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Mobilizing the Urban Ecosystem in Support of Resilience
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Introduction

Toronto's current focus on resilience has a history that began over ten years ago the City of Toronto pursued a staff-led to the evolving field of urban climate adaptation planning. Through this work the City has aimed to develop an evidence based foundation on which to build a more resilient city.

> Urban Resilience is "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience." – 100 Resilient Cities

This paper will speak to ongoing efforts to engage a broad range of stakeholders in support of urban resilience, which initially began with a focus on climate adaptation. A chronological outline of key activities and milestones, associated in particular, to the work conducted in 2016 in response to recommendations arising from the staff report - Resilient City – Preparing for a Climate Change, is also included. As a final point this paper will speak to challenges and future questions that will need to be addressed. In that regard, the discussion will centre on work arising from the 100 Resilient Cities initiative.

Early Efforts on Climate Adaptation and Resilience

The iterative development of current resilience work in Toronto has been shaped by a number of earlier initiatives. These include work on the City of Toronto's Climate Drivers Study (2011), the development of the City's climate change risk assessment tool and the Ahead of the Storm document and associated report to Toronto City Council (2008).

In 2009, a study was commissioned to better understand the impact of a changing climate on weather, in-particular the extremes (temperature, precipitation, etc.) that would impact City infrastructure and services in the future (specifically the period 2040-2050). The results of this innovative project highlighted changes in weather the city was likely to face as a result of a changing climate. While the focus of the study was on extremes, the findings were largely consistent with those from regional and national bodies. In essence, the City can expect to get hotter and wetter.

The City of Toronto's thinking around climate risk was further shaped by work that was conducted with the assistance of Deloitte in 2009-11, based on concepts of Enterprise Risk Management and the International Standard for Risk Management, also known as ISO 31000. The work resulted in a tailored approach to climate change risk assessment for Toronto and a customized Microsoft Access software tool known as the Toronto Climate Change Risk Assessment Tool (TCCRAT). Utilizing the outputs from the Climate Drivers Study, the City led an effort to utilize the Toronto Climate Change Risk Assessment Tool (TCCRAT) to inform an understanding of how weather/climate was likely to impact City infrastructure, operations and services.

Toronto's Transportation Services Division (TSD) piloted the climate change risk assessment tool and through over a dozen half-day workshops 90+ assets and services were analysed using this approach.

This work and other studies initiated through the Engineer's Canada, PIEVC[1] risk assessment process catalysed various studies focused on better understanding the impact of climate change on key assets (e.g. dams, social housing, culverts) in Toronto, whether led by the corporation, City agencies or partners (E.g. Toronto Region Conservation Authority). This work played an important role in informing an understanding of risks and opportunities to improve resilience, but also the importance of engaging a broader array of stakeholders (Note: In collaboration with the Transportation Association of Canada, the TCCRAT tool is now being web-enabled for cross-Canada application within the transportation sector).

A Growing Ecosystem

Building on the knowledge, experience and relationships developed through this work, efforts were focused on engaging a broader range of stakeholders and experts to expand the community of practice around adaptation, as well as support broader implementation. In that regard, The City of Toronto partnered with a major convener, CivicAction[2] to found the WeatherWise Partnership. The Weatherwise Partnership was focused on understanding climate change and associated extreme weather risks of concern to a broad range of over 60 private, public and NGO stakeholders. Examples of stakeholder groups included, major banks, utilities, the insurance sector, telecom companies, universities, road and sewer departments from surrounding cities, provincial and federal government representatives.

Work by members of Weatherwise Partnership, in particular, the City of Toronto and various utilities, led to a focus on better understanding the impacts of climate change on the electrical sector. Natural Resources Canada funding also played a role, in further cementing collaboration. In part, due to relationships developed through the activities of the Weatherwise Partnership, a number of organizations chose to pursue funding to better understand the impacts of extreme weather and climate change on electrical transmission[3] and distribution[4] infrastructure. The resultant studies, once again informed by the PIEVC protocol, were the product of a collaboration between private, public and non-governmental organizations.

These projects emphasized the criticality of relationships both physical and personal as it relates to the operations and management of critical infrastructure. While the connections between critical infrastructure systems was and is inherently understood, the importance of understanding the dependencies and interdependencies of those relationships is still evolving. Both, the process, and ultimately the outcomes of the above mentioned studies, highlighted the figurative and literal connections between these infrastructure systems and the impact of climate/weather on their infrastructures

While this work was underway to advance aforementioned risk assessments and associated work, two extreme weather events further catalyzed resilience building efforts at the City. Specifically, the extreme rainfall and associated flooding that impacted the City on July 8th 2013, as well as the ice-storm of December 2013 further emphasized the interconnectedness of critical infrastructure and the socioeconomic systems they support in municipalities and the community at large.

[1] Engineers Canada – Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol
[2] http://www.civicaction.ca/adapting-to-climate-change-in-toronto/
[3] Home> Ontario's Electrical Transmission Sector - Climate Change Vulnerability Assessment
Ontario's Electrical Transmission Sector - Climate Change Vulnerability Assessment, https://pievc.ca/ontarios-electrical-transmission-sector-climate-change-vulnerability-assessment
[4] Toronto Hydro-Electric System Limited Climate Change Vulnerability Assessment – Distribution Sector, https://pievc.ca/enhancing-resilience-severe-weather-and-climate-change-distribution-sector

The Impact of Extremes

The flooding and impacts of July 8 2013 were the result of 126 mm of rain[5] that impacted infrastructure and services across the City of Toronto, and surrounding municipalities. Two major transformers supply Toronto's electricity. The July 8th event flooded one, resulting in a loss of power to over 750,000 people[6], some for over three days. Over 4,759 homes were flooded, 1400 GoTrain commuters stranded, and $1 billion in insurance claims[7] were reported, as well as $70 million in costs to the city, excluding 5784 insurance claims against the City[8]. If both transformers had been impacted, large scale power disruption could have impacted the entire city and region, including low income/socially isolated individuals.

Later that same year, Toronto and the region experienced an extreme winter storm on December 21 - 22, 2013, which produced freezing rain, ice pellets and wind, resulting in power loss for more than 1 million people due to power lines downed by fallen trees[9]. The severity and extent of the storm left parts of the city and region without power for close to a week[10]. In total, the City incurred $171million in storm damage in 2013 as a result of these two events[11]. This acute crisis highlighted chronic challenges. As an example, staff registered 3,187 residents in need of support and issued ~9,300 grocery gift cards. In the region at large, 5 deaths were reported as a result of carbon monoxide poisoning.

The aforementioned flooding and ice-storm of 2013 served to catalyzework on a staff report: *Resilient City: Preparing for Extreme Weather Events*[12] and *Resilient City – Preparing for a Changing Climat*[13]. These reports and associated recommendations, including the development of a Climate Change Risk Management Policy for Toronto and the creation of an internal/external Resilient City Working Group (RCWG), played a key role in furthering the development of resilience thinking in Toronto. The adoption of the Policy outlined the City's approach for integrating climate change resilience into decision-making and coordination of City operations and services, and it defined the City's governance structure for climate change resilience.

The High Level Risk Assessment (HLRA)

Informed by the recommendations from the Resilient City – Preparing for a Changing Climate staff report, and more specifically a directive to identify and assess potential risk of climate change and associated extreme weather; define the interdependencies between key infrastructure and service providers, both private private and public sector; and outline the actions that could be taken to mitigate priority risks required a process and approach that would seek to further expand the urban resilience ecosystem.

In developing a process to undertake this work, the Environment & Energy Division of the City of Toronto, informed by the City's cross-corporate Resilient City Work Group (RCWG), undertook a

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[5] Environment Canada, "Canada's Top Ten Weather Stories for 2013: Toronto's Torrent."

[6] City of Toronto, "Impacts from the July 8, 2013 Storm Event on the City of Toronto."

[7] Insurance Bureau of Canada, "Canada Inundated by Severe Weather in 2013: Insurance Companies Pay out Record-Breaking $3.2 Billion to Policyholders."

[8] City of Toronto, "Impact of July 8, 2013 Storm on the City's Sewer and Stormwater Systems."

[9] Davies Consulting, "The Response of Toronto Hydro-Electric System Limited to the December 2013 Ice Storm."

[10] Ibid.

[11] City of Toronto, "Impacts from the July 8, 2013 Storm Event on the City of Toronto."

[12] City of Toronto, "Resilient City: Preparing for Extreme Weather Events."

[13] City of Toronto, "Resilient City: Preparing for a Changing Climate."
http://www.toronto.ca/legdocs/mmis/2014/pe/bgrd/backgroundfile-70623.pdf

jurisdictional review of other cities and the approach they adopted to address similar issues. Toronto modelled its resilience building efforts on similar work conducted in Barcelona and New York City. In Barcelona, the city established a Resilience Board that included 37 public and private infrastructure groups mandated to develop and implement resilience building efforts. Following Superstorm Sandy and the impacts it had on New York City's population, environment and economy, the City undertook a significant review of the events that transpired, their impacts and means to mitigate these risks in the future. “A Stronger, More Resilient New York”, outlines a comprehensive plan for increasing the resilience of natural, built and social infrastructure. In that regard, like Barcelona, the plan recognizes the critical importance of a broad range of public, private and non-governmental organizations to developing the cities resilience. Furthermore, the climate adaptation work of these two cities was based on a sectoral/thematic area approach, which lent itself to collaborative work among these various key stakeholders.

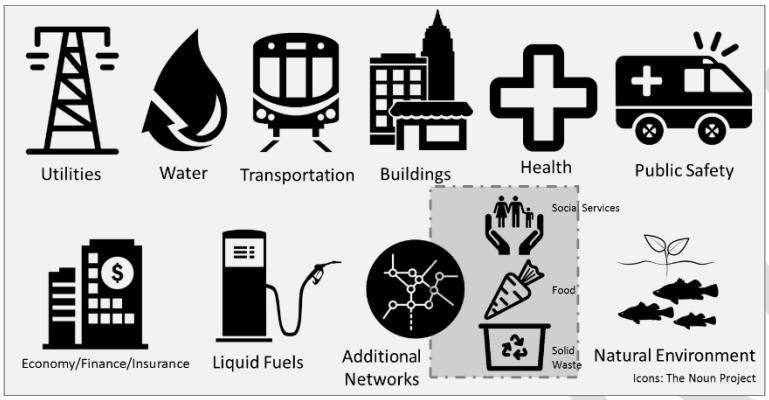

Figure 1: Icons used to depict the focus for the City of Toronto's High Level Risk Assessment (HLRA) work. Icons: The Noun Project.

To facilitate the implementation of the Climate Change Risk Management Policy and ensure interdependencies would be identified, ten Thematic Areas were defined, and relevant organizations in the pertinent Thematic Areas were invited to participate in the HLRA process.

The ten thematic areas were defined as follows:

1. Utilities (electricity, telecommunications, natural gas, district heating and cooling);
2. Transportation (public transit, highways, roads, railways, airports);
3. Water (water treatment and supply, wastewater collection and treatment, stormwater management);
4. Buildings (private and publicly owned);
5. Public safety (fire/police/emergency medical services);
6. Liquid fuels (accessibility, pumping capability, supply chain breakdowns);
7. Additional networks (waste management, social services, food supply);
8. Local economy/insurance/finance (economic impact on government, residents & businesses including insurance costs);
9. Health (healthcare facilities, clinics, outpatient care centres, and health oriented programs and services); and,
10. Natural environment (ecosystem services which includes a holistic acknowledgement of the critical role played by the environment, in providing direct and indirect contributions to the health and well-being of Toronto residents).

The first three Thematic Areas to be evaluated were Utilities; Transportation; and Water. The decision to focus initial efforts on these three areas was informed by the following factors:

1. Priority for organizations under City ownership and control. An initial understanding of the City's dependencies on these critical infrastructure systems, and our ability to influence work in these Thematic Areas.
2. Polling of the Resilient City Work Group about what they felt should be a priority.

3. Readiness of staff from different organizations to participate in this new work.

Table 1 below provides an overview of the High Level Risk Assessment (HLRA) process. The success of the process relied heavily on the capacity to engage a range of stakeholders inside and outside of the corporation. In addition to the organizations identified in Table 1, the Environment and Energy Division also engaged with City Planning, Toronto Public Health, Engineering and Construction Services and Toronto Region Conservation Authority in supporting this work[14].

Table 1: High Level Risk Assessment Participants	
Transportation	Transportation Services Division, Toronto Transit Commission, Metrolinx
Utilities/Telecom	Toronto Hydro, Hydro One, Independent Electrical System Operator (IESO), Enbridge Gas, Enwave Energy Corporation, Telecommunication companies
Water	Toronto Water

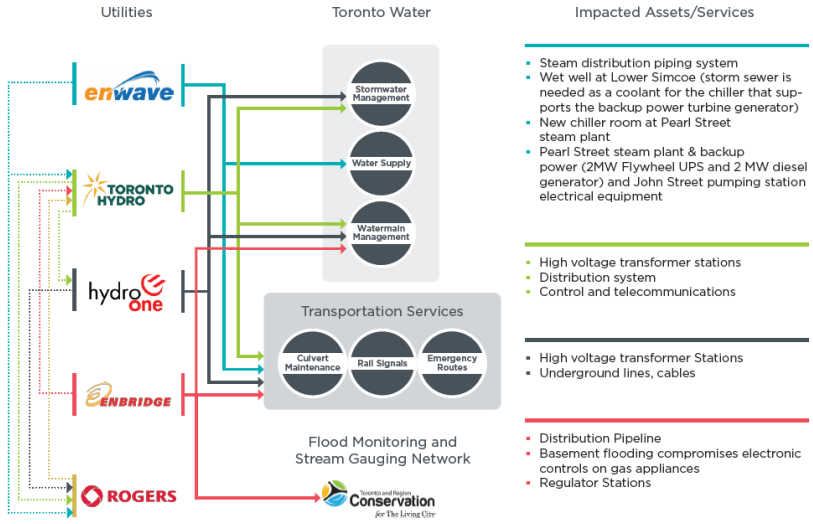

Figure 2: Interdependencies Diagram, adapted from CIty of Toronto grahic and reproduced from C40 Report. Provides and overview of impacted assets and services evaluated through Toronto's High Level Risk Assessment process.

The HLRA process helped to identify dependencies and interdependencies, enhance awareness of climate change and extreme weather related risks, and catalyze dialogue between key infrastructure groups. Our findings and feedback from participants led us to conclude that the process has provided a broad range of benefits to the participating organizations as well as a valuable contribution toward resilience building efforts by identifying complex issues and interdependencies of which they may not have been fully aware. (An example of the documented interdependencies is included in the box)

In some instances, an organization may have understood that the loss of the service they provide has an impact, but did not fully understand the consequences. As an example, telecom services, specifically, cellular systems, are used to transmit stream flow data from TRCA's river flow monitors. This information is critical to Transportation Services Division, Toronto Water, Metrolinx and various utilities in understanding watershed conditions, especially during periods of heavy rain. A communications outage therefore, has the potential to impact the ability for various organizations to manage their operations.

The process to undertake the HLRA was carefully developed, but during execution it sometimes required modification to accommodate the needs and requests of participating organizations. These requests were accommodated with an effort to maintain as much consistency of process and approach as

[14] Resilient City - Preparing for a Changing Climate - Status Update and Next Steps (Dec, 2016), http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.PE15.2

possible. For instance, the HLRA workshops conducted with the Transportation and Water Thematic Areas were different from those conducted with the Utilities. For privately owned organizations, such as utilities, a different engagement approach and a different type of discussion around risks and vulnerabilities was required. Despite the need for some modifications, stakeholders all worked with a consistent 'risk matrix' to inform an understanding of what would constituted low, medium and high risk. Nonetheless, the discussions were considered valuable by all parties, resulting in subsequent follow up beyond the scope of the HLRA process.

Conducting a risk assessment exercise on another organizations' infrastructure and services, requires the development of trust and substantial buy-in. This process relies on active participation of subject matter experts and a considerable time commitment.

To realize the full benefit of the HLRA process, the involvement of diverse stakeholders, with sufficient technical or operational expertise to best inform the exercise is required. Where those resources were made available and senior leadership directly participated in the process, the outcomes of the workshops have yielded more thorough results. Recognizing the sensitivity associated with some of the risks discussed, factors of liability, confidentiality, disclosure and privacy issues needed to be addressed to varying degrees.

Further Expanding the Urban Resilience Ecosystem – 100 Resilient Cities

While work was underway to develop the HLRA process in late 2015, the decision was also made to pursue membership within the 100 Resilient Cities network. In that regard, a recognition existed that resilience building efforts needed to expand beyond climate adaptation work. The City of Toronto articulated in its application that it wished to expand upon its climate adaptation work, to address broader resilience challenges (e.g. social equity concerns, housing issues, transportation, and mitigation focused efforts).

Having been successful in its application, in December 2016, the City formally launched the 100 Resilient Cities process with an initial 'Agenda Setting Workshop (ASW)' and also began its recruitment process for its Chief Resilience Officer. In June 2017, Elliott Cappell, was hired as the Toronto's first Chief Resilience Officer.

Natural challenges and opportunities remain. Recognizing the size and complexity of the corporation itself, as well as scale, scope and variety of issues to consider as they relate to urban resilience, this is unlikely to be an easy task. In joining the 100 Resilient Cities network, alongside existing connections to C40, the US Sustainability Directors Network (USDN), and the Carbon Neutral Cities Alliance (CNCA), the City hopes to further benefit from regional and international collaboration, in that sense a much wider ecosystem of organizations and individuals focused on sustainability and resilience.

Under the auspices of the 100 Resilient Cities process and the existing Resilient City Initiative (adaptation focused), a need exists to reconcile a variety of activities underway in Toronto, that ultimately serve to enhance resilience. There is currently a need to reconcile the placement of climate adaptation work in the broader context of the development of Toronto's 'resilience strategy' through the 100 Resilient Cities initiative, and in the context of broader strategic initiatives; for example, poverty reduction efforts and greenhouse gas mitigation work, recognizing the various political and financial considerations in play (e.g. development of the long-term financial plan, upcoming council elections in Fall 2018).

What is evidently clear from work on the Resilient City Initiative, as well as broader 100 Resilient Cities activities, is that the mobilization of broader private, public and NGO participation in addressing resilience challenges will be central to these efforts. As practitioners, the focus of this concluding section will focus on elucidating some of the challenges and opportunities that remain, but also importantly the questions that could serve to focus our and a broader community of resilience professionals, efforts at answering them. Although a number of challenging technical questions have arisen, the focus will centre rather on broader considerations informing urban resilience building.

As previous mentioned, and obvious to all, cities are complex entities that operate at a variety of scales and temporal dimensions. Resilience challenges can be quite micro (e.g. flooding concerns at a neighbourhood level), versus macro (the interaction between flooding and our most vulnerable populations across multiple areas of the city). The temporal consideration is also important, whether with respect to a yearly budget, the life of a five year program, or a longer term capital commitment.

Challenges and Opportunities

Table 2: Overview – Challenges and opportunities to mobilizing the resilience ecosystem.	
Challenges	Opportunities
Communications	
The term 'resilience' like 'sustainability' can mean many things to different groups of stakeholders, important work needs to focus on better articulating the value of 'resilience thinking' In promoting better communication and collaboration, it is vital to consider the operating language of various stakeholders, for example, engineer's technical language differs significantly from the technical language of equity/or social service professionals.	Conversely, resilience is broad enough a concept that many stakeholder, internal and external to government can see their concerns and objectives within it – consequently, it provides an opportunity to bring a broad range of stakeholders to the table. Frequently 'resilience' can be associated with emergency management, while there is clearly a relationship, communications focused activities need to focus on differentiating between the proactive and the reactive aspects of resilience.
Day-to-Day vs. Strategic Policy/Action	
Cities are constantly having to reconcile the tension between high-level strategic considerations and direct day-to-day operational/service needs – adding a resilience lens cab be perceived as an additional complication/barrier.	Resilience provides a frame to find the intersection between operational/service considerations which are very short-term and the broader long-term implications of strategic decision making
Organizational Dynamics	
Operationalising resilience is fundamentally about working across silos – again, whether an organization is large or small, private, public or other – this can be challenging.	A resilience approach, similarly to a sustainability approach requires a cross-disciplinary approach – actively facilitating and supporting cross-disciplinary relationships and collaboration within organization is key to realizing opportunities

In addition to the brief overview of challenges and opportunities that exist, it is vital to consider how as practitioners we can work to more effectively articulate the benefits of resilience thinking beyond our professional enclaves. In the municipal context, that requires careful consideration of messaging and communications with the public at large as well as political leadership. In that regard, a need exists to

articulate how emergency preparation and management exist within a 'resilience continuum'. Far to often, the default understanding of resilience is limited to, 'oh, you mean disaster risk reduction or emergency management?'

In considering the role of academia in supporting resilience practice various questions remain, for example, how can organizations (municipalities, in this case) use a resilience lens to prioritize investment and effectively inform decision making, with particular consideration to how financial considerations are factored into this resilience builiding. Given the nature of the work and the way human being think, it is also, often easier to think of resilience in terms of physical things, for example infrastructure, an opportunity exists to work with academia to better frame and incorporate the consideration of social cohesion and equity into our decision making process. Consequently, how do we define metrics and benchmarks for resilience that highlight the quantitative cost/benefit relationships associated resilience thinking, but also vital qualitative data.

In all instances, stakeholder diversity is central to the practice of resilience building in the municipal context. Engaging a broad range of stakeholder inside and outside of government (including regional, provincial and federal groups) is vital to sustaining a resilient *ecosystem* of practitioners, professionals and citizens equipped to better manage the challenges and opportunities of the 21st century.