



## STAFF REPORT ACTION REQUIRED

### Climate Change Adaptation Strategy

<b>Date:</b>	May 13, 2008
<b>To:</b>	Executive Committee
<b>From:</b>	Lawson Oates, Director, Toronto Environment Office
<b>Wards:</b>	All
<b>Reference Number:</b>	P:\2008\Cluster B\TEO\EX08005

#### SUMMARY

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In July 2007 Toronto City Council unanimously adopted the Climate Change, Clean Air and Sustainable Energy Action Plan (the “Climate Change Action Plan”). The central focus of the plan is the reduction of greenhouse gases released to the atmosphere by curbing the burning of fossil fuels to help fight global warming.

The Climate Change Action Plan includes many commitments including: energy conservation and efficiency measures; increased use of renewable energy sources such as wind and solar; sustainable transportation practices, such as increased public transit through new streetcar lines; doubling the tree canopy; and promoting the purchase of food grown locally to reduce the distance that our food travels from the field to our kitchen tables. Activities like these, whose primary goal is to reduce greenhouse gas emissions, are referred to as climate change “mitigation”.

In adopting the Climate Change Action Plan, City Council also directed that a plan be established to reduce the negative impacts of unavoidable changes to climate that are already underway, including: extreme heat; more intense storms; floods and droughts; damaging insects; and newly introduced diseases. Activities intended to reduce the effects of unavoidable climate change are referred to as climate change “adaptation”.

Climate change involves a long-lasting shift in weather patterns. Our infrastructure and buildings will need to withstand weather that is different from the past. In addition, climate change has the potential to significantly affect many civic programs and services such as public health, water supply, storm water management and urban parks, forests and ecosystems. Special attention will be required for isolated seniors, the homeless and others who are particularly vulnerable to extreme weather.

This staff report responds to Council's direction that a climate change adaptation strategy be developed. It is intended to lay the foundation for a comprehensive climate change adaptation strategy, which will strive to prevent or minimize the negative effects of unavoidable climate change and take advantage of potential opportunities.

In keeping with the direction of the Climate Change Action Plan, the adaptation strategy is aimed at both City services and the larger Toronto community. It is designed to help protect the health of Torontonians, introduce measures to strengthen our infrastructure and building stock, help protect the natural environment from the negative effects of climate change, and support a resilient economy.

## **RECOMMENDATIONS**

The Director of the Toronto Environment Office recommends that:

1. in order to adapt to the long-lasting change in weather patterns due to climate change, City Council direct that climate change mitigation measures and explicit goals for adaptation of infrastructure and buildings be incorporated into Toronto's Official Plan and request that the Chief Planner report on the amendments appropriate to the Official Plan incorporating such measures;
2. City Agencies, Boards, Commissions, Corporations and Divisions likely to be strongly affected by climate change also be requested to incorporate climate change mitigation measures and explicit goals for adaptation in their plans, programs, strategies and assessment procedures;
3. City Council request all City Agencies, Boards, Commissions, Corporations and Divisions to incorporate climate change concerns into planning for 2009, and identify in their 2009 budget submissions specific actions and programs they plan to undertake regarding climate change mitigation and adaptation, including, but not limited to the Council direction provided through the adoption of the Climate Change, Clean Air and Sustainable Energy Action Plan;
4. the Deputy City Manager and Chief Financial Officer report back on a funding strategy for climate change adaptation planning and actions, including the creation of an Extreme Weather Reserve, the purpose of which is to mitigate the expenditure impacts arising from extreme weather conditions by providing funding at the end of the year to offset wholly or partly a budget shortfall resulting from unbudgeted and uninsured extreme weather-related costs incurred during the year;
5. the Director of the Toronto Environment Office support the work of the Deputy City Manager and Chief Financial Officer cited above in Recommendation No. 4, by establishing, in consultation with the Climate Change Adaptation Steering Group, a methodology to prioritize short-term Climate Change Adaptation actions recommended by City Divisions prior to the 2009 Budget Cycle process;

6. the Director of the Toronto Environment Office establish a process for the development of a longer-term, comprehensive adaptation strategy, that: identifies key vulnerabilities to climate change of the City, 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, City Council authorize the Director of the Toronto Environment Office to co-ordinate City staff participation in the establishment and development of the proposed Urban Climate Change Network.

## **Financial Impact**

There are financial impacts associated with the adoption of the recommendations in this report. Potential Short-term Climate Adaptation Actions recommended by City Divisions, outlined in Appendix C, represent significant costs to the City. A methodology will be required to prioritize the list of Potential Short-term Climate Adaptation Actions recommended by City Divisions. City Agencies, Boards, Commissions, Corporations and Divisions will report out through the 2009 Budget cycle process on financial impacts of climate change mitigation and adaptation measures.

The Deputy City Manager and Chief Financial Officer will report out on the establishment of an Extreme Weather Reserve through the 2009 budget process.

The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information.

## **DECISION HISTORY**

In July 2007, Council unanimously adopted the “Climate Change, Clean Air and Sustainable Energy Action Plan, dated June 13, 2007 (the “Climate Change Action Plan”). It is summarized in a Highlights document, “Change is in the Air, date June 2007 which is found at: [http://www.toronto.ca/changeisintheair/pdf/clean\\_air\\_action\\_plan.pdf](http://www.toronto.ca/changeisintheair/pdf/clean_air_action_plan.pdf).

The Climate Change Action Plan directs,

*“The Director of the Toronto Environment Office, in consultation with the Medical Officer of Health, to complete “a process that engages all relevant City Divisions and*

*Agency, Boards, Commissions and Corporations and community partners in order to prepare a report to the Executive Committee that:*

- i. identifies the components of a climate change adaptation strategy for City operations and the community;*
- ii. includes the actions steps required to develop a climate change adaptation strategy including project budget costs;*
- iii. ensures the strategy will incorporate the response mechanisms required to meet identified environmental changes including health related impacts, such as the heat alert response program;*
- iv. identifies the requirements for data collection and management and modelling; and*
- v. incorporates stakeholders input.”*

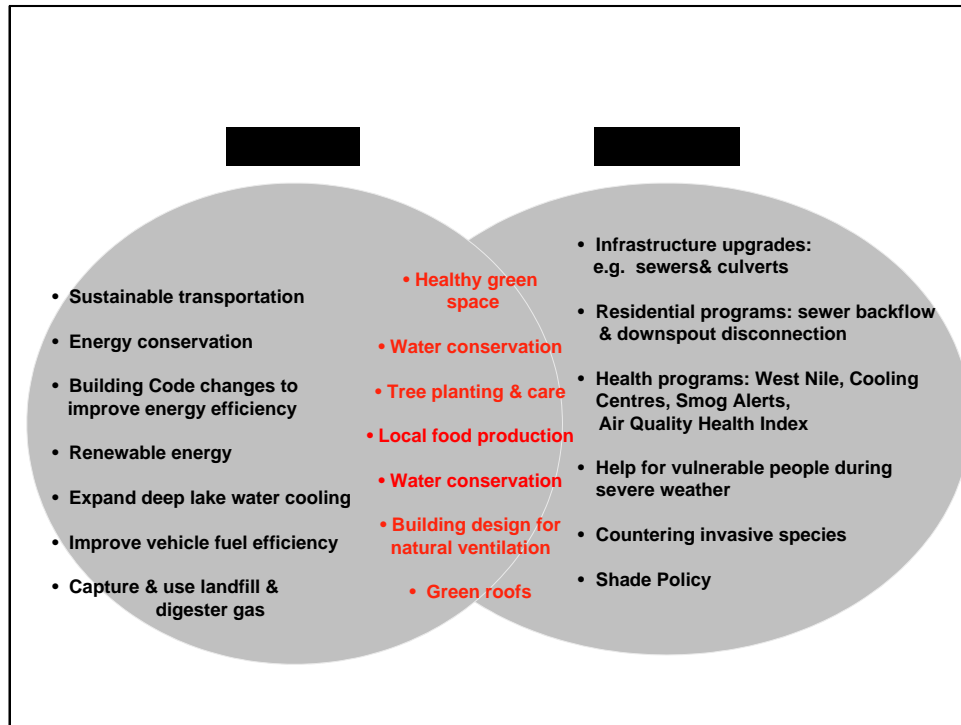
This report responds to the directions provided by City Council.

## **ISSUE BACKGROUND**

### **Complementary Strategies: Mitigation and Adaptation**

Toronto’s Climate Change agenda includes two broad complementary strategies: mitigation and adaptation. Mitigation has been called “the globally responsible thing to do.” It focuses on actions that reduce the greenhouse gas emissions that contribute to climate change. Adaptation has been called “the locally responsible thing to do”. It focuses on actions that minimize or prevent the negative impacts of unavoidable climate change.

In many cases, actions to support mitigation also support adaptation. This is illustrated in the following Venn diagram, which shows a sample of actions that reduce emissions and at the same time reduce climate change impacts such as heat waves or intense storms.



Mitigation: the globally responsible thing to do. Actions that reduce the emissions that contribute to climate change.

Adaptation: the locally responsible thing to do. Action that minimize or prevent the negative impacts of climate change.

## COMMENTS

### Formation of Climate Change Adaptation Steering Group

In order to facilitate and co-ordinate the development of a climate change adaptation strategy, the Director of the Toronto Environment Office facilitated the formation of the Climate Change Adaptation Steering Group, with representation from the following invited corporate bodies:

- Toronto Water
- Communications, PPFA
- Economic Development
- Corporate Financial Strategies (Corporate Finance)
- Facilities & Real Estate
- Parks, Forestry and Recreation
- Planning
- Public Consultation, PPFA
- Social Development
- Insurance & Risk Management (Corporate Finance)
- Toronto & Region Conservation Authority
- Toronto Building
- Toronto Public Health
- Clean Air Partnership
- Transportation Services
- Toronto Environment Office
- Office of Emergency Management

The Steering Group is chaired and supported by the Toronto Environment Office and provides updates to the Executive Environment Team, Chaired by Deputy City Manager Richard Butts.

The Steering Group is in the process of establishing formal terms of reference and expanding its membership. To enhance the work of the Steering Group, a number of administrative steps will be taken, including:

- formalizing the Steering Group’s working relationship to the Executive Environment Team;
- participation in climate change adaptation networks and collaboration with the Federal and Provincial governments, other municipalities and non-governmental organizations that can provide useful new knowledge, research, and potential funding opportunities that support Toronto’s adaptation strategy development and implementation;
- support for the establishment or enhancement of adaptation working groups in the fields of water, health, infrastructure, building stock, energy, economy and urban ecosystems (parks/forestry/green space);
- identification of climate change adaptation training needs and opportunities for City staff;
- development of a communications plan and in-reach activities such as workshops, ‘webinars’ and electronic communications to increase the awareness and knowledge of management and front-line City staff concerning climate change adaptation;
- creation of a City website that contains general interest information concerning climate change and adaptation, available resource materials in the form of a Municipal Climate Change Adaptation Reference Collection, key City climate

change documents, such as the Climate Change Action Plan and the associated summary document *Change is in the Air*, and the public engagement document *Ahead of the Storm*, which addresses climate change adaptation.

## **Ahead of the Storm**

The Climate Change Adaptation Steering Group was instrumental in the design and content of the document titled “Ahead of the Storm – Preparing Toronto for Climate Change”. This document is designed to help members of the public and other stakeholders think about and engage in the process of designing and implementing a climate change adaptation strategy for Toronto.

The forty-five page full *Ahead of the Storm* document is available at [http://www.toronto.ca/teo/pdf/ahead\\_of\\_the\\_storm.pdf](http://www.toronto.ca/teo/pdf/ahead_of_the_storm.pdf).

A highlights version is available at [http://www.toronto.ca/teo/pdf/ahead\\_of\\_the\\_storm\\_highlights.pdf](http://www.toronto.ca/teo/pdf/ahead_of_the_storm_highlights.pdf).

Included in the body of *Ahead of the Storm* are: (i) climate change adaptation measures that the City is already doing; (ii) planned short-term climate change adaptation actions; and (iii) potential short-term climate change adaptation actions; and (iv) a process for development of a longer-term, more comprehensive adaptation strategy. These components are summarized below, with details provided in the appendices.

## **What Toronto is Already Doing**

The City has a number of current programs that help Toronto adapt to climate change. These include the *Wet Weather Flow Master Plan*, which is designed to reduce the potential of flooding from more intense rainfall, deep lake water cooling, which cools downtown buildings without stressing the electrical distribution system, and *Public Health’s Hot Weather Response Plan*, designed to reduce the impact of heat waves on Toronto’s vulnerable populations.

Many of these programs not only help to protect Torontonians from the impacts of climate change, but they also increase the overall liveability and sustainability of the city. Examples of other existing programs that contribute to climate change adaptation programs are outlined in Appendix A.

## **Planned Short-term Climate Change Adaptation Actions**

The City is undertaking a series of short-term actions that build on existing programs that will enhance climate change adaptation. Upgrades to trunk sewers controlling combined sewer overflows will reduce the impacts of intense rainstorms, for example. Revisions to

the Green Development Standard to incorporate future climate conditions, will promote the resilience of Toronto's built form. A list of short term climate adaptation actions planned for this year is attached as Appendix B.

### **Potential Short-term Climate Change Adaptation Actions**

In addition to adaptation actions that are already in progress, City Divisions and other corporate bodies have recommended a number of actions that could enhance existing programs and services and increase Toronto's resilience to climate change. A list of these potential short-term actions, such as developing species recovery areas, eliminating new reverse slope driveways and supporting implementation of green roofs and rainwater harvesting systems, is attached as Appendix C.

### **Developing a Longer-term Adaptation Process**

While a number of short-term actions can help reduce Toronto's vulnerability to climate change, the City also needs to develop a comprehensive longer term adaptation strategy that addresses problems that climate change presents for long-lived infrastructure and long-term planning. This larger strategy needs to incorporate up-to-date climate science and rapidly-developing knowledge about the most effective ways to reduce climate impacts. Because climate change will touch so many City operations and services, it will be important to prioritize areas for action. The development and implementation of a comprehensive adaptation strategy should involve the following steps:

1. Create the internal mechanisms and processes for a longer term adaptation process;
2. Engage the public, business and other stakeholder groups;
3. Incorporate climate change adaptation into city policies and high level plans;
4. Use best available science to analyze how climate is changing locally and what the future is likely to bring;
5. Use this information to identify Toronto's vulnerabilities to climate change;
6. Conduct a risk assessment to identify priority impacts requiring adaptation action;
7. Identify and assess adaptation options to reduce the risk;
8. Develop and implement climate change adaptation strategies; and
9. Monitor climate change, evaluate the effectiveness of adaptation initiatives in protecting the City from continuing changes, and adjust strategies when necessary.

### **A Collaborative Approach to Climate Change Adaptation**

The Toronto Environment Office is collaborating on climate change issues with corporate bodies through the Steering Group. Given the magnitude of predicted climate change impacts, the establishment or enhancement of working groups is viewed as important for tackling climate change issues related to City operations. The Toronto Environment Office will be working closely with working groups as they are formed and enhanced.



For example, an existing working group in Toronto Water addresses climate change issues as they pertain to storm and waste water. Plans for a public health working group are underway. It is anticipated that this working group will incorporate planning for climate change into current Toronto Public Health initiatives including the Hot Weather Response Plan, Shade Policy, Air Quality Health Index and West Nile Virus program. The Working group will also seek to better understand anticipated health impacts of climate change and public health best practices respecting climate change and incorporate this knowledge into Toronto Public Health policies and programs, as appropriate.

Recognizing the broad implications of climate change on the City, any given climate change impact is likely to affect more than one City Agency, Board, Commission or Division. As such, it is envisioned that working groups will collaborate on common issues and impacts of concern.

### **Input from Climate Change Adaptation Experts**

The Toronto Environment Office organized two Expert Panel meetings 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. Please see Appendix D, a list of “Expert Panel Participants on Climate Change Adaptation”.

### **Proposed Urban Climate Change Network**

One Expert Panel member recommended the creation of an Urban Climate Change Network (or Centre) in Toronto. The general purpose of this group would be to support co-operation, communications and research among Federal, Provincial and Municipal governments, colleges, universities and non-governmental organizations on climate change mitigation and adaptation actions and strategies.

To this end, the Toronto Environment Office organized a meeting at Ryerson University attended by representatives from the Federal and Provincial governments, as well as representatives from the Toronto and Region Conservation Authority, the University of Toronto, York University and Ryerson University. Approximately 40 people attended. The event was facilitated by the City’s Public Consultation Unit.

The group agreed that there is a need for an organization to better co-ordinate activities relating to climate change in the Greater Toronto Area. Natural Resources Canada has announced a funding program for regional programs in support of climate change adaptation. It is possible that this funding could be used to help support the Urban Climate Change Network concept.

This report has recommended that the Director of the Toronto Environment Office coordinate City staff participation in the establishment and development of the proposed Network.

### **Public Engagement Process**

The Toronto Environment Office has endeavoured to engage public stakeholders in the development of City's climate change adaptation strategy. Appendix E provides a list of public and stakeholder engagement meetings on Toronto's Climate Adaptation Strategy.

To date, the feedback from the public and stakeholders can be summarized as follows:

- engaged members of the public are concerned about climate change impacts on the City, including the health of its citizens, economic costs and stresses on the natural environment;
- the idea of climate change adaptation is new, even to members of the public familiar with climate change and committed to climate change mitigation, and those in attendance wanted the City to provide more public information and education on climate impacts and on adaptation strategies, including personal actions that could be taken to reduce impacts and contribute to the overall sustainability of the City;
- there was considerable support for adaptation actions that reduce emissions and impacts of unavoidable climate change at the same time; and
- there is an expectation that the City will play a leadership role in the process of adapting to changing weather patterns.

### **Live Green Toronto**

The Toronto Environment Office is launching a program (subject to Council approval of selection criteria) to facilitate greening projects in neighbourhoods throughout Toronto. This program will provide facilitators and funding opportunities to address components of climate change mitigation and adaptation.

Live Green Toronto will also link to established City initiatives such as 20/20 The Way to Clean Air and Smart Commute and Zerofootprint Toronto, which help citizens reduce greenhouse gas emissions.

Examples of projects that could support climate change adaptation include: tree planting and care; natural habitat restoration to reduce climate stress on local ecosystems; neighbourhood shade/cooling projects; promotion of local food; and implementation of

neighbourhood renewable energy projects that reduce stress on the electrical supply and distribution system.

### **Proposed Extreme Weather Reserve**

Contained in this report is a recommendation to establish an Extreme Weather Reserve. Severe weather conditions such as extreme heat, extreme cold, snowstorms, high winds, thunderstorms, flooding and drought can affect a range of City programs and services including: the condition of roads, bridges and culverts; the integrity of utilities including electricity distribution; snow clearing; transit service; trees, parks and streams; water usage; street cleaning; public health and homeless shelters and services. These may have significant financial implications for the City.

Damages to property arising from extreme weather events are for the most part insurable. However, not all properties or all damages are covered by insurance policies. As an illustration, the August 19, 2005 rainstorm caused significant damage to the City's physical infrastructure, requiring an estimated total of \$44 million in multi-year operating and capital costs to repair and/or rebuild.

The amount that was recovered through the City's property insurance policy was approximately \$2 million. The remainder of the damage was to uninsured infrastructure such as roads and bridges. The physical damages at Finch Avenue West near Keele Street (burst water lines and the resulting collapsed bridge) and Edwards Garden and Highland Creek/Colonel Danforth Park (damaged bridges, footpaths and parking lots) were not insured losses.

The winter of 2007/2008 was a near-record year with respect to snowfall. Snow clearing and removal have created significant pressure on Transportation Services' Winter Maintenance budget. The severe freeze-thaw cycles have escalated the demand for pothole repairs which has put additional pressure on the budget as well. It has been estimated that there would be an over-expenditure of over \$20 million in the 2008 Winter Maintenance Operating Budget.

Severe rain storms with high winds could result in tree failures and extensive property damages. Three severe storms in 2007 (March 1, June 8 and June 19) account for the majority of more than 9,000 tree failures in the City. The cost associated with emergency response and all follow-up tree maintenance incurred in 2007 is estimated at \$6 million, and has resulted in increased service delays of approximately nine months.

As a funding option, a new stabilization reserve for extreme weather is recommended to provide funding for situations where programs incur extraordinary weather-related uninsured costs resulting in an operating deficit. Typically, a target level would be set and annual contributions would be made into the reserve from unspent program budgets, or fixed direct contributions, or a combination of both. By funding the reserve at an

appropriate level, it could be used as a stabilization mechanism to smooth out cost spikes arising from these conditions in a variety of program areas.

### **Obtaining Detailed Local Climate Change Prediction Information**

The Toronto Environment Office is working with the Toronto and Region Conservation Authority, other GTA regional governments and Environment Canada to facilitate research to:

- analyze key historical climate trends in the Toronto region;
- produce downscaled climate projections; and
- develop case studies of recent climate events that provide local climate data and practical information on climate change and its local impacts.

The work that will be undertaken will be similar to the work underway by the Region of Peel working with the Toronto Region Conservation Authority.

This research will support the process of adapting components of our infrastructure to the long-lasting changes in weather patterns.

### **SUMMARY**

The realities of climate change require us to introduce a new climate lens to assess our plans, policies and programs to ensure they are adaptive to the long-lasting changes in weather patterns brought on by climate change.

To this end, the principal recommendation of this report seeks Council direction to incorporate into the City's Official Plan climate change mitigative measures and explicit goals for adaptation, and that Agencies, Boards, Commissions, Corporations and Divisions likely to be strongly affected by climate change also incorporate climate change mitigation measures and explicit goals for adaptation in their plans, programs, strategies and assessment procedures.

Some examples of plans and programs that would be reviewed under this proposed direction, in addition to the City's Official Plan, are the Wet Weather Flow Master Plan, Green Development Standard and environmental assessments of new capital projects.

This report has also recommended that:

- City Agencies, Boards, Commissions, Corporations and Divisions identify in their 2009 budget submission specific actions and programs to undertake climate change mitigation and adaptation;
- the Deputy City Manager and Chief Financial Officer report back on a funding strategy for climate change adaptation actions and programs;

- an Extreme Weather Reserve fund be established to help manage financial pressures resulting from extreme weather events;
- a process for the development of a long-term, comprehensive adaptation strategy be established; and
- City staff participate in a proposed Urban Climate Change Network to help facilitate multi-party dialogue and research on climate change.

## **CONTACT**

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Director, Toronto Environment Office

## **ATTACHMENTS**

### Appendix A

Examples of Existing and Ongoing Toronto Programs that Help Adaptation to Climate Change

### Appendix B

Examples of Climate Adaptation Actions for 2008

### Appendix C

Potential Short-term Climate Change Adaptation Actions

### Appendix D

Expert Panel Participants on Climate Change Adaptation

### Appendix E

Public and Stakeholder Engagement Meetings on Toronto's Climate Adaptation Strategy

**Examples of Existing and Ongoing Toronto Programs that Help Adaptation 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 with planning for the future.
- **The Wet Weather Flow Master Plan.** This 25-year implementation plan is designed to reduce flooding from intense rainfall, and water quality and erosion impacts on streams and lake water. Toronto Water is using information from the August 19, 2005 storm to guide its implementation of 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.** Part of the City’s Green Roof Strategy, “Making Green Roofs Happen”, this program provides an incentive for green roofs to be installed on new or renovated Toronto buildings. Green roofs capture and retain storm water and they also cool the buildings on which they grow.
- **A Commitment to Double the Tree Canopy.** Parks, Forestry and Recreation (PFR) is undertaking a major study of canopy potential and associated implementation strategy with Planning & Transportation Services. PFR is actively planting new forests and maintaining and protecting existing ones. 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 Deep Lake Water Cooling (Enwave), Peaksaver and Keep Cool Programs (Toronto Hydro).** These and several other innovative programs that conserve energy, reduce peak electricity demand on hot summer days also 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, conserve water, reduce storm water runoff and enhance neighbourhood green space. Many of these features will contribute to reducing the impacts of climate change.
- **Integrated Plant Healthcare (IHPC) Program.** Parks, Forestry & Recreation Division uses IHPC methods to maintain over 3100 hectares of parkland, including sportsfields, 5 City owned golf courses and 32 lawn bowling greens across the city. This program maintains healthy greenspaces that are both functional for Torontonians and contribute to environmental quality, including cooling the city and providing wildlife habitat.
- **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.

## APPENDIX B

### Examples of Climate Adaptation Actions for 2008

SHORT TERM ADAPTATION ACTIONS	ANTICIPATED BENEFIT	CITY GROUP(S) RESPONSIBLE
<b>Engage Toronto's Neighbourhoods and Communities through Live Green Toronto</b>	To support neighbourhoods and communities in greening projects, including initiatives that will reduce climate change impacts.	Toronto Environment Office (TEO)
<b>Develop Regional Extreme Precipitation Intensity, Duration and Frequency Curves</b>  <b>Review Urban Flooding Issues</b>  <b>Conduct the Don Trunk Sewer &amp; Waterfront Wet Weather Flow Control Projects</b>	To improve ability to design storm drainage infrastructure for extreme runoff events.  To identify future policy and program requirements for flood protection.  To assess the effects of extreme weather on long term performance of existing and new wet weather flow facilities and attain water quality goals.	Toronto Water
<b>Conduct Urban Heat Island Research to Inform Land Use Planning Policy Approaches to "cooling" the City</b>	Identification of Toronto's "hot spots", what causes them, and implementing strategies to cool the city.	City Planning Clean Air Partnership TEO Toronto Public Health
<b>Conduct a Scan of Methods used in other jurisdictions to Assess Vulnerability to Heat</b>  <b>Evaluation of the Air Quality Health Index (AQHI) Pilot</b>	To create a heat-related vulnerability assessment tool that improves the effectiveness of the City's Hot Weather Response Plan.  Evaluation will help identify behaviour changes that citizens are making as a result of the AQHI and identify improvements in education initiatives that can help maximize health benefits when air quality is poor.	Toronto Public Health
<b>Reduce Stream Erosion and Increase Stream Restoration</b>	Coordinate procedures among different levels of government to reduce stream erosion and in the long-term aid in stream restoration.	Toronto Water, TRCA, Parks, Forestry and Recreation, Ministry of Natural Resources, Department of Fisheries and Oceans
<b>Complete Flood Warning System Updates</b>  <b>Conduct Lake Ontario Shoreline Planning</b>	To improve existing systems to prepare for flood emergencies.  Adaptive design for aquatic diversity and flood protection will take into account fluctuations of water level.	Toronto Water TRCA



<b>SHORT TERM ADAPTATION ACTIONS</b>	<b>ANTICIPATED BENEFIT</b>	<b>CITY GROUP(S) RESPONSIBLE</b>
<b>Improve Future Climate Change Prediction Capabilities</b>	Improved information on expected climate changes will permit better decision-making on adaptation planning.  Models will help develop watershed plans that will aid adaptive management in the Rouge, Don and Humber River watersheds.	TEO TRCA Toronto Water City Planning
<b>Increased systematic tree pruning services</b>	Systematic maintenance promotes healthy tree growth, reducing long term maintenance costs. Stronger trees are more likely to survive climate stresses such as drought and wind.	Parks, Forestry & Recreation
<b>Naturalization of parklands and lands surrounding water and wastewater facilities</b>	Decreased storm water runoff. Increased canopy cover in our parks and open spaces, from the existing 30% to over 50%. Reduced use of fossil fuels for maintenance of cut grass.	Parks, Forestry & Recreation Toronto Water TRCA
<b>Increased planning regulations/guidelines to support healthy trees</b>	For example, expanded implementation of new standards for supporting healthy tree growth by continuous soil trench systems in commercial areas.  Extending the life of trees from 6 years to 35 years in commercial areas, increasing shade, reducing energy demand for cooling.	Transportation Services City Planning Parks, Forestry & Recreation
<b>Implementation of new standards for supporting healthy tree growth by continuous soil trench systems in commercial areas</b>	Extending the life of trees from 6 years to 35 years in commercial areas, increasing shade, reducing energy demand for cooling.	Transportation Services City Planning Parks, Forestry & Recreation
<b>Increased street tree planting</b>	Reduce urban heat island effect and reduce storm water runoff.	Transportation Services Parks, Forestry & Recreation
<b>Sustainable Sidewalk Field Test</b>	Construction of a sidewalk and parking bay using soil cell technology to allow healthy tree growth and utilizing storm water to sustain trees.	Toronto Water City Planning Urban Forestry Transportation Services Technical Services
<b>New winter weather technologies to improve monitoring for snow and freezing rain conditions</b>  <b>Combination ploughing and salting vehicles</b>	These innovations will allow: a) better use of salt; and b) reduced accident claims and service delivery costs in freezing rain episodes expected to increase under climate change.	Transportation Services

<p><b>Green Development Standard: Anticipating impacts of climate change on built form</b></p>	<p>The GDS promotes resilience in built form and sustainable development. It will be reviewed with Climate Change adaptation in mind.</p>	<p>City Planning</p>
<p><b>Analysis of when and where green roofs could be required</b></p>	<p>This analysis will support recommendations for a new Green Roof by-law. Green roofs assist in reducing demand for air conditioning and in reducing storm water runoff.</p>	<p>City Planning</p>
<p><b>Renewable Energy By-Law</b></p>	<p>Defines conditions for renewable energy technologies to be incorporated into planned development. Promotes resilience in the City's energy supply and demand system.</p>	<p>City Planning</p>

## APPENDIX C

### Potential Short-term Climate Adaptation Actions

The recommendations in the table below are not listed in any particular order, and are not currently funded. Both internal and external sources of funding should be considered for these initiatives. Staff will need to develop the appropriate business case and financial impact statements for the formal recommendation of individual actions included below.

<b>SHORT TERM ADAPTATION ACTIONS</b>	<b>ANTICIPATED BENEFIT</b>	<b>CITY GROUP(S) RESPONSIBLE</b>
<b>Evaluation of the City of Toronto Hot Weather Response Plan</b>	Evaluation of the Hot Weather Response Plan would help identify improvements in City and community responses to extreme heat and maximize health benefits of the Plan.	Toronto Public Health (Subject to Health Canada funding)
<b>Climate Change Vulnerability Risk Assessment of major road culverts and bridges</b>	Reduce the risk of infrastructure failure due to extreme weather. Improved design standards. Avoid disruption to the public. Avoid significant insurance claims.	Transportation Services Toronto Water TRCA Toronto Buildings City Planning
<b>Expand the Integrated Plant Health Care Program (IHPC)</b>  <b>Increase systematic tree pruning services</b>	Provides ground cover, provides cooling and reduces storm water runoff.  Systematic maintenance promotes healthy tree growth, reducing long term maintenance costs. Stronger trees are more likely to survive climate stresses such as drought and wind.	Parks, Forestry & Recreation
<b>Expand parkland naturalization and naturalization of lands surrounding water and wastewater facilities</b>	Decreased storm water runoff. Increased canopy cover in our parks and open spaces, from the existing 30% to over 50%. Reduced use of fossil fuels for maintenance of cut grass.	Parks, Forestry & Recreation Toronto Water TRCA
<b>Introduce a new standard for supporting healthy tree growth by continuous soil trench systems in commercial areas</b>	Extending the life of trees from 6 years to 35 years in commercial areas, increasing shade, reducing energy demand for cooling.	Transportation Services City Planning Parks, Forestry & Recreation
<b>Increase street tree planting</b>	Reduce urban heat island effect and reduce storm water runoff.	Transportation Services Parks, Forestry & Recreation
<b>Increase enforcement of tree protection and planting requirements for private lands during development review</b>	Tree protection during development and education of residents to promote healthy tree growth is necessary for sustaining and increasing the tree canopy.	Parks, Forestry & Recreation City Planning

**APPENDIX C (Continued)**

<b>SHORT TERM ADAPTATION ACTIONS</b>	<b>ANTICIPATED BENEFIT</b>	<b>CITY GROUP(S) RESPONSIBLE</b>
<b>Species Recovery Planning</b>	Develop species recovery areas to aid in the survival of species threatened by climate change (and other stressors).	TRCA Toronto Zoo
<b>Expanding Regional Watershed Monitoring and Reporting to include climate change</b>	Expanding the scope of the existing monitoring program to evaluate the changes arising from climate change to terrestrial and aquatic systems.	
<b>Provide indoor cooling centres &amp; outdoor cooling stations</b>	Provides summer heat escape locations for City dwellers and tourists.	Parks, Forestry & Recreation & TRCA
<b>Expand Sustainable Technologies Evaluation Program (STEP) to monitor green building technologies</b>	Provide data and analysis to support implementation of roof top gardens, permeable pavement, bio retention swales, rainwater harvesting systems, erosion and sediment control ponds and bio filtration systems all of which will help adapt to extreme rain and droughts expected under climate change.	Multi agency partnership involving -TRCA - MOE -Toronto Water - Other regional municipalities
<b>Citywide Mandatory Downspout Disconnection</b>  <b>Uninterrupted Power Supply for Water Treatment</b>  <b>Assess Design Standards for Wet Weather Flow Master Plan</b>  <b>Assess Effects of Extreme Weather, Droughts and Heat on Water Quality of Area Watercourses and Beaches</b>	<p>Reduce flooding, and pressure on storm water systems.</p> <p>Develop enhanced contingency plans to operate critical water treatment and distribution systems and waste water treatment systems during extended power outages.</p> <p>Assess new design standards to help identify tradeoffs between storing water on site &amp; getting water off the lot. Establishing &amp; assessing new design standards will reduce property flooding in the long term.</p> <p>Confirm simulations of recent modelling exercises with real data from Rouge and Humber River watershed studies, to define the extent to which climate change affects water quality.</p>	Toronto Water
<b>Elimination of New Reverse Slope Driveways</b>	Reduce flooding during extreme precipitation events.	Toronto Water City Planning Toronto Buildings
<b>Source Water Protection</b>	<p>Further studies on the impacts of warmer lake water on algae growth and the possible increase in taste, odour and water quality issues for water treatment plants.</p> <p>Assess the vulnerability of water intakes to spills from sewer breaks and discharge plumes from extreme runoff events.</p>	Toronto Water MOE Regions of Peel, Durham, Halton, Hamilton- Wentworth, and Niagara TRCA

## APPENDIX D

### Expert Panel Participants on Climate Change Adaptation

**First Panel, December 4, 2007:** *A meeting with City Staff attended by approximately 40 City staff.*

Dr. Ian Burton	Co-Chair, Ontario Expert Panel on Climate Adaptation, and Professor Emeritus, University of Toronto, and Member, Intergovernmental Panel on Climate Change
Dr. David McKeown	Medical Officer of Health, City of Toronto
Dr. Brad Bass	Manager, Canadian Climate Change Scenarios Network, Adaptation & Impacts Research Division, Environment Canada and Adjunct Professor, Centre for Environment, University of Toronto
Dr. Paul Kovacs	Director, Institute for Catastrophic Loss Reduction
Don MacIver	Director, Adaptation and Impacts Research Group, Environment Canada
Joan Klaassen	Senior Climatologist, Adaptation and Impacts Research Group, Environment Canada
Dr. Quentin Chiotti	Director, Climate Change Programme & Senior Scientist Pollution Probe
Ryan Ness	Manager, Water Resources Toronto and Region Conservation Authority
Pamela Kertland	Sr. Policy Advisor, Climate Change Impacts and Adaptation Directorate, Natural Resources Canada

**Second Panel: January 22, 2008:** *A Special meeting of the Parks and Environment Committee to hear deputations from the Expert Panel. Total attendance approximately 150 people.*

Dr. David Pearson	Co-Chair, Ontario Expert Panel on Climate Adaptation and Professor, Laurentian University
Darrel Danyluk, P. Eng.	Chair, Public Infrastructure Engineering Vulnerability Committee, Engineers Canada
Don Haley, P. Eng.	Water Management Technical Advisor, Climate Change, Watershed Management Division, Toronto and Region Conservation Authority
Mark Yakabuski	President and CEO, Insurance Bureau of Canada
Don MacIver	Director, Adaptation and Impacts Research Group, Environment Canada
Dr. Monica Campbell	Manager, Toronto Public Health

**APPENDIX E**

**Public and Stakeholder Engagement Meetings on  
Toronto's Climate Adaptation Strategy**

<b>Date</b>	<b>Group Description</b>	<b>Number of Participants</b>	<b>Location</b>
December 4/07	Panel of Nine Experts on Climate Change Adaptation	40	City Hall
January 22/08	Panel of Six Experts on Climate Change Adaptation	150	Council Chambers
April 22/08	Federal, Provincial government staff, and faculty and students from the three GTA universities	40	Ryerson University
May 1/08	General public	13	North York Civic Centre
May 5/08	General public	35	Metro Hall
May 15 /08	Small & Medium businesses	TBA	Finch & 400 Highway
May 15/08	Business Improvement Area (micro businesses)	TBA	Scarborough East
May 27 /08	Large businesses	TBA	Downtown