

Summary of the Consultant’s Report: Environmental Benefits and Costs of Green Roofs

The City of Toronto, in partnership with EETech (formerly CRESTech), hired a team from Ryerson University to undertake a study of the municipal level benefits and costs of implementing green roof technology in Toronto. The team conducted an extensive literature review to identify and quantify the benefits related to green roofs. It also collected information on the types of buildings in Toronto and their geographic distribution. The information collected was modeled and applied to an inventory of existing flat roofs within the City for aggregating the benefits on a citywide basis. The team also developed a method to compute the monetary value of the benefits. A survey of the existing green roof technologies and standards was carried out to inform the development of minimum requirements for green roofs.

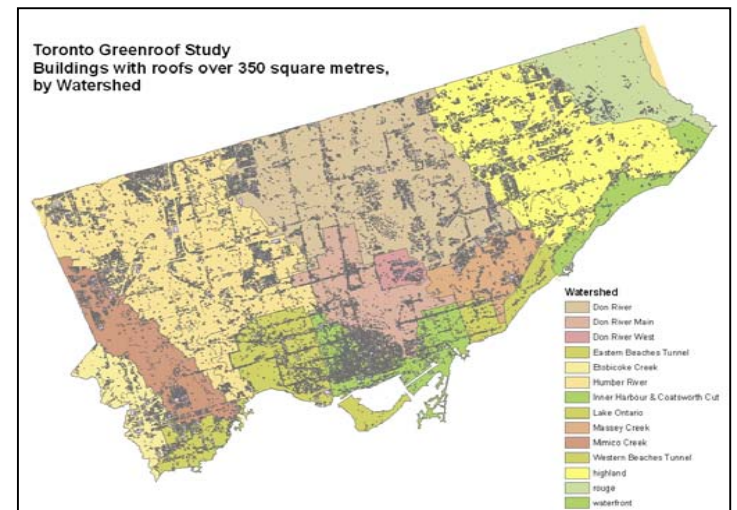
The findings of the work are presented in five sections of the report. Section 1 (About the Study) provides historical background related to this work; Section 2 (Survey of Research Related to Green Roofs) provides the findings of the literature review on benefits of green roofs; Section 3 (Survey of Types of Green Roofs and their Standards) provides information on the different green roof technologies currently available and the performance standards pertaining to green roofs; and Section 4 (Green Roof Benefits and Costs for the City of Toronto) describes the calculated municipal-level benefits if green roofs were implemented citywide. The report ends with recommendations of the minimum criteria for green roofs, and guidance for further work.

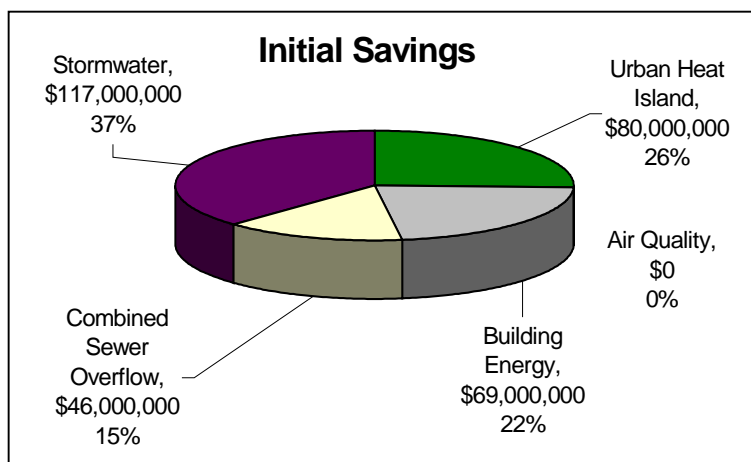
The study quantified some of the many benefits associated with green roofs, based on currently available research data, but recognized that the benefits that were not quantified (such as aesthetic improvement of the urban landscape, increases in property values, use of green roofs for food production, and increased bio-diversity) still have value. The study quantified the benefits from stormwater flow reduction - including impacts on combined sewer overflow (CSO), improvements in air quality, reductions in direct

Section ONE



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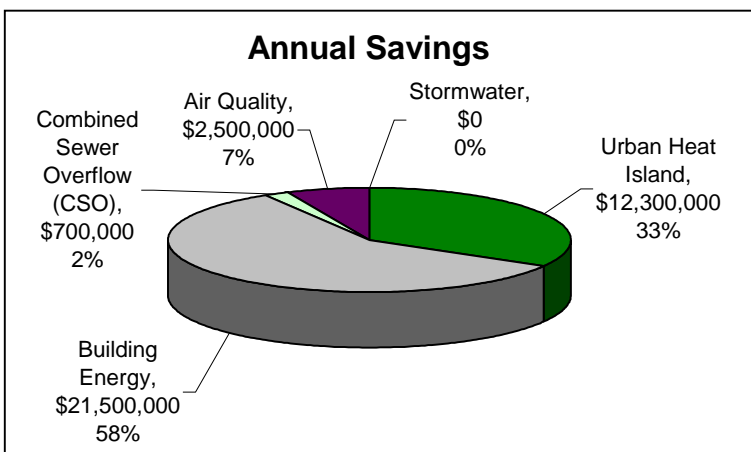


energy use, and reductions in urban heat island effect. The benefits on a citywide basis were calculated based on the assumption that 100% of available green roof area would be used. The available green roof area included flat roofs on buildings with more than 350 sq. m. of roof area, assuming that at least 75% of the roof area would be greened. The total available green roof area citywide was determined to be 5,000 hectares (50 million sq. m.). The benefits were determined as initial cost savings related to capital costs, plus the level of annual cost savings. These are shown in the charts and table to the left.

The report also presents its assumptions used in calculating City benefits as the minimum design criteria for a green roof to achieve the stated benefits. The key considerations were that the roof system be “extensive”, that it cover a significant portion of the roof, have a maximum stormwater runoff coefficient of 40%¹, and have a growing medium depth of at least 150 mm, where structural loads permit. Green roofs with shallower growing media could be used on roofs where structural loading does not permit the 150 mm. depth, although it would be recognized that the benefits would be reduced.

Green roofs are an emerging technology and some questions need further exploration. These include uncertainty related to some of the calculated benefits, the impact of less than 100% green roof coverage, the impact of building-specific constraints, quantification of other social benefits and consideration of the effectiveness of alternative technologies to green roofs. Moreover, the calculation of City program costs would allow a complete cost-benefit analysis of green roofs to the City. These questions are important and will need to be considered further as the City develops its policy on green roofs. Nevertheless, there is enough evidence of the benefits calculated in the report to show that there is a case for developing public programs and promoting green roofs in Toronto.

¹ New information from recent monitoring of green roofs in Toronto resulted in adjusting this to 50% in the study.



Category of Benefit	Initial	Annual
Air Quality	\$0	\$2,500,000
Building Energy	\$69,000,000	\$21,500,000
Combined Sewer Overflow (CSO)	\$46,000,000	\$700,000
Stormwater	\$117,000,000	\$0
Urban Heat Island	\$80,000,000	\$12,300,000
Total	\$312,000,000	\$37,000,000