



Columbia building on success of advanced monitoring stations

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Data from Columbia's water monitoring stations helped the city identify, evaluate and accelerate the restoration of its previously flood-prone Martin Luther King Jr. Park. The project won a 2019 APWA South Carolina Chapter Project of the Year Award. (Image courtesy of Woolpert)

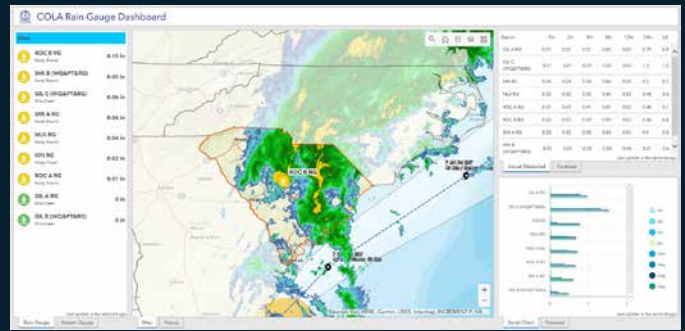
Nearly a decade after launching a water quality monitoring program to comply with regulatory standards, the city of Columbia, S.C., is operating one of the most innovative and technologically advanced water monitoring systems in the Southeast. The system monitors water quality and quantity and shares data in near real time via a public dashboard, which supports local citizens, environmental action groups, city leadership and federal agencies.

Columbia installed its water quality monitoring system in 2013 to comply with the Clean Water Act and the National Pollutant Discharge Elimination System permit. This required the city to monitor the quality of the water discharging to waterbodies that the regulatory authority classified as impaired. Woolpert was contracted by the city to create a network of continuous, water quality

monitoring stations to determine baseline water quality conditions in the impaired waterways and assess progress toward meeting future TMDL requirements.

The city initially had three continuous water monitoring stations installed at strategic locations around the city, intending to collect and apply that information for internal use. However, the subsequent deluge of requests for this information and the overflowing applications for the data have led to increasing the number of stations to 12, as well as the implementation of additional technology and a map-based data visualization dashboard. The result has been an accurate, accessible program that comprehensively supports the city.

"The information that these monitoring stations provides allows city staff to calibrate stormwater models, establish appropriate watershed-specific design guidelines and standards, and measure the effectiveness of flood control structures," said Wesley Harrison, a senior



Columbia's Esri ArcGIS dashboard streamlines data visualization to view the water monitoring information generated by the city's water monitoring stations. The dashboard helps identify weather patterns and ancillary datasets in one location, allowing informed decisions to be made. (Image courtesy of Woolpert)

engineer with the city of Columbia. "The data helps the city prioritize its master list of capital improvement projects, including budgets and construction time phasing."

Technology on the Rise

Columbia's 12 water monitoring and water quality stations are each equipped with Campbell Scientific data loggers, a water level monitoring device, and many additionally have SonTek IQ flow meters, YSI sondes and TB4 rain gauges.

The SonTek IQ uses a five-beam pulsed Doppler design to collect area velocity and volume data every five minutes, around the clock, within flood-prone areas. The field data is sent through cellular telemetry to a data visualization dashboard, enabling city staff to identify and mitigate flooding. This reduces the need to run out during storm events to measure the velocity of the water through stream cross sections, as was done previously.

The Esri ArcGIS dashboard streamlines data visualization to view monitoring information, weather patterns and ancillary datasets in one location allowing informed decisions to be made. Woolpert Innovation Portfolio Manager Daniel Michalec said it eliminates middleware and other redundant software, since data is pulled directly into the dashboard.

"All data is viewable in a single interface, regardless of the data type," Michalec said. "Seeing all data points together is extremely impactful. You can make connections and trends that otherwise would not be readily apparent. This technology is scalable and supports the intelligent decision-making and situational awareness needed to effectively prepare for and mitigate water quality and flooding issues."

Hosted on the secure city website and viewable to the public, the dashboard also can display predicted rainfall amounts based on National Weather Service models, which are overlaid with current radar and rainfall totals



Columbia has 12 water monitoring stations strategically located throughout the city, equipped with state-of-the-art technology that feeds a public, map-based data visualization dashboard. The accurate, accessible system comprehensively supports the needs of the city, the public and other agencies that rely on this data.

collected via the water monitoring stations. Columbia also utilizes a private access point that allows for near-real-time Internet of Things devices to transmit data securely without interruption from public bandwidth use, which is essential in times of emergency.

Applications Overflowing

The value and expanding applications of this data have been recognized internally and externally. Since the data are collected and updated every five minutes, it allows for it to be utilized for city flood warnings, modeling and studies. Columbia also is developing a monitoring strategy to integrate multiple city departments, including utilities, engineering, and parks and recreation—many of which have already benefited from this data.

In 2017-2018, the data helped the city identify, evaluate and accelerate the restoration of its previously flood-prone Martin Luther King Jr. Park. The design and construction of an off-line dry detention area assisted with stormwater attenuation, increased the overall stormwater storage capacity and provided pollutant trapping with new storage areas at the site. The project won a 2019 APWA South Carolina Chapter Project of the Year Award.

“MLK Park was often muddy and much of it was unusable, but now it is a beautiful recreation destination with

a handicap-accessible boardwalk,” said Trevor Gauron, Woolpert engineer and project manager. “This is what these water monitoring stations can do—provide accurate, consistent, defensible data so a municipality can allocate resources effectively for the good of the region and its residents.”

Columbia Stormwater Manager AJ Jessee said the city is weighing whether to install additional monitoring stations to establish a tighter-knit grid of the region and whether to add capabilities to the current stations. These updates would include data storage and support of the city’s stormwater management program needs, like dry-weather flow identification. Additional features also could include alarms that trigger/signify potential flooding events to alert officials.

“The capability is there to be sent a text when a bridge is compromised, for example,” Jessee said. “This technology can make sure people get the right information at the right time.”

Woolpert also worked with the U.S. Environmental Protection Agency to adjust code for a machine learning tool to identify potential abnormalities within water quality data, using static Columbia data to beta test the program. Later, Columbia was first to implement the program. Michalec said additional machine learning and

artificial intelligence capabilities could target predictive storm modeling and remote access and control features.

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Product manufacturers also are allowing Woolpert, based on the success of the Columbia program and the work of its staff, to assist with testing new designs. Manufacturers of level radars and flow monitoring equipment are working with end-users to improve the design of the equipment for an urban use.

Opportunities Downstream

As needs and capabilities continue to evolve, the goal of this program has remained true: to provide real, defensible data to help the city of Columbia successfully address permit requirements, reach water quality or quantity

goals, and make informed asset management decisions to avoid catastrophic infrastructure failures.

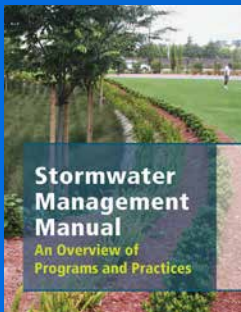
“This data will help prioritize watershed flooding criticality in the future once complete models have been established for all the city’s watersheds,” Harrison said. “Completing an analysis of the city’s critical flood areas and collecting condition assessment data on individual stormwater assets will help the city forecast critical areas for improvement and maintenance strategies moving forward.”

Jessee added that, out of all the applications and users, the community sees the need for monitoring water quality and quantity most clearly.

“One of the city’s main goals is to reduce the suffering that residents and businesses endure during and after flood events, and to ensure that the city’s waterbodies are clean and will be preserved for future generations to enjoy,” Jessee said. “Our monitoring stations supply us with the data that we need to make decisions that best protect our valuable water resources and ensures that the city is providing the level of service that residents and businesses expect.”

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