

Columbia, SC, Shares Its Waterway Monitoring Data With the Community

BY TREVOR GAURON AND MICHAEL LONG



The continuous monitoring stations were strategically positioned in waterways around the city to provide accurate and reliable water-quality data.

In 2013, the City of Columbia, SC, installed a water-quality monitoring system to comply with regulatory standards that protect the state's waterways. Since the continuous monitoring stations were strategically positioned in waterways around the city, both the City and the public have benefited from the project's evolution from required compliance into a voluntary data-sharing partnership.

Today, an array of waterway information, from rainfall to pollutants to river velocity and much more, is being shared on a publicly available website that has become a popular resource for special interest groups, educational facilities, neighboring governments, and even the National Weather Service (NWS).

The monitoring network provides Columbia with accurate and reliable water-quality data to prove it is compliant with

state and federal clean water standards. Because data are publicly shared, citizens concerned about the environment are

assured they have access to data through a transparent relationship with city hall, local universities can easily obtain data needed for student research, and the NWS supplements its weather alert capabilities with timely data to alert residents of pending weather situations.

Open access to this data has helped advance Columbia's image as a well-managed, environmentally aware city, delivering best practices that benefit many sectors of the community.

Monitoring for Problems

Under the Clean Water Act, state environmental agencies are required to monitor water quality and designate impaired waters. The South Carolina Department of Health and Environmental Control has developed total maximum daily load (TMDL) requirements for impaired waterways, including those within Columbia's jurisdiction.

Because Columbia's municipal separate storm sewer system discharges to waters that drain to several impaired waters



In February 2013, engineers installed three continuous water-quality monitoring stations in strategic locations designed to identify potential pollutants entering the waterway.

monitored by the state, the City must comply with a National Pollutant Discharge Elimination System permit that requires a monitoring plan.

Woolpert was contracted by the City of Columbia to help the community stay in compliance with its permit by creating a network of continuous water-quality monitoring stations. The goal was to determine baseline water-quality conditions in the impaired waterways and assess progress toward meeting future TMDL requirements.

The state already had a few stations established that relied on sporadic discrete and limited sampling. Columbia wanted to install a more sophisticated system that continuously monitored the waterways—one that was more analogous to a video than a single photo—to produce more comprehensive results than the state's sampling. Unlike the state's system, which pulls a sample and takes it to a lab for testing, Columbia's system is designed to detect in-stream water-quality parameters every 15 minutes.

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stations in strategic locations designed to identify potential pollutants entering the waterway. Since then, the number of monitoring stations has increased to nine. Each station has a Yellow Springs Instrument (YSI) 6600 V2-2 multi-parameter sonde equipped with sensors that measure pH, specific conductivity, temperature, dissolved oxygen, turbidity, and depth of the stream. The sondes are housed in 4-inch PVC stilling wells. Water-quality data are transmitted in near-real time via cellular telemetry to the City's monitoring website. Because of the versatility of the Campbell Scientific data loggers that the City uses, the monitoring stations can be programmed to send text messages and emails if they detect a problem.

As the number of monitoring stations in the system increased, the City also decided to measure other parameters, including how rainfall events affect the waterways, to determine if flooding was imminent. The information was particularly useful for businesses in areas that had experienced damage from recent increased flooding, including a devastating

event in 2015 in which 20 inches of rain fell over five days.

Data Sharing

The City of Columbia initially expected to maintain the data collected by the monitoring stations for internal use only, but requests for data started streaming in from many segments of the community, including water-quality advocates, citizen groups, the University of South Carolina, the NWS, engineering firms, and others.

Responding to requests and qualifying the data became a time-consuming process for City employees. To fulfill the increasing interest in monitoring information, the City began sharing monthly periodic reports with the public by posting them on the City's stormwater website. The basic information included details required by the City's permit.

The University of South Carolina, located in Columbia, has a very innovative civil and environmental engineering program that conducts research on the environmental quality of water, air, and soil. When professors learned about the City's

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website, they expressed interest in gaining access, especially to information about water quantity. The school saw potential in the data for students to update stormwater management models as a learning tool.

Former geology professor Allan James says that having the data collected and available meant professors and students didn't have to take the time to physically go out and collect samples.

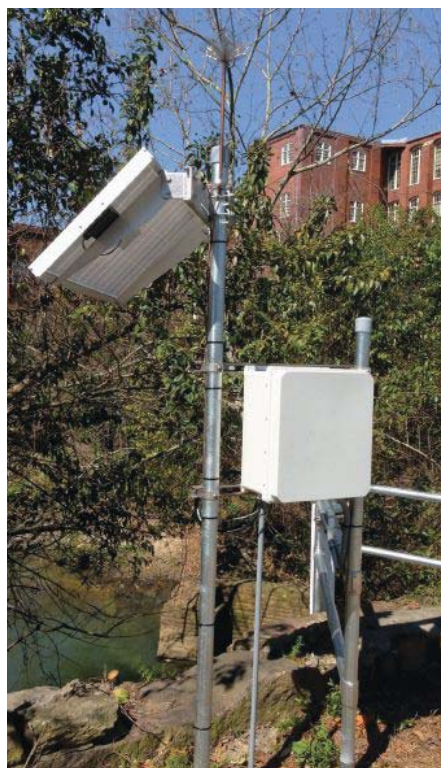
"The online data was very valuable to us," says James. "It's not uncommon [for universities] to have hydrologic data. Having small watersheds is the key. Information on small watersheds is hard to get. We felt very lucky."

James, who has taught geology for 29 years, says students published multiple papers on projects using the data and completed advanced degree work using the data. He has studied Rocky Branch Creek, which runs through the university campus and contributes to flooding of nearby businesses.

"It's a tremendous benefit to being able to understand flood risks," he says.

To provide more information in a timely manner and address additional requests for more detailed data, the City of Columbia established login accounts on a website hosted by Woolpert. The collaborative process recognizes the needs of the community by offering a convenient means of sharing the data. Visitors to the website see a map of the Columbia area and the locations of each of the water-quality monitoring stations. To reveal a color-coded table of information, visitors simply hover over the station location.

Community reaction to the City sharing



Water monitoring systems can also be used to highlight the need for community projects that address local flooding issues.

such a large amount of data has been positive. There has even been interest in installing additional monitoring stations in various locations to supplement the City's monitoring effort.

Timeliness of Data Key for NWS

NWS also has taken advantage of the data provided by the City of Columbia for use in multiple ways, including flood warnings, modeling, and studies. An NWS spokesman says the service would

like even more rainfall gauges and webcams installed at stream locations to show not only how much rain has fallen, but how it's impacting the area around the streams.

Columbia's monitoring data has allowed the NWS's Advanced Hydrologic Prediction Service to more accurately alert areas prone to flooding, verify Next Generation Weather Radar (NEXRAD) data, and review data collection at a faster interval.

The City's monitoring stations record new data every

five minutes. NWS shows data in 15-minute increments and updates hourly. For example, during an intense rain storm, the NWS radar indicates the rainfall is an intense event but must wait for an hour to show details. Columbia's monitors can provide accurate, detailed data on how the rain is affecting waterways within five minutes.

"The rainfall data helps the core mission of the NWS to protect life and liberty by comparing and verifying with ground truth information about the precipitation estimates from the radar and, if necessary, issue flood advisories or flash flood warnings for portions of the city," says NWS spokesman Leonard Vaughan.

Vaughan notes that Columbia's stream gauges are vital because streams around the city have areas prone to flooding during heavy rainfall events. The combination of rainfall data and stream gauge data allows the NWS to provide life-saving flash flood warnings.

"The reaction time of the stream is in minutes, not hours, and without the data it would be difficult to know the exact conditions along the creek," says Vaughan, a senior service hydrologist and meteorologist in the Columbia NWS office.

Improving Relationships

Making the information about the quality of the area's water available to concerned special interest and advocacy groups also has improved the City of Columbia's interactions with these entities. Being more transparent with the data through sharing has solidified the idea that both the City and environmental advocacy groups are working toward the common good of the area's waterways.

This transparency also has garnered national attention. The City has been recognized by the What Works Cities Certification program, an effort by Bloomberg Philanthropies to encourage cities around the US to enhance the way they use data to deliver results and drive change for residents.

Bloomberg recognized Columbia among some much larger cities, because it established "a data governance team and developed an open data policy to advance strategic priorities, starting with repairs and improvements to the local stormwater system."



An engineer reconnects a new sensor to the data logger. Each monitoring location contains a Campbell Scientific data logger, a power source, and cellular telemetry, which allows the city to view the data on a website.

Future for Monitoring Waterways

While any city can duplicate the water-quality monitoring network of Columbia, the investment for the technology and ongoing costs for monitoring and maintenance can be substantial. The monitors are highly sensitive and technologically advanced pieces of equipment that require regular attention.

As technology improves, cities may want to take advantage of new water monitoring technology like CANARY software. Developed by IBM and Sandia National Labs in conjunction with US EPA, CANARY was initially intended to identify potential poisons in drinking water plants in a closed, highly controlled system. Woolpert is taking the technology to another level by testing it on surface water to see if it will detect contamination in open river systems.

During one of those tests, CANARY alerted the City of Columbia to a change in one of its monitored waterways. In this case, rather than a pollutant being added, a truck was collecting water from the waterway for a nearby construction proj-

ect. Before the City's network of monitors could record the change in water levels, CANARY technology picked it up and sent a message to check it out.

The future for water-quality monitoring systems also may include best management practice studies to determine how a community intends to reduce the source of pollutants for a TMDL and then monitoring afterward to see if it was the most effective method. Having the most accurate data allows officials to make sound and informed decisions.

Water monitoring systems also could be used to highlight the need for community projects that address local flooding issues. The City of Columbia is currently working on a detention pond project at a local park that will increase storage capacity to alleviate downstream flooding. The need for the project partly resulted from data collected by the monitoring system.

Highly accurate monitoring systems could also help communities avoid capital investments in additional sewer and stormwater facilities mandated by

a regulating agency. Communities can use data from the monitoring systems to show permit compliance, thus avoiding the need for additional water treatment facilities.

Through its open sharing of water-quality data, the City of Columbia continues to show the public it cares about the safety and quality of the community's water supply. Having access to the data also allows other agencies to use the data to improve the safety of the community because surrounding emergency management agencies can issue more accurate flooding alerts and road closure notices. And recreational waterway users, such as kayakers, have access to a more accurate way to gauge their safety by checking river stage reporting. 💧

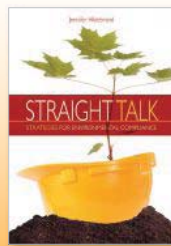
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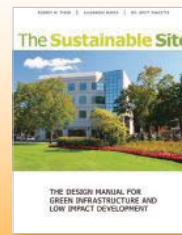
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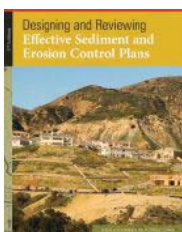
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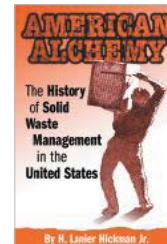
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