Case Study: Toronto's Wet Weather Master Plan

Geo346

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April 3, 2012

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*Introduction*

Toronto is taking the lead on what is the least addressed issue across Canada. Storm water from urban areas negatively impacts natural water systems (Riversides, 2009), effecting water quality, stream banks, and ecosystems (Condon, 2010) that ultimately effect human health (MOE Policy Review, 3). Compounding this issue is aging infrastructure that at an urban level, is inadequate, and at an ecological level disastrous (Riversides, 2009). In many areas of the city, sewer and storm systems are designed to handle 1-2 year storm cycles and some are combined, creating contamination issues during flood events caused by more frequent 25 to 100 year events (Toronto Water, 2012). In response to a Federal mandate to improve water quality and to address aging infrastructure and the impact of increased water flows through climate change resulting in flooding (Kloss et al., 2011), Toronto adopted the Wet Weather Master Plan (WWFMP) in 2003. The Plan largely focuses on green infrastructure, such as green roofing requirements, alternative storm water management standards for new development, and most importantly downspout disconnections (Kloss et al., 2011). Grey, engineered stormwater elements such as sewage pipes, underground storage tanks, treatment facilities, constructed ponds and wetlands are also included but to a lesser degree, for areas where green infrastructure is not adequate (Kessler, 2011). Relying on green infrastructure is highly cost effective (University of Toronto, 2008), increasing the lifespan of existing sewer systems by reducing flows at the source (Cigana, 2000). With these two motivations in mind, downspout disconnection has been the focus of its efforts since 1998 with the role out of a voluntary program adopted by City Council (Kloss et al., 2011) which became mandatory in November 2011. Mandatory disconnections are initially for combined sewer neighbourhoods in older parts of Toronto (Toronto Water, 2012). Focusing the WWFMP on downspout disconnections targeting combined sewer neighbourhoods is an effective and well-chosen technique to achieve the biggest impacts, reducing infrastructure costs and improving water quality through reduced sewage outflows (CMHC, 2012).

*History of Engagement*

In 1972, Toronto was listed as a place of concern in the Canada/US Great Lakes Water Quality Agreement because of pollution entering Lake Ontario and its tributaries from urban runoff (Kloss et al., 2011). The Remedial Action Plan was subsequently adopted in 1987 by Canada and the US (Riversides, 2009), which outlined how water and habitat areas within the city and along the shores would be remediated for recreational and ecological benefit (Garrison et al, 2011). Toronto has been involved in the protection of natural water systems since that time.

In 2000, City Council adopted a plan recommending a green roof and rooftop gardens strategy. The same year, a more stringent sewer use bylaw came into play and in 2002 an official plan was approved that included green building design and construction practices. A diversification of source control strategies can be seen coming into play, where residential downspout disconnection was being complemented with green roofing as a means to control large scale runoff (Kloss et al., 2011).

In 2003, the Wet Weather Flow Master Plan (WWFMP) was approved, focusing on two neighbourhoods and tributaries with the highest level of risk due to combined sewer systems (CSO's) and prone to basement flooding by disconnecting downspouts from the storm sewer system and directing them to on site greenspace. An investigative body called the Green Roof Task Force was created, as a way to act upon previously identified action steps (Kloss et al., 2011).

In 2005, a study by Ryerson University supported this strategy, indicating that if all flat roofs in Toronto were green, it would save the City $30 million annually. There was also a severe storm event this year which caused damage to homes, natural water courses and city infrastructure, which lent a sense of urgency and justification to Plan implementation. This prompted the creation of the Basement Flooding Protection Program, which upon investigative studies, calls for measures beyond green infrastructure. This includes the installation of underground storage tanks, dry ponds, and upgrades to storm sewers in neighbourhoods with chronic flooding problems due to high water tables, surface flooding, or issues inherent in old sewer/sanitary systems (Kloss et al., 2011).

2006 was a big year for the WWFMP, the downspout disconnection program was showing results with 26,000 disconnected, and the City of Toronto Act was passed supporting mandatory green roofs on new development. This was partnered with the adoption of the Toronto Green Standard, the approval of a green roof strategy, and a pilot project providing green roofing incentives. The Green Standard established two initially non-mandatory tiers of performance targets for both buildings and sites requiring new planning applications. Tier 1 called for a minimum of 5mm on site retention, which acts as an incentive for rainwater harvesting (Toronto Green Standard, 2010). Tier 2 featured higher performance levels and included a monetary incentive, where planning related development cost charges for review and permitting qualified for a 20 percent refund. The City also opted to provide a free downspout disconnection service, to encourage higher voluntary uptake (Kloss et al., 2011). When this wait list was capped in 2007, 19,900 residences had been signed up. The service was discontinued in 2011, with only 6,900 disconnections at a cost to the City of $1,300 per downspout (Levy, 2011) having been accomplished, as the program was neither time nor cost efficient. Disconnection was made mandatory, and the City left private contractors to fill the void in order to save costs. Urban Forest became an active strategy along with mandatory disconnections, with $1million in funds transferred from Toronto Water to Parks, Forestry, and Recreation for the planting of 11,000 trees (Kloss et al., 2011). A constructed wetland project was also implemented, intended to filter urban pollutants from runoff and improve Lake Ontario's west end Toronto beaches (Chernos, 2006). Toronto continued making progress in successive years, voting to make downspout disconnection mandatory for 2011, adopting source management guidelines for developers in 2007, committing to doubling its urban forest canopy in 2008, and adopting green roof construction standards for large buildings in 2009.

*Analysis*

There are several pieces of legislation at the Provincial level that empower Toronto in applying this plan. Largely, they focus on the provision of safe drinking water, and attempt to empower municipalities to take the steps needed to ensure it. The Clean Water Act of 2006 recognises the cost and health benefits of preventing contamination before water is treated for drinking and helps to enforce municipal provisions to this end. The Provincial Policy Statement tool that cities use in land use planning uses the watershed as the base for development planning and draws its power from the Planning Act. The Planning Act has no enforcement, and so this makes it difficult for Toronto to fully role out green infrastructure requirements and design new developments to work with natural systems (Riversides, 2009). However the Toronto Act (2006) does provide backing for mandatory green roofing (Toronto Green Standard, 2010). Despite minimal legislative support, Toronto has been able to fairly successfully implement strategies to control storm water flows, likely due to the Federal Remedial Action Plan which requires Toronto to address run off impacts on Lake Ontario.

An article written by John F. Cigana published in Pollution Engineering in June of 2000 identifies best practices for municipalities in addressing wet weather events. In an assessment of both European practices and studies of systems implemented in the United States and Canada, Cigana came up with the following order of priorities for modifying existing combined sewer systems: control storm water at the source, add upstream holding capacity, ensure weirs optimize desired flow outcomes, and increase end of pipe capacity at the waste water treatment facility (Cigana, 2000, 50). Toronto's Wet Weather Flow Master Plan combines both source and end of pipe priorities. At-source infrastructure incorporates 'green' technology, such as green roofs, rainwater harvesting, swales, and permeable parking lots (Lemieux, 2011), which according to Cigana, maximize the capacity and lifespan of existing systems by reducing the water volume entering storm drains. This reduces the potential for hydraulic surcharge caused by overload. On site infiltration and water retention or upstream holding capacity is created by a focus on redirecting rain spouts to green areas, green roofing, and rainwater harvesting. Source control is also the best way to positively impact the health of receiving water bodies and natural systems as it can reduce dissolved solids, hydro carbons, and heavy metals (Cigana 2000,50) or more plainly: gasoline, pesticides, and road salt (Lemieux, 2011). However, the focus on 'green' infrastructure is novel, considering that Cigana as an industry expert, recommends 'grey' infrastructure modifications (Cigana, 2000). The Basement Flooding Protection program for areas prone to flooding exemplifies recommendations by Cigana and may be indicative of green infrastructure limitations as a modification to pre-existing urban systems.

In an analysis if several downspout disconnection programs and Torontos in particular, the Canada Mortgage and Housing Corporation identified several areas where this favoured strategy is limited. It found limitations in effectiveness, cost, and implementation. Effectiveness limitations include site specific characteristics, where on average only ¾ of the downspouts on a site can be disconnected affordably. It also has a small impact on water quality, since it redirects largely clean water from roof areas. In higher density areas, or in situations where soil is heavily compacted or the site is largely impermeable, more costly and complex onsite infrastructure must be installed and maintained to manage wet weather flows. Implementation issues were found to revolve around site suitability, where setbacks are to close or the lot size is too small, buildings both on and off site can be damaged. If soft landscaping is not available or the site is too steep for infiltration, the runoff will gain entry to the storm system via the street (CMHC, 2012). The CBC reported in 2011 that these limitations have made themselves known through Torontos experience with the free disconnection program (CBC News Toronto, 2011) but when one takes into account Torontos most pressing concerns, this technique is the most effective for achieving the biggest impacts. Despite limitations, achieving a 2/3 overall disconnection percentage will reduce CSO overflow events, which is one of Torontos biggest pollution issues. It also reduces infrastructure costs, as it increases the lifespan of existing systems as they will not have to be upgraded to accommodate growth, and reduces the cost of new infrastructure as reduced volumes require smaller conveyance systems and treatment plants (in CSO areas). It is also affordable for single family homeowners, averaging about $100 to do it themselves. This one simple strategy effectively addresses Torontos biggest stormwater pollution factor and most pressing infrastructure concerns. This also has major environmental benefits, as it reduces the impact of stormwater discharge on natural waterways, which can destroy ecosystems and impact the health of not only native flora and fauna, but human life as well (Condon, 2010). In short, targeting combined sewer systems in the first phase through the WWFMP is a highly effective and knowledgably selected method for addressing Torontos most pressing stormwater management priorities.

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