Action plan for sustainable city of Toronto
Case study of green roofs

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1. Green City Program

Building reputation of a 'Green City', last ten years Toronto was building strategy for global changes toward sustainable future. Knowing that in sustainable city, clean and healthy environment are strongly related with community engagement, city of Toronto develop strategy for public engagement through Global action plan for climate change, clean air and sustainable energy.
The City of Toronto is committed to address that challenge through environmental leadership and a sustainable future for all Torontonians. In a sustainable city, a clean and healthy environment goes hand-in-hand with strong community engagement, a thriving economy and access to opportunity for all residents.
During public engagement for the Climate Change, Clean Air and Sustainable Energy Action Plan, it was heard very clear message: the residents of the City of Toronto want action and they want the knowledge and support needed to make real changes in their homes, businesses and neighborhoods.
Toronto has a long history of leadership on climate change. The Better Buildings Partnership has created more than $80 million in energy retrofits in buildings; the City's Energy Retrofit Program has carried out $30 million worth of energy-related projects in City facilities. The Toronto Atmospheric Fund, the installation of wind, solar, hydrogen facilities at Exhibition Place, Enweaves Deep Lake Water Cooling system and policies such as the Toronto Green Development Standard are just a few other examples of ways in which the City of Toronto has been in the forefront of the movement to reduce greenhouse gas emissions.
As a result of 'Green City' program, city of Toronto was involved in many Sustainable projects such as: Reconstruction of waterfront, Development of green building policy, Development of sustainable neighborhoods, Sustainable transportation, etc.

The City's ***Climate Change, Clean Air and Sustainable Energy Action Plan*** was designed to be held in two phase:
Phase 1 outlines the City's response to the challenge of climate change and poor air quality. It is designed to move the City from a framework for discussion, to concrete action. This Action Plan will accelerate global work to significantly reduce release of greenhouse gases to the atmosphere and make substantive positive changes to local air quality. The sustainable energy component of the plan will move Toronto from its current unsustainable state of energy use to a state of energy sustainability. It also recommends the creation of funding and other programs that encourage energy efficiency and renewable energy initiatives.
A number of other initiatives, such as the development of a Sustainable Transportation Implementation Strategy, Green roof strategy, the proposed Green Economic Sector Development Strategy, the Water Efficiency Plan and the 70% Solid Waste Diversion plan will also play an important role in meeting the City's climate change and air quality targets.

Phase 2 of the Climate Change, Clean Air and Sustainable Energy Action Plan will more clearly link these other related initiatives.

2. Green Roof By-law

Toronto has been at the forefront of organized green roof activity over the last several years. In early 1990's volunteers under the Rooftop Garden Resource Group (RGRG) started to

promote green roof development in the city. This has been taken over by Toronto-based Green Roofs for Healthy Cities, a not for profit organization, which carries out world-wide education on green roofs. The City held a set of consultation workshops with green roof stakeholders to receive input on its proposed strategies to encourage green roofs.
Following these consultations, the City prepared a discussion paper, called Making Green Roofs Happen, which proposed options for encouraging implementation of green roofs. These options were based on a discussion and analysis of the results of The Environmental Benefits and Costs of Green Roof Technology study, the policies of municipalities considered international leaders in green roof development, and the findings of the stakeholder workshops. The paper also proposed criteria for defining green roofs, and identified barriers and solutions to green roof implementation

In November 2005, Making Green Roofs Happen was presented at a public meeting of Toronto's Roundtable on the Environment, an advisory body to City Council on matters of sustainability.

Following some additional suggestions from the Roundtable, on February 1, 2006, Toronto City Council approved a set of recommendations to encourage green roofs which, for over 3 years, effectively comprised Toronto's green roof strategy. The initiatives in this strategy fell into four main categories: installation of green roofs on City buildings; a pilot grant program; use of the development approval process to encourage green roofs; publicity and education. The City of Toronto Act (COTA) of 2006 provided Toronto City Council with the authority to pass a bylaw requiring and governing the construction of green roofs. In contrast to the initiatives under Toronto's original green roof strategy, which were to encourage green roofs on new private development, the new authority under COTA allows the City to require green roofs as-of-right on new private development. The provincial authority was specific in allowing the City to set standards only for green roofs. This is an "exception" to the Building Code Act, 1992 which generally prohibits municipal bylaws from exceeding the requirements of the Ontario Building Code.

In a joint report in October 2008, City Planning and Toronto Building provided a draft framework and draft construction standard for a Green Roof Bylaw. The City conducted two rounds of stakeholder consultations in 2008 and early 2009, on the draft proposal to require green roofs in Toronto. Included among the more than 150 participants were building owners, architects, landscape architects, developers, green roof designers, installers and manufacturers, roofing contractors and manufacturers, industry associations, City ABCD and interested members of the public and business community. In facilitated workshop sessions, the participants identified key issues and provided valuable feedback on the proposed thresholds for requiring green roofs and on the construction standard. Staff received 149 written submissions from individuals who attended the consultation sessions and 14 written submissions on the draft proposals for the Green Roof Bylaw. Comments were generally supportive of the intent of the Bylaw; however there were many suggestions as to how best the Green Roof Bylaw could support the sustainability objectives of the City. Several meetings were also held with individual stakeholders including the Toronto District School Board, the Toronto Catholic District School Board and roofing contractors to further explore issues raised during the public consultation. Also, a Green Roof Technical Advisory Group (TAG), comprised of stakeholders with expertise in green roofs and building regulation, was convened and tasked with providing technical comments on the draft Toronto Green Roof Construction Standard. Toronto is the first City in North America to have a bylaw to require and govern the construction of green roofs on new development. It was adopted by Toronto City Council in May 2009, under the authority of Section 108 of the City of Toronto Act. The Bylaw applies to new building permit applications for residential, commercial and institutional development made after January 31, 2010, and will apply to new industrial development as of January 31, 2011. The Bylaw requires green roofs on new commercial, institutional and residential development with a minimum Gross Floor Area of

2,000m^2 as of January 31, 2010. Starting January 31, 2011, the Bylaw will require green roofs on new industrial development. Green roofs are an emerging technology in North America, and as a result, there are currently no standards incorporated into Ontario's OBC for the City to measure the design and construction of green roofs against. The purpose of the Toronto Green Roof Construction Standard (TGRCS) is to provide requirements and recommendations that will allow a designer to design a green roof that will meet the City's minimum requirements for green roof construction while also meeting the OBC requirements for the remainder of the building. The TGRCS will also provide City staff with the technical foundation necessary for the development of a Toronto Green Roof By-law (TGRB) consistent the City of Toronto Act. The TRGRCS will provide certainty and clarity for builders, contractors, developers, manufacturers and designers when designing and building green roofs in the City. To assist City staff with the development of the TGRCS, a Green Roof Technical Advisory Group (TAG) was established with group members representing a diverse cross section of industry experts including a representative from the Ontario Industrial Roofing Contractors Association (OIRCA).

During this whole process the City undertook a coordinated public consultation with affected stakeholders. These sessions provided an opportunity to address proposed thresholds, coverage, alternative compliance and transition provisions for requiring green roofs. When enacted the TGRB would require green roofs on certain types of new buildings and regulate the design and construction of green roofs in Toronto. Building size and use characteristics will dictate the extent of green roof required. Determining the size of the green roof area based on the building footprint ensure that the size of the green roof relates to the area contributing to the environmental impact of the building and that the size is not minimized through building design.

- It is proposed that the By-law require an above grade green roof with minimum total area coverage as follows:
- All residential development with a gross floor area (GFA) greater than 5,000 sq. m. are required to install a green roof.
- All Industrial, Commercial and Institutional (ICI) development with a GFA greater than 2,000 sq. m. are required to install a green roof.
- Any new development where there is more than one use in a single building, apply the threshold for the use with the largest GFA.
- Size of the required green roof is determined by the GFA of a building i.e. larger buildings require larger green roofs.

Gross Floor Area * (Size of Building)	**Coverage of Available Roof Space (Size of Green Roof)**
2,000 - 4,999 m^2	20%
5,000-9,999 m^2	30%
10,000-14,999 m^2	40%
15,000-19,999 m^2	50%
20,000 m^2 or greater	60%

* Note: Residential buildings less than 6 storey or 20m in height are exempt from being required to have a green roof.

Graphic 1 – Requirement for Green roofs, City of Toronto Municipal Code Chapter 492, Green Roofs, under section 108 of the City of Toronto Act, 2006.

- Green Roof coverage ranging from 20-50% of the footprint of the building GFA for affordable housing is exempt from the total GFA calculation.

For any industrial use development where the installation of a green roof is not technically practical or feasible, the applicant may choose to implement the following alternative compliance for industrial buildings:

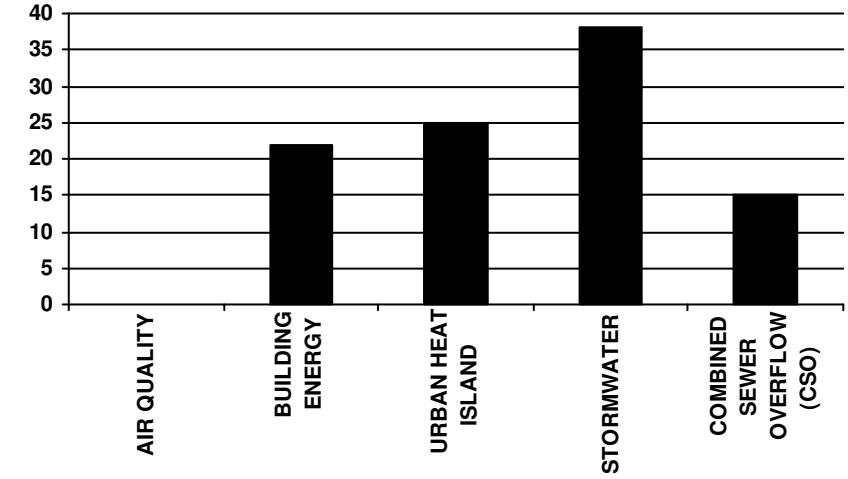
- Cool Roofing materials for 100% of available roof space; and
- Plant shade trees within car parking areas, at a minimum ratio of one tree planted for every five parking spaces supplied.
- Plant shad trees at the equivalent of 6 - 8 meter intervals starting from the property line along all street frontages, open space frontages and public walkways, excluding driveways and easements; and
    - A) Green* an area at grade or on the roof equivalent to the size of the required green roof; or
    - B) Retain rainwater from the roof for reuse up to and including the level of the 100 year storm, and Green* an area equivalent to 25% of the size of the green roof requirement.

* Green is defined as one or a combination of the following: a green roof, green wall, soft landscaping, shaded hardscape, open grid pavement, high-albedo surfacing materials.

The By-law will establish both the administrative framework and technical requirements that will govern green roof construction. Included would be a permit system for anyone wishing to construct a green roof. The TGRCS will establish criteria for all green roof system components, structural requirements, safety issues such as wind uplift and fire resistance, waterproofing best practices and vegetation performance.

3. Environmental Benefits and Costs of Green Roof Technology for the City of Toronto

Green roof technology is an emerging technology and many questions need further exploration. The City of Toronto has had an interest in encouraging green roofs for some time, starting with its participation in the construction of two demonstration green roofs on the podium of City Hall and the roof of the Eastview Community Centre.
The study held by Ryerson University, Toronto has made several advances in predicting benefits of green roofs, and it has provided information for the City of Toronto to move further on programs and policies pertaining to green roofs, there are several areas that will require further work.



Graphic 1 – Initial saving in %, Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto, Ryerson University, Toronto

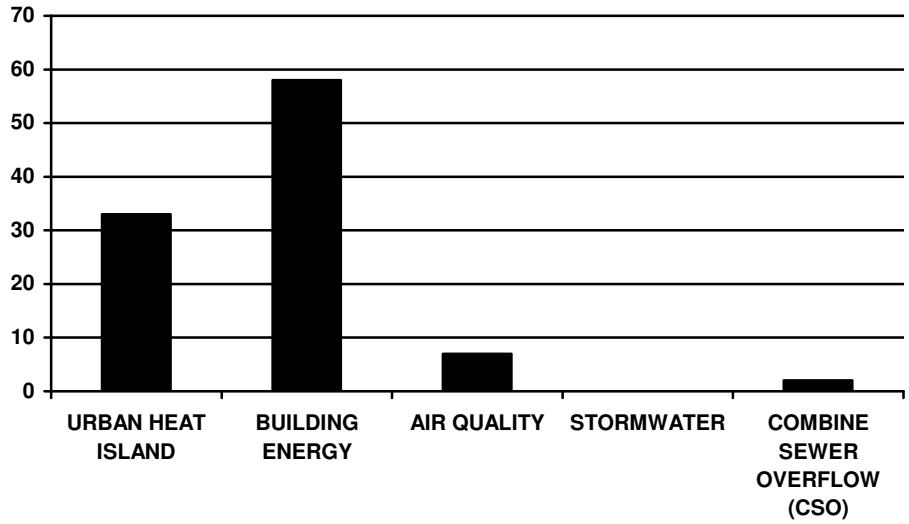
Questions remain to be answered regarding the uncertainty of the benefits, impact of less than 100% green roof coverage, impact of building specific constraints, the quantification of program costs leading to a complete cost benefit analysis, quantification of other social benefits and consideration of the effect of alternative technologies that may be able to perform one or more of the functions of a green roof. These questions are important and will need to be considered in further studies

Air Quality	Building Energy	Urban Heat Island	Stormwater	Combined Sewer Overflow (CSO)
$0	**$68,700,000**	**$79,800,000**	**$118,000,000**	**$46,600,000**

Graphic 2 – Initial saving in $, Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto, Ryerson University, Toronto

The Study indicated that widespread implementation of green roofs in Toronto would provide significant economic benefits to the City, particularly in the areas of storm water management and reducing the urban heat island and associated energy use for cooling Of the many benefits of green roofs reported in the study, the ones that had the most quantifiable monetary value based on currently available research data are: benefit from storm water flow reduction including impact on combined sewer overflow (CSO), improvement in air quality, reduction in direct energy use, and reduction in urban heat island effect as well as the benefits that could not be quantified. These benefits included: aesthetic improvement of urban landscape, increase in property values, benefits resulting from green roofs used as amenity spaces, use of green roof for food production, and increased biodiversity. Further work is needed to quantify these benefits.

The benefits on a city-wide basis were calculated based on the assumption that 100% of available green roof area be used. The available green roof area included flat roofs on buildings with more than 350 sq. m. of roof area, and assuming at least 75% of the roof area would be greened. The total available green roof area city-wide was determined to be 5,000 hectares (50 million sq. m.). The benefits were determined as initial cost saving related to capital costs or an amount of annually recurring cost saving..



Graphic 3 – Annual saving in %, Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto, Ryerson University, Toronto

Air Quality	Building Energy	Urban Heat Island	Stormwater	Combined Sewer Overflow (CSO)
$2,500,000	$21,560,000	$12,320,000	$0	$750,000

Graphic 4 – Annual saving in $, Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto, Ryerson University

The report also presents the minimum considerations for the type of green roof to achieve the stated benefits. The key considerations include that: the roof system be of the type known as an extensive roof system, that it cover a significant portion of the roof, have a maximum runoff coefficient of 50%, and have at least a 150 mm. depth where structural loads permit. Green roofs with less depth could be used on roofs where structural loading does not permit the 150 mm. depth. The benefits quantified in this report show that there is a case for development of public programs and the promotion of green roofs.

4. Toronto's Green Roof Strategy - Making Green Roofs Happen: Options and Strategies to Implement Green Roof Technology

The participants in the Green Roof Technology Workshops 24 generated a large number of suggestions for the City to encourage green roof development. This section lists and discusses those options, as well as policies instituted in the municipalities. The options are categorized under five areas: financial incentives, regulatory options, procedural improvements, education and promotion, and additional work needed.

4.1 Financial Incentives

Since the costs associated with green roofs were highlighted as a major barrier to green roof development in Toronto, financial incentives that offset some of those costs should encourage more green roof construction. These incentives might involve a onetime grant, or

might take the form of ongoing rebates or reductions in fees. Below, financial incentives to offset initial costs are discussed first, followed by incentives to offset ongoing, operating costs.

- ***Subsidies or Grants (to offset initial costs)* -** A grant program could take a number of possible forms. In its basic form, the program would provide a grant of a specified dollar amount per square foot to help to offset the higher cost of installing a green roof over a conventional roof. The *Municipal Act 2001* prohibits municipalities from directly or indirectly assisting any industrial or commercial enterprise by granting bonuses for that purpose. However, grant and other incentive programs may be made available to these types of businesses where the City receives valuable consideration for the assistance, or where the assistance is available to all businesses equally. Another form of incentive program, which was suggested by some workshop participants, would see the City cover the costs of an initial assessment of the feasibility, costs and benefits of implementing a green roof on a specific building. This would be comparable to (though not exactly the same as) Toronto's Better Building Construction (BBC) and Better Buildings New Construction (BBNC) Programs, which subsidize the costs of private consultants who can carry out energy efficiency studies to determine any gains made in retrofit construction (BBC) and new construction (BBNC), in order for the construction to qualify for the federal Commercial Building Improvement Program.
- **Sources of Funding**-Two possible sources for funding and promoting green roofs through a grant program have been identified to date: Toronto Water and Toronto Hydro. From a stormwater perspective, any incentive program should distinguish between new construction and retrofitting existing buildings with green roofs. New development is required by Toronto's Water Pollution Solution25 to manage stormwater on site, and green roofs could be one way to do this. Since most new construction likely to incorporate a green roof is subject to a development approval process, green roofs could be encouraged on new construction (with, for example, the adoption of the new stormwater management guidelines) without the use of a financial incentive. However, the City has no tools to encourage green roof technology on existing buildings, which will continue to comprise the vast majority of building stock in Toronto for the foreseeable future. Therefore, it is suggested that the City target existing buildings for retrofitting through a pilot grant program. Toronto Hydro has an interest in encouraging energy efficiency, and has been directed by the Province of Ontario to reduce demand by 5% by September 2007. To this end, Toronto Hydro has a Conservation and Demand Management (CDM) program through which it can spend up to $40 million to reduce demand by 250 MW (5%). Using these funds, Toronto Hydro is providing financial incentives for energy efficiency projects. Any entity in Toronto with a Toronto Hydro meter can apply for a subsidy for its project. Toronto Hydro provides $1 per 6W of demonstrated energy savings. Eligible projects need to be substantially physically complete by September 2007, and the funds are distributed on a "first come, first serve" basis

- **Reduction in Development Charges (to offset initial costs)**. In the City's *Water Pollution Solution*, there is an assumption that new development would not result in any net increase in stormwater flow. Development charges were set based on this assumption. Development charges cannot be reduced for installing a green roof, since the green roof would not reduce the need for the infrastructure covered by the development charge. Green roofs can only function as a tool to help developers to meet the goal of producing no net increase in stormwater flow from a site.

- **Property tax reductions or rebates (to offset ongoing costs)**. Property tax reductions are not permitted for commercial or industrial buildings under the Municipal Act, since it is considered "bonusing". In general, the difficulty in providing property tax exemptions or reductions is that the City can lose control of its budget, particularly since exemptions tend to continue indefinitely. By contrast, grant programs allow the City to set criteria to be met for a specific project, define a budget, and apply the program only as long as necessary to achieve the desired results.

- **Reduction or Rebate in Water or Energy Rates (to offset ongoing costs)**. The water rate is based on the anticipated cost of maintaining the water supply and treatment systems, and relatively little of this cost applies to stormwater treatment. Specifically, for every dollar paid on water fees, approximately 52 cents are spent on water supply, 39 cents spent on wastewater (sanitary) treatment, and 9 cents are spent on stormwater treatment. This, and the fact that the water rate as a whole is quite low, means that rebates from the water rate are not likely to constitute large sums of money relative to the expense of installing a green roof. Nevertheless, there would be symbolic value in providing reduced water rates to properties with green roofs. Moreover, in order for a property to continue to pay reduced rates, it would need to show that the green roof was still in existence and in working order.

- **Introduce a Stormwater Management Charge and reduce it according to the Stormwater Management Measures on-site, including Green Roofs(to offset ongoing costs)**

4.2 Regulatory Options-Green Roofs through Regulation

- **Density bonuses-** Section 37 of the *Planning Act* allows the City to grant a height and/or density increase for a particular project that is greater than the zoning by-law would otherwise permit, in return for community benefits. Section 37 can be used in situations in which an amenity or service that a developer provides would constitute an inordinate cost to the developer. Examples where this would be the case include provision of a daycare or park improvements, or undertaking preservation of an historic building. However, the construction of a green roof on a *new* development, according to the criteria presented in this report, would not present a significantly higher cost to warrant the use of Section 37. Capital costs are much greater for retrofits, but Section 37 is obviously not applicable in retrofitting an existing building. Also, the idea behind Section 37 is that when areas in the City are redeveloped with increased density, it is necessary to provide the services and amenities to accommodate the additional population (above and beyond what is achieved through Development Charges). Provision of a green roof alone would not provide the services necessary to accommodate the increased density, and therefore it is not suggested that the City provide density bonuses for green roof development. However, as the City moves toward implementing Green Development Standards, further consideration should be given to using Section 37 for implementing a full range of environmental measures (potentially including green roofs, along with others), since these would require greater costs to the developer, but provide more benefits to the City. When the City does apply Section 37, however, it is common and appropriate to include other amenities in the Section 37 agreement between the City and the developer. At this stage, use of Section 37 should be limited to situations where the impetus for providing the density bonus in the first place was for another purpose (such as providing park improvements, daycare, etc.). In those cases, efforts

should be made to secure green roofs in such an agreement, and include detailed arrangements for maintenance.

- **Allow green roof space to be included as parkland dedication.** Some workshop participants suggested that if a green roof is maintained, it should qualify as parkland dedication. Under some circumstances, Toronto Parks accept at grade green roofs, for example over parking garages, as parkland if the area has a growing depth of at least 1.5 meters to accommodate trees and other landscaping suitable for parks. However, this is not a preferred option. Toronto Parks do not accept green roofs on top of elevated structures as part of parkland dedication because such areas provide limited access to members of the public, and usually serve only building tenants.

- **Procedural Improvements-Accommodate Green Roofs in the Development Approval Process.** Many workshop participants suggested that improving the approval process for development applications with green roofs would encourage green roof development. Suggestions included standardizing and streamlining the approval process, and fasttracking applications.

- **Green Roofs as a Stormwater Best Management Practice.** In Toronto, green roofs will be identified as a best management practice for stormwater management in the interim stormwater management guidelines being produced by Toronto Water. This means that when a green roof is proposed, it will be considered part of a new development's overall stormwater management plan. The more effective a development's green roof is in reducing stormwater runoff, the fewer other stormwater measures would be required to meet stormwater management requirements. The City will be working with the Toronto and Region Conservation Authority (TRCA) to coordinate a methodology for evaluating and quantifying stormwater benefits.

- **Integrate Green Roofs into Green Development Standards.** The City is committed to encouraging green development in a holistic manner, and to this end will be developing Green Development Standards within the next year. The intention is that green roof policy will be integrated into Toronto's Green Development Standards as they are being developed.

4.3 Education and Promotion

It is clear that a successful City Green Roof policy must promote the benefits of green roofs and educate, to some degree, a number of audiences who would be interested or involved in green roof development.

- **Require green roofs on all new municipal buildings.** An initiative is already underway to determine the feasibility of installing green roofs on Toronto's municipal buildings. Following a survey of all the roofs of municipal buildings, the City's operating divisions identified three properties whose roofs are due for replacement in 2006 and which are suitable for green roof technology. Moreover, there may be an opportunity to include a green roof at the podium level of Nathan Phillips Square at City Hall as part of the renewal of the square. It is recommended that a policy be adopted to install green roofs on all new City buildings, and, where feasible, to install them on existing buildings when roofs are due to be replaced.

- **Website.** It is recommended that the City develop a web site about green roofs. This would provide a definition of green roofs, describe their benefits, and provide information about the City's approvals process, technical guidelines, maintenance, etc. This tool would target many audiences.

- **Technical booklet.** It will be important to provide fairly detailed technical information to people who are interested in building green roofs. One way of doing this is to produce a technical booklet targeted primarily at developers, building owners and designers. It is recommended that the City produce a technical booklet, which includes information about the City's interests in green roofs, Toronto's green roof policies and programs, Toronto's criteria for green roofs, the City's design and construction approvals process as they relate to green roofs, suggested plant materials to encourage biodiversity, and construction and maintenance guidelines.

- **Information brochures and posters.** It is recommended that the City produce and distribute brochures and posters about green roofs. These would describe what a green roof is, the benefits of green roofs, and provide information about further resources on green roofs.

- **Media advertising.** Some workshop participants suggested that the City use an advertising campaign to promote green roofs. Although advertising can be effective in raising awareness, it is an extremely expensive form of promotion. Therefore, it is recommended that the City use limited and targeted advertising to promote green roofs.

- **Technical Workshops.** In order to address the specific questions and concerns of developers and building owners (particularly in the industrial and commercial sectors), it is recommended that the City hold workshops targeting this audience. The possibility of partnering with an organization like the Toronto Industry Network should be considered, in order to increase publicity and awareness of the events. Although it was suggested that the City hold workshops for green roof professionals, this would not appear to be a wise use of City resources, since most information that the City could provide to professionals could be made available on the City's website or through the technical booklet.

- **Training of City Staff.** It is clear that all City staff who may be involved in the various stages of green roof development will need to receive training on the City's green roof policies. For example, they will need to be clear about the City's definition of, and criteria for, a green roof, and staff will need to know how to address building applications with green roofs, and how green roof applications relate to the Ontario Building Code. They should also be in a position to encourage green roofs on applications they review.

- **Designated City resource person.** There was a suggestion at the workshop that the City designate a staff person as a green roof resource person, to provide such information as funding options, the necessary approvals and their processes, resource materials, etc

- **City competition for most attractive green roofs.** There are a number of ways that the City could recognize outstanding green roofs, to draw attention to the benefits of green roofs. It is recommended that the City add a Green Roof category to the Green Toronto Awards to highlight the City's new green roof policies and programs.

- **Host the Green Roofs for Healthy Cities Conference in Toronto.** The Green Roofs for Healthy Cities Conference has the potential to attract widespread media attention, locally, nationally, and possibly even internationally. It is recommended that the City invite Green Roofs for Healthy Cities to hold their next available

conference in Toronto, to heighten general awareness of green roofs, highlight the City's new green roof policy, and showcase some of the existing green roofs in Toronto.

- **Cost-benefit analysis from building owner's point of view.** Building owners are interested in seeing a credible cost-benefit analysis of green roofs from a building owner's point of view. It is recommended that information about the costs versus the benefits of green roofs be included in the technical booklet.

- **List of legitimate contractors, suppliers and systems.** Some participants suggested that the City provide a list of suppliers, contractors, and green roof systems that are credible and legitimate. This would be comparable to the list of approved water-efficient toilets used by the City's Toilet Replacement Program.

- **Reach out and partner with industry associations** It is recommended that the City establish communication with the appropriate industry associations to publicize its policies and programs.

- **Provide certification for professionals and labourers.** Although professional certification was identified as a need in the field of green roof design, construction and maintenance, it would be beyond the scope of the City's activities to provide such certification.

- **Provide training on green roof maintenance.** Although maintenance training was identified as a need, it would be beyond the scope of the City's activities to provide such training.

4.4 Additional Work Needed

It was clear from the workshop participants' input that because green roofs are new technology and an evolving field, much work still needs to be done on assessing the costs and benefits of green roofs, on improving green roof materials and making them widely available, and developing standards for green roof construction and maintenance Some actions within the City's capacity include:

- **Collect information about costs and benefits of green roofs to building owners**. With the growing number of green roofs in the GTA, it is recommended that the City start collecting information from green roof owners and installers about the costs of installation and maintenance, and benefits like energy savings. This would allow the City to provide examples of costs and benefits to building owners looking for such information.

- **Green roof systems, materials and standards development**. There are several public entities that engage in research and development of environmental technologies, or provide grants for it, and the City can also look to partner with them. For example, Natural Resources Canada has a research and development centre, called the CANMET Energy Technology Centre (CETC), which develops and delivers technology-based programs for the sustainable use of Canada's energy supply. Since CETC works in partnership with many other bodies, including municipal government departments and agencies, it is recommended that consideration be given to whether the City can partner with CETC, or another appropriate agency, in e work on green roof materials and systems.

Reference list:

1. Ryerson University, Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto, Toronto, 2005.
2. City of Toronto Municipal Code, Chapter 492, Green Roofs, under section 108 of the City of Toronto Act, 2006
3. Toronto Environment Office, Climate Change, Clean Air and Sustainable Energy Action Plan: Moving from framework to Action, Phase 1, 2007
4. Welsh Jane, Making Green Roof Happen, Green Technology Seminar, Toronto City Planning, 2006.
5. Ecology Action centre, Nova Scotia Green Roof Manual, Halifax, 2009.

Projects:

1. Green Roof, Residential building, 492 Parlament St., Toronto, Canada, 2008.
2. Green Roof, Plump paper industrial building “Jovsic”, Belgrade, Serbia, 2008.
3. Green wall, Residential Townhouse complex, 1183 Queen St. E, Toronto, Canada, 2010.

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