

Climate Change Adaptation in the City of Toronto

Lessons for Great Lakes Communities

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Clean Air Partnership



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About the Clean Air Partnership

The Clean Air Partnership (CAP) is a registered charity dedicated to improving air quality, minimizing greenhouse gas emissions and reducing the impacts of air pollution and climate change. Our applied research on municipal policies strives to broaden public policy debate on air pollution and climate change issues.

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Executive Summary

Like other communities in the Great Lakes region, Toronto is undergoing significant changes in its climate. The city is becoming hotter, weather is becoming more variable, extreme weather is more common, and insect pests are multiplying as a result of warmer winters. Because of the millions of tonnes of greenhouse gases already released to the atmosphere, these changes will continue for the next century or more, even if we are successful in dramatically reducing emissions in the near future.

Many municipalities in the Great Lakes and elsewhere in Canada have developed climate change mitigation strategies designed to reduce greenhouse gas emissions. However, most of these municipalities have not yet begun to develop plans to reduce the impacts of climate change that is already underway and is unavoidable. The City of Toronto is one of the first cities in Canada to develop a comprehensive climate change adaptation plan, as a result of a lengthy and thoughtful process.

This report describes the work done by the City of Toronto in 2007-2008 to develop its adaptation strategy. The Ontario Ministry of the Environment provided funding for Jennifer Penney, the Director of Research at the Clean Air Partnership to support the City's Adaptation Steering Committee in the development of their strategy. This report will assist other Great Lakes communities which can benefit from this experience and will find it easier to develop their own adaptation strategies as a result of lessons learned from the Toronto experience.

The report examines the principle actors involved in development of Toronto's adaptation strategy, how they organized themselves and how they reached out to City staff, external experts and the public. It summarizes the major features of the adaptation strategy itself, and activities that are currently underway to implement the strategy.

One section of the report takes a closer look at one of the primary areas of vulnerability for the City of Toronto under a changing climate – stormwater management. It describes how more intense storms as a result of climate change add to the existing challenges of preventing floods, erosion and water pollution in Toronto. The section examines ways in which Toronto Water is trying to address these problems and short-term adaptation actions it is preparing to take. The report also proposes further actions that Toronto Water could take to adapt to climate change and enhance the city's resilience to intense storms.

The report ends with observations about the strengths and weaknesses of the Toronto adaptation process, and identifies 19 lessons for other Great Lakes communities that are looking to develop their own adaptation strategies and processes.

Summary of Lessons Learned

Climate Change Adaptation in the City of Toronto Lessons for Great Lakes Communities

1. Initial and continuing political and executive support is essential for the initiation, development and implementation of a comprehensive climate change adaptation strategy. Champions may emerge independently at the political or executive level, but more often, it takes a determined effort by staff or by external organizations that raise awareness of climate change impacts, make available credible information in plain language, and actively lobby for the development of an adaptation strategy.
2. Consult an available guide on climate change adaptation planning for local governments, to help in developing a clear process and avoid “reinventing the wheel.” Available guides include:
 - [*Preparing for Climate Change: A Guidebook for Local, Regional and State Governments*](#) (King County, Climate Impacts Program and ICLEI-US, 2007)
 - [*Climate Adaptation: Risk, Uncertainty and Decision-Making*](#) (UKCIP, 2003)
 - [*Climate Change Impacts and Risk Management: A Guide for Business and Government*](#) (Australian Greenhouse Office, 2006)
 - [*Adapting to Climate Change: A Risk-based Guide for Ontario Municipalities*](#) (Bruce, Egner & Noble for Natural Resources Canada, 2006)
 - [*Preparing for Climate Change: A Guide for Local Government in New Zealand*](#), New Zealand Climate Change Office, 2004.
3. Establish an interdepartmental team to work on climate change adaptation.
4. Ensure that the team has:
 - A clear mandate for its work
 - Participation by key policy and program staff
 - Allocation of staff time
 - A regular meeting schedule
 - A reporting structure that ensures appropriate and timely responses from decision-makers
 - Training and capacity building opportunities
 - Smaller working groups that can take on analysis and planning for key risk areas
5. It takes time and a concerted “inreach” effort to have the key departments understand what adaptation is, why it is necessary, and to get them to incorporate climate change into their thinking and planning. An explicit strategy of communications and engagement with staff is advisable.
6. Take advantage of the growing number of external conferences, workshops, seminars and webinars to introduce staff to issues related to climate change impacts and adaptation.

Climate Change Adaptation in the City of Toronto Lessons for Great Lakes Communities

7. Organize internal workshops and learning events to get staff familiar with the concept of climate change impacts and adaptation.

8. Ensure availability of on-line resource/reference collections to become more informed about existing knowledge and best practices (See Toronto's [Climate Change Adaptation Reference Collection](#).)

9. Initiate or join the efforts of others in the region to get a better handle on climate trends and regional climate projections.

10. Great Lakes communities should make use of the deep layer of existing expertise in the region on climate impacts and adaptation. Mobilize external resources and expertise by:

- Identifying local experts who would be willing to provide information and advice
- Establishing an Expert Panel or Advisory Committee with expert participation to provide input into vulnerability assessments and adaptation planning
- Inviting experts to comment on draft plans and strategies
- Utilizing local experts to conduct workshops or participate in working groups and contribute to building the capacity of staff
- Participating in available peer networks such as the Alliance for Resilient Cities

11. Use available resources to undertake a quick initial scan of vulnerabilities for your community to increase awareness of climate change impacts and the need to take action on adaptation. A review of recent extreme weather events, as reported in the local press, may provide useful indicators about impacts, costs and vulnerabilities. Later in the adaptation process, a more specific and detailed analysis of vulnerabilities may be necessary.

12. Prepare and release an issues paper or framework document that outlines the expected impacts of climate change and how to prepare for them, in order to engage staff, Council members and the public in thinking about the issues and the decisions that need to be made. If possible, engage a broad range of staff and other potentially affected stakeholders in reviewing and contributing to the document. *Ahead of the Storm* provides an outline that may be useful for other communities to use in developing their own framework documents.

13. Education is necessary to inform the public about local climate change impacts and to help them understand adaptation actions that can be taken at the level of the individual household, and in the municipality.

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14. Public consultation on climate change adaptation strategies can work both to increase awareness of local climate change impacts, and also to build support for necessary actions.

15. Identify the actions that the municipality is already taking that reduce the risk of current extreme weather, and that are likely to provide some protection from future climate change. This can provide a foundation on which to build a stronger, more comprehensive adaptation strategy.

16. Adaptation planning needs to include short-term actions, longer-term planning processes, the implementation of upstream preventive measures and emergency preparation and response. Adaptation planners need to consider how to include and balance this range of activities.

17. It takes time to develop a municipal adaptation plan. Some short-term actions can be identified and acted on fairly quickly, but these should not substitute for longer-term assessment of vulnerability, priority risks and the effectiveness of different adaptation options.

18. Maintain a strong and focused climate change adaptation team to oversee the work of integrating adaptation strategies into different policies and departments.

19. The goal of overall environmental sustainability should inform climate change adaptation strategies. Adaptation options and strategies that increase greenhouse gas emissions or contribute to other environmental and social problems should be avoided.

1. Introduction

This report describes the development of a Climate Change Adaptation process and strategy in the City of Toronto, which took place from March 2007 to June 2008. Jennifer Penney, Director of Research for the Clean Air Partnership, served as a consultant to the City of Toronto's Adaptation Steering Group throughout this process.

The purpose of this report is to share information on the development of the City of Toronto's Climate Change Adaptation program, so that other Great Lakes communities can benefit from this experience.

2. The Evolution of the City of Toronto's Climate Change Adaptation Program

2.1 Previous Climate Change Initiatives

The City of Toronto has been active since 1989 in the development and implementation of programs to reduce emissions of greenhouse gases. The City has backed a wide variety of climate change mitigation initiatives including:

- The Toronto Atmospheric Fund, which finances many emissions reduction initiatives both for City operations and the community
- The Better Buildings Partnership, which supports energy efficiency retrofits as well as the design and construction of new energy-efficient buildings
- Collection and burning of landfill gas to generate electricity
- Conversion of street lights to energy-efficient lighting systems
- Renewable energy installations at Exhibition Place and elsewhere
- Deep Lake Water Cooling of downtown buildings, and
- The Green Fleet Transition Program.

In addition to these mitigation initiatives – but before the City committed to developing a comprehensive adaptation program – some City departments and related agencies had begun to incorporate climate change impacts into their thinking, and to propose and implement adaptation strategies to reduce the negative effects of these impacts (though these actions were not explicitly referred to as adaptation).

Notable among these programs is Toronto Public Health's [Heat Health Alert](#) system, launched in 1999, and the [Hot Weather Response Plan](#), which aims to protect Toronto citizens from the effects of hot weather and heat waves that are worsening as climate change advances. Toronto Public Health also commissioned the research report [Influence of Weather and Air Pollution on Mortality in Toronto](#) to quantify some of the likely impacts of climate change on health in the city.

Toronto Water developed a basement flooding program in 2006 to reduce the impacts of intense storms, which caused costly floods in 2000 and 2005, and are expected to intensify as global warming continues. The City also improved design standards for sanitary sewers and overland flow controls and developed the [Basement Flooding Protection Subsidy Program](#) to help Toronto households invest in basement flood protection.

The [Toronto Region Conservation Authority](#) has also worked on climate change impact issues for a decade or more, conducting research, producing publications, and organizing workshops on climate concerns related to watershed management.

In late 2005, the Clean Air Partnership (CAP), with the collaboration of the City, initiated a project called [Adapting to Climate Change in Toronto](#). This project involved the development and publication of four research reports:

- [A Scan of Climate Change Impacts on Toronto](#) (2006), which summarized current information on the current and expected impacts of climate change on the city
- [Cities Preparing for Climate Change](#) (2007), which drew lessons from six urban regions in Canada, the US and the UK, that had begun work on adaptation programs
- [Time to Tackle Toronto's Warming](#) (2007), which discussed adaptation options to deal with increased heat under climate change, and
- [Climate Change Adaptation Options for Toronto's Urban Forest](#) (2007).

CAP also hosted two workshops for City of Toronto staff on Climate Change Impacts and Adaptation, in November 2005 and June 2006. City staff from the City Manager's Office, Toronto Public Health and the Toronto Environment Office served on the advisory committee for the project. Staff from several City departments also participated in discussions during the development of the heat and urban forest reports.

All these activities helped to raise the profile of climate change impacts and adaptation at the City of Toronto.

2.2 Change is in the Air – Toronto's Climate Change Plan

Following his re-election in November 2006, Toronto's Mayor David Miller made climate change one of his top priorities. In early 2007, the Toronto Environment Office began developing a new, broad-based climate change plan. In February, the City invited a group of experts to make presentations to a special meeting of the Parks and Environment Committee on what should be included in the new plan. Most of these presentations focused on further actions the City government could take to reduce emissions, but the Executive Director of the Clean Air Partnership encouraged the City to include adaptation in its climate change planning.

In March 2007, the City released [Change is in the Air](#), a framework document for public discussion. The 27 potential climate change actions listed in the document included a proposal to develop an adaptation plan, starting with a scan of the vulnerability of City operations to climate change.

Over the following months, the City held a number of public consultations on *Change is in the Air*. There was almost no comment on climate change adaptation, which is consistent with CAP's observation that the public is largely unaware of adaptation issues. Nevertheless, in addition to a broad strategy to reduce greenhouse gas emissions, the City committed to developing an adaptation strategy in the final [Climate Change, Clean Air and Sustainable Energy Action Plan](#).

2.3 Getting Organized for Adaptation Planning

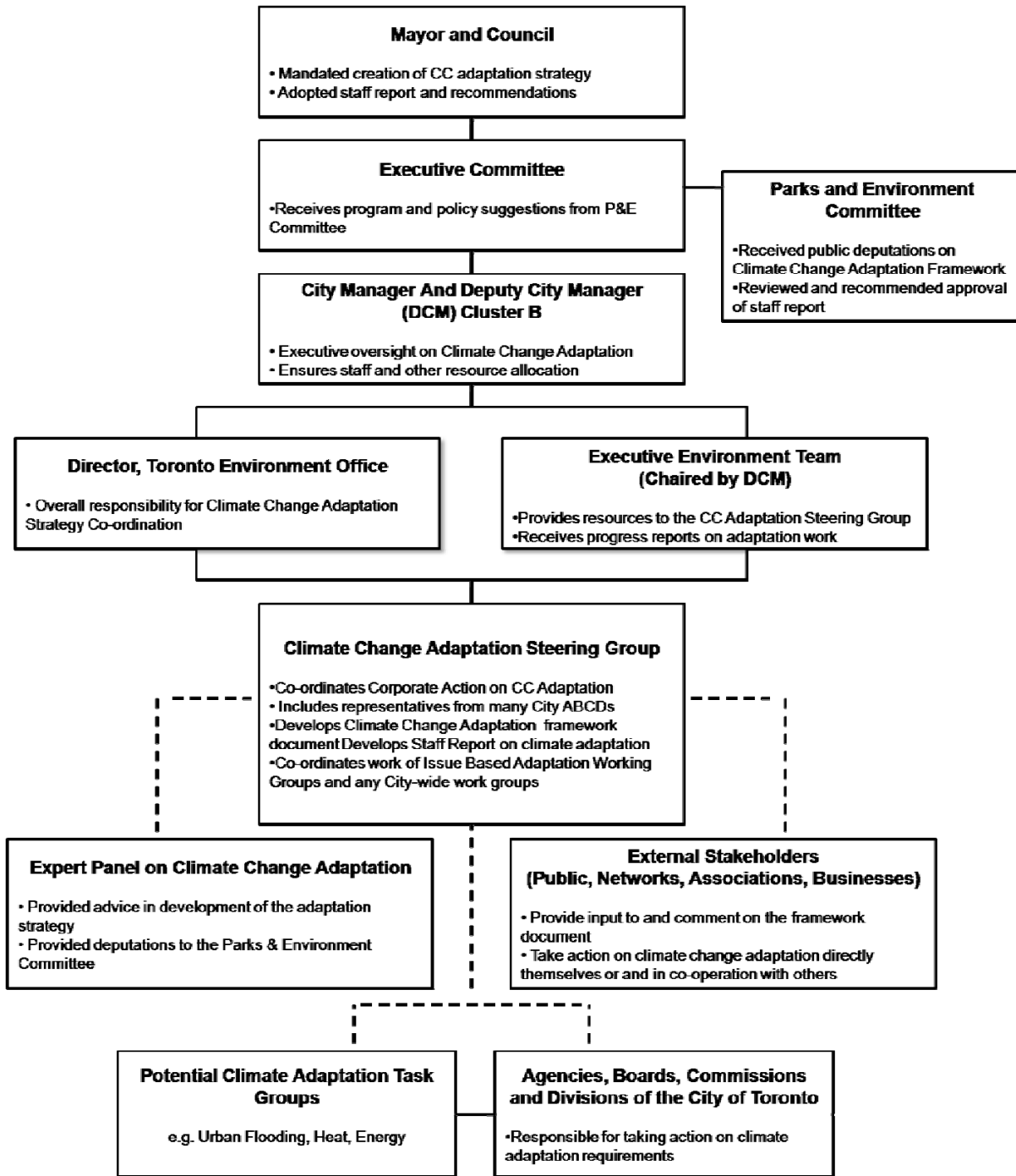
Following Council's approval of the Climate Change Plan, the City mobilized several existing organizations and created two new teams to work on an adaptation plan for the City. The organizations that played a major role included:

- **The Mayor's Office**, which has committed to ensuring that Toronto develops and implements a strong climate change plan, and which took an active role in reviewing and discussing the adaptation strategy as it developed
- **City Council's Parks and Environment Committee**, which has responsibility for environment-related policy in the City. The Chair and one of the Vice-Chairs reviewed and commented on proposals for the adaptation strategy and the public consultation process
- **The Executive Environment Team**, a senior management team from all City Divisions, Agencies, Boards and Commissions with responsibility for significant environmental initiatives, which received and discussed reports about the developing strategy
- **The Toronto Environment Office**, which coordinates work on environmental issues across the City, had responsibility for developing the strategy and chaired two new adaptation working groups (described below)
- **The Adaptation Steering Group**, with representatives from the City Divisions expected to be impacted most by climate change, including: Finance; Office of Emergency Management; Parks, Forestry and Recreation; Planning; Social Housing; Toronto Public Health; Toronto Water; Transportation Services; Toronto Building; and the Toronto Region Conservation Authority. This group met periodically to review progress in development of the strategy, and to provide input from the perspective of their individual divisions or agencies, and
- **The Adaptation Core Group**, a smaller group formed from the membership of the Adaptation Steering Group, which met frequently and worked closely with TEO in the day-to-day work of mapping out a framework document, strategy and public consultation process.

The organizational chart on the next page shows the relationship of these bodies to the development and implementation of the climate change adaptation strategy.

The City of Toronto also invited a number of climate change impacts and adaptation experts to act as an **Expert Panel** to provide advice to the City on the development of its strategy. (See page 10 for more detail.)

Figure 1: City of Toronto Organization of Climate Change Adaptation¹



¹ The original version of this organizational chart was developed by David MacLeod of the Toronto Environment Office. It has never been officially approved however, and is included here for illustration purposes only.

In addition to these internal City groups, two external organizations were involved in the development of the adaptation strategy and related work:

- **The Clean Air Partnership**, an environmental NGO, which participated in the Adaptation Core Group and Steering Group, and took a major role in developing and writing *Ahead of the Storm*, the framework document which outlined an adaptation process for the City, and was used for consultations with the public, and
- **The Institute for Catastrophic Loss Reduction**, which provided support for development of a web-based library of adaptation resources, helped with ideas for business continuity planning and with consultations with the business community on the adaptation strategy.

The Toronto Environment Office (TEO) had the primary responsibility for developing the adaptation strategy. In April 2007, TEO assigned a staff person to lead the development of an adaptation work plan. He convened the Adaptation Steering Group, with representatives from many of the City divisions expected to be impacted by climate change.

At the initial meeting of the Steering Group, a smaller Adaptation Core Group was formed to collaborate with TEO in the early work of mapping out a strategy and developing a public consultation process. This group included representatives from TEO (Chair), Planning, Toronto Public Health, Toronto Water, Communications and Public Consultation. The Core Group met frequently throughout the spring and summer of 2007, and began meeting almost weekly in the fall.

There were initial problems in getting some divisions to participate in the larger Steering Group. However, a few months after the adaptation work began the Deputy City Manager, who chairs the Executive Environment Team, informed all divisions that he expected them to cooperate with the process, which resolved the issue.

2.4 Gathering Information about Climate Change Impacts and Adaptation

One of the first tasks of TEO and the Adaptation Core Group was to become better acquainted with the large body of knowledge about climate change impacts and adaptation and to meet with researchers active in this field. These activities continued through the year and are described in Table 1 on the next two pages.

Table 1: Getting Started: Knowledge Building and Networking Activities

Activity	Results
<p>Hired a graduate student intern to survey other Ontario municipalities to find out what they are doing about assessing their vulnerability to climate change and planning to adapt</p>	<ul style="list-style-type: none"> ▪ Found that very few Ontario municipalities had started to assess their vulnerability or to develop deliberate plans for adapting to climate change. In the summer 2007 most Ontario indicated they had not heard of climate adaptation, though Peel Region was active. ▪ Sudbury was the exception, but was not making its vulnerability studies or adaptation plans publically available
<p>Gathered and catalogued a number of climate change impacts and adaptation reports, guidelines and other resources</p>	<ul style="list-style-type: none"> ▪ Resources were collected to help inform staff about the impacts of climate change, adaptation frameworks and actions
<p>Developed a list of useful contacts in senior levels of government and elsewhere</p>	<ul style="list-style-type: none"> ▪ List provided contact information for knowledgeable individuals and organizations in the field and was useful for recruiting an Expert Panel to advise the City on its adaptation strategy
<p>Participated in teleconference and face-to-face meetings of the Urban Leaders Adaptation Initiative, a network of local government leaders in the US</p>	<ul style="list-style-type: none"> ▪ Provided further useful information and contacts and led to several subsequent exchanges with the City of Chicago and King County, Washington to discuss specific climate strategies and adaptation efforts
<p>Participated in the Alliance for Resilient Cities Symposium on September 20, 2007 and in subsequent bi-monthly ARC Webinars</p>	<ul style="list-style-type: none"> ▪ Provided new information and contacts for Adaptation Steering Committee Members ▪ TEO display for the Symposium explained the difference between climate change mitigation and adaptation, and areas of overlap ▪ ARC webinars have provided useful learning opportunities for the Steering Group.
<p>Met with the Chief of Emergency Management for Ontario</p>	<ul style="list-style-type: none"> ▪ Concluded that climate change needs to be a consideration in developing emergency and business continuity plans, that the public would be receptive to appeals to prepare for severe weather events and that this preparation could serve for other emergency situations as well

Table 1 Continued: Knowledge Building and Networking Activities

Activity	Results
<p>Organized a meeting for key City Managers and Directors with the Chair and Manager of Engineers Canada’s Public Infrastructure Engineering Vulnerability Committee</p>	<ul style="list-style-type: none"> ▪ Familiarized City Managers in several divisions with PIEVC pilot projects and protocol for assessing the risk of climate change to a variety of types of public infrastructure, including: water supply; stormwater systems; roads; bridges; and buildings
<p>Organized a meeting with members of the Canadian Institute of Planners who are involved in developing a climate impacts program for city planners</p>	<ul style="list-style-type: none"> ▪ Reinforced the importance of proactively incorporating climate change considerations into long-range planning, development approvals, infrastructure planning and other aspects of city planning
<p>Attended a meeting of the Toronto office of the Disaster Recovery Information Exchange</p>	<ul style="list-style-type: none"> ▪ Discussed possible collaboration in business continuity planning in the face of climate change, especially for small businesses
<p>Organized a meeting with Environment Canada staff responsible for the Canadian Climate Change Scenarios Network</p>	<ul style="list-style-type: none"> ▪ Discussed how the City of Toronto could use the CCCSN network and website to understand better the changes in climate that are underway and likely to occur in the Toronto region

2.5 The Expert Panel

During one of its earliest discussions the Adaptation Core Group decided to establish an Expert Panel to advise the City on the development of its adaptation strategy. Climate scientists and adaptation researchers from local offices of Environment Canada, Natural Resources Canada, the University of Toronto, the Toronto Region and Conservation Authority, the Institute for Catastrophic Loss Reduction, Engineers Canada and Pollution Probe were invited to participate on the Panel. An impressive list of scientists and researchers agreed to take part, likely because they saw an opportunity to put their research into practice in Canada’s largest city.

The Expert Panel participated in two key meetings organized by TEO and the Adaptation Core Group. The first of these was held in December 2007, and was attended by members of the Adaptation Steering Group and senior staff from many of the City’s divisions. Eight members of the Expert Panel made short presentations and responded to questions on key climate change impacts that the City of Toronto faces and on key considerations in the development of an adaptation strategy.

On January 22, 2008, a [special public meeting of the Parks and Environment Committee](#) was held to hear presentations by members of the Expert Panel. This meeting was widely advertised, and was attended by about 150 members of City staff, environmental organizations and the public. There was some media coverage of the event, which raised the profile of climate change impacts and adaptation in Toronto.

The Adaptation Core Group had in mind an active role for the Expert Panel in the development of the adaptation strategy. However, though members of the Expert Panel played an important role in the two key meetings described above, they were not invited to comment on the adaptation strategy as it developed. Some members of the Core Group and some members of the Expert Panel view this as a missed opportunity.

2.6 Early Work in Development of the Adaptation Strategy

In April 2007, City Council asked for a Staff Report to be prepared to provide recommendations for a broad-based climate change strategy that included adaptation and also an estimate of the resources needed for implementing the adaptation strategy. This was not possible in the two-month time period available. There is a steep learning curve for any City looking to develop a comprehensive adaptation strategy and it can't be done in a few months.²

However, TEO staff and the Adaptation Core Group did prepare a brief report which identified some of the likely impacts of climate change on Toronto, described some existing programs that reduce Toronto's vulnerability, and outlined the tasks necessary for developing a climate change strategy. This report was summarized on pages 45-46 of the June 13, 2007 [Climate Change and Clean Air Action Plan – Staff Background Report](#) for City Council.

In preparation for writing this report, each of the divisions participating in the larger Adaptation Steering Group were asked by TEO to identify current activities that help reduce the potential impacts of climate change. Some of these are described in the box on the facing page.

Divisions that had already been thinking about climate change impacts, or had developed programs or strategies to protect against current weather extremes, were able to identify current activities that protect against future climate impacts. However, some divisions had a great deal of difficulty in distinguishing between climate change mitigation strategies (designed primarily to reduce greenhouse gas emissions) and adaptation strategies (designed to protect against impacts such as heat waves or extreme weather events). This is not uncommon. Staff from other cities have also experienced this confusion, which speaks to the need for "inreach" activities that familiarize City staff with information about climate change impacts and adaptation.

² Other major cities that have developed comprehensive climate change strategies have taken a few years to do so (Penney and Wieditz, 2007).

Examples of Existing Toronto Programs That Reduce Vulnerability to Climate Change

- **Toronto's Heat Alert System and Hot Weather Response Plan.** Toronto Public Health issues heat warnings and works with community agencies to prevent illness and death during periods of extreme hot weather. Toronto Public Health has studied climate change and its effects on heat and air pollution in the City to help long-term planning.
- **The Wet Weather Flow Master Plan.** This 25-year plan is designed to reduce flooding from intense rainfall and impacts on streams and lake water. Toronto Water is using information from the August 19, 2005 storm to guide future amendments to this plan.
- **Basement Flooding Protection Subsidy Program.** The City is subsidizing the costs of installing back-water valves and sump pumps on household sewer connections in order to provide additional protection against flooding from sanitary sewers.
- **Flood Warning Forecasting.** The Toronto Regional Conservation Authority is improving the existing system to better prepare for flood emergencies and reduce damage to life and property.
- **The Green Roof Pilot Incentive Program.** This program provides an incentive for green roofs to be installed on new or renovated Toronto buildings. Green roofs capture and retain stormwater and they also cool the buildings on which they grow.
- **A Commitment to Double the Tree Canopy.** Parks, Forestry and Recreation is undertaking a major study of canopy potential and associated implementation strategy with Planning & Transportation Services. Expanding the tree canopy in Toronto will provide shade, lessen the urban heat island effect, and reduce runoff and other effects of climate change.
- **The Peaksaver Program.** Toronto Hydro initiated this and several other innovative programs that reduce peak electricity demand on hot summer days and reduce the risk of brownouts and blackouts during heat waves.
- **The Green Development Standard.** The Standard provides a set of performance targets for the design and construction of new developments in Toronto. The Standard will increase energy efficiency of buildings, reduce greenhouse gas emissions, reduce the urban heat island effect, conserve water, reduce stormwater runoff and enhance neighbourhood green space. Many of these features will contribute to reducing the impacts of climate change.
- **Greening Parking Lots.** Draft design guidelines for greening surface parking lots have been prepared by City Planning and pilot projects are in progress. Greener parking lots are expected to reduce heat and stormwater runoff.
- **The Better Buildings Partnership.** This program works with building owners and developers to increase energy efficiency in existing buildings and in new construction, which decreases energy use and peak energy demand, reducing the vulnerability of the grid to brownouts and blackouts during heat waves.
- **Emergency Plan.** Toronto's Emergency Plan prepares the city to protect the health, safety and welfare of the community in the face of a variety of hazards, including severe weather, floods, power failures, etc. – that may occur more frequently as a result of climate change.

2.7 The “Framework Document”

In the fall of 2007, the Adaptation Core Group decided to create a “Framework Document” that would:

- Provide information on the impacts Toronto can expect from climate change
- Explain why adaptation is necessary, and
- Outline a process for developing adaptation strategies in the City.³

The Document was to form the basis for public consultations, after which a Staff Report would be written to recommend an adaptation strategy to City Council.

The Core Group agreed on an initial outline for the document and drafted specific sections in an iterative process which took about three months.

When a draft was ready, it was sent to the Director of the Toronto Environment Office and to the larger Adaptation Steering Group. The draft proposed a long-term adaptation process that would:

- Establish an internal structure to help the City tackle adaptation
- Analyze how climate is changing in the Toronto region
- Undertake a detailed climate change vulnerability assessment
- Prioritize the risks
- Analyze adaptation options for priority risks, and
- Develop, implement and monitor the effectiveness of adaptation strategies.

However, the TEO Director wanted more emphasis on actions that could be implemented in the short term. The Mayor and interested members of Council wanted to include visible adaptation activities that could begin as soon as possible. They did not want to await the outcome of a longer-term research-based process before taking action.

The Adaptation Steering Group was asked to identify adaptation projects that were underway or could be ramped up quickly in their divisions and a new section on Planned and Proposed Short-term Adaptation Actions was added to the Framework Document. Some of the short-term adaptation actions proposed by Toronto divisions are outlined in the table below.

³ The City used the services of the Clean Air Partnership to develop the Framework Document and contribute to the subsequent Staff Report. These services were financially supported by the Land and Water Branch of the Ontario Ministry of the Environment.

Table 2: A Selection of Short-Term Adaptation Projects Proposed by City Divisions⁴

SHORT TERM ADAPTATION ACTIONS	DESCRIPTION & ANTICIPATED BENEFITS	CITY GROUP(S) RESPONSIBLE
Climate Change Preparedness Kits	Development of Climate Change Preparedness Information Kits for citizens and small businesses	Toronto Environment Office (TEO) Office of Emergency Management
Improved “All Hazards Emergency Planning” for Micro, Small and Medium Size Businesses	Organization of focus groups to seek input on 72 hour emergency and business continuity planning for households and businesses	TEO Office of Emergency Management
Future Climate Prediction Modelling	Improved information on expected climate extremes as well as gradual changes to permit better decision making on adaptation planning and for use in next generation watershed plans	TEO Toronto & Region Conservation Authority (TRCA) Environment Canada Toronto Water Region of Peel
Climate Change Vulnerability and Risk Assessment of City Operations	Improved understanding of where vulnerabilities are and ranking of risks to help prioritize adaptation actions.	TEO Insurance & Risk Management
Don and Waterfront Trunk Sewers, and Combined Sewer Overflow Control Strategy Project	Better understanding of effects of extreme weather on performance of drinking water and wastewater facilities, and attainment of water quality goals	Toronto Water
Development of regional extreme precipitation intensity, duration and frequency curves	Improved ability to design storm drainage infrastructure for extreme runoff events	TRCA Environment Canada Conservation Ontario GTA municipalities
Scan of methods used in other jurisdictions for assessing vulnerability to heat	Leading to development of heat-related vulnerability assessment tool to provide strategic direction for the City’s Hot Weather Response Plan	Toronto Public Health

⁴ This is only a selection of the short-term actions proposed by City of Toronto divisions. For a complete list, please see pages 17-20 in [Ahead of the Storm](#).

Table 2 Continued: A Selection of Short-Term Adaptation Projects Proposed by City Divisions

SHORT TERM ADAPTATION ACTIONS	ANTICIPATED BENEFIT	CITY GROUP(S) RESPONSIBLE
<p>Analysis of when and where green roofs could be required</p> <p>Green Development Standard: Anticipating impacts of climate change on built form</p>	<p>Support for a new Green Roof by-law (to reduce demand for air conditioning and storm water runoff)</p> <p>Increased resilience in built form</p>	<p>City Planning</p>
<p>Urban Heat Island research to inform land use planning policy approaches to “cooling” the City</p>	<p>Identification of Toronto’s “hotspots”, what causes them, and planning strategies to reduce them</p>	<p>City Planning Clean Air Partnership</p>
<p>City of Toronto Integrated Energy Strategy</p>	<p>Increased resilience in the City’s energy supply and distribution</p>	<p>Toronto Hydro Energy Efficiency Office</p>
<p>Climate Change Vulnerability Risk Assessment of major road culverts and bridges</p>	<p>Reduced risk of infrastructure failure due to extreme weather, avoided disruptions to the public and significant insurance claims.</p>	<p>Transportation Services Toronto Water TRCA</p>
<p>Expand parkland naturalization and naturalization of lands surrounding water and wastewater facilities</p>	<p>Increased canopy cover in our parks and open spaces from 30% to over 50%; Reduced stormwater runoff, and use of fossil fuels for maintenance of cut grass</p>	<p>Parks, Forestry & Recreation Toronto Water TRCA</p>
<p>Introduce a new standard for supporting healthy tree growth by continuous soil trench systems in commercial areas</p>	<p>Extended life of trees from 6 years to 35 years in commercial areas, increasing shade, and reducing energy demand for cooling</p>	<p>Transportation Services City Planning Parks, Forestry & Recreation</p>
<p>Increase street tree planting</p>	<p>Reduced urban heat island effect and stormwater runoff.</p>	<p>Transportation Services Parks, Forestry & Recreation</p>
<p>Elimination of New Reverse Slope Driveways</p>	<p>Reduced flooding during extreme precipitation events.</p>	<p>Toronto Water City Planning Toronto Buildings</p>
<p>Uninterrupted Power Supply for Water Treatment</p>	<p>Enhanced contingency plans to operate critical water treatment, distribution and waste water treatment systems during extended power outages</p>	<p>Toronto Water</p>

Fourteen divisions commented on the draft framework document. Some of these commentaries focused on issues of specific concern to the division. Others provided thoughtful observations on the proposed adaptation process and its implications for the City as a whole.⁵

The comments from the City's divisions were integrated in the subsequent draft of the document to the extent possible, and the revised draft was sent to the Mayor's office, and to the Chair and Vice-Chair of the Parks and Environment Committee. A few red flags were raised. The Mayor's office wanted the adaptation strategy to be more clearly positioned in the context of the City's climate change policy as a whole. Adaptation was not to be regarded as a stand-alone strategy. There was also concern about including consideration of preparing for severe weather related emergencies. These concerns generated a new round of edits.

The process of developing the Framework document was slower than expected. However, the iterative process engaged a broad array of City divisions and staff and increased their ownership in the document.

The final framework document was called [Ahead of the Storm](#), and was released in mid-April. The Table of Contents is reproduced on the next page.

2.8 Public Consultations on the Climate Change Adaptation Framework

From the beginning of the process, the City was committed to conducting a series of public consultations on the framework and the strategy. However, the framework document was lengthy – almost 50 pages – and quite detailed. The Adaptation Core Group and the Toronto Environment Office felt strongly that a shorter, illustrated document would more likely get the attention of members of the public.

Soon after releasing the longer framework document, the City published [Ahead of the Storm – Highlights](#). This shorter version was made available prior to a series of public consultation meetings.



⁵ A few divisions suggested the authors delete all recommendations pertaining to how the City should organize internally to incorporate adaptation into its planning and programs. These recommendations were retained, however, on the grounds that the City needs to commit to a transparent process for integrating consideration of climate change into plans and programs, and for allocating resources to adaptation.

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Six consultation meetings were held in total. The first of these meetings, held at Ryerson University on April 22, 2008, invited faculty and students from Toronto's three universities, as well as officials from the Province and the federal government, and some independent consultants. The other five meetings were open public meetings, although they had different target groups, as outlined in Table 3. Each of the meetings began with a presentation that summarized the main issues and recommendations from *Ahead of the Storm*. Attendees were then asked to discuss and provide opinions on three questions:

1. What should the City do to adapt to climate change?
2. What should be added to the plan (as outlined in *Ahead of the Storm*)?
3. What is missing from the plan?

The university and government group also discussed the potential for organizing a Center for Urban Climate Change in Toronto.

Table 3: City of Toronto Public Consultation on Climate Change Adaptation

Type of Event (Attendance)	Date/Time/Target	Recruitment/ Promotion
Public Workshop (13) Format: Plenary presentation followed by facilitated table discussions of 3 questions	May 1, 2008 7-9 pm Target: <i>General public, NGOs and other stakeholders</i>	<ul style="list-style-type: none"> ▪ Emails/ mailing from Toronto Environment Office list ▪ Ads in community newspapers (Guardian/Mirror chain plus NOW)
Public Workshop (40) Format: Plenary presentation followed by facilitated table discussions of 3 questions	May 5, 2008 7-9 pm Target: <i>General public, NGOs and other stakeholders</i>	<ul style="list-style-type: none"> ▪ Emails/ mailing from TEO list ▪ Ads in community newspapers (Guardian/Mirror chain plus NOW)
Business Focus Group (12) Format: Presentation followed by discussion of 3 questions	May 15, 2008 7-9 am Target: <i>Small & medium sized businesses</i>	<ul style="list-style-type: none"> ▪ Emails from list provided by Toronto Economic Development
Business Focus Group (10) Format: Presentation followed by discussion of 3 questions	May 15, 2008 Noon to 2 pm Target: <i>Micro and small businesses</i>	<ul style="list-style-type: none"> ▪ Direct contact with the manager of the Sheppard East Village BIA through Toronto Economic Development
Business Meeting (25) Format: Presentation followed by discussion of 3 questions	May 27, 2008 Noon to 2 pm Target: <i>Large businesses</i>	<ul style="list-style-type: none"> ▪ Emails from lists provided by TEO, Toronto Public Health & Toronto Economic Development

The majority of comments received during the public consultations were ideas for reducing greenhouse gas emissions. Most participants did not initially understand the difference between climate change mitigation and adaptation. Relatively few of the people who participated in the public consultation process had read *Ahead of the Storm*, partly because it was not ready until a few days before the first of the consultation meetings. However, a presentation about expected climate change impacts on Toronto and about some adaptation options helped participants discuss the issues. Several recommendations emerged from the public discussion:

- The City of Toronto should **increase and broaden education programs for students, residents and business on climate change adaptation** – including making Torontonians aware of the threats and solutions.
- The City of Toronto should undertake community outreach activities with both residents and business to find community-based solutions for adaptation. **Experts should be made available to work with business and residents to assist with adaptation issues.** For business, this included continuity and disaster planning.

- The City of Toronto should consider **financial incentives to encourage the implementation of climate change adaptation actions.**

Participants also raised concerns about:

- The general preparedness of the City of Toronto for climate impacts
- Climate impacts on drinking water sources, including potential water shortages, as well as increasing problems for stormwater management
- Impacts on infrastructure including the reliability of power supply
- Evacuation planning, emergency response and survival issues
- The protection of seniors and other vulnerable populations
- Heat waves and extreme weather, and
- The need for the City of Toronto to set an example with its own actions.

Only three of the large number of comments expressed scepticism about the validity of the science of climate change or the importance of developing public policy to address it.

2.9 Other External Consultations and Outreach

In addition to the public consultation meetings on *Ahead of the Storm*, TEO engaged in a number of outreach activities that continue today. The outreach involves:

- Meetings with individuals and organizations that were already thinking about climate change impacts and adaptation, to expand and strengthen the City's network of useful contacts and exchange ideas about adaptation strategies
- Presentations at relevant events, to let participants know about the City of Toronto's climate change concerns and adaptation planning, and
- Active participation in relevant workshops and conferences to promote the necessity of thinking about and planning for climate change adaptation.

These external consultations and outreach activities included presentations to the Conference Board of Canada, discussions with other municipalities, participation in the Disaster Recovery Information Exchange (DRIE), presentations to students at local universities and colleges and professional associations. This outreach continues.

2.10 Engaging and Consulting City Divisions

TEO also developed an active "inreach" program with City divisions and agencies. TEO arranged meetings with staff in several City divisions and agencies to galvanize wider interest and engagement in the adaptation process. At some of these meetings, TEO made formal presentations using Powerpoint slides and in some cases supplied written materials to support its case that climate change adaptation needs to be on the agenda. Over an eight-month period, TEO met with:

- Senior **Insurance and Risk Management** staff, to discuss potential climate change impacts on the City and the implications for the City budget and insurance

- **Community Development** staff within the Community and Neighbourhood Services division, to discuss the extent to which the City’s “priority neighbourhoods” are vulnerable to climate change and might be mobilized
- **Water Infrastructure Management** (Toronto Water), to discuss implications that climate change might have for Toronto’s 25-year Wet Weather Flow Master Plan, as well as climate change research needs for the division
- **Office of Emergency Management** and the City’s **Emergency Management Working Group** to discuss the need to explicitly incorporate climate change concerns into emergency planning
- **Economic Development Office** to explore the interest of the business community in climate change adaptation, and to discuss potential economic impacts of climate change on Toronto’s employment sectors
- **Toronto Public Health** to discuss ways in which climate change impacts on health in the City and the potential for a specific Public Health Working Group on climate impacts and adaptation
- **Toronto Hydro’s Director of Strategic Issues** to discuss current activities of the utility that contribute to climate change adaptation, and potential climate change impacts that could strain or disrupt electricity distribution in the City
- The **Executive Environment Team** to brief them about developments in climate change adaptation planning and receive advice, and
- The **Mayor**, his **Senior Advisor, Climate Change** and the **Chair and Vice-Chair of the Parks and Environment Committee** to brief them about developments and receive advice.

2.11 Adaptation Recommendations Adopted by Council

All of these activities informed the [Climate Change Adaptation Strategy – Staff Report](#) that was sent to the Parks and Environment Committee. The Committee received 10 written submissions and heard 14 public deputations on the strategy, almost all of which endorsed strong action on climate change mitigation *and* adaptation. On May 21st, the Committee endorsed the report, and it was approved by City Council on July 15, 2008.

The main recommendations of the report were:

1. To incorporate climate change mitigation measures and explicit goals for adaptation of infrastructure and buildings into Toronto’s Official Plan
2. To incorporate climate change mitigation and explicit goals for adaptation into the plans, programs, strategies and assessment procedures of City Agencies, Boards, Commissions, Corporations and Divisions likely to be strongly affected by climate change
3. To incorporate climate change concerns into planning of all City Agencies, Boards, Commissions, Corporations and Divisions for 2009 and identify in 2009 budget submissions the specific actions they plan to take regarding climate change mitigation and adaptation

4. To develop a methodology to prioritize short-term Climate Change Adaptation actions recommended by City Divisions prior to the 2009 Budget Cycle process
5. To report on a funding strategy for climate change adaptation planning and actions, including the creation of an Extreme Weather Reserve
6. To establish a process for the development of a longer-term, comprehensive adaptation strategy that: identifies key vulnerabilities to climate change, including financial vulnerability; prioritizes risks; identifies, assesses and implements adaptation actions that will reduce vulnerability; and takes advantage of opportunities presented by a changing climate, and
7. To support co-operation, communications and research among Federal, Provincial and Municipal governments, universities, colleges and non-governmental organizations on climate change mitigation and adaptation actions and strategies relevant to the City of Toronto and other urban centres, by participating in the establishment and development of an Urban Climate Change Network.

2.12 Current Activities

At the time of writing, the City of Toronto is working in a number of areas to implement the adaptation strategy outlined in *Ahead of the Storm* and in the Staff Report adopted by Council. The Deputy City Manager has asked all divisions to incorporate climate change mitigation and adaptation into their programs in the short term, and to identify funding needed for climate change activities in their budget submissions for 2009. TEO has also developed a methodology for City divisions to rank the short-term adaptation actions they are proposing to include in their 2009 budget requests. Potential adaptation actions will be highly ranked if they:

- Generate significant economic benefits
- Avoid significant costs
- Address a required item in the Toronto Climate Change Plan
- Can be financed primarily from external sources
- Achieve a direct measurable increase in resilience for the City
- Respond to a climate change problem that is considered high risk for the City, and
- Contribute to greenhouse gas reductions.

TEO is also working on a Climate Change Adaptation webpage to be included on its website to better inform the public about climate change impacts, the City's adaptation programs and strategies, and what individual citizens and households can do to protect themselves from climate change. TEO and the Institute for Catastrophic Loss Reduction have jointly developed the Toronto Reference Collection on Urban Climate Change Adaptation. This collection is available on-line on the City of Toronto's website.

In addition to these short-term activities, City staff are working on fleshing out a longer-term strategy. TEO is preparing to hire consultants to help with two key tasks in assessing priority climate change risks:

- An analysis of weather patterns and trends in the Toronto area and existing climate change projections for the short and medium-term, and

- A formal assessment and quantification of risks that climate change poses for Toronto, which will provide better information for prioritizing action and allocation of resources.

TEO is also encouraging the development of new working groups to oversee adaptation strategy development in three priority areas: Climate Change Risk Assessment, Urban Flooding/Drainage, and Health. City Planning is also preparing to integrate climate change mitigation and adaptation goals into Toronto's Official Plan.

Finally, TEO has initiated the Toronto Urban Climate Change Network, which brings together government, three Toronto Universities, the Toronto Region Conservation Authority and several NGOs to collaborate on issues of urban climate change impacts and adaptation in the region. At the time of writing, this group was planning a major Forum on Infrastructure and Climate Change Adaptation.

3 Priority Areas of Vulnerability and Action – The Case of Stormwater Management

3.1 Climate Change, Stormwater and Flooding in the City of Toronto

Priority areas of vulnerability for the City of Toronto have not yet been formally identified. This will await the vulnerability/risk assessment which should be underway by the end of 2008. However, from what is already known about climate change and its challenges for the Toronto area, stormwater is very likely to be identified as one of the top priorities.

Intense rainfall and associated flooding, streambank erosion and runoff have already proved to be a serious concern for the City. In a January 2008 presentation to the City's Executive Environment Team, the Director of Water Infrastructure Management told the City's senior managers that climate change may lead to more intense precipitation, with increased flooding risks and serious streambank erosion.⁶

The extreme rainfall of August 19, 2005 demonstrated the vulnerability of Toronto. The three-hour storm dropped more than 150 mm of rain in some areas of the city and cost approximately half a billion dollars in damages – the most expensive natural disaster ever in Ontario. Impacts included: flash floods of creeks, rivers and ravines; streambank erosion and collapse; damage to parks and trees; damage to roads and to water mains, gas mains, underground hydro and telephone cables, sanitary sewers and bridge foundations; vehicles caught on flooded streets and parking lots; and more than 4200 flooded basements in both homes and commercial properties.

The August 19th downpour was just one of 8 extreme rainfall events in the past 20 years that resulted in basement flooding and other damages. The August 19th storm exceeded the rainfall expected in a 1-in-100 year storm. Most of the other storms were estimated previously as having a 1-in-25 year to 1-in-50 year chance of occurring. Taken together, these events

⁶ Michael D'Andrea has given a number of public presentations on this theme. His presentation to a 2007 Columbia Basin Trust workshop in BC – [Climate Change: Impacts on Infrastructure and Water Management](#) – provides an overview of the City's concerns and related programs.

indicate that intense rainfalls are already on the rise in the Toronto area and that design standards for stormwater management need to be revised.

3.2 Current Programs to Manage Stormwater and Reduce Flooding

Toronto Water embarked on an ambitious program of stormwater management even before the risks of more intense storms under climate change became clear. In 2003, after several years of planning, Council adopted the [Wet Weather Flow Master Plan](#), at an estimated capital cost of a billion dollars over 25 years, or \$42 million annually. The goal of the plan is to reduce and ultimately eliminate the adverse impacts of stormwater on the built and natural environment. The Plan commits to improving water quality and reducing erosion and flooding by implementing a “hierarchy of solutions” with priority given to controlling stormwater where it falls. In order of priority, the solutions include:

- **Source controls** – reducing stormwater releases at the lot level by means of downspout disconnection, rain barrels, tree planting, absorbent landscaping, permeable pavements, green roofs, tree planting, underground storage, rainwater harvesting, ditches and swales and other means
- **Improvements in the conveyance system** – including sewer and stormwater pipes, catchbasins, exfiltration trenches, ditch and swale drainage systems and overland flow routes, and
- **End-of-pipe controls** – tunnels, tanks and stormwater ponds and wetlands that capture and facilitate the treatment of stormwater before releasing it to local water bodies.

Since approval of the Wet Weather Flow Master Plan, the City has embarked on an array of programs designed to reduce the impact of more frequent intense precipitation events. These are outlined in Table 4.

Table 4: Programs Expected to Reduce Flooding Impacts of Intense Storms or Extended Rainy Periods

Program	Description
Downspout Disconnection	<ul style="list-style-type: none"> ▪ This was a voluntary program in which the City paid for disconnection of downspouts from sewer lines and directed the flow to rain barrels or to the gardens of participating property owners. ▪ In 2007, the City made it mandatory for homeowners in combined sewer areas of Toronto to disconnect their downspouts. (This will take 3 years to complete and affect 120,000 properties.)
Green Roofs	<ul style="list-style-type: none"> ▪ In 2006, Council committed to installing green roofs on all new City-owned buildings and existing buildings where possible, with an eventual target of 50-75% green roof coverage on City facilities. ▪ Council also established a Green Roof incentive pilot program, offering grants to property owners who install green roofs. Currently, the City is developing a green roof by-law to require green roofs on new buildings.

Tree Planting	<ul style="list-style-type: none"> ▪ The City has embarked on an aggressive tree planting program and care program in the last few years, to help reduce flood flows in severe storms. Since 2006, Toronto Water has financed tree planting in floodplains and along river banks. In 2008, this contribution was \$2 million.
Rainwater Harvesting (and re-use)	<ul style="list-style-type: none"> ▪ In 2007, the City provided funds to support a rainwater harvesting system (for use in toilets and street cleaning) at Exhibition Place to demonstrate its usefulness for on-site stormwater management.
Front Yard Parking and Landscaping	<ul style="list-style-type: none"> ▪ In 2006, the City passed new by-laws restricting the creation of front-yard parking pads and set out requirements for soft landscaping. A major goal of these by-laws was to allow infiltration of stormwater.
Greening Surface Parking Lots	<ul style="list-style-type: none"> ▪ In 2007, City Council approved Design Guidelines for Greening Surface Parking lots, including recommendations for landscaped street edges, bio-retention areas and permeable surfaces to retain stormwater on-site.
Community Program for Stormwater Management	<ul style="list-style-type: none"> ▪ Funds have been made available for non-profit organizations to initiate projects that support the goals of the Wet Weather Flow Master Plan. Funded activities have included: community-based rainwater harvesting, steep slope planting, wetland creation and bio-swale projects.
Basement Flooding Program (\$78 million allocated for 2008)	<p>This program aims to provide protection against sanitary sewer backups into basements and protection against surface flooding by:</p> <ul style="list-style-type: none"> ▪ Sewer system inspections to identify and correct blockages in sanitary sewers, deteriorated pipes and other problems that contribute to sewer system backups from heavy rainfall ▪ Assessment of overland flow routes and evaluation of options to reduce severe ponding on streets during extreme storms ▪ Detailed environmental assessments of 31 priority areas at risk of flooding, to develop solutions ▪ Subsidies for homeowners who install a backflow valve and/or sump pump, or who disconnect and cap their foundation drain.
Separation of Combined or Cross-connected Sewer Systems	<ul style="list-style-type: none"> ▪ Separation of road (stormwater) drainage from combined sewer systems is implemented on a case-by-case basis. ▪ Cross-connecting sewer and stormwater lines have been identified and separated.
Enhancement of Roadside Water Infiltration	<ul style="list-style-type: none"> ▪ More than a dozen projects have been initiated since 2006 to improve roadside ditches or swale drainage systems or to install pervious catchbasins and pipes to allow infiltration of stormwater into soil.
Stormwater Management Ponds	<ul style="list-style-type: none"> ▪ Several stormwater management ponds have been constructed recently to hold and filter stormwater runoff before releasing it to Lake Ontario.

While the array of activities that the City of Toronto is undertaking to address stormwater is impressive, it is not clear that it will be sufficient to protect against the more intense precipitation expected as climate change progresses.

3.3 The Additional Challenge of Adapting to Climate Change

Toronto Water manages a large and complex water and wastewater/stormwater system. The agency has more than 1600 employees and a 2008 budget of almost \$800 million, funded by the sale of water. The wastewater department alone manages: 4 wastewater treatment plants; 4400 km of sanitary sewer, 1300 km of combined sewer and 360 km of trunk sewer; 370 km of watercourses; 43 stormwater management ponds; and 2300 sewer outfalls. About 10% of the wastewater system is more than 80 years old and requires major investment to replace. The City has invested increasing amounts of money to get its current system into a state of good repair, but doesn't expect to achieve that goal until 2017. A growing population also puts new demands on Toronto Water services and infrastructure.

Managing this system, replacing aging infrastructure and implementing the Wet Weather Flow Management Plan are complex enough in a stable climate. However, incorporating climate change considerations and adaptation strategies into planning and operations will add new challenges. The August 19th storm provided a potent warning about the damage that more intense precipitation can do, and about the need to plan for it.

During the process of developing a City of Toronto adaptation strategy, Toronto Water provided a representative to the Adaptation Steering Group and participated in the process of developing a comprehensive strategy for the City. Senior staff for the division attended meetings and a workshop with TEO staff to discuss adaptation. The division also provided feedback on the framework document and made several suggestions for short-term action to include in Toronto's adaptation strategy. The Staff Report included most of these suggestions, as well as short-term adaptation actions that were recommended by other divisions, but need the participation of Toronto Water. Table 5 lists short-term actions that are already underway to help the City protect itself against more intense precipitation. Adaptation actions that could be undertaken in 2009 if budget allocations are approved by City Council are outlined in Table 6.

Table 5: Short-term Adaptation Actions Underway that Assess or Reduce the Stormwater Impacts of Climate Change

SHORT-TERM ADAPTATION ACTIONS	ANTICIPATED BENEFIT	CITY GROUP(S) RESPONSIBLE
Improve Future Climate Change Prediction Capabilities	<p>Improved information on expected climate extremes and gradual changes will permit better decision making on adaptation planning.</p> <p>Models will help develop watershed plans that will aid adaptive management in the Rouge, Don and Humber River watersheds.</p>	TEO (TEO) Toronto Region Conservation Authority (TRCA) Toronto Water City Planning
Development of regional extreme precipitation intensity, duration and frequency curves	Updated IDF curves Improve the ability to design storm drainage infrastructure for extreme runoff events.	Toronto Water
Review urban flooding issues	This will help identify future policy and program requirements for flood protection.	Toronto Water
Don and Waterfront Trunk Sewers, and Combined Sewer Overflow Control Strategy Project Planning	This project will integrate wet weather flow control projects with upgrades for the Don and Waterfront Trunk Sewers and may involve intensified use of source controls such as downspout disconnection, rain barrels, porous pavers, etc.	Toronto Water
Complete flood warning system updates	Improvements to existing systems will help to prepare for flood emergencies.	Toronto Water TRCA
Naturalization of parklands and lands surrounding water and wastewater facilities	Naturalization will decrease stormwater runoff and increase canopy cover from 30% to 50%.	Parks, Forestry & Recreation Toronto Water TRCA
Planning to reduce stream erosion and increase stream restoration	Coordinated procedures among different levels of government will reduce stream erosion and aid in long-term stream restoration.	Toronto Water TRCA, Ontario MNR Fisheries & Oceans
Conduct Lake Ontario shoreline planning	This planning is focused on adaptive design for aquatic diversity and flood protection	Toronto Water TRCA
Sustainable Sidewalk Field Test	Pilot is constructing sidewalk and parking bay using soil cell technology and stormwater to allow healthy tree growth and sustain trees	Toronto Water City Planning Urban Forestry Transportation Services

Table 6: Additional Short-term Adaptation Actions that could be initiated in 2009

PROPOSED SHORT TERM ADAPTATION ACTIONS	ANTICIPATED BENEFIT	CITY GROUP(S) RESPONSIBLE
Assess effects of extreme weather, droughts and heat on water quality of watercourses and beaches	Recent simulations will be compared to real data from Rouge and Humber River watershed studies to define the extent to which climate change affects water quality.	Toronto Water
Source water protection	This project will assess the vulnerability of water intakes to spills from sewer breaks and discharge plumes from extreme runoff events.	Toronto Water Ministry of Environment Regions of Peel, Durham, Halton, Hamilton-Wentworth and Niagara TRCA
Citywide mandatory downspout disconnection	Downspout disconnection will reduce pressure on stormwater systems and flooding.	Toronto Water
Elimination of new reverse slope driveways	This will reduce flooding during extreme precipitation events.	Toronto Water City Planning Toronto Buildings
Planning for uninterrupted power supply for water treatment	This project will enhance contingency plans to operate critical water treatment and distribution and waste water treatment systems during extended power outages.	Toronto Water
Assess design standards for Wet Weather Flow Master Plan	The assessment will help identify tradeoffs between storing water onsite and moving water offsite (during intense precipitation). New design standards will reduce property flooding in the long term.	Toronto Water
Climate change vulnerability and risk assessment of major culverts and bridges	This will lead to an Improved understanding of vulnerabilities of culverts and bridges to flooding and target areas for remedial action.	Transportation Services Toronto Water
Expand Sustainable Technologies Evaluation Program (STEP) to test green development technologies	STEP will provide data and analysis to support implementation of green roofs, permeable pavement, bio-retention swales, rainwater harvesting systems, erosion and sediment control ponds and bio-filtration systems to aid in adaptation to extreme rainfall and droughts.	Multi-agency partnership including: TRCA Ministry of Environment Toronto Water Other regional municipalities

These current and proposed actions are important steps for increasing the protection and resilience of Toronto in the face of extreme weather patterns that are increasing under climate change. However, Toronto Water will need to go further. Although the division is concerned about climate change and its impacts, it has not yet systematically integrated climate change impacts and adaptation into its planning. It has been suggested that the division should establish a Climate Change Adaptation Task Force to do just that. A dedicated task force could:

- Enhance the knowledge of the division about the potential effects of climate change on its operations
- Assess the extent to which the current Wet Weather Flow Master Plan provides protection from more intense precipitation scenarios expected in the future
- Systematically assess adaptation options, especially of “green infrastructure”⁷ that can simultaneously provide other benefits to the City, and
- Improve public communications about the risks of flooding and about how Toronto residents and businesses can reduce their risks.

Such a Task Force was set up in the Department of Environmental Protection (DEP) in New York City in 2005, to examine and address the impacts that climate change presents for water supply, drainage and wastewater management systems.⁸ DEP’s Climate Change Task Force recently released the first report of its work, the [Assessment and Action Plan: Report 1](#). The mandate of the Task Force includes the following:

- Work with climate scientists to improve regional climate change projections
- Enhance DEP’s understanding of the potential impacts of climate change on the Department’s operations
- Determine and implement appropriate adaptations to DEP’s water systems
- Inventory and manage greenhouse gas emissions, and
- Improve communication and tracking mechanisms.

Ahead of the Storm laid out a process that the City as a whole needs to undertake to develop a long-term adaptation strategy. This process would also be of value at the level of individual departments or divisions like Toronto Water. Similar to the process of the New York DEP, this would involve:

- Setting up a clear internal mechanism – such as a Task Force – for investigating and addressing climate impacts
- Engaging relevant internal and external stakeholder groups (e.g. Transportation Services, City Planning, Toronto Region Conservation Authority)
- Formally incorporating climate change mitigation and adaptation goals into high level plans such as the Wet Weather Flow Master Plan
- Using the best available science to analyze the additional challenges that climate change may create for the division
- Identifying and assessing adaptation options to reduce risk (while this work is ongoing at Toronto Water, this effort could be enhanced, as discussed in the paragraph below)
- Developing and implementing adaptation strategies, and
- Monitoring and evaluating the effectiveness of implemented strategies in protecting the City.

⁷ Green infrastructure refers to source control options such as downspout disconnection, rain barrels, porous pavement, green roofs and other strategies that slow the release of rainwater to stormwater systems

⁸ DEP is the name New York gives to its water department.

Toronto Water could benefit from revisiting an assessment of stormwater control alternatives that the division commissioned five years ago, [Wet Weather Flow Management Master Plan: List of CSO / Stormwater Control Alternatives](#). This assessment suggested that many “green infrastructure” strategies would have little impact on controlling stormwater. However, the information on which it based this opinion was very limited and is now outdated. For example, the most recent study it cites on porous pavement was written in 1997, 11 years ago. There are many more recent studies of the efficacy of green infrastructure strategies – and policies to implement them widely – that should be considered. An up-to-date and more thorough review could lead to stronger implementation of a number of green infrastructure strategies that are of benefit to the City not only for stormwater management, but for heat reduction, improved air quality, and enhanced liveability of the City.

4 Observations about the City of Toronto Process and Lessons for Other Great Lakes Communities

The City of Toronto is one of a handful of cities in North America that has made a commitment to developing and implementing a comprehensive climate change adaptation strategy. The City has made significant progress in this work, though like most other cities that have started on a conscious process of climate change adaptation, it still has much to learn and do. As an early leader, the City of Toronto has had to find its own way, and there are both strengths and weaknesses in its adaptation work so far. This section provides some observations about the City of Toronto process, and makes recommendations (in green textboxes) that may help other Great Lakes cities in their own adaptation processes.

4.1 Getting and Making the Most of Political and Executive Support

Climate change is beginning to affect an array of municipal infrastructure and services. Adaptation will require bold action and significant investment, neither of which is likely to occur unless there is strong political and executive support. In some cities, political or executive champions have emerged and lead the effort to develop a climate change adaptation program. More often, there has been a bottom up process initiated by concerned staff, climate researchers, and/or environmental NGO’s, who have alerted decision-makers to the risks of climate change and persuaded them to act.

In Toronto there have been elements of both top-down and bottom-up leadership. The City has arguably the greenest Council in its history, and recently adopted a comprehensive new climate change and energy plan to try to meet the ambitious goal of reducing greenhouse gases 80% by 2050. Support for climate change mitigation does not always translate into support for adaptation, but Toronto leaders were able to see the significance of both, though mitigation still very much dominates the climate change agenda for the City.

Toronto Public Health, the Toronto Region Conservation Authority, the Clean Air Partnership, the Institute for Catastrophic Loss Reduction and Pollution Probe all played a role in a bottom-up effort over several years to get climate change impacts and adaptation on the agenda.

While Toronto’s adaptation strategy was under development TEO reported frequently to the Executive Environment Team on its progress, as well as to the Mayor’s office and Councillors responsible for the Parks and Environment Committee. This helped keep executive attention focused on climate change impacts and adaptation. When resistance to participating surfaced

among a few Divisions, the Deputy City Manager insisted on cooperation with the development of the adaptation plan.

Resistance appeared to stem from:

- Lack of knowledge about the current and short-term impacts of climate change
- Uncertainty or scepticism about the pace of climate change, and when or where its impacts might be felt, and
- A feeling of overload among some staff who see climate change adaptation as an additional burden added to more immediate responsibilities.

The first two reasons for resistance can be addressed over time by making available credible and comprehensible analyses of climate change and its impacts. The latter may be more difficult to overcome. In the first instance, it may help to include adaptation in the job description of those who participate actively in adaptation planning (and to reduce their other responsibilities correspondingly). In the long run, climate change impacts will become integrated as one of many factors that need to be considered in most planning and programs, and will not stand out as an additional burden.

In Toronto, ambivalence about making adaptation a priority may be reduced when the City's analysis of climate trends and its climate change risk assessment is completed, or as climate impacts increasingly make themselves felt. However, a continued process of outreach to politicians, management, staff and the public is also likely to be necessary.

LESSONS

- 5. Initial and continuing political and executive support is essential for the initiation, development and implementation of a comprehensive climate change adaptation strategy. Champions may emerge independently at the political or executive level, but more often, it takes a determined effort by staff or by external organizations that raise awareness of climate change impacts, make available credible information in plain language, and actively lobby for the development of an adaptation strategy.**

4.2 Adopting a Clear Process for Adaptation Planning

Most local governments would benefit from following a clear process to develop an adaptation strategy. There are several guides currently available that provide useful directions and a set of steps for adaptation planning that could make it more manageable for local governments. Although they vary in details and the suggested order of necessary actions, all the guides include the following steps:

- Set up an adaptation team and reporting structure
- Engage stakeholders and the public in thinking about climate change impacts and adaptation
- Examine vulnerabilities to current climate
- Assess and prioritize risks of future climate change (and your resiliency)
- Review adaptation options
- Develop an adaptation strategy/ preparedness plan, and
- Implement, monitor, and update as needed

The City of Toronto did not explicitly set out to follow any of the existing guides in developing their adaptation strategy; rather, they relied on the strong background of their consultant from the Clean Air Partnership for advice. Also, the Chair of the Steering Group made significant efforts to contact peer municipalities through the Urban Leaders Initiative. Key influential municipalities were Chicago, New York City and King County.

The process was somewhat ad hoc, rather than developed in accordance with a stepwise strategy developed at the beginning of the process. In the end, however, the City came up with a plan similar to that suggested by several of the guides. In hindsight, if the Adaptation Steering Group had begun their work by becoming familiar with one or more of the guides, the planning may have been easier, but would have required more lead-in time for the Steering Group members.

There is a plan and funding to conduct a climate change risk assessment in 2009. It is anticipated that there will be close consideration of [Adapting to Climate Change: A Risk-based Guide for Ontario Municipalities](#) by Bruce, Egner and Noble (2006). There are also plans to benchmark against other leading cities methodologies.

LESSONS

6. Consult an available guide on climate change adaptation planning for local governments, to help in developing a clear process and avoid “reinventing the wheel.” Available guides include:

- [Preparing for Climate Change: A Guidebook for Local, Regional and State Governments](#) (King County, Climate Impacts Program and ICLEI-US, 2007)
- [Climate Adaptation: Risk, Uncertainty and Decision-Making](#) (UKCIP, 2003)
- [Climate Change Impacts and Risk Management: A Guide for Business and Government](#) (Australian Greenhouse Office, 2006)
- [Adapting to Climate Change: A Risk-based Guide for Ontario Municipalities](#) (Bruce, Egner & Noble for Natural Resources Canada, 2006)
- [Preparing for Climate Change: A Guide for Local Government in New Zealand](#), New Zealand Climate Change Office, 2004.

4.3 Creating and Supporting a Climate Change Adaptation Team

Most of the cities or regional governments that have taken leadership on adaptation have set up an interdepartmental team or teams to work together on adaptation planning. The individual members of such teams are much better situated to understand how climate change can impact the operations and facilities of their own departments than someone in a Citywide environmental office, but bringing representatives of different departments together allows them to understand common threats and develop integrated responses.

In the City of Toronto, TEO was given the responsibility for developing and overseeing the climate change adaptation strategy. There are also plans to benchmark against the activities of other leading cities

Early in the process TEO set up a seven-member Adaptation Core Group, which met almost weekly for close to six months during the development of the Toronto adaptation plan. Core Group members brought the perspective of several key divisions to the project. Over time, the Core Group members developed a good overview of climate change impacts that the City is facing and an understanding of a variety of strategies for tackling them.

Unfortunately, the Core Group has not met regularly since Council adopted the Climate Change Adaptation Strategy (July 2008), which is worrisome, since the hard work of implementing the strategy has barely begun.

In addition to the Core Group, the City established a larger Adaptation Steering Group, also chaired by TEO. This group represented a broader array of City divisions, and brought a wider perspective to the process when it met to consider the plans developed by the Core Group. Steering Group members commented on the draft version of *Ahead of the Storm*, resulting in a much more comprehensive document. The Adaptation Steering Group also played an essential role in identifying short-term adaptation actions that the City could undertake to kickstart its adaptation program.

The Adaptation Steering Group did not make as much of a contribution as it might have, however, because there was no regular schedule of meetings. This meant that interaction with some key divisions was minimal and engagement was weak. Those Divisions that were represented in the larger Adaptation Steering Group but not in the Core Group had much less opportunity to develop an understanding of climate change impacts and adaptation issues and less say in the development of the strategy.

While both of these groups played an important role in developing an adaptation plan, neither had a formal mandate and some staff representatives had difficulty getting the necessary time to meet and work on the strategy. Both *Ahead of the Storm* and the Staff Report on Climate Change Adaptation call for the City to develop a formal mandate and clear reporting mechanisms (such as those shown on page 4) for the Adaptation Steering Group. These will likely be necessary if the comprehensive strategy is to be implemented, especially in divisions which are resistant to incorporating adaptation into their work.

Major climate vulnerabilities in Toronto include heat, air quality, intense rainfall and flooding. The potential for flooding is an issue that affects many departments and agencies including emergency management, finance and risk management, transportation, public health, electrical and gas utilities. During the development of the City of Toronto adaptation strategy, working groups were proposed to develop detailed health and stormwater management adaptation strategies. Given the multiple Divisions affected, an interdepartmental working group would be of particular value in developing an adaptation strategy to reduce the impacts of flooding from intense storms. However, at the time of writing neither task force had been established.

LESSONS

7. **Establish an interdepartmental team to work on climate change adaptation.**
8. **Ensure that the team has:**
 - **A clear mandate for its work**
 - **Participation by key policy and program staff**
 - **Allocation of staff time**
 - **A regular meeting schedule**
 - **A reporting structure that ensures appropriate and timely responses from decision-makers**
 - **Training and capacity building opportunities**
 - **Smaller working groups that can take on analysis and planning for key risk areas**

4.4 Building Internal Capacity to Tackle Adaptation

Although reducing greenhouse gas emissions and energy use has been on the agenda of cities in developed countries for some time, until recently little attention has been paid to local climate change impacts. As a result, relatively few municipal government staff have given much thought to the issue, and face a steep learning curve when asked to develop a climate change adaptation strategy. Leading cities have tackled this issue by:

- Sending staff to conferences and workshops or organizing these learning events internally
- Participating in learning networks focused on climate change impacts and adaptation
- Collecting, organizing and providing staff with existing useful research, and
- Involving staff in research to better understand how climate change will affect the community and what responses could reduce the risks.

Over the last year, the City of Toronto did all these things, largely because of the proactive approach of the Chair of the Adaptation Steering Group. Several members of the group attended the Symposium in September 2007, which launched the Alliance for Resilient Cities (ARC), and subsequently participated in bimonthly ARC webinars as well as relevant webinars and seminars offered by the Federation of Canadian Municipalities, Environment Canada, and the Institute of Catastrophic Loss Reduction.

Early on, the Chair of the Adaptation Steering Group participated in webinars for the US Urban Leaders Adaptation Initiative. The Chair followed this up by organizing one-on-one teleconferences with counterparts in Chicago and King County to learn more about their experiences that could help Toronto understand its vulnerabilities and formulate its strategy.

TEO and the Clean Air Partnership also organized a workshop for the Adaptation Steering Group, with presentations on climate change impacts and on what other cities had done to adapt. TEO also organized a meeting with the Public Infrastructure Engineering Vulnerability Committee of Engineers Canada to discuss their work on assessing the vulnerability of municipal infrastructure to climate change.

In addition to a general understanding of why adaptation is necessary, local government policy staff and decision-makers need access to science and other research that helps them identify specific risks; determine actions that might provide protection; and calculate how much it might cost if they act (or if they don't). The literature is growing in all of these areas, although not all of it is easily accessible to municipalities. Staff, senior executives and city politicians have limited time to search for and sift through journal articles and research reports, however useful these may prove.

TEO used the services of the Institute for Catastrophic Loss Reduction to identify a large number of resources that could help specific divisions find out more about climate change impacts and adaptation strategies, and organized these into a [Climate Change Adaptation Reference Collection](#), made available to staff on the City's website. It is not clear to what extent City staff make use of these resources. However, they could be very helpful for long-term integration of adaptation into the work of the City and could also aid other Great Lakes communities undertaking similar work.

Few communities have access to good historical climate trend information or to climate modelling that provides future projections for regional climate. This information is particularly important for planning long-lived infrastructure. The City of Toronto recognizes the importance of getting this kind of information into the hands of its staff, but is also concerned about the cost and reliability of regional climate projections. The City is joining forces with other nearby jurisdictions to gather and analyze historical trends data and existing regional climate projections. This information will likely be of value for many nearby Great Lakes communities.

LESSONS

- 20. It takes time and a concerted "inreach" effort to have the key departments understand what adaptation is, why it is necessary, and to get them to incorporate climate change into their thinking and planning. An explicit strategy of communications and engagement with staff is advisable.**
- 21. Take advantage of the growing number of external conferences, workshops, seminars and webinars to introduce staff to issues related to climate change impacts and adaptation.**
- 22. Organize internal workshops and learning events to get staff familiar with the concept of climate change impacts and adaptation.**
- 23. Ensure availability of on-line resource/reference collections to become more informed about existing knowledge and best practices (See Toronto's [Climate Change Adaptation Reference Collection](#).)**
- 24. Initiate or join the efforts of others in the region to get a better handle on climate trends and regional climate projections.**

4.5 Use of External Resources

External resources and expertise can and should be mobilized to help communities with climate change impact assessments and adaptation planning. Many Great Lakes communities have local experts who have useful information and ideas that they are very willing to contribute. There are knowledgeable people in local universities, local offices of Environment Canada, the Ontario Ministry of Natural Resources and elsewhere. Many of these experts are eager to have their work inform policy and programs and would willingly travel some distance to help a community come to grips with adaptation issues.

The City of Toronto was able to access a number of local experts at no cost and to obtain the advice of one or two others by paying for their travel. Toronto is home to three universities, all of which have faculty members conducting research on climate change impacts and adaptation. The Adaptation and Impacts Research Division of Environment Canada is headquartered in Downsview, in Toronto's northwest. The Toronto and Region Conservation Authority has been conducting research related to climate impacts and adaptation for a number of years. The Institute for Catastrophic Loss Reduction – which has been active in disaster prevention related to climate change – has offices in Toronto and London, Ontario. Finally, two non-governmental organizations based in Toronto – Pollution Probe and the Clean Air Partnership – have also been heavily involved in research and policy development on climate change adaptation.

The City of Toronto also draws on expert knowledge through its participation in the Alliance for Resilient Cities and the US Urban Leaders Adaptation Initiative, which host regular events to share research and best practices in climate impacts and adaptation. TEO staff were proactive about following up with contacts made during these events to learn more about relevant work elsewhere. TEO has also been proactive in inviting Engineers Canada and the Canadian Institute of Planners to discuss their work on impact assessment and adaptation with City of Toronto staff.

The City also created an Expert Panel for advice on impacts and adaptation. This Panel included scientists and researchers from Environment Canada, Natural Resources Canada, TRCA, local universities and from the City's own Public Health department. Although Expert Panel members were willing to participate actively in the development of adaptation planning for Toronto, the City made limited use of Panel members, inviting them to make presentations at one internal meeting of City managers and staff, and a second public meeting of the Parks and Environment Committee. The Panel was not invited to comment on drafts of the adaptation framework and strategy, or to participate in an ongoing fashion in the development of Toronto's adaptation planning, which is unfortunate.⁹ However, some of the panel members are involved in providing advice in implementing the Climate Change Adaptation Strategy. Some panel members have been particularly active with input to the Toronto Urban Climate Change Network, and some are actively involved in projects.

⁹ In contrast, London, New York and Chicago have all established continuing task forces or partnerships that include outside experts to advise their climate change adaptation activities.

LESSONS

25. Great Lakes communities should make use of the deep layer of existing expertise in the region on climate impacts and adaptation. Mobilize external resources and expertise by:

- Identifying local experts who would be willing to provide information and advice
- Establishing an Expert Panel or Advisory Committee with expert participation to provide input into vulnerability assessments and adaptation planning
- Inviting experts to comment on draft plans and strategies
- Utilizing local experts to conduct workshops or participate in working groups and contribute to building the capacity of staff
- Participating in available peer networks such as the Alliance for Resilient Cities

4.6 Gaining an Initial Understanding of Vulnerabilities to Climate Change

The vulnerability of individual towns, cities and regions will vary according to their particular geographical features (e.g. location on a floodplain); weather patterns (e.g. frequent freeze-thaw cycles); the age and condition of its infrastructure; and other factors. In order to reduce the impacts of climate change, it is very important to have an early understanding of the vulnerabilities of the local community. This helps a local government to know which departments need to be involved and can create initial motivation and momentum for adaptation planning.

In developing its initial strategy, the City of Toronto drew heavily on [A Scan of Climate Change Impacts on Toronto](#), published by the Clean Air Partnership in 2006. The *Scan* summarized the scientific literature available at the time, as well as information from interviews with City of Toronto staff and agencies and some Environment Canada researchers. The *Scan* had previously served an important function in raising the profile of climate change impacts in the City, drawing the attention of Toronto's Mayor and Council to the need for an adaptation strategy.

Although new scientific research and analysis has become available since the *Scan* was published, the report could help other Great Lakes communities – which have similar climate change challenges to those of Toronto – to understand some of their vulnerabilities. The Ontario chapter of [From Impacts to Adaptation: Canada in a Changing Climate 2007](#) also provides valuable information about the vulnerabilities of the Great Lakes area.

The vulnerability of communities to climate change can also be informed by paying attention to recent weather patterns. The Great Lakes area has been subjected to an array of weather extremes in the last decade, most of which climatologists link to climate change. In the last four years, for example, Toronto has suffered through unprecedented heat waves and smog (2005), the costliest flood in the City's history (2005), one of the driest summers on record (2007) followed by one of the wettest (2008) and the snowiest winter in 50 years (2007-2008). All of these have been costly for the City and its residents. Most of these events were also experienced by other Great Lakes communities.

An analysis of recent climate impacts and their costs can provide a potent illustration of a community's vulnerability to climate change, and can be used to engage political and executive leaders, as well as the media and the public in climate change adaptation discussions.¹⁰

As adaptation planning progresses, local communities may need to undertake more detailed or specific analyses of their vulnerability to climate change than the overview suggested above. The City of Toronto is currently planning to deepen the knowledge of its vulnerabilities by hiring a consultant to help with a comprehensive analysis of the City's vulnerability to climate change and an assessment of priority risks.

LESSONS

26. Use available resources to undertake a quick initial scan of vulnerabilities for your community to increase awareness of climate change impacts and the need to take action on adaptation. A review of recent extreme weather events, as reported in the local press, may provide useful indicators about impacts, costs and vulnerabilities. Later in the adaptation process, a more specific and detailed analysis of vulnerabilities may be necessary.

4.7 Collaborative Development of a Framework Document or Issues Paper for Internal and Public Consultation

Before adopting a major new policy or program, most local governments will ask for a staff report and recommendations. Sometimes these reports take the form of an issues paper or framework document. For an issue such as climate change, which has potential impacts relevant to most local government departments, it is valuable to develop such a document with the collaboration of staff from all the affected departments. This increases discussion of the issues among City staff and enriches the thinking that goes into development of an adaptation strategy. Such a document can also be a way of reaching out to the public on the issues before settling on the specifics of an adaptation strategy.

The City of Toronto developed *Ahead of the Storm* as a framework document to help in consulting the public on climate change adaptation with input from the interdepartmental Adaptation Steering Group. The iterative process took some time, but incorporated the thinking of many divisions on an issue that affects them all. Several important sections were added to the framework document as the result of this collaborative effort, including a description of existing programs that provide some protection against climate change, and that form a basis for an expanded adaptation strategy.

¹⁰ The United Kingdom's Climate Impacts Program has recently piloted a project they call the [Local Climate Impacts Profile](#), which shows local governments how to undertake an inexpensive review of the impacts of recent weather extremes to lay the groundwork for an initial vulnerability assessment. This may also be a useful tool for Great Lakes communities.

The resulting document was too detailed to serve as a good public consultation document. However, the City produced a summary version for public consultation. *Ahead of the Storm* also provided a sound basis for development of the Staff Report and recommendations to Council. We believe that other Great Lakes communities could use the headings and some of the content of *Ahead of the Storm* to develop their own adaptation plans. (See page 14.)

LESSONS

27. Prepare and release an issues paper or framework document that outlines the expected impacts of climate change and how to prepare for them, in order to engage staff, Council members and the public in thinking about the issues and the decisions that need to be made. If possible, engage a broad range of staff and other potentially affected stakeholders in reviewing and contributing to the document. *Ahead of the Storm* provides an outline that may be useful for other communities to use in developing their own framework documents.

4.8 Public Outreach and Consultation

Most members of the public have relatively little knowledge about the effects which climate change is likely to have locally and even less understanding about what it means to adapt and reduce the impact of these effects. There are several reasons for raising public awareness of these issues. To begin with, individuals and families that are aware of their vulnerability to climate change can take some individual actions to reduce their susceptibility. They may also take actions that contribute to reducing overall vulnerability of their communities. A broader public awareness of climate change vulnerabilities may also contribute to greater support for action by local government both to mitigate and to adapt to climate change.

The City of Toronto made a significant effort to involve the public in discussions of its climate change adaptation framework and strategy, holding six consultation meetings over the period of a month in May of 2007. The consultations were not very successful in achieving focused recommendations for adaptation. One reason was that the initial framework document was quite long and detailed, and was the only version available for the first two public meetings. It was evident that most of the participants at the public meetings had not read the document.

Perhaps more importantly, the members of the public and businesses who attended the consultation meetings or sent their written comments tended to be knowledgeable about ways to reduce greenhouse gas emissions and about the global impacts of climate change, but for the most part were not well-informed about local impacts of climate change, and their implications for Toronto. They had trouble grappling with the idea of a climate change *adaptation* strategy aimed at reducing the impacts of heat waves, storms, and other effects of climate change and during the consultations returned repeatedly to the topic of *mitigation* strategies (such as renewable energy, electric cars and public transportation). By the end of each meeting, most participants did have a better sense of the local impacts of climate change and some grasp of the idea of an adaptation strategy, but they felt that much more needed to be

done to educate the public on these issues, and called on the City to develop a public education campaign.

Halifax Regional Municipality (HRM) is one community that actively seeks to build public awareness about climate change impacts and both mitigation and adaptation strategies. HRM has a dedicated website on the issues as well as guides for individual households to prepare for climate-related emergencies. The municipality also includes regular articles on climate change and adaptation in its *Naturally Green* newsletter, distributed to every Halifax household on a bimonthly basis.

LESSONS

- 28. Education is necessary to inform the public about local climate change impacts and to help them understand adaptation actions that can be taken at the level of the individual household, and in the municipality.**
- 29. Public consultation on climate change adaptation strategies can work both to increase awareness of local climate change impacts, and also to build support for necessary actions.**

4.9 Shaping the Strategy

Municipalities already take action in many areas to decrease the impacts of a changing climate and extreme weather even if they are not consistently incorporating information about future climate conditions into their long-term planning. Identifying adaptive actions or programs that are already underway helps lay the foundation for building a strong adaptation strategy. The City of Toronto identified eleven current programs that provide some protection from future climate change. This made the task of shaping a strategy less daunting.

In developing an adaptation strategy, municipalities face the challenge of finding a balance between taking visible action in the short term and undertaking thoughtful long-term planning which may take some time to show results. Politicians are often accused of having a short-term perspective – having relatively short terms of office during which they can influence policy and programs, and also needing to be seen as leaders who can get things done in order to be elected again.¹¹ Senior policy and program staff – especially in departments that deal with planning, long-lived infrastructure, or public health – often have a longer-term perspective, wanting to put into place programs that make sense well into the future, and willing to take the time to ensure that these are based on credible research and analysis of options. In some circles this may seem like foot-dragging.

¹¹ Short-term actions can also be important for kickstarting implementation of a climate change adaptation strategy, and developing momentum. Most adaptation champions recommend short-term actions that will reduce the impact of current weather extremes, or that achieve multiple benefits in addition to increasing resiliency in the face of climate change and are therefore “worth doing anyway.”

Similarly, in planning for adaptation, governments need to allocate resources between anticipating and responding to emergency situations such as floods or heat waves on the one hand and creating the conditions that prevent them from occurring or structurally reduce their impact.

The tensions among these choices certainly surfaced during the development of the Toronto adaptation strategy. The earliest draft of *Ahead of the Storm* emphasized a staged, long-term planning process for adaptation, including:

- Collecting and analysing information about how climate is changing and what impacts this is likely to have for Toronto
- A process to prioritize likely climate change impacts and risks
- Investigation of alternative responses to reduce these impacts, and finally
- Development and implementation of a strategy.

Senior staff attuned to the needs of politicians ensured that the next draft included an array of short-term actions that the City could take to reduce climate change impacts, and that did not depend on a lengthy planning process.¹² There were no criteria for prioritizing short-term actions to include in the draft strategy, and so almost everything suggested to the Adaptation Core Group was incorporated. Criteria were developed later, however, to help prioritize the short-term actions in the budget process.

The draft strategy now included both short-term actions and a long-term planning process. The longer-term process included plans to collect and analyze data on local weather trends as well as regional climate change projections to better prepare for the likely impacts of climate change on the City. However, one key City Councillor argued strongly that it is not the job of the City to undertake climate projections and that in any case such projections are not useful because of large uncertainties in current climate modelling. He was concerned that waiting for this data would delay necessary action on climate change adaptation. Consequently, this aspect of the strategy was downplayed in the Staff Report.

Emergency preparedness was another issue that concerned some politicians and political staff when they reviewed the draft strategy. The initial list of short-term adaptation actions included increasing public awareness of the potential for climate related emergencies and included recommendations for provision of 72-hour emergency preparedness kits for households and small businesses, planning for recovery from wide-scale business disruptions and severe weather events, and flood warning systems. Although these suggestions were supported by businesses and some members of the public who participated in the public consultations, these items were removed from the list of short-term adaptation actions included in the final framework document and in the staff report.

The City of Toronto is not the only local government that has struggled with the question of emphasis on emergencies and emergency preparedness in adaptation planning. Halifax includes on its climate change website a guide for its citizens on preparing for weather emergencies. However, some other city governments have expressed the concern that a focus and spending on short-term crises reduces the attention and resources needed to make longer term changes that will make cities more resilient to climate change.

¹² Interestingly, many of the short-term actions submitted by individual Divisions involved research that would help them better understand the risk of climate change for their operations or facilities, or that would pilot potential adaptation actions.

Hardly anyone at the City of Toronto expected to take almost a year to develop an adaptation strategy, or that the approved strategy would still need considerable work to fill out the details.

City politicians originally asked for a Staff Report on an adaptation strategy to be produced a few months after adoption of *Change is in the Air*. A similar timeframe was given for development of a climate change mitigation strategy. Developing a mitigation strategy was challenging, but because the City had a greenhouse gas inventory, and had been working on ways to reduce greenhouse gas emissions for many years, the key elements of a mitigation strategy were easier to outline in a relatively short period.

However, attention to near-term climate change impacts and to adaptation is much more recent and requires more time to investigate and process. It is not clear that City politicians understand the amount of information and effort that is necessary to develop an effective adaptation strategy.

In the end, a balance was achieved in the Framework Document and in the Staff Report. The City has committed to move ahead with short-term adaptation actions that make sense in light of current climate extremes such as heat and intense storms, and which have benefits apart from reducing the impact of climate change. But the City is *also* investing in research on climate trends together with other partners, and in a comprehensive assessment of the risks to Toronto of climate change, and this information is expected to inform Toronto's long-term adaptation strategy development.

LESSONS

- 30. Identify the actions that the municipality is already taking that reduce the risk of current extreme weather, and that are likely to provide some protection from future climate change. This can provide a foundation on which to build a stronger, more comprehensive adaptation strategy.**
- 31. Adaptation planning needs to include short-term actions, longer-term planning processes, the implementation of upstream preventive measures and emergency preparation and response. Adaptation planners need to consider how to include and balance this range of activities.**
- 32. It takes time to develop a municipal adaptation plan. Some short-term actions can be identified and acted on fairly quickly, but these should not substitute for longer-term assessment of vulnerability, priority risks and the effectiveness of different adaptation options.**

4.10 Implementing the Plan

As this report is being written, several Canadian communities are in the process of developing an adaptation plan, but almost none have been implemented to date. The City of Toronto is just beginning to implement the strategy that was adopted in the summer of 2008. So there are as

yet few lessons to be drawn from the Toronto experience. However, some general comments can be made.

A large amount of work goes into the development of an initial adaptation process and strategy. Once a strategy is outlined, there is still much to be done to work out the details and to begin implementation. Some of the work may involve more detailed research on specific vulnerabilities and on potential adaptation options. Much of it will be done by small groups in individual departments, which could have the effect of fragmenting the work.

There is also a danger that once the adaptation strategy is outlined and adopted by Council the staff involved in developing the strategy will return to their other responsibilities and the momentum for implementing the plan will be lost. This is one reason why it is important to appoint a climate change adaptation team, provide it with a clear mandate and structure, and ensure that it continues to meet to maintain an information flow and monitor and integrate adaptation measures across different departments. The work of this team may also be essential in maintaining the interest and attention of politicians.

Although such a mandate and structure was proposed for the City of Toronto's Adaptation Steering Group, it was never formally adopted. In the late fall of 2008, the work of the Adaptation Steering Group was folded into a new Environmental Risk Working Group, which will oversee general environmental risk management in the City. This may dilute the focus of the group on climate change impacts, and make it more difficult to motivate and coordinate action on adaptation.

LESSONS

33. Maintain a strong and focused climate change adaptation team to oversee the work of integrating adaptation strategies into different policies and departments.

4.11 Integrating Climate Change Adaptation with Mitigation and Sustainability

There is a growing literature that explores the issue of integrating efforts to reduce greenhouse gas emissions, protect against climate changes that are already underway, and create more sustainable communities. For the most part, this discussion is still fairly preliminary and theoretical, though a number of adaptation advocates have identified practical "win-win" activities that can both reduce emissions and near-term impacts.

At the City of Toronto the Adaptation Core Group did talk fairly early on about the potential overlap for mitigation and adaptation activities, and the Chair of the Group produced the Venn diagram on the next page to illustrate this idea.

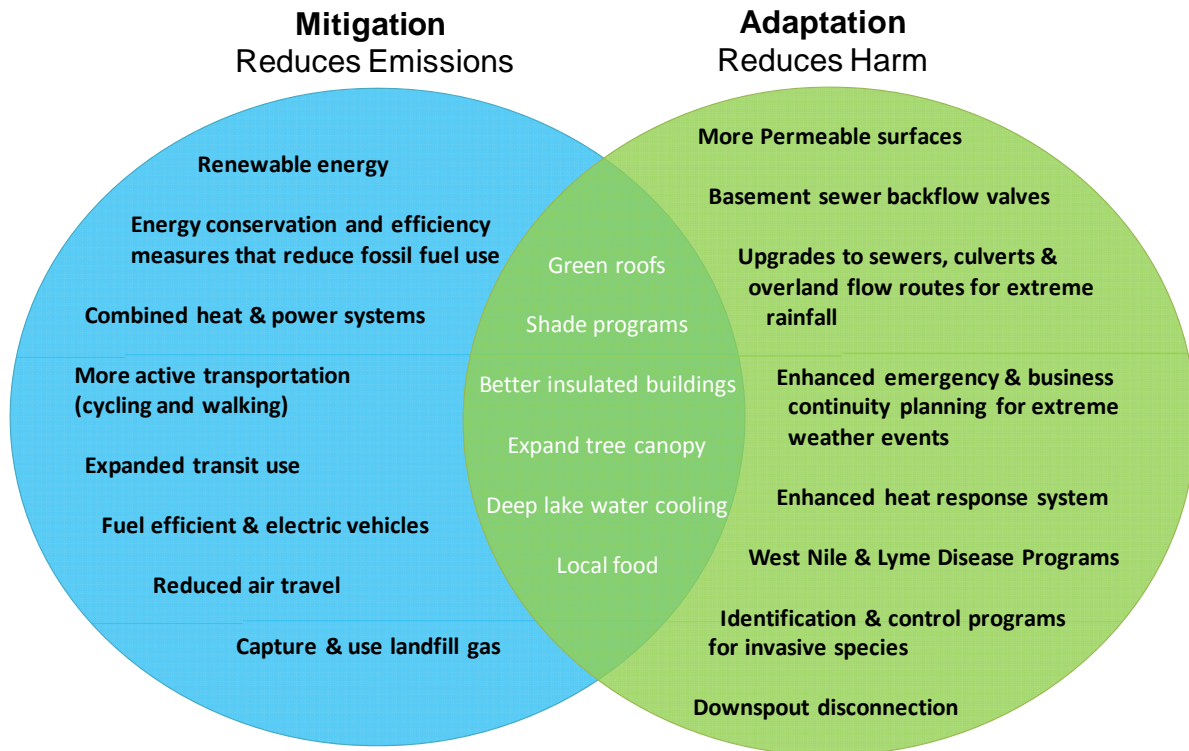


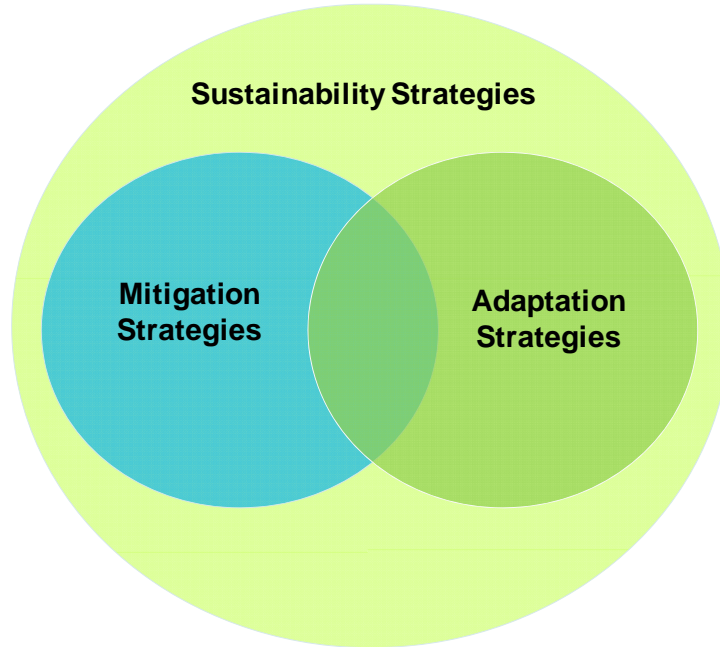
Figure 2: Climate Change Mitigation and Adaptation Options

The potential for “win-win” solutions did not, however, drive the selection of the short-term adaptation actions that were included in Toronto’s adaptation strategy. It is possible that they may be more important in developing the longer-term strategy. Certainly TEO recommended that in budget proposals for climate change activities in 2009 City Divisions should consider the contribution that the proposed actions would make to emissions reduction *and* to reducing impacts.

It remains to be seen the extent to which mitigation and adaptation can be planned together. There is no question that these strategies should complement each other wherever possible. It is important that mitigation actions do not increase the impacts of near-term climate change, and that adaptation actions avoid contributing to greater emissions. However, mitigation and adaptation cannot be completely integrated. Take for example, actions that may reduce flooding from more intense storms. Some actions such as increasing naturalized areas, green roofs, and permeable pavements are likely to decrease flooding and, because of their contribution to cooling the local environment, reduce the use of energy for air conditioning and associated emissions. However, reducing the impacts of flooding may also require dykes, stormwater ponds, enlargement of culverts and other actions that do little or nothing to contribute to emissions reduction. This does not make them less necessary.

There was some early discussion among City of Toronto Adaptation Core Group members about trying to put together a strategy that integrated climate change adaptation and overall city sustainability. This approach is expressed conceptually in Figure 3.

Figure 3: Mitigation and Adaptation as Subsets of Sustainability



This way of framing the discussion around climate change adaptation in the City of Toronto did not really develop very far, and did not strongly influence the adaptation strategy that was approved by the City. However, it remains a framework that could and should guide the development of future climate change policy in Toronto and elsewhere.

LESSONS

- 34. The goal of overall environmental sustainability should inform climate change adaptation strategies. Adaptation options and strategies that increase greenhouse gas emissions or contribute to other environmental and social problems should be avoided.**

Appendix 1

City of Toronto Activities in Development of Climate Change Adaptation Strategy	
Date	Activity
February 2007	<ul style="list-style-type: none"> Presentations by invited experts to Parks and Environment Committee on scope of new Climate Change Plan
March 2007	<ul style="list-style-type: none"> Release of <i>Change is in the Air: Framework for Public Review and Engagement</i>, which included development of an Adaptation Strategy as one of 27 potential actions
April 2007	<ul style="list-style-type: none"> TEO (TEO) appoints a staff person to develop Adaptation Strategy TEO staff meet with members of Environment Canada's Adaptation and Impacts Research Group to discuss available resources for work on adaptation TEO convenes first Adaptation Steering Group meeting with representatives from 13 City Divisions, the Toronto Region Conservation Authority and CAP, and sets up a smaller Adaptation Core Group to manage day-to-day development work TEO participates in US Urban Leaders Adaptation Initiative meeting, along with a number of US cities/urban regions active in developing adaptation strategies
May 2007	<ul style="list-style-type: none"> Members of the Adaptation Steering Group supply information on actions already underway that help the City adapt to climate change; This is tabulated in a table of Current and Planned Climate Adaptation Actions, which identifies the social, environmental and economic benefits of the actions TEO develops background materials for a Staff Report to City Council on the overall climate change strategy.
June 2007	<ul style="list-style-type: none"> City Council unanimously approves the Climate Change, Clean Air and Sustainable Energy Action Plan that commits to the development of a climate change adaptation strategy, identifies needs for data collection and incorporates stakeholder input TEO staff develop draft risk assessment tool for use in assessing and prioritizing risks of climate change in different areas of City responsibility and operations TEO briefs senior Insurance and Risk Management staff on climate change adaptation and the implications for City insurance The City of Toronto becomes a member of the US Urban Leaders Adaptation Initiative
Summer 2007	<ul style="list-style-type: none"> TEO staff arrange teleconference of Adaptation Steering Group members with City of Chicago and King County, Washington officials to discuss climate strategies TEO hires a master's student intern to survey other Ontario municipalities about their climate change adaptation actions

	<ul style="list-style-type: none"> ▪ Student gathers and catalogs a collection of climate change impacts and adaptation reports, articles and other resources as well as an initial list of useful contacts ▪ TEO develops a summary of climate change risks that may affect City operations and Divisions as well as a risk assessment spreadsheet and scoring system ▪ TEO conducts a survey of the research needs of City Divisions related to climate change, air quality and energy ▪ TEO presentation to Senior Management on Balancing Budget Constraints, Legal Liability and the Need for Action on Climate Change ▪ TEO meets with staff from Toronto Public Health to discuss cooperation in the development of a strategy (Kate Bassil)
September 2007	<ul style="list-style-type: none"> ▪ TEO identifies a range of climate change impacts and adaptation experts in the Toronto area, and begins recruiting them for an “Expert Panel” to advise the City ▪ TEO meets with representatives from the Institute for Catastrophic Loss Reduction to discuss possible collaboration ▪ TEO meets with Toronto Water staff to discuss the implications that climate change might have for the 25-year Wet Weather Flow Master Plan ▪ Adaptation Core Group begins meeting weekly; With input from Core Group, TEO staff develop an outline for a Climate Change Adaptation Strategy document, and a public consultation process ▪ Several members of the Adaptation Steering Group attend the Alliance for Resilient Cities Symposium; TEO develops display posters explaining the different goals and strategies for climate change mitigation and adaptation strategies, and areas where they overlap
October 2007	<ul style="list-style-type: none"> ▪ Presentation to the City's Executive Environment Team on climate change impacts and potential components of an adaptation strategy (?) ▪ TEO and Transportation Services staff meet with Engineers Canada to discuss the possibility of City of Toronto participation in one of a series of studies coordinated by the Public Infrastructure Engineering Vulnerability Committee on vulnerability of infrastructure to climate change (Not possible in 2008) ▪ TEO staff meet with BC Ministry of the Environment staff to share information about adaptation approaches in Toronto and in BC communities; This led to an exchange of information about adaptation initiatives with City of Vancouver staff ▪ TEO briefs the Mayor, and the Chair and Vice-Chair of the Parks and Environment Committee on the progress of the Adaptation work
November 2007	<ul style="list-style-type: none"> ▪ Ontario Ministry of the Environment confirms funds for work by the Clean Air Partnership in support of the Adaptation Steering Group ▪ Core Group develops plans for websites on adaptation, one for staff and the other for general access by the public; ICLR agrees to contribute a catalog of resources on climate change impacts and adaptation ▪ TEO briefs the Chair and Vice-Chair of the Parks and Environment Committee on plans for Expert Panel meeting in December ▪ TEO makes presentation on Climate Change Adaptation to the Toronto Board of Trade

	<ul style="list-style-type: none"> ▪ Adaptation Steering Group Chair participates in two-week international Leadership in Environment and Development (LEAD) training program focused on Climate Change Adaptation ▪ Adaptation Steering Group members participate in Alliance for Resilient Cities webinar, on the topic <i>Developing an Urban Adaptation Strategy</i>
December 2007	<ul style="list-style-type: none"> ▪ Expert Panel meets with Adaptation Steering Group and senior staff from a number of City Divisions and Agencies to discuss expected climate change impacts and adaptation strategies that the City needs to consider ▪ Work begins in earnest on a Climate Change Adaptation Framework Document for public review and engagement
January 2008	<ul style="list-style-type: none"> ▪ Workshop for larger Adaptation Steering Group, with presentations on <i>Climate Change Impacts and Adaptation in Toronto</i> and <i>What Other Cities have done to Adapt</i> (to Climate Change); Participants are asked to identify short-term actions that would contribute to adaptation in their operations ▪ Expert Panel members address a Special Meeting of the Parks and Environment Committee with approximately 150 (?) members of the public and City staff in attendance ▪ Meeting with Engineers Canada representatives to discuss the Public Infrastructure Engineering Vulnerability Committee research and ... ▪ TEO Director makes a presentation to the Conference Board of Canada's Leaders Forum on Climate Adaptation about the Toronto process ▪ CAP volunteer produces a scan of the literature on Estimating the Costs of Climate Change
February 2008	<ul style="list-style-type: none"> ▪ First draft Framework Document completed (and goes through several iterations as a result of input by the Core Group and TEO's Director) ▪ ICLR completes initial listing of resources on climate change impacts and adaptation for posting on City of Toronto internal website ▪ TEO briefs the Executive Environment Team; Deputy City Manager directs all divisions to cooperate with the work of the Adaptation Steering Group ▪ Teleconference with Chicago's Environment Commissioner, to discuss study underway for the City of Chicago on the costs of climate change
March 2008	<ul style="list-style-type: none"> ▪ Draft Framework Document goes out to larger Adaptation Steering Group, inviting their comments (Comments received from 14 Divisions and to the extent possible, these are integrated into the final document) ▪ Drafting begins on a "highlights" document for public distribution ▪ Workshop/meeting with Toronto Public Health staff on preparing for climate change
April 2008	<ul style="list-style-type: none"> ▪ Draft Framework Document goes to Mayor, Deputy Mayor, Chair and Vice-chair of the Parks and Environment Committee for comment ▪ Meeting with Toronto Hydro

	<ul style="list-style-type: none"> ▪ <i>Ahead of the Storm</i> completed and released ▪ Highlights version of <i>Ahead of the Storm</i> document prepared ▪ Consultation meeting organized for academics and other levels of government to discuss <i>Ahead of the Storm</i> and discuss follow-up, especially about the possibility of creating a Centre for Urban Climate Change ▪ Discussion with TRCA about cooperative project on regional climate change modelling to support climate change risk assessment in Toronto and other parts of the GTA
May 2008	<ul style="list-style-type: none"> ▪ Five public consultation meetings on <i>Ahead of the Storm</i> (two with the general public, and three with business organizations of different sizes) ▪ TEO Director and staff met with the City of Toronto's Emergency Management Working Group to discuss how emergency and business continuity planning could take into account the increased extreme weather events expected as a result of climate change ▪ Preparation of Staff Report to Council on the adaptation strategy (also developed in an iterative fashion with input from Adaptation Steering Committee members) ▪ Special Meeting of Parks and Environment Committee to hear public comment on <i>Ahead of the Storm</i>; Parks and Environment endorsed the Staff Report, which now goes to Executive Committee ▪ Workshop for TEO, TRCA and CAP staff by Environment Canada to discuss how the data and scenarios currently available from the Canadian Centre for Climate Modelling and Analysis (CCCMA) could be used for impacts assessment purposes at the City ▪ Short video news release prepared for Toronto's participation in the Urban Leaders Initiative meeting in Seattle, Washington
June 2008	<ul style="list-style-type: none"> ▪ Deputy City Manager requests all Divisions to incorporate climate change concerns into planning and budget submissions for 2009, in anticipation of acceptance by Council of the Staff Report on Climate Change Adaptation ▪ Executive Committee approves Staff Report (anticipated) ▪ TEO develops a climate change adaptation action prioritization methodology to help rank proposed short-term adaptation actions included in planning and budget submissions ▪ Adaptation Steering Committee workshop on Risk Assessment Methodology proposed in <i>Adapting to Climate Change: A Risk-based Guide for Ontario Municipalities</i> (anticipated)
July 2008	<ul style="list-style-type: none"> ▪ City Council approves recommendations in Staff Report