Climate Change and Water Governance in the Greater Toronto Area

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Introduction

At this point in the 21st century, most of us are at least vaguely familiar with the notion of climate change, an encompassing term that includes global warming. Climate change has a variety of known effects. This article will focus on water-related effects linked to climate change in Toronto and the rest of the Greater Toronto Area (GTA), which lead to a multitude of urgent social and environmental problems. The effects of climate change at the watershed level include an increased risk of erratic and extreme weather events such as heavy rainfalls and, consequently, floods. These events put increased stress on crucial infrastructure like roads and sewer systems, and result in decreased water quality. The various water-related effects of climate change are interlinked and come together as a package, reiterating the importance of taking climate change seriously. This article offers a brief snapshot of some recent extreme rainfall events in the GTA, their effects, and what is being done about it.

What is climate change?

Climate change refers to the gradually changing climate characteristics of various regions on Earth. There exist in the Earth's atmosphere increasing concentrations of greenhouse gases (GHGs) such as carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, and perfluorocarbons. This increasing concentration of GHGs is due in large part to human activities since 1750. During this post-1750 period of approximately 260 years, the concentrations of GHGs in the atmosphere have been

increasing at a rate much faster than they were previously and reaching levels not seen for at least 650 thousand years, based on ice core data (IPCC, 2007).

GHGs appear in the atmosphere and aid in reflecting some of the Earth's outgoing longwave radiation back to Earth. This process of blocking some outgoing radiation and retaining it within the Earth's atmosphere is known as the natural greenhouse effect, and it keeps the Earth's temperature inhabitable. However, increasing concentrations of GHGs in the atmosphere aid in reflecting increasing amounts of outgoing radiation back to the Earth, thus increasing the temperature within the Earth's atmosphere, producing what is known as global warming. Side effects of this warming include increased frequency and intensity of extreme weather events such as rainstorms (IPCC, 2007).

Basic problems in the GTA

It comes as no surprise that the GTA is experiencing increased stormwater flooding when one considers the facts. The GTA is facing increasingly frequent extreme precipitation events because of climate change. Yet, the GTA's stormwater management systems were not designed to handle such intensive precipitation events. Toronto's sewers are of varying ages, yet old or new, they are ill-equipped for the type of extreme precipitation events that are becoming more and more commonplace. In addition, an increasingly concrete-covered GTA results in less water absorption into the ground, leaving more water on the surface to flood. All of this results in catastrophes such as the notorious August 2005 flood in the northern part of the city as well as increasingly commonplace basement flooding (The Clean Air Partnership, 2006).

Along with flooding and the dangers associated with it, increasingly frequent extreme precipitation events also result in decreased water quality for all Torontonians.

Heavy rainfalls wash a variety of natural and artificial pollutants into sewers, which release these pollutants into water bodies like Lake Ontario, Toronto's source of drinking water. Heavy rainfall also erodes (and thus brings soil into) riverbanks, decreasing water quality even more. Furthermore, the increased temperatures (characteristic of our changing climate) result in more favourable conditions for bacteria and contaminants to thrive in (The Clean Air Partnership, 2006).

Climate change can also lead to an unfavourable combination of increased water demand and decreased water supply. Toronto's water supply from Lake Ontario is not unlimited – if the demand and supply are altered, Toronto residents could experience some serious consequences. As has happened in northern Toronto in 1988, too little available water makes it difficult for water supply to meet the demand. Because climate change results in hotter summers, we should be prepared for the possibility of dryer summers too (i.e. lower average supply of water). At the same time, as temperature increases, so does the demand for water (e.g. for drinking, gardening, swimming in). Added to this is the strain that may be put on Toronto's water supply if neighbouring communities' groundwater supplies dwindle as a result of a warming climate, thus further increasing the demand for Lake Ontario's water (The Clean Air Partnership, 2006). So, as the climate continues to warm, we can expect an increasing disparity between the amount of available water and the amount of water needed to quench the GTA's thirst.

As is now clear, climate change is creating and worsening a variety of water-related problems for residents of the GTA. A number of extreme weather-related events in recent years have brought climate change, especially with regard to water, to the forefront in the GTA.

Recent Events

Certain events stand out as of late that remind us of the devastation that water is capable of in the context of climate change. Perhaps most noteworthy of all recent weather events occurred in 2005. On August 19, 2005, the GTA was in the spotlight as a case-in-point for the damage that stormwater can do and thus for the need to better deal with it. Beginning in the afternoon that day, the GTA was hit with an onslaught of extreme precipitation in the form of an intense 2-3 hour storm. The highest precipitation measurements in Toronto were recorded in the North York and Scarborough regions, including some measurements of 150mm or more. An unusually intense rainfall event combined with an increasingly urbanized landscape and insufficient sewer systems resulted in a chain of sewer flooding and backups, along with a ruptured sewer main. The storm cost the city $34 million in damages. The sum of insurance payouts to homeowners with flooded basements is estimated at over $400 million. (City of Toronto, n.d.[a]; Riversides, 2009). The most destructive effect of the storm occurred in North York, in the neighbourhood of Black Creek.

Located due west of York University's Keele campus, Black Creek is a low-income neighbourhood of 17 000 residents living in high-rise and single-family residential buildings, in addition to commercial and industrial buildings. Black Creek is also home to a tributary by the same name, which flows into the Humber River. Furthermore, urban development has reduced the amount of soil available for water

absorption and ultimately reduced water quality (SNAP, 2011; City of Toronto Planning Division, York University Development Corporation & The Planning Partnership, 2008).

Most noteworthy in this particular storm was the destruction of the section of Finch Street that runs over the Black Creek. As the water in the creek rapidly rose, it was not long before it flooded onto the road, which soon collapsed into the creek, leaving a trench 6m wide and 3m deep. In the short time that the storm lasted, the road was transformed into a gaping pit of dirt and rubble. Repairs to Finch Street cost an estimated $6 million, in addition to $9 million in damages to nearby property. With increasingly frequent extreme weather events due to climate change, this type of destruction can be expected to become more frequent if adequate mitigation and/or adaptation does not take place (City of Toronto, n.d.; Riversides, 2009).

Looking beyond Black Creek, Toronto's east end has also been a key area for water damage in recent years. For instance, on July 8, 2008, an intense storm swept through Toronto, dumping approximately 50mm of rain on the city. The intense rainfall proved too much for a particular 50-year old section of the sewer to handle, resulting in over 200 reported residential and commercial basement floods, including some with as much as 40cm of water. The broken sewer section also sent sewage into the Humber River, leading to E. coli contamination in Lake Ontario, and therefore to a number of beach closures. Expert opinion places blame at the crossroads of an aging sewer system and an increasingly urbanized GTA (Bielski, 2008).

Heavily concreted downtown Toronto has also felt what extreme precipitation events can do. On July 27, 2010, during the now infamous G20 summit in Toronto, extreme rainfall caused flooding that affected roads as well as the subway system. The

Don Valley Parkway had to be closed because over 30cm of water left it unusable. Sections of Lakeshore Boulevard and Bayview Avenue were among the other streets that were closed due to flooding. Toronto's subway system was not necessarily a viable alternative as Union station, the centrepiece of the Yonge-University-Spadina line, was also closed due to flooding (O'Neil, 2010).

GTA residents will likely be able to recall other notable extreme weather events as well. However, these three cases give a snapshot of the damage that the GTA faces as a result of increasingly frequent extreme weather events, aging stormwater management systems, and an increasingly urbanized landscape. One of the key components of water-related climate change problems, as shown above, is infrastructure.

Infrastructure

Aging infrastructure can be a contributor to, as well as a victim of, the immense water-related damage linked to climate change – the events listed above clearly illustrate this. Sewer systems in the GTA were simply not built to withstand the level of stormwater produced during extreme weather events in recent years. It goes without saying that something needs to be done. In 2003, the City of Toronto adopted the Wet Weather Flow Master Plan (WWFMP) with the long-term goal of improving the city's aging sewer systems to allow for better management of stormwater and therefore to minimize the damage incurred by stormwater overload (City of Toronto, 2011a). As part of the WWFMP, sewer upgrades are scheduled in various parts of the city. According to the City of Toronto's website, these include:

- Traffic island at Kingston Road and Dundas Street
- Coxwell Avenue at Dundas Street
- Hiawatha Road at Dundas Street
- Queen Street between Kingston Road and Orchard Park Boulevard

- Woodfield Road at Queen Street and at Eastern Avenue
- Craven Road at Queen Street
- 100m of Kent Road, extending north from Queen Street
- 200m of Ashdale Avenue, extending north from Queen Street
- Edgewood Avenue between Maughan Crescent and Fitzgerald Mews

Construction is expected to be completed by summer of 2011 (City of Toronto, 2011b). Furthermore, the City of Toronto, in accordance with the WWFMP, has also been conducting several environmental assessment studies across the city with the goal of improving sewer performance and stormwater management (City of Toronto, 2011c).

In addition to sewer upgrades, the City of Toronto is also conducting upgrades of roads and roadside drains in order to improve stormwater management. Significant work on Black Creek Boulevard is scheduled for the summer of 2011. This will include adjusting the slope of the road to stop stormwater from flowing onto property at a lower elevation than the road. In addition, the road's drains and gutters will be upgraded and new ones will be added (City of Toronto, 2011d). Similar work will be done to various roads in the affluent North York neighbourhood of Hogg's Hollow to stop future flood-prone properties from flooding. This work is scheduled to take place from June to December of 2011 (City of Toronto, 2011e). Along with infrastructure, another major water-related climate change issue is housing, specifically basement flooding.

Housing

Looking back to the August 2005 mega-storm and the consequent basement flooding, we can get a sense of what is liable to happen if stormwater management is not significantly improved upon. Hundreds of millions of dollars in damage across the GTA in 2-3 hours is almost beyond comprehension, yet flooding can cost victims their health as well. Basement flooding can cause mould to develop in affected areas of a given

basement if water-damaged material is not quickly removed. This mould threatens the resident(s) with potential long-term effects like respiratory disease and allergic reactions. Unfortunately, many people are not aware of the urgency with which action needs to be taken to minimize these risks (Sandink, 2007). With the goal of minimizing basement flooding, the City of Toronto offers subsidies and strategies for homeowners who have fallen victim to flood damage.

Weeks after the August 2005 storm, the City of Toronto approved the Basement Flooding Protection Subsidy Program (BFPSP) in order to prevent future basement floods. Only homeowners were eligible for this program, and only under the condition that they had reported the flood when it occurred. Successful applicants to the BFPSP would receive flood-preventing plumbing devices in their homes (City of Toronto, 2005). The BFPSP continues to this day – each eligible homeowner (owner of a single-family, duplex, or triplex residence) is required to have a City of Toronto-licensed plumber decide whether or not a particular home should be disconnected from the city's sewer system to minimize future flooding. If it is decided that the home should be disconnected from the sewer system, the City of Toronto will pay for 80% of the homeowner's cost of installation of a backwater valve, a sump pump, and/or having pipes severed and capped (City of Toronto, n.d.[b]).

The City of Toronto also encourages homeowners to take other measures to prevent flooding, such as fixing leaks, ensuring proper upkeep of plumbing, disconnecting the downspout, ensuring that yard grading directs water away from the residence, and considering 'soft-surface' landscaping that allows for maximum water absorption (City of Toronto, n.d.[c]). However, it is only when we look further into how

different residents are affected by basement floods, and who is left out by the City of Toronto, that we begin to understand the class-sensitive nature of the phenomenon.

An issue of class

While homeowners are an important portion of Toronto residents, they are not the only portion. Renters make up another group of residents in need of flood relief. In the case of basement flooding, I of course refer to renters of basement apartments in particular. Dan Sandink (2007), research coordinator at the Institute for Catastrophic Loss Reduction, conducted an analysis of Calgary housing in the aftermath of a major Calgary storm in June of 2007 that delivered approximately 100mm of rain.[1] His analysis supports what can be easily assumed when comparing basement renters to homeowners in the context of basement flooding – that is, that renters are the hardest hit by floods. Sandink found that homeowners who suffer flooded basements tend to be perturbed after losing various items from the basement. They can only hope that their insurance covers most of the damages sustained to things like walls, floors, extra furniture, and other items that are stored in the basement. On the contrary, when basement renters fall victims to flooding, they lose *everything*. The basement is the extent of their residence and therefore basement flooding can be life-changing for them, rather than simply a nuisance. I do not wish to downplay the loss that occurs when a homeowner's basement is flooded – it is a costly occurrence to be sure. Rather, my aim is to stress the importance of basement flooding for basement renters, as they are the most vulnerable group in this regard. Unfortunately, this is not reflected in the City of Toronto's flood-prevention initiatives.

[1] An enormous single-event rainfall, despite being notably less extreme than the GTA's August 2005 storm that delivered rainfall of 150mm or more in some areas.

Indeed, renters seem to be left out of the City of Toronto's BFPSP and related flood-prevention literature altogether. From the subsidies offered after the August 2005 storm to the subsidies offered today under the BFPSP, only homeowners, rather than renters, are eligible. The tips offered by the City of Toronto to prevent flooding, from leak-fixing to landscaping, are only realistic for homeowners, as renters may not have the funds or the landlord's permission to make such drastic changes. Even if a renter approaches the landlord with the desire for such changes to be made, the renter appears to be ultimately powerless as he/she is not the property owner. Furthermore, some of the precautions suggested by the City of Toronto may also be too expensive for landlords who wish to make the improvements – so how are renters or landlords to make these improvements to the property without subsidization? I contend that the City of Toronto's BFPSP program needs to be extended to include renters as well as homeowners in order to better meet the objective of flood prevention for the city's residents. Perhaps in the future, the City of Toronto will take a more holistic approach to preventing stormwater damage, such as basement flooding.

What the future holds

When speculating on what the future holds for climate change and stormwater management in the GTA, we must first keep in mind that initiatives like the WWFMP and the BFPSP are dynamic programs with long-term goals. Hopefully these programs evolve as necessary in the future and work with residents to ensure the best possible protection for the GTA and those who call the GTA home. Beyond these programs, the August 2005 storm reiterated the importance of accurate weather forecasting.

Fortunately, students and faculty at York University are currently doing work on just that – work that will continue to be carried out into the future. Glenn MacMillan, Senior Manager of Water and Energy Management at the Toronto and Region Conservation Authority (TRCA), took the August 2005 storm as evidence of the urgency of improved hydrological monitoring and modelling for the rapidly urbanizing GTA. As a result, he sought the expertise of veteran climatologist Dr. Rick Bello of York University's Geography Department. Dr. Bello stressed the importance of understanding urban evaporation, given that the majority of fallen precipitation returns to where it came from via evaporation, leaving only a small amount for human use and consumption, among other things. The equipment required to establish and maintain evaporation stations is costly and requires expert supervision. Yet, with the financial contributions of the Region of Peel and the Ministry of the Environment, Dr. Bello was able to initiate an evaporation monitoring project. He enlisted the help of then-undergraduate student (and current graduate student) Josh Arnett and Derek Smith of the TRCA to carry out measurements at the first evaporation station, located in the non-urban locale of the Kortright Conservation Area. Along with graduate students Shishir Handa and Daphne So, Dr. Bello is now taking measurements from a second station, located on a rooftop in the urban Downsview community. Comparative analyses of the two evaporation stations have been carried out, showing a definitive difference between urban and non-urban evaporation – the urban station showed much higher levels of runoff, as a result of the water not being able to be absorbed into the ground. Dr. Bello asserts that the evaporation monitoring project, which is a long-term project unlike any other in the country, will be useful for understanding urban flood vulnerability and for being able to anticipate how

climate change will affect urban water issues in the future (CC-RAI, 2011). This gives us a look into some of the upcoming developments that will be taking place in the near future with the aim of improving our understanding of climate change and water-related problems in the GTA and other urban locales. As climate change becomes more widely accepted and prominent in government agendas, other similar projects may come into fruition as well.

Final thoughts

As long as we acknowledge the threat posed to us by the Earth's changing climate, we are responsible for seeking out solutions to the changing climate as well as to the problems it creates. In the case of the GTA, recent years have shown us that extreme weather events are occurring with increasing frequency and intensity. The damage, in particular to infrastructure and housing, has been shocking and costly for many residents as well as the City of Toronto. Measures are being taken to minimize damage caused to the GTA and its residents, yet more needs to be done. Basement renters need to be recognized as the most vulnerable group of residents with regard to basement flooding. With the long-term projects currently underway by the likes of the City of Toronto and York University, the potential for more action in the near future is there. I join the residents of the GTA in hoping that this potential is realized.

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