

Metropolitan Sewer District of Greater Cincinnati

Digital twin technology helps city reduce combined sewer overflow volume by 247 million gallons and saves an estimated \$38 million in capital project work

The Metropolitan Sewer District of Greater Cincinnati (MSD) serves an Ohio population of more than 850,000 spread out across 290 square miles. Like many large cities, Cincinnati MSD operates combined and sanitary sewer systems, some of which were built more than a century ago. Whether by design, or due to infiltration and inflow of stormwater, these systems have a tendency to overflow, discharging untreated sewage into local waterways or flooding streets and basements.

The challenge

Cincinnati's sewers discharge an average of 11.5 billion gallons of combined sewage every year into the Ohio River and its tributary streams within Cincinnati's urban watershed.

In 2002, the EPA entered into a federal consent decree with MSD, mandating the elimination of sanitary sewer overflows and significant mitigation of combined sewer overflows into receiving waterways. Engineers estimated the cost to mitigate the sewer overflows at \$3.1 billion, an unacceptable capital expense to pass along to MSD's customers.

Recognizing the generally inadequate stormwater management capabilities of their existing combined sewer system, MSD prepared a comprehensive wet weather improvement plan. MSD recognized that full sewer separation and deep tunnel construction are massive capital investments that have very low return on investment because they create only episodic benefits during peak flow events and are single use assets with little additional community wealth creation.

Instead, **MSD's objective is to maximize existing capital assets** — such as sewer interceptors, storage and treatment facilities, and pump-stations — **to reduce overflows and gain system-wide benefits through advanced control logic that will optimally operate MSD's watershed.**



An example of MSD's operational dashboard.

Program highlights:

- Overflow volumes reduced by 247 million gallons annually
- More than a 90% reduction in cost compared to initial capital work estimate of \$38 million
- CSO mitigation achieved at a price of less than \$0.01/gallon

The solution

To overcome these challenges MSD partnered with Xylem to optimize the performance of their existing assets through the power of decision intelligence.

MSD and Xylem began by focusing on the Mill Creek Interceptor (MCI), a major carrier of flows through the MSD service area, and MCI's most upstream asset, the SSO 700 Storage and Treatment facility (STF). This facility, along with four additional control sites, were originally designed to reduce overflow volumes from the constructed outfall at the river. SSO 700 STF has 4.2 million gallons of storage and 15 million gallons of high-rate treatment capacity. These assets, combined with the real time control (RTC) facilities located downstream on the MCI, provide multiple points to control sewage along the length of the interceptor.

Historically, SSO 700 STF and the RTC facilities have been controlled locally without any coordination between them and other facilities, and MSD needed to implement a solution to cost-effectively increase performance and capacity utilization.

Xylem worked with MSD to implement [Xylem's SSO/CSO Prediction and Prevention applications](#), which utilize a combination of sensors and weather data, along with artificial intelligence, to create a real time decision support system that delivers automated, optimized control of existing assets to reduce sewage overflows, maximize storage, and maximize treatment during wet weather.

SSO 700 STF is now controlled based on real-time upstream and downstream conditions, along with real-time feedback on what's happening at two of the downstream RTC facilities (Ross Run and Mitchell Ave). This allows MSD to harness the power of real-time data and analytics when deciding whether to activate or deactivate high rate treatment and when to fill or drain tanks.

The results

The project was an overwhelming success – after MSD implemented the coordinated RTC program, overflow volumes were reduced by 247 million gallons annually (based on 2015 rainfall). **Implementation of the control system, when compared to a capital work estimate of more than \$38 million, meant a reduction in cost of more than 90% was passed on to MSD's customers.** Moreover, CSO mitigation was achieved at a price of less than \$0.01/gallon.

Taken together, these approaches enabled MSD to achieve significant reductions in both the capital and operating costs of collecting and treating wastewater in compliance with environmental regulations.

"The real-time decision support provided by Xylem gives our operators the time and confidence they need to ensure we are optimizing our collection system to reduce sewer overflows during wet weather events."



Matthew Van Doren,
Supervising Engineer for MSD