

# Best Practices in Climate Resilience From Six North American Cities



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## INTRODUCTION

This research report on best practices in climate resilience was written for decision support purposes for City of Toronto staff writing a major policy proposal for Toronto City Council known as the "Resilient City – Preparing for Climate Change" Staff Report. The research was based on interviews and internet based research pertaining to six cities known to have strong initiatives in the field of climate change resilience and adaptation.

For the purposes of this report and the report to City Council, the following definition of resilience has been used:

*Resilience is "the ability of a system, entity, community, or person to withstand shocks while still maintaining its essential functions and to recover quickly and effectively."  
(Rockefeller Foundation)*

Local governments have an essential role and responsibility in climate change adaptation. Cities have many of the tools necessary to help initiate adaptation such as city planning, local codes and standards and emergency planning and response. Local governments invest in operational programs but also capital projects that are expected to serve the city over many decades. The cost of inaction on adaptation, both from a public safety and infrastructure maintenance and repair perspective could be much higher than proactively planning and building to be resilient to future climate changes.

Six North American cities, namely Vancouver, New York, Seattle, Chicago, Calgary and San Francisco/Oakland, were studied to provide examples and awareness of best practices in climate change resilience and adaptation. The six cities were selected as they are mostly comparable in size to Toronto and are North American leaders in climate change adaptation and resilience to extreme weather. All six cities were identified as amongst the most resilient cities in the world according to Grosvenor's Resilient City Research Report 2014<sup>i</sup>.

Angelovski and Carmen (2011) identified that municipal adaptation plans in global cities tend to take three forms. The first is a model where a plan is developed and serves as a basis for future assessments and enhanced public engagement. The second model starts with assessing the city's vulnerabilities followed by a list of active recommendations. The third model strategically links adaptation and adaptation actions to a larger long-term city vision of sustainability<sup>ii</sup>. Toronto tends to follow the first model described but it is important to learn from other cities that opt for a different approach to planning.

## **METHODOLOGY**

This report examines two major categories of best practices for cities resilience to climate change:

- a) Governance – which refers to the organization structure and human resource deployment of staff for decision making and direction of the city on the issue of resilience to climate change.
- b) Programs and Actions – which refers to the more specific tactics implemented to increase resilience.

The approach to conducting the research for this report was established taking into account the amount of time available on the part of City staff and graduate student researchers. An important source of information for the research was personal interviews with staff and former staff from the cities of interest. The interviews were conducted through the use of specific questions developed by city staff shown in Appendix 1. Online research was also conducted. Materials examined included articles from academic journals on municipal climate adaptation governance and websites from the six municipal governments as well as discussion papers and reports from organizations that deal with sustainable and resilient communities.

As a result of the research, the nine major themes were identified and are discussed in this report:

- Development and Monitoring of Performance Indicators
- Analysis of the Cost of Inaction
- Prioritization of Adaptation Efforts
- Investment in Critical Infrastructure
- Update of Building Regulations and Land Use Planning Principles
- Care of Vulnerable Populations
- Protection and Restoration of Natural Systems
- Partnership & Collaboration
- Education and Outreach

## REVIEW OF GOVERNANCE SUPPORTING RESILIENCE

While many cities have a plan to mitigate climate change, fewer have developed a strategy to address the issue of climate resilience and adaptation. To facilitate, coordinate and support work on climate change and resilience, most municipalities established dedicated offices either within a relevant department such as the environmental department or as a separate cross-cutting unit under either the Mayor's or City Manager's office<sup>iii</sup>. The following describes governance structures in the cities under study.

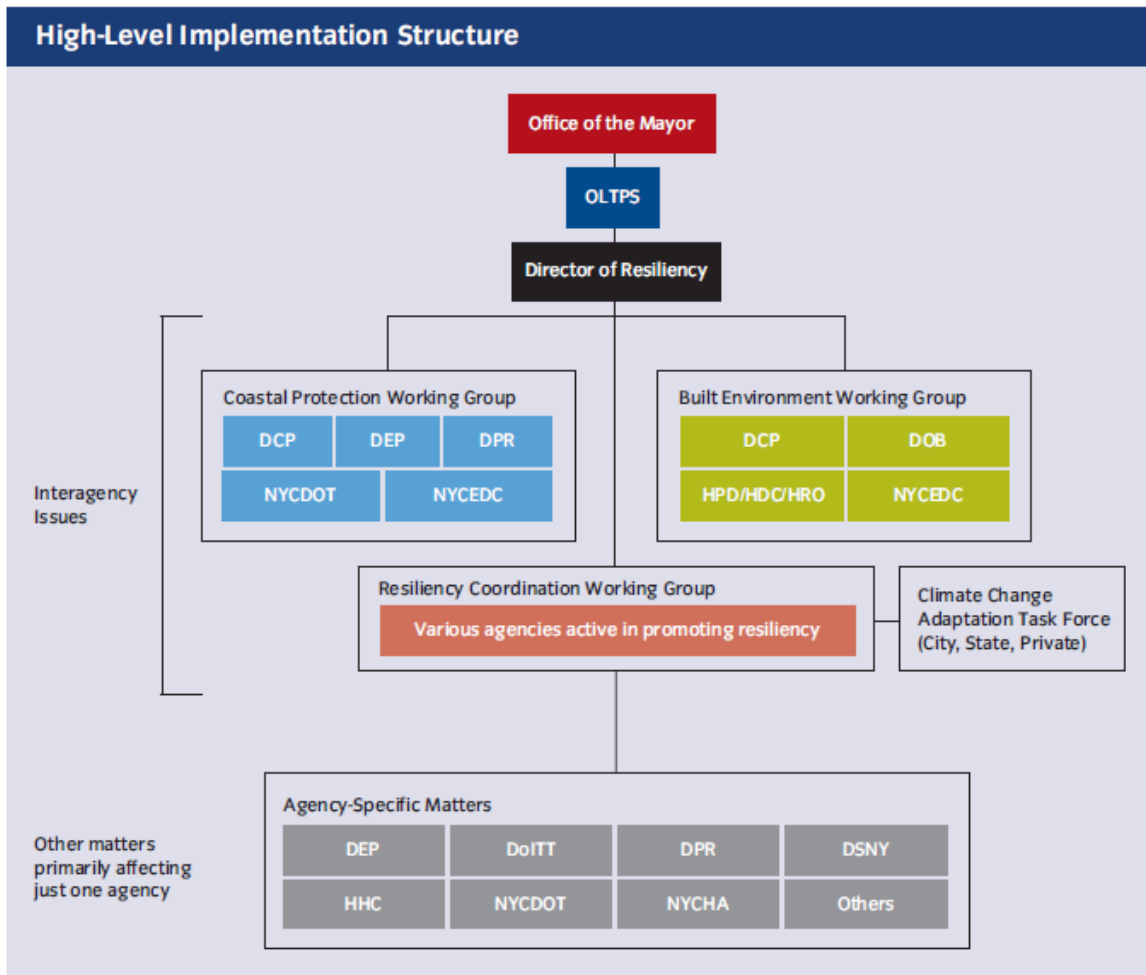
### New York City

PlaNYC was developed under Mayor Bloomberg and in 2007, a report entitled A Greener, Greater New York defining NYC's goals of reducing the City's GHG emissions by 30% by 2030 and the 126 initiatives to be undertaken by City agencies to reach the objective. In 2006, the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) was established to lead the effort. The OLTPS coordinates with all other City agencies to develop, implement, and track the progress of PlaNYC and other issues of infrastructure and the environment which cut across multiple City departments. There is also an external Sustainability Advisory Board tasked to provide best practice advice and guidance.

In issues that are primarily the responsibility of one agency such as Transportation (Department of Transportation), water and wastewater (Department of Environmental Protection), solid waste (Department of Sanitation), telecommunication (Department of IT and Telecommunications) and parks (Department of Parks and Recreation), the individual agency is responsible for implementation and is made accountable. The overall steward of all these initiatives is the OLTPS which is in charge of coordination and is informed about climate change and its overall impact on NYC.<sup>iv</sup>

OLTPS has a staff of about 50 working with the Director of Resiliency who oversees the work of three working groups. The Resiliency Coordination Working Group is made up of 1-2 representatives from each of the City's agencies and guides the overall work on resilience. The working group is also part of the Climate Change Adaptation Task Force consisting also of state and private companies who control the city's critical infrastructure. As of spring, 2014, the budget for resilience planning is estimated to be about \$20 billion and about \$10 billion of that has been allocated from city capital and federal sources and another \$5 billion will be provided primarily by the federal government. The funding gap of \$4.5 billion still needs to be filled.

The following diagram illustrates New York City's Climate Resilience implementation structure<sup>v</sup>.



## San Francisco

Climate change and adaptation work is overseen by the City's Department of the Environment, in partnership with the Public Utilities Commission and Planning Department. San Francisco's Climate Adaptation Working Group includes representatives from the City Administrators Office, the Port, the San Francisco International Airport, the Department of Public Works (water, power & sewer), the Municipal Transportation Association, the Department of Public Health, and the Department of Recreation and Parks.

The Department of the Environment operates under the direction of the Commission on the Environment which also advises the mayor and Board of Supervisors on environmental programs and policies. The seven members of the Commission are appointed by the Mayor. The Mayor's Office applied for the Rockefeller 100 Resilient Cities challenge grant and has secured funding for a

Chief Resilience Officer whose role will be to coordinate and oversee the resilience activities, coordinate stakeholders, and ensure resilience is a city-wide priority. There are two to three staff working on climate issues within the Energy & Climate Unit of the Department of Environment.

## Chicago

In 2006, the City of Chicago created the Climate Task Force to develop an action plan that addresses both mitigation and adaptation. The Task Force was led by staff from the Mayor’s Office and various city departments as well as environmental and non-profit groups, the business community, educational and research institutions and members of the State government. In 2008, the Chicago Climate Action Plan was released, containing a framework for the implementation of actions for coping with the effects of climate change. The plan also included methodology for monitoring and evaluating progress.

The governance structure for Chicago’s adaptation organization is as follows: Overall leadership is from the Mayor’s Office which oversees the Green Steering Committee. Leadership, planning and communications are under the Department of the Environment, while management of extreme heat events is led by Office of Emergency Management & Communications. Management of extreme precipitation events are led by Department of Water Management. Management of buildings, infrastructure and equipment vulnerability from extreme climate is led by Department of Buildings and Department of Transportation. Ecosystem protection is led by the Department of Zoning and Land Use Planning. Chicago’s Climate Resilience Structure is illustrated by the diagram below.



## Seattle / King County

King County is the home of the City of Seattle, 39 others cities and numerous county public purpose districts. King County is also known for having taken significant planning and infrastructure upgrades taking into account the risk of flooding and reduced freshwater supplies associated with climate change. The County looked at the facilities and services it directly controls to select four areas where county action could have the greatest impact on climate change. Using four levers of change — land use planning, transportation, environmental management, and renewable energy policy — King County government has become a successful living laboratory and national model of strategies to reduce and prepare for global warming impacts.

Climate change and adaptation are the responsibility of the City's Office of Sustainability and Environment. In 2013, the City of Seattle adopted the Seattle Climate Action Plan and as of October 2013 the City has been working to realize the vision of this plan through their implementation strategy<sup>vi</sup>. They have created a Climate Adaptation Working Group within the city. King County has taken many steps to address Climate adaptation. In 2007, the County created a County Climate Plan that focuses on water supply, public health, emergency preparedness, flooding, salmon recovery, and forest health<sup>vii</sup>.

## Calgary

Calgary's Department of Utilities and Environmental Protection houses the Environmental and Safety, Water Resources, Water Services and Waste and Recycling Services. is The vast majority of the work being done currently centers around flood recovery and not adaptation. In response to the largest flood in Calgary's history in June 2013, an Expert Management Panel was created to "examine, evaluate and prioritize environmental, infrastructure and policy measures that would significantly reduce the potential harm from floods"<sup>viii</sup>. A set of themes has been identified including forecasting methods and infrastructure and property resiliency.

Other priority actions have also been acknowledged for assessment including increasing the capacity of the Glenmore Reservoir and considering temporary or permanent berms for river communities. Calgary is in their initial stage of adaptation planning with a focus on long-term recovery from the 2013 flood. Calgary has established a Recovery Operations Center with a staff of six that draws on resources from other business units.



## Vancouver

A key reason for success for Vancouver's adaptation strategy was due to its context within the City's comprehensive "Greenest City 2020" campaign. The Greenest City Plan is the collaboration between up to 60 City departments and 120 organizations. The Greenest City Action Team, is tasked to make Vancouver the greenest city in the world by 2020, and was formed in 2009. The resulting Greenest City Plan, released in July, 2011, includes mitigation actions and an action directing development of an adaptation strategy under the Climate Leadership goal.

Evaluation of strategies, research and partnership around adaptation and climate change work are carried out by climate program staff in the Sustainability Group. The Climate Change Adaptation Team appointed by the Deputy City Manager and coordinated by Sustainability Group is responsible for providing a 5-year update on actions on adaptation. The Sustainability Group includes the Climate Adaptation Program with a focus on flood resilience, the Risk Officer dealing with insurance related issues and the Emergency Management Office which focuses on earth quakes and disaster response.

Vancouver's climate adaptation plan has a budget of \$100,000 annually which is derived from their coastal flooding fund and is spread out across city staff. The budget is divided across departments and part of the regular operational budget. They are integrating changes into the capital plan for the first time. Currently there is one full time equivalent staff administering the Climate Adaptation program with a budget of about \$100,000 from the coastal flooding fund. Approximately about \$300,000 is spent per year across various departments on resilience planning.

## REVIEW OF PROGRAMS AND ACTIONS SUPPORTING RESILIENCE

Beyond the implementation structures on climate resilience, programs and actions around a number of key areas were studied including:

### Development and Monitoring of Performance Indicators

Cities are developing indicators to measure whether their programs and actions are successfully moving towards their climate resilience goals. The Department of Natural Resources and Parks (DNRP) of King County has developed a set of Community and Environmental Indicators that measure the existing environmental conditions. They have also developed performance indicators to determine the degree that their programs are achieving their stated targets related to environmental, social, and fiscal considerations. For example, in relation to climate adaptation, the City tracked the flood protection projects, the relocation of homes to higher ground, and the progress in increasing the elevation of several homes etc. In 2012, this rating system determined that Climate Adaptation response still needs improvement<sup>ix</sup>.

### Analysis of the Cost of Inaction

Many cities have tried to model projected costs associated with climate change related events as well as the potential costs of inaction and savings associated with adaptation measures. For example, in New York City, an analysis demonstrated that “While Sandy caused \$19 billion in economic damage, a similar storm in the 2050s would cost \$90 billion in lost property, jobs, infrastructure and government expense”<sup>x</sup>. This kind of measurement allows the City to communicate the risk of inaction in order to promote actions that reduce these risks and subsequent future costs<sup>xi</sup>.

In 2008, Oliver Wyman conducted a Corporate Risk Case Study to advise the Chicago Climate Task Force in the development of the Chicago Climate Action Plan<sup>xii</sup>. This model demonstrated the cost of inaction as it created a baseline on a “business as usual scenario” that assumed current operations and authorized investments. Next, they conducted research on 18 City Departments to see how their operations, assets, personnel and services would be impacted by climate change. Finally, they analyzed the economic effects on each of these impacts. As a result, the report makes a conservative estimate that the anticipated costs between 2010 and 2099 is \$2.54 billion under a high emission scenario. In particular, the reduction of energy and maintenance costs associated with a lower emission scenario was shown to have the highest impact on financial savings. This report demonstrates the economic advantage for the City to pursue mitigation and adaptation actions that would yield lower emissions for the municipality<sup>xiii</sup>.

While the Chicago study estimated anticipated costs of \$2.54 billion over 89 years, this number could be called into question considering Toronto is also a Great Lake city which is similar in size to Chicago. Only one storm in Toronto in 2013 cost over \$1 billion in insurance claims alone.

## **Investment in Critical Infrastructure**

Residents of cities depend on city infrastructure in order to provide essential services even in the event of extreme weather,. For example, maintenance and upgrades of road infrastructure helps to ensure access to emergency services, food and medical care are retained during extreme weather conditions. Green spaces and a healthy, abundant tree canopy helps mitigate effects of severe storms by capturing rainwater, preventing erosion and reducing cooling demands through the lessening of urban heat island effect.

The City of Vancouver has created a city-wide water plan and a power back-up plan to minimize water supply and electrical power disruption. It is also actively working to replace and maintain the City's sewer pipes<sup>xiv</sup>. Since its 2011 Urban Tree Canopy Assessment Report, Vancouver has undertaken the mapping of existing and possible urban tree canopy and proposed strategies to increase the coverage to reach its target of 28% by 2030<sup>xv</sup>.

Chicago's Green Alley Way program introduced in 2007 by the Chicago Department of Transportation reduces stormwater through converting alleyways with permeable paving, bottom catch basins, high-albedo pavement, and recycled materials. From 2006 to 2010 over 100 Green alleys have been installed<sup>xvi</sup>.

## **Update of Building Regulations and Land Use Planning Principles**

Many municipal governments have re-examined their construction and building standards to ensure they will stand up to future climates. Some cities are incenting builders to prepare for potential climate events. Vancouver has changed the minimum flood constructions level to 4.5 meters from 3.5 meters. The one meter of sea level rise represents the median of current global scientific projects and is the increase recommended by the province<sup>xvii</sup>. In addition, the City has changed its bylaws so that mechanical and electrical equipment are installed on higher floors or roofs if possible. Builders are also encouraged to construct structures that will last until the year 2100<sup>xviii</sup>.

At the time of writing this report, New York City's (NYC) Building Incentive Program was still in the design stage, but it is expected to provide a grant to incentivize large building owners to protect mechanical and electrical equipment. NYC has also been working with the Federal Emergency Management Agency

and Congress to ensure affordability when implementing mechanisms to reduce risk as well as advocating for flood insurance reform within the federal government<sup>xix</sup>.

King County, to which Seattle belongs, has a Flood Buyout and Home Elevation Program. The buyout program is designed to purchase homes through the voluntary sale of homes that are highly threatened by floods or serious erosion. This is intended to reduce costs related to emergency response actions and have the benefit of creating open spaces and improving flood storage and conveyance. The home elevation aspect helps residents with the costs of raising their homes above the 100-year elevation to help protect dwellings in flood zones and reduce future damage<sup>xx</sup>.

One of the current tasks of the San Francisco Adaptation Working Group is to strengthen the City's sea walls to prevent flooding and ensure that new developments are built to withstand floods and that residents have proper flood insurance<sup>xxi</sup>. The city's innovative use of building codes has also dramatically improved building safety.

### **Care of Vulnerable Populations**

Vulnerable and at-risk populations are often the most affected by extreme weather events. As part of the Resilient Cities Campaign, many cities around the world have committed to make their schools and hospitals safer and to work towards plans that will enable their continued operation in the time of extreme weather events<sup>xxii</sup>. New York City recognizes that school and healthcare facilities are at risk of closures during extreme weather as illustrated during Hurricane Sandy. Schools and hospitals house some of the most vulnerable populations and it is important that interruptions of service provided by these institutions are minimized. As part of the Special Initiative for Rebuilding and Resiliency, "A Stronger, More Resilient New York", NYC is addressing the issues of transportation, food supply and power outage, all of which are essential in keeping both schools and hospitals in operation<sup>xxiii</sup>.

The City of San Francisco is working to prioritize neighbourhoods to ensure those who face the greatest risk are prepared. The Department of Emergency Management has also developed a Disability Inclusion Appendix to clarify policies, strategies and resources for the care of people with disabilities during emergencies. In addition, a Feeding Appendix was created describing how the City government and local non-profit food providers can work together to feed people after a disaster<sup>xxiv</sup>.

## Protection and Restoration of Natural Systems

In most cities, natural environments have been replaced by urban development, often compromising the cities' abilities to endure extreme weather events. Mitigation of the effects of these events must include protection of natural areas that contribute to the cities' resilience. The San Francisco Adaptation Working Group is focusing on the enhancement of natural systems to protect the shoreline from coastal erosion, prevent storm water runoff, and promote natural cooling. This includes maintaining wetlands, watersheds, urban forests and green spaces. Some of this work is done through the Natural Areas program which preserves, restores, and enhances remnant natural areas, and develop and support community-based site stewardship of these areas<sup>xxv</sup>.

New York City has undertaken a number of restoration projects and flood protection studies for the Upper New York Bay. A study of Plumb Beach, Brooklyn recommended a reconstituted beach, which was completed in 2012, prior to the arrival of Hurricane Sandy. This beach provided significant protection to the Belt Parkway during the storm. Another project, the Hudson-Raritan Estuary Comprehensive Restoration Plan was released in May 2009 with an aim of improving 11 ecosystem types within the estuary. Although the plan does not focus on flood protection, study findings show opportunities to achieve ecosystem and flood protection benefits in the areas adjacent to the ecosystems<sup>xxvi</sup>.

## Partnership & Collaboration

Climate change affects every resident and business and efforts to adapt to its effects must be taken not only by the government but also with the assistance of the community. Collaboration within the city government and with external stakeholders and community organizations is therefore vital. Seattle and King County benefit from partnerships with the Climate Impacts Group at the University of Washington to work on Climate Change Actions<sup>xxvii</sup>. For example, King County worked in collaboration with the University of Washington and ICLEI to develop a Guidebook for Local, Regional, and State Governments<sup>xxviii</sup>.

In response to the threat of rising sea levels, Seattle Public Utilities (SPU) has worked in collaboration with the University of Washington's Climate Impacts Group to develop sea level rise scenarios in 2050 and 2100 to be used for planning capital investments, developing new facilities, or creating land use policies and plans<sup>xxix</sup>.

Since 2007, San Francisco's Department of Emergency Management has completed more than 25 training and functional exercises with City staff and more than 60 partner agencies on emergency management and created an

online toolkit to help plan exercises. Lessons learned are tracked in their Master Improvement Plan to help city departments ramp up their planning efforts<sup>xxx</sup>.

## Education and Outreach

Effective communication and education is fundamental in ensuring residents and businesses understand the impact of climate change and are prepared for extreme weather.

Prior to each storm season, Seattle Public Utilities launches a multi-media educational campaign along with nearby jurisdictions. Their “Take Winter By Storm” website provides coordinated messages on how property owners can protect themselves and increase the resilience of their properties. Public service announcements featuring elected officials, and tips delivered by weather reporters during broadcasted weather forecasts help educate residents about what they should do before and during storms<sup>xxxii</sup>.

Oakland is a leader in community partnerships and community-based resilience planning. The Pacific Institute and Bay Localize have developed hazard mapping and outreach tools for community residents. The Oakland Climate Action Coalition, a network of about 40 local groups, led by and for low-income communities has played a key role in the City's community-based climate resilience planning. Oakland has conducted a number of studies on impacts and vulnerability related to sea level rise and flooding, and an initial analysis of seismic hazards in soft-story housing. This is all part of the city's plan to increase resilience as well as social and economic equality through community engagement<sup>xxxiii</sup>.

New York City's OLTPS is developing Heat-Health Warning Systems, which works alongside with enhanced urban heat island mitigation measures and increased access to air conditioned spaces, to create a replicable model for heat illness prevention. This model is to be implemented at the various high-risk neighbourhoods in the city<sup>xxxiii</sup>.

Social media can assist with disaster management and recovery and provide early warnings by improving the communication of crucial information. It allows authorities to provide instructions for residents and share information on evacuation, emergency services etc. It can also encourage community involvement on extreme weather with its potential to reach larger populations.

San Francisco uses social media including a blog, Facebook and Twitter to educate and motivate the public to take important steps in advancing their personal resilience. San Francisco's Department of Emergency Management has created an emergency preparedness hub called SF72 which includes a website and brochures providing information on how to stay connected and be prepared

in the event of an emergency. SF72 has partnered with nextdoor.com, a social networking site for neighbourhoods that enables communication and the sharing of information between neighbours on a variety of topics including emergency planning. SF72 also utilizes other outreach resources including smartphone applications, an online emergency preparedness quiz as well as an emergency supply shopping campaign carried out in partnership with a number of retailers in the city<sup>xxxiv</sup>.

## CONCLUSION

It is evident that many North American municipalities, including the six studied, are working towards making their cities more resilient. Planning for and adapting to extreme weather events are challenging tasks as cities struggle to establish effective governance structures and policies while working to engage communities and ensure public safety.

Whilst no city can claim to have the solution to the global problem of climate adaption, some of the best practices in North America discussed in this document can be applied to the City of Toronto's resilience strategy including:

- The development of indicators and possible future scenarios for planning purposes
- The calculation of projected costs associated with inaction to illustrate the value and importance of adaptation efforts
- The modelling and monitoring of risks associated with climate change to help prioritize actions
- The examination of transportation, food resources and utilities to develop a plan that ensure the most vulnerable are cared for during extreme weather events
- The development of city-wide water and back-up power plan
- The update of construction and building standards taking future climate into account
- Providing resources for property upgrades that will help residents and businesses prepare for extreme weather
- Increase green infrastructure such as permeable paving and green spaces
- Enhance the city's natural systems and encourage stewardship to help mitigate the effects of extreme weather
- The education of city departments and partner agencies on climate resilience and extreme weather preparedness
- Provide coordinated messaging and education to the public on climate resilience and adaptation
- Work with communities to build support networks and improve communication
- Increase the use of social media and internet/smartphone technology to increase communication and build community

In order for Toronto to continue to develop its climate resilience action plan, it is vital that we continue to learn from other cities and integrate some of their best practices into our current strategy.



## **ACKNOWLEDGEMENTS**

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## Appendix 1: Informants and interview questions

A number of informants were interviewed to support the research including:

- Karen Weigert, Chief Sustainability Officer, City of Chicago
- Olivia Cohn, former Manager of climate change mitigation and adaptation performance measurement for Chicago's sustainability plan, the Chicago Climate Action Plan (CCAP).
- Tamsin Mills, Senior Sustainability Planner, City of Vancouver
- Garrett Fitzgerald, Urban Sustainability Directors Network, Strategic Partnerships Advisor, Former Sustainability Coordinator, City of Oakland
- Leah Cohen, Director, Climate Analysis, Special Initiative for Rebuilding and Resiliency, New York City
- Katherine Hodges, Project Manager, River Flood Mitigation Program, City of Calgary

The following questions formed the basis of the telephone interviews:

- 1) How are residents and businesses engaged in the development of the resilience plan for extreme weather?
- 2) Does your municipality have a resilience office/plan and what is its governance structure?
- 3) What resources (staff, budget) are dedicated in these cities for resilience planning?
- 4) What are some best examples of actions taken by your city to improve climate resilience?
- 5) What are the cost savings and benefits associated with these actions to improve climate resilience?
- 6) Who is your best internal contact on the issue of flood resilience and insurance for further discussion? Are there other contacts who may be of help.

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