Philadelphia uses smart technology to manage stormwater runoff and reduce pollution

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—Erin Williams, Stormwater Billing Program Manager, Philadelphia Water Department

The City of Philadelphia operates a combined sewer system that handles both wastewater and stormwater. To help prevent heavy rains from overburdening the system, the Philadelphia Water Department (PWD) worked with Microsoft partner Opti to install smart water monitoring and control technology running on the Microsoft Azure cloud platform. The solution optimizes runoff storage and release to keep the sewers running smoothly, and it provides real-time and long-term data analysis that can help the PWD transform its operations.

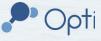## City of Philadelphia
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When a rainstorm hits a big city, residents may look at it as a passing inconvenience, with puddles to walk through and snarled-up traffic. But for employees of the city's water department, there's a much larger issue to deal with—figuring out where all that water goes when it flows off sidewalks, roads, and parking lots. That issue can take on greater importance in the 860 American municipalities that use "combined sewers"—sewer systems that were designed, sometimes a century or more ago, to channel both wastewater and stormwater through a single pipe. As the cities have grown, the combined sewers may no longer be able to handle normal wastewater volume combined with heavy storm runoff. The result can be untreated wastewater entering and polluting local waterways.

There are various ways to address the problem of combined sewer overflows (CSOs), and the City of Philadelphia has taken a holistic and proactive approach. Under the Green City, Clean Waters program adopted in 2011, the city embarked on a 25-year plan to significantly reduce CSOs. After just five years, improvements made under the program are keeping 1.5 billion gallons of polluted water out of local rivers each year.

Bringing smart technology to stormwater management

Most cities tackle CSOs through some type of stormwater diversion—during heavy rainfall, excess water that enters the sewers is intercepted and put into a holding tank, reservoir, or tunnel, and then slowly released when the rain event is over. Philadelphia does things differently. "We're unique in that we take a source-based approach," says Erin Williams, Stormwater Billing Program Manager for the Philadelphia Water Department. "Rather than managing excess water once it enters the system, we employ strategies for keeping runoff from entering sewers during a storm."

The city's source-based strategies include working with commercial property owners to adapt existing properties to better handle stormwater runoff. To make these projects attractive to owners, the city offers grant programs and billing credits to help finance modifications. These projects take many forms, from replacing runoff-generating pavement with porous materials to more leading-edge smart technology solutions.

The Philadelphia Water Department (PWD) prides itself on being at the forefront of innovation for all aspects of its operations. The department's willingness to try new technologies led to an engagement with Microsoft CityNext partner Opti. "Like PWD, Opti is focused on improving the environment through intelligent management of stormwater assets," says Jamie Lefkowitz, Director of Project Development at Opti. "We view Philadelphia as one of the most forward-thinking communities in the world on this issue, so we were excited to work with them."

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> —Jamie Lefkowitz, Director of Project Development, Opti

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The Opti stormwater management product is OptiNimbus, which combines weather forecast monitoring with real-time, automated control of stormwater infrastructure plus comprehensive data reporting. OptiNimbus is a cloud-based, continuous monitoring and adaptive control (CMAC) solution running on the Microsoft Azure cloud platform. "We chose Azure for its reliability, scalability, and flexibility," says Lefkowitz. "We also trust its level of security—it's been approved by the Federal Risk and Authorization Management Program, which is an important factor when we work with government agencies."

Deploying the technology and gauging results

In November 2016, PWD chose to pilot OptiNimbus on 8 acres of commercial property within the city. The property had a stormwater retention pond, but it didn't meet the city's standards for runoff capture and release, thus contributing to potential CSOs. Opti installed CMAC technology on the pond's existing outlet control structure, including a water level sensor, an actuated valve, and an internet-connected control panel. The OptiNimbus software in the cloud continuously monitors the National Weather Service forecast, and when it predicts rain, the pond's outlet valve closes automatically. After the storm, the software gauges the water level in the pond and opens the valve to gradually release water at an optimal rate that the combined sewer can handle.

During the first 212 days after installation, approximately 20 inches of rain fell on the site. Using OptiNimbus, PWD kept 2.7 million gallons of water out of the city's combined sewer during the storms, which accounted for 98.8 percent of total runoff on the property. "The Opti solution has worked exactly how we hoped it would," says Philip Pickering, Engineering Supervisor for the Philadelphia Water Department. "It's been a huge success so far."

"With this technology, we can optimize the performance of traditionally designed stormwater systems—taking what was a static system and turning it into a smart, predictive system," says Williams. "In the past, we could only assess performance by doing site visits, but now we can do real-time performance tracking of things like water level and discharge rates. And we have access to long-term monitoring data and control that can help shape our requirements and our design for future projects. This technology could transform the way we work."

Finding local solutions to a global issue

PWD continues to work with Opti on ways to retrofit other existing commercial properties to meet CSO requirements. It's also talking with developers about deploying the technology on new construction projects and looking at ways to use Opti in PWD infrastructure projects. The department engages residential customers to become part of the CSO solution as well. "Through our Rain Check program, homeowners are eligible for subsidies up to $2,000 to make their property less prone to runoff," explains Pickering. "This could include something as simple as a rain barrel under a downspout or a more complicated project such as replacing pavement with a water-friendly patio."

In addition, Philadelphia has a robust and aggressive capital program under which it's implementing green infrastructure projects on city-owned properties. These include rain-absorbing tree trenches along streets and rain gardens in city parks. And PWD is eager to share the results of all these projects with other water utilities. "Water management isn't a local issue—it's a global issue," says Williams. "We're frequently in touch with colleagues in other cities and even other countries to exchange ideas, because at the end of the day, we're all here to help each other."

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Engineering Supervisor,
Philadelphia Water Department

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