Geoffrey F. Bruce Fellowship in Canadian Freshwater Policy

Green Infrastructure Implementation in the City of Toronto

Integrating Water and Other Municipal Strategies

Policy Brief

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Introduction

Around the world, urbanization and population growth in cities are leading to increased intensification of urban spaces and water uses. Simultaneously, we are facing some of our most challenging and complex environmental problems due to factors such as climate change and pollution. The threats posed to our aquatic and terrestrial ecosystems as well as the air that we breath are increasing in magnitude and severity. In urban centres, we are increasingly facing environmental hazards on multiple fronts. These include but are not limited to stormwater management challenges (e.g. increased urban runoff and flooding), urban heat island effects, habitat fragmentation and biodiversity loss, lack of access to green space for citizens, and air pollution. Increased impervious surfaces and conventional grey infrastructure serve to exacerbate these growing trends in cities.

Green Infrastructure (GI) can be used as a means to help mitigate the severity of these environmental challenges and allow for the planning, design, and building of resilient, adaptive urban centres. GI is defined as encompassing both natural and socially engineered green space, resulting in "an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife" (Benedict & McMahon, 2006, p. 6).

One of the ecosystem services which GI has been found to be promising for is its capacity to help manage our hydrologic cycle more sustainably by lowering incidents of combined sewer overflows (CSOs), increasing water capture and conservation, and preventing floods (Gill et al., 2007; Foster et al., 2011; De Sousa et al., 2012; Hoang & Fenner, 2015; Vogel et al., 2015). Source control strategies such as GI aim to minimize the rate and volume of stormwater entering the collection system, whilst promoting infiltration, evapotranspiration, and capture and reuse of stormwater on individual lots (De Sousa et al., 2012).

In addition, GI has the potential to contribute to a multifunctional planning and governance approach as it helps to mitigate the impacts of the urban heat island effect, prevents loss of biodiversity, aids in carbon sequestration, helps to filter air pollutants and can bring about positive psychological, social, and health benefits with improved access to green space (McMahon, 2000; Benedict & McMahon, 2006; Gill et al., 2007; Foster et al., 2011; Pugh et al., 2012; Zhou & Parves Rana, 2012; Demuzere et al., 2014; Hansen & Pauleit, 2014; Jayasooriya & Ng, 2014; Kabisch, 2015; Norten et al., 2015; Connop et al., 2016).

The Policy and Governance Problem

Observed and expected increases in the frequency and magnitude of rainfall events due to climate change in Southern Ontario (Jyrakama & Sykes, 2007; Vasiljevic et al., 2012), a projected population increase of 42.3 percent for the Greater Toronto Area (GTA) by 2041 (Ontario Ministry of Finance, 2017) and the subsequent increase in urban development, requires policy-makers and practitioners to heed the implications of these challenges and plan for resilient, sustainable urban communities. Given the cumulative and multifunctional benefits, the role of GI can be extended beyond just a measure of stormwater management and towards a more holistic approach for land use planning that incorporates hydrological,

ecological, economic, social, and built environment functions (Hansen & Pauleit, 2014; Hoang & Fenner, 2015).

Despite the many benefits however, GI implementation has remained relatively slow in comparison to the swift and adaptive actions that required for cities to effectively address climate change, pollution, and growing water problems. Uncertainties still exist about certain design aspects and technical barriers (Carlet, 2015; Hoang & Fenner, 2015) however these have been overcome in many jurisdictions in the past few years. On an institutional level, further governance innovation and social learning is required by actors and organizations to facilitate collaborative planning amongst the many stakeholders whom play an active role in GI implementation (Hoang & Fenner, 2015). Cognitive barriers and path dependence can also play a role in a slower implementation process. When path dependence occurs, institutions become accustomed to dealing with activities over time in a certain manner and are reluctant to respond accordingly to new and emerging imperatives (Head, 2007; Matthews et al., 2015, Dhakal et al., 2017). The result can be a 'layering and conversion' of GI policies and efforts on top of the dominant grey infrastructure approaches (Johns 2019). The current institutional and governance capacity for sustainable urban water management for example, was established within the context of the conventional approach of grey infrastructure and water management.

Complexity and uncertainty require more adaptive governance arrangements and an increase in inter-organizational interaction and wide stakeholder participation – something that has not been characteristic of the conventional approach (van de Meene et al., 2009). A lack of embedded and agreed upon values, a lack of training in GI across disciplines (e.g. GI university courses and workplace training), a limiting regulatory environment that impedes technological innovation (e.g. insufficient regulations on amount of stormwater runoff produced), and ineffective leadership and collaborative governance structures all feed into a weak governance regime for sustainable water management and GI (Rijke et al., 2013).

Rijke at al. (2013) identify that a transition consists of the interactions between the dominant regime at the meso level, the societal landscape at the macro level, and the niches at the micro level. Niches are where innovation occur and eventually can make their way into mainstream society (Rijke et al, 2013). In order for us to move beyond niche to "business as usual" we need to address the barriers which have been discussed in the literature and identified by practitioners and advocates of GI. Action-oriented solutions which confront the dominant regime and its inherent weaknesses for sustainable stormwater and ecological planning in cityscapes are required.

This Masters thesis research aims to contribute to needed research to address some of the barriers faced in implementing GI by integrating city planning strategies and illuminating challenges faced when working to link stakeholders across these strategies. This research also focuses on identify where current strengths and efforts related to GI in the City of Toronto exist and where gaps in policy and strategy implementation may be present.

Policy Research

Currently, the City of Toronto has established various policy tools and implementation arrangements to aid in the implementation of GI (Johns 2018) however, implementation remains slow (Johns, 2018). There is a need to examine relevant strategies where GI is 'mentioned' or there is a stated policy goal. This study is building upon an already established plan of GI goals by the City of Toronto and the research explores if the strategies being examined (*Toronto Green Standard, Green Streets Technical Guidelines, Wet Weather Flow Master Plan, Ravines Strategy, Parklands Strategy, Pollinator Strategy,* and *Biodiversity Strategy*) reflect an integrated GI vision (and if there is a need/opportunity for integration across strategies) or if planning and policy gap exists across relevant strategies and documents. Synergizing these strategies to find where overlapping priorities lie will help to optimize the implementation of projects which can serve multiple ecosystem service benefits.

This study also uses illustrative case studies or 'hotspots' identified by City of Toronto staff as having potential for GI projects and implementation efforts. Hotspots are locations where GI indicators which reflect multifunctional benefits of GI are present (e.g. storm water benefits, air quality benefits, availability of and access to green space).

The evaluation framework and indicators used to guide this study will aid in assessing if there is a need for/opportunity for developing a GI master plan for implementation for each case study examined and for future 'hotspots' that the City of Toronto identifies. Some of the factors considered for the case studies will include various policy, institutional, and governance factors that impact the capacity to successfully implement GI. The findings from this research will inform recommendations to be made in order to help guide a successful GI implementation project in these areas and to produce research relevant to decision-makers, planners, and relevant stakeholders that will help in aiding the transition from grey to green infrastructure.

Building on existing research to date, particular attention will be focused on overcoming some of the institutional barriers and other barriers which GI has faced. By using a case-study analysis and research focused on multifunctional GI hotspots in the City of Toronto, the study will also incorporate linking mechanisms between policy, urban planning design and GI design at more of a local level. It is hoped the findings can be extended to other cases in Toronto and beyond. The initial phases of research and content analysis of city documents show that there are some important linkages to be made between strategies in respect to GI and a vision for a long-term holistic GI strategy to continue to be developed.

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