MINIMIZING CSO’s USING HYDRAULIC MODELING WITH REAL-TIME CONTROLS AND OPTIMIZATION TECHNOLOGY AT THE CITY OF HAMILTON (A058)

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Abstract
The City of Hamilton owns and operates one of the largest and most complex combined sewer systems (CSSs) on the Great Lakes. The overall wastewater collection system includes three wastewater treatment plants, approximately 65 wastewater outstations, 8 combined sewer overflow (CSO) tanks, one equalization tank and approximately 1,600 km (1000 miles) of sanitary sewer and combined sewers. The area is blessed with a large natural harbour providing for a wide range of industrial and recreational uses and also contains sensitive receiving waters, most notably Cootes Paradise Marsh. This area is the site of one of the largest wetland rehabilitation projects in North America. Three large interceptor sewers collect combined sewage from an area of approximately 54 km² (209 mi²) and convey it to a wastewater treatment plant (WWTP). During dry weather and small storm events, all combined sewage is conveyed to the WWTP where it receives treatment before being discharged into the eastern end of Hamilton Harbour. During larger storm events 21 combined sewer overflow outfalls are active, discharging untreated combined sewage to receiving waters to avert sewer system surcharging, basement flooding, and to avoid over capacitating the WWTP.

The City has been using a calibrated trunk sewer model to support hydraulic analyses of its combined and sanitary trunk system. The existing wastewater model in MOUSE is a fully dynamic model capable of continuous simulation of sewer hydraulics including sewer surcharging and backwater effects, complex control structures, and rule-based real-time controls. The rules-based RTC strategies evaluated with the model have been implemented for operation of the regulator gates, CSO tanks and pump facilities. The existing model functions as a cornerstone tool for the RTC system and is also utilized in many ways to support related City activities such as:
- Supporting the City’s Water and Wastewater Masterplan beyond 2031.
- Collection system performance analysis for capital planning and budgeting
- Operational planning and support (post-flood event forensics and evaluating short-term, non-standard operating scenarios)
- Water quality and loading calculations; and
- Ultimately, flow frequency-based system design and performance monitoring.

The City has been implementing upgrades to the existing wastewater system and CSO facilities to improve operation of the system and provide additional capacity to support growth related flows and minimize bypasses/overflows during wet weather events. The operational and structural improvements implemented thus far have continued to reduce CSO’s, but in order to reach the ultimate goal of achieving 90% capture of wet weather flows in an average year, the City has recently initiated Phase 2 of the RTC System Implementation.

Phase 2 (initiated November 2008) involves full-scale design and on-line implementation of a comprehensive state-of-the art RTC system that is fail-safe, reliable, flexible, robust and user friendly. The consulting team for the Phase 2 works is being lead by Stantec and BPR-CSO, who together bring a strong understanding of how to apply the operational capabilities of RTC to a complex collection/treatment system so that performance targets are achieved and capital investments are reduced. The planned system integrates with the City’s SCADA systems, Asset Management systems, and Computerized Maintenance Management System (CMMS) and is being developed concurrently by the same consulting team with an expanded all pipes sanitary and combined sewer model to provide real-time information and decision support at all times during dry and wet weather conditions. Some of the major challenges to the success of Phase 2 and the realization of a fully operational RTC system include using the refined MIKE URBAN model to assess planned capital infrastructure and upgrades, completion of the project in a phased manner so that the target of 90% wet weather capture is achieved as soon as possible and in conjunction with planned WWTP primary clarifier upgrades. Other goals for this second phase of RTC implementations includes maximizing CSO tank use while minimizing interceptor use, providing a pre-defined constant flow to the WWTP, reducing the impact of the peak flow factor on secondary treatment design and providing opportunity for water quality based RTC. In addition, there is a significant human component of change management that must be applied in order to develop a system that wastewater operators will trust, utilize during intense storm events, feel significant involvement in developing, and have pride of ownership in. Currently, the Baseline assessment and RTC Approach are scheduled for completion summer 2009 with development of RTC systems design for spring 2010. The initial implementation of RTC and pilot testing of the system is planned out to summer 2011 with substantial completion and implementation of the fully functional, on-line RTC system by spring 2012. The RTC project is an important contributor to the City’s Vision 2020 and, in conjunction with a number of other important initiatives, will lead to a transformational clean-up of Hamilton Harbour, launching a new era of sustainable urban watershed management.