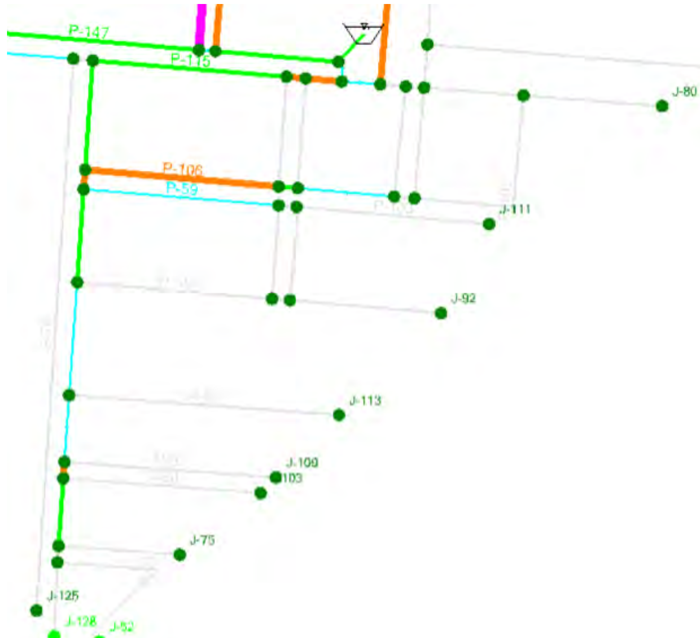


Photo courtesy of Itron

Figure 2. This hydraulic model shows the scenario in which the bottleneck pipes highlighted in Figure 1 are upgraded from 100 mm to 150 mm, relieving the pressure issue in the majority of the system (node colors changed from orange to green).

these replacements or repairs to ensure that the system will perform as needed for years to come. For example, if a large section of pipe needs to be replaced, the model can simulate various scenarios of operations using a different combination of pipe diameters to see if it will perform the same, better, or worse.

Demographic growth. As populations rise, it is critical that water utilities understand if and how their system will handle the increase in demand. For example, if a subdivision or industrial center is added, how will that affect the pressure and flow? Will a larger-diameter pipe be required, or can the current infrastructure manage the additional gallons per day (GPD)? A hydraulic model can make these calculations and simulate infrastructure performance.

Visibility into deviations from forecast. Demand forecasting and other forecast models are critical tools that can help water utilities plan for the future. Sometimes a forecast will deviate from actual measurements. This can be caused by either an unexpected change in the model or outdated forecast parameters. Hydraulic models can offer some insight as to what caused the deviation and help water utilities adjust accordingly, resulting in more accurate forecasts and better long-term planning.

What Water Utilities Need To Get Started

To begin employing hydraulic modeling, water utilities must first gather as much information as possible about their current assets, including the most up-to-date maps of pipes, valve and endpoint locations, pipe diameters, and more. If the utility uses a geographic information system (GIS), this can be a vital tool for hydraulic model-based network management. Those that lack a GIS solution can start with tools such as Google Earth or QGIS and start mapping the network changes as a first step.

The more sensors and data sources that can be incorporated into the hydraulic modeling software, the more accurate and useful it will be. Those that are concerned about the lack of in-house expertise can work with vendors that offer cloud-based systems. Many times, these vendors are also able to offer their own expertise on an as-needed basis, which can be easier and more cost effective than trying to hire an in-house hydraulic modeling expert. ■

Manmohan Prajapat is a technical consultant for Itron and has more than 17 years of experience in training and leading teams in the field of hydraulic modelling, DMA formation (sectorization), water loss reduction planning, water data analytics, and KPI monitoring for municipal water networks. He has guided teams to design thousands of km of water and wastewater networks. He has also trained more than 3,000 engineers for water, storm, and sewer network hydraulic modelling, design optimization, and lifecycle management. As part of the global Itron team, he is engaged in delivering consulting and SaaS solutions for tackling the most critical water network problems. Manmohan has a bachelor's degree in civil engineering and a Master of Technology in water resources.