

Toronto: Ahead of the storm – development of the climate change adaptation action plan

Climate change impacts addressed	High temperatures Urban flooding River flooding Lake level rise
Spatial scale	Town or city
Response type	Action Plan
Themes driving the initiative	Adaptation to future climate Response to current climate Mitigation of climate change
Good practice	Prioritising adaptation Internal collaboration External collaboration Outsourcing research Sound evidence base Raising awareness internally Public engagement

Summary

In 2008, the City of Toronto became one of the first cities in Canada to develop a comprehensive climate change adaptation strategy. The document, titled *Ahead of the Storm*, details a number of short and long-term actions to adapt Toronto to projected more frequent and more severe heatwaves and flooding. The Strategy highlights the importance of investment in storm water management and in parks and urban forests. The implementation of the actions in the strategy is still at an early stage, and this case study focuses on the process of developing the strategy by the local authorities in Toronto. This included the formation of an inter-departmental Adaptation Steering Group, raising awareness among staff, development of short and long-term adaptation strategies, extensive public consultation, and inclusion of the adaptive actions in budgets of the relevant departments of the City.

Case study location

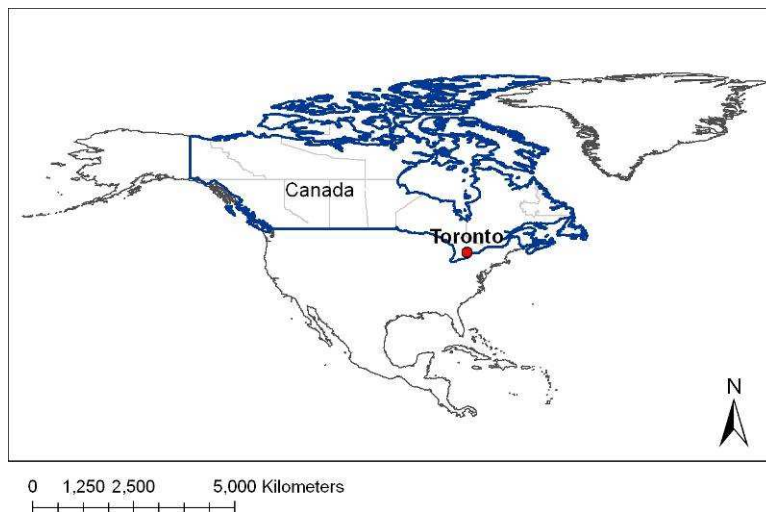


Figure 1. Location of Toronto in Canada.

Toronto is situated on the north-western shore of Lake Ontario, the smallest of North America's Great Lakes. It is Canada's largest city, with approximately 2.7 million inhabitants in an urban region of more than 5 million people. Toronto is the capital of the province of Ontario ⁽¹⁾.

Toronto has a continental climate with cool winters and hot summers. The climate is moderated by Lake Ontario to the point of Toronto's climate being one of the mildest in Canada. The daily mean temperature for July is 22.1°C, with the extreme maximum recorded of 40.6°C (1961-1990) ⁽²⁾.

The effects of climate change are already being seen in Toronto. In the last decade, the City has been exposed to extreme heat, floods, drought, new insect pests and new vector-borne diseases ⁽³⁾. In 2005, more than 150mm of rain fell over a three-hour storm in some areas of the city. The

storm caused flash flooding, which damaged a major road, flooded over 4200 basements and caused damage to property estimated as up to \$500 million (the most expensive storm in Toronto’s history). The same summer was the hottest on record: 41 days exceeded the maximum temperature of 30°C ⁽⁴⁾. Heat waves currently contribute to an average of 120 deaths per year. The projections for the future include hotter and drier summers (Figure 2). It is predicted that heat-related illnesses and deaths in Toronto will double by 2050s and treble by 2080s if no adaptive actions are taken ⁽⁵⁾.

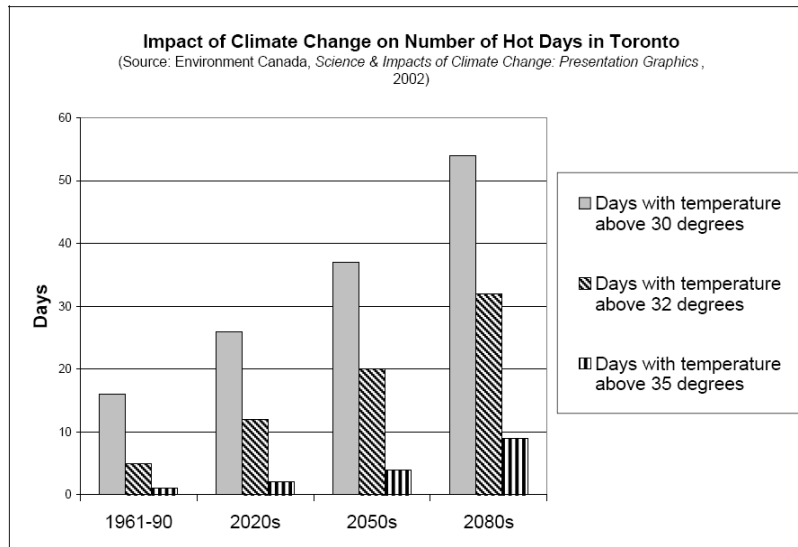


Figure 2. Projected increase in a number of hot days in summer in Toronto ⁽³⁾

Development of the initiative

Key aims

The City of Toronto is one of the first Canadian cities to establish a citywide process to respond to its vulnerability to climate change and develop a climate change adaptation plan - *Ahead of the Storm* (Figure 3) ⁽⁴⁾. The goals of the document are to:

- Provide a rationale for incorporating adaptation to climate change into City of Toronto policies, programs and activities, by presenting the current climate, recent changes and future projections;
- Build on existing partnerships to engage the City urban area, including businesses, residents and other stakeholders, in actions aimed at adaptation to climate change;
- Describe programs and actions already underway in the City that provide protection from climate change;
- Suggest short-term actions to increase protection from climate change and provide other benefits to Toronto; and
- Recommend a process to systematically assess the risks to Toronto of climate



Figure 3. Title cover of “Ahead of the Storm” ⁽⁴⁾

change, prioritize areas for action, and develop strategies to reduce the impacts and protect Toronto ⁽³⁾.

The adaptation strategy emphasises actions focusing on use of green and blue spaces, such as increase of tree cover, provision of green roofs, or actions aiming at improved plant health. The strategy lists the necessary actions that need to be undertaken in the short and long term in order to progress adaptation of Toronto to climate change impacts including hotter and drier summers, and more intense precipitation events. It provides recommendations related to the organisational structures of the City Council.

Themes driving the initiative

Need for adaptation

Until recently, the City of Toronto paid greater attention to reducing greenhouse gas emissions than to local climate change impacts and the need for adaptation. This has begun to change as Toronto’s weather has become noticeably more extreme. In the last four years, Toronto has experienced the hottest and smoggiest summer in the City’s history (2005), the most intense rainfall and costliest flood (also 2005), and one of the driest summers on record (2007) followed by the wettest (2008) ⁽¹⁾.

Climate Change Action Plan mandate

The *Climate Change, Clean Air and Sustainable Energy Action Plan* outlining the actions aimed at mitigation of climate change was adopted unanimously by the City Council in July 2007. The Plan also provided a mandate for an adaptation strategy to be developed ⁽⁶⁾. Urban green and blue spaces have been identified to simultaneously contribute to mitigation and adaptation to climate change (Figure 4).

TORONTO'S CLIMATE CHANGE AGENDA INCLUDES TWO BROAD AND COMPLEMENTARY STRATEGIES: MITIGATION AND ADAPTATION

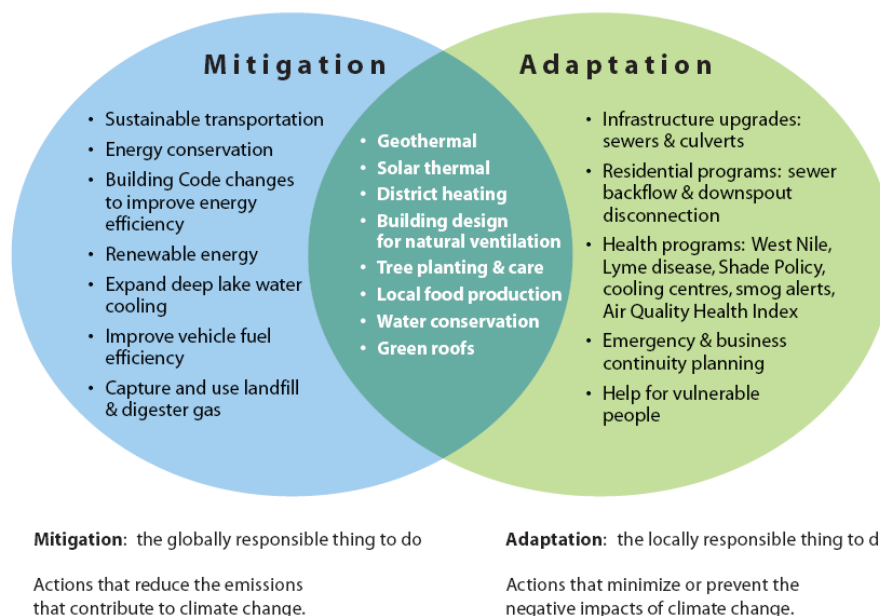


Figure 4. Green spaces as means to both mitigate and adapt to climate change ⁽⁴⁾

Existing initiatives aiming at enhancement of green spaces

A number of existing initiatives related to green and blue spaces reinforce their importance in the adaptation strategy ⁽³⁾:

- Green Roof Pilot Incentive Program, which provides incentives for green roofs to be installed on new or renovated buildings;
- Green Development Standard, which sets performance targets for the design and construction of new developments in Toronto. Amongst other things this aims to reduce stormwater runoff and enhance neighbourhood green space;

- A commitment to double the tree canopy in the City of Toronto to increase shade, reduce the urban heat island effect and reduce runoff;
- Green Parking Lots: draft design guidelines for greening surface parking lots to reduce heat and runoff, prepared by City Planning and pilot projects.

Details of the initiative

Ahead of the Storm proposed a number of short-term actions (for 2008-2009) that could help address current and future climate impacts. Those related to green and blue spaces are as follows ⁽³⁾:

- Live Green Toronto: Direct engagement of communities in greening projects (carried out by Toronto Environment Office and Parks, Forestry and Recreation Department).
- Analysis of when and where green roofs could be required, which will support recommendations for a new Green Roof by-law (City Planning).
- Development of new requirements for the Green Development Standard (City Planning).
- Urban Heat Island research, which aims to identify Toronto's "hotspots", what causes them, and how planning strategies can reduce them (City Planning and Clean Air Partnership).

These adaptation actions were supplemented by activities recommended by individual divisions within the City of Toronto:

- Increase street tree planting (Transportation Services; City Planning; Parks, Forestry and Recreation).
- Expand parkland naturalisation and naturalisation of lands surrounding water and waste water facilities (Parks, Forestry and Recreation; Toronto water; TRCA).
- Increase enforcement of tree protection and planting requirements for private lands during development review, to increase the overall canopy cover (Parks, Forestry and Recreation; City Planning).
- Expand the Integrated Plant Health Care Programme and increase systematic tree pruning services to improve health of plants and trees (Parks, Forestry and Recreation).
- Introduce a new standard for supporting healthy tree growth by continuous soil trench systems in commercial areas. This aims to increase the life of trees from 6 years to 35 years, and consequently increasing shading and cooling (Parks, Forestry and Recreation; City Planning).
- Expand pools, cooling and misting stations to provide summer heat escape locations for City dwellers and residents (Parks, Forestry and Recreation and TRCA).

It was emphasised by the City of Toronto that divisions and agencies that have identified and proposed short term adaptation actions should make the business case for implementing these actions and seek the appropriate approvals to ensure implementation.

However, these short-term actions form only a part of the Strategy, and the emphasis is on development of a comprehensive long-term adaptation strategy. This is to be achieved by completing nine steps. Each of the steps includes several recommended actions ⁽³⁾. A timeline between 2009 and 2011 for carrying out these steps has been developed. The steps are as follows:

Step 1: Create the internal mechanisms and processes for development of a comprehensive adaptation strategy

- Establish a mechanism to secure ongoing **leadership** from City Council and **championship** among senior managers; ensure that the city's leaders are regularly updated about climate change impacts and adaptation planning; make climate change a **key mandate** of the environment department team and commit to **coordination** of climate change planning across the city's agencies, departments and other units to ensure efficient and effective implementation.

- Ensure appropriate **staff time allocations** in the departments likely to be significantly affected by climate change to assess the impacts and review the adaptation options.
- Develop a **comprehensive funding strategy** for the city's climate change adaptation initiatives.
- Establish a city-wide **Adaptation Steering Group** with a formal mandate, work plan, responsibilities and regular reporting mechanism, including representatives of all sectors that are likely to be affected by climate change.
- Create **issue-based adaptation working groups** in areas that are already experiencing impacts from extreme weather, or at are high risk of impacts.
- Increase the **adaptation capacity of City staff** by awareness-raising activities, engagement in studies on climate change impacts on specific city services and infrastructure, and identification of training needs and opportunities.
- Mobilise **existing expertise**, including the national and regional government agencies and local university researchers, by establishing mechanisms for regular communications and consultations and promotion of the formation of an urban climate change research group to facilitate needed climate change research.
- **Collaborate with adaptation networks and programmes** (regional, national and international), including networks of cities that are developing adaptation strategies, regional initiatives or national associations conducting research and developing guidelines to plan for climate change.

Step 2: Engage the public, business and other stakeholder groups

- **Develop and implement an awareness and engagement strategy**, including: a website with up-to-date information on climate change and its impacts on the city, on the City's strategy, and what residents and businesses could do to protect themselves; public meetings to discuss climate change impacts and proposed adaptation strategies; collaboration with organizations that support vulnerable people in Toronto to make and implement plans that reduce their risks and support for community groups to take adaptive actions.
- **Work with local business leaders and associations** to discuss climate change impacts, strategies and possibilities for long-term cooperation on climate change adaptation.

Step 3: Incorporate climate change adaptation into City policies and high level plans

Particular policies and plans to target should include, for example, spatial plans, green space strategies, emergency response plans, and economic development strategies.

Step 4: Analyze how climate is changing locally and what the future is likely to bring

Undertake research to analyse key historical climate trends in the Toronto region, produce downscaled climate projections and case studies of recent key climate events that provide local climate data and practical information on climate change and its local impacts.

Step 5: Develop a city-wide inventory of climate vulnerabilities and risks

This should include an assessment of vulnerability associated with people's health, infrastructure, physical and natural environment of the city, and the cost to the economy.

Step 6: Conduct a risk assessment to prioritize impacts for action.

This should include assessment of the probability of the impact's occurrence and the severity of impact, and evaluation of the severity of an impact on the physical and natural environment of the city, the health and well-being of Toronto's citizens, and costs to the economy.

Step 7: Identify and assess adaptation options

For high priority risks, identify and evaluate a range of adaptation options that could reduce vulnerability to specific climate change impacts, and that could be implemented in a comprehensive adaptation strategy. Box 1 shows recommended examples of green and blue space adaptation options.

Step 8: Develop and implement detailed climate change adaptation strategies

It was observed that the City will need to **develop clear criteria** for choosing among identified options and developing adaptation strategies. These criteria could include:

- The effectiveness of the adaptation action in protecting vulnerable populations;
- The extent to which proposed adaptation options protect against loss of life or major economic losses;
- Whether the adaptation option reduces stress on vulnerable systems;
- The cost of the adaptive action compared to the cost of alternative strategies, or the potential cost of not acting;
- The extent to which adaptation options also reduce greenhouse gas emissions or provide other benefits that increase the sustainability and liveability of the City.

Also, in creating its adaptation strategy, the City can build on a number of existing programs such as the Heat Alert and Hot Weather Response system and the Wet Weather Flow Master Plan; programmes which are designed to protect the City from the current weather extremes or those aimed primarily at climate change mitigation.

Box 1. Selected green and blue space adaptation options for Toronto ⁽³⁾

Stormwater and flooding:

- Expand the implementation of sustainable urban drainage systems including permeable pavements, green roofs, stormwater retention ponds, constructed wetlands and swales.
- Create natural eco-system buffers for vulnerable water bodies and low-lying areas.

Energy supply:

- Increase street tree planning and maintenance, green roofs and high-albedo surfaces to reduce urban heat and unsustainable energy demand for air conditioning.

Urban ecosystems:

- Protect existing ecosystems and develop connected greenway system to allow natural species migration.
- Create and preserve green spaces in low-lying areas for flood management.
- Increase shoreline buffers to protect against increased runoff from more intense storms.
- Enhance conditions for street tree survival and growth.
- Monitor and control pests and invasive species that can expand with warmer winters.

Health:

- Interventions to reduce heat island effects including street tree planting, green roofs, high albedo roof and road surfaces.

Step 9: Monitor and measure progress.

Formal mechanism for periodic review of progress on climate change adaptation should be established. The progress of the implementation of the plan should be communicated to decision-makers and the public.

Implementing the initiative

The process started in September 2007, and on July 2008 the Toronto City Council unanimously adopted "Ahead of the Storm", as a climate change adaptation strategy for the City. This builds on existing programs that provide protection from current weather extremes. It includes a commitment to short term actions, as well as a longer term process for developing a comprehensive strategy. Currently, Toronto is at the early stages of implementing the strategy ⁽¹⁾.

The Toronto Environment Office established a **cross-departmental Adaptation Steering Group**, including representatives of policy and programme staff from 14 City divisions and agencies. The Steering Group is chaired and supported by the Toronto Environment Office and provides updates to the Executive Environment Team ⁽³⁾.

Whilst some individuals involved in the process expressed concerns regarding the scientific basis of climate change, additional workload and cost of adopted measures, a strong steer from the Deputy City Manager's office ensured that the group worked together ⁽¹⁾.

Many members of the Adaptation Steering Group had little experience in assessing climate change impacts and planning to adapt to them. To raise the awareness, the following actions were undertaken ⁽¹⁾:

- Compiling information about what other municipalities were doing on the issue;
- Encouraging attendance at workshops and conferences to increase familiarity with concepts and issues relating to climate change impacts and adaptation;
- Participating in the regular webinars of the new Canadian Alliance for Resilient Cities as well as meetings of its U.S. counterpart, the Urban Leaders Adaptation Initiative; and
- Organizing meetings with the Climate Change Scenarios Network, the Public Infrastructure Engineering Vulnerability Committee, the Canadian Institute of Planners, and others to help the City with thinking about climate change scenario modelling, infrastructure risk assessment and other issues.

The group met weekly between September 2007 and April 2008 and jointly prepared a broad adaptation strategy. When the first draft was completed, fourteen City departments made detailed and, in many cases, contradictory recommendations, which had to be considered in reworking the document. The outcomes of the process were included in the framework document (*Ahead of the Storm*) and a summary report for wider distribution, which were subject to public consultations ⁽¹⁾. The adoption of the adaptation strategy means that the Council is now committed to:

- Incorporate explicit goals for adaptation of infrastructure and buildings into Toronto's Official Plan (up for review in 2010), which guides all land-use planning and development for the City. This will ensure that climate change impacts are taken into account in all new developments and major redevelopments;
- Incorporate climate change into planning of all City agencies and divisions and identify in the 2009 budget submissions for specific short-term actions;
- Investigate a funding strategy for climate change adaptation;
- Establish a process for the development of a long-term, detailed and comprehensive adaptation Strategy;
- Establish an Urban Climate Change Network to support co-operation, among governments, universities, colleges and non-governmental organizations ⁽¹⁾.

Building the evidence base

Due to lack of specific information related to climate change projections for the City of Toronto, *Ahead of the Storm* and the actions included in the strategy are not based on climate change data. However, *Ahead of the Storm* recommended a number of short-term actions targeted at increasing knowledge about climate change impacts and adaptation responses. Completion of the study of recent climate trends and future climate projections for the region carried out by the Toronto Environment Office will help to establish specific adaptation targets for the new or expanded programmes produced by the City of Toronto divisions. The information collection actions included:

- Future climate prediction modelling that would improve the information on expected climate extremes and gradual changes to permit better decision-making on adaptation planning;
- Assessments of climate change vulnerability and risk assessment of City operations, to prioritise needs for adaptation actions based on consideration of highest vulnerability and risk;
- Development of regional extreme precipitation intensity, duration and frequency curves to improve ability to design storm drainage infrastructure for extreme runoff events;
- Scan of methods used in other areas for assessing vulnerability of the population to heat ⁽³⁾.

Monitoring and evaluation

Monitoring arrangements were not included in the adaptation strategy. However, it was observed that periodic assessment of the progress that Toronto makes in preparing for climate change is necessary. It was recommended that this assessment should focus on the following:

- Level of public, staff and stakeholder awareness about climate change and its impacts and support for actions to protect against climate change;
- Vitality and perseverance of collaboration between the City, its communities, researchers, non-governmental organizations and other levels of government on addressing climate change issues;
- Technical capacity to assess the risks of climate change;
- The extent to which climate change considerations have been incorporated into high level policies, plans and practical programs in priority impact areas;
- The extent to which climate change adaptation strategies reduce stress on vulnerable systems;
- The effectiveness of implemented adaptation strategies in extreme weather events.

Sources of funding

In January 2009, the City created an Environmental Protection Reserve Fund for the purpose of funding the development of Toronto's long-term adaptation strategy, the operating budget for the Toronto Environment Office and Energy Efficiency Office, and for projects such as Deep Lake Water cooling and expanding the tree canopy. For 2009, the City committed \$500,000 from this fund for the climate and risk assessment studies.

The Parks, Forestry and Recreation Division successfully appealed to the City for extra funds to expand the maintenance of existing trees, increase tree planting and to support research into effective ways of improving the health and growth of urban trees and increasing the tree canopy.

The Toronto Environment Office budgeted funds in 2008 for predictive computer modelling of the Toronto area's climate, which will provide decision makers with better information on future severe weather scenarios. Budget was also available in 2008 to obtain expert assistance in vulnerability and risk assessment. Additional funds may be necessary in the future to identify the costs and benefits of effective adaptation strategies, and other investigative tasks recommended in this report. Funds will also be needed for expanding activities and programs that reduce the impacts of extreme weather such as heat waves, intense rainfall and droughts ⁽³⁾.

Stakeholder engagement

Collaboration with key stakeholders

The Clean Air Partnership (CAP), a local non-governmental organisation, played a crucial role in emphasising the need for including adaptation in climate change action plans produced by the Council. CAP had published *A Scan of Climate Change Impacts on Toronto* in 2006, and met individually with the Mayor and many City Councillors to discuss the need to adapt to avoid the worst impacts. CAP also hosted two workshops for City of Toronto staff on the issue. As a consequence, the City incorporated a commitment to investigate Toronto's vulnerability to climate change in *Change is in the Air*⁽⁸⁾, the City's climate change plan.

Working with stakeholders was crucial to developing the adaptation action plan. The following stakeholder collaboration was undertaken by the CAP:

- Established an Expert Panel of leading local scientists and policy thinkers to obtain ideas from experts on the topic of climate change adaptation. The first meeting was primarily for City staff, and the second was convened at a Special Meeting of the Parks and Environment Committee in January 2008. Over 150 people attended this public event⁽⁷⁾.
- Met with Environment Canada, Institute for Catastrophic Loss Reduction, Engineers Canada, Canadian Institute of Planners to learn about climate change scenarios, infrastructure risk assessment, integrating adaptation into spatial planning and other issues;
- Joined the Alliance for Resilient Cities network of Canadian cities & the U.S. Urban Leaders Adaptation Initiative to exchange information & ideas with peers in other cities;
- Held internal meetings with key City divisions to discuss expected impacts on their operations, describe what other cities are doing, and initiate discussions about adaptation planning;
- Hosted internal & public events to present and discuss issues and plans with political officials, staff, the public and the media⁽¹⁾
- The Environment Office set up the Toronto Urban Climate Change Network (TUCCN; <http://www.tuccn.org/index.php>) to support co-operation, among 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. One of the first activities of the Network was to organize the *Forum on Infrastructure and Climate Change Adaptation* in April 2009, designed to promote the integration of climate change considerations into urban infrastructure projects. A large number of City staff attended this forum and participated actively in its discussions and deliberations.

Engaging the public

The Toronto Environment Office held six meetings to consult the public and stakeholders on *Ahead of the Storm*. Each of the meetings began with a presentation of the main issues and recommendations from the document. Attendees were then invited to discuss the impacts they felt were key, any gaps they saw in the City's analysis and action the City should take.

Many of the participants at the consultation meetings struggled with the concept of climate change adaptation. They were much more familiar with – and many were more committed to – mitigation measures to reduce greenhouse gas emissions than adaptation. Business representatives were quick to understand some of the potential impacts of climate change, since several had experienced the adverse economic effects of power outages, floods and other results of extreme weather. As a result, business groups had a strong focus on emergency response issues. All the meetings recommended that the City should increase and broaden education programs to make Torontonians aware of the threats of climate change, and about potential adaptation solutions⁽¹⁾.

The public was invited to comment on the Strategy via scheduled public meetings (details provided on the City of Toronto website); submitting written comments by email and mail; calling the 24-

hour comment line for the City of Toronto Climate Change Adaptation project; or providing a personal input to the Parks and Environment Committee on a given date ⁽⁴⁾.

Capacity building in the community is one of the main action streams in the adaptation strategy. This includes development and implementation of a further public and stakeholder engagement strategy, including creating a website outlining the climate change impacts and adaptation, organising public meetings to discuss adaptation strategies as they develop, and support community and neighbourhood groups taking adaptation actions through Live Green Toronto website (<http://www.toronto.ca/livegreen/index.htm>). Work will be undertaken to collaborate with organisations that support vulnerable populations in Toronto to make and implement plans that reduce their risks to climate impacts, and with local business leaders and associations to discuss climate impacts, strategies and possibilities for long-term cooperation on climate change adaptation.

Political buy-in

Following the public consultations the Toronto Environment Office prepared a Staff Report on a *Climate Change Adaptation Strategy* with recommendations for Council ⁽⁷⁾. The report was adopted unanimously by Council on July 15, 2008.

Can it have an impact?

The City has shown considerable leadership in acknowledging the need for adaptation and taking early action. Also, there are existing projects and initiatives that have the potential to provide a springboard for future adaptation responses. However, this array of current projects and activities is not yet welded together into a detailed long-term strategy, and there are both internal and external barriers to the development and implementation of such a strategy. These barriers include ⁽¹⁾:

- **Uncertainty about future climate change and impacts.** It is hard to get decision-makers to commit to what could be expensive and long-term adaptation projects and retrofits when they are not yet convinced about the extent and the timeline of expected changes to the climate. This will be addressed by the two research projects on future climate impacts commissioned by the Toronto Environment Office.
- **Limited staff and lack of organisational structures.** While the City has dozens of staff working on projects and programs related to climate change mitigation, there is only one staff member whose primary work is adaptation ⁽³⁾. Toronto's Adaptation Steering Group worked as an ad hoc group without a clear mandate, targets, or regular meeting schedule. Activity by the group as a whole diminished after City Council adopted the Climate Change Adaptation Strategy, at a time when the hard work of implementing an integrated strategy needed sustained attention.
- **Financial resources.** Toronto has a major infrastructure deficit stemming from cutbacks in spending by governments at all levels during the previous two decades. While the need to replace infrastructure may be regarded as an opportunity for incorporating adaptation options, existing funding is inadequate: either lacking or requiring quick solutions to problems, which is likely to reduce the integration of climate change adaptation measures in the projects.

Despite these challenges, it is important to recognize the leadership that Toronto has shown as one of the first urban centres in Canada to acknowledge the need for climate change adaptation and to take substantive action to tackle the problem. Toronto has made significant headway in the development and implementation of climate change adaptation plans and activities. It will be important for the City to maintain focus and momentum in order to weld together a coordinated and comprehensive strategy out of the array of activities on which it has embarked, to protect its citizens from the impacts of climate change ⁽¹⁾.

Key messages

- Setting up an inter-departmental Adaptation Steering Group was crucial to the success of the project.
- Involvement of staff in seminars, conferences, and other events was a successful strategy to raise awareness and gain acceptance for the project.
- Cross-cutting character of climate change adaptation was captured in the requirement for all the relevant departments to include climate change adaptation in their actions.
- The requirement for divisions to specifically address mitigation and adaptation in their budget submissions is a major step forward in mainstreaming adaptation thinking and action.
- Adaptation in Toronto will require continued engagement, institutional commitment, creative thinking, and funding ⁽¹⁾.

Contact organisation

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