TORONTO, ONTARIO, CANADA

A CASE STUDY OF HOW GREEN INFRASTRUCTURE IS HELPING MANAGE URBAN STORMWATER CHALLENGES

TYPES OF GREEN INFRASTRUCTURE USED: Green roofs, blue roofs, rain barrels/cisterns, permeable pavement, rain gardens, infiltration trenches or vaults, vegetated swales, street trees, planter boxes, downspout disconnection

Toronto has made green infrastructure a central component in its efforts to reduce urban stormwater runoff and sewage overflows that contribute pollution to Lake Ontario. The city has enacted a long-term Wet Weather Flow Master Plan that establishes a comprehensive strategy to use both gray and green infrastructure approaches to eliminate adverse effects of wet weather runoff, with a focus on managing rainwater where it falls. The city has implemented programs for downspout disconnection, which became mandatory in 2011, adopted construction standards to require buildings to include green roofs, established rainwater-capture pilot and demonstration projects, and provided funding for tree plantings to double the city's existing tree canopy, among other initiatives. Toronto is also using green infrastructure to reduce the costs of implementing its Master Plan. The city estimates that its downspout disconnection program and initiative to increase tree cover will help reduce costs for stormwater infrastructure and capital improvement projects, and that further savings could be realized by replacing impervious surfaces in alleys and laneways with permeable pavements.

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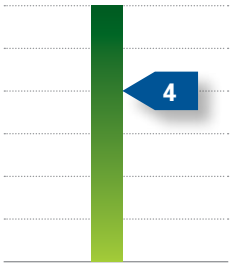

Total Criteria Score
Out of a possible 6

EMERALD CITY CRITERIA*

- ☐ Requirement to use GI to reduce some portion of the existing impervious surfaces?
- ☐ Dedicated funding source for GI?
- ☑ Incentives for private-party actions?
- ☑ Long-term Green Infrastructure (GI) Plan?
- ☑ Retention Standard?
- ☑ Guidance or other affirmative assistance to accomplish GI within City?

BACKGROUND

Toronto, the largest city in Canada, covers 248 square miles and is home to 2.5 million residents, with another 5 million people living within the larger metropolitan area. The city contains an extensive network of sewer infrastructure, including 2,800 miles of storm sewers with more than 2,600 outfalls, and 807 miles of combined sewers with 79 CSOs.[1,2] Toronto's urban stormwater is a leading cause of water pollution in Lake Ontario and its tributaries, and under a 1972 bilateral Canada-U.S. Great Lakes Water Quality Agreement, was identified as the primary cause for the city being listed as an Area of Concern for the Great Lakes. In response to this listing, Toronto established a Remedial Action Plan (RAP) in 1987 to develop plans for the restoration of drinkable, fishable, swimmable, and aesthetically pleasing water and habitat areas within the city and surrounding watersheds.[3]

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Toronto's City Council adopted construction standards in May 2009 that require all new buildings and retrofits with more than 2,000 square meters (approximately 21,528 square feet) of floor area to include a green roof; since the bylaw went into effect, approximately 1 million square feet of additional green roofs have entered the planning phase.

Faced with the difficult challenge of limiting stormwater runoff and pollution, Toronto developed a unique policy approach for managing stormwater, with the goal of eliminating adverse effects of wet weather flows and achieving measurable improvement in ecosystem health within the watershed. In 2000, it established what was considered a stringent sewer-use bylaw to restrict what can be disposed of through the sewer and in what quantities.[4] Three years later, Toronto's City Council approved a 25-year, $1.03 billion* stormwater plan, the Wet Weather Flow Master Plan, that sets forth a comprehensive strategy utilizing both traditional and green stormwater methods to deal with surface water quality and quantity, sewage overflows, and habitat and wildlife protection, with an emphasis on managing rainwater where it falls.[5]

The city adopted management guidelines in 2007 to provide further guidance for developers on the design and implementation of stormwater source control measures necessary to achieve the Wet Weather Flow Master Plan's long-term goals. Instead of mandating specific best management practices, however, the plan provides a flexible framework for the city to consider any innovative approach that can demonstrate specific performance objectives with respect to controls for peak flows, flood management, water quality, and annual runoff volume.[6] Specific water quality targets include removing 80 percent of total suspended solids annually over the entire site; specific runoff volume targets encourage infiltration, evapotranspiration, and rainfall harvesting. These include maintaining the pre-development volume of overland runoff, allowing a maximum runoff of 50 percent of annual precipitation, and require a minimum retention of 5 millimeters per event, an equivalent of .20 inches.[7]

DOWNSPOUT DISCONNECTIONS

Toronto's Downspout Disconnection Program was established as a voluntary program in 1998. The program, which was adopted by the City Council, provided free downspout disconnections to property owners whose downspouts were legally and directly connected to either the combined or separate sewer system. Its objective was to reduce the amount of stormwater entering the systems and reduce pressures on flood-prone areas. The city's 2003 Wet Weather Flow Master Plan identified downspout disconnections as one of the most effective and readily available source control options. It estimated that 40 percent of all properties could be disconnected through a voluntary program and made this goal a focus of the implementation plan.[8]

In 2003 and 2004, the Downspout Disconnection Program aimed its efforts at two particular neighborhoods and tributaries with combined sewer systems, as well as properties that were subject to basement flooding. The focus area was enlarged in 2004 and 2005.[9] In a review of the program in 2006, it was reported that a total of 26,000

*All money figures are given in U.S. dollars.

downspouts had been disconnected, at an average rate of 2,300 downspouts disconnected each year with $1.5 million in annual funding.[10] In November 2007, the City Council voted to move from a voluntary program to one that would be mandatory starting in November 2011, with all areas of the city phased in by the end of 2016.[11]

TORONTO'S GREEN ROOFS AND GREEN STANDARD

In 2000, Toronto's City Council adopted an environmental plan that recommended the city develop a strategy to encourage green roofs and rooftop gardens. In 2002, an official plan was approved that promoted green building designs and construction practices, such as green roofs and green spaces. After a Green Roof Task Force was formed in 2003 to investigate and promote the benefits of green roofs, a 2005 Ryerson University study estimated that if a green roof were installed on every flat roof, the city would save nearly $270 million in municipal capital costs and more than $30 million annually.[12,13] Subsequently, a Green Roof Task Force discussion paper identified a list of options and strategies, both financial and regulatory, to implement green roof technologies.[14] This led to the development and approval of a green roofs strategy in 2006.[15] As a result of this process, a two-year Green Roof Incentives Pilot Program was formed, with an initial budget of $200,000, to provide financial incentives of up to $20,000 per project to property owners through Toronto Water, the agency responsible for implementing the city's Wet Weather Flow Master Plan.[16,17]

In 2006, *Rooftops to Rivers* reported that there were 100 green roofs built or planned in Toronto. That same year, the passage of the City of Toronto Act gave the city the authority to mandate green roofs on new development. In May 2009, the Toronto City Council adopted construction standards requiring all new buildings and retrofits with more than 2,000 square meters of floor area (roughly 21,500 square feet) to include a green roof. Today there are approximately 135 built green roofs, totaling about 120,000 square feet in the city.[18] Moreover, according to Stephen Peck, founder of Green Roofs for Healthy Cities, approximately 1 million square feet of additional new green roofs have entered the planning phase since the bylaw went into effect.[19]

Toronto's building certification program, the Toronto Green Standard, was originally adopted in 2006. It sets performance targets related to site and building design in order to promote more environmentally sustainable development. The system is broken into two tiers, with Tier 1 being mandatory for all new planning applications as of January 31, 2010, and Tier 2 being voluntary and including higher levels of environmental performance. To encourage participation in Tier 2, Toronto refunds 20 percent of all development charges related to planning review and obtaining permits.[20] The University of Toronto Faculty of Architecture, Landscape and Design found that the benefits of building greener under the Toronto Green Development Standard overwhelmingly outweigh the associated costs, and that stormwater management requirements bring no additional financial burden to developers, consumers, and municipalities.[21] Instead, as compared with conventional systems, green stormwater management requirements lower initial and life-cycle costs while improving water quality, and reduce the need for stormwater systems to expand as quickly to accommodate growth and development. The study reported that water conservation requirements are also highly cost effective, when considering the avoided energy costs (for pumping, heating, and treatment) and the avoided costs for water treatment and sewage treatment plant expansion.[22] As part of the Toronto Green Development Standard, the city also put together design standards for greener parking lots and established green stormwater management standards for development.[23]

RAIN BARRELS, TREE PLANTINGS, AND OTHER GREEN INITIATIVES

The number of green infrastructure demonstration projects and programs within Toronto continues to increase. Typically, each initiative starts out as a pilot, to provide the city time to evaluate and revise existing codes, measure success, and identify ways to expand the pilot into a full-fledged program. In 2006, for example, the Ontario Building Code was amended to allow the use of rainwater inside a building, and the city is currently piloting demonstration projects at the city's Automotive Building at Exhibition Place and the Metro Zoo to evaluate the use of roof catchments with dual plumbing systems.[24,25] The 5 millimeter minimum retention standard put forth by the Wet Weather Flow Master Plan has also acted as a driver for rainwater harvesting, particularly in the densely packed urban center.[26] Additionally, the city's Urban Forestry Services has initiated numerous tree planting efforts. In 2006, for example, Toronto Water provided $1 million to the Parks, Forestry and Recreation Division, to plant more than 11,000 trees.[27] With the approval of its Climate Change Action Plan in 2008, the city made a commitment to double the existing tree canopy to increase shade, reduce the urban heat island effect, and reduce stormwater runoff.[28]

FINANCING STRATEGY

The City Council's 2003 Wet Weather Master Plan was projected to cost $1 billion over 25 years. While population pressures, increased flooding events due to CSOs combined sewer overflows could push the cost higher, Toronto views green infrastructure as a means to bring costs down. For example, Toronto Water estimates that downspout disconnections thus far have saved the city about $140 million in infrastructure costs. More than 350,000 residential downspouts were estimated to still be directly connected as of 2007, with each downspout costing the city from $1,000 to $1,330 to disconnect. As a result, the cost for the city to maintain its voluntary disconnect program could have been substantial. But as the city moved to a mandatory program in 2007 to ensure that inflow into the system under extreme storm events would be controlled—effectively transferring costs of disconnection over to homeowners, where the cost of disconnection is considerably lower—the city is expected to save an additional $8 million in short-term capital costs over three years.[29,30,31] A 2008 study on the Toronto Green Development Standard estimated that, at a cost of $36 million over 10 years, borne largely by private building owners and developers, 6 percent of Toronto's roofs can become green roofs, resulting in an annual savings of $100 million in stormwater costs and $40 million in CSO capital costs. Replacing the city's 1,864 miles of narrow alleys, or laneways, with permeable pavements would provide a net benefit of $27 million to $40.5 million in stormwater infrastructure savings. The study additionally estimated that by doubling its urban tree cover to 40 percent, Toronto could reduce stormwater flow by 20 to 30 percent, resulting in $7 billion in stormwater infrastructure cost savings.[32]

Toronto Water established a Stormwater Management unit in 2005 to oversee the plan's implementation.[33] The city generally implements water, sewage, and stormwater projects using pay-as-you-go financing, with revenue coming from the sale of water, a wastewater levy, and other miscellaneous revenue. Reserve funds are used to fund capital projects and lessen water rate impacts when unforeseen circumstances arise; these funds come from a water rate charged to water customers, net operating surplus, development charges, and interest income. To continue its pay-as-you-go approach, since 2002 Toronto Water has issued annual rate increases of approximately 9 percent.[34] One other source of funding available for green infrastructure projects is the Environmental Protection Reserve Fund, which the city created in January 2009 to fund the city's Climate Change Action Plan and several other key projects. Money from this fund has been used toward meeting the city's urban tree canopy goals.[35]

*EMERALD CITY RATING SYSTEM

Each of the cities profiled in *Rooftops to Rivers II* is a leader in green infrastructure investment—rethinking the design of municipal services and infrastructure. These cities leverage funding in creative ways. They provide tools to residential and commercial land owners to retrofit private properties and realize the multiple benefits provided by green infrastructure. In short, they are changing how cities look and function.

NRDC's Emerald City Rating System identifies six actions cities should undertake to maximize their green infrastructure investment. Our metric does not directly compare one city to another, due to geographical, population, budgetary and other differences. Instead, it identifies the presence or absence of common factors of success that NRDC believes are essential elements of a robust green infrastructure commitment. Only one city profiled, Philadelphia, is undertaking each of the actions identified, although each city is undertaking at least one.

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