Sustainable Stormwater Transitions: Exploring the Promotion of Sustainable Stormwater Management in Kitchener and Waterloo

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any requires final revisions, as accepted by my examiners.

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Abstract

Canadian cities are undergoing changes in the way they fund and provide stormwater management services. These changes include the promotion of sustainable stormwater management technologies. The cities of Kitchener and Waterloo are the first two municipalities in Canada to implement stormwater utility rates and stormwater credit programs that encourage the installation of sustainable stormwater management. This research utilises mixed methods research to understand how various factors have influenced the uptake of sustainable stormwater management on private residential property in Kitchener and Waterloo; why each city encountered barriers in the promotion of sustainable stormwater management, and; what solutions can be gleaned from each city's experience in overcoming the barriers. The findings demonstrate that in Kitchener and Waterloo, socio-economic, demographic, and geographic factors had little influence on the uptake of sustainable stormwater management. Instead, the most likely group to participate were environmentalists. Findings show that the most effective strategies for encouraging sustainable stormwater management in Kitchener and Waterloo were: a targeted approach to outreach programs; 'lightning rod issues' that encourage action on stormwater issues; partnerships and networks to reach a wider range of participants; using multiple media and communication channels that engage property owners, while remaining cognisant of the type of property owner one is trying to reach out to (e.g. social media savvy, or not?); and strong legislation. This research addresses the need to understand barriers to sustainable stormwater transitions in a Canadian context, while transcending the inappropriately narrow focus on technical barriers that occurs within much of the literature on stormwater management. This research contributes to planning practice by providing a list of recommendations for planners attempting to promote sustainable stormwater management transitions in their municipality. It also highlights the need for collaboration across disciplines and calls for better integrated stormwater education programs in all levels of education (elementary, high school, and university planning programs). Future research can follow the next five years of the stormwater transition process in Kitchener and Waterloo to understand how new approaches, especially surrounding aesthetics-based promotion strategies, impact the uptake of sustainable stormwater management on private, residential property.

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List of Abbreviations

SCP: Stormwater Credit Program

REEP: Residential Energy Efficiency Project

WSUD: Water Sensitive Urban Design

LO: Landscape Ontario

List of Definitions

The purpose of this section is to clearly define specific terms that will be used throughout this thesis in order to ensure that the readers have a common understanding of key concepts. These definitions are also incorporated within this thesis as appropriate.

Depave Paradise: Is a project of Green Communities Canada in partnership with the Green Communities Foundation. The program works to assemble groups of volunteers that replace the pavement in a part of their community with native vegetation, thereby increasing infiltration and improving groundwater recharge (Green Communities Canada, N.D). Each Depave event is organised by a local actor (e.g. an environmental non-profit).

Grey Infrastructure: In contrast with sustainable stormwater management, grey infrastructure is the status quo method for dealing with stormwater management. Grey infrastructure denotes traditional stormwater conveyance systems that are engineered to capture and transport stormwater. These include conventional gutters, sewers, tunnels, culverts, and detention basins (AR, ASLA, EN, & WEF, 2012).

RAIN: A local stormwater education and action program that operates in both Kitchener and Waterloo to promote sustainable stormwater management. It was created by Green Communities Canada and is delivered by REEP Green Solutions in partnership with the cities of Kitchener and Waterloo since 2011 (Green Communities Canada, 2016). RAIN is the first non-profit/municipal partnership on stormwater education and promotion in Canada.

REEP Green Solutions: A local environmental organisation that operates in Kitchener and Waterloo. This group delivers the RAIN program to promote sustainable stormwater management.

Stormwater: Precipitation that falls onto surfaces, either man made (e.g. homes and pavement) or natural (e.g. fields and forests). Stormwater can be considered a natural resource, especially in an urban setting, as many cities rely on stormwater to recharge their groundwater sources and to reduce the demand on municipal water resources for watering gardens.

Stormwater Credit Program (SCP): A program instituted by the City of Kitchener and the City of Waterloo that provides property owners with a rebate on their stormwater utility charge up to 45% when they install sustainable stormwater management.

Stormwater Management: Stormwater Management systems include all infrastructure, programs, and policies aimed at dealing with precipitation from the point of initial contact to the point of eventual discharge into waterways and groundwater sources.

Stormwater Utility Rate: A separate stormwater charge on a property owners' water utility bill. In Kitchener and Waterloo, this charge can be reduced when a property owner installs sustainable stormwater management.

Sustainable Level of Service: Providing an urban service such as stormwater management at a service level that is appropriate for a community, while ensuring there is secured and dependable funding to continue service provision at that level. Cost considerations should include upkeep, maintenance, and foreseeable expansion costs.

Sustainable Stormwater Management: These are any stormwater management practices that promote natural infiltration or divert runoff from entering piped systems through storage. These include rain barrels, rain gardens, permeable pavers, and cisterns among others. There are a diversity of terms applied to the concept of sustainable stormwater management through the vast body of literature on stormwater management; these terms include: Low Impact Development (LID); Best Management Practices (BMP); Water Sensitive Urban Design (WSUD); Innovative Stormwater Management (ISM); Green Infrastructure (GI); blue-green infrastructure; sustainable stormwater management; sustainable urban drainage; and stormwater control measures (Barbosa, Fernandes, & David, 2012; Cettner et al., 2014; Keeley et al., 2013; Thorne et al., 2015).

1 Introduction

1.1 The Nature of Municipal Stormwater Challenges

During the summer of 2013, Canadians were transfixed by news coverage of the destructive and disruptive floods that inundated portions of the downtown cores of Calgary, AB and Toronto, ON. The aftermath of these flood events highlighted the importance of effective and functioning stormwater management systems and the increasing threat of urban flooding from stormwater runoff (Barbosa, Fernandes, & David, 2012; FCM, 2007; Wheater & Evans, 2009; Feltmate & Thistlewaite, 2013). Stormwater management is a growing concern for many Canadian municipalities. Aging stormwater infrastructure, increasing population and development, and increasing frequency and intensity of storm events due to climate change are all contributing to pressures on municipalities to upgrade, retrofit, and expand their existing stormwater management systems (CIELAP, 2011; EPCCA, 2009; Kessler, 2011; Parikh et al., 2005; Barbosa, et al., 2012). While municipalities across the country must deal with these increasing pressures to improve stormwater management, ever-decreasing budgets for capital investment and a lack of financing options for future infrastructure upgrades have left municipalities across the country scrambling to upgrade their stormwater management systems at an affordable cost (CIELAP, 2011; FCM & NRC, 2005; FCM, 2007; Feltmate & Thistlewaite, 2013; Feltmate, 2013; Crabbe and Robin, 2006). The infrastructure deficit for stormwater management systems in Ontario alone is over 23 billion (CVC, 2015).

Traditionally, stormwater management in Canada is delivered through the use of grey infrastructure. Grey infrastructure refers to stormwater conveyance systems that are engineered to capture and transport stormwater to prevent flooding; this includes conventional gutters, sewers, tunnels, culverts, and detention basins (AR, ASLA, EN, & WEF, 2012). As grey infrastructure is highly engineered and typically large scale, it is costly to maintain and install. As cities face lower budgets for stormwater management, finding the most cost effective method to deliver stormwater services is of great concern. Increasingly, sustainable stormwater management methods are being incorporated into stormwater management plans in an effort to cut cost and improve service (EPCCA, 2009; Barbosa, Fernandes, & David, 2012; Shuster et al., 2008). Sustainable stormwater management methods are stormwater management practices that promote natural infiltration, or divert runoff from entering piped systems through storage and controlled release. Examples include rain barrels, rain gardens, permeable pavers, cisterns, and trees. Compared to grey infrastructure, sustainable stormwater management practices have the additional benefits of removing contaminants from runoff and increasing water quality, recharging groundwater, creating less energy intensive urban ecological systems, reducing flood loss and infrastructure costs, and greening neighbourhoods (CW, 2012; AR, ASLA, EN, & WEF, 2012; Thurston, 2012; Cettner et al., 2014; Abhold, Loken, & Grumble, 2011; Thurston et al., 2012).

Notwithstanding the many benefits offered by sustainable stormwater management, uptake of these practices is still low (Olorunkiya et al., 2012).

The inclusion of sustainable stormwater management into existing municipal stormwater management systems requires collaboration across multiple disciplines. Planners, landscape engineers, urban designers, politicians, and communication specialists are some of the disciplines which play a role in the promotion of sustainable stormwater management. Planning regulations, such as permit requirements, site plans, secondary plans, and master plans, watershed plans, and sub-watershed plans can also work to either encourage the installation of sustainable stormwater management, or maintain the status quo of grey stormwater infrastructure.

In response to projected stormwater management system upgrade costs and flood damage costs, and in to ensure funding for a sustainable level of service provision of stormwater services, the neighbouring Ontario municipalities of Kitchener and Waterloo have changed their stormwater management funding structures. Both municipalities have implemented a utility charge to fund their stormwater management systems, as opposed to the traditional model of property tax based funding. In concurrence with this, each city has also decided to implement a Stormwater Credit Program (SCP), allowing residents to reduce their monthly stormwater utility charge by installing sustainable stormwater management on their property. Kitchener and Waterloo are the first municipalities in Canada to implement a utility charge and credit program structure. Together with local outreach and education programs, these tools are transforming not only how stormwater management is funded, but also how it is provided, by encouraging the installation of sustainable stormwater management on private property. This thesis seeks to understand what barriers have prevented the uptake of sustainable stormwater management on private residential property in Kitchener and Waterloo, and how each municipality has tackled these barriers to sustainable stormwater management uptake. This thesis provides a novel, Canadian case study to add to the international body of literature on sustainable stormwater management, therefore addressing the need to understand barriers to sustainable stormwater transition in a local Canadian context, while transcending the inappropriately narrow focus on technical barriers that occurs within much of the literature on stormwater management. This research aims to provide a list of recommendations and suggestions to other Canadian municipalities looking to institute similar sustainable stormwater management changes to those that have occurred in Kitchener and Waterloo.

1.2 Research Questions

This thesis aims to explore the stormwater management transitions of Kitchener and Waterloo by answering the following research questions:

1) What kind of barriers have Kitchener and Waterloo encountered to the uptake of sustainable stormwater management on private residential properties?

a. Why have they encountered these barriers?

2) How have Kitchener and Waterloo tackled these barriers?

a. What engagement methods and strategies are useful in promoting the uptake of sustainable stormwater management on private residential property in each city?

1.3 Study Significance

The Federation of Canadian Municipalities estimated Canada's infrastructure deficit to be 123 billion, and growing; in Ontario alone, stormwater management system infrastructure deficit is over 23 billion (CK 2015a; CVC, 2015). Sustainable stormwater management is part of the solution to creating economically sustainable stormwater management regimes (Shuster et al., 2008). Understanding Kitchener and Waterloo's approach to the promotion of sustainable stormwater management, the barriers to adoption they have faced, and the solutions they have found, can help guide other Canadian municipalities looking to make similar stormwater management changes.

Matthews et al. (2015) assert that there has not been enough research into the barriers to the uptake of sustainable infrastructure in cities, especially given the relatively slow uptake of sustainable infrastructure, which Matthews et al. (2015) label as "perplexing", stating that, "The uptake of best practice may also depend upon the dissemination of new ideas, clear communication strategies, effective demonstration projects and the ability to creatively overcome the inertia that may be present in planning systems. But we currently lack research into these important potential barriers and enablers to green infrastructure". Moser and Ekstrom (2010), in their exploration of barriers to climate change adaptation, suggest the need for future research to "explore the range of pathways actors have found to overcome specific adaptation barriers they have encountered". Literature focused on the barriers to sustainable stormwater transitions suggests that often research focuses on technical and legislative barriers to stormwater transitions, ignoring a wider range of social and political barriers that may exist (Brown & Farrelly 2009a; Matthews et al., 2015). This research is designed to allow for a range of influences and barriers to stormwater transitions to emerge from the data. This research therefore addresses the need to understand barriers to sustainable stormwater transition in a Canadian context, while transcending the inappropriately narrow focus on technical barriers that occurs within much of the literature on stormwater management.

Akin to Mills' (2010) work on the adoption of Low Impact Development in Atlantic Canadian municipalities, my work identifies barriers, current municipal perspectives, and suggests opportunities for improvement, but in the context of Ontario instead of the Atlantic provinces. Mills (2010) advocates for context-specific research on stormwater management changes so as to provide well-documented research on the local conditions which impact these changes. Further justifying the need for Canadian case studies, Bedard (2005)

states that in Canada, "there is limited material on how to raise public, professional, and decision-maker interest in applying stormwater source controls (a form of sustainable stormwater management)", she suggest that examples from Canadian jurisdictions would provide useful information to other governments looking to implement similar stormwater changes. In response, my research provides a Canadian case study from which other Canadian communities can learn. Regardless of a community's location, transition to sustainable urban stormwater management requires knowledge of what has worked and why (Brown, N.D); this research seeks to understand what has worked and why in the context of stormwater transitions occurring in Kitchener and Waterloo.

1.4 Thesis Organisation

This thesis is organized into 7 chapters. This introduction chapter outlines the broad changes occurring in the field of stormwater management, which has driven this research. It also contains the guiding research questions that this thesis aims to explore. Chapter 2 provides a literature review that outlines categorical barriers and potential solutions to sustainable stormwater transitions. This chapter also provides a brief overview of the options cities have for re-structuring how they fund their stormwater management services using a utility rate and credit program, like in Kitchener and Waterloo. Chapter 3 contains my theoretical framework, conceptual framework, and research methodology. Chapter 4 provides a contextual overview of the changes in stormwater management funding and provision that have occurred in Kitchener and Waterloo. Chapter 5 conveys the overall findings of my research, while chapter 6 contains a summary of the key research findings and discusses the research findings. Finally, chapter 7 presents my thesis conclusions, recommendations, and areas for future research.

2 Literature Review

2.1 Overview

This literature review begins by outlining alternative funding tools for municipal stormwater management systems. The subsequent sections of the literature review discuss the potential barriers, and the related solutions to the implementation and uptake of sustainable stormwater management. The goals of this literature review are to:

- Provide an overview of the tools municipalities can use to fund stormwater management provisions, comparing the likelihood each would produce a more sustainable stormwater system
- Situate stormwater management policy changes in theoretical urban policy landscapes
- Identify common categorical barriers to sustainable stormwater management transitions

- Identify solutions to overcome barriers and further promote sustainable stormwater management transitions

To achieve the goals of this literature review, this thesis is informed by research on sustainable stormwater management transitions, as well as the broader literature on the uptake of sustainable innovations, and sustainable transitions. This literature review asserts that barriers to the uptake of sustainable stormwater management transcend solely technical barriers and include social and political aspects.

2.2 Understanding Changes: Alternative Stormwater Management Funding Structures

Kitchener and Waterloo had many options for restructuring their stormwater management funding. The following discussion describes alternative funding structures for municipal stormwater management provision. It illuminates the degree to which different funding structures support the promotion of sustainable stormwater management.

Traditional funding models for stormwater management in Ontario rely on annual municipal budget allocations provided by property taxes (CVC, 2008). This permits stormwater management to become a somewhat 'invisible cost' to most citizens, as there is no direct or clearly visible charge for the use of stormwater services. This can be problematic when attempting to alter stormwater funding structures, as it means the average citizen is fairly unaware of stormwater service provision costs, and therefore, to change either the type of stormwater management used or the funding structures behind stormwater provision, a larger degree of social learning must occur.

Relying on annual budget allocations to fund stormwater management is also problematic because it does not provide dependable and steady funding. In many communities, stormwater management is not a particularly salient issue politically, and if councillors vote to cut funding to stormwater management, few in the community tend to object. This can lead to chronic underfunding of a city's stormwater management services. Therefore, traditional stormwater management funding structures do not guarantee steady long-term funding. This makes long-term asset management planning (which is the key to sustainable stormwater service provision) very difficult for planners and technicians. Additionally, since traditional stormwater management funding is drawn from property taxes based on the assessed value of a property, this structure excuses tax-exempt properties (e.g. schools) from contributing to stormwater funding even though these properties contribute to the stormwater loads a municipal system receives.

Dentinho (2010) explains that providing urban services (e.g. stormwater management) through funding that is based on average provision costs (e.g. through property taxes) ultimately leads to the underfunding of these services, and also to resource degradation. For example, most Ontario municipalities fund stormwater

based on average provision costs; this model generates an inconsistent funding stream and fails to incentivize sustainable stormwater management (for a breakdown of alternative stormwater funding models, see Table 1). In order to ensure steady long-term funding for stormwater management, municipalities must adopt new funding policies and stormwater programs. The next section will introduce alternative stormwater management funding tools and structures.

2.2.1 Alternative Funding Tools and Structures

There are a number of funding structures and tools that can be used to fund stormwater management. Funding structures have a major role to play in the promotion of sustainable stormwater management; some funding structures provide space for incentivising the installation of sustainable stormwater management while others do the opposite, hiding the costs of stormwater management from people's bills and minds. Parikh et al. (2005) assert that there is no one method of stormwater funding that is inherently superior to the others, but rather each is appropriate in different situations. Table 1 offers a summary of the types of stormwater funding structures available, and outlines the opportunity they present for encouraging or enabling the installation of sustainable stormwater management infrastructure.

Table 1: Funding Structures for Stormwater Management (CVC, 2008 p. iv; AECOM, 2013; Harvard Law School, 2014; Parikh et al., 2005)

Opportunity for Sustainable Stormwater Management Promotion	Type	Primary Advantages	Primary Disadvantages	Location
Little opportunity	**Property Tax:** This is the traditional funding source for stormwater management. Property owners pay a rate based on assessed property value. A dedicated tax levy can also be earmarked for stormwater.	-Already accepted by the public as a revenue source -Billing system already established -Can be used to fund all stormwater program activities	- Low fairness and equity as runoff is not correlated to payment -Not a stable or sustainable revenue stream -No incentive to reduce runoff or pollutant loading -Large properties that are tax exempt do not contribute -Can result in a funding gap as tax revenue is not guaranteed at a steady rate to fund stormwater management (AECOM, 2013)	The status quo funding method for cities in Canada and the USA.

Partial opportunity	**Development Related Charges and Fees:** This is a one-time fee paid by developers to the city. These are used to pay capital costs for stormwater facilities, and future operations and maintenance costs.	-Already an accepted cost by developers - Charges more equitable than taxes based on property values, as charges are based on contributing area - Fees can be used by cities to install sustainable	-Depend strongly on developable land availability and growth conditions -Charges cannot be used for operations and long term maintenance of stormwater management infrastructures	Ottawa and Milton (Area specific Development Charges) (City of Ottawa, 2015; Town of Milton, ND). - New Zealand passed their Local Government Rating Act in 2002 which allows for this type of charge to be levied (Eason et al., 2003)
Strong opportunity	**Stormwater Utility Rate:** Charges to property owners based on impervious area	-Fair and equitable -Sustainable and dedicated funding source -Provides incentive opportunity to reduce stormwater runoff and pollutant discharge -Mechanism to charge tax-exempt properties	-Additional cost of rate implementation -May not be well received by the public	Over 800 communities in the USA including Newton, Massachusetts and South Burlington, Vermont (USEPANE, 2009). Between 20-30 municipalities in Canada including Aurora, London, Kitchener, Waterloo, Calgary, Edmonton, Richmond, Langley, and Surrey (AECOM, 2013)
Strong opportunity	**Cap and trade programs:** set an overall allowable runoff 'cap' which is then allocated to different users as allowances; these allowances can be traded through a free market	- Promotes efficient stormwater management: properties with higher sustainable installation costs can buy credits from more efficient properties - No need for regulators to 'get the price right' - Can be voluntary	-Does not provide municipality with immediate revenue for stormwater management (as credits are usually distributed for free) -Difficult to enforce/oversee (Harvard Law School, 2014) -Depend on low transaction costs and a well-educated population	-Voluntary program run in D.C, USA (DOEE, ND)

2.2.2 Utility Rate Structures

Stormwater utility rates are clear, itemised, charges on property owners' utility bills for municipal stormwater management service provisions. They can be structured in a number of different ways to conform to local political and economic concerns. As Kitchener and Waterloo have both implemented a utility rate charge, this literature review will take a closer look at the alternative forms of utility rate structures that could have been employed in either city. The different types of utility rates are outlined in the chart below, from least accurate to most accurate charge as they relate to stormwater runoff and pollutant loading (from AECOM, 2013, p 24-25). The most accurate rate would measure a charge based on the exact millilitres of runoff from a property, while the least accurate rate would not be based on the amount of runoff a property produces at all. The utility rates in Table 2 can apply to residential and non-residential properties.

Table 2 - Types of Utility Rates (AECOM, 2013, p24-25)

Types of Utility Rates	
Flat Fee	**Residential and Non-residential:** Charge does not vary according to usage of the property (e.g., a charge of 5 per month per water meter account) or per hectare of land.
Tiered Flat Fee	**Residential and Non-residential:** Extends the Flat Fee by offering different ratepayer categories (e.g., 5 per month per residential property, and 1,000 per year per commercial/industrial property).
Runoff Coefficient	**Residential and Non-residential:** Charge varies by property size and an assumed coefficient that reflects stormwater runoff potential by property type (e.g., residentially zoned properties are assigned a runoff coefficient of 0.4 and industrially zoned properties are assigned a runoff coefficient of 0.7).
Intensity of Development Factor	**Residential and Non-residential:** Similar to Runoff Coefficient billing method with added adjustment factors applied to account for the property's development status (e.g., a factor of 0.0 for undeveloped properties, 1.0 for fully developed properties, and a factor between 0.0 and 1.0 for properties considered to be underdeveloped within their underlying zoning category).
Equivalent Residential Unit (ERU)	**Residential:** A statistical sampling of measured impervious area for residential dwelling units is performed to determine the average ERU size (i.e., square meters of impervious area). The average impervious area for all types of residential dwelling units becomes the base-billing unit. Charges for residential properties are based on assigning one stormwater-billing unit to each residential dwelling unit, regardless of density. **Non-Residential:** Given the wide variability in impervious area statistics for non-residential properties, the impervious area for each non-residential property should be measured. The charge for non-residential properties is determined by dividing the measured impervious area by the average ERU size.
Single Family Unit (SFU)	**Residential:** Statistical sampling of measured impervious area for single-family detached homes is performed to determine the average SFU size (i.e., square meters of impervious area). The average impervious area for single-family detached homes becomes the base billing unit with one stormwater billing unit assigned to each single-family detached home and fractional billing units assigned to other residential property types. Multi-family residential properties such as apartments, condominiums, and townhouses have a smaller SFU size than single-family detached homes. **Non-Residential:** The charge for non-residential properties is determined by dividing the measured impervious area by the average SFU size.
Tiered Residential	**Residential:** Extends the SFU method by accounting for the wide variability in

Rate (e.g., Tiered SFU)	impervious area among residential properties by assigning three tiers to single-family detached homes (e.g., Small, Medium and Large). The number of categories for multi-family residential properties can also be extended to distinguish high-rise apartments and condos, for example.
Level-of-Service/Geography Base	**Residential and Non-residential:** The ERU and SFU billing unit methods can be extended to include separate rate structure calculations that vary by the level of service provided within distinct geographical boundaries (e.g., a higher rate in urban areas that receive more frequent O&M activities and facilities that provide a higher level of flood protection than in rural areas).
Impervious Area Measurement (Complete Coverage)	**Residential and Non-residential** : The most accurate of all billing unit methods is to measure the impervious area of all properties within a given jurisdiction.

2.2.3 Engaging Property Owners in Stormwater Management: Credit Programs and Education

Utility rate charges are often followed by a corresponding credit program. Credit programs allow users to reduce their utility fee if they reduce their service use by installing sustainable stormwater management, including rain barrels, rain gardens, cisterns, trees, and increasing permeable area. Different municipalities provide different credit options. For example, the City of Portland offers 100% credit to non-residential properties (City of Portland, 2015). Comparatively, Kitchener and Waterloo both offer a 45% credit (CK, 2016d; CW, 2016). Credit Valley Conservation (2008) in Ontario recommends that credit programs offer no more than a 50% credit to sustain the funding revenue needed to provide stormwater services.

Even with an accompanying credit program, it is not recommended that municipalities implement a rate charge without also embarking on an education and awareness program for their citizens (Harvard Law School, 2014; Porter-Bopp et al., 2011; CVC 2008). In order to gain public support for a utility charge and credit program (which is a political must in most municipalities), and to get people installing sustainable stormwater management, municipalities need to budget to include public outreach efforts. Sustainable stormwater techniques and their proper installation are not common knowledge, so in order for cities to successfully promote their installation, they have to educate not only property owners, but also contractors and landscapers who have the opportunity to install sustainable stormwater management.

Finally, there is no consensus on whether or not price instruments, including utility rates and corresponding credit programs, are enough to get property owners to participate in sustainable stormwater management. Both Parikh et al., (2005) and Lindsey and Doll (1999) assert that user fee systems alone fail to encourage widespread adoption of sustainable stormwater management. Stavins (2001) asserts that price instruments tend to fail because they are either improperly structured, or their incentive level is too low. Therefore, while utility rate fees and corresponding credit programs may serve as fiscal incentives to promote sustainable

stormwater management, if the return on investment is too low, they may also operate as barriers. The impact of these fiscal tools in the promotion of sustainable stormwater management in Kitchener and Waterloo will be explored through my research. This will provide novel research on the impact of price tools to promote sustainable stormwater management in a Canadian setting.

2.2.4 Situating Stormwater Management Changes in a Theoretical Landscape

This discussion will situate the new manifestations of sustainable stormwater management policy, discussed above, in the theoretical landscapes that inform the structure of these new policies.

2.2.4.1 *The Trouble with Governing Shared Resources*

Shared resources can become overused and depleted when individuals feel a sense of entitlement to a resource without an accompanying responsibility for maintaining resource health and sustainability. This phenomenon is known as a "tragedy of the commons" (Hardin, 1968). Although this concept was originally envisioned in more rural contexts, in an increasingly urbanizing world, academics are observing manifestations of the tragedy of the commons phenomenon in uniquely urban settings (Blais, 2010; Dentinho, 2010; Foster, 2011). For instance, long-term degradation of natural capital, public amenity overuse, and funding shortfall for infrastructure systems has resulted in what Dentinho (2010) has deemed a "tragedy of urban infrastructure". This funding shortfall and mismanagement of urban resources is a phenomenon also observed by Foster (2011), who outlines how this mismanagement is often due to regulatory slippage and results in a collective management over shared urban resources (Parker & Johansson, 2012). Parker and Johansson (2012) reflect on the work of Foster (2011) and assert that it is necessary to apply theory to this phenomenon by introducing the notion of urban commons (and urban commons mismanagement). Here we come full circle to acknowledge that shared urban resources, especially those privy to funding shortfalls, which enter a period of collective management, can be identified as urban commons. This assertion then relates back to Hardin's (1968) definition of the tragedy of the commons, but within an urban lens: if everyone continues to use a bit of a common resource (e.g. stormwater systems such as groundwater infiltration) in a way that is detrimental to the system (e.g. creating impermeable areas that lead to increased runoff), each of these small actions can lead to a large negative impact on the common resource (e.g. flooding, low groundwater recharge, high levels of waterborne pollutants). I therefore assert that stormwater management systems, which are a shared resource in Canadian municipalities and often suffer from underfunding and mismanagement, can be theorized as a "tragedy of urban infrastructure" or "tragedy of the urban commons" phenomenon; this is phenomenon, in the context of Canadian stormwater systems is discussed below.

Funding structures are an important part of governing urban resources and providing related public services. As discussed, traditional stormwater funding structures render stormwater charges invisible to citizens by burying them in municipal tax rates; this perpetuates the tragedy of urban infrastructure because it enables

the public's ignorance of stormwater management service costs, allowing these services to continuously go underfunded until infrastructure systems reach a breaking point and fail to perform as required. The tragedy of urban infrastructure scenario has led to the sorry state of stormwater management systems in Ontario, which face a 23 billion dollar deficit (CVC, 2015). One solution to reducing this fiscal burden on the municipality is to spread the cost out to the populace. In the case of stormwater management, this can take the form of a utility charge for stormwater and the accompanying promotion of the installation of small-scale stormwater infrastructure on private residential property (such as rain barrels and rain gardens).

This new approach to stormwater, which places added responsibility on individuals to install and care for infrastructure rather than government, falls in line with neoliberal shifts in urban policy orientation which have occurred over the past few decades in the west. These neoliberal policy orientations embrace a reduction in government control, and promote service privatization and decentralization (Hackworth, 2007). The intersection between neoliberal policy and stormwater management changes will be discussed in more detail in the following section.

Intriguingly, this neoliberal approach to stormwater management changes falls in line with the obvious solution to the tragedy of the urban commons scenario: relying on small actions by many users to resolve common resource (in this case, stormwater) management issues. Indeed, Foster (2011) has observed that in the face of urban commons management dilemmas, the role of government is moving away from a centralized approach to resource and amenity management; instead, governments are moving towards a **cooperative management model** where they enable collective action from private actors to manage resources and amenities, without full resource privatization (Foster, 2011; Parker & Johansson, 2012). Foster (2011) suggests partnerships are necessary, as part of a cooperative management model, to ensure a smooth transition into such collective resource management regimes, and that governments should play a main role in creating these partnerships (Parker & Johansson, 2012). Foster (2011) also suggests governments need to enforce and monitor any agreements over common resource management (Parker & Johansson, 2012).

An example of this form of cooperative management in a stormwater context could be the use of a utility rate and credit program. Through a utility rate and credit program, a municipal government is incentivizing property owners (private actors) to participate in the collective management of stormwater by encouraging source control stormwater management using economic penalties and rewards (reflecting the neoliberal ideology that underpins this policy). Overall, the literature suggests that if a shift towards sustainable management of urban commons resources (including infrastructure) were to occur, the following three complexities would need to be addressed:

1) The need for partnerships
2) The importance of enforcement and monitoring
3) The role of private actors and privatization

These complexities will all be explored in the context of Kitchener and Waterloo during expert interviews.

2.2.4.2 *A Neoliberal Approach*

It is important to situate stormwater management policy changes in the wider context of urban policy trends to exemplify the author's understanding that global external forces and policy landscapes influence local municipal policy. During the early 20th century, government management of public resources and services in the interest of the public good was a sacrosanct policy orientation; however, over the past few decades, this mindset has shifted so that privatisation and reduced government are now the hegemonic policy orientation in western, and especially North American, nations (Hackworth, 2007). Hackworth (2007, p 11) reflects that this shift can be attributed to the rise of, "neoliberalism as an ideology, mode of city governance, and driver of urban change".

One can situate stormwater management changes occurring in cities like Kitchener and Waterloo within this neoliberal ideology; in order to ensure sustainable funding for stormwater management services, cities are promoting private citizen action to install sustainable stormwater management infrastructure on private property, thereby decentralising the service of stormwater management and promoting a shift of responsibility from government to private actors. It is important to note two caveats in this situation: The first is that the privatisation occurring in the field of stormwater management in Kitchener and Waterloo is not shifting stormwater management services over to a private company from municipal government control, but to civil society in the form of the property owners in these cities (i.e. small scale actors). However, it is important to recognise that this is vastly different than an example like privatizing electricity creation from the hands of government into the hands of one private corporation, because stormwater is not being privatised to large scale private corporations, but instead to individual property owners . Second, it is important to note that this discussion, which identifies the alignment of neoliberal policy with stormwater management policy changes in cities like Kitchener and Waterloo, should not be misconstrued as a negative reflection on the policy choices of these cities; rather, it is a neutral observation of the municipal policy changes' alignment within the wider phenomenon of the neoliberalisation of urban space and urban policy that has been occurring for decades (Hackworth, 2007).

To add depth to the discussion on neoliberal policy in relation to stormwater policy changes, it is important to shortly discuss the addition of morality to neoliberal policy formation. This is a concept explored by Reigner (2016) in relation to urban transportation policy. Reigner (2016, p.196) asserts that we are currently in an era of neoliberalism where morality can be used to silence challenges to neoliberal policy decisions. She

explains how the intersection between neoliberal policy and moral motivations can lead to a disregard of negative social outcomes that may arise in the context of urban transportation policy:

> *"Characterized by the emphasis placed on users' individual responsibility and their capacity to adopt economically rational behaviours on the one hand and by powerful moral injunctions for them to adopt the 'right' safe, healthy, sustainable behaviours on the other, a neoliberal and neohygienist rationality feeds these public policies. Legitimated by 'noble causes' and depoliticized, these policies give a powerful organization of traffic in the city whose social challenges are evaded. The use of morality works as a powerful democratic anaesthetic that dissolves any objection"*

In the case of stormwater management, the moral sentiment of 'sustainability' motivates the 'noble cause' of a decentralised stormwater management system which shifts responsibility from government to private actors. When policy is formed under such moral imperatives, policy makers and citizens must ensure opposition is not dissolved under the guise of pure and 'noble causes'; it is still important to challenge what appear as morally motivated policies to ensure there are no unintended social consequences to such policy changes. For example, in the case of sustainable stormwater management policies, it is still important to question whether these 'sustainable' and 'green' policies exhibit program bias through factors like wealth and education, which could serve to further the divides between socioeconomic groups; the fact that the policy is a 'sustainable' and 'environmentally considerate' one should not prevent meaningful policy discussion and adjustment. The issue of program bias will be addressed in this thesis.

2.3 Barriers to the Uptake of Sustainable Stormwater Management

This section of the literature review will focus on the barriers to sustainable stormwater management transitions. Understanding the *multiple* barriers involved in sustainable transitions is important to understanding what may contribute to successful sustainable stormwater management transitions (Brown & Farrelly, 2009). Achieving this understanding requires an exploration of barriers to sustainable stormwater management outside of those that are exclusively technical in nature; indeed, research on sustainable transitions processes must be open to identifying a wide range of barriers beyond those that are technical in nature (Wong & Brown, 2008; Brown & Farrelly, 2009; 2009a; Moser and Ekstrom, 2010; Matthews et al., 2015). This section of the literature review outlines a number of barriers to sustainable stormwater management that have been deduced through the literature. For the purpose of this research, a barrier will be defined as an ***actors' interpretations or collective understandings of hindrances to sought after outputs which can be overcome by concerted effort, creative management, creative thinking, prioritization, shifts in resources, social support, political will, land use changes, and institutional changes etc.*** (Moser & Ekstrom, 2010; Beisborek et al., 2013). The identified barriers are categorised as ***perceived barriers, real barriers, institutional barriers, and communications barriers***. Perceived barriers are those that occur

based on a lack of knowledge and understanding; real barriers are those that tangibly prevent people from installing sustainable stormwater management; Institutional barriers are those routed in legislative and political concerns, and; communications barriers are those related to the *process of the transfer of knowledge* between actors (e.g. government, NGOs, property owners, etc.). These four categories were developed through a deductive reading of academic literature on stormwater management and sustainable transitions, and are part of this thesis' contributions to urban planning theory.

2.3.1 Perceived Barriers

The first set of barriers are categorised as 'perceived' because they are founded on a lack of knowledge and understanding; these barriers are largely perceptual, not physical. Perceptual barriers include feelings of increased risks (financial and technical), social norms, and perceived complexity.

2.3.1.1 *Increased Risk*

There is often too much risk (both perceived and real) and not enough incentive when it comes to sustainable stormwater management (Abhold, Loken, & Grumble, 2011). It is the perception of increased risk that constitutes the greatest barrier to sustainable stormwater management uptake (Olorunkiya, Fassman, and Wilkinson, 2012; Abhold, Loken, and Grumble, 2011; Brown et al., 2016). Perceptions of risk are often tied to feelings of uncertainty, which are exacerbated by a lack of knowledge. Thoughts and feelings of uncertainty regarding sustainable stormwater management can differ between cities and even neighbourhoods (Thorne et al., 2015). For example, the adoption of sustainable stormwater management in Portland is limited by technical uncertainty about its hydrological performance and uncertainties surrounding public preferences for sustainable stormwater management (Thorne et al., 2015).

Risk is also associated with new responsibility. A shift from grey to sustainable stormwater management requires property owners to take on added responsibility for stormwater infrastructure installation and maintenance, as sustainable stormwater methods must be installed and maintained by property owners, not the municipality (as is the case for traditional grey infrastructure); with this added responsibility comes increased risks for property owners, which can be divided into two main themes, financial risk, and technical risk (Abhold, Loken, and Grumble, 2011; CEILAP, 2011; Olorunkiya, Fassman, & Wilkinson, 2012). Financial risks relate to concerns about the fiscal costs associated with sustainable stormwater management, while technical risks relate to concerns over the installation and maintenance processes associated with sustainable stormwater management; each type of risk is discussed in greater detail below.

Financial Risk

Responsibility for the costs associated with maintenance and installation of traditional grey infrastructure rests with the municipal government, however, with sustainable stormwater management, some of this responsibility is shifted to private property owners (Barbosa, Fernandes, & David, 2012; Chocat et al., 2007). Although property owners have always

been indirectly responsible for stormwater management system costs through their property taxes, they have not had to implement sustainable stormwater management on their property or pay directly for the costs of stormwater management provision or upkeep. This shift towards paying directly for stormwater management poses a financial barrier to the uptake of sustainable stormwater management infrastructure many property owners view this as an added and uncertain cost (Abhold, Loken, and Grumble, 2011; Keeley et al., 2013; Brown & Farrelly, 2009a). However, Abhold, Loken, and Grumble (2011) contest that 'cost' as a barrier tends to be a catch all for the real barrier to uptake, which is financial risk and uncertainty.

Even though sustainable stormwater management technologies tend to be a financially advantageous approach to stormwater management, there is a large amount of uncertainty regarding financial risk and future costs on the part of property owners for installation and maintenance; this uncertainty serves as a major deterrent to the installation of sustainable stormwater management (Abhold, Loken, and Grumble, 2011; Olorunkiya, Fassman, and Wilkinson, 2012; Thurston, 2012; Brown et al., 2016). A lack of data on building and maintenance costs over both the short- and long-term present a deterrent to investment in sustainable stormwater management (Abhold, Loken, & Grumble, 2011). Accordingly, some authors suggest that localities quantify the fiscal impacts of sustainable stormwater management investment to clarify the costs and thereby reduce feelings of uncertainty and risk (Abhold, Loken, & Grumble, 2011). Brown (N.D.) found that in the case of transition towards more sustainable stormwater management in Melbourne, Australia, ensuring that there was a well-articulated business case for a shift to sustainable stormwater management helped enable change; having a 'well-articulated business case' requires clarity about costs of change and payback periods to reduce risk and uncertainty associated with sustainable stormwater spending. Additionally, studies have shown that effective financial incentive programs serve as a key tool in altering perceptions and inciting public adoption of sustainable stormwater management (Thurston, 2012). Unfortunately, financial incentive programs often provide only a small payout such that the individual's investment outweighs the financial benefit received (within what individuals view as a reasonable payback period); this often results in an ineffective incentive program (Parker & Johansson, 2012).

Technical Risk

If property owners themselves don't know how to install or maintain a new stormwater technology or management technique, and service providers (such as landscapers and contractors) do not know how to install or maintain new stormwater technologies, they are

unlikely to be implemented. Property owners holding insufficient technical knowledge about sustainable stormwater management design, installation, maintenance and performance results in an increased perception of risk associated with the installation of these technologies (Abhold, Loken, and Grumble, 2011; Olorunkiya, Fassman, and Wilkinson, 2012; Thorne et al., 2015). Perceptions of high technical risk have also been shown to act as barriers to the uptake of other sustainable technologies, such as renewable energy and electric vehicles, as there is often a consumer scepticism that accompanies emerging technologies (Reddy & Painuly, 2004; Steinhilber, Wells, & Thankappan, 2013). Overall, insufficient technical knowledge and experience in development and consulting industries present a barrier to the uptake of sustainable stormwater practices at the community level (Abhold, Loken, & Grumble, 2011). It is important for communities looking to transition towards sustainable stormwater management to ensure the presence of professional technical knowledge in the transition process (Brown & Clarke, 2007; Brown & Farrelly, 2009a; Moser & Ekstrom, 2010; Brown, 2008a; Brown et al., 2016; Moglia et al., 2010; Corbett, 2010; Thurston, 2012).

2.3.1.2 *Social Norms*

Resistance to changes to the status quo and behavioural norms, along with negative consumer and community perceptions surrounding sustainable stormwater management act as strong barriers to the uptake of sustainable technology (Reddy & Painuly, 2004: Olorunkiya et al., 2012; Thorne et al., 2015). This is challenging, as there must be major societal shifts in how stormwater management is viewed and understood for a municipality to achieve transition towards more sustainable forms of stormwater management (Wong & Brown, 2008). Public perceptions of sustainable stormwater management are very divisive; Brown et al., (2016) found that the environmental ties people associated to sustainable stormwater management brought some users into sustainable stormwater programs, while others made the same association and dismissed sustainable stormwater programs as "green lunatic nonsense" (p. 87). There is also much contention around public perception of the aesthetic qualities of sustainable stormwater infrastructure. Abhold, Loken, and Grumble (2011), use the statement, " One person's native plant is another person's weed", to summarise the challenge aesthetic preferences pose to the uptake of sustainable stormwater management infrastructure. Many members of the public find sustainable stormwater management, which can include native plants and alternatives to grass, as 'ugly' (Abhold, Loken, and Grumble, 2011). Furthermore, aesthetic preferences were also shown to be influential factors in property owners' choice of stormwater management installation (e.g. rain gardens or rain barrels) (Brown et al., 2016; Kaplowitz & Lupi, 2012).

2.3.1.3 *Complexity*

Some communities offer incentives to promote the installation of sustainable stormwater management on private property. In order to participate in these programs and receive financial rewards, there is often and application process property owners must endure. The complexity of these applications can act as a barrier to

sustainable infrastructure uptake as a complex application increases the perception that participation takes too much time and effort, thereby dissuading property owners from attempting to participate in sustainable stormwater management programs (Brown et al., 2016).

2.3.2 Real Barriers

Real barriers to sustainable stormwater management are those that cannot be overcome by changes in perception alone; these include cost barriers and time barriers.

2.3.2.1 *Cost*

Although Abhold, Loken, and Grumble (2011) contest that 'cost' as a barrier tends to be a catch all for the real barrier to uptake, which is financial risk and uncertainty (see *Financial Risk,* above), there are real costs associated with the installation of sustainable stormwater management which all property owners may not be able to afford (Parker & Johansson, 2012). While incentive programs may help lessen this financial burden, they are often not enough (or are provided after installation), and therefore do not help make sustainable stormwater management more affordable for all property owners (Parker & Johansson, 2012).

2.3.2.2 *Time*

Brown et al. (2016) found that homeowners often cited 'being too busy' or having competing priorities as barriers to installing sustainable stormwater management and participating in municipal incentive programs that promote the installation of sustainable stormwater management.

2.3.3 Institutional Barriers

Institutional barriers to sustainable stormwater management are those which pertain to top-down government related action and capacity barriers to sustainable stormwater management. Institutional barriers include organisational barriers, legislative barriers, political barriers, and engagement barriers.

2.3.3.1 *Organisational Barriers*

Organisational barriers are not often addressed or explored in stormwater management research because of an excessive focus on the research of technical barriers (Wong, 2006; Brown & Farrelly, 2009a). However, organisational barriers are important to understand as the capacity and capability of an organisation affects its ability to implement plans and organise changes regarding sustainable transitions (Berke et al., 2006; Hamann & April, 2013). Insufficient staff and personnel resources, as well as insufficient financial resources, are two very common organisational barriers which decrease organisational capacity and capability (Foster, 2011; Government of Ontario, 2011; Hamann & April, 2013; Hodson & Marvin, 2010; Pitt & Bassett, 2013; Brown& Farrelly, 2009; Moser & Ekstron, 2010). For example, Abhold, Loken, and Grumble (2011) find that

there is often a lack of funding for hiring staff to promote the implementation of sustainable stormwater management.

Institutional capacity is also necessary to ensure strong relationships between actors, thereby enabling change towards sustainable stormwater management (Rauch et al., 2005). A lack of inter-agency and community cooperation leads to fragmented roles, which is a barrier to the installation of sustainable stormwater management (Abhold, Loken, and Grumble, 2011; Mills, 2010; Keeley et al., 2013; Brown & Farrelly, 2009). Other institutional barriers include: unclear or overlapping responsibilities between organisation and actors, stifled vertical and horizontal coordination, and institutional inertia, a lack of common vision amongst actors, institutional fragmentation, undefined organisational responsibilities, poor organisational commitment, poor community capacity to participate in the process, and a lack of experience with facilitating integrated management processes (Keeley et al., 2013; Brown, N.D.; 2008a).

2.3.3.2 *Legislative Barriers*

Legislative barriers often take the form of a lack of incentives, guidelines, or performance standards regarding sustainable stormwater management, as well as a lack of 'credit' given to the multiple benefits of sustainable stormwater management. For example, a lack of design standards and planning regulations to facilitate the installation of sustainable stormwater management infrastructure can serve as a barrier to their installation (Abhold, Loken, & Grumble, 2011).

Additionally, necessity to comply with planning legislation and codes were found to be major barriers to the adoption of sustainable stormwater management in Australian and North American communities (Olorunkiya et al., 2012; Brown & Farrelly, 2009a; Thurston, 2012). One reason compliance may present difficulties is because multiple levels of regulations regarding stormwater management can be conflicting, thereby complicating or preventing the installation of sustainable stormwater management (Abhold, Loken, & Grumble, 2011). Exemplifying this point, in Australia, inconsistent and conflicting legislation was the third most significant barrier to sustainable urban water management (Brown & Farrelly, 2009).

2.3.3.3 *Political Will*

A lack of political will to transition towards more sustainable forms of stormwater management, and climate change adaptation more broadly, present a barrier to these endeavours (Brown & Farrelly, 2009; Brown & Clarke, 2007; Biesbroek et al., 2013; Eriksen & Lind, 2009; Brown, 2008a; Wong & Brown, 2008). Politics plays an important role in the adoption of sustainable infrastructure; without political support it is difficult to bring about sustainability transitions (Keeley et al., 2013; Thorne et al., 2015). For example, local governments play a key role in promoting climate change adaptation at the household level by fostering the growth of informal networks and cooperation amongst local actors including schools, businesses, libraries, NGO's, churches, and other social groups (Crabbe & Robin, 2006). Furthermore, local political support is necessary to ensure proper funding distribution, raising community awareness, and ensuring continued

momentum for the promotion of sustainable stormwater management (Rauch et al., 2005). Indeed, in regards to the scale of political support necessary, in some cases, even politics as fine grained as local ward politics impacts the transition to sustainable stormwater management (Morison & Brown, 2011).

2.3.3.4 *Poor Community Engagement*

Limited community engagement, empowerment, and participation are barriers to delivering sustainable urban stormwater management (Brown & Farrelly, 2009). Communication streams with the public are important; an overreliance on technical expertise and a disregard of the importance of community participation in decision-making impedes transition to more sustainable stormwater management systems (Brown, 2005). The main barriers to effective public engagement in sustainability transitions are: untargeted participation methodologies that are inconsiderate of specific community needs and dynamics; overestimation of community capacity; lack of engagement expertise by facilitators; and organizational structures and norms that prevent knowledge integration from the bottom up (Rauch et al., 2005). The benefits of including publics in the transition process towards sustainable stormwater management are discussed further in section 2.4.4.

2.3.4 **Communication**

Communication barriers involve how information is created, communicated, and received, as, "Misunderstood information, unintended interpretation of conveyed information, complete lack or insufficient frequency or content of communication can severely interrupt or derail social interactions among those involved in the adaptation process" (Moser & Ekstrom, 2010). It is important that communications plans deliver, "information about the problem, solutions, and their implications" in order to enable sustainable adaptations to climate change (Moser & Ekstrom, 2010). Indeed, communications strategies can be factors of high importance in the success and failure of new approaches to water management (Moglia et al., 2010). Substantiating the importance of communication within the field of stormwater management, Brown and Farrelly (2009) identified poor communications as a barrier to sustainable urban stormwater management in 19% of the papers they reviewed concerning sustainable urban water management in Australia.

There are multiple streams of communication that must function effectively in order to ensure the success of sustainable stormwater management transitions. Uncoordinated or unclear communication in any of the following streams can prove to be a barrier to sustainable stormwater management transitions. First, poor communication streams within governance structures, including interdepartmental communication, can prevent coordinated action on sustainable stormwater transitions (Barbosa et al., 2012). Second, poor communication streams between government and external actor groups (such as community groups and NGOs) can present a barrier to the uptake of sustainable stormwater management as this is an important communication stream for knowledge transfer (Thorne et al., 2015: Barbosa et al., 2012). Third, streams of communication between government and citizens via public engagement and participation must function

effectively and efficiently to promote sustainable stormwater management transitions (Barbosa et al., 2012). Overall, in order to be successful, a shift to sustainable stormwater management requires a high level of coordination between a multitude of actors, which is facilitated through strong coordination (Abhold, Loken, and Grumble, 2011; Keeley et al., 2013).

2.4 Overcoming Barriers

There is no 'one size fits all' approach to overcoming barriers to sustainable stormwater management because every community faces a unique mix of barriers based on specific contextual factors (Brown et al., 2016). The following discussion outlines a number of tools that can be deployed to tackle some of the barriers to the uptake of sustainable stormwater management. These tools include: education; media and communication strategies; targeted communication and education; creating a shared vision and community support through public engagement; social pressure for change; collaborative stormwater governance; supportive policy and incentives; demonstration projects; effective monitoring and evaluation.

2.4.1 Education

Eason et al. (2003) notes that education is a powerful tool for changing behaviours and encouraging sustainability. Section 2.3.1.1 identified how perceptions of risk constitute a major barrier to the adoption of sustainable stormwater management. Education is often cited as a solution to overcome the perceptual barriers to the adoption of sustainable stormwater management that are routed in a lack of knowledge (Thorne et al., 2015; Neiswender & Shepard, 2010; Abhold, Loken & Grumble, 2011; Olorunkiya et al., 2012; Brown et al., 2016; Mills, 2010; Bedard, 2005; Kaplowitz & Lupi, 2012). Abhold, Loken, and Grumble (2011) also underscore the importance of education to, "reduce real and perceived risks to shifting paradigms from gray to green." (p.3). In their survey of over 150 communities across the United States, Abhold, Loken, and Grumble (2011) found that education efforts were commonly cited as necessary to enabling the uptake of sustainable stormwater management. In fact, frequently, political and community support for sustainable infrastructure hinges on a well-educated populace (Abhold, Loken, and Grumble, 2011; Brown et al., 2016; Bedard, 2005).

Through Neiswender & Shepard's (2010) study on stormwater education programs across the American Midwest, they deduced a number of recommendations to ensure communities administer successful stormwater education programs. They suggests communities go beyond just raising awareness by using outcomes-based education principles, ensuring educational programs are targeted to specific audiences, especially decision makers. Furthermore, the knowledge of technical experts, such as consultants and engineers, should be integrated into the development of educational programing while ensuring technical information is digestible to the layperson. Neiswender & Shepard's (2010) suggestions speak to the

important role communications strategies play in educational stormwater campaigns; communications as a solution to overcome barriers to sustainable stormwater management will be discussed in depth in the following section (2.4.2).

Unfortunately, stormwater education programs tend to be underfunded, which reduces their efficacy and ability to promote sustainable stormwater management; stormwater education programs should be appropriately resourced to ensure they are implemented correctly and efficiently (Neiswender & Shepard, 2010; Abhold, Loken, & Grumble, 2011). Another solution to funding stormwater education programs is to encourage learning alliances, actor partnerships, and coordination between actors as these often lead to the pooling of resources between actors (Neiswender & Shepard, 2010; Corbett, 2010)(the role and benefit of partnerships will be discussed in depth in section 2.4.6). Finally, to further improve the efficacy of stormwater education programs, combining these programs with fiscal incentives is an effective strategy which amplifies the impact of each (Neiswender & Shepard, 2010; Brown et al., 2016). Overall, communication, partnerships, and coordination with fiscal incentives all impact the efficacy of stormwater education programs.

2.4.2 Media and Communications

Risk and uncertainty were identified as barriers to the uptake of sustainable stormwater management in section 2.3.1. While education is an effective means of overcoming these barriers, all education efforts must be accompanied by effective media and communications strategies to ensure the necessary information reaches intended audiences (Neiswender & Shepard, 2010). Media and communications have the power to enable comprehension of ideas, and influence attitudes, perceptions, and behaviours of people (Durfee, 2006 from Olorunkiya et al., 2012). In essence, it is the effective communication of knowledge and media engagement that can increase awareness and understanding of sustainable stormwater management practices, thereby enabling the implementation of sustainable stormwater management policy and practices (Abhold, Loken, and Grumble, 2011; Brown & Farrelly, 2009a; Olorunkiya et al., 2012; Brown et al., 2013; Chater et al., 2011; Thurston, 2012).

Effective communications about sustainable stormwater management follow numerous channels. One of these channels is the community champion. Community champions hold positions of trust in large networks and therefore command a high quantity of social capital. Champions can communicate to others through word of mouth on the benefits of sustainable stormwater management; this is proven to be an effective means of garnering community support for sustainability issues and changes (Brown et al., 2016; Brown, N.D; Brown e al., 2014; Abhold, Loken, and Grumble, 2011; Olorunkiya et al., 2012; Bos & Brown, 2015).

Another channel for communications is social and traditional media (Facebook, Twitter, Newspapers, Radio, TV, etc.). It is recommended that education and outreach programs supporting sustainable stormwater

management involve various forms of media to be as effective and successful as possible (Neiswender & Shepard, 2010; Brown et al., 2016; Abhold, Loken, and Grumble, 2011). Media and communication campaigns are most effective when tailored to the community they wish to reach (Bedard, 2005; Olorunkiya et al., 2012).

Regardless of the communication channel, language use is important in communications (Abhold, Loken & Grumble, 2011). Communications should not be overly technical, but instead, easily digestible; this can include the use of visual information (Abhold, Loken & Grumble, 2011). It is critical to ensure that technical expertise and technical information is communicated through efforts to promote sustainable stormwater management, however, it is also key that technical information is then disseminated in a digestible fashion for the layperson (Neiswender & Shepard, 2010).

2.4.3 Targeted Communication and Education

Supporting a tailored approach to stormwater management outreach and education for high levels of efficacy and impact, Neiswender & Shepard (2010) cautions that an overreliance on mass media and broad audiences should be avoided, instead suggesting the use of multiple media streams, targeted to engage with specific groups. They suggest there are three groups of audiences that should be targeted. The first group are those that must act (e.g. contractors, government officials and property owners). It is highly important to ensure contractors and service providers are up to speed with new sustainable stormwater technologies if they are to promote and install them (Neiswender & Shepard, 2010; Corbett, 2010; Abhold Loken & Grumble, 2011; Mills, 2010; Brown et al., 2013). Furthermore, education of government, including municipal staff, helps ensure there is interdepartmental coordination to promote sustainable stormwater management, as well as cross-agency collaboration (Abhold Loken & Grumble, 2011). The second group Neiswender & Shepard (2010) selects for targeted engagement are those that must *support* change (e.g. Media, community organisations). The third and final group to target in communication strategies are those who will act in the future (e.g. students and teachers) (Neiswender & Shepard, 2010). Overall, targeting is important in developing an effective outreach strategy (including education and communication) to promote sustainable stormwater management.

2.4.4 Creating a Shared Vision and Community Support Through Public Engagement

Public engagement is an important factor in increasing a community's commitment to, and support for, sustainable stormwater management policies and practices, thereby reducing barriers to the implementation of sustainable stormwater management (Brown & Farrelly, 2009; Brown, 2005; Morison and Brown, 2011; Kaplowitz & Lupi, 2012; Neiswender & Shepard, 2010; Thorne et al., 2015; Abhold, Loken, & Grumble, 2011; Wong & Brown, 2008; Brown, N.D; Barbosa et al., 2012; Rauch et al., 2005; Shuster et al., 2008). It is important for stakeholders (including the public) to engage in a learning process about new technologies and programs as this helps create a window of opportunity for more sustainable technology development and adoption (Pesch, 2015; Breukers & Upham, 2015). Overall, guided public engagement can lead to changing

social practices and behaviours, and thereby increases acceptance and support for sustainable stormwater management implementation (Rauch et al., 2005; Shuster et al., 2008; Morison & Brown, 2011). Effective public engagement can be attained when the process is easy to participate in, iterative and adaptive to local needs (Bos & Brown, 2015). Timing plays an important role in public engagement as well; engagement should be an early and long-term processes to increase buy-in (Hendrickson, 2010).

Public engagement is particularly effective in promoting sustainable stormwater management installation and understanding because it supports local dialogue and word-of-mouth on the topic; word-of-mouth has been shown to be a very effective means of garnering support for sustainable stormwater management by dispelling uncertainties and perceived risks (Brown et al., 2016). One way to support this local dialogue is to integrate stormwater management issues (and solutions) into other environmental and local issues that already hold salience amongst local residents (Morison and Brown, 2001). Another method of supporting local dialogue is to engage the public through hands-on work with sustainable stormwater installation and demonstration projects (Shuster et al., 2008) (demonstration projects will be discussed further in section 2.4.8).

A third means of ensuring public dialogue is the use of visioning exercises. Visioning exercises, such as charrettes, include members of the public and promote alignment on stormwater issues, solidifying socio-political capital in support of sustainable stormwater transitions (Brown N.D.; Brown & Clarke, 2007). Visioning and partnership building exercises that include public engagement are most effective earlier on in the partnership building process (Hamann & April, 2013). Overall, these efforts promote sustainable stormwater changes by solidifying shared visions (though communication and collaboration exercises) and thereby reducing institutional, political, and coordination barriers to sustainable urban transitions (Brown, N.D.; Brown & Clarke, 2007; Brown & Farrelly, 2009; Hamann & April, 2013; Hodson & Marvin, 2010; Kemp, Loorbach, & Rotmans, 2007).

2.4.5 Social Pressure for Change

Social networks play an important role in promoting sustainable behaviour change (Brown et al., 2016); an individual will adopt a new technology (such as sustainable stormwater management) based on two factors: personal interests and social influence (Olorunkiya, et al., 2012). In an effort to create social influence, some communities installing sustainability programs or technologies make individuals' participation in these new programs or technologies very visible. For example, the community of Red Deer, Alberta, created lawn signs for all the participants in their *Composting At Home* program to attempt to normalise and encourage backyard composting (City of Red Deer, 2014); the intention was for the highly visible signs to create social pressure, thereby encouraging others to join the program.

2.4.6 Coordination, Collaboration, and Partnerships - Collaborative Stormwater Governance

Local and regional authorities, employers, landscape architects, engineers, planners, zoning reviewers, department heads, watershed managers, environmentalists, decision-makers, politicians, academics, NGOs, community groups, and federal researchers interact to form governance structures; the ways in which these actors collaborate, coordinate, and partner to promote sustainable stormwater management impact the outcome of these efforts (Brown, 2003; Water Environment Research Foundation, 2009; Shuster et al., 2008; Brown at al., 2013). In order to garner long-term political and public support for stormwater transition, there needs to be coordinated and sustained action across multiple agencies and actors (Thorne at al., 2015). Morison and Brown (2011) found that municipalities with high commitment to sustainable stormwater management often contained strong environmental policy coalitions, which included regional or watershed based actors, as well as locally oriented organisations and groups, showcasing the importance of collaboration and coordination between actors. Empirical findings from Australia show that the most successful municipal sustainable stormwater management programs display strong co-management governance structures throughout program implementation across both vertical (state–local) and horizontal (local–local) partnerships (Morison & Brown, 2011). Additionally, improved *inter-sectorial* professional development and *inter-organisational* coordination was found to be an important tool to overcoming knowledge barriers to improve the uptake of sustainable stormwater management in the nation (Brown & Farrelly, 2009).

Overall, sustainable transitions literature, urban commons resource management theories, and stormwater management literature all emphasize the importance of a collaborative management approach, strong multi-sectorial partnerships, and coordination and collaboration across actor groups when transitioning to sustainable urban resource management models (including sustainable stormwater management) and overcoming associated barriers (Brown, 2005; Brown, 2003; Foster, 2011; Morison & Brown, 2011; Healey, 1998; Neiswender & Shepard, 2010; Keeley et al., 2013; Water Environment Research Foundation, 2009; Vlachos and Braga, 2001; Marsalek, 2001; Abhold, Loken, and Grumble, 2011; Brown & Farrelly, 2009; Brown & Clarke, 2007; Crabbe & Robin, 2006; Rauch et al., 2005; Shuster et al., 2008). Governance structures should work to enable and facilitate the required coordination, collaboration, and partnerships between actors to promote sustainable stormwater management (Foster, 2012; Brown, 2005). Abhold, Loken, and Grumble (2011) recommend that local governments hire a "green infrastructure coordinator" to facilitate the creation of strong networks and communication streams between local actors who can promote the uptake of sustainable stormwater management in the community. Brown (N.D) and Brown & Clarke (2007) echo the need for a coordination role, suggesting that 'bridging organisations' are key in enabling a transition to sustainable stormwater management. It is especially helpful if the coordinating party is non-governmental when attempting collaboration between government and the public because a third party is often seen as more trustworthy by the public (Brown et al., 2014).

2.4.7 Supportive Policy and Incentives

In order to promote the uptake of sustainable stormwater management practices, there is a need to incorporate sustainable stormwater practices into government policies surrounding natural resources and planning; this incorporation can include the use of fiscal incentive policies (Neiswender & Shepard, 2010; Reddy & Painuly, 2004; Brown & Clarke, 2007; Bos & Brown, 2015; Brown et al., 2016). Incentives also serve to reduce barriers to participation, especially fiscal barriers, but only if the incentives are large enough (Brown & Clarke, 2007; Thurston, 2012; Brown et al., 2016). Alternative supportive policies include zoning and design guides. For example, Portland, Oregon, the city used zoning codes and design manuals to ensure that new and redevelopments would install sustainable stormwater practices (Water Environment Research Foundation, 2009). Even with incentive programs, participation in sustainable stormwater management installation takes time (Brown et al., 2016).

2.4.8 Demonstration Projects

Demonstration projects entail installing sustainable stormwater management in a community; this provides local property owners with a real life example of what sustainable stormwater technology looks like, how it works, how it is maintained, and its benefits. By providing a real-life, local example of sustainable stormwater management, demonstration projects reduce the perceptual barriers of technical risk and uncertainty surrounding maintenance and aesthetics of sustainable stormwater management (Reddy & Painuly, 2004; Abhold, Loken, & Grumble, 2011; Brown & Clarke, 2007; Barbosa et al., 2012; Keeley et al., 2013; Brown & Farrelly, 2009a; Olorunkiya et al., 2012; Brown et al., 2016; Mills, 2010; Water Environment Research Foundation, 2009; Roy et al., 2008). Demonstration projects are most successful when they are highly visible and when they are participatory, thereby exposing a large number of people to sustainable stormwater management technologies (Abhold, Loken, & Grumble, 2011).

Some cities have instituted programs to encourage sustainable stormwater management demonstration projects, such as Melbourne's 10,000 rain gardens program (Corbett, 2010). However, empirical studies reveal that caution must be used when installing demonstration projects to ensure that the functionality, feasibility, and aesthetics are balanced; this helps ensure perceptions of sustainable stormwater management as "ugly and unsafe" are overcome (Morison and Brown, 2011, p89). Indeed, showcasing the community greening and beautification that accompanies sustainable stormwater management installations has contributed to the success of Portland's efforts to promote sustainable stormwater management since the 1990s, exemplifying that well executed and presented demonstration projects can have huge benefits on a community's embrace of sustainable stormwater management (Environment Research Foundation, 2009).

2.4.9 Effective Monitoring and Evaluation

Effective monitoring and evaluation can impact the transition to sustainable stormwater management (Brown & Farrelly, 2009). Adaptive management based on effective feedback can aid in overcoming the barriers to participation in sustainable stormwater management as this allows programs to adjust depending on how they are received by a particular community (Bos & Brown, 2015; Shuster et al., 2008). In order to have effective evaluation, there must be targets against which to measure. For this reason, binding targets are an important part of transitioning to sustainable stormwater management (Brown & Clarke, 2007, Neiswender & Shepard, 2010). Evaluations should occur at multiple time scales (short, medium, and long-term) in order to ensure stormwater and associated education and engagement programs are on track (Neiswender & Shepard, 2010).

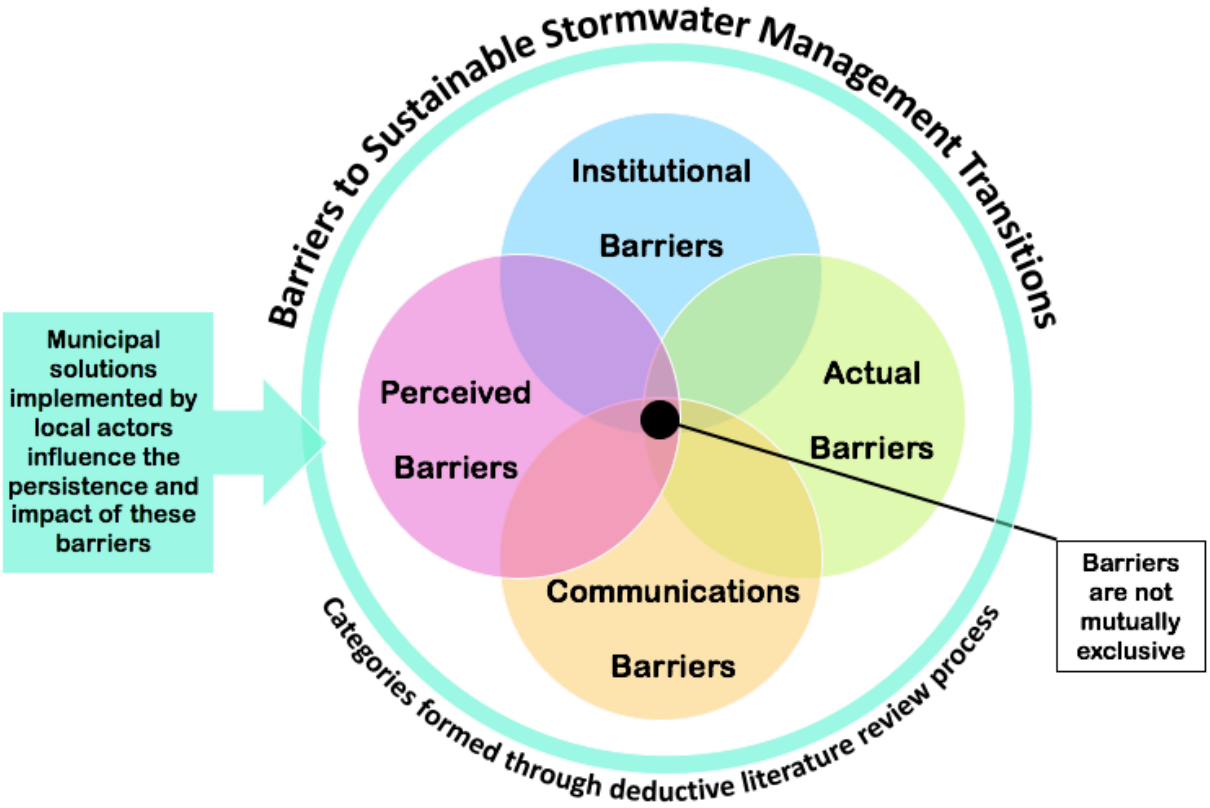
3 Research Design and Methodology

This research uses an embedded case study to explore the barriers and solutions to sustainable stormwater transitions in Kitchener and Waterloo. An embedded case study method allows for in depth exploration using multiple methods (both quantitative and qualitative) of more than one unit of sub-analysis (Yin, 2003). This approach is appropriate in exploring the experiences of Kitchener and Waterloo as they transition to a more sustainable form of stormwater management funding and provision, as embedded within the higher level phenomenon of neoliberalisation of municipal policy and the widespread experience of the tragedy of the urban commons phenomenon. This chapter will introduce the theoretical and conceptual framework, and outline the research methodology.

3.1 Introduction and Theoretical Framework

This research is theoretically grounded in literature on urban transitions to sustainability and sustainable stormwater management. Through a deductive reading of the relevant literature during the literature review, the theoretical framework for this study emerged. First, it is clear that in sustainable urban stormwater transitions there are multiple barriers and solutions to promote sustainable stormwater management. Deductive technique applied to relevant littrature on the topic of sustainable transitions and stormwater management led to the identification of four categories of barriers that impede the progress of sustainable stormwater management transitions. These categories include perceived barriers, actual barriers, institutional barriers, and communications barriers. Municipal solutions implemented by local actors influence the persistence and impact of these barriers. The theoretical framework which emerged through the use of deductive techniques during the literature review is displayed below:

Figure 1: Theoretical Framework



This framework guides the formation of my research questions and my methodological decisions.

3.2 Research Questions

This thesis aims to explore the stormwater management transitions of Kitchener and Waterloo by answering the following research questions:

1) ***What kind of barriers have Kitchener and Waterloo encountered to the uptake of sustainable stormwater management on private residential properties?***

a. ***Why have they encountered these barriers?***

2) ***How have Kitchener and Waterloo tackled these barriers?***

a. ***What engagement methods and strategies are useful in promoting the uptake of sustainable stormwater management on private residential property in each city?***

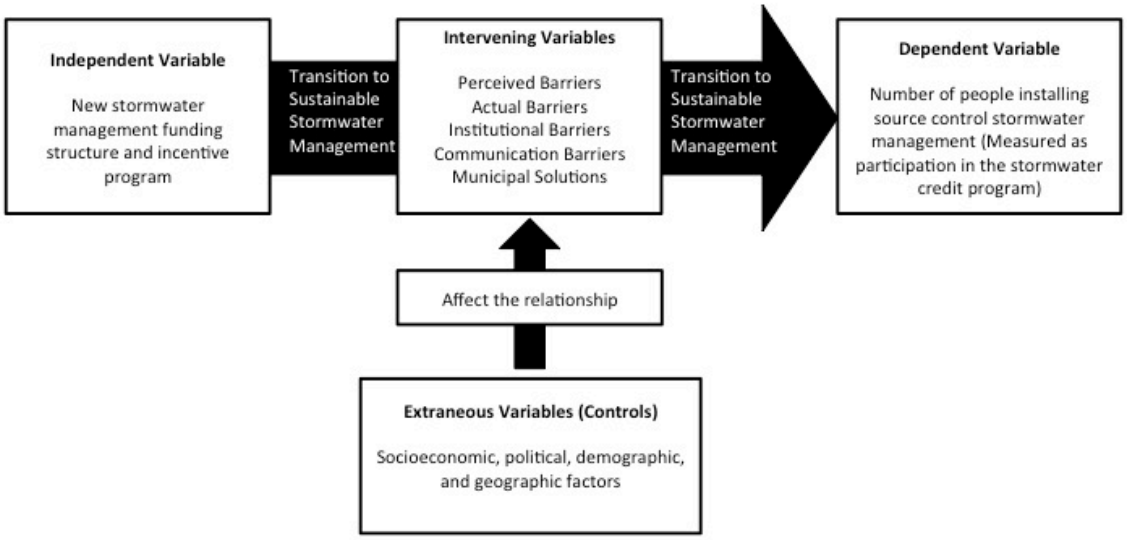
Research questions are formatted to ensure a very open approach to barrier identification, preventing the research from focusing excessively on technical barriers, which can often be the case in sustainability and stormwater management transitions research (Wong, 2006; Brown & Farrelly, 2009a).

3.3 Conceptual Model

My conceptual model guides my research design and methodology. It operationalizes my research questions based off of existing literature in the field of sustainable stormwater management, as guided by my theoretical framework. An overview of my conceptual framework is presented in Figure 2 below. An explanation of the literature in relation to my conceptual framework and methods can be found following the research design in section 3.4.

The barriers and municipal solutions identified in the literature review and represented in the theoretical framework and can be conceptualised as intervening variables in the transition process towards sustainable stormwater management, as illustrated below (modified from Kumar, 2011):

Figure 2: Conceptual Framework



3.3.1.1 *Converting Concepts into Variables*

To operationalize concepts relating to barriers and solutions to transitions to sustainable stormwater management, as identified through deductive process during the formation of the literature review, concepts must be transformed into variables (Kumar, 2011). This study considers two types of variables; intervening variables and extraneous variables (Kumar, 2011)(see conceptual framework, Figure 2 above). Intervening variables are those that link the independent and dependent variables (Kumar, 2011). In the context of this study, the intervening variables are those that impacted the uptake of sustainable stormwater management in Kitchener and Waterloo after new stormwater management funding structures and incentive programs were instituted. Extraneous variables are contextual, "real life" factors that may affect changes in the dependent variable, and may increase or decrease the relationship between dependent and independent variables (Kumar, 2011). Extraneous variables are used as controls in this study, and include socioeconomic, political, geographic, and demographic factors.

Extraneous variables are measured using quantitative techniques (see section 3.4.4). Intervening variables are measured through qualitative techniques (interviews) and are converted into measurement during the data analysis (coding) phase in the form of qualitative categories (Kumar, 2011) (see section 3.4.6 on the coding process). The methodologies used to measure each variable are discussed in the following section, *Research Design*.

3.4 Research Design

This research is convergent in nature. Convergent research combines quantitative and qualitative methods in parallel to provide a comprehensive analysis of the research problem through integration of multiple research methods (Creswell, 2014). In my research, the phenomenon explored is the promotion of sustainable stormwater management in Kitchener and Waterloo, as reflected through my research questions (See section 1.2). For the purposes of this research, participation rates in Kitchener and Waterloo's SCPs are the measure of sustainable stormwater management uptake in each city.

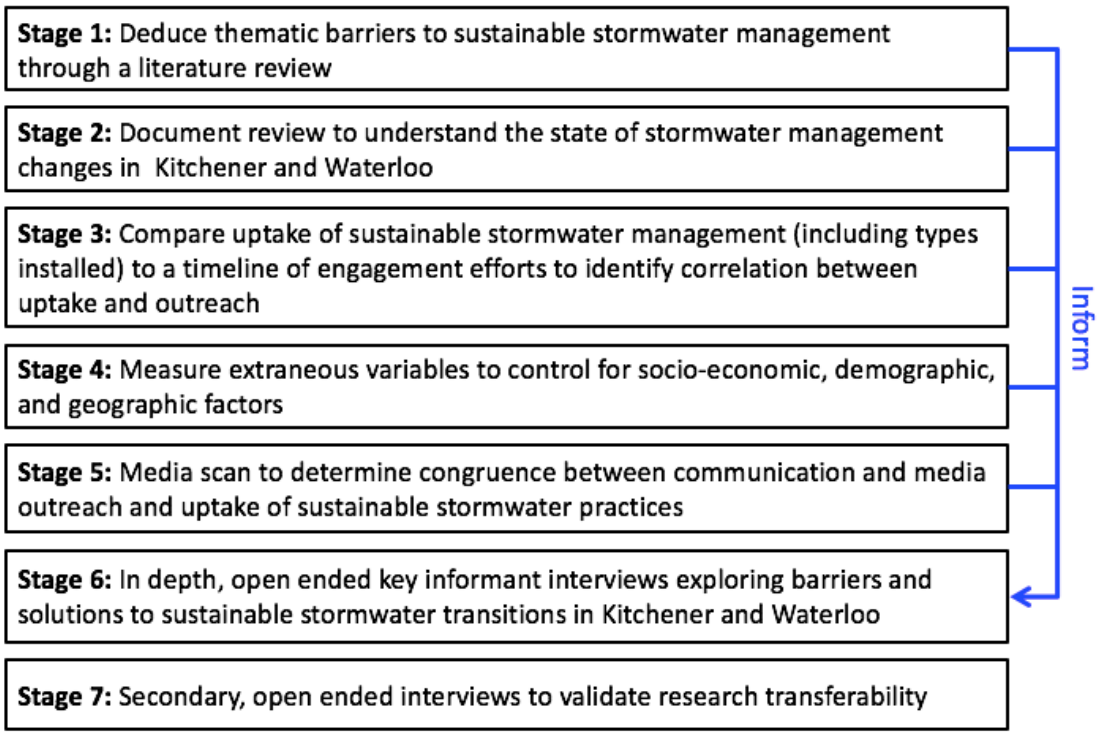
This research was approached through an embedded case study (Yin, 2003; 2009). Case studies are supported as valid research methods as they allow for the implementation process to be studied inclusive to the 'real-life' contextual factors that play a role in observed outcomes (Edvardsen, 2011; Flyvbjerg, 2006; Peters et al., 2013; Yin, 2009). This is important, as context plays a major role in the experience of sustainable stormwater transitions (Brown et al., 2016). Edvardsen (2011) asserts that case study research helps describe the strength of causal links in real-life policy implementation. Overall, the contextual analysis provided by an embedded case study approach can aid policy makers considering adoption of similar programs. Furthermore, a case study approach allows for the use of multiple sources of evidence including interviews, discourse analysis, and secondary quantitative data collection; this enables triangulation of multiple data sources to provide rigour to the research process (Morison & Brown, 2011; Yin 2009). To facilitate an embedded case study approach, this research loosely follows the research design of Morison and Brown (2011) described in Section 3.4.4.

Finally, although the deductive themes identified in the literature review facilitated the design of this study, they did not restrict the findings from the data (Crabtree & Miller, 1999). On the contrary, the findings of this research rest on inductive themes that emerged in the data, through interviews, the coding process, and triangulation of data (see section 3.4.6) (Boyatzis, 1998). Following the inductive identification of themes generated through data collection, the analysis stage allowed for the comparison of deductive to inductive themes (Fereday & Mui-Cochrane, 2006).

3.4.1 Overview

The research design is partitioned into 7 main stages of data collection, as illustrated below:

Figure 3: Research Design



3.4.2 Study Location

This research takes place within the municipalities of Kitchener and Waterloo. These two sites have been selected for study because they are the first municipalities in Canada to implement stormwater utility rates and SCPs, in part, to promote the installation of sustainable stormwater management on private property (with the overarching goal of creating a sustainable stormwater management system). Both cities used similar outreach strategies, along similar implementation timelines; comparing the similarities and differences in approaches helps identify which engagement strategies and events were the most helpful in promoting sustainable stormwater management installation.

Additionally, Kitchener and Waterloo are appropriate study areas as each is experiencing pressures on their stormwater management systems similar to many other mid-sized Canadian cities. This includes aging stormwater management infrastructure systems, increased pressures due to climate change, increased pressures due to population growth and development, and a lack of municipal financing for stormwater

management upgrades and maintenance. The similarities between Kitchener and Waterloo and other mid-sized Canadian cities should produce research findings that are helpful for municipalities across the country.

3.4.3 Stage 1 and 2: Literature Review and Document Review

A literature review (see Chapter 2) and document review serve to gather background data on transitions to sustainable stormwater management broadly, and contextualise the experiences of Kitchener and Waterloo through this process. Documents were ascertained through grey literature searches on city and REEP websites, and though correspondence with each city and REEP. A review of documents published by the municipalities of Kitchener and Waterloo, as well as documents published by REEP contributed to a base timeline for the sustainable stormwater management promotion in each city; this helped form an implementation chain for each city (See section 3.5.4, Data Organisation). Municipally produced documents that comprise this analysis include informational PowerPoints, formal meeting minutes, webpages, flyers, application, bill inserts, and other sources of online documentation of the SCP. REEP documents reviewed include online informational PDFs, flyers, signs, and webpages.

Morison and Brown (2011), who investigate the impact of demographic, socio-economic, and environmental contextual characteristics on the commitment of 38 municipal councils to WSUD, utilized secondary literature to build their individual organisational case studies; my research uses a literature review and document review (of local grey literature) to do the same. Mills (2010) used a literature review to guide the development of a research question and then to explore the main topic of research and methods; this reflects my own strategy. Mills (2010) conducted a graduate thesis research project "exploring the adoption of low-impact development (read: sustainable stormwater management) in Atlantic Canadian Municipalities". Two of his main research goals were to "identify barriers to and perceptions of LID through discussion with urban stormwater professionals in Atlantic Canadian municipalities" and, "to analyze information from these discussions to reveal current perspectives, trends and patterns relating to LID in Atlantic Canada", both very similar to the goals of this research, which is why Mills' methodological approach is applicable.

The information gathered in this stage informed the following stages of data collection and analysis[1].

3.4.4 Stage 3, 4, and 5: Quantitative Data Collection

This stage uses quantitative methods to explore any trends between sustainable stormwater management uptake and socio-economic, demographic, and geographic factors, media and communications outreach, and the types of stormwater controls installed (extraneous variables). This research stage involved quantitative data collection from four sources. First, SCP records from the municipalities of Kitchener and Waterloo provide the number of SCP participants in each municipal ward by month, and the types of sustainable

[1] Some documents were provided to the researcher by REEP and municipal sources after interviews, the information from these documents was therefore added to the analysis

stormwater management installed. Second, Census Canada data provides information on the socioeconomic and demographic factors of each municipal ward; this information is compared to SCP participation rates by ward. Third, the University of Waterloo's GIS database provides geographic and zoning data, also compared to SCP participation rates by ward. Fourth, data on media outreach regarding the stormwater credit program (promotion of sustainable stormwater management) was ascertained through a media scan of social and local newspaper medias; this was compared to an overall timeline of SCP participation rates. Together, this quantitative data collection allows for the following:

Identification of program coverage and bias

Coverage is the degree to which intended targets participated in a program compared to the intended number of participants outlined in the program's design (Rossi, Lipsey, & Freeman, 2004). Bias refers to the instance of some subgroups within an eligible population participating in greater or lesser proportions than other groups (Rossi, Lipsey, & Freeman, 2004). In order to address coverage and bias, my research includes a comparison of participation rates at the municipal ward level, to socioeconomic indicators from Statistics Canada. Morison and Brown (2011) found that higher levels of wealth, post-secondary education, and population size were correlated to support for stormwater management changes in Australia. Identifying bias can suggest whether certain socioeconomic, demographic, and geographic factors played a role in encouraging or preventing the uptake of sustainable stormwater management in Kitchener and Waterloo.

As my theoretical framework shows, there are multiple barriers to the adoption of sustainable stormwater management. One study that explores barriers to sustainable stormwater management is Morison and Brown (2011) who undertook a study of 38 municipalities in Melbourne, Australia where 'Water Sensitive Urban Design (WSUD)' (a type of sustainable stormwater management policy) was to be implemented by municipal councils. Their research objectives were to "examine the potential relationship between municipal context, comprising environmental values and socio-economic factors, and municipal commitment to WSUD" (p.85). They aimed to investigate whether demographic, socio-economic and environmental contextual characteristics of municipalities were associated with the commitment of municipal councils to WSUD; identify distinguishing features of WSUD commitment municipal populations; and develop recommendations for improving intergovernmental policy and program design. Using quantitative analysis and interviews, they found that particular demographic, socio-economic, and environmental characteristics of municipalities were associated with municipal commitment to WSUD, and identified distinguishing features of municipalities in limited commitment, partial-commitment, and high-commitment groups. The researchers found that there was an association between the municipality's size, wealth, and environmental wealth, and their commitment to WSUD. Municipalities that had more wealth were able to commit more to urban stormwater best management practices associated with WSUD (Morison and Brown, 2011). They also found that geographic variations in residential natural environment, income, and education are tied to variations in

community priorities; these priorities impacted the status of stormwater issues in the community (Morison and Brown, 2011). Overall, Morison and Brown (2011) highlight that sustainable stormwater practices tend to be ignored in municipalities of lower socio-economic status, with fewer natural environmental assets, in part due to poor communication about stormwater management and a lack of alignment with community priorities and environmental concerns. With these findings in mind, my research borrows quantitative methods from Morison and Brown (2011), to help identify potential barriers to the adoption of sustainable stormwater management by identifying program bias in sustainable stormwater management promotion in Kitchener and Waterloo.

Mirroring Morison and Brown (2011), I compare rates of sustainable stormwater management installation to socio-economic, demographic and geographic factors. Instead of comparing these at the municipal level, as Morison and Brown (2011) have, this thesis observes data at the municipal ward level, as policies within Kitchener and Waterloo are the focus of this thesis (not provincial or regional policy, as is the case with Morison and Brown). Morison and Brown (2011) state that local ward politics may impact the commitment of some communities to WSUD, therefore motivating my decision to set my unit of analysis at the ward level; this allows for the observation of the potential influence of local ward politics on the uptake of sustainable stormwater management. Morison and Brown (2011) test the alignment of various socio-economic, demographic, and geographic variables within the lowest and highest performing groups of municipalities to identify any trends which characterise these top and bottom performers. Furthermore, the top and bottom performing wards in each city are compared to various socio-economic, demographic, and geographic factors, identify any alignment or trends, to identify program bias (as extraneous variables).

The following process was used for addressing bias:

1) Sources of potential bias (extraneous variables) were identified through the literature review and conceptual model.

2) Measures for these sources were identified from 2011 National Household Survey[2] data from Statistics Canada and grouped at the level of municipal ward. A list of measures used can be found in Appendix B.

3) A Pearson correlation test was run to compare participation rates to the different measures.

4) Given that the data were compared at the level of municipal ward, correlation above 0.8 was considered significant.

5) To further ensure internal validity in measures of program bias, the lowest-performing and highest-performing wards in each region were compared to observe any instances of participation level extremes matching with socioeconomic indicator extremes. For example, the three wards with

[2] Long form Census data were not available due to the political decision to remove funding for the program. With the new government elected in fall 2015, the long form Census is reinstated and future researchers will have access to more recent and robust data.

the highest participation rates were compared to see if they were also the three wards with the highest education level, highest level of floodplain covered area, lowest level of education etc. This strategy for comparing extreme cases was utilised in the very similar research of Morison and Brown (2011).

6) Since there was no indication of program bias, the qualitative data collection stages that follow were not shaped to explore any particular bias in greater depth; only general questions about program bias were posed to interviewees.

SCP participation rate timeline, including the types of stormwater management adopted

Creating an SCP participation rate timeline that includes the types of stormwater management adopted allows for the comparison of sustainable stormwater management uptake levels between each city and amongst wards. This can be used to identify correlations between engagement events and spikes in SCP applications. Comparisons are made on a monthly timeline because Peters et al., (2013) asserts that implementation activities contain changing elements, and observing elements at varying points in time contributes to a thorough understanding of contextual factors impacting policy implementation. Participation rates in each city's SCP were used to represent the uptake in sustainable stormwater management. These rates were determined through the following process:

i) The number of participants in each municipal ward was provided by each city

ii) The number of residential properties in each ward was determined through city data and GIS data available at the University of Waterloo GIS Lab *(See Appendix A for a list of property types used to calculate participation rates)*

iii) The number of participants was compared to the number of eligible participants to produce a participation rate for each municipal ward in Kitchener and Waterloo

Kaplowitz and Lupi (2012) assert that there are stakeholder preferences for best management practices in regards to stormwater controls. This is why the *type* of sustainable stormwater management installed is a part of the quantitative exploration of this research. Observing the most and least popular sustainable stormwater management methods and comparing these to the implementation events can help identify effective outreach methods and suggest property owner preferences for types of stormwater management (these concepts are explored further in expert interviews). City data on SCP participation by month, and overall, was divided into the *type* of stormwater management that was used for the application. This resulted in an understanding of what types of stormwater management were installed over time in Kitchener and Waterloo. These results are explored further during qualitative interviews with experts in Kitchener and Waterloo.

Media Scan

The media is a useful tool to engage and inform the public of urban planning developments and policies (Pyzoha, 1994). Based on the importance of media and communications, as outlined in the literature review, this research includes a media scan. Media scans of local newspapers, municipal Facebook, and municipal twitter accounts were conducted to identify when information on the SCP was shared. Results from all three scans are combined to produce a media timeline that is compared to the implementation timeline during research analysis. This allows for comparison between media events and sustainable stormwater management uptake to help determine the usefulness of different styles of media outreach. A varying strength of causality (low, medium, high) was ascertained through a comparison of media outreach (e.g. Social media postings, newspaper articles) and sustainable stormwater management participation rates (Edvardsen, 2011).

Methods for the various types of media scans are outlined below:

Facebook Scan

Three separate searches were used to create the timeline of Facebook posts relating to stormwater (both management and the SCP) for both Kitchener and Waterloo. The timeline for Kitchener Facebook posts involved searching for public posts using two search entries. The first entry was 'stormwater' AND 'Kitchener' AND 'Waterloo'; the second entry was 'Kitchener' AND 'Stormwater'. This provided a posting of all public Facebook posts mentioning both stormwater and Kitchener. The timeline for Waterloo Facebook Posts involved searching for public posts using two search entries. The first entry was 'stormwater' AND 'Kitchener' AND 'Waterloo'; the second entry was 'Waterloo' AND 'Stormwater'. This provided a posting of all public Facebook posts mentioning both stormwater and Waterloo. All irrelevant posts (e.g. ones referring to a neighbourhood in Australia with the same name) were not included in the count.

Twitter Scan

Three key accounts were searched in order to create a timeline of promotion of the SCP and other stormwater awareness posts on Twitter. The accounts for REEP (@REEPgreen), Kitchener (@CityKitchener), and Waterloo (@citywaterloo) were specified on a search of the keyword, "stormwater". The resulting tweets were read to ensure relevance. Relevant postings were then recorded onto the media timeline.

Newspaper Scan

Three local newspapers, The Record (Waterloo Region), The Waterloo Chronicle, and the Kitchener Post, were searched for the keywords "stormwater credit" and "stormwater"; resulting articles were recorded by date, and were read to determine their tone (positive, negative, or neutral).

3.4.5 Stage 6 and 7: Qualitative Data Collection

Qualitative data collection consists of expert interviews and surveys with local politicians.

Interviews

There are a number of benefits to the inclusion of interviews in this research. First, as Khakee (1998) outlines, in implementation research it is important to understand the relationships between various interests and their interplay within the overarching organisational culture. In order to gain in-depth knowledge into these relationships expert interviews are advantageous tools; they allow researchers the opportunity to gather information on the intricacies of relationships between policy and implementation actors that may not be recorded elsewhere in formal policy or program documentation. Second, interviews provide insight into staffing levels and staff resources. In researching municipal adoption of climate change mitigation policies, Pitt (2010) found that staffing levels influenced the impact of these policies. In the case of stormwater management policy, staffing transcends all levels of program implementation; so analysing the staffing levels at municipalities and at REEP are necessary to understand how a program has been implemented (Pyzoha, 1994). Finally, expert interviews allow for further exploration of trends identified in the quantitative research and insight into what parts of the SCP program were most and least effective – an insight that is not provided through document research alone.

In their investigation into the impact of demographic, socio-economic, and environmental contextual characteristics of municipalities on the commitment of municipal councils to WSUD, Morison and Brown (2011) utilized expert interviews as part of their mixed methods research design. In recognising that interviews are an important part of data triangulation and understanding quantitative data, my research also utilises expert interviews as a form of data collection (Morison & Brown, 2011). Morison and Brown (2011) interview significantly more municipalities than are within the scope of my study, therefore to guide my interview data collection, I turn to the experiences of Cettner et al. (2014a), Keeley et al. (2013), and Mills (2010), as explained below.

As stated, the primary quantitative data component of my research utilises in-depth, expert interviews; this research design choice is based primarily off of Cettner et al. (2014a). Cettner et al. (2014a) use practice as a foundation to investigate the conditions of importance for sustainable urban stormwater development in

Sweden, based off of the perceptions, experiences, and visions of Swedish municipal water professionals. My research is also based on practice (see Chapter 2) to identify potential barriers and solutions to the adoption of sustainable stormwater management. Importantly, both Cettner et al. (2014a) and this research accept and explore the social aspects which may lead to poor uptake of sustainable stormwater management. The difference between Cettner et al.'s (2014a) research and my own is first, scale: Cettner et al.'s study takes place at the national level through nine interviews with water professionals; alternately, the scope of my research is only the two municipalities of Kitchener and Waterloo, and my in depth interviews are with professionals within these two cities. Cettner et al. (2014a) cite Trost (2005), asserting that a, "limited number of interviews conducted can provide an overview with a depth not normally possible in much larger samples"; my research stands on the same logic in using in-depth interviews with five key informants from Kitchener and Waterloo. Cettner et al. (2014a) also utilise a thematically structured interview guide which focuses on extracting how to best develop urban stormwater management; this is similar to my own interview guide, which is based on the themes that emerged in the literature, in order to give respondents the space to discuss the variety of barriers and opportunities that may arise when their communities promote sustainable stormwater management.

Keeley et al., (2013) examine the challenges that arise in "integrating grey and green infrastructure for stormwater management". They utilise expert interviews, with four interviewees from each city they observe; the interviewees are selected based off of their experience and ability to speak to urban stormwater management issues. The interviews were between 60-90 minutes with open-ended questions, framed to elicit an explanation of the challenges encountered when promoting sustainable stormwater management. My own research reflects this approach as I selected experts who could represent the experience in each city (Kitchener and Waterloo) with 3-4 experts being able to speak to the experience in each city. My interviews are also semi-structured, in-depth, and have open-ended questions, with a timeline of approximately 60-90 minutes each. Keeley et al. (2013) ensured that interview questions allowed for interviewees to discuss technical, administrative, political, and financial barriers and conditions. As a reflection of Keeley et al. (2013) and my literature review and theoretical framework, my interview questions are also framed to allow for a discussion of these multiple sources of barriers and opportunities.

Mills (2001) study of sustainable stormwater management in Atlantic Canada also used semi-structured expert interviews, with data then coded and analysed to identify trends and patterns. My own research reflects this strategy. Specifically, Mills (2010) used 4 expert interviews to represent stormwater management experiences for all of Atlantic Canada – with each respondent representing a different municipality in a different province (essentially one interview to represent each province). I am using interviews with 5 experts from Kitchener and Waterloo to represent and understand the experience of stormwater changes in those two cities. My participant selection process ensured that those interviewed were highly knowledgeable about the stormwater experiences in Kitchener and Waterloo (see below).

Overall, Mills' (2010) accepted thesis study validates my own choice to use expert interviews (and the selection process for these interviews) to adequately represent stormwater management changes within the municipalities.

This research utilises semi-structured interviews with three groups of participants:

1) Municipal stormwater staff
2) REEP staff managing stormwater engagement
3) Depave Paradise leads in 5 Ontario communities

Interview Sampling: Interviews utilize expert sampling through purposive sampling (non-probability sampling based on specialist knowledge of the research issue) and snowball sampling (non-probability sampling where appropriate respondents are identified, interviewed, and asked to then suggest another appropriate respondent). The lead stormwater management policy coordinator in each municipality was contacted for an interview along with a lead on SCP outreach from REEP. Two experts from the city of Waterloo, one expert from the city of Kitchener, and two experts from REEP participated in the interview process. For Depave Paradise interviews, purposive sampling was used to contact the Depave Paradise project leads through Green Communities Canada (who oversee the program). Five Depave leads from different Ontario communities who had run Depave projects in the last three years responded and participated in the interview process.

Interview Style: Interviews were conducted face-to-face whenever possible as this method helps yield a higher response rate, especially when conducting interviews that are more time consuming (Seasons, 2003). When face-to-face interviews were not possible, telephone interviews were conducted; this was the case for all Depave Paradise interviews. Interview questions included open-ended questions, as these can be an effective way to generate a wide range of responses that represent different perspectives (Seasons, 2003). Interview questions were open ended to allow for a range and depth of answers

Interview Focus for City and REEP staff: The focus of these interviews was to: gain a clear understanding of each actors' role in the promotion of sustainable stormwater management; verify policy and implementation timelines; explore trends in participation rates and their correlation with other identified factors; provide insight into the relationships between different groups involved in SCP policy formation and implementation; and to provide insight into which engagement methods were most and least effective for the promotion of sustainable stormwater management.

Interview Focus for Depave Paradise Leads: Interviews with Depave Paradise leads were included in this research in order to identify strategies for the promotion of sustainable stormwater

management that may have been absent in the experiences of Kitchener and Waterloo, and to verify that challenges faced in the transition to sustainable stormwater management in Kitchener and Waterloo are experienced in other Ontario municipalities. This helps ensure reliability of the research findings from Kitchener and Waterloo.

Survey of Municipal Councillors to Identify Political Impacts and Program Bias at the Municipal Ward Level

In order to determine political support for the sustainable stormwater management changes, a short survey was emailed to municipal councillors to identify whether or not they were in support of the SCP, what steps they had taken to promote the program in their community, and any reasons why they think the SCP was embraced or ignored in their ward. Additionally, questions about council support for the SCP program in each city were posed. A copy of this survey can be found in Appendix C. The surveys were returned through email.

Morison and Brown (2011) found that communities where local government officials self-reported to have a high sustainable stormwater management policy commitment, also tended towards higher commitment levels to sustainable stormwater management policy. Eason et al.'s, (2003) study, "Providing Incentives for Low-Impact Development to Become Mainstream", identified city council staff as a key stakeholder group in implementing sustainable stormwater management. In recognising the important role city council could play in uptake of sustainable stormwater management, the data collected in the quantitative phase was sorted by municipal ward. This sorting allows for the comparison between councillor support for stormwater changes and the uptake of sustainable stormwater management in their ward. By comparing ward participation rates to the levels of political support for stormwater management changes, this research illuminates whether politics played a role in creating a window of opportunity for the proliferation of sustainable stormwater management in Kitchener and Waterloo communities (See section 2.3.3.3).

Morison and Brown (2011) (research described above) included surveys with municipal councils as part of their data collection. On average they received three respondents per municipal council, although some councils were represented by only one respondent. Morison and Brown (2011) used this survey to understand levels of commitment to "Water Sensitive Urban Design". My research is inspired by Morison and Brown (2011), and uses surveys, sent to municipal councillors, to measure their commitment as a councillor to the promotion of sustainable stormwater management in relation to their fellow councillors. The goal of the survey is to explore the role local politics may have played in the uptake of sustainable stormwater management (see section 2.3.3.3). Furthermore, Keeley et al., (2013) highlights the importance of the local level and community leaders, who can encourage public buy-in to sustainable stormwater management.

Thorne et al., (2015) also recognise that barriers to the adoption of sustainable stormwater management vary "not only between cities, but also between neighbourhoods"; they utilise expert interviews at the municipal level to draw out these differences (as this research also does). The aforementioned studies and others (Brown & Farrelly, 2009; Biesbroek et al., 2013) recognise the differences that can occur regarding barriers to sustainable practices at the local level, and therefore support my methodological decision to analyse sustainable stormwater choices at the municipal ward level, as it allows my research to consider the impact city councillors may have had on participation within their wards, and the variations that exist in populations *below* the municipal level of research.

3.4.6 Stage 8: Data Organization and Analysis

3.4.6.1 *Interview Coding*

After each interview was completed, the audio files were transcribed by the researcher, verbatim. Coding followed transcription. This research takes a grounded theory approach to qualitative data analysis. It approaches grounded theory from the perspective that because of a researchers' prior knowledge, it is impossible to code without the influence of that prior knowledge, however, researchers must keep an open mind towards unexpected concepts and categories that may emerge in the data (Benaquisto, 2008 a). A codebook was developed during the coding process and can be found in Appendix E. The codebook outlines key concepts, their definitions, and their criteria for recognition (Benaquisto, 2008 a). The codebook was developed and refined throughout an iterative process of data collection, coding, and analysis (Benaquisto, 2008 a).

Code Book Development

The first step to develop the codebook was memoing, which involved reading through the interview data, and taking notes on the insights, ideas, patterns and connections that emerged (Benaquisto, 2008 a). Step two was open coding; this involved taking the notes formed during memoing, refining them into labels and identifiers, and rereading the interviews to label and identify as many ideas, events, words, phrases, and concepts as possible, without worrying about how the concepts relate (Benaquisto, 2008 a; Mills, Durepos, & Wiebe, 2010). Open coding does not reduce information, rather, it aids in organisation of the data into meaningful categories (Mills, Durepos, & Wiebe, 2010).

The third step in the coding process was focused coding. This step is akin to a *coding of codes;* the most frequent and significant codes identified in open coding were turned into focused codes. These focused codes were used to organise and analyse the data (Charmaz, 2014).

The fourth step in coding was to relate each focused code, to a research sub questions. Any themes that emerged that were not related to a sub questions, but provided an unexpected insight, were sorted into a new

category. This sorting process allowed for the researcher to easily organise and reference data when writing the findings and analysis sections of this thesis. A summary of coding steps are outlined below:

1) **Memoing** – Form open codes
2) **Open Coding** – Reread transcriptions and label open codes thoroughly
3) **Focused Coding** – "Coding" of open codes into groups based on relationship such as shared meaning or topic.
4) **Sort** focused codes by how they relate to each sub-question.

3.4.6.2 *Implementation Chains*

Implementation chains were constructed to represent the flow of engagement events in Kitchener and Waterloo. Creating these chains involved listing all activities carried out in connection to stormwater management programs in Kitchener and Waterloo on a timeline (Pyzoha, 1994). Implementation chains facilitate the creation of links between inputs and outcomes by making timelines clear, while ensuring policy and program aspects are not overlooked (Edvardsen, 2011). As layers of information were combined (both quantitative and qualitative), and compared to sustainable stormwater management installation rates, the effects (or lack of) of certain engagement strategies and events became apparent. This researcher recognises that overlap may occur in regards to motivating factors for property owners to participate in sustainable stormwater management, and that an event may impact someone to participate, but not until months after the initial event took place. For this reason, this research cannot say with certainty that any singular event had a direct impact on sustainable stormwater management installations, but can only suggest that an event influenced application rates strongly based on overlap between implementation chains and application timelines.

3.5 Reliability, Credibility, and Validity

In regards to credibility and validity, case study research has been criticised for its lack of replicability; this leads some academics to lower the value of case study research in explaining phenomenon (Markusen, 2003). Hudson (2003) responds to this criticism by asserting that the value of research does not come from its replicability, since time-space specific circumstances impact findings; instead, emphasis should be placed on triangulation to assure value in findings. Further, Hudson (2003) explains that by holding 'replicability' as the key component of research validity, one would have to assume that the objects and subjects of study are unchanging; this is not true in respect to the context of this research exists within. Lagendijk (2003) adds that contextual case study approaches to research are rooted in the particularity of subjects, place and time; relational analysis is the key in assessing the quality of research (Peck, 2003).

In order to address the issue of credibility and validity in this study, multiple sources of evidence have been incorporated into the methodology to allow for triangulation of data. This provides enhanced credibility, rigour, and validity to the research process, including data analysis (Long and Johnson, 2000; Yin 2009).

Credibility, validity and reliability are ensured through methodological design, similar to Cettner et al. (2014a). Cettner et al. (2014a) aim to be true to the original text regarding pattern and theme identification during analysis by using constant analysis review and redesign; their process, and this research involved, "working close to the data, going back to the interviews, listening to the recordings of the interviews and reading the transcriptions in a search for other aspects not earlier considered and in this way validating the results. The work often leads to re–thinking and re-doing parts of the analysis and two or more valid results could emerge. According to Yin (2003) the validity of this study is strengthened when the patterns coincide with themes and in generalizing the results to the broader issue of sustainable stormwater development" (Cettner et al. 2014a). My research follows the same analysis process for interviews and document review. The iterative coding process for interviews and documents to ensure credibility, validity, and reliability in the findings can be found in section 3.4.6.1.

3.6 Limitations

There are three important limitations that must be recognised. First, as Talen (1996) discusses, 'multicausality' can be used to dispute the analysis and conclusions established in implementation research. Concrete chain links between plans, socioeconomic factors, and implementation are unattainable, but logical associations between each can be established. Second, using SCP application rates as a representation of the uptake of sustainable stormwater management in Kitchener and Waterloo is not 100% accurate, as people who have sustainable stormwater management installed have not necessarily applied for the SCPs. Lastly, due to privacy restrictions, the cities of Kitchener and Waterloo could not provide SCP participation data at the household level; instead data were provided at the municipal ward level. The decision was made to divide data at the municipal ward level to allow for the observation of politicians' influence on the uptake of sustainable stormwater management. Due to the data representation at a ward level, identification of program bias could have been more accurate, for example, if data was compared at the household or census division level.

4 Context: Kitchener and Waterloo's Stormwater Management Experiences

Progressive steps towards sustainable stormwater management governance, funding, and infrastructure provision are underway in the Ontario municipalities of Kitchener and Waterloo. In response to projected stormwater management system upgrade costs and flood damage costs, Kitchener and Waterloo have both implemented Stormwater Credit Programs (SCPs) and stormwater rate utility fees. The credit program and utility fee work together to ensure sustainable funding for stormwater management systems, and to encourage sustainable stormwater management on private property, thereby reducing demand on piped systems. Although stormwater utility rates date back to before 1977, with over 15,000 American communities instituting a form of user fee or utility rate, this is not the case in Canada (Water Environment Research Foundation, 2009; O'Neill, 2016). Kitchener and Waterloo are two of the first municipalities in Canada to implement an impervious area-based method of stormwater funding and corresponding

stormwater credit program; municipalities and conservation authorities across the country are looking to both cities to learn from their experiences (AECOM, 2013; CVC, 2008; CK, 2015a). The leading edge status of both cities within the field of Canadian stormwater management lead to their selection for this research. The following discussion will provide context and background information to introduce the reader to the state of stormwater management in Kitchener and Waterloo.

4.1 Location, Demographics, and Additional Background Information on Kitchener and Waterloo:

Kitchener and Waterloo are twin cities located in southern Ontario, within the Region of Waterloo. Both cities are part of the Grand River Watershed. In 2013, Kitchener had a population of 233,700(CK, 2014). The city of Waterloo's population in 2014 was estimated to be 132,300 (CW, 2015a). Weather for both cities range from hot in the summer time (above 30 ^{0}C) to very cold in the winter (below -20 ^{0}C). Average monthly precipitation ranges from 50-90-mm/ month, with the summer months having the highest average rainfall (The Weather Network, 2016).

4.2 Regulatory Requirements and the Nature of Local Government Powers and Resources in Ontario

Both Kitchener and Waterloo are located within the province of Ontario and must adhere to various federal and provincial legislation. The following table highlights the different plans and legislation that impact stormwater management decisions in Ontario municipalities (AECOM, 2013).

Table 1: Stormwater Legislation (AECOM, 2013)

Federal and Provincial Legislation	
Ontario Water Resources Act (OWRA)	- Prohibits the discharge of pollutants into waterways - Gives the Ministry Of Environment authority to regulate water supply, including stormwater, which is defined as "sewage" - Retrofit controls for stormwater can be mandated through the Ministry of Environment; however, currently retrofits have only been *encouraged.*
Provincial Water Quality Objectives (PWQO)	-Outline numeric and chemical indicators of satisfactory water quality for Ontario surface and groundwater
Ontario Clean Water Act (2006)	-Protects drinking water in Ontario by requiring communities (19 "Source Protection Committees" in the province) to create collaborative, science-based source protection plans; this includes the preventing pollutants from entering waterways
Ontario Water Opportunities Act (2010)	-Require municipalities to create "municipal water sustainability plans"; these are meant to sustain water infrastructure, conserve water, and overall ensure sustainable, innovative, and cost efficient management of drinking water, sewage, and stormwater systems
Municipal Act (2001)	Municipalities have the authority to pass a "Fees and Charges" bylaw to gather stormwater management funding (SO, 2001, s.391)
The Planning Act (1990)	Municipalities may charge fees for planning matters (including stormwater management)
The Development	Fees can be charged to pay for the long-term growth-related capital costs of

Charges Act (1997)	new development (e.g. Stormwater system hook-up)
The Building Code Act (1992)	Fees can be charged to administer and enforce the Building Code (e.g. the building code can include stormwater control provisions)
Environmental Protection Act (1999)	- Focus on preventing pollution and protecting human health to promote sustainable development - Particularly relevant to stormwater in regards to salt management practices
Fisheries Act	- Prohibits the deposit of a deleterious substance "of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water" (Fisheries Act, 1985).
Watershed Plans	
Grand River Watershed Management Plan	-Goal is to improve the water quality and river health in the Grand River and Lake Erie -Recommendations regarding stormwater suggest that municipalities implement practices that focus on sustainable funding of stormwater programs; develop stormwater management master plans; improve sediment and erosion control; enhance stormwater communication and education; opportunities to retrofit existing uncontrolled areas, and a focus on and plan for maintenance and operation of facilities (GRW, 2014); this impacts the construction and maintenance of stormwater management facilities
Regional Plans	
Region of Waterloo Official Plan	-Requires stormwater to be considered when undertaking a variety of works and studies, including watershed studies; outlines "Wellhead Protection Areas" and their management requirements; allows for the use of alternative protection measures within "Vulnerable Source Water Protection Areas", and promotes the use of partnership programs within these areas to encourage changes in land use practices (e.g. stormwater management)
Local Plans	
City of Kitchener Strategic Plan	- Kitchener must, "Continue to show leadership in the development of an environmentally sustainable community." The City continues to ensure effective implementation of the stormwater management facilities in a sustainable and optimized manner in order to protect the environment and source water." (Murphy, 2011)

4.2.1 Additional Legislation

4.2.1.1 *The Places to Grow Act and Increasing Development Demand*

Under the Ontario Places to Grow Act (2005), the province created the Proposed Growth Plan for the Greater Golden Horseshoe. Together, these documents are meant to guide development in the province during a period of high population growth, while protecting green space and promoting sustainable development, mainly through densification requirements. The Growth Plan identifies "Urban Growth Centres" where high levels of population growth are anticipated; in order to promote densification over sprawl, these identified Urban Growth Centres will be required to hold 200 people and jobs per hectare, and 50 jobs per hectare in areas of greenfield development by 2031. Both Uptown Waterloo and Downtown Kitchener are identified as Urban Growth Centres and must densify; overall, Waterloo Region is expected to see a population rise up to 729, 000 people. This is relevant to stormwater planning, as ensuring sustainable funding for each city's

stormwater systems must account for this expected influx of development, which is likely to increase impermeable surfaces and place an added burden on the existing physical stormwater infrastructure.

4.2.1.2 *Stormwater Management Planning and Design Manual*

The Ontario Ministry of Environment published their first design manual for stormwater management planning in 1994; this guide was updated in 2003 and emphasises the use of a 'treatment train approach' to managing stormwater. In this approach, a series of controls are used at multiple stages in the stormwater cycle, including prevention, lot-level conveyance and controls, and end-of-pipe controls. Lot-level conveyance and controls include the application of sustainable stormwater management, which is a recognised part of a treatment train approach to stormwater management (Ontario Ministry of Environment, 2003; Bradford & Gharabaghi, 2004).

4.3 Stormwater Management Changes in Kitchener and Waterloo

Both Kitchener and Waterloo used to fund their stormwater management programs through traditional, property tax structures until 2010 (CK, 2016d). From 2004 to 2009, both cities completed a Storm Water Management Program and Funding review as a joint service initiative (CK & CW, 2010; CK, 2016d; TSH & CDM, 2009; AECOM 2013). The cities chose to undertake this study due to deficiencies in their current levels of stormwater service provision; deficiencies in legislative compliance; stormwater funding deficits; and a need to consolidate stormwater activities across departments and budgets (AECOM, 2013). The study identified future stormwater program needs (levels of service) and evaluated various methods to fund those needs sustainably (CK, 2016d; TSH & CDM, 2009; TSH & CDM, 2009; AECOM 2013). Findings showed that the City of Kitchener's level of service was 8 million /year, whereas a sustainable level of service for stormwater management was 13 million/ year (55 per capital) (CK & CW, 2010; AECOM, 2013). Approximately 6.2M of the 2010 stormwater management budget (8.9 million) came from the tax-supported operating budget; the balance came from supporting federal grants and subsidies from the city-owned water, sanitary, and gas utilities (CK, 2015a). For Waterloo, the current level of service was 2.4 million, while the sustainable level of service was 4.5 million (52 per capita) (CK & CW, 2010; AECOM, 2013). The objectives of each city's new funding model was to be (CK & CW, 2010):

- Fair and equitable
- Reasonably easy to administer
- Provide a steady stream of funding for planning and scheduling
- Flexible enough to allow users who conserve runoff and reduce pollution to be rewarded

Three options were studied by the cities: a stormwater management user rate; a dedicated tax levy for stormwater management; and the status quo approach (do nothing). For the stormwater management user

rate, a Residential Flat Rate and Residential Tiered Rate were determined to be the best choices for study, as they provide a balance between their accuracy and the level of effort required to run the program (CK & CW, 2010). The study suggested each city transition to a utility rate structure for their stormwater funding. The benefits of this include (CK & CW, 2010):

- Dedicated funding source
- Charges based on runoff contribution, not property value (more fair)
- Includes properties that do not pay property tax (equitable)
- Potential to include incentives to reduce runoff and pollutants through a credit program
- Raises awareness and knowledge or stormwater management functions

Additionally, the study recommended that the rate be increased over time to eventually fund a sustainable level of service, and to adopt a credit and rebate policy (CK & CW, 2010). After the presentation of this study to council in 2009, the joint service initiative reached completion and each municipality implemented a stormwater utility rate on their own terms. Both cities implemented their own "tiered flat fee" for their residential utility charge; this means the property was charged a flat fee based on property type and size (See section 3.1.2, Table 2).

4.3.1 Implementing A Utility Rate: Kitchener

Kitchener introduced their stormwater utility charge in January of 2011; Council had approved the charges on June 14th, 2010 (Gollan, and Corbett, 2010; CK & CW, 2010). Kitchener did not phase in their utility rate as they had a backlog of expensive water projects to pay for, including the remediation of Victoria Park Pond, a major feature in the city (The Record, 2011). Kitchener flat fees differed by property type and size as follows: Single Detached Small/Medium/Large; Residential Townhouse; Residential Condominium; Multi-Residential (2-5 or >5 units). For a Single Detached Medium home, the monthly utility rate was 9.45, with an annual charge of 113.40(CK, 2011). This has risen to 11.44 in 2016 (CK, 2016b)

4.3.2 Implementing A Utility Rate: Waterloo

The city of Waterloo Council approved of their stormwater utility rate on June 21, 2010, and began implementing the charge January 2011 (Gollan & Corbett, 2010). Waterloo phased in their utility rate over 4 years, with no level of service increase over the phase in period. The phase in consisted of slowly raising the amount charged through the utility rate, while lowering the amount charged through property taxes, producing a net zero cost. Waterloo residential flat fees differed by property type and size as follows: Residential Small/Medium/Large; Multi-residential Small/Medium/Large. For a Residential Medium home, the phase in for monthly utility charges were as follows:

- 2011 Monthly Rate: 1.11 (25% utility rate, 75% property tax)
- 2012 Monthly Rate: 2.21 (50% utility rate, 50% property tax)
- 2013 Monthly Rate: 3.32 (75% utility rate, 25% property tax)
- 2014 Monthly Rate: 4.43 (100% utility rate)

Therefore, in 2014, the annual charge for a Residential medium home was 53.14, which maintained current levels of service. The monthly rate for a residential medium sized home has since risen, at 6.74 in 2015, and 8.43 in 2016 (CW, 2016; 2015b). Although each city implemented their rate structures differently, there is still lasting coordination to ensure that the stormwater utility structure between the two cities is consistent, fair, and efficient (CK, 2016d). This coordination and cooperation extended into the second aspect of stormwater management restructuring: the institution of a stormwater credit program (SCP) in each city.

4.4 Implementing Stormwater Credits in Kitchener and Waterloo

In order to provide property owners with the option of reducing their stormwater charge, and to promote sustainable stormwater management on private property, Kitchener and Waterloo decided to consider implementing a Stormwater Credit Program. Both cities undertook a study with AECOM (engineering and research firm) to evaluate credit policy possibilities; this process included extensive public consultation. The program compared a non-residential program, residential program, rebate program, a combination of the above, or a do nothing approach to stormwater credits. The Stormwater Credit Program in each city was to be (Gollan, and Corbett, 2010, p6):

- Fair and equitable to users/rate payers;
- Reasonably easy to administer;
- A steady stream of funding for planning and scheduling;
- Flexible enough to reward users who conserve runoff and reduce pollution;
- Encourage non-residential property owners to manage stormwater on their site;
- Ensure stormwater best management practices installed on private property are properly maintained by certification reports and municipal inspections; and,
- Defer infrastructure capital costs

The overall expected policy results of the Stormwater Credit Program for Kitchener and Waterloo are that (CK, 2016c):

- Stormwater will be diverted, resulting in long-term improvements in surface water quality

- Existing privately owned stormwater best management infrastructure (such as oil and grit separators) will be required to be maintained as a result of ongoing follow-up on credits and incentives
- Property owners implement best management practices and make choices that benefit the environment
- The community will be engaged and will have the opportunity to demonstrate ownership over greening their neighbourhoods
- The cities of Waterloo and Kitchener will demonstrate continued cooperation on the shared initiative to address water quality; General knowledge of stormwater issues by the public will be increased

After the study, both cities settled on a residential credit policy structure based solely on water quantity reduction; properties could receive a maximum monthly credit on their utility charge up to 45% for the amount of runoff storage on their property.

4.4.1 SCP in Kitchener

In Kitchener, the SCP began in October 2012, and was retroactive to January 2011 (AECOM, 2013). Residents were informed of the program through the use of utility bill inserts, mailed out in October 2012. Residential property owners can receive credits for any of the following sustainable installations that capture over 200L of stormwater: Rain barrels; Cisterns; Infiltration galleries; Rain gardens; Permeable pavers. The breakdown for credits received in Kitchener is as follows:

Table 2: Stormwater Credits in Kitchener

Credit Type	Volume Captured	Examples	Credit
Basic Residential Credit	*200 - 800 L	1-4 rain barrels Small cistern	20%
Normal Residential Credit	801 - 3200 L	Large cistern Combination of cisterns and rain barrels	30%
Enhanced Residential Credit	3201 L or more	Large cistern Infiltration gallery	45%

*Note: The minimum volume eligible for a credit is 200 litres (L)

4.4.2 SCP in Waterloo

In Waterloo, the SCP began in January 2013. Residential property owners can receive credits for any of the following sustainable installations that capture over 200l of stormwater: rain barrels; cisterns; infiltration

galleries; rain gardens; certified permeable pavers, and trees. the breakdown for credits received in Waterloo is as follows:

Table 3: Stormwater Credits in Waterloo

Volume Range (L)	Credit Granted
200L- 400L	9%
401L- 800L	18%
801L- 2000 L	27%
2001L- 3200L	36%
>3201L	45%

4.5 Implementing Stormwater Programs: Building Partnerships

Kitchener and Waterloo partnered with a local environmental organisation, REEP Green Solutions to educate property owners about stormwater management issues and sustainable solutions, as well as to promote participation in the SCPs through the installation of sustainable stormwater management on private property. Through this partnership, REEP delivered Green Communities Canada's RAIN program in both municipalities; RAIN is a community-based social marketing program that exists to motivate property owners to install sustainable stormwater management and other sustainable stormwater practices (such as using less salt in the winter) (RAIN, 2014). This section will discuss the RAIN program and the partnerships between both cities and REEP.

RAIN began in 2011, with the start of the utility rates in both Kitchener and Waterloo. The RAIN program began with four partners: The City of Kitchener; the City of Waterloo; Green Communities Canada, who developed the initial model for the RAIN program; and local non-profit, REEP Green Solutions, who delivered the RAIN program locally (City of Kitchener, 2016 a). Funding for RAIN came from both cities of Kitchener and Waterloo, and an over 1 million grant from the Ontario government's 'Showcasing Water Innovation' program (from 2011-2013). The six objectives for RAIN are to (RAIN, 2014):

1. Grow expertise among related fields and service providers;
2. Engage community in making wise choices for stormwater management;
3. Facilitate stormwater mitigation demonstration projects;
4. Provide incentives and credits to landowners who implement stormwater mitigation measures;
5. Develop and deliver home consultations on stormwater mitigation measures; and
6. Communicate the RAIN stormwater management approach to other jurisdictions, and provide resources that can be used by other jurisdictions.

Goals 1 through 5 of RAIN are directly related to the SCP and sustainable stormwater management promotion in Kitchener and Waterloo. To accomplish these goals, RAIN developed materials to engage community members with the SCP and sustainable stormwater management in both a residential and non-residential setting. The list of services and resources RAIN provides follows (RAIN, 2014):

- Promotion of stormwater credit applications
- Contractor training: to increase contractors' awareness and knowledge of sustainable stormwater management techniques
- Face-to-face and neighbour-to-neighbour outreach
- RAIN yard signs to raise social encouragement for sustainable stormwater management
- Residential and non-residential participant case studies
- Hands-on workshops and training
- High profile demonstration projects
- Clear, simple, and consistent messaging
- Partnership building within community champions
- Home and business visits: engaging property owners to create a customized action plan for their site specific stormwater needs
- Online knowledge sharing
- List of local contractors knowledgeable about sustainable stormwater management

The outreach and tools used to promote the SCP and sustainable stormwater management through the cities' partnership with REEP will be explored through expert interviews. It is important to understand which efforts were most and least effective at promoting sustainable stormwater management so that other municipalities can learn from the Kitchener and Waterloo experiences.

5 Findings

This chapter presents findings from multiple data sources to address the main objective of this thesis, to explore the barriers and solutions to promoting the transition to sustainable stormwater management in Kitchener and Waterloo. This chapter presents the data collected through multiple methods to establish: the barriers encountered and strategies used to encourage sustainable stormwater management; the most effective strategies used to promote sustainable stormwater management; expert recommendations to better promote sustainable stormwater management uptake; and experts' overall reflections on the SCP and sustainable stormwater promotion.

This chapter presents primarily quantitative findings first, and subsequently presents qualitative findings. These findings will be discussed in the context of the literature review in the following chapter. Findings from expert interviews with Depave leads are included, where relevant, in the footnotes.

Quantitative findings are organised into three sections:

5.1 Identifying Program Bias

5.2 Implementation Chain Mapping

5.3 Types of Stormwater Management

Qualitative findings are divided into five sections that explore the lived experiences of barriers and solutions to sustainable stormwater promotion in Kitchener and Waterloo, through expert reflection on the current stormwater programs. The qualitative findings are categorised as follows:

5.4 Perceived Barriers

5.5 Real Barriers

5.6 Institutional Barriers and Solutions

5.7 Solutions: Effective Outreach and Communication Strategies

5.8 Municipal Experts' Overall Reflections On SCP and Stormwater Outreach

5.9 Ideas for Change

Reference key for experts interviewed:

K1= City of Kitchener Employee, works on the SCP and stormwater management

W1=City of Waterloo Employees (2) who work on the SCP and stormwater management

R1= Former REEP RAIN Program Coordinator

R2= Current REEP RAIN Program Coordinator

Depave Paradise leads are referenced based on the city in which their Depave Paradise project occurred. These employees are not associated with the municipality, but rather, are from local non-profits.

5.1 Identifying Program Bias

Quantitative data exploration allowed for identification of program implementation bias, thereby identifying extraneous variables in Kitchener and Waterloo's transition to sustainable stormwater management. In order to identify potential program bias, correlations between ward SCP participation rates, and the socioeconomic, demographic, and geographic characteristics of wards were compared. This exercise serves as a control, to ensure that these factors are not impacting sustainable stormwater participation rates, augmenting the information gathered during expert interviews. As discussed in section 3.4.1 *Addressing Program Coverage and Bias*, to ensure internal validity in measures of program bias, two methods were used to organise and analyse the quantitative data collected, a Pearsons Correlation test, and a bias indicator test based off of the methods of Morison and Brown (2011).

Pearsons Correlation Factor Results

The first method used to identify signs of program bias was a Pearson's correlation test between SCP participation rates and socioeconomic, demographic, and geographic factors in each ward. Appendix H showcases all of the Pearsons correlation test results for each demographic, geographic, and socioeconomic indicator. As there were no characteristics with a correlation above +/- 0.7 for both cities, the correlations that do exist were not considered to be suggestive of influence on the uptake of sustainable stormwater management, but instead, just a matter of chance.

Morison and Brown (2011) Bias Indicators

The second method used to identify signs of program bias, to ensure internal validity, is a method based off of the work of Morison and Brown (2011). The two lowest and two highest SCP participating wards in each municipality were identified; these wards were then compared to the socioeconomic, demographic, and geographic indicators of each ward. The goal was to identify any matches between the highest and lowest SCP participating wards and the highest and lowest instances for each indicator. No instances of matching between top and bottom performing wards were found for either municipality.

As there was no correspondence between Pearsons indicators of bias, and Morison and Brown (2011) indicators of bias, there is nothing to suggest program bias in the available data, based on the observed indicators.

Political Support

To determine program bias tied to local politics, first, voting records in both the city of Kitchener and City of Waterloo were observed. The City of Waterloo unanimously approved the Stormwater Credit program on February 27, 2012. The City of Kitchener voted on the Stormwater Credit Program on March 5, 2012, and was approved, with only Ward 3 and 4 councillors voting in opposition. Comparing the wards with dissenting councillor votes to SCP participation rates revealed that the two wards with the only councillors to vote against the SCP have the highest SCP participation rates. This suggests councillor support did not play a role in the uptake of sustainable stormwater management in Kitchener.

In Waterloo, all councillors voted for the SCP. To further explore whether or not political support impacted the SCP outcome, a survey was sent out to municipal councillors asking them to comment on the SCP. Of the 3 municipal councillor surveys returned, all were from Waterloo councillors. Two councillors stated that they and their colleagues all promoted the program relatively equally while the third surveyed councillor commented that it was not council's job to promote the program, but rather the job of other groups (like REEP). The unanimous support for the SCP in Waterloo, in addition to the responses from Waterloo Councillors suggesting individual councillors and politics did not play a large role in the uptake of sustainable stormwater management in Waterloo either.

Bias Assessment Through Interviews

Although Pearson's Tests, Morison and Brown's Bias Indicators, and an observation of political impacts did not suggest a program bias, interviews with stormwater professionals did. Professionals from both Kitchener and Waterloo explained that most of the program participants were either environmentalists, or those who had problems with flooding on their own properties (K1, W1). K1 stated that the residential incentive was too low to motivate people outside of these two groups to participate in stormwater management. Those who did install sustainable stormwater management were motivated by either environmental convictions, or self-preservation (to prevent flooding on their property). [3]

This theory presented by W1 and K1 is reflected in the participation rate data in both cities, which shows a high influx of participants at the programs' start (see figures 4 and 5). W1 and K1 explain that this trend reflects how those who already had installed sustainable measures on their properties prior to the creation of the credit program were responsible for the high amount of applications received over the first year. They suggested that the drop-off in applications after the first year could be attributed to the inadequate ability of the SCP to motivate the uptake of sustainable stormwater management.

5.2 Implementation Chain Mapping

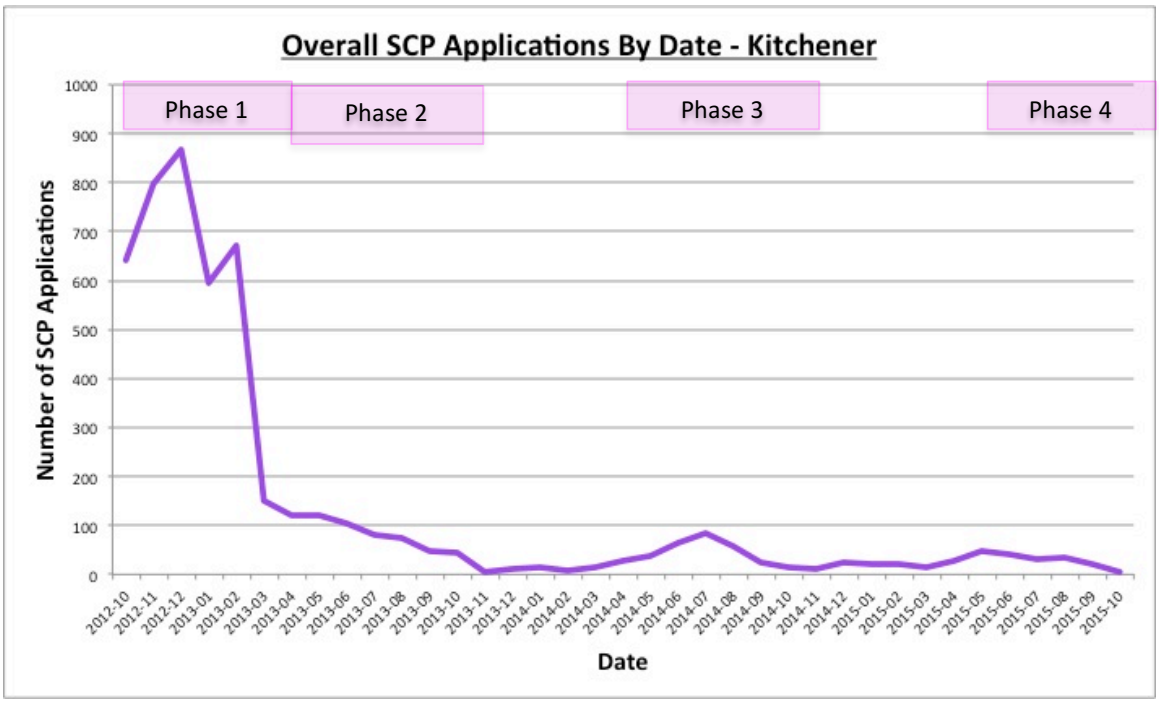
Utilizing SCP participation data provided by each municipality, timelines were constructed to represent the number of SCP applications received over time in each municipal ward, representing the installation of sustainable stormwater management over time. The timelines of overall SCP application in each city are displayed below. Ward-specific results were also observed for this analysis but are not represented visually due to document length constraints. SCP application timelines are compared to the timeline of outreach events compiled in Appendix F. Layering this information helps identify what outreach and engagement effort correlate to spikes in the uptake of sustainable stormwater management, helping to build a reliable explanation of what strategies worked well to promote sustainable stormwater uptake, and what strategies

[3] It is also useful to compare the experience of Kitchener and Waterloo to the Depave Paradise programs, regarding the instance of participation bias. As with experts from Kitchener and Waterloo, some of the Depave leads also suggested that it was environmentalists and those who were directly impacted by stormwater issues that were more likely to participate in Depave events. In particular, Kingston's Depave lead said that, "people suffering from flooding are probably more interested in actually participating because there is a direct benefit for them". The Depave organiser at Green Communities Canada said that many who participate are part of their member groups' network, which implies high participation from environmentalists (as their member groups are typically environment focused). However, thanks to the active nature of the Depave projects, participants were also regular members of the community, "who just liked the idea of being outside and contributing to the community and shovelling some dirt for an afternoon" (Depave Ottawa). The Depave organiser at GCC stated that Depave tries to engage with broader media (newspaper and radio) for coverage of their events, in order to engage an audience outside of 'traditional environmentalists' on stormwater issues. The GCC organiser also suggested that the active and community building nature of Depave projects attracts participants outside of the 'traditional environmentalist' group.

were less impactful.

Kitchener

Figure 4: Overall SCP Applications by Date - Kitchener



Kitchener has 4 periods of heightened applications: phase 1 is the most intense, from the start of the program to 2013-03; phase two is 2013-03 to 2013-10; phase 3 is 2014-04 to 2014-08; and phase 4 is 2015-04 to 2015-08. In Kitchener, the largest spikes in applications are received during Phase 1 from wards 1, 4 and 5; all wards follow the general 4-phase trend in applications, but to varying degrees of intensity. Kitchener had a much more intense influx of SCP applications at the program's start than Waterloo (see Figure 5). The following observations can be made after overlaying the application and outreach event timelines (Appendix F):

- March 2013 is the last month Kitchener residents can apply for retroactive credits[4], which may explain why application rates drop off sharply after this date (after Phase 1)
- Residential outreach activities are very active through phase two compared to after 2013, which may explain the more sustained levels of applications through this phase
- Between phase 2 and 3 is Winter, which means few sustainable stormwater management projects can be installed, likely reflecting the drop in applications. This seasonal impact is also reflected in

[4] Retroactive Credits in Kitchener allowed people who already had sustainable stormwater management installed before the start or the SCP to receive back credits until January 2011. This retroactive credit ended in March of 2013.

outreach, as outreach activity is reduced between phases 2 and 3, because K1, W1, and R1 suggest heightened outreach in the Spring and Summer, which is when people are more likely to install and think about sustainable stormwater management

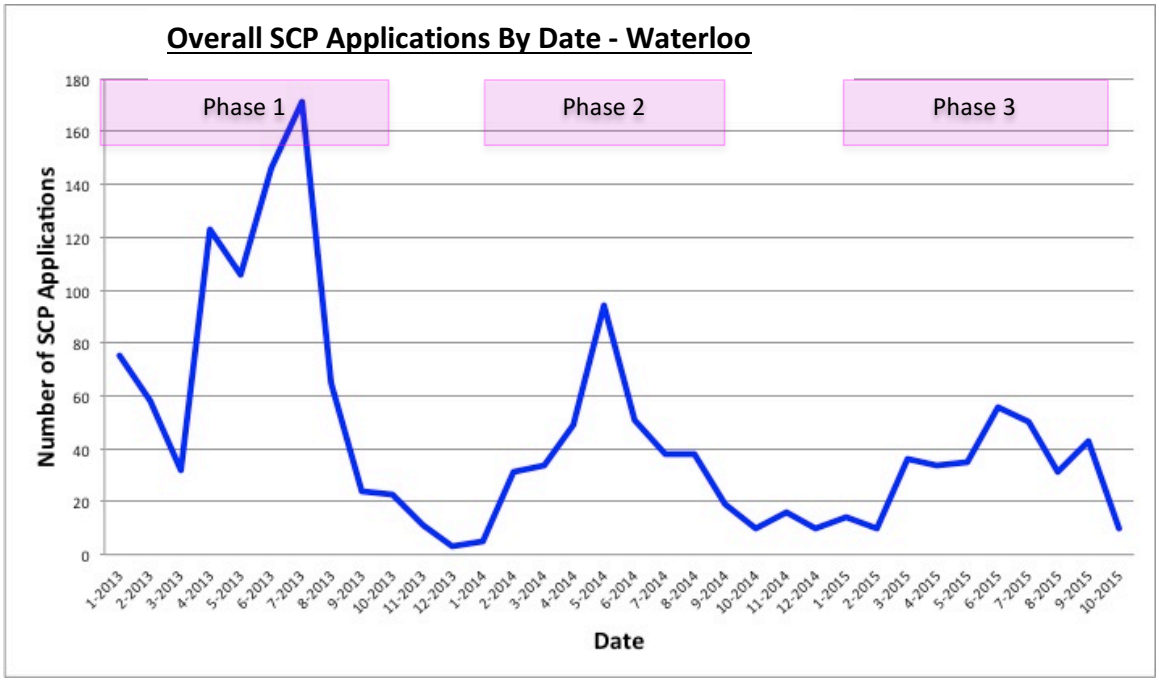
- Utility Bill inserts are sent out right as phase 3 and 4 begin, suggesting that these inserts either kick start renewed seasonal awareness of stormwater issues by citizens, or that this represents the start of outreach season by REEP
- Applications rise during phase 3, even though there is little residential outreach over this period, this suggests that the outreach efforts taken over phase 3 were effective, even though there was less outreach overall

Comparing application rates at the ward level to the residential outreach activities produced the following observations:

- The wards that contained neighborhoods targeted for outreach prior to the SCP's implementation (Wards 10, 9, and 8) did not have a higher application rate during phase 1, or any subsequent phases.
- Wards which contained neighborhoods targeted for outreach throughout the SCP's implementation (Wards 10, 9, and 8) did not show higher rates of participation; conversely, wards which did not contain neighborhoods targeted for outreach, had the highest rates of participation (Wards 1, 4, and 5).

Waterloo

Figure 5: Overall SCP Applications By Date - Waterloo



In Waterloo there are three periods of heightened levels of SCP applications. Phase 1 is between 04-2013 to 07-2013 (highest application period); Phase 2 is 02-2014 to 08-2014 (second highest application period); and Phase 3 is 03-2015 to 09-2015 (third highest application period). These trends are visible, to varying degrees, in all ward-specific data. In Waterloo, Ward 5 had the most intense spike in applications, while wards 6 and 7 saw the lowest spikes in applications. In both Kitchener and Waterloo, it is clear that applications are received more in the summer and less in the winter months. Waterloo had significantly fewer applications through phase 1 than Kitchener.

Waterloo's application timeline was compared to the timeline of residential outreach activities (Appendix F). The following observations can be made after overlaying both timelines:

- There was an influx of SCP applications after a rain barrel sale in April 2013 (where over 1300 rain barrels were sold)
- Residential outreach reduced after 2013, which is reflected in Waterloo application rates
- There is a spike in SCP application during July-August 2013, which overlaps with door to door outreach efforts by REEP as well as a string of stormwater workshops
- Like Kitchener, Waterloo SCP applications follow a seasonal pattern
- SCP application pick up around March of each year; this correlated to the time of year Waterloo send out their utility bill inserts reminding Waterlooians of the SCP
- There is a spike in application in May of 2014, but this does not correlate to any particular outreach activities. This could be a reflection of the seasonal nature of stormwater management; those who were engaged in the program at an earlier point may have waited until the spring to install sustainable stormwater management, and subsequently apply to the SCP
- A spike in application after June 2015 in is line with a Waterloo rain barrel sale in June of 2015
- Even though Waterloo's credit level increased over time (the credit was increased by 25% each year for 4 years) the application rate did not increase over time. This suggests that the amount of credit people received was not the main driver of their choice to apply for a credits/install sustainable stormwater management

Observing application rates at the ward level and comparing these timelines to the residential outreach activities (Appendix F), the following observations can be made:

- The wards that contained neighborhoods targeted for outreach prior to the SCP's implementation (Wards 1 and 7) did not have a higher application rate during phase 1, or any subsequent phases.
- The ward that contained a neighborhood targeted for outreach throughout the SCP's implementation (Ward 7) did not show higher rates of participation; conversely, wards that did not contain neighborhoods targeted for outreach had the highest rates of participation (Wards 4 and 5).

5.3 Types of Stormwater Management

Descriptive statistics were used to identify trends in the type of stormwater management listed on SCP applications with the purpose of illuminating trends that could be explored further during interviews to understand *why* some types of sustainable stormwater management were installed more than others. This exploration may uncover what barriers prevent the installation of some forms of sustainable stormwater management, and what encourages the installation of other forms. Rain barrels were the most popular form of stormwater management in both Kitchener and Waterloo (See figures 8 and 9). This is likely due to two reasons:

a) Ease of installation, and;
b) The history of rain barrel sales were held in the Region of Waterloo

Although rain barrels hold less stormwater than other controls, W1 said they were still an important part of the stormwater solution, adding to overall stormwater volume reductions. In Kitchener, infiltration galleries were the second most common type of stormwater management indicated on SCP forms. This is likely because many homes in Kitchener were built with infiltration galleries, and these properties were notified of this fact to encourage their participation in the SCPs. In Waterloo, the second most popular application was under 'trees - basic level', which is likely related to the fact that many properties would not have had to install anything to gain this credit

5.3.1 Types of Stormwater Controls and Implementation Chain Mapping (Control Type Choices Over Time)

It is also useful to observe the breakdown of the type of stormwater management applied to over time, for each municipal ward to highlight trends in the types of stormwater management favoured by property owners.

Kitchener

When comparing the application data to the outreach timeline (Appendix F), the following observations can be made:

- The period after the Waterloo Rain Barrel sale in April 2013 does not indicate any spike in rain barrel applications, suggesting the rain barrel sale did not impact Kitchenerites as much as Waterlooians.
- The most residential outreach occurred before and during 2013; this aligns with applications, which drop after the summer of 2013.
- The main types of stormwater management applied to during Kitchener's first period of increased applications are rain barrels and infiltration galleries. A high amount of rain barrel and infiltration gallery applications before the retroactive credit ends in March 2013 signifies that these controls

were likely in place before the SCP began. K1 said that many people already had rain barrels and infiltration galleries installed because the region had been selling rain barrels for years before the SCP, and because some homes were required by zoning regulations to include infiltration galleries to keep the water balance. Property owners with known sustainable stormwater management infrastructure were targeted with mailers to inform them about their SCP eligibility, and therefore many applied (K1).

- The main types of stormwater applied to during the second phase of heightened application are rain barrels and infiltration galleries. These may be residual applicants who are applying from the same reasons as in phase one.
- In the third period of heightened applications, rain barrel applications are most common, with infiltration galleries in second. This may be due to the fact that rain barrels are the easiest and fastest control method to install, for anyone installing a brand new sustainable stormwater management.
- The fourth phase is driven by a rise in applications from infiltration galleries, this may be from homes built with infiltration galleries recognizing their qualification for the SCP.
- When the same data is observed at a ward-specific level, the popularity of rain barrels during phase one are relatively consistent across all wards suggesting the location of rain barrel sales in the city does not impact their dispersion.
- Overall we can see that after an initial rush of application over the first year of the SCP, there is significant drop off in applications that only rise minutely around summer periods.

Waterloo

When comparing the application data to the outreach timeline (Appendix F), the following observations can be made about Waterloo's experience with different types of sustainable stormwater management:

- Waterloo's rain barrel sale in April 2013 is in line with a spike in rain barrel applications seen in all Waterloo wards in the months following this sale; the same spike cannot be seen in Kitchener (most barrels were sold to Waterlooians, and for a cheaper price than to Kitchenerites).
- There was also a spike in rain barrel applications across wards after the June 2015 rain barrel sale. Again, the rise in rain barrel applications did not occur in Kitchener. The results of this sale, and the previous April 2013 sale suggest rain barrel sales are an effective means of promoting sustainable stormwater management and participation in the SCP. This also suggests that ward location of rain barrel sales does not impact their citywide dispersal.
- Like Kitchener, each phase has a lower amount of applications than the one before it.
- Waterloo has lower application numbers overall, although this reflects Waterloo's smaller monetary contributions to REEP, resulting in less SCP outreach in Waterloo compared to Kitchener.

5.4 Perceived Barriers

The following section presents findings related to the perceived barriers to the uptake of sustainable stormwater management on private residential property in Kitchener and Waterloo.

5.4.1.1 *Lack of Knowledge*

All stormwater program experts from the cities and REEP expressed that there is a lack of knowledge on stormwater issues, solutions, and SCPs in Kitchener and Waterloo. This lack of knowledge prevents residents from participating in the SCP and installing sustainable stormwater management. They stated that education is the solution to this barrier. The RAIN program and outreach are part of the education solution, but experts recognise that this program needs to reach many more people.[5]

5.4.1.2 *Risk and Uncertainty*

Lack of knowledge also created uncertainty and risk surrounding sustainable stormwater management. R1 stated, "If there is a new idea and nobody has heard of it, and it is untested, people won't trust things"; it is important for people to understand sustainable stormwater management if they are to trust it enough to invest in. Experts from both cities and REEP, along with City of Kitchener documents, explained that feelings of risk and uncertainty arose around the aesthetics of sustainable infrastructure (Would it look good?), uncertainty over payback periods on investments (Would the investment be worth it?), and uncertainty over how to install and take care of sustainable infrastructure (What does installation and maintenance entail, or who can install this infrastructure?). A Kitchener Market Study on stormwater management found that aesthetics in particular were a huge barrier to people installing sustainable stormwater management, as "the most important motivation for homeowners regarding their home's landscape is it 'appearance, curb appeal, and beauty'" (Aquafor Beech Ltd & Freeman Associates, 2015). This finding is problematic for the promotion of sustainable stormwater management, as research in the GTA found that homeowners view rain barrels and cisterns negatively, in part because they are considered 'unattractive' (Aquafor Beech Ltd & Freeman Associates, 2015). R1 summarized, "People want certainty, which includes knowing that it will look good." Aesthetic uncertainty was a major barrier to sustainable installations.

[5] The number one barrier to participation that Depave leads identified was a lack of knowledge; nearly every Depave interviewee stated that their communities were largely unaware of the impacts of poor stormwater management, and that once residents were made aware, many were sympathetic to Depave's cause and took interest in the project with varying levels of commitment. For example, the Depave lead in Ottawa said that many people are unaware of the combined sewage overflow that occurs in the city during large storm events. Once people learn about what is discharged into the Ottawa River during these storms, most think it is something to be concerned about. The solution identified by most Depave leads was continued and sustained outreach and engagement as a means to educate the population on stormwater issues.

5.4.1.3 *Cost: Time, money, and low return on investment*

Every expert interviewed in Kitchener and Waterloo stated that cost was the number one barrier to participation in the SCPs and sustainable stormwater management installation. R1 stated, "*… if you do nothing, just send out a flyer, the city gives high level information, nobody does anything! [It's] Just too much noise. If you do something like a home or business visit without incentive, people will do maintenance activities. If you add incentives, then that is where the magic happens, the more support with money and services to help them understand how to do things and guide them the more results you will get*." R2 summarised, "I'll go back to the carrot and the stick; I think the carrot isn't big enough for people to take notice, in terms of the utility fee." These comments illustrate the insufficient return on investment property owners make from installing sustainable measures. This is a sentiment that was echoed by both W1 and K1.

The SCPs provide, at most, a return on 45% of the utility charge. If a property owner installs two rain barrels, with each barrel costing an average of 100, and they only receive a minimum return on their monthly charge, the return on investment is not enough motivation for most people to act (W1). As the K1 identified, the cost of stormwater controls contributes to peoples' lack of motivation to participate in the SCP. K1 stated that if people were not already interested in sustainable stormwater management (for environmental or personal flooding reasons), that it was very unlikely property owners would go out and spend a fair amount of time and money on a stormwater project that would not see them a monetary return on their investment.

To further support the issue of cost as a barrier, a RAIN Home Visit survey from 2013 showed that 35% of respondents did not act to improve stormwater management on their property because of financial constraints. The low return on investment was even cited in local newspaper articles as a reason for the lower-than-expected program uptake. Even people who already had sustainable measures installed did not seem to value the cost return enough to fill out the online SCP application. For example, the city of Waterloo explained that during one of their rain barrel sales, they sold about 600 rain barrels but only got about 50 applications. This occurred even though the credit was explained to buyers at the sale, and paper copies of the application were handed out. The time required to fill out the application form online or on paper became a barrier because the refund given was so low(W1). Earning the credit wasn't seen as a worthy investment compared to the costs (time, monetary, and effort). [6]

[6] Just as experts in Kitchener and Waterloo found that cost was a major barrier to participation in sustainable stormwater management, so too did Depave Paradise leads. Depave leads from Hamilton and Ottawa both ran into problems with the cost of installing sustainable stormwater management on their demonstration sites because they could not finalise costs up front and did not have a dependable funding source.

5.5 Real Barriers

The following section explores the real barriers to SCP and sustainable stormwater participation on private residential property in Kitchener and Waterloo.

5.5.1.1 *Installation Challenges*

As established through expert interviews, there is a lack of knowledge preventing the installation of sustainable stormwater management and participation in the SCPs. This lack of knowledge is not limited to property owners, it also applies to contractors and landscapers who are supposed to provide sustainable installation services. A survey conducted by RAIN in 2013 following up with participants of their 'Home Visit' program (which helps homeowners identify how to retrofit their properties to prevent flooding and increase infiltration) found that 10% of respondents listed 'difficulty locating a contractor' as a major barrier to taking action on stormwater. This is 10% of people who were keen enough on stormwater to actually have a RAIN home visit in the first place, so it is likely that these homeowners put more of an effort to find qualified contractors than most. To further illustrate the difficulty of locating a knowledgeable contractor, it is important to note that in 2013, while attempting to create an infiltration gallery as part of a demonstration project, REEP and the cities themselves found it difficult to locate a contractor to complete the job (R1). [7]

Trends in SCP participation data align with the assertion that installation is a major barrier to SCP participation and sustainable stormwater management. The results in Figures 7 and 8 below show that in both Kitchener and Waterloo, rain barrels are the most popular form of stormwater control. In their interview, when asked about *why* rain barrels were so popular, one reason the City of Waterloo gave was that they were easy to implement (W1). Rain barrels require little setup and maintenance, and winterising them is as simple as storing the barrel and redirecting downspouts away from homes.

[7] Ottawa's Depave group ran into problems because they were not able to finalise the costs with their contractor until after the work was complete. This was due to the many variables involved with retrofitting for a rain garden by removing concrete, but stemmed from the contactor inexperience with similar projects. This identifies another common barrier: the need to educate and train local contractors and landscapers in stormwater management techniques. This is a goal of Depave groups, and echoes the experience of REEP in Kitchener and Waterloo.

Figure 6: Sustainable Stormwater Management in Kitchener

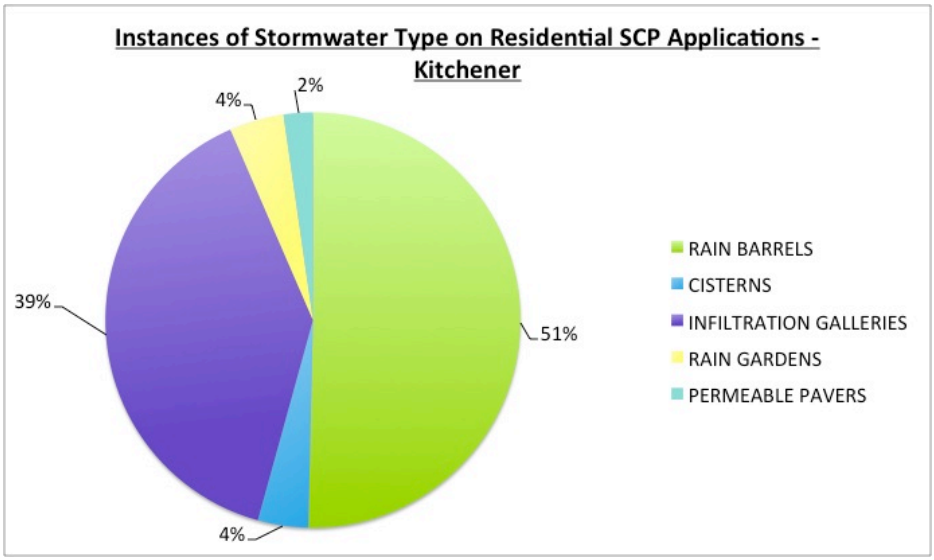
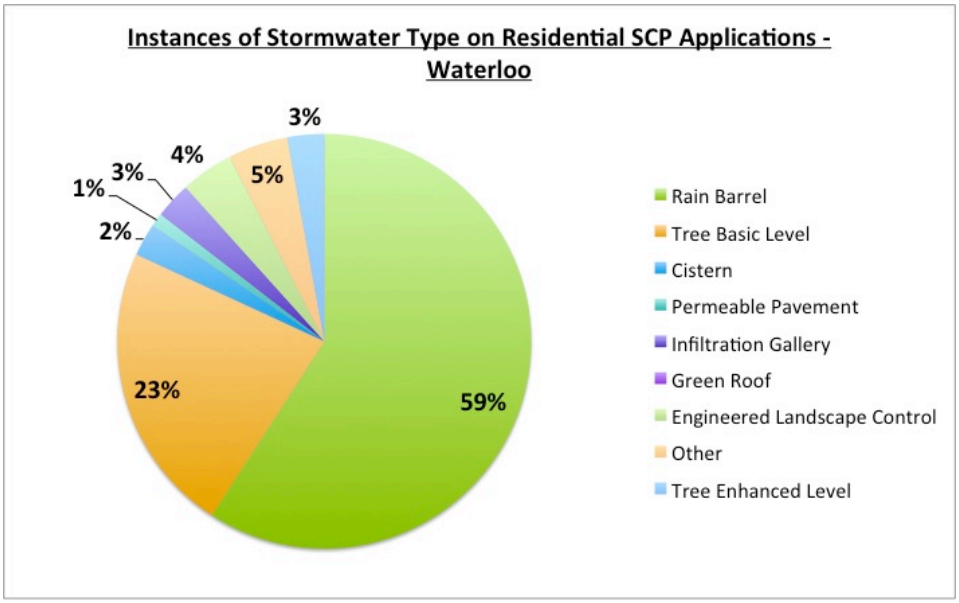


Figure 7: Sustainable Stormwater Management in Waterloo



5.5.1.2 *Lack of Time*

A survey conducted by RAIN in 2013 following up with participants of their 'Home Visit' program found that 40% of survey respondents had not taken action on installing sustainable stormwater management or following through with other suggestions from the RAIN home visit because of 'time constraints'. Time constraint as a barrier aligns with data on stormwater types in Kitchener and Waterloo; Rain barrels are the most installed type of sustainable in each, but are also the fastest control to install (Figure 7 and 8).

5.6 Institutional Barriers and Solutions

The following section explores institutional barriers and helpful solutions Kitchener and Waterloo experienced as they promoted participation in the SCP and sustainable stormwater management. This includes an overview of the strategy Kitchener and Waterloo used to implement and promote sustainable stormwater uptake, including goal formation, timeframes, and evaluation and monitoring.

5.6.1.1 *Provincial Legislation*

R1 identified lagging legislation as a barrier to the implementation of sustainable stormwater management. This barrier was influential in terms of the *cities'* choices, rather property owners' choices. R1 explained that because the provincial legislation guiding stormwater management does not allow for sustainable stormwater management to *replace* grey infrastructure, the cost benefits of making the switch are reduced. Additionally, city planners and engineers who aren't as familiar with sustainable measures as they are with the status quo, are often reluctant to take the 'risk' of installing leading edge sustainable measures unless they are legislated to do so. More progressive and demanding provincial legislation on stormwater management would help Kitchener and Waterloo push harder for sustainable stormwater management (R1).

5.6.1.2 Institutional Capacity: *Funding*

Waterloo was not able to provide as much funding to REEP for outreach as Kitchener. As a result, REEP focused outreach efforts in Kitchener. REEP also noted that both cities reduced their funding over time. REEP said that the funding they received directly impacted how much outreach they could provide. This matches the participation data from both cities, as Waterloo has lower participation rates than Kitchener, and over time, new application rates diminish in both cities. Lack of funding for outreach programs is therefore a barrier to engaging people in sustainable stormwater management.

5.6.1.3 *Strategies*

This section will discuss the strategy that Kitchener and Waterloo each took to implement their SCP, promote sustainable installation, and engage their citizens on issues of stormwater management. Understanding each city's strategy allows for an identification of the strengths and weaknesses of each approach.

Kitchener and Waterloo: A United Approach Makes Transition to Sustainable Stormwater Management Easier

Kitchener and Waterloo worked together to promote sustainable stormwater management throughout the process of SCP implementation, and beforehand, in order to coordinate studies and public consultations leading up to the implementation of the utility fee and SCPs. The cities shared costs for these initial studies and also shared costs and time for program and communications planning (CK, 2015 a). They worked together on expert panels and steering committees monthly for over 2 years to ensure that both cities took a relatively similar approach to their stormwater management programs, as they did not want large program discrepancies for citizens living just down the street from each other (CK, CW, & RGS, 2013; W1).

The cohesive approach of Kitchener and Waterloo had a political impact. K1 noted that the cities working together, and at the same general pace, made it slightly easier to pass policy through city council; the joint approach indicated a strong base of support for policy changes, and made taking a step forward less intimidating for council. This political benefit was magnified for Waterloo, as they brought many stormwater issues to council just after Kitchener had already approved changes; Waterloo could then point to Kitchener as an example, making council more open to their stormwater proposals (K1).

There were two major differences between Kitchener and Waterloo's utility charge and coordinating SCP. First, the utility charge was phased in over 4 years in Waterloo, while the charge was not phased in in Kitchener. K1 stated they were glad Kitchener did not phase in their utility rate, while R1 and R2 also said not phasing in the rate was a smoother choice. W1 stated that the City of Waterloo had no choice in phasing in the rate, as it was a decision of council. The second difference is that Waterloo's fee was lower. Additionally, since it was phased in, it was especially low towards the beginning of the program (meaning credits were also lower in Waterloo). Interestingly, installation of sustainable stormwater management did not increase as the phased in credit increase (see section 5.2).

REEP confirmed that both cities' campaigns were generally the same, with Waterloo's scaled back at about a 2:1 ratio because they provided significantly less funding than Kitchener. In terms of non-monetary support, REEP stated that both cities were "phenomenal" in answering questions and providing support whenever it was requested (R1). For example, both cities provided REEP with access to their communications teams. REEP also stated that the barriers experienced while conducting outreach to promote sustainable stormwater management were similar in both cities (R1, R2).

Many stormwater outreach activities conducted within one city were attended by citizens of both Kitchener and Waterloo (e.g. annual Home and Garden shows, Environment Day Activities, REEP hosted stormwater workshops). This crossover extended to contractor training sessions coordinated by REEP, as contractors generally served the whole region and surrounding areas, rather than just one city. Since program outreach was fairly similar in both cities, and the impact of an activity was not limited to the city in which it occurred, the subsequent analysis posits that all outreach activity regardless of the city it was based in, has the potential to influence members of both cities (e.g. A Waterloo rain barrel sale can impact the uptake of sustainable stormwater management in Kitchener).

Unclear Goals: A Barrier to Transitions

Goal formation proved to be an important factor in the implementation of stormwater outreach in Kitchener and Waterloo. Expert interviews and SCP documents revealed that the goals of each residential SCP program and associated community engagement to promote sustainable stormwater management were at times

unclear. There were no hard numbers set by either city for how many properties they wanted to participate in the SCP (K1, W1, R1). With no hard numeric targets it is difficult to assess whether or not participation goals were reached. Conversely, the ambiguity of goals allowed a space for program adjustment, which was seen as beneficial by city experts in Waterloo (W1).

W1 said they had not set hard goals for participation in their SCP program, but that they had budgeted for about 3000 applications in the first year. This ended up being an over-estimate; they have since adjusted to budget for about 400 applications per year. W1 stated that their goals for the residential program were to more generally promote stormwater management education, with a secondary goal of having the public install sustainable stormwater management to lead to an overall reduction in maintenance costs on stormwater infrastructure for the city. W1, suggests that other municipalities do not set hard targets for their programs, but that they make conservative estimates in regards to budgeting to ensure they have enough to cover program costs.

When asked if they'd reached their stormwater outreach goals, W1 said they received a moderate level of applications, but that they want to continue to work forward to eventually have around 20% of properties participating in the SCP. W1 disclosed that they were shifting towards a focus on the non-residential side of the programs; they felt this provided a greater return on investment (both time and money). W1 said the city recognises that they are becoming denser, with more multi-residential properties going up; the city wants to target larger properties so they have a greater impact on the amount of stormwater diverted.

When asked about their goals for the program, K1 said Kitchener started out with volumetric goals, then realised that at the residential level it was more important to focus on education than diverting stormwater. K1 recommended that other municipalities start off with educational goals rather than volumetric goals.

REEP provided a perspective on both cities' goals for the SCP program. As REEP was in charge of delivering the RAIN program (SCP and stormwater outreach), it is first important to identify the goals of RAIN, which are (R1, Green Communities Canada, 2016):

1. Grow expertise among related fields and service providers;
2. Engage community in making wise choices for stormwater management;
3. Facilitate stormwater mitigation demonstration projects;
4. Provide incentives and credits to landowners who implement stormwater mitigation measures;
5. Develop and deliver home consultations on stormwater mitigation measures; and
6. Communicate the RAIN stormwater management approach to other jurisdictions, and provide resources that can be used by other jurisdictions.

The goals for the RAIN program were created through discussion with Kitchener, Waterloo, and Green Communities Canada, who created the national template for the RAIN program. REEP did state that there were never any hard numeric goals handed down to them from either city for how many people to drive to apply for credits,

> *"That's one thing the city was never clear about. We'd ask them [about goals] and they would say 'I don't know, do what you can'. For a program like ours and a manager like me, I work to a target, to a deadline, we had targets like how many workshops to run and how many home visits, but in terms of people we would drive to apply for credits we did not have those specific targets. You find when you're not answering to those targets, you don't drive towards them."* (R1)

R1 suggested that hard numeric targets are beneficial for non-profits charged with promoting a stormwater program. Overall, the interview results show that there is a disconnect between the cities and REEP around what goal setting should look like; each city suggests soft goals are set, while REEP suggests harder goals are set to help push for their achievement.

Long Timeframes

When asked if they had achieved their goals with the SCP regarding the installation of sustainable stormwater management, W1 explained that they had very long timeframes for their stormwater management goals (20+ years). W1 explained that they wanted to look at a long time horizon, to slowly change the norms around stormwater management, similar to how recycling slowly became a norm in the region. W1 suggested that other municipalities shouldn't expect huge uptake at the start of the program from most citizens, as they are likely not knowledgeable about stormwater issues. W1 said that although it takes a long time to change norms, the good news is that even small changes help when aggregated over time. Looking at the SCP as a long-term program was a strategy that helped Waterloo keep the program outcomes in perspective, and helps them remain optimistic for the future of stormwater management in their city.

5.6.1.4 *Data Collection, Monitoring and Evaluation in the SCP process*

Data collection, monitoring, and evaluation were important parts of both Kitchener and Waterloo's SCP outreach efforts (K1, W1). Waterloo and Kitchener both tracked where participants lived, what controls they installed, the volume of stormwater associated with those controls, when the controls were implemented, and how people found out about the program (K1, W1). The applications were also all attached to a GIS database, making sorting and analysing data easy to do, and showed any geographic discrepancies in participation (K1, W1). Waterloo found it was especially useful to keep track of *when* people had installed their stormwater management, as this was a good indication of how effective the program was at getting people to newly install sustainable stormwater management. It also provided the city with an understanding of why application rates dropped off so drastically after the first year of the SCP, showing many instances of sustainable

stormwater management were installed before the SCP began (W1). When asked if there was any data that wasn't tracked that would be helpful, W1 stated that it could have been illuminating to have ask *why* people decided to participate in the program and install sustainable stormwater management, as this could help suggest new methods for getting people interested in installing sustainable stormwater management.

REEP found that it was very important for each city to make program goals and the desired metrics for tracking those goals clear at the start of outreach (R1). This did not always occur. R1 said, "We [REEP] weren't really keeping close enough tabs with each city saying exactly what data are you looking for? Because we would think of what we wanted and propose it to them and they would say yeah that sounds good. But we wouldn't say, what are some pieces of data you really need to show your manager that this program is worthwhile." R1 said it would have been easier for REEP if city and council staff had told them which metrics to track. REEP wanted to know which metrics the city and council would accept to prove that the program was effective. Since this was not clear from program outset, instead REEP had to scramble to gather certain metrics or find the next best option when the city or council asked for certain measures of program efficacy. This made it more difficult for REEP to prove their worth and secure ongoing program funding. The issue of unclear metrics also relates to the issue of unclear goals (see above).

REEP also identified public feedback as a useful method of monitoring and evaluation, leading to outreach improvements. When REEP set up booths at community events, they would occasionally ask people what they had done to deal with stormwater management, and what they were hoping to do in the next two years. This provided REEP with an idea of how to change their program for the future. REEP found that people were very interested in rain gardens, and have since begun to shift their outreach to focus on this form of stormwater management. REEP also found it useful to gather feedback after workshops and other outreach events, like home visits, so that they could constantly improve the programs. In responses received through some of the feedback surveys, people suggested that feedback surveys be sent immediately after events to ensure accurate responses.

Finally, a very key part of program evaluation in both cities was the feedback REEP gleaned after completing demonstration projects. Running a demonstration project illuminated the barriers and hurdles property owners encountered when trying to install sustainable management in Kitchener and Waterloo. This included both the physical barriers encountered (finding a contractor, pavement issues etc.) and the administrative or technical barriers encountered (zoning regulations, SCP application difficulties, etc.).[8]

[8] The Kingston Depave lead highlighted the importance of monitoring the aftermath of each Depave project. They said it was important to gather hard data on the project's outputs so it could later be used to support the argument for more program funding. Hard data would allow the non-profit to clearly show the Depave project's benefits to council and city staff. Just as Kitchener and Waterloo's REEP employees suggested, strong

5.6.2 Identifying Local Institutional Barriers: Demonstration Projects

R1 explained that demonstration projects were a great way to identify local institutional barriers to the installation of sustainable stormwater management, as they required REEP and the city to actually go through all the steps involved. Through this process, barriers such as conflicting regulation or long application process could be identified and corrected. REEP also realised the complications involved with finding a contractor through this effort and then created a stormwater contractor list for property owners. [9]

5.7 Solutions: Effective Outreach and Communication Strategies

This section highlights the outreach and communication strategies that experts in Kitchener, Waterloo, and at REEP, found to be most effective at promoting sustainable stormwater management, SCP participation, and engagement in stormwater issues.

5.7.1 Targeting Specific Groups for Outreach

REEP targeted specific neighbourhoods for focused outreach in both Kitchener and Waterloo. In Kitchener, the neighbourhoods targeted for outreach were Old Westmount (ward 8), Central Frederick (ward 10), Belmont Village (ward 8), Cherry Park (ward 9). In Waterloo, the neighbourhoods targeted for outreach were Mary Allen (ward 7) and Old Westmount (ward 7). REEP's strategy for targeting neighbourhoods involved two target overlays (R1). First REEP would look at what areas in each city were most at risk of flooding (R1). These areas were usually built prior to 1960, and had little or no on-site stormwater management infrastructure (CK, CW, & RGS, 2013). Next, REEP would look at what neighbourhoods had active community associations, garden groups, or other activity that showed there were active community members and events. REEP would overlay these two layers to identify where they would target, choosing areas that were both at risk for flooding and with an active community (R1).

These double-targeted were most likely to act on stormwater issues, as they had lively community groups and also stood to benefit from reduced flooding risks (R1, W1). W1 explained that is was very hard to engage people that were not at risk of personal flooding, as they would not see a personal benefit to their investment. REEP found their targeting strategy to be effective in gaining participants, especially at the start of the program (R1). REEP also found this method valuable because it didn't only focus on engaging environmentalists (who may not have been at risk from stormwater damages), but ensured areas at risk of flooding were targeted as well, leading to a benefit to the city (less people complaining about and being flooded) (R1).

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monitoring and evaluation helps prove the worth of a program to those making funding decisions, which is important for program sustainability (R1).

[9] Depave also found that demonstration projects helped staff identify the barriers property owners face when trying to install stormwater management, therefor helping to streamline the processes (e.g. through suggestions for zoning regulations or contractor lists)

In a report completed in 2013, REEP states that there are a variety of outreach methods used to engage target neighbourhoods. This includes:

- A presentation to neighbourhood association
- A presentation to a local transition group
- A presentation at a local library or community centre
- A presentation to a local school
- A door-to-door visit
- Participation in community events and festivals
- Emails to neighbourhood association leaders who will distribute our messages through their listservs, Facebook pages, and print and/or online newsletters
- Social media

(CK, CW, & RGS, 2013)

It is important to note that REEP took a thorough approach to engage target neighbourhoods through many different means.

Another group that was targeted for engagement were those who were already known to be living on properties with stormwater controls installed. K1 stated that they, "ended up targeting people we knew were already practicing, or already had rain barrels or infiltration galleries." These people were identified through Region of Waterloo rain barrel sale records and through Kitchener zoning requirements (K1). Waterloo also targeted areas they knew were built with infiltration galleries (W1).

Also targeted for engagement, though unintentionally, were environmentalists. REEP ended up attending events, holding workshops, and hosting presentations that were largely attended by the environmentally conscious. While it is not wrong to engage environmentalists, both K1 and W1 noted that this group did not need as much attention through engagement efforts, since many were already acting on stormwater issues without the encouragement of the city. It was therefore not an efficient investment to focus on engaging environmentalists. K1 suggested other cities target environmentalists only at the start of their outreach efforts, in the hopes that this slowly snowballs to impact and influence a wider audience. R1 said that engaging with environmentalists first was the easiest way to get people involved, and to get the ball rolling at the start of the SCPs. Findings from Kitchener's recent Stormwater Market Study align with this observation about targeting environmentalists; the report suggest targeting non-environmentalists through a focus on the aesthetic benefits of sustainable stormwater management, rather than the environmental benefits (Aquafor Beech Ltd & Freeman Associates, 2015). R1 suggested that another way to reach people outside of the environmental crowd was to partner with institutions that had networks outside of environmentalists. For example, REEP partnering with Laurier University lead to a diverse group of participants for a stormwater

walk and workshop held at the university (R1). R1 also suggested churches as a good location for workshops, to tap into that existing community.

Overall, all experts interviewed were in favour of a targeted approach over broad messaging. K1 suggested that the most effective outreach was not one method or one event, but rather a targeted strategy. K1 suggested that the most important thing a city can do to help improve the efficacy of their stormwater outreach is to target their message to a specific demographic, neighbourhood, or event.

5.7.2 Lightning Rod Issues

Kitchener stressed the importance of using 'lightning rod issues' to get people to pay attention to and take action on stormwater issues. In Kitchener, the lightning rod issue was the buildup of sediment, unwelcome scent, and avian disease in Victoria Park Lake (K1). This lead to public, and then council support for the creation of the stormwater utility fee to secure project and maintenance funding for the rehabilitation of Victoria Park. Kitchener suggested that in many other communities, their lightning rod issue may be flooding, but that each community had to find their own powerful 'lightning rod' to make people pay attention to and act on stormwater issues. [10]

5.7.3 Using Partnerships and Networks

Partnerships emerged as a theme integral to the promotion of sustainable stormwater management in Kitchener and Waterloo. This section will discuss the importance of partnerships and networks, exploring the different types of partnerships and networks that were key in the promotion of sustainable stormwater management in Kitchener and Waterloo. The types of partnerships and networks are identified below, providing order to this subsection:

[10] A similarity between Depave and Kitchener and Waterloo's experiences, is the recognition that in order to engage people in stormwater management, you need to find a 'lightning rod issue' with which to attract them. The Depave lead at Green Communities Canada, as well as the Depave lead from Hamilton underlined the importance of finding common goals to help promote sustainable stormwater management. For example, Hamilton's Depave lead explained, "… trying to figure out what the trigger is for that community. So for us when we go out to the school, we know the school's main concern isn't stormwater management. They are more concerned with students having somewhere to go out and enjoy their time outside on something that is not pavement. So trying to figure out how your goals align, and trying to figure out how you can meet your goals and someone else's goals. It's like how people do sales, how can your goals align and how can we help people reach their goals while reaching our own? So trying to do that with your site. Rather than just 'yes we have the site-alright lets Depave', try and figure out if you can help them reach their goals as well as your own goals....And then trying to link your project to greater issues going on. We got the media coverage because there was a lot going on at the time [flooding]. So if you are able to make connections to bigger issues to the province, or the city, you are going to get more coverage and reach more people and be able to engage a larger audience. " This strategy echoes the suggestion of K1, to find an issue people care about that is connected to stormwater management, and to use that issue to drive forward engagement in your stormwater program.

a) The Community as Champions
b) Targeted Community Champions
c) Government and Non-profit Partnerships
d) Expert Panels
e) Community Groups and Existing Networks
f) Multi-Level Government Partnerships

A) The Community as Champions

K1 and W1 cited resident support as one of the main drivers for the creation of the residential SCPs, and also the current levels of success seen in the sustainable stormwater management uptake levels in each city. W1 said that there was a base of residents that pushed for the residential SCP, and that this base was largely responsible for spreading the word to their friends and neighbours to boost SCP participation. W1 also posited that Waterloo is overall, a progressive community, with many citizens that care about environment and sustainability (reflected in their strategic plans); Waterloo attributes their progressive citizenry as partially responsible for their current levels of sustainable stormwater management uptake.

Kitchener also said that bottom-up resident push for stormwater issues was an important driver of SCP participation (K1). K1 explained that it was citizens who pushed for the rejuvenation of Victoria Park, which became Kitchener's 'lightning rod issue' around which to push for changes to stormwater management in the city. Citizen delegations gave presentations to council in order to get funding approved for the Victoria Park rehabilitation, which eventually resulted in the creation of the stormwater utility rate (K1). Without support from the community in both cities, neither would have seen their current levels of SCP participation.

B) Targeted Community Champions

Community champions were selected by REEP to help promote sustainable stormwater management installation and participation in the SCPs (R1). Champions were usually selected because of their interest and support in stormwater issues and other environmental initiatives, their willingness to run a demonstration project, and their large presence in community networks. R2 stated, "I think [community champions] are not only cost effective, they are effective." Although REEP did not have to spend money on community champions, they did explain that building these relationships was a time intensive process, not only for REEP but also for the champion. For this reason, R2 explained that it was very important to give these community champions recognition for their help in promoting the program. REEP accomplished this with their annual community awards, where stormwater champions were recognised; this provided community champions with social capital in return for their help in program promotion. REEP found that once there was a greater general awareness of the RAIN program and their activity, community champions began to come to REEP, instead of REEP needing to locate and pursue these people (R2).

C) Government and Non-Profit Partnerships

The partnerships between the cities and REEP were key to the promotion of sustainable stormwater management and SCP implementation (R1, R2, K1, W1). This partnership benefits both parties: The cities used REEP to educate and engage property owners in the SCP and sustainable stormwater management. It was important for REEP to be the face of community outreach, because property owners are more willing to let third parties onto their properties to talk about flooding and stormwater management than the city - people aren't comfortable with the government "sniffing around" (R1) on their properties (R1, K1, W1). Working with REEP also allowed for outreach material to be more informal and fun, compared to municipal outreach, which tends to be much more vetted and formal (R1).

REEP benefit from their partnership with the cities, as they were able to use city resources for their outreach programs and events (R1). For example, REEP used the communications team in each city to help with promotional materials. R1 suggested that non-profits should use internal city resources that are available to them, such as leveraging city communications staff, and using media relationships that have already been built up between the municipalities and media outlets, in order to be more efficient and effective in their outreach.

W1 suggested that the key thing cities must consider when choosing partner organisations, is to look at the organisation's base. W1 suggested that it is better to partner with groups already established in the community (like REEP) as it is difficult to start relationships with the community from scratch.

D) Expert Panel

An Expert Panel (See Appendix G) was set up between the cities of Kitchener and Waterloo to guide stormwater policy and program development, including development of the SCPs. The panel was made up of local consulting firms, contractors, landscape architects, engineers, watershed planners, academics, REEP, and city stormwater staff and provided feedback on communications pieces, consultation approaches, charge rates, and design details for demonstration projects. Expert Panel meetings were held monthly to steer the SCP and monitor and adjust the utility charges. The expert panel was an important partnership as it enabled two-way benefits: First, REEP could get the networks represented on the Expert Panel to distribute information on events to their membership (acting as community champions), and REEP could use the panel to vet their promotional plans. Second, REEP provided these experts and their networks with information about what challenges property owners were facing when attempting to install sustainable stormwater management; this information could help experts change processes in their own respective fields to make sustainable stormwater management installation easier for property owners. The variety of backgrounds on the panel provided well-rounded perspectives on the subjects that were discussed and was a useful tool in stormwater outreach for both cities and REEP (CK, CW, & RGS, 2013, R1, W1). Additionally, REEP found that including vocal but knowledgeable dissenters of the stormwater program was an effective method to deal

with pushback (R1). It happened that two vocally opposed citizens were also landscapers; REEP ensured that these knowledgeable voices joined the Expert Panel. REEP said the extra voices on the panel were useful because they provided challenging feedback, which ensured decisions were well thought out.

E) Community Groups and Existing Networks

Part of REEP's engagement strategy was to connect with community members through existing community groups and organisations. R1 identified that it was particularly effective to ask community groups to promote the SCP and related events to through their communications streams (e.g. newsletters and Facebook pages). REEP engaged with many groups and organisations to do this, including neighbourhood associations, gardening groups, transition groups, people who attended local community and garden events such as the annual Home and Garden Show, REEP's own existing network of environmentalists, the local Chamber of Commerce, and Grand River Conservation authority to name a few (R1). Another effective means of engagement through existing community groups and networks was for REEP to attend community event, such as Earth Day celebrations and neighbourhood parties (R1).

REEP also partnered with large local institutions such as Wilfred Laurier University and Waterloo University to hold workshops and events (R2). R2 explained that their event at Wilfred Laurier University brought out a more diverse crowd than REEP was used to, because of the network Laurier provided access to. Tapping in to existing networks outside of REEP's own helped to diversify the audience for events, as REEP noted that sometimes attendees to their stormwater events were repetitive (R1).

REEP also looked outside of the Kitchener-Waterloo community when trying to tap into existing networks. REEP partnered with Landscape Ontario to hold contractor-training workshops. REEP's partnership with Landscape Ontario (LO) helped raise awareness within LO's networks of the growing importance of drought resistant and stormwater wise landscaping. REEP's efforts to engage with LO have led to LO taking the initiative to hold workshops all across the province to teach their members about 'fusion landscaping', which is a form of landscaping that includes sustainable stormwater management (R1). REEP explained,

> *"It's really important to try to partner with an organization that is well known and respected and has staying power, because at the end of the day… you want a larger organization to do this stuff, so that they will take it and run with it, so that people can be trained all across Ontario. And Landscape Ontario is a member of provincial landscaping associations across Canada. So now what has happened, is Landscape Ontario has loved this idea, they run with it, now they are committing a large sum of money to train people in fusion landscaping over the next few years. It's looking at landscaping that is drought tolerant, supports habitat, and will keep stormwater away from foundations. So the little seed we planted there, is now this*

province wide program with Landscape Ontario…. once they do this, they want to do fusion landscaping across the country."

The series of events that took place with LO showcases how small outreach efforts really can snowball to have large impacts. REEP's initially small outreach to LO has resulted in a province wide program to teach stormwater wise landscaping techniques.

F) Multi-Level Government Partnerships

Waterloo and Kitchener are part of a two-tier municipality with the Region of Waterloo. The Region of Waterloo has been handing out cheap rain barrels for years, as part of their water conservation programs. These sales have provided both Kitchener and Waterloo with a base of rain barrel users. K1 noted that thanks to a good relationship between the region and the city, based on common goals of improving water management, the Region provided Kitchener with a list of all the properties that had bought rain barrels; Kitchener proceeded to send out special mailers to these properties about the SCP, resulting in many SCP participants for Kitchener (K1).

Furthermore, because the Region is fairly dependant on groundwater for their water supply, there has been an increased awareness of water issues dating back to the early 1980s. This awareness has resulted in many water studies taking place in Kitchener and Waterloo, studies that most other communities may only be completing now (W1). The shared water priorities of both the region and the municipalities has enabled a water consciousness in Kitchener and Waterloo, which contributes to each city's ability to take action on stormwater issues.

5.7.4 Media and Communications

Media and communications were an integral part of encouraging people to install sustainable stormwater management in both Kitchener and Waterloo. The five main lessons about communications and media strategy that emerged through exploration of the promotion of sustainable stormwater management and the SCPs are expanded upon below:

1. Use multiple streams of communication and media to engage people in stormwater issues, but focus on the ones most suited for your community
2. Get your timing right
3. Keep messages clear, simple, and consistent, and keep actions quick and easy
4. Use partner networks to get the message out
5. Hiring professional marketers can help get a program going

5.7.4.1 *Use Multiple Streams of Communication and Media*

REEP partnered with communications teams in Kitchener and Waterloo, to form and coordinate communications materials (R1). A number of media outreach methods were used in both cities, including formal media releases, social media announcements and advertisements, radio and TV interviews, REEP newsletters, YouTube videos, print ads in the Waterloo Chronicle and Kitchener Citizen, Weather network online ads, and utility bill inserts[11]. Both Kitchener and Waterloo found that the most effective method of engagement was through utility bill inserts (K1, W1). Waterloo and Kitchener tracked how people who applied to the SCP heard about the program; the highest response rate, by far, came from the utility bill inserts (K1, W1). W1 explained that utility bill inserts were an effective method for outreach because most people open their bills. Utility bill inserts are sent out to property owners in Kitchener and Waterloo at least once a year after utility rates increase; this typically occurs early in the new year (around March). Periodically the cities will send out other utility bill inserts about stormwater, usually if a major water work is completed (K1).

Social media was another avenue used to promote the SCP and sustainable stormwater management in both cities. Overall, media postings about the SCP do not correlate to SCP application rates (See Appendix J). Experts from both Kitchener and Waterloo reported that a very low number of SCP applicants attributed their participation in the program to social media outreach (W1, K1). W1 posit that social media was ineffective as an outreach tool for two main reasons. First, because many property owners tended to be from older populations that may not be as in touch with social media as younger generations (who are more likely to live in apartments and condos in the downtown, where the stormwater charge does not affect them)(W1). Second, the cities of Kitchener and Waterloo do not hold a mastery over social media, and so their impact through social media may not be as effective as necessary to promote action on stormwater issues (W1). W1 suggested that social media should not be the focus of the outreach campaign; instead outreach efforts need to be moulded to the homeowner population. Streams that are already used for communication should be capitalised on, as the utility bill inserts accomplish. It should be emphasised interviewees did not discount social media as a communications tool, but recommended that it not be the major or stand-alone communications platform(W1). Social media can be effective in partnership with other methods through an entire campaign. For example, REEP advertised one of their rain barrel sales on Facebook (this add cost 50), and the add got over 36,000 hits, resulting in the rain barrel orders selling out in one weekend (R1).

The SCP and stormwater management was also promoted in local newspapers. Through a media scan of local papers, it can be observed that overall, newspaper coverage on the SCP and stormwater management was infrequent (Appendix J). Most articles published were neutral in tone and merely meant to inform the reader of the SPC program and stormwater management changes (See Appendix K). A negative article written in

[11] Utility bill inserts are informational notices that are inserted into a property owner's utility bill.

2012 was an opinion piece, but articles on the SCP became increasingly positive over time. There was not a correlation between the timing of newspaper articles published and SCP application rates. Although newspaper coverage did not correlate with SCP application rates, K1 identify that newspaper coverage of the utility rate did lead to a lot of calls to the city with people voicing their concern over the program. So although newspapers may not have been effective in promoting SCP applications, they did seem to impact the rhetoric surrounding the program in Kitchener, especially when the rhetoric was negative. Therefore, it may be more important for cities to control and counter *negative* media articles if they are to make the transition to sustainable stormwater management smoother.

R1 explained that media outside of text media (social media and newspaper) was also an important part of their outreach strategy, "…. You can get relatively good exposure that way (with social media), but especially when you get on the radio, television, the newspaper, that's when it takes it to a new audience." Although REEP valued radio, television, and newspaper coverage, Kitchener and Waterloo found that these sources of communication were not often identified on SCP applications as the place participants heard about the program (W1, K1). [12]

5.7.4.2 *Timing of Outreach and Communications Activity*

K1suggested that it was most important to preform outreach at the start of the new year, towards the beginning of spring, as this is when people are thinking most about doing landscaping and outdoor maintenance (this sentiment was echoed in CK, CW, & RGS, 2013). This aligns well with Kitchener and Waterloo's strategy of distributing SCP utility bill inserts annually around March (K1, W1).

5.7.4.3 *Messaging: Keep it Clear, Simple, and Consistent*

W1, R1 and R2, along with Kitchener stormwater reports (CK, 2015a) all stated that one of the most effective means of delivering information on stormwater management and the SCPs was to keep messages clear, simple, and consistent. R1 explained a time when messages were not kept clear and simple: towards the start of their outreach, REEP experimented with the use of lawn signs to promote sustainable stormwater management. The signs were handed out to anyone who wanted one, not necessarily to people who had installed sustainable stormwater management correctly, or at all. Therefore, it was not clear what the signs were meant to communicate; did they represent program support, or recognition of a home that was participating in the SCP? An issue arose when the City of Waterloo became reluctant about handing out the signs to homeowners for fear that some who used the sign would have improperly maintained or installed

[12] As stated by K1, W1, and R1, Depave interviewees also found it useful to engage property owners through a variety of communications pathways including social media, door to door outreach, radio, newspaper, and flyers.

stormwater management on their property, which would then reflect badly on the city and the program. This experience showcases the importance of simplicity and clarity in all communications.

In Kitchener, a clear and consistent message was key to dealing with pushback at the start of the SCP and utility rate program. Kitchener found that when they started to issue utility bills in 2011, they were receiving upwards of 300 calls a week from citizens concerned about the program. Kitchener said the most important tool they developed to deal with pushback was a 5-page list of most frequently asked questions and their answers (an FAQ guide). Those 5 pages were distributed to all customer service representatives, councillors, and everyone working on the stormwater portfolio. This ensured that when people called the city they were getting the same clear and consistent answer - even if they were calling multiple people to try and get a more desirable answer. Kitchener found that many people thought their situation was unique, while really there were many others in the same position. K1 said it was important to be personable but that clarity and consistency was key when dealing with this form of pushback.

5.7.4.4 *Use Partner Networks to Get the Message Out*

As part of REEP's community based social marketing approach to communications, two key strategies used to promote sustainable stormwater management and participation in the SCPs were an embrace of networks and partnerships. Kitchener and Waterloo both stated that "word of mouth" was one of the top three ways people who completed SCP application indicated they heard about the program (K1, W1). This means neighbours telling neighbours and friends telling friends about the program was a great way to get the word out about the SCPs and sustainable stormwater management. One group that was especially critical to REEP's outreach efforts were neighbourhood associations, "The neighbourhood associations have a network all across Kitchener and Waterloo, so if you mention it [a message you want to get out] to their central communications person, they will communicate with all of their neighbourhood associations" (R1). R1 added that the participation of these neighbourhood groups, transition groups, and garden groups helped 'super charge' their outreach efforts. However, when outreach efforts that target certain neighbourhoods are compared to application rates in those wards, there is no correlation. This does not necessarily suggest that efforts to engage these groups were not effective, but rather, it may indicate that neighbourhood specific outreach is too low a level of outreach to be reflected in participation rates for an area as large as a municipal ward (a limitation of the research methods).

R2 said it was important to get the message out about the SCP programs by 'piggybacking' on other events, such as workshops, community events like garden shows, and earth day events. Piggybacking provided access to groups of people who may be interested in the program, but aren't connected to REEP or municipal communication channels. Piggybacking also removed some of the burden of event organisation from REEP, as they only had to attend pre-organised events with an information booth, instead of organising their own

events. Another form of piggybacking was leveraging city communications staff throughout the SCP promotion and communication process which proved useful for REEP (R1). [13]

5.7.4.5 *Hire a Professional:*

Hiring a professional marketer towards the start of the program proved very helpful to getting the communications and marketing plan for the SCP and sustainable stormwater management going strong from the start (R1; CK, CW, & RGS, 2013).

5.7.5 Using Concrete Examples to Communicate the Benefits of Sustainable Stormwater Management: Demonstration Projects as Communication Tools

R1 suggests that the best way to overcome barriers of risk and uncertainty are to build trust using case studies and demonstration projects; to show people that sustainable stormwater management work in their own communities. R1 stated, "[property owners] want to know that something works, [they] want to know it will look attractive, and that it's not going to drive [them] crazy [with maintenance]". Proving sustainable stormwater management projects work, are aesthetically pleasing, and are reasonable to maintain can all be achieved through well-planned demonstration projects; these projects are themselves a communication tool that transfers knowledge to the public about what sustainable stormwater management looks like, how it is installed, and what it can do. [14]

5.8 Municipal Experts' Overall Reflections On SCP and Stormwater Outreach

This section highlights Expert's reflections on the SCP and sustainable stormwater management that are not discussed above, with a focus on two emergent themes: the decision to have non-residential credits, and plans to change strategies in the future.

5.8.1 Focus on Non-Residential

In their interview, W1 stressed that although the residential SCP was not as successful as anticipated in terms of participation numbers, it was still necessary and beneficial. Waterloo felt that if they were charging a user fee for stormwater, that it was only fair to then provide people the opportunity to lower that fee based on

[13] Again reflecting the experiences in Kitchener and Waterloo, Depave leads also found it very useful to be able to tap into existing networks to find participants. Some Depave groups ran workshops with local garden groups and landscapers to teach them stormwater wise gardening and landscaping techniques (Depave Collingwood). All Depave groups partnered with an existing community business or institution (such as a school) as the site of their Depave project. This allowed Depave organisers to tap into the existing community of the site provider (e.g. A school's students and their families). Depave leads also found it useful to engage with local politicians, as this led to greater media coverage of their event.

[14] Depave demonstration projects across Ontario helped remove some of the perceived risk and uncertainties that associated with sustainable stormwater management installations by showing communities exactly the projects work, and installed, and look.

their use. In Waterloo, the credit program was not just about reducing stormwater; it was about ensuring fairness for its citizens. Kitchener had similar sentiments about their residential stormwater program, explaining that initially, they only wanted to institute a non-residential credit, but that the public pushed for a residential program so they could control their costs (K1). They ended up including the residential program to ensure fairness and equity for residential rate-payers (K1).

Overall, both K1 and W1 suggested that a residential credit program was not the most efficient or effective way to reduce stormwater volume through sustainable measures, but rather, the residential programs were necessary to ensure their stormwater charges were fair and equitable to property owners. Both cities suggested a focus on businesses rather than residential sectors to reduce stormwater runoff volumes, as non-residential properties on average have much higher stormwater runoff loads than residential properties. This means the impact from engaging one non-residential property owner in stormwater management has a much greater impact on stormwater runoff levels than using an equal amount of resources and employee time to engage with residential property owners.

Waterloo found that the best way to have a large impact on stormwater reduction and to promote sustainable stormwater management installation is at the development level. W1 said some of the best reductions in stormwater volume they had seen were in areas where developers installed stormwater controls to either promote the water balance or to meet development requirements. As Waterloo looks forward to densification within their boundaries, W1 said it was important to have policy that would either encourage, or in some cases demand, sustainable stormwater management as part of new building and retrofits. W1 suggested the use of regulation and legislation that promotes sustainable stormwater management in other cities that are looking at densification and stormwater issues over the next few decades.

K1 discussed the installation of sustainable stormwater management at the time of development as well. K1 explained that regulations were responsible for the high number of infiltration galleries installed in Kitchener. K1 went on to explain that the costs for installing those galleries would have been buried in the overall cost of the new house, thereby making the cost more easily accepted by homeowners, compared to an equal cost investment as a very visible charge on a retrofit project.

5.8.2 Progress: Past Reports and Future Strategies

In March of 2014, REEP completed a program summary on their SCP outreach, as required by the Government of Ontario, who provided initial program funding. Interestingly, after 4 years of the program, including the full implementation of the credit program in Waterloo, residential participation rates in each city's SCP have stagnated. Many of the findings in the 2014 report echo the suggestions of this thesis. This repetition suggests the need for a larger shift in outreach strategies. This reflects the response of stormwater

experts interviewed who assert that mainly environmentalists are the main participants in sustainable stormwater management so (K1, W1). Kitchener is in the process of embarking upon a new strategy that aims to change market demand for sustainable stormwater management through a visually-focused outreach strategy, promoting stormwater management as a means of beautifying one's property, thereby attempting to change norms surrounding landscaping practices and stormwater management practices. Monitoring the progress of Kitchener's new strategy will be useful in determining how to change norms surrounding stormwater management, hopefully leading to greater levels of sustainable installation.

5.9 Ideas for Change

This section contains suggestions from experts interviewed on how they believe outreach and engagement with citizens surrounding stormwater management issues can be improved. These suggestions have not been tested in Kitchener or Waterloo.

5.9.1 Monetise benefits

R1 suggested that it would be helpful to find a way to monetise how much the city saves for every rain barrel, cistern, permeable driveway, rain garden (etc.) that is installed. This would allow for a clearer picture of outreach benefits, which in turn helps ensure sustained outreach funding from council, who like to know the economic outcome of their program investments (R1). Monetising these benefits can also help the city figure out exactly how much of a credit they could give people for different projects.

5.9.2 Creating Demand

The SCPs were meant to create a demand for sustainable stormwater management installation services and landscaping in Waterloo Region by providing homeowners with a fiscal incentive to request and install these services (CK, 2015a). While REEP promoted the installation of sustainable stormwater management, they simultaneously needed to ensure local contractors were trained to provide these services (R1). R2 said it was a somewhat of a chicken and an egg scenario: if people were not demanding a services enough, it was understandable that the service was not offered by local contractors; conversely, because not many contractors were trained in green stormwater services, it was not often offered as an option to homeowners. This kept knowledge of sustainable stormwater management services low, thereby keeping demand for the services low. One solution REEP suggested for this scenario was to create demand by partnering with a large supplier of landscape contracting jobs (like the city) to only hire contractors who are "certified stormwater smart", a certification for contractors trained in sustainable stormwater management. This would create a demand for contractors to go out and get the training they need, to know how to manage stormwater on-site. Kitchener's Stormwater Market Strategy Report (Aquafor Beech Ltd & Freeman Associates, 2015) provides a long list of suggestions for how to create this demand amongst Kitchener homeowners. Some of these suggestions will be followed by the city of Kitchener over the next few years (K1).

5.9.3 Piggybacking on Energy Sector Outreach

R1 suggested that one unexplored method of partnership for SCP promotion is piggybacking on energy sector outreach activities. Specifically, R1 suggested that options for sustainable stormwater management be integrated into energy sector home visits (the type that aim to reduce a household's energy use). R1 said,

> *"Those programs and models are already out there, they exist [*energy efficiency home visit programs]. *So as more municipalities implement stormwater utilities… they can get looped in with those other programs…There are providers that go to businesses and also to residential properties that will do energy assessments, and they will have a list of programs, that's like a menu the owner can choose from each year. They can see what the return on investments are, and they can just choose from that suite, and then go from there. So, to have stormwater programs listed in that suite of items would just be a natural next step."*

This idea is supported by feedback REEP received in their 2013 door-to-door survey. REEP found that over half of the people who had heard about REEP, had heard of them because of REEP's Energy Audit program. This suggest that raising stormwater issues during energy (or other) outreach activities may be an effective way of raising awareness for a new program, like the SCP and sustainable stormwater management.

5.9.4 Changes to Credits

Experts offered various suggestions for changes to a residential credit program. R1 suggested that credits change to be more targeted, similar to the way REEP targeted certain neighbourhoods for outreach. R1 questioned whether it would be more beneficial to target an area at high risk of flooding and give them the money to install sustainable stormwater management fully, instead of offering a credit to the entire city. Alternatively, R1 suggested that credits could be offered at 100% until the premium of the sustainable management costs (e.g. the cost difference between installing permeable pavement vs. regular pavement) is returned, at which point the rebate would go back down to 45%. R1 posits that this would promote action in the neighbourhoods that need it most, and would therefore have the greatest impact on flood damage reduction for the city. It should be noted that neither city set their credit at 100% due to fears that if too many people signed up for the program, they would not have enough funding to manage existing stormwater infrastructure (R2).

5.9.5 Unique Strategies and Solutions

Although the experience of Kitchener and Waterloo is a helpful one for other municipalities to learn from, K1 made it clear that there is no copy-paste solution; each community needs their own 'made in X solution' that is cognisant of local conditions to promote sustainable stormwater management most effectively.

5.9.6 Coordinate Timing

Although Kitchener and Waterloo did not implement their SCP at the same time as their utility rate, Kitchener suggested that it would make for a smoother acceptance from the public if both a utility rate and credit program were put online at the same time (CK, 2015a).

5.9.7 Suggestions from Kitchener's Market Strategy Report

In September 2015, Kitchener published a draft of their Market-Based Strategy Report on, "securing uptake of at-source stormwater management practices on private property". Through intensive market research, the report recommended that the city, "undertake a marketing and promotional initiative targeting single-family homeowners and focused on transitional landscapes for lot-level SWM. For homeowners, targeted marketing must focus on the beauty of transitional SWM landscape – it's about creating a new landscape paradigm based on a composite of lot-level best practices that homeowners will desire and seek to obtain." (Aquafor Beech Ltd & Freeman Associates, 2015, p 59). The three pillars of the suggested approach are the promotion of sustainable stormwater management through a traditional landscape paradigm focused on improving property beauty; a visually-based outreach campaign; and a focus on creating demonstration projects in target neighbourhoods that showcase beautiful solutions to stormwater management (Aquafor Beech Ltd & Freeman Associates, 2015). [15]

6 Discussion

This chapter presents an analysis of the key findings conveyed in chapter 5 in relation to findings from the literature review, in response to my thesis research questions.

6.1 Summary of Key Findings

This section amalgamates the findings presented in Chapter 5 to highlight the most significant themes that emerged; these themes are explored further, with reference to extant literature, in the following section on analysis and discussion.

6.1.1 Barriers to Uptake of Sustainable Stormwater Management

Experts identified a number of key barriers preventing the uptake of sustainable stormwater management in Kitchener and Waterloo. One of these barriers was cost. Experts stated that many people were not installing

[15] Interestingly, two Depave leads discussed the importance of showing communities the beauty that could result from sustainable stormwater management installation. Depave projects aimed to remove the uncertainties surrounding the aesthetic outcome of stormwater management upgrades. This reflects the strategy that Kitchener is now looking to after the findings from their Stormwater Market Study (Aquafor Beech Ltd & Freeman Associates, 2015).

sustainable stormwater management because there was an inadequate financial incentive provided through the SCPs. This is a curious finding, as the quantitative data shows no correlation between income levels and sustainable stormwater management installation, suggesting that cost is not a real barrier, but rather a perceived barrier. In other words, the implication is that property owners may attribute 'cost' as a barrier based on their low **valuation** of the benefits of sustainable stormwater management.

Closely linked to the cost barrier is a lack of widespread knowledge about stormwater issues and the benefits of sustainable stormwater management amongst Kitchener and Waterloo populations. This lack of knowledge blinds people of the benefits to sustainable stormwater management, as well as the consequences of inaction, making property owner investment in sustainable stormwater management unlikely. While the SCP outreach program (REEP's RAIN program) is meant to educate the populace on stormwater issues, it has not reached enough people outside of the early adopter group, which consists mostly of environmentalists. Communities trying to promote sustainable stormwater management in cities outside of Kitchener and Waterloo also find a lack of knowledge to be a barrier to this sustainable stormwater transition.

A third barrier to the uptake of sustainable stormwater management in Kitchener and Waterloo are the risk and uncertainty associated with sustainable stormwater management . Risk and uncertainty surrounding sustainable stormwater management stem from a lack of knowledge on the topic. Residents are uncertain that sustainable stormwater management will function properly, what maintenance is required, what the sustainable stormwater management will look like once installed, and exactly how much the project will cost them overall. Risk and uncertainty are barriers that also exist in communities outside of Kitchener and Waterloo, which is why various other Ontario communities host Depave Paradise demonstration projects: to provide concrete and clear examples of sustainable stormwater management projects and reduce risk perceptions and uncertainties associated with sustainable stormwater management.

Overall, the barriers of risk and uncertainty are further exacerbated by the difficulty of finding a contractor or landscaper who is very knowledgeable in sustainable stormwater management. Therefore, complications in locating a sustainable stormwater service provider is another barrier to sustainable stormwater management. It was even difficult for REEP to find a contractor for their own demonstration project (R1). Interviews with Depave Paradise leads revealed that even communities outside of Kitchener and Waterloo face this same barrier of finding knowledgeable contractors. Contractors and landscapers who are knowledgeable about sustainable stormwater management are in a powerful position to become champions of sustainable stormwater management transitions, as this group is in contact with many people about to invest in landscaping and many property owners trust these practitioners' advice. Contractors and landscapers can convince property owners to invest in beautiful, sustainable, stormwater management through their landscape improvements (Aquafor Beech Ltd & Freeman Associates, 2015; R1).

The main institutional barriers to greater uptake of sustainable stormwater management were a lack of funding for outreach programs, out-dated legislation, and unclear and uncoordinated goals and timelines. Both cities reduced their funding for stormwater outreach over time, which directly impacted how much outreach REEP could provide. Regarding legislative barriers, R1 explained that because the provincial legislation guiding stormwater management does not allow for sustainable stormwater management to replace grey infrastructure, the cost benefits of making the switch to sustainable stormwater management are reduced. This limits the amount cities can save installing sustainable stormwater management instead of traditional grey infrastructure, therefore this potential savings cannot be transferred to property owners in the forms of larger credits. Additionally, city planners and engineers who aren't as familiar with sustainable measures as they are with the status quo, are often reluctant to take the 'risk' of installing leading edge sustainable measures unless they are legislated to do so. More progressive and demanding provincial legislation on stormwater management would help Kitchener and Waterloo push harder for the installation of sustainable stormwater management (R1).

Another institutional barrier encountered were unclear and uncoordinated goals and timelines for the promotion of the SCPs and sustainable stormwater management. This lack of clarity and coordination served to reduce the efficacy of REEP's outreach as they could not establish any concrete numeric targets to reach; at times they were even unsure of whether municipal goals were volumetric or based on the number of households engaged through educational outreach(R1). There were no hard numeric goals set by either city for how many properties they wanted to see participating in the SCP (K1, W1, R1). This made program monitoring difficult for REEP, who would have preferred hard targets for SCP applications; these would have pushed REEP to drive towards them (R1). However, Kitchener's goals moved away from 'hard targets' over time; Kitchener started off with volumetric goals for stormwater runoff reduction, but then shifted towards educational goals for their residential SCP program (K1). Kitchener recommends other municipalities set residential SCP goals as educational ones, instead of volumetric (K1). Comparatively, Waterloo felt that soft goals allowed the program to adjust based on feedback (since this was a new program in Canada) (W1). The cities felt that soft targets were beneficial for the SCP programs as these were new programs in Canada, facing many uncertainties. Conversely, REEP would have liked hard targets to drive their work forward. Overall, there is a disconnect between the cities and REEP surrounding what goal setting should look like. A lack of clearly defined and consistent goals prevented REEP from being able to channel all of their efforts into creating a long term, clear strategy to reach each city's goals for the promotion of sustainable stormwater management.

Finally, ineffective communication strategies served as a barrier to the promotion, and therefore uptake, of sustainable stormwater management in Kitchener and Waterloo. When communication strategies were not accurately targeted towards the intended audience, outreach efforts were wasted as they had lower than anticipated impacts. Although a mixture of communication tools helps reach a broad audience, to convince

citizens to install sustainable stormwater management, targeted messages sent through platforms appropriate for the intended audience are key.

6.1.2 Solutions to Encourage Sustainable Stormwater Management

There was no single engagement method that was *the* key to promoting sustainable stormwater management uptake in Kitchener and Waterloo. The strength of each city's outreach approach derives from the layering of different outreach methods. The most important strategy for promoting sustainable stormwater management was the use of partnerships and networks. While planning demonstration projects, REEP's decision to reach out to partners' networks helped expose more people to the demonstration projects; what's more valuable is that these people were outside of the 'regulars' that attended REEP events, thereby helping REEP expand their circle of influence. The cities of Kitchener and Waterloo used their networks (especially local media connections) to promote outreach events like rain barrel sales; this aided in boosting attendance at such events. The cities also used their connection to the Region of Waterloo to get information from past regional rain barrel sales, allowing each city to target mailers to households known to have rain barrels to improve SCP participation (W1). Finally, REEP also relied heavily on their community partners and stormwater champions to promote stormwater issues and events through their own networks, in person, and through social media (R1).

Another effective method to promote sustainable stormwater management was the use of 'lightning rod' issues. These are issues that can galvanise a community to take action on sustainable stormwater management, but are not focused on stormwater management as the main problem. In Kitchener, their lightning rod issue was the need to remediate and restore Victoria Park Lake; this issue motivated residents to place political pressure on local politicians to ensure funding for the project now and into the future, resulting in the stormwater utility rate charge. Exemplifying further use of lightning rod issues, Depave Paradise leads often use school yard beautification and natural play area creation as lightning rod issues to promote sustainable stormwater management in Ontario communities.

Experts in Kitchener and Waterloo also posit that targeting specific groups for engagement was an effective means of engaging the pubic to promote sustainable stormwater management. Targeting included overlaying areas which needed sustainable stormwater management with areas that contain highly active and connected community groups, to pinpoint which communities to target at the start of sustainable stormwater promotion programs (like SCP outreach). This targeting was not always completed effectively in Kitchener and Waterloo; for example, social media was used to try and reach out to homeowners, while this may not have been the most effective communication tool, as homeowners tend to be older and less engaged with municipalities and REEP on social media platforms. The lesson Kitchener and Waterloo learned is to use multiple sources of

media and communications to reach out to property owners, and that communications should be targeted to specific demographics (including age, stage in life, and social media savvy).

Demonstration projects proved to be another effective means of promoting sustainable stormwater management in Kitchener and Waterloo. These projects reduced risk and uncertainty, exposed new audiences to concepts of sustainable stormwater management. Demonstration projects also helped REEP and each city learn where and how to streamline their processes for sustainable stormwater management installation.

Finally, strong regulation proved very effective in promoting sustainable stormwater management in Kitchener and Waterloo. The areas in Kitchener and Waterloo that were required, through regulation, to install sustainable stormwater management were the most likely neighbourhoods to have done so.

6.1.3 Suggestions for the Future: Residential Stormwater Credits, or a Better Way Forward?

Both cities suggested that channelling time and funding into a residential credit program is not the most efficient route to reduce stormwater runoff volumes. W1 suggested that a residential SCP focus more on educating the population on stormwater issues, with long-time horizons for uptake of sustainable stormwater management comparable to the uptake of recycling in the region. Kitchener's Stormwater Market Study suggests a shift from focusing on credits to promote sustainable installation, to using landscape beautification as an incentive to promote sustainable installation (Aquafor Beech Ltd & Freeman Associates, 2015). REEP experts suggested targeted credits of higher value in areas that were at a higher risk of flooding. As each set of experts had different suggestions for moving forward, it is clear that residential stormwater credits are not incentivising sustainable installation enough to incite action in either Kitchener or Waterloo.

6.2 Addressing Research Objectives

This section addresses my original research questions and situates my findings within the literature.

6.2.1 What kind of barriers have Kitchener and Waterloo encountered to the uptake of sustainable stormwater management on private residential properties? *Why have they encountered these barriers?*

6.2.1.1 *Program Bias*

To identify barriers to the uptake of sustainable stormwater management in Kitchener and Waterloo, this research first explored the potential for SCP program bias, identifying any demographic, geographic, or political factors that may have influenced a property owner's likelihood to install sustainable stormwater management. Unlike the findings of Morison and Brown's (2011), who found a correlation between participation in sustainable stormwater management and certain socioeconomic and demographic factors including higher levels of wealth, post-secondary education, and population size, there were no correlations

between any of the socioeconomic factors explored in Kitchener and Waterloo (See Appendix H). One explanation for the lack of correlation is that the analysis was at too high a level (municipal wards) to identify any indications of program bias. Another explanation may be that socioeconomic factors are not of major significance to determining who early adopters of stormwater management were in Kitchener and Waterloo. This may change as sustainable stormwater management becomes the norm and should be tracked to ensure program bias is prevented. Overall, it appears as though socioeconomic and demographic factors did not impact sustainable stormwater management transitions in Kitchener and Waterloo.

Morison and Brown's (2011) study also found that areas bounded by the coast or areas with over 50% of their land cover by vegetation had a higher commitment to sustainable stormwater management. This suggested that the presence of nature (or lack thereof) could impact sustainable stormwater transitions. Kitchener and Waterloo SCP data showed no indication of greenspace coverage correlating to SCP participation rates. Therefore, it appears as though vegetative coverage did not impact the transition to sustainable stormwater management in Kitchener and Waterloo.

Finally, it is also important to discuss the impact of local politics in the uptake of sustainable stormwater management. In studying sustainable stormwater management policy implementation in Australia, Morison and Brown (2011) found that communities where local government officials self-reported to have a high sustainable stormwater management policy commitment also tended towards higher commitment levels to sustainable stormwater management policy. This suggested that councillor support for stormwater management policy may impact the participation of city wards in stormwater programs like the SCP. Since councillor support was fairly even across Kitchener and Waterloo, ward politics could not be said to have played a major role in the uptake of sustainable stormwater management.

Overall, findings suggest that socioeconomic, demographic, geographic, and ward politics did not play a role in the uptake of sustainable stormwater management in Kitchener and Waterloo. This serves as a control for this research, allowing the uptake of sustainable stormwater management in each city to be discussed without focusing on the potential impact of these extraneous variables (see Figure 2, conceptual framework), allowing for a focus on intervening variables. Therefore, no specific extraneous variables were an explicit point of inquiry when discussing the potential for program bias during the expert interviews conducted for this research.

While socioeconomic, demographic, geographic, and political factors did not appear to have an impact on sustainable stormwater management uptake, program bias still identified as there was an overrepresentation of *environmentalists* participating in the SCPs in Kitchener and Waterloo. This aligns loosely with the findings of Morison and Brown (2011) who found that in municipalities with the lowest commitment to WSUD, environmental issues were held in low regard. Overall, the findings of Morison and Brown (2011) suggest

that the uptake and promotion of sustainable stormwater management is tied to the level of environmentalism in a community. My research findings support the theory that higher levels of environmentalism in a populace create a more supportive landscape for the transition to sustainable stormwater management, as the early adopters of sustainable stormwater practices in Kitchener and Waterloo were disproportionately environmentalists. The disproportionate representation of environmentalists amongst early adopters of sustainable stormwater management will be discussed further in this analysis.

6.2.1.2 *Real and Perceived Barriers*

There are real costs associated with the installation of sustainable stormwater management on private residential property; these costs may be prohibitive to the uptake of sustainable stormwater management (Parker & Johansson, 2012). However, Abhold, Loken and Grumble (2011) contest that 'cost' as a barrier tends to be a catch all for the actual barriers to uptake, which are financial risk and uncertainty. In Kitchener and Waterloo, the findings of this research support the assertion that cost is a perceived barrier, with the underlying causes being risk and uncertainty, routed in the public's low valuation of the benefits of sustainable stormwater management.

As previously discussed, income and property value were not identified as extraneous variables impacting the uptake of sustainable stormwater management in Kitchener and Waterloo. Cost as a real barrier to sustainable stormwater management is therefore a very questionable claim in the case of Kitchener and Waterloo. Further illustrating this point is the City of Waterloo's experience with their incremental implementation of their credit system. When the City of Waterloo increased their credit levels by 25% each year for 4 years, they did not see an accompanying increase in the SCP application rates over time; this suggests that a financial return was not the main motivator inciting participation in sustainable stormwater management. R1 stated, "*… if you do nothing, just send out a flyer, the city gives high level information, nobody does anything! [It's] Just too much noise. If you do something like a home or business visit without incentive, people will do maintenance activities. If you add incentives, then that is where the magic happens, the more support with money and services to help them understand how to do things and guide them the more results you will get.*" This perspective is interesting, because it posits that financial incentives are the main drivers to the uptake of sustainable stormwater management. In Kitchener and Waterloo however, given the program bias towards environmentalists, it seems that the main motivator was not financial benefit, but concern for the environment and fear of flooding. K1 stated that if people were not already interested in sustainable stormwater management (for environmental or personal flooding reasons), that it was very unlikely property owners would go out and spend a fair amount of time and money on a stormwater project that would not see them a monetary return on their investment. This perspective highlights that, while time and money are barriers to people installing sustainable stormwater management, the bar at which that barrier becomes real is not based as much on actual installation costs, as it is based on a property owners' *valuation* of the benefits

of sustainable stormwater management, which include environmental benefits and flood attenuation. For example, REEP chose neighbourhoods at high risk for flooding, and neighbourhoods who were engaged in environmental issues and community groups, to target for SCP outreach because of the higher likelihood these residents had for installing sustainable stormwater management based on their values and circumstances. If property owners in Kitchener and Waterloo *valued* the functions of sustainable stormwater more, then the financial incentive that was presented through the SCPs may have been enough to tip people over a 'cost' barrier and install sustainable stormwater management.

Another perceived barrier to the uptake of sustainable stormwater management in Kitchener and Waterloo were perceptions of risk and uncertainty attached to sustainable stormwater management installation. One of the risks associated with a shift to sustainable stormwater management is based in aesthetics (Brown et al., 2016; Kaplowitz & Lupi, 2012 Abhold, Loken, & Grumble, 2011); people do not want to install sustainable stormwater management in Kitchener and Waterloo because they fear it will be aesthetically unpleasing (Aquafor Beech Ltd & Freeman Associates, 2015; R1). Therefore, aesthetic risk was a barrier to uptake of sustainable stormwater management (Aquafor Beech Ltd & Freeman Associates, 2015).

Another risk that presented a barrier to the uptake of sustainable stormwater management was the technical risks associated with installation stemming from a lack of professional technical knowledge (which was identified as a barrier to sustainable transitions by Brown & Clarke, 2007; Brown & Farrelly, 2009a; Moser & Ekstrom, 2010; Brown, 2008a; Brown et al., 2016; Moglia et al., 2010; Corbett, 2010; Thurston, 2012). A survey conducted by RAIN in 2013 following up with participants of their 'Home Visit' program (which helps homeowners identify how to retrofit their properties to prevent flooding and increase infiltration) found that 10% of respondents listed 'difficulty locating a contractor' as a major barrier to taking action on stormwater. This is 10% of people who were keen enough on stormwater to actually have a RAIN home visit in the first place, so it is likely that these homeowners are making more of an effort to find qualified contractors than most. Further illustrating the difficulties related to locating a knowledgeable contractor, in 2013, while attempting to create an infiltration gallery as part of a demonstration project, REEP and the cities themselves found it difficult to locate a contractor to complete the job (R1). Trends in SCP participation data align with the assertion that technical risk associated with installation and maintenance is a major barrier to the uptake of sustainable stormwater management; rain barrels are the most popular form of stormwater control in both cities, and rain barrels are also the easiest control to install and maintain (W1).

Underlying both perceptual cost barriers and technical risk barriers is a lack of knowledge. Overall, people in Kitchener and Waterloo are not knowledgeable enough about the risks associated with stormwater management, nor are they knowledgeable enough about sustainable stormwater management (including its cost, how it works, how to install it, or how to maintain it) (K1, W1, W2, R1, R2). As R1 explained, "If there is a new idea and nobody has heard of it, and it is untested, people won't trust things"; it is important for people

to understand sustainable stormwater management if they are to trust it enough to invest in. The finding that lack of knowledge is a barrier to the uptake of sustainable stormwater management aligns with much of the literature on sustainable transitions (Thorne et al., 2015; Neiswender & Shepard, 2010; Abhold, Loken & Grumble, 2011; Olorunkiya et al. 2012; Brown et al., 2016; Mills, 2010; Bedard, 2005; Kaplowitz & Lupi, 2012).

6.2.1.3 *Institutional Barriers*

There are 3 main institutional barriers to the uptake of sustainable stormwater management in Kitchener and Waterloo. These include a lack of funding for sustained outreach programing, lagging top down legislation, and a lack of institutional coordination (unclear goals, associated timelines, and monitoring and evaluation challenges).

Insufficient staff and personnel resources, as well as insufficient financial resources, are two very common organisational barriers which decrease organisational capacity and capability (Foster, 2011; Government of Ontario, 2011; Hamann & April, 2013; Hodson & Marvin, 2010; Pitt & Bassett, 2013; Brown& Farrelly, 2009; Moser & Ekstron, 2010). For example, Abhold, Loken, and Grumble (2011) find that there is often a lack of funding for hiring staff to promote the implementation of sustainable stormwater management. Lack of funding was an issue for Waterloo in particular, but for both cities over time. Waterloo was not able to provide as much funding compared to Kitchener (nor was it proportional to their population size); for this reason, REEP focused outreach effort in Kitchener (R1); this is reflected in the uptake of sustainable stormwater management in each city. Over time, both cities reduced their funding and outreach was reduced accordingly (R1). R1 explains that insufficient funding for outreach and education to citizens results in a drop in the uptake of sustainable stormwater management because there is less contact made with residents to inform and encourage them to install sustainable stormwater management.

Lagging top down legislation was a minor institutional barrier in the case of Kitchener and Waterloo (R1). Because provincial legislation guiding stormwater management does not allow for sustainable stormwater management to *replace* grey infrastructure, the cost benefit the city could transfer to property owners was reduced (resulting in a lower credit rebate) (R1). More progressive and demanding provincial legislation on stormwater management would also help Kitchener and Waterloo gain the political capital to push harder for sustainable stormwater management (R1).

A lack of common vision amongst actors, along with stifled horizontal and vertical communication can pose a barrier to sustainable transitions (Keely et al., 2013; Brown, N.D.; 2008a). In Kitchener and Waterloo, these barriers manifest as uncoordinated and unclear goal formation and monitoring requirements regarding the installation of sustainable stormwater management through the SCP. Kitchener and Waterloo did not provide consistent, hard numeric goals for REEP to reach regarding either stormwater volume reductions or the

number of property owners to engage, nor did they provide a consistent timeline in which they wanted to reach their goals. Even experts interviewed had difficulty clearly defining the goals of their outreach programs (K1, W1, R1). This lack of consistency and coordination reduced the efficacy of REEP's outreach as they could not work towards clear goals (R1). This made program monitoring difficult for REEP, who would have preferred hard targets for SCP applications, as those would have pushed REEP to drive towards them (R1). Overall, there is a disconnect between the cities and REEP surrounding what goal setting should look like which prevented REEP from being able to channel all of their effort into creating a long term, clear strategy to reach each city's goals for the promotion of sustainable stormwater management.

6.2.1.4 *Communication Barriers*

Communicating the problems related to traditional stormwater funding structures, and the benefits and 'how-tos' of sustainable stormwater management are an important part of promoting the uptake of sustainable stormwater management (Barbosa et al., 2012; Brown & Farrelly, 2009). The major barrier Kitchener and Waterloo encountered in regards to communication was a mismatch between communication technique and intended audience. Social media was used heavily to promote the SCP and sustainable stormwater management, but this was almost never cited as the means of communication that lead people to install sustainable stormwater management (W1, K1). Instead, utility bill inserts were the most useful communication stream to promote the installation of sustainable stormwater management (K1, W1). This illustrates the importance of ensuring communications channels used are targeted effectively towards their intended audience.

6.2.2 How have Kitchener and Waterloo tackled these barriers? What engagement methods and strategies are useful in promoting the uptake of sustainable stormwater management on private residential property in each city?

6.2.2.1 *Educational Engagement*

It is well established that stakeholder/public engagement is important for successful commons resource management (Bravo & De Moor, 2008) and increasing a community's commitment to sustainable stormwater management policies (Brown, 2005; Morison and Brown, 2011), and that educational programs are critical to transition to sustainable stormwater management (Thorne et al., 2015; Neiswender & Shepard, 2010; Abhold, Loken & Grumble, 2011; Olorunkiya et al., 2012; Brown et al., 2016; Mills, 2010; Bedard, 2005; Kaplowitz & Lupi, 2012). Both Kitchener and Waterloo recognised the importance of engagement and education of the populace as a critical component of the promotion of sustainable stormwater management, and so, hired REEP to run public outreach and education campaigns leading up to and throughout the duration of the SCP. This outreach continues today. There was no single engagement method that was the key to promoting sustainable uptake in Kitchener and Waterloo. The strength of each city's outreach program came from the

layering of different outreach methods. The most important *strategies* for engagement that were part of this layering are discussed below:

A) Targeting specific groups for outreach: REEP targeted neighbourhoods that were at higher risk of flooding and that also had active community organisations for their initial SCP and stormwater outreach. Targeting groups for engagement and tailoring outreach to these groups is a strategy recommended by Neiswender & Shepard (2010). Targeting allows for a more focused use of resources to engage people who are most likely to become early adopters of sustainable stormwater management. This increased likelihood of participation stems from the target group's community building and engaging mentality, and the fact that they have a vested interest in flood attenuation. The added benefit of targeting this group first is that they are most likely to suffer from flooding, and therefore convincing them to install sustainable stormwater management benefits the city, as once controls are installed, this group is less likely to experience flooding and file flooding complaints to the city. It is important to remember that when targeting specific groups for outreach, the best channels for communications with these groups must be contemplated. Communicating through existing community organisations (e.g. newsletters and email lists) is one effective way to reach target groups. It should *not* be assumed that social media is the best way to reach people, even if a city or community group has many followers, because not all property owners are social media savvy; this explains why utility bill inserts were a great way communicate with homeowners, and also showcases the importance of tailoring outreach to your target group.

B) Using lightning rod issues to gain momentum: Morison and Brown (2011) suggest that in order to enable greater participation in sustainable stormwater management, municipalities must link stormwater action to greater public concerns. Using common goals to promote sustainable installations adds to the incentive for private property owners to take on the burden of responsibility and costs of sustainable stormwater management measures. K1 describes the use of this tactic and labels it a 'lightning rod' issues. Kitchener's 'lightning rod' issue was the rehabilitation of Victoria Park Lake, which led to support for stormwater management changes. Experts from Kitchener, Waterloo, REEP, and Depave leads agreed that in order to engage people in stormwater issues, you have to show them how stormwater is connected to issues they already know they care about, like landscape aesthetics, the environment, or community building. Kitchener is about to embark on a new stormwater management outreach strategy that uses landscape beautification as a lightning rod issue to promote sustainable stormwater management. Lightning rod issues are the driving motivation behind Depave Paradise, who partner with institutions to reach their landscaping goals *while also* incorporating sustainable stormwater management. Overall, K1, W1, and R1 all suggested using lightning rod issues to garner support for sustainable stormwater management, asserting that this was an important part of their stormwater transition.

C) Using partnerships and networks: Social networks play an important role in promoting sustainable behaviour change (Brown et al., 2016). However, as Foster (2012) notes, "strong social ties and dense social networks alone are not enough for collective efficacy to be present. Rather, those ties and networks have to be "activated" through actual engagement that enables residents to exert more effective informal social control on each other." (86) Activating community networks was the responsibility of REEP. REEP employed a variety of engagement techniques including: attended community events, running educational workshops, and running demonstration projects to build relationships with community groups, in order to activate these networks to take action on stormwater issues. This engagement allowed outreach and education efforts to reach a wider range of property owners because demonstration projects and the SCPs could be advertised through these networks, which were wider than the cities' and REEP's alone.

D) Using a variety of pathways for media and communications outreach: In order to maximise the impact of communications efforts in Kitchener and Waterloo, it was important to use a variety of pathways for communication, including social media, newsletters, radio, door-to-door outreach, and newspaper. Although utility bill inserts were the single most effective method of communication with property owners about sustainable stormwater management(W1), using other forms of communication were still important for outreach (R1) as all forms of outreach resulted in new citizens learning about sustainable stormwater management. However, with the clear success of using utility bill inserts as a means of communication, it is clear that communications tailored to the intended audience (e.g. older property owners) is an important part of an effective communications strategy (as suggested by Beddard, 2005, and Olorunkiya et al., 2012).

E) Demonstration projects: Demonstration projects achieved multiple benefits in the promotion of sustainable stormwater management in Kitchener and Waterloo. First, demonstration projects were recognised as a great way to help educate the public on sustainable stormwater management, by dispelling some of the fears and uncertainties surrounding aesthetics and installation (W1, R1, R2). Second, having a city or associated group like REEP run a demonstration project allows for identification of existing barriers to the installation of sustainable stormwater management, from the perspective of a property owner (R1). Once these barriers are identified, the municipality can work to streamline the processes, thereby reducing barriers to uptake (including conflicting legislation (Abhold, Loken, and Grumble, 2011), and complex application processes (Brown et al., 2016)). The benefits of demonstration projects are recognised outside of Kitchener and Waterloo, which is why Green Communities Canada promotes Depave Paradise projects, where sustainable stormwater demonstration projects are installed in communities across the country.

F) Legislation: Experts asserted that the neighbourhoods with the highest sustainable stormwater management installation rates were those mandated to install controls, usually to ensure water table balance. This finding, compared to the apparent inefficacy of credits as motivators to sustainable stormwater

installation, suggests that in the case of Kitchener and Waterloo, a rigid policy approach is more effective than small economic incentives when promoting the installation of sustainable stormwater management.

7 Recommendations and Conclusions

7.1 Thesis Conclusions

This thesis aims to answer the questions:

1) ***What kind of barriers have Kitchener and Waterloo encountered to the uptake of sustainable stormwater management on private residential properties?***

a. ***Why have they encountered these barriers?***

2) ***How have Kitchener and Waterloo tackled these barriers?***

a. ***What engagement methods and strategies are useful in promoting the uptake of sustainable stormwater management on private residential property in each city?***

Through quantitative data collection on SCP uptake, and qualitative interviews with stormwater experts both within and outside of Kitchener and Waterloo, I was able to identify key barriers and enablers to promote the installation of sustainable stormwater management on private residential property; this may help other Canadian municipalities looking to promote the installation of sustainable stormwater management.

This research demonstrates that in Kitchener and Waterloo, socio-economic, demographic, geographic factors, and local ward politics, had little influence on the uptake of sustainable stormwater management. This suggests that these factors do not inhibit the uptake of sustainable stormwater management. Environmentalists were identified as the most likely group to install sustainable stormwater management. Experts suggested that environmentalists not be targeted through engagement programs since they are likely to participate in sustainable stormwater practices without targeted efforts by municipalities. The most effective strategies for encouraging sustainable stormwater management in Kitchener and Waterloo were identified as: taking a targeted approach to outreach programs; using 'lightning rod issues' to encourage action on stormwater issues; using partnerships and networks to reach a wider range of participants; using multiple media and communication channels to engage property owners, while remaining cognisant of the type of property owner one is trying to reach out to (e.g. social media savvy, or not?); and using legislation to ensure uptake of sustainable stormwater management.

This research contributes to the field of planning's understanding of how to promote the installation of sustainable stormwater management on private residential property in a Canadian context. Municipalities are facing major challenges in ensuring their current stormwater systems are sustainable into the future, in

respect to both funding and environmental quality. Encouraging sustainable stormwater management installation is one piece of the puzzle in ensuring the sustainability of municipal stormwater management systems into the future. Encouraging sustainable stormwater management installation through a credit policy is not enough; outreach programs must be effective in engaging and convincing property owners that an investment in sustainable stormwater management on their property is one they want to make.

Theoretically, this research contributes to literature on sustainable stormwater management by providing a case study on the experiences of the two first cities in Canada to undergo these types of stormwater management changes, while transcending the inappropriately narrow focus on technical barriers that occurs within much of the literature on stormwater management. Regardless of a community's location, transition to sustainable urban stormwater management requires knowledge of what has worked and why (Brown, N.D); this research seeks to understand what has worked and why in the context of stormwater transitions occurring in Kitchener and Waterloo.

7.2 Recommendations

The intent of this research is to analyse the stormwater management transition experiences of Kitchener and Waterloo in order to identify lessons for other Canadian municipalities looking to encourage sustainable stormwater management. This section outlines key lessons that can be passed on from the experiences of Kitchener and Waterloo:

7.2.1 Credits and Incentives

The experiences of Kitchener and Waterloo uphold the claim in stormwater management literature that fiscal incentives are often too small to encourage widespread installation of sustainable infrastructure (Parker & Johansson, 2012). Experts in Kitchener and Waterloo assert that the residential stormwater credit program is not the most effective means of promoting the installation of sustainable stormwater management; however, a credit or rebate program is necessary to ensure fairness and equity when instituting a stormwater utility charge. If a utility charge is instituted, property owners must have a means of reducing the charge based on how much of the service they use (W1, K1). If cities are aiming to reduce the volume of stormwater entering their systems in the most efficient way possible, interviewees suggested a focus on encouraging the non-residential sector to adopt sustainable stormwater management, as these properties are often larger and have a higher amount of stormwater to divert (W1). Staff hours spent forming relationships with large non-residential property owners are therefore more efficiently spent, as they result in a larger diversion of stormwater. Essentially, focusing on a non-residential credit program has more 'bang for buck' regarding reduction of stormwater volumes (W1). Other Canadian cities recognise this; Mississauga, Ontario has decided not to include credits for single-family residential properties in their stormwater credit program, and instead only offer credits to non-residential and multi-residential properties. Kitchener's Market Based Stormwater Strategy Report suggests that instead of focusing on residents, engagement programs should

focus on providing incentives for service providers (e.g. landscapers and contractors) to promote and install sustainable stormwater management (Aquafor Beech Ltd & Freeman Associates, 2015). Green Communities Canada (2015) suggests construction grants and credits for contractors, citing that targeting contractors and service providers results in economies of scale, leading to more installations of sustainable stormwater management with fewer resources spent on promotion and education to the wider public.

7.2.2 Clear Goal Setting

I suggest cities set clear goals and monitoring programs for their sustainable stormwater outreach programs at the program's start. Clear goals are important in motivating actors towards program targets. In the case of Kitchener and Waterloo, REEP would have preferred clear, numeric goals on the number of sustainable stormwater management projects each city would have liked to see installed annually. This would have helped REEP reach higher targets (R1). REEP suggests that other municipalities provide non-profit groups working on stormwater outreach with hard numeric goals to help guide their efforts.

Providing hard numeric goals is also helpful for program monitoring. Bernstein (2001) notes that performance monitoring can help improve public confidence in government programs. It can also improve government support for their own programs; if the SCPs or similar programs are to be funded annually by city councils, councillors must be able to clearly measure the outputs of their investments. Cities and their partners should agree upon monitoring indicators at the start of a stormwater program, as this will allow actors to monitor whatever the city council requests as justification for renewed program funding annually. If indicators are not clarified at the start of a program, it can be difficult or impossible to assemble required data at the last minute.

7.2.3 Engagement Strategies: Two Phases of Partnership Building

My next recommendation is that municipalities take a two-phased approach to engagement. First, municipalities should focus on building relationships with existing community groups, using those networks to spread information about sustainable stormwater management installation and stormwater issues more broadly. In this first phase, municipalities should target the easiest groups to form partnerships with - environmentalists. This includes garden groups, local conservation authorities, transition groups, environmental not for profits, and others. Research in Kitchener and Waterloo shows that once these groups have been engaged, non-environmental groups must be targeted to prevent reaching a plateau in sustainable installations; the challenge now facing Kitchener and Waterloo is to breakthrough to engage what Moore (1991) calls the 'early majority' and 'late majority' of adopters; in other words, the mainstream must now adopt sustainable stormwater management as the new norm.

This is where the second phase of engagement must begin. For this second phase, groups located in areas in or around flood zones should be targeted. These can include churches, schools, and local businesses. This model follows the Depave Paradise program model, as these events engage people in stormwater action that

would otherwise not give much thought to stormwater issues. In order to engage these groups, municipalities have to find an enticing common goal or 'lightning rod' issue to encourage non-environmentalists to care about sustainable stormwater management installation. Municipalities need to find an issue that is salient to their particular community to unite property owners in stormwater action. If flooding is a major issue, then flood prevention would be a strong 'lightning rod' issue. That issue may be beautifying a municipal parking lot, creating healthy green space for children to play in at a school, or creating a relaxing space for contemplation on church or hospital properties. Regardless of what the 'lightning rod' issue is, finding it and using it to build partnerships with groups traditionally unconcerned with stormwater issues is an important part of bringing the majority of property owners on board with sustainable installation. Kitchener is currently exploring a market transformation approach to reach new groups of property owners in their stormwater efforts. Their new approach suggests influencing market factors to increase the desirability of sustainable stormwater management (e.g. promoting the aesthetic benefits of sustainable stormwater management, and incentivising installations for service providers instead of property owners) (Aquafor Beech Ltd & Freeman Associates, 2015). Other municipalities should follow the progress of this approach; if the approach is successful it should be considered for adoption.

I also recommend that throughout their engagement approach municipalities, look for partners to help them promote sustainable installations both within and outside of their own communities, as the most important strategy for the promotion of sustainable installation in Kitchener and Waterloo was to engage networks and partnerships through cross-issue coordination, or 'lightning rod' issues. For example, REEP engaged with Landscape Ontario for contractor training sessions; this has snowballed into plans for a province-wide program to educate landscapers and contractors on stormwater-wise landscaping. Asset management and sustainable stormwater management are issues coming to the forefront of infrastructure management bodies across the country. It is therefore recommended that municipalities look to provincial and national bodies to engage in high-level programs that can help them promote sustainable installations within their communities.

7.2.4 Methods for Engagement: Mixed Methods with a Focus on Demonstration Projects

No single method of engagement lead to the levels of sustainable installations seen in Kitchener and Waterloo. The strength of each approach came from the layering of multiple outreach methods. To engage with property owners, Green Communities Canada (2015) suggest that municipalities focus less on door-to-door campaigns and cold calling, and more on engaging property owners at community events. The problem with this approach is that it often engages environmentalists, as they are most likely to visit a booth on stormwater at a community event. This will quickly become redundant outreach as these people are most likely to either already have sustainable stormwater management installed, or be early adopters of sustainable technology. Alternatively, I would suggest that municipalities focus less on engaging people at

community events, and focus more on creating events to engage multiple networks (outside of environmentalists) in the community.

One method for accomplishing this is to create demonstration projects. Demonstration projects counteract the barriers faced in the promotion of sustainable stormwater management. They reduce the perceived risk of sustainable installation by providing an example of a beautiful and functioning sustainable project. Demonstration projects can also be a great way to engage with new networks, to reach people who would otherwise be unengaged in stormwater issues. For example, partnering with a school or a hospital to use their property for a demonstration project gives the city access to those networks. Demonstration projects would then use the beautification and naturalisation of those properties as a lightning rod issue to get the community interested in installing sustainable stormwater management in other places. A third benefit of demonstration projects is that they allow the city to run through a sustainable installation project, highlighting the barriers property owners may face during this process. This knowledge of the experience allows cities to work to streamline the installation process.

After holding a number of demonstration projects, REEP suggested numerous strategies for running successful and effective demonstration projects. These suggestions are summarised and ordered from project start to close by this thesis author, below:

1) Create demonstration project criteria and standard monitoring criteria (CK, CW, & RGS, 2013)

2) Put out a call for demonstration project partners through your own networks *and* partner networks.

3) Choose a site for the demonstration project. Demonstration projects should occur in target neighbourhoods who are at higher risk of flooding, if possible. Although this could not occur in Kitchener and Waterloo, as those willing to install demonstration projects were early adopters, and therefore not plentiful, taking a more targeted approach to demonstration project locations is where R1 suggested the program move to in the future. The ideal partner for a demonstration project would be a person or an organisation that has a large network as this makes promotion of the project and dissemination of results easier and more impactful. Cities should run demonstration projects on their own property if they cannot find willing participants for demonstration projects in target areas.

4) Advertise the event through every channel you can. This includes social media, and traditional media and utility bill inserts. Leverage your partners to share the news through their networks on social media, through newsletters, or however else they can. Be sure to engage local radio,

television, the newspaper, as these are great mediums with which to engage people outside of the usual channels – to get new people aware of stormwater issues. Reaching out to these groups may be easier if the city communications department is used as a point of contact.

5) Use the demonstration project as a test run. Identify any technical or institutional barriers that draw out the process: Were there too many forms to fill out? Were there restrictive bylaws or zoning codes? Was it very difficult to find a contractor due to lack of training? Work with the city and local contractors to correct barriers and streamline the installation process.

6) Turn the demonstration project into a local case study. This makes a vague concept real and shows a local, aesthetically pleasing, and functional outcome of sustainable stormwater management. REEP did this effectively in Kitchener and Waterloo.

7) Take lots of pictures and share these and the case study through your network and the network of your partners. Engage using multiple media pathways (social media, newspaper, radio, television, etc.)

8) Reward those who volunteer for demonstration projects. This can be in the form of a year-end sustainability award, or stormwater champion award. Providing these awards gives people recognition and social capital for their progressive efforts, and further helps to spread the word about stormwater management through their networks. The event and winners should be publicised through local media and available networks to help disseminate information on stormwater management and its benefits.

9) The entire process should take approximately 1 year (CK, CW, & RGS, 2013)

7.2.5 Dealing with Pushback: FAQs

Kitchener found that the most effective means of responding to pushback upon the implementation of their utility rate and SCP was to ensure all staff who would be interacting with the public (e.g. staff receiving telephone inquiries on the programs) were given the same FAQ sheets that addressed the most common resident concerns. This ensured that the message leaving the city was clear and consistent, leaving no room for residents to misinterpret the new program rules and regulations. I also recommend that this FAQ sheet be published online and in a local newspaper to help calm program pushback, and to help increase understanding of newly adopted stormwater programs.

7.2.6 Legislation

City experts interviewed made it clear that a large proportion of properties which had sustainable stormwater management practices installed, did so because they were required to through zoning regulations. Therefore, if a city aspires to prioritise the installation of sustainable stormwater management and reduce the amount of stormwater entering municipal systems, zoning regulations and design standards are an effective means to this end.

7.2.7 Education and Youth

Neiswender & Shepard (2010) suggests that 'future actors' should be targeted for engagement when attempting to transition to sustainable stormwater management – this includes teachers and students. W1, outlined long timelines for transition to sustainable stormwater management, and likened the stormwater program to that of the blue bin recycling program; therefore, I would suggest that cities make a strong effort to engage youth in sustainable stormwater management issues by including the topic in the public school curriculum. Abhold, Loken, & Grumble (2011) highlight the importance of educating children, citing that they will likely go home and educate their parents on stormwater issues; therefore this suggestion would not only reap long term benefits (creating a population knowledgeable about stormwater management), but may also produce short term benefits (swaying parents to learn more and engage in sustainable stormwater management). Overall, Neiswender & Shepard (2010) suggests locally driven programs, which help ensure the particularities of the local audience are kept in mind. Given the overarching findings from this research, that targeted outreach is best, and suggestions from experts interviewed that the solution and outreach program must always be customised to a community's unique characteristics, I would echo Neiswender & Shepard's suggestion to ensure local audiences drive how the topic is worked into the existing curriculum.

7.3 Areas for Further Research

Future research should evaluate Kitchener's new Market Based Strategy for the promotion of sustainable stormwater management on private property. If this strategy proves effective, it would provide an example of how to bridge the gap between engaging early adopters and engaging the majority by shifting norms surrounding sustainable stormwater management. Research on how to monetise the benefits of sustainable installations (in dollars) would also be helpful. This knowledge would allow cities to accurately calculate how much each rain barrel or cistern installation saves the city, allowing for a more accurate calculation of how high municipal incentive programs can be while maintaining their worth to the municipality. Lastly, monitoring the uptake of sustainable stormwater management as majority groups adopt sustainable technologies, allows for comparison to socio-economic, demographic, and geographic data; this comparison can indicate program bias, including the potential of green gentrification, as sustainable stormwater management becomes the norm. This knowledge can help cities adjust outreach programs as time goes on, to engage with under-represented groups and prevent green gentrification (Thurston, 2012; Hammel & Wyly, 1996).

7.4 Contributions to Planning

Following the above conclusions, in recognizing that this research was undertaken as part of a masters in planning program, the question then remains: what are the implications of this research for the planning profession?

First, regarding implications for policy, this thesis research makes clear that municipal residential stormwater credit programs may not be the most effective route to reducing the amount of stormwater entering municipal systems during storm events. Municipalities can achieve more 'bang for their buck' by focusing on higher scale stormwater management projects and partnerships; in Kitchener and Waterloo, an example of this could be partnering with a commercial property owner, such as Conestoga Mall to implement source control management projects on a large scale. A second implication for policy is that if a municipality wants to see a drastic rise in the number of sustainable stormwater management projects installed and a decrease in the amount of stormwater entering pipe systems, it is effective to require new developments to have a sustainable stormwater management component before receiving development permits; indeed, site-level design criteria is an important factor which affects the success of stormwater management measures (Ontario Ministry of the Environment, 2003) . Sustainable stormwater management could also be worked into secondary plans, master plans, watershed plans, or sub-watershed plans by ensuring an upper limit on site-by-site imperious area (such as 10% recommended by the Ontario Ministry of Municipal Affairs and Housing (2002)), or working sustainable stormwater demonstration projects in to secondary plans (e.g. street-side stormwater management gardens, which are utilized in Portland, or stormwater management demonstration projects in parks with educational signage, used in Toronto).

Second, regarding implications for the practice of the planning profession, this thesis supports the role of planners as communicators, marketers, and educators, as a part of a collaborative planning process. Godscalk and Mills (2007) outline the importance of a collaborative planning process surrounding urban service provision; a process where "citizens and planners come together in a common effort" (p 2). Indeed, Healey (1998) asserts that collaborative planning can help build local institutional capacity. In the case of stormwater management, an example of collaborative management could be a strong partnership between planners and the public to implement demonstration projects in different neighbourhoods. This would not only help demystify the sustainable stormwater management installation process, but also provide a platform for two-way discussion on stormwater topics between the public and planners; this two-way dialogue is important in a collaborative approach to planning (Godscalk & Mills, 2007). Collaborative planning that strengthens local institutional capacity can take place during both the "direction-setting" and "implementation" phases of planning (Margerum, 2002), therefore, meaningful public engagement techniques could be used to form public outreach and education strategies realted to stormwater

management, which could lead to more effective engagement and promotion of the issue (as strategies would be vetted by the public).

Third, regarding the implications for training and education, this thesis exemplifies the need for planners to be aware of stormwater management issues and solutions in order to ensure sustainable levels of stormwater management service provision. The lack of focus on stormwater issues in planning education programs may play a role in enabling the underfunded and inadequate stormwater management systems that exist across the country today. This is thanks, in part, to past generations of planners who may not have been cognizant of the importance of ensuring sustainably managed and funded stormwater systems. Universities should ensure that stormwater issues are worked into the standard planning curriculum so that all planning students are taught to keep stormwater issues in mind. One way to help ensure this integration of stormwater issues in to planning curriculum is to find and keep stormwater management experts as planning faculty staff member (instead of pushing them into environmental management faculties).

Finally, the issues discussed in this thesis highlight the importance of collaboration across disciplines to find sustainable and effective stormwater management solutions. Planner must work with engineers, landscape architects, and urban design professionals to find solutions to stormwater management capacity shortfalls. Kitchener and Waterloo displayed excellent cross-discipline coordination with the use of Expert Panels to guide the stormwater credit program's development. In order to get the public on board with necessary changes, planners must also work with communications experts, public engagement experts, local politicians, and local community groups. Stormwater management solutions cannot come from planners' efforts alone, coordination and partnerships across disciplines is an important part of the successful promotion of sustainable stormwater management.

7.5 Concluding Thoughts

There is no single method that ensures the uptake of sustainable stormwater management installation on private residential property in Kitchener and Waterloo. Partnerships and networking are invaluable to the promotion of sustainable stormwater management installation, as is the establishment of clear goals and monitoring requirements at the start of a stormwater management transition. Kitchener and Waterloo are at the forefront of stormwater management transitions in Canada. Although their approach to engaging property owners to install sustainable stormwater management has not been an astonishing success, it has engaged early adopters to install sustainable stormwater management. These early adopters spread the word on stormwater management issues and sustainable solutions through their networks; this word of mouth education is an important part of the promotion of sustainable stormwater management. Kitchener and Waterloo, in partnership with REEP have achieved great progress and should be congratulated for their efforts. Their future progress should be monitored in order to track whether new strategies prove to be more

effective at shifting stormwater management norms and engaging the majority of the population in sustainable stormwater management installations.

The experiences of these two cities also begs the question, is a neoliberal approach, which places the responsibility in the hands of individual property owners, and motivates through monetary means, really the most effective way to promote transitions towards sustainable stormwater management? From what we can see in Kitchener and Waterloo, the answer may be, no. The neighbourhoods with the highest rates of stormwater management installation were those that were mandated to do so. They had no choice, and so they did. The second most likely group to participate were environmentalists, who were not motivated through monetary mechanisms, but rather, through their concern for their physical environment. Therefore, is an approach that mandates the installation of sustainable stormwater management, accompanied by an educational campaign to explain why this action is necessary, a more efficient approach? Maybe. Observing the approaches of other Canadian municipalities will hopefully provide a number of policy routes that experts can monitor to understand which approaches are best at promoting sustainable stormwater management in Canada.

References

Abhold, K., Loken, L., & Grumbles, B. (2011). *Barriers and gateways to green infrastructures.* Washington, DC: Clean Water America Alliance. Retrieved from: https://issuu.com/savetherain/docs/barriers-and-gateways-to-gi_cwaa

AECOM (2013). *City of Mississauga stormwater financing study.* Retrieved from: http://www7.mississauga.ca/Documents/TW/Environment/RPT_MississaugaStormwaterFinancingStudy_Apr2013_Final.pdf

American Rivers, American Society of Landscape Architects, ECONorthwest, & Water Environment Federation (AR, ASLA, EN, and WEF) (2012). *Banking on green: A look at how green infrastructure can save municipalities money and provide economic benefits community wide*. Retrieved from: http://www.asla.org/uploadedFiles/CMS/Government_Affairs/Federal_Government_Affairs/Banking%20on%20Green%20HighRes.pdf

Aquafor Beech Ltd & Freeman Associates. (2015). *Integrated stormwater management master plan (iswm-mp): Municipal class environmental assessment: leading jurisdictions report*. Retrieved from: https://www.kitchener.ca/en/livinginkitchener/resources/SWM_Images/INS_SWM_Master_Plan_Kitchener_Leading_Jurisictions_Report_FINAL_05-2-15.pdf

Barbosa, A.E., Fernandes, J.N., & David, L.M. (2012). Key issues for sustainable urban stormwater management. *Water Research, 46*, 6787-6798.

Bedard, N. (2005). Sustaining Quebec water resources urban run-off source and on-site control implementation strategies for Quebec urbanized areas. (Environmental Management Master's thesis, Royal Roads University). Retrieved from: http://search.proquest.com.proxy.lib.uwaterloo.ca/docview/304913347?accountid=14906

Benaquisto, L. (2008 a). Codes and Coding. *The Sage Encyclopaedia of Qualitative Research Methods Online*. DOI: http://dx.doi.org.proxy.lib.uwaterloo.ca/10.4135/9781412963909.n48

Berke, P., Backhurst, M., Day, M., Ericksen, N., Laurian, L., Crawford, J. & Dixon, J. (2006). What makes plan implementation successful? An evaluation of local plans and implementation practices in New Zealand. *Environment and Planning B, 33*, 581-600. DOI:10.1068/b31166

Bernstein, D. (2001). Local government measurement use to focus on performance and results. *Evaluation and Program Planning, 24*(1), 95-101. DOI:10.1016/S0149-7189(00)00050-1

Biesbroek, G.R., Klostermann, J., Termeer, C., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change, 13*(5), 1119-1129. DOI:10.1007/s10113-013-0421-y

Blais, P. (2010). Perverse cities: Hidden subsidies, wonky policy, and urban sprawl. Toronto: UBCPress.

Bos, D., & Brown, H. (2015). Overcoming barriers to community participation in a catchment-scale experiment: building trust and changing behaviour, *Freshwater Science, 34*(3), 1169- 1175. DOI: 10.1086/682421

Bos, J. & Brown, R. (2014). Assessing organisational capacity for transition policy programs. *Technological Forecasting & Social Change, 86,* 188–206. DOI:10.1016/j.techfore.2013.09.012

Boyatzis, R. (1998). Transforming qualitative information: Thematic analysis and code development. Thousand Oaks, CA: Sage.

Bradford, A. & Gharabaghi, B. (2004). Evolution of Ontario's stormwater management planning and design guidance. *Water Quality Resources Journal Canada, 39*(4), pp. 343-355.

Bravo, G., & De Moor, T. (2008). The commons in Europe: from past to future*. International Journal of the Commons, 2*(2), 155. Retrieved from: https://www.thecommonsjournal.org/articles/10.18352/ijc.98/

Breukers, S. & Upham, P. (2015). Organisational aspects of public engagement in European energy infrastructure planning: the case of early-stage CCS projects. *Journal of Environmental Planning and Management, 58*(2), 252-269. DOI: 10.1080/09640568.2013.851597

Brown, H.L, Bos, D.G., Walsh, C.J., Fletcher, T.D., & Rossrakesh, S. (2016). More than money: how multiple factors influence householder participation in at-source stormwater management. *Journal of Environmental Planning and Management, 59*(1), 79-97. DOI: http://dx.doi.org/10.1080/09640568.2014.984017

Brown, R. (2008a). Local institutional development and organizational change for advancing sustainable urban water futures. *Environmental Management, 41*(2), 221–233. DOI: 10.1007/s00267-007-9046-6

Brown, R. (N.D.). *Transition to Water Sensitive Urban Design: the story of Melbourne, Australia* [Powerpoint Presentation]. Retrieved from: http://www.citg.tudelft.nl/fileadmin/Faculteit/CiTG/Over_de_faculteit/Afdelingen/Afdeling_watermanagement/Secties/waterhuishouding/Leerstoelen/Waterbeheer/onderzoek/Projects/Projecten/Completed/OUD/020_SUW/020_database/090_sympo/doc/3_Presentation_Rebekah_Brown.pdf

Brown, R. & Clarke, J. (2007). *Transition to Water Sensitive Urban Design: the story of Melbourne, Australia* [PDF document]. Retrieved from: http://www.monash.edu.au/fawb/publications/final-transition-doc-rbrown-29may07.pdf

Brown, R. & Farrelly, M. (2009). Delivering sustainable urban water management: a review of the hurdles we face. *Water Science & Technology, 59* (5), 839- 846. DOI: 10.2166/wst.2009.028

Brown, R. & Farrelly, M. (2009a). Challenges ahead: social and institutional factors influencing sustainable urban stormwater management in Australia, *International Association on Water Pollution Research, 59*(4), 653-60. DOI: 10.2166/wst.2009.022

Brown, R., Farrelly, M. & Loorbach, D. (2013). Actors working the institutions in sustainability transitions: The case of Melbourne's stormwater management. *Global Environmental Change, 23*(4), 701-718. DOI: 10.1016/j.gloenvcha.2013.02.013

Brown, R.R. (2005). Impediments to integrated urban stormwater management: The need for institutional reform. *Environmental Management, 36*(3), 455-468. DOI: 10.1007/s00267-004-0217-4

Canadian Institute for Environmental Law and Policy [CIELAP]. (2011). *Greening stormwater management in Ontario.* Retrieved from: http://cielap.org/pdf/GreeningStormManOntario.pdf

Cettner, A., Ashley, R., Hedstrom, A., & Viklander, M. (2014). Assessing receptivity for change in urban stormwater management and contexts for action. *Journal of Environmental Management , 146*, 29-41. DOI: 10.1016/j.jenvman.2014.07.024

Cettner, A., Ashley, R., Hedstrom, A., & Viklander, M. (2014a). Sustainable development and urban stormwater practice. *Urban Water Journal, 11*(3), 185-197. DOI: http://dx.doi.org/10.1080/1573062X.2013.768683

Charmaz, K. (2014). *Constructing Grounded Theory*. Sage: Los Angeles.

Chater, N., Chee, D., Cirillo, C., Fell, T., Joyce, J., Sich, H., & Smith, N. (2011). Green infrastructure: Our round table participants discuss the challenges of rethinking the definition of green infrastructure and incorporating sustainable systems into built projects. *Ground Magazine*, 20 – 25. Retrieved from: http://www.oala.ca/wp-content/uploads/2011/06/GROUND-15-Planning-Infrastructure.pdf

Chocat, B., Ashley, R., Marsalek, J., Matos, M.R., Rauch, W., Schilling, W., & Urbonas, B. (2007). Toward the sustainable management of urban storm-water. *Indoor and Built Environment, 16* (3), 273-285. DOI: 10.1177/1420326X07078854

City of Kitchener (CK). (2011). *Stormwater credit financial analysis appendix g*. Retrieved from: http://www.kitchener.ca/en/livinginkitchener/resources/SWCPAppendixG-September2011FinancialAnalysis.pdf

City of Kitchener (CK). (2014). Fast facts about Kitchener. Retrieved from: https://www.kitchener.ca/en/insidecityhall/resources/EDFastFacts.pdf

City of Kitchener (CK). (2015a). *2016 sustainable communities awards — background application form*. Retrieved through private correspondence.

City of Kitchener (CK). (2016b). *Stormwater utility.* Retrieved from: www.kitchener.ca/en/livinginkitchener/stormwater_utility.asp

City of Kitchener (CK). (2016c). *Stormwater credit policy.* Retrieved from: http://www.kitchener.ca/en/livinginkitchener/Stormwater_Credit_Policy.asp

City of Kitchener [CK]. (2016d). *KW joint services.* Retrieved from: http://www.kitchener.ca/en/insidecityhall/KWJointServicesInitiative.asp

City of Kitchener & City of Waterloo [CK &CW]. (2010*). Kitchener/Waterloo stormwater utility based on impervious area: A tale of two cities.* [PowerPoint Slides]. Retrieved from: http://www.creditvalleyca.ca/wp-content/uploads/2012/05/3DDMcGoldrickNGollan-Kitchener-WaterlooStor.pdf

City of Kitchener, City of Waterloo, & REEP Green Solutions [CK, CW, & RGS]. (2013). *RAIN: An ecological approach to stormwater management in Kitchener and Waterloo.* Retrieved through private correspondence.

City of Ottawa. (2015). *Area-specific development charges for stormwater management facilities.* Retrieved from: http://ottawa.ca/en/area-specific-development-charges-stormwater-management-facilities

City of Portland. (August 2015). *Stormwater credit manual*. Retrieved from: http://www.portlandmaine.gov/DocumentCenter/View/9714

City of Red Deer. (November 7, 2014). *Composting at home pilot phases 1 & 2: final report.* Retrieved from: http://www.reddeer.ca/media/reddeerca/city-services/environment-and-conservation/your-yard/2014-11-07-Composting-at-Home-Pilot-Report-condensed.pdf

City of Waterloo (CW). (2016). *2016 water service rates.* Retrieved from: http://www.waterloo.ca/en/living/rates_water.asp

City of Waterloo (CW). (2015a). *Stats and Facts*. Retrieved from: http://www.waterloo.ca/en/business/statisticsandfacts.asp

City of Waterloo (CW). (2015b). *Water service rates 2015 chart.* Retrieved from: http://www.waterloo.ca/en/contentresources/resources/government/Water_services_rates_2015.xls.pdf

City of Waterloo [CW]. (2012). By Law NO.2012-125. Retrieved from: http://www.waterloo.ca/en/contentresources/resources/living/Waterloo_Stormwater_Rate_Bylaw.pdf

Corbett, D. (2010) Achieving sustainable stormwater management in Melbourne, Australia, as part of the journey to a water sensitive city. Retrieved from: http://documents.irevues.inist.fr/bitstream/handle/2042/35638/13101-015COR.pdf?sequence=1

Crabbe, P., & Robin, M. (2006) Institutional adaptation of water resource infrastructures to climate change in, Eastern Ontario. *Climate Change, 78*(1), 103–133. DOI: 10.1007/s10584-006-9087-5

Crabtree, B., & Miller, W. (1999). A template approach to text analysis: Developing and using codebooks. In B. Crabtree & W. Miller (Eds.), *Doing qualitative research* (163-177). Newbury Park, CA: Sage.

Credit Valley Conservation (CVC). (July, 2015). *Credit Valley Conservation's showcasing water innovation project.* Retrieved from: http://www.creditvalleyca.ca/wp-content/uploads/2015/07/SWICaseStudy_15July2015.pdf

Credit Valley Conservation [CVC]. (May 2008). *Credit river water management strategy update: Municipal stormwater financing study.* Retrieved from: http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/credit-river-water-management-strategy-update-municipal-stormwater-financing-study/

Creswell, J. (Eds.). (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Los Angeles: Sage.

Dentinho, T. (2010). Unsustainable cities, a tragedy of urban infrastructure. *Regional Science Policy & Practice, 3*(3), 231-248. DOI: 10.1111/j.1757-7802.2011.01039.x

Department of Energy and Environment (DOEE). (ND). *Stormwater credit trading program.* Retrieved from: http://doee.dc.gov/src

Eason, C. T. , Dixon, J. , Feeney, C. , van Roon, M. , Keenan, B. , & Craig, J. (2003). Providing incentives for low-impact development to become mainstream. Proceedings from *3rd South Pacific Conf. on Stormwater and Aquatic Resource Protection, Landcare Research, Auckland*. Retrieved from: http://www.landcareresearch.co.nz/publications/researchpubs/EasonE79.pdf

Edvardsen, M. (2011). Evaluations of local planning efforts: A simple test of policy implementation and corresponding results? In *Hull, A., Alexander, E.R., Khakee, A., &Woltjer, J (Eds.). Evaluation for participation and sustainability in planning,* (47-66). New York: Routledge.

Eriksen, S, & Lind, J. (2009). Adaptation as a political process: adjusting to drought and conflict in Kenya's Drylands. *Environmental Management, 43*(5), 817–835. DOI: 10.1007/s00267-008-9189-0

Expert Panel on Climate Change Adaptation [EPCCA]. (2009). *Adapting to climate change in Ontario: Towards the design and implementation of a strategy and action plan.* (PIBS 7300e). Queen's Printer for Ontario: Minister of the Environment. Retrieved from: http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std 01_079212.pdf

Federation of Canadian Municipalities [FCM]. (2007). *Danger ahead: The coming collapse of Canada's municipal infrastructure.* Retrieved from: https://www.fcm.ca/Documents/reports/Danger_Ahead_The_coming_collapse_of_Canadas_municipal_infrastructure_EN.pdf

Federation of Canadian Municipalities & National Research Council (FCM & NRC). (2005). *Conveyance and end-of-pipe measures for stormwater control.* Retrieved from: https://www.fcm.ca/Documents/reports/Infraguide/Conveyance_and_End_of_Pipe_Measures_for_Stormwater_Control_EN.pdf

Feltmate, B. (July 2013). Extreme weather? Why we should adapt. *Financial Post.* Retrieved from: http://business.financialpost.com/fp-comment/extreme-weather-why-we-should-adapt

Feltmate, B., & Thistlewaite., J. (July 29, 2013). Canada's real housing crisis: Extreme weather. *Globe and Mail*. Retrieved from: http://www.theglobeandmail.com/opinion/canadas-real-housing-crisis-extreme-weather/article13480928/

Fereday, J,, & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods, 5*(1), 80-92. Retrieved from: https://ejournals.library.ualberta.ca/index.php/IJQM/article/view/4411/3530

Fisheries Act, Revised Statutes of Canada. (1985, c. F-14 (Section 36)). Retrieved from the Justice Laws website: http://laws-lois.justice.gc.ca/Search/Search.aspx?txtS3archA11=deleterious+substance&txtT1tl3=%22Fisheries+Act%22&h1ts0n1y=0&ddC0nt3ntTyp3=Acts

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry, 12*(2), 219-245. DOI: 10.1177/1077800405284363

Foster, S. (2011). Collective action and the urban commons. *Notre Dame Law Review, 87*(1), 57+.

Godscalk, D. & Mills, W.E. (2007). A collaborative approach to planning through urban activities. *Journal of the American Institute of Planners, 32*(2), 86-95.

Gollan, N., and Corbett, N. (July 7, 2010). *Cities of Kitchener and Waterloo memorandum: Credit policy development – Memorandum 1.* Retrieved from: http://www.kitchener.ca/en/livinginkitchener/resources/SWCPFINALMemo1.pdf

Government of Ontario. (2011). *The partnership project: An Ontario government strategy to create a stronger partnership with the not-for profit sector.* Retrieved from: http://www.citizenship.gov.on.ca/images/pp/downloads/MCI_Partnership_Project_accessible_030211.pdf

Grand River Watershed (GRW). (2014). *Watershed management plan – executive summary*. Retrieved from: https://www.grandriver.ca/en/our-watershed/resources/Documents/WMP/Water_WMP_Plan_ExecutiveSummary.pdf

Green Communities Canada. (2016). *RAIN community services.* Retrieved from: http://www.raincommunitysolutions.ca/en/for-property-owners/rain-story/

Green Communities Canada. (N.D.) *Depave Paradise – why depave?* Retrieved from: http://www.depaveparadise.ca/why-depave.html

Green Communities Canada. (November, 2015). Soak it up! A toolkit of policies and programs for community-side implementation of green stormwater infrastructure [DRAFT]. Retrieved from: http://www.raincommunitysolutions.ca/en/toolkit/

Hackworth, J. (2007). *The Neoliberal City.* Ithaca: Cornell University Press.

Hamann, R. & April, K. (2013). On the role and capabilities of collaborative intermediary organisations in urban sustainability transitions. *Journal of Cleaner Production, 50*(1), 12-21. DOI:10.1016/j.jclepro.2012.11.017

Hardin, G. (1968). The tragedy of the commons. *Science, 162,* 1243-1248. DOI: 10.1126/science.162.3859.1243

Harvard Law School. (2014). *Regional and municipal stormwater management; A comprehensive approach.* Retrieved from: http://blogs.harvard.edu/environmentallawprogram/files/2014/07/Regional-Stormwater-paper_FINAL-6-19-14.pdf

Healey, P. (1998). Building institutional capacity through collaborative approaches to urban planning. *Environment and Planning, 30*(9), 1531-1546. Retrieved from: http://epn.sagepub.com/content/30/9/1531.abstract

Hendrickson, D.J. (2010). Community indicators and sustainable consumption a blended approach toward implementation. *Canadian Journal of Urban Research, 19*(1), 111-133. Retrieved from: http://connection.ebscohost.com/c/articles/96158560/community-indicators-sustainable-consumption-blended-approach-toward-implementation

Hudson, R. (2003). Fuzzy concepts and sloppy thinking: Reflections on recent developments in critical regional studies. *Regional Studies, 37*(6&7), 741-746. DOI: 10.1080/0034340032000108822

Kaplowitz , M. & Lupi, F. (2012). Stakeholder preferences for best management practices for non-point source pollution and stormwater control. *Landscape and Urban Planning, 104*, 364-372. DOI: 10.1016/j.landurbplan.2011.11.013

Keeley, M., Koburger , A., Dolowitz , D., Medearis, D., Nickel , D., & Shuster, W. (2013). Perspectives on the use of green infrastructure for stormwater management in Cleveland and Milwaukee. *Environmental Management, 51,* 1093-1108. DOI 10.1007/s00267-013-0032-x

Kemp, R., Loorbach, D., & Rotman, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development & World Ecology, 14*(1), 78-91. DOI: 10.1080/13504500709469709

Kessler, R. (2011). Stormwater strategies: Cities prepare aging infrastructure for climate change. *Environmental Health Perspectives, 119*(12), A514-A519. DOI: 10.1289/ehp.119-a514

Khakee, A. (1998). Evaluation and planning: Inseparable concepts. *The Town Planning Review, 69*(4), 359-374. Retrieved from: http://www.jstor.org/stable/40113511

Lagendijk, A. (2003). Towards conceptual quality in regional studies: The need for subtle critique – A response to Markusen. *Regional Studies, 37*(6&7), 719-727. DOI: 10.1080/0034340032000108804

Lindsey, G., & Doll, A. (1999). Financing retrofit projects: The role of stormwater utilities. In *Proceedings of the National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments.* Paper Presented at National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments. Chicago, pp. 113-118.

Long,T. & Johnson, M. (2000). Rigour, reliability and validity in qualitative research. *Clinical Effectiveness in Nursing*, *4*(1), pp. 30–37. DOI:10.1054/cein.2000.0106

Markusen, A. (2003). On conceptualization, evidence and impact: A response to Hudson, Lagendijk and Peck. *Regional Studies, 36*(6&7), pp. 747-751. DOI: 10.1080/0034340032000108831

Margerum, R. (2002). Collaborative planning: Building consensus and building a distinct model for practice. *Journal of Planning and Education, 21*(3), 237-253.

Matthews, T., Lo, A., & Byrne, J. (2015). Reconceptualizing green infrastructure for climate change adaptation: Barriers to adoption and drivers for uptake by spatial planners. *Landscape and Urban Planning 138*, 155-163. DOI: 10.1016/j.landurbplan.2015.02.010

Mills, A., Durepos, G., & Wiebe, E. (2010). Coding: Open Coding. *Encyclopedia of Case Study Research*. DOI: http://dx.doi.org.proxy.lib.uwaterloo.ca/10.4135/9781412957397.n55 Print pages: 156-158

Mills, M. (2010). Exploring the adoption of low-impact development in Atlantic Canadian municipalities. (Master's of Landscape Architecture thesis, University of Guelph, Guelph, Ontario). Retrieved from: http://las.sinica.edu.tw:1085/search~S0?/d0639/d++++0639/47%2C-1%2C0%2CE/frameset&FF=d++++0768&617%2C%2C1496

Moglia, M., Cook, S., Sharma, A.K., & Burn, S. (2010). Assessing decentralised water solutions: Towards a framework for adaptive learning, *Water Resources Management, 25*(1), 217-238. DOI: 10.1007/s11269-010-9696-7

Morison, P. & Brown, R. (2011). Understanding the nature of publics and local policy commitment to Water Sensitive Urban Design. *Landscape and Urban Planning, 99*(2), 83-92. doi:10.1016/j.landurbplan.2010.08.019

Moser, S.C., & Ekstrom, J.A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceeding of the National Academy of Sciences of the United States of America, 107*(51), DOI: 107:22026–22031

Murphy, G. (May 2011). City of Kitchener Staff Report on Community and Infrastructure Services Committee. Retrieved from: http://www.kitchener.ca/en/livinginkitchener/resources/SWCPAppendixK1-6.pdf

Neiswender, C. & Shepard, R. (2010). Elements of successful stormwater outreach and education. Retrieved from: http://webapp1.dlib.indiana.edu/virtual_disk_library/index.cgi/5573229/FID1518/Papers%20508%20Accessible/25Neiswender.pdf

O'Neil, J. (2016). Incenting Green Infrastructure for Stormwater Management. Retrieved from: http://www.raincommunitysolutions.ca/en/news/

Olorunkiya, J., Fassman, E., & Wilkinson, S. (2012). Risk: A fundamental barrier to the implementation of low impact design infrastructure for urban stormwater control. *Journal of Sustainable Development, 5*(9), 27-41. Retrieved from http://search.proquest.com.proxy.lib.uwaterloo.ca/docview/1039111093?accountid=14906

Ontario Ministry of the Environment. (2003). *Stormwater management planning and design manual 2003.* Ontario Ministry of the Environment. Toronto, Ontario.

Ontario Ministry of Municipal Affairs and Housing. (2002). *Oak Ridges Moraine Conservation Plan*. Queen's Printer for Ontario.

Parikh, P., Taylor, M., Hoagland, T., Thurston, H., & Shuster, W. (2005). Application of market mechanisms and incentives to reduce stormwater runoff: An integrated hydrologic, economic and legal approach. *Environmental Science and Policy, 8*(2), 133-144. Retrieved from: https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=104866

Parker, P., & Johansson, M. (2012). Challenges and potentials in collaborative management of urban commons. In Modic, D., Valic, T.B., Lamut, Rinzivillo, U., Renaud, C., Basov, N., Nenko, A., Molan, M., Kotar, D.P., Kovacic, A., (Eds.) *Multi-faceted nature of collaboration in the contemporary world* (92–113). Vega Press, Ltd. Retrieved from http://dspace.mah.se/handle/2043/14619

Peck, J. (2003). Fuzzy old world: A response to Markusen. *Regional Studies, 37*(6&7), 729-740. DOI: 10.1080/0034340032000108813

Pesch, U. (2015). Tracing discursive space: Agency and change in sustainability transitions. *Technological Forecasting and Social Change, 90*, 378-388. DOI: 10.1016/j.techfore.2014.05.009

Peters, D., Adam, T., Alonge, O., Agyepong, I., & Tran, N. (November, 2013). Implementation Research: What it is and how to do it. *British Medical Journal,* 347. DOI: 10.1136/bmj.f6753

Pitt, D. (2010). The impact of internal and external characteristics on the adoption of climate mitigation policies by US municipalities. *Environment and Planning C: Government and Policy, 28*(5), 851–871. DOI:10.1068/c09175

Pitt, D. & Bassett, E. (2013). Collaborative planning for clean energy initiatives in small to mid-sized cities. *Journal of the American Planning Association, 79*(4), 280-294. DOI: 10.1080/01944363.2014.914846

Places to Grow Act, Ontario Laws. (2005, S.O., c. 13). Retrieved from the Government of Ontario Website: https://www.ontario.ca/laws/statute/05p13

Porter-Bopp, S., Brandes, O., Sandborn, C., University of Victoria Environmental Law Centre, POLIS Project on Ecological Governance, & Canadian Electronic Library. (2011). *Peeling back the pavement: a blueprint for reinventing rainwater management in Canada's communities.* Retrieved from: http://books.scholarsportal.info/viewdoc.html?id=413105

Pyzoha, D. (1994). *Implementing a stormwater management program.* Boca Raton: CRC Press Inc.

RAIN. (September, 2014). *Showcasing Water Innovation Case Study.* Retrieved from: http://reepgreen.ca/wp-content/uploads/2014/09/RAIN_SWI_CaseStudy.pdf

Rauch, W., Seggelke, K., Brown, R. & Krebs, P. (2005). Integrated approaches in urban storm drainage: where do we stand? *Environmental Management, 35*(4), 396–409. DOI: 10.1007/s00267-003-0114-2

Reddy, S. & Painuly, J.P. (2004). Diffusion of renewable energy technologies— barriers and stakeholders' perspectives. *Renewable Energy, 29*, 1431–1447. DOI: 10.1016/j.renene.2003.12.003

Reigner, H. (2016). Neoliberal rationality and neohygienist morality. A Foucauldian analysis of safe and sustainable urban transport policies in France. *Territory, Politics, Governance, 4*(2), 196–215. DOI: http://dx.doi.org/10.1080/21622671.2015.1123647

Rossi, P., Lipsey, M.W., and Freeman, H.E. (2004). *Evaluation, a systematic approach* (7th ed.). Thousand Oaks, CA: Sage.

Roy, A., Wenger, S., Fletcher, T., Walsh, C., Ladson, A., Shuster, W., Thurston, H., & Brown, R. (2008). Impediments and Solutions to Sustainable, Watershed-Scale Urban Stormwater Management: Lessons from Australia and the United States. *Environmental Management 42*(2), 344-359. DOI: 10.1007/ s00267-008-9119-1.

Seasons, M. (2003). Monitoring and evaluation in municipal planning: Considering the realities. *Journal of the American Planning Association, 69*(4), pp. 430-440. DOI:10.1080/01944360308976329

Shuster, W., Morrson, M., & Webb, R. (2008). Front-loading urban stormwater management for success – a perspective incorporating current studies on the implementation of retrofit low-impact development. *Cities and the Environment, 1*(2), 1-15. Retrieved from: http://digitalcommons.lmu.edu/cgi/viewcontent.cgi?article=1012&context=cate

Stavins, R.N. (2001). Experience with market-based environmental policy instruments resources for the future. (Discussion Paper 01-58). Retrieved from: http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-01-58.pdf [From Parikh et. al, 2005].

Steinhilber, S., Wells, P., & Thankappan, S. (2013). Socio-technical inertia: Understanding the barriers to electric vehicles. *Energy Policy, 60*, 531-539. DOI: 10.1016/j.enpol.2013.04.076

Talen, E. (1996). After the plans: Methods to evaluate the implementation success of plans. Journal of Planning *Education and Research, 16*(79), 79-91. DOI: 10.1177/0739456X9601600201

The Record (February, 2011). *Stormwater User Fee Impacts Budget Talks*. Retrieved from: http://www.therecord.com/news-story/2574884-storm-water-user-fee-impact-budget-talks/

The Weather Network. (2016). *Historical Precipitation Data.* Retrieved from: http://www.theweathernetwork.com/forecasts/statistics/precipitation/cl6147188/caon0728

Thorne, C.R., Lawson, E.C., Ozawa, C., Hamlin, S.L., & Smith, L.A. (2015). Overcoming uncertainty and barriers to adoption of blue-green infrastructure for urban flood risk management. *Journal of Flood Risk Management,* 1-13. DOI: 10.1111/jfr3.12218

Thurston, H. (2012). *Economic incentives for stormwater control*. Boca Raton, FL: CRC Press.

Town of Milton. (ND). *Development Charges*. Retrieved from: https://www.milton.ca/en/build/developmentcharges.asp

TSH & CDM. (2009). *Kitchener Waterloo Stormwater Management Program and Funding Review DRAFT FINAL REPORT: Stormwater Funding Analysis.* Retrieved from : http://www.waterloo.ca/en/contentresources/resources/living/stormwater_report_feasiblity_study.pdf

United States Environmental Protection Agency New England [USEPANE]. (April, 2009). *Funding Stormwater Programs.* Retrieved from: http://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf

Water Environment Research Foundation. (2009). Portland, Oregon building a nationally recognized program through innovation and research. Retrieved from:

https://www.werf.org/liveablecommunities/studies_port_or.htm : Portland, Oregon Building a Nationally Recognized Program Through Innovation and Research

Waterloo Region Record, (May 11, 2015). Waterloo reports surplus of almost 1 million. Retrieved from: http://www.therecord.com/news-story/5612811-waterloo-reports-surplus-of-almost-1-million/

Wheater, H., & Evans, E. (2009). Land use, water management and future flood risk. *Land Use Policy, 26,* S251-S264. DOI: 10.1016/j.landusepol.2009.08.019

Wong, T., & Brown, R. (2008). Transitioning to water sensitive cities: Ensuring resilience through a new hydro-social contract. *Proceedings from the 11th International Conference on Urban Drainage*. Edinburgh, Scotland: UK. Retrieved from: https://web.sbe.hw.ac.uk/staffprofiles/bdgsa/11th_International_Conference_on_Urban_Drainage_CD/ICUD08/pdfs/638.pdf

Yin, R. (2003). *Applications of case study research.* Newbury Park, CA: Sage.

Yin, R. (2009). *Case study research: Design and methods.* Thousand Oaks, California: Sage.

Appendix A – Calculating SCP Participation Rates

The number of SCP participants in each ward was provided by each city. The total number of SCP eligible residential properties in each ward was provided by the City of Kitchener. To obtain these numbers for the City of Waterloo, the property categories, outlined in the table below, were identified for each ward. Property parcel shape files were then overlaid with the below zoning codes, and the number of 'Residential' properties in each ward was identified.

Table 4: Waterloo Property Points Contained in 'Eligible Residential Properties'

1	Duplex
2	Freehold townhouse/ rowhouse
3	Link Home
4	More than one structure used for residential purposes with at least one of the structures occupied permanently
5	Residential common elements condominium
6	Residential condominium
7	Residential Property with 3 self-contained units
8	Residential Property with 4 self-contained units
9	Residential Property with 5 self-contained units
10	Residential Property with 6 self-contained units
11	Row housing with 3-6 units under single ownership
12	Semi-detached residential
13	Semi- detached with both units under one ownership
14	Single family detached not on water
15	Single family detached on water
16	Townhouse block freehold units

Appendix B – Socioeconomic, Demographic, and Geographic Features of Municipal Wards

Socioeconomic, demographic, and geographic features of municipal Wards used to identify program bias as an experimental control when compared to SCP participation rates. Sources of data included.

Table 5: Characteristics Used to Assess Program Bias

Data Used	Source
Number of participants in the SCP in each municipal ward	Cities of Kitchener and Waterloo
Number of residential properties in each municipal ward	University of Waterloo GIS Map databases. Overlay of 3 maps: a) Municipal Wards b) Property Parcels c) Municipal Zoning
The division of SCP applications based on method of sustainable used	Cities of Kitchener and Waterloo
Total Area of each municipal ward	University of Waterloo GIS Maps databases, Municipal Ward Map
% of each municipal ward covered by flood plains	University of Waterloo GIS Map databases, overlay of: a) Municipal Wards b) Floodplain Coverage
% of each municipal ward covered by Natural Area	University of Waterloo GIS Map databases, overlay of: a) Municipal Wards b) Natural Area Cover
% of Population in each of the 3 age brackets: a) 0-29 b) 30-59 c) 60+	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Total Number of Economic Families By Ward	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Average Family Income (Economic Family)	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
% of ward that is low income before taxes	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.households
Unemployment Rate	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
% of the following occupations in each ward a) Management b) Business and finance c) Natural and Applied Sciences d) Health e) Arts, culture, and recreation f) Sales and service occupations g) Trades, transport, and equipment,	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Primary mode of transportation by ward a) Car/truck/van driver b) Car/truck/van passenger c) Public transit d) Walking	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.

e) Bicycle f) Motorcycle g) Taxi h) Other method	
Educational Attainment by ward a) No certificate, diploma, or degree b) Certificate, diploma, or degree c) High school certificate or equivalent d) Apprenticeship, trade certificate, or diploma e) College of CEGEP or other non-university certificate f) University certificate, diploma, or degree g) University certificate or diploma above a bachelor level	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Language most spoken at home a) English b) French c) Non-official	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Immigration Status a) Non-immigrant b) Immigrant	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Average # of Kids at home per census family	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
Average number of bedrooms per dwelling	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
% of occupied private dwellings that are: a) Owned b) Rented	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
% of private occupied dwellings that require a) Minor repairs b) Major repairs	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.
% of occupied private dwellings built from 1996-2000	University of Waterloo GIS Map databases (Municipal Ward Map) overlaid with Census Canada Demographic Data*.

**Note: Census Canada data is divided into census tracts. These do not alight perfectly with municipal ward boundaries. In order to compare data between wards, census Canada data tract data was averaged; when tracts were in two municipal wards, averages were weighted based on the percentage of the tract that fell within each ward.*

Appendix C – Councilor Survey

Letter of Information

Dear [Address to specific Municipal Councillor],

This letter is to inform you about this academic study regarding the implementation of the Residential Storm water Credit Program in Kitchener and Waterloo. This study is being conducted as a Master's Thesis project under the Department of Planning, at the University of Waterloo and is receiving national funding from the Social Sciences and Humanities Research Council of Canada. This project is under the supervision of Dr. Luna Khirfan (lkhirfan@uwaterloo.ca) and will be conducted by myself, Masters student, Alexandra Lavasidis. Your experiences with the **Stormwater Credit Program** as a Municipal Councillor are important to this study. Thus, I would greatly appreciate your participation.

Participation in this study is voluntary and would involve 5-minute questionnaire that is attached to this document (scroll down). The choice to participate or not in the study will **not** be shared with your employer or the public. There is minimal risk involved in your participation in this study, as your responses will never be published; instead, the general trends of all councillors' answers will be compared to the participation rates in the Stormwater Credit Program and these generalised results will be published in my thesis. **Your answers will remain confidential**. The purpose of this research is to identify strengths in the program's implementation and to suggest areas for improvement should other municipalities attempt a similar program, so being open with areas for improvement is critical to the research. The results of this study will be shared in a Master's thesis, and may be shared in reports, presentations, and/or publication, which will be shared with the academic community, municipalities, and NGOs both within and outside of Kitchener and Waterloo. The intention of this research is to aid municipalities in implementing successful sustainable stormwater management programs by learning from the experiences of Kitchener and Waterloo, and from other outreach programs. To minimize any minimal risk to individuals, **your name will never be published, and your answers will remain confidential, being quoted as 'a city councilor'**. You may decline answering any questions you feel you do not wish to answer. The full questionnaire is attached at the bottom of this letter.

Only researchers associated with this study will have access to the password protected study records. We will keep your data for a minimum of **2** years. You can withdraw your consent to participate and ask that your data be destroyed by contacting one of the researchers within this time period. It is not possible to withdraw your consent once papers and publications have been submitted to publishers. All data will be destroyed according to University of Waterloo policy.

If after receiving this letter, you have any questions about this study, would like additional information to assist you in reaching a decision about participation, or would like to book an interview time, please feel free to contact myself, Alexandra Lavasidis, at alavasid@uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

Thank you kindly for your assistance with this project. I am excited to hear about your experiences.

Yours sincerely,

Alexandra Lavasidis
Student Investigator- (Candidate) Masters in Planning

CONSENT FORM

I agree to participate in an interview being conducted by Alexandra Lavasidis of the Department of Planning under the supervision of Professor Luna Khirfan. I have made this decision based on the information I have received in the Information Letter and have had the opportunity to receive any additional details I wanted about the study. As a participant in this study, I realize that I will be asked to take part in an approximately 5 minute questionnaire and that I may decline answering any of the questions, or stop the questionnaire at any time if I so choose. I understand that the information I provide will not be attributed to my name in any publications resulting from this research; instead, any quotations will be attributed to 'a municipal councillor in [Kitchener or Waterloo]'. The results of this study will be shared in a Master's thesis, and may be shared in reports, presentations, and/or publication, which will be shared with the academic community, municipalities, and NGOs both within and outside of Kitchener and Waterloo. The intention of this research is to aid municipalities in implementing successful sustainable stormwater management programs by learning from the experiences of Kitchener and Waterloo, and from other outreach programs. I understand that there is minimal anticipated risk to participants in this study. I understand that I may withdraw this consent at any time by stopping the questionnaire. I understand that if I would like a copy of the final report, or I have any further questions I can contact the Student Investigator at alavasid@uwaterloo.ca.

I acknowledge that this project has been reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee and that I may contact this office at 519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca if I have any comments or concerns about my participation in this study.

By signing this consent form, you are **not** waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

I agree to the use of quotations in any thesis or publication that comes of this research that maintains confidentiality of my identity, e.g. being quoted as "a city councilor", not by name or ward.

☐YES ☐NO

Participant's Name: _____

Participant's Signature: _____

Name of Witness: _____

Signature of Witness: _____

Date: _____

Questionnaire

Kitchener and Waterloo have implemented a Stormwater Credit Programs and Stormwater rate charges in recent years in an effort to promote sustainable stormwater management on private residential property, and to reduce stress on the aging municipal stormwater system. This questionnaire on your experience with the Stormwater Credit Program has 3 questions and should take about 5 minutes. You can stop the questionnaire at any time, decline to answer questions, and ask for clarification at any time. Please review and sign the consent form above, complete the three questions below, and send this document back to alavasid@uwaterloo.ca. If you

have any questions or would like to receive the final report, please email alavasid@uwaterloo.ca. I thank you for your participation in my Masters in Urban Planning thesis research.

1) Compared to your colleagues on municipal council, how did you promote the Stormwater Credit Program in your ward? **(Choose ONE)**

a. Not at all
b. Less than my colleagues did in their ward
c. About the same as my colleagues
d. Slightly more than my colleagues
e. Much more than my colleagues
f. Other groups provided outreach and information; I did not need to
g. Other: (list)_____

2) How did you promote the Stormwater Credit Program in your ward? (Please list or describe)
3) Do you have any additional comments on the Stormwater Credit Program, Stormwater Rate Charge, or the implementation of either in your municipality?

Thank you for participating in this questionnaire! Please email this questionnaire and the completed consent form (above) to alavasid@uwaterloo.ca.

Appendix D – Participation Rates By Ward

Table 6: Kitchener and Waterloo SCP Participation Rates by Ward

Kitchener		Waterloo	
Ward	Participation Rate	Ward	Participation Rate
Ward 1	7.9	Ward 1	4.3
Ward 2	5.7	Ward 2	4.0
Ward 3	14.0	Ward 3	4.4
Ward 4	12.5	Ward 4	6.7
Ward 5	11.8	Ward 5	6.1
Ward 6	5.9	Ward 6	4.6
Ward 7	3.8	Ward 7	5.0
Ward 8	6.8	Average	5.1
Ward 9	5.9		
Ward 10	6.4		
Average	7.8		

Participation rates were slightly higher in Kitchener (7.8% average) than in Waterloo (5.1% average). This difference in participation rates between cities is reflected in the funding difference; Kitchener provided significantly more funding than waterloo throughout the SCP outreach process; as such, Kitchener received more outreach services than Waterloo (R1). The distribution of participation rates between wards is more uniform in Waterloo than in Kitchener; In Waterloo, the range of participation rates by ward is a narrow 4%-6.7%, whereas in Kitchener the range is much larger at 3.8% to 14%. This is likely because some wards in Kitchener had a high number of properties built with infiltration galleries already installed.

Appendix E – Code Book

Table 7: Code Book

	Code Book	
	Focused Code	**Secondary Codes**
1a	**Goals**	Clear
1b		Unclear
1c		goal setting
1d		common goals
2a	**Partnerships/ networks**	cross-issue coordinating
2b		community champions
		looking up
		suggestions
3a	**Barriers**	COST / low incentive
3b		Installation
3c		Time/Application
3d		unengaged
3e		Rules/regulations
		lack of knowledge
3f		solution
4a	**Engagement Methods**	successful
4b		unseccessful
4c		suggested
4d		continuous
4e		targeting (vs broad approach)
4f		Demo Projects
		why engage
5a	**WHO participates**	early adopters
5b		environmentalists
5c		directly impaccted by swm
5d		who doesn't participate
5e	**Education**	of community
5f		of municips/reep
		of contractors/industry
6a	**Strategy**	Phase in/no phase in
6b		Expert Pannel
6c		Legislation
6e		Community Based Social Marketing
6f		Roles/Responsibilities
6g		fairness and equity
6h		Creatng Demand
		who si invloved in forming strategy?
		Market Strategy (Kitchener Report)
6i		Non-rez vs rez
7	**Bottom up/ community led**	
8	**Communication (or messaging)**	
9	**Media**	
10	**Politics**	
11	**Beauty/Aesthetics**	this should go under barriers
12	**Contractors/ industry**	
13	**Data Collection/Monitoring/evaluati**	includes followup; overall can be tied to GOALS/goal
14	**Trust**	this should go under barriers
15	**Risk and Uncertainty**	this should go under barriers
16	**Dealing with pushback**	
17	**Long time frame/slow process of change**	
18	**Suggestions from Experts**	should probably go under "strategy"
19	**Docs to read**	
20	**Kitchener vs Waterloo**	under 'strategy'?
21	**Timeline**	
22	**Depave Strategy Only**	
23	**External impacts**	
24	**tragedy of the commons**	
25	**TYPE of SWM**	
26	**ST Transitions**	norms
27	**Suggestion**	Market Strategy

Appendix F - Residential Outreach Timeline

The timeline below outlines most SCP and Utility Fee residential outreach activities and SCP related events that took place in both Kitchener and Waterloo. This timeline was compiled with information from reports provided by REEP, Kitchener, and Waterloo, through a media scan, and through interviews with stormwater experts in both Kitchener and Waterloo. The majority of residential outreach occurred from 2011-2013, with a shift in focus to non-residential outreach in 2013. REEP continues to promote stormwater management activities for the residential sector that are carried out by community groups and the regional government (such as rain barrel sales).

- **2004-2009**
  - Stormwater Management and Funding Program Review to determine how to deliver a sustainable level of service related to stormwater management infrastructure (joint approach between Kitchener and Waterloo);
- **April 2010**
  - Ecological History and Stormwater Walk through Victoria Park
- **June 2010**
  - June 14, Kitchener Council approves the Stormwater Utility
  - June 21, Waterloo Council approves the Stormwater Utility (Waterloo's Fee is less than half than that of Kitchener)
  - Kitchener Councillors approve report on the implementation of the 13 million/year stormwater utility; only Councillor John Gazzola in Ward 3 votes against the staff recommendations to approve the fee
  - Councillor John Gazzola writes an editorial in the local paper against the stormwater utility fee
- **January 1 2011:**
  - Utility Fee begins in Kitchener and Waterloo
    - Waterloo begins phase-in of fee, at 25% of the eventual Utility rate, to increase another 20% each year over 4 years
    - Utility Bill Inserts sent to all property owners to let them know about the fee
- **March 2011**
  - City of Kitchener staff gives stormwater management report to Kitchener City Council
- **July 2011**
  - Stormwater Education Session at the REEP House (Kitchener Ward 9)
- **September 2011**
  - Stormwater Credit Public Consultations begin in Kitchener
  - Kitchener Info Session on potential SCP
- **October 2011**
  - Stormwater Credit Public Consultations begin in Waterloo
  - Stormwater Public Info Session at RIM Park
- **November 2011**
  - Kitchener unveils proposed SCP framework
  - Kitchener holds public meeting on the potential SCP
- **December 2011**
  - Waterloo holds public meeting on the potential SCP
  - Last month for public input on potential stormwater credit in both Kitchener and Waterloo
- **February 2012**
  - Waterloo Council unanimously approves the SCP

- **March 2012**
  - Showcasing Water Innovation (Provincial) Grant provides the RAIN program with 1,000,000 over 2.5 years
- **April 2012:**
  - Expert Panel created, includes 6 'experts' from various sectors; meetings are held monthly to steer the SCP and monitor and adjust the utility charges; Sectors represented on the panel are:
    - Civil engineering (SWM)
    - Civil engineering (permeable paving)
    - Watershed planning (with LID retrofit expertise)
    - Landscape architecture
    - Landscape installation
    - Alternative SWM/LID
    - Academia
  - RAIN Program Launch: Launched crowd sourced video, opening ceremonies with local politicians, some media and crowd source video (15 people engaged)
  - Organic Home Gardening Show Booth Outreach (20 people)
  - Kitchener Earth Day event at Huron Natural Area (250)
- **May 2012**
  - Animate the Trail Booth (50)
- **June 2012**
  - Eco Fest Booth (100)
  - KPL booth and outreach event (19)
  - Westvale Community Association Event Booth and Mini Presentation (Waterloo Ward 1) (100)
- **July 2012**
  - Cherry Park Festival (Kitchener Ward 9) (100)
  - Rain barrel sale online (130 people engaged)
  - Realtor water focus group (3)
- **August 2012**
  - Waterloo Public Library Booth and mini presentation (20)
  - Call goes out for Stormwater Demonstration Project Partners
  - Two REEP students knocked on 768 doors in 3 target neighbourhoods in Kitchener and 1 in Waterloo to talk to home owners about stormwater management (Central Frederick (Kitchener Ward 10), Cherry Park (Kitchener Ward 9), Belmont Village (Kitchener Ward 8) and Mary-Allen (Waterloo Ward 7)
- **September 2012**
  - RAIN thank you event (8)
  - Kitchener in Bloom Event (22)
  - Doors Open Waterloo Region (266)
  - KPL water talk (20)
  - Central Frederick Garden Festival (Kitchener Ward 10) (42)
  - Waterloo tree planting event- booth (20)
  - Victoria Park Sustainability Event booth (49)
- **October 2012**
  - Kitchener Makes Online and Paper SCP application Available
  - Utility bill Inserts to inform all residents in Kitchener about the SCP/Utility Charge (from **http://www.trca.on.ca/dotAsset/180005.pdf)**

- Kitchener councillor Yvonne Fernandes discusses stormwater credits at Kitchener library October 12, 2012
- Native Tree Planting and Stormwater Management workshop at the REEP house

- **November 2012**
- Stormwater Study Focus Group (9)
- The Museum – Exhibit (42)
- Local Film Festival: video and logo shown before movies (291)
- RAIN Jeopardy at the Kitchener Public Library and Grand River Library

- **January 2013**
- SCP launches in Waterloo on January 1, 2013; credit rate to be phased in over 4 years (full credit potential, 45%, to be achievable by 2016)

- **March 2013**
- Utility Bill Inserts sent out to property owners about the stormwater utility rate and the SCP (In both Kitchener and Waterloo, From February to March)
- Last month for Kitchener Property owners to apply for retroactive credits (back until January 2011)
- KW home and Garden Show – Information and help filling out SCP applications (430)
- Open House at REEP to learn about types of sustainable stormwater management

- **April 2013**
- Waterloo Rain Barrel Sale (1100 people)- SOLD ALMOST 1300 rain barrels
- Stormwater Saturdays (75)
- Kitchener Earth Day Celebrations (20)
- Kitchener City Staff available at the Market to discuss stormwater management

- **May 2013**
- City of Waterloo Earth Day activities (25)
- (Summer 2013) Local Service Provider List Now Online at REEP website/SLOWRAIN
- Waterloo City Staff available at the Uptown Library to discuss stormwater management
- Toronto experiences Major Flooding along the Don Valley: REEP uses the Don Valley Flooding incident to promote better stormwater management

- **June 2013**
- June-July 2013: 748 people engaged (533 in Kitchener and 200 in waterloo)
  - Neighbourhoods targeted through door to door RAIN outreach:
  - Mary Allen (Waterloo Ward 7) - June 2013
  - Old Westmount Waterloo (Waterloo Ward 7) – June and July 2013
  - Old Westmount Kitchener (Kitchener Ward 8) – June and July 2013
  - Central Frederick (Kitchener Ward 10)– June 2013
  - Belmont (Kitchener Ward 8) – June 2013
- Permeable Paving and Underground Cistern Workshop
- Rain Garden and Cistern Workshops (22-66)
- Region of Waterloo Eco-Fest (175)
- Animate the Trail Event (35)
- KW Multicultural Fest booth (285)
- Chamber of Commerce Environmental Expo Kitchener (booth) (150)
- St Johns Water Festival- St John the Evangelist Church Demo Project Completion (60) (Kitchener Ward 10)
- REEP uses Kitchener flooding to promote better stormwater management (on social media)
- Calgary Flooding takes over the national news
- Flooding in parts of Kitchener and Waterloo, reported in local papers

- **July 2013**
  - Kitchener Collegiate Institute Demo Project Completion (Kitchener Ward 9)
  - Latin Fest Waterloo, booth (96)
  - Aboriginal Student Center Garden Opening- Demo Project (Waterloo Ward 7) (60)
  - Rain Garden and Cistern Workshops (22-44)
  - REEP presents at Doors Open Waterloo
  - Uptown Waterloo Market Booth (15)
  - Neighbourhoods targeted through door to door RAIN outreach:
    - Cherry Park (Kitchener Ward 9) – July 2013

- **August 2013**
  - Open Streets Waterloo (48)
  - KW Newcomers group talk (15)
  - Breithaupt-Mount Hope Neighbourhood Association Street Party – materials handed out (10)
- **September 2013**
  - Waterloo north Doors Open booth (112)
  - Frederick Community Garden party booth (Kitchener Ward 10) (24)
  - 5 Contactor Training Workshops in the fall of 2013: Topics include rainwater harvesting, infiltration galleries (x2), rain gardens, and permeable paving
- **October 2013**
  - Weber Park Demo Project and Rainwater Harvesting/Infiltration Gallery Workshop (together) (Kitchener Ward 10) (17)
  - Planter Box Rain Garden Workshop (only 4)
  - RAIN Certified Water Guides completed about 230 home visits between June and October 2013, showing residents how to manage the rain that falls on their property, and qualify for stormwater credits
  - Kitchener Collegiate Institute Water Project Opening (29) (Kitchener Ward 9)
  - Central Frederick Community Garden rainwater harvesting- Demo Project (Kitchener Ward 10)
  - Waterloo lifts SCP application fee (250) for non-residential and multi-residential properties
- **November 2013**
  - REEP meeting with the Kitchener Horticultural Society and Rockway Gardens Board to promote the SCP
  - Rain Barrel Workshop (15)
  - Ontario Government decides that school boards are exempt from paying stormwater utility charges
- **December 2013**
  - Educational Workshop on Stormwater Management in Region of Waterloo Council Chambers (for entire Region) (25)
- **January 2014**
  - Kitchener Councillors discuss stormwater infrastructure and environmental impact during budget talks
  - Kitchener Council votes 6-5 in favour of increase to the stormwater management rate
- February 2014
  - REEP attends annual seed exchange to talk with people about SCP
- March 2014
  - Utility Bill Inserts sent out to property owners about the stormwater utility rate and the SCP (In both Kitchener and Waterloo, From February to March)
- **November 2014**

- RAIN community awards
- Flooding in Kitchener (November 24th)

- **December 2014**
- Business visit educational workshops (note that these spread the word to the employees too!)

- **January 2015**
- Public engagement session about "Planning around Rapid Transit Central Stations in Kitchener" (includes discussion on stormwater management)
- RAIN Expert Panels Continue to meet monthly
- Kitchener Council votes to increase stormwater rate by 3%

- **March 2015**
- Utility Bill Inserts sent out to property owners about the stormwater utility rate and the SCP (In both Kitchener and Waterloo, From February to March)
- Spring thaw flooding in at a Waterloo food bank (March 11)
- REEP hosts 'Stormwater Saturdays' where residents of Kitchener and Waterloo can meet with city reps to get help with their SCP applications
- Tour and walk of Wilfred Laurier campus includes discussion of stormwater management
- Innovations in Stormwater Management Talk at UW

- **June 2015**
- Stormwater Master Plan public info session, Kitchener
- Rain barrel sale - 20 for Waterloo residents if pre-ordered, 40 for Kitchener/Cambridge residents the day of (over 700 sold)
- Kitchener now offers stormwater category for their "InBloom" garden recognition program
- Walk through Victoria Park to celebrate the end of the stormwater project
- Info Session in Kitchener on Stormwater Management

- **July 2015**
- Kitchener online stormwater survey begins; Kitchener seeks public input for Stormwater Master Plan

- **August 2015**
- Rain Garden Party/Workshop: Learn how to create a rain garden and apply for the SCP at the REEP house

- **November 2015**
- RAIN Community Awards

- **January 2016**
- Kitchener finance committee vote 7 to 4 to approve 9.2% Stormwater Rate increase

- Scheduled 2016
- Integrated Stormwater Management Master Plan (ISWM-MP) currently being completed as a Schedule B Municipal Class EA. This plan will serve as a decision support tool, methodology for the prioritization of works, and a transparent community process through which Kitchener can establish stormwater management guidelines and policies for the next 15 years. Ultimate goal of the Master Plan is to protect rivers, streams, and ground water (all sources of drinking water).

Appendix G - Standout Engagement Methods

Multiple methods were used to reach out to and engage the public in the SCP and promote sustainable installation in each city. A 2013 report on Kitchener and Waterloo's stormwater programs found that people engaged in RAIN program (REEP) outreach events were more likely to change their behaviour and make physical changes to improve stormwater management on their property, especially: emptying rain barrels more often; installing more rain barrels; apply for stormwater credits; and spending money on materials and contractors to make physical changes to their property (CK, CW, & RGS, 2013). The chart below highlights the standout methods for engaging people in sustainable stormwater management, indicated by experts from Kitchener, Waterloo, and REEP. An understanding of the main methods of engagement carried out in Kitchener and Waterloo is necessary for determining an effective overall strategy for engaging residents in the installation of sustainable stormwater management and SCP participation.

Table 8: Engagement Methods

Engagement Method	Description of experience in Kitchener and Waterloo
Batch Letters	Kitchener knew that some properties had stormwater controls already installed because of either zoning requirements (for infiltration galleries) or participation in regional rain barrel sales (data provided by the Region of Waterloo) (K1). Sending targeted letters out to these groups to let them know about the SCP resulted in a higher participation by these groups, as can be noted by the comparatively high levels of infiltration galleries in the SCP in Kitchener compared to Waterloo (K1).
Rain Barrel Sales	The City of Waterloo held rain barrel sales periodically. At these sales, rain barrels were 20 for people from Waterloo who pre-order online and 40 for people outside the city that show up the day-of. Advertising for these sales consisted of getting the word out to REEP and city networks through social media and newsletters. For one sale, REEP purchased a 50 Facebook add; the add received over 36,000 views and the rain barrels sold out in one weekend. Selling rain barrels for such a cheap price helps to reduce the cost barrier to sustainable stormwater management. K1 noted that although many people who bought rain barrels did not apply for the SCP, they are just happy to know the controls are out in the community. Another strategy for rain barrel sales that proved effective to raise engagement levels was to form a partnership with a local charity. On April 27, 2013, close to 13000 rain barrels were sold by the region; 10 from every 50 barrel sold went to a partner charity. This helped engage people who were in the charity's network (CK, CW, & RGS, 2013).
Workshops	REEP ran multiple workshops to teach both community members and contractors about sustainable stormwater management. REEP found workshops to be beneficial because they allowed people to "get their hands dirty", which made engaging people in the workshops easier and resulted in a multiplier effect (R2). Workshops also made attracting media coverage easier, as there were actions that could be filmed and photographed that were more exciting than a simple PowerPoint presentation (R2). R2 provided two suggestions when asked which types of workshops a city should promote if they are being selective with their workshop offerings. The first suggestion was to focus on rain garden workshops, as those engage gardeners, who were a key target group for engagement in Kitchener and Waterloo. The second suggestion was to partner with large institutions for workshops; REEP partnered with Laurier University for one of their workshops and this drew out a large and diverse crowd that REEP did not typically contact.

	Workshops with contractors were key to ensuring local contractors had the knowledge to provide stormwater services, like rain garden and cistern installation. REEP said that it was very important to identify champions within the industry to lead the way in industry education on sustainable stormwater management. These champions were instrumental in getting the attention of their peers onto sustainable stormwater management, and also to providing their services to the community. Another use for workshops was to train volunteers (CK, CW, & RGS, 2013). In 2013, REEP held a workshop on winterizing and maintaining rain barrels. Of the 19 people that attended the workshop, 10 people volunteered at the 2013 rain barrel sale and subsequently trained the 1,100 people who bought rain barrels about how to winterise and maintain them (CK, CW, & RGS, 2013).
Website	REEP hosted a dedicated stormwater management website as part of their RAIN program. Each city also hosted pages on their municipal website dedicated to stormwater management and the SCPs. These linked back to REEP's stormwater website. REEP's website hosted the following information on stormwater management: a. Links to videos showcasing sustainable stormwater management techniques b. Explanations on how to manage stormwater and reduce impact on local water sources c. Information about "naturescaping" (stormwater conscious landscaping) d. Links to sustainable stormwater management demonstration projects e. Case studies of sustainable stormwater management in Kitchener and Waterloo f. Links to SCP applications g. Rain-proofing checklist for homeowners h. List of local service providers (http://reepgreen.ca/incentives-rebates/local-service-providers/) The website was an important source of information for citizens looking for information on sustainable stormwater management; people phoning into the city were often directed to city stormwater the website for information, which directed visitors to REEP's site.
Stormwater Awards	REEP provided annual awards to community champions and local businesses taking action on stormwater issues and installing sustainable stormwater management on their properties. These awards give people recognition and social capital for their progressive efforts (R2). This helps REEP and the cities maintain positive relationships with these stormwater champions. The awards also help to build a brand and community status surrounding green stormwater practices (R1). The event and winners are publicised through REEP's social media and through partner networks which helps raise awareness on stormwater management and its benefits (R1).
Demonstration Projects	This outreach method involved installing sustainable stormwater management on willing properties, and recording, advertising, and broadcasting the activity. This serves as an example for the community, displaying what sustainable measures look like, how they function, and how they are installed. R1 stressed the importance of demonstration projects for their multiple benefits. First, demonstration projects are great for raising awareness and educating the public on sustainable stormwater management. Second, demonstration work to counteract the fear and uncertainty associated with sustainable stormwater management, as people are usually unfamiliar with how they work or what they look like. Third, running demonstration projects allowed REEP and the cities to experience the technical and bureaucratic hurdles that property owners had to go through to install sustainable measures. With this knowledge, the cities could then streamline processes to make the

	installation and SCP application processes easier for property owners.
Case Studies	REEP created case studies that summarised the process and outcome of demonstration projects in Kitchener and Waterloo. Case studies are important because not only do they demystify the process of installing sustainable, and provide a real life and local example, but they are also a gratifying reminder to the participant of the great work they did in deciding to install sustainable stormwater management (R1).
Presentations	REEP gave presentations to local gardening groups and neighbourhood association on the importance of stormwater issues, as well as how to take action to solve these issues (R1).
Door-to-door Outreach	REEP conducted door to door outreach in target neighbourhoods, mostly in promotion of the RAIN Home visit (R1). REEP found that people were very responsive to door-to-door outreach. R1 stated that if they had more resources, expanding door-to-door outreach to be more robust, like returning to homes where there was initially no answer, would be an area to consider for expansion. Door-to-door canvassers found that it was best time to canvass was mid-afternoon to late evening to get people while they were home (CK, CW, & RGS, 2013).
Complications with Engagement Methods	
Lawn Signs	Lawns signs were given out to households that wanted to support the RAIN program; homeowners did not have to have functioning stormwater management installed on their properties to get a sign. This became a contentious tool for program promotion. Waterloo felt that because people were not required to have properly installed stormwater management on their property before receiving the signs, the signs could end up around poorly installed controls, or no controls at all. Waterloo felt this could reflect poorly on the city and the stormwater management program, and send a confusing message to other property owners. R1 suggested that if other communities wish to use signage, that they gather a community focus group to determine if the intended message is being relayed through lawn sign design.
RAIN Home Visits	These visits are completed by trained REEP employees and are, "a comprehensive 1 ½ - 2 hour home visit to help homeowners understand all stormwater issues on their property and assist them in planning/prioritizing action to eliminate the incidence and impact of runoff and water/moisture reaching the storm sewer and/or infiltrating the home." (CK, CW, & RGS, 2013). R1 and R2 found these visits were most useful for promoting good maintenance of existing sustainable and green stormwater habits, but not very effective at promoting the installation of new sustainable stormwater management because price remained a major barrier. There is an ongoing study on the home visit program being conducted by a UW Masters student that should illuminate these barriers and solutions further. A study completed in 2013 found that the RAIN program could be improved by providing households with a more extensive contractor list for different recommendations, more information on rain gardens, and increased assistance with filling out credit application (4.5 RAIN home visit report).
The Umbrella Online Platform for Practitioners	This was an online resource developed by REEP and Green Communities Canada as a platform for stormwater professionals to share their experiences, case studies, and recommendations (R1). Uptake stagnated because key influencers did not participate in the project (R1).

Appendix H – Quantitative Data Results on Program Bias

Few correlations were identified with above a +/- 0.8 correlation factor; those present are highlighted in RED. Correlation factors above +/- 0.7 but below +/- 0.8 are highlighted in yellow.

Table 9: Pearson Correlation Factor Results

Indicator	Correlation to SCP Participation Rates: Waterloo Wards	Correlation to SCP Participation Rates: Kitchener Wards
TOTAL AREA (M2)	0.34	0.74
FLOODPLAIN COVERAGE (M2)	0.26	0.67
% FLOODPLAIN COVERAGE	0.13	0.49
NATURAL AREA COVER (M2)	0.39	0.61
% NATURAL AREA COVER	0.37	0.15
% OF POP 0-29	-0.30	0.56
% OF POP 30-59	0.06	-0.50
% OF POP 60+	0.33	-0.10
Total Number of Economic Families By Ward	0.59	-0.89
Average Family Income (Economic Family)	-0.01	0.07
% of ward that is low income before taxes	0.01	-0.01
Unemployment rate	-0.28	-0.30
Management occupations	-0.02	0.30
Business, finance and administration occupations	0.92	-0.07
Natural and applied sciences and related occupations	-0.37	0.53
Health occupations	-0.11	-0.03
Occupations in social science, education, government service and religion	-0.35	-0.17
Occupations in art, culture, recreation and sport	-0.29	-0.27
Sales and service occupations	0.26	-0.14
Trades, transport and equipment operators and related occupations	0.33	0.05
Occupations unique to primary industry	-0.35	-0.10

Occupations unique to processing, manufacturing and utilities	0.03	0.00
Car, truck, van, as driver	0.20	-0.19
Car, truck, van, as passenger	-0.12	-0.07
Public transit	-0.43	0.10
Walked	-0.06	0.25
Bicycle	-0.12	0.32
Motorcycle	0.07	0.51
Taxicab	0.04	0.17
Other method	-0.51	-0.21
Total non-single occupant vehicle	-0.18	0.17
No certificate, diploma or degree	0.02	0.17
Certificate, diploma or degree	-0.04	-0.14
High school certificate or equivalent	0.28	-0.34
Apprenticeship or trades certificate or diploma	0.31	0.31
College, CEGEP or other non-university certificate	0.44	-0.12
University certificate, diploma or degree	-0.41	0.02
University certificate or diploma below bachelor level	-0.12	-0.10
University certificate or degree	-0.42	0.00
Bachelor's degree	-0.18	-0.08
University certificate or diploma above bachelor level	-0.17	0.22
Degree in medicine, dentistry, veterinary medicine or optometry	-0.43	-0.08
Master's degree	-0.51	0.01
Earned doctorate	-0.63	0.34
Language most spoken at home: English	0.59	-0.02
Language most spoken at home: French	0.47	0.38
Language most spoken at home: non-official	-0.61	0.02
Immigrant status: non-immigrant	0.70	-0.04
Immigrant status: immigrant	-0.71	0.03
Average # of kids at home per Census family	-0.13	-0.13
Average # of bedrooms per dwelling	-0.12	-0.06

% of occupied private dwellings that are owned	-0.04	0.02
% of occupied private dwellings that are rented	0.03	-0.01
% of occupied private dwellings that require regular maintenance	0.10	0.55
% of occupied private dwellings that require minor repairs	-0.09	-0.66
% of occupied private dwellings that require major repairs	-0.15	-0.22
% of occupied private dwellings built from 1996-2000	0.01	0.15
% of occupied private dwellings built from 2001-2006	-0.11	0.59
Average # of persons per private household	-0.11	-0.02

Appendix I – Types of Stormwater Management Listed on SCP Applications Over Time

Figure 8: Types of Stormwater Management Installed Over Time - Kitchener

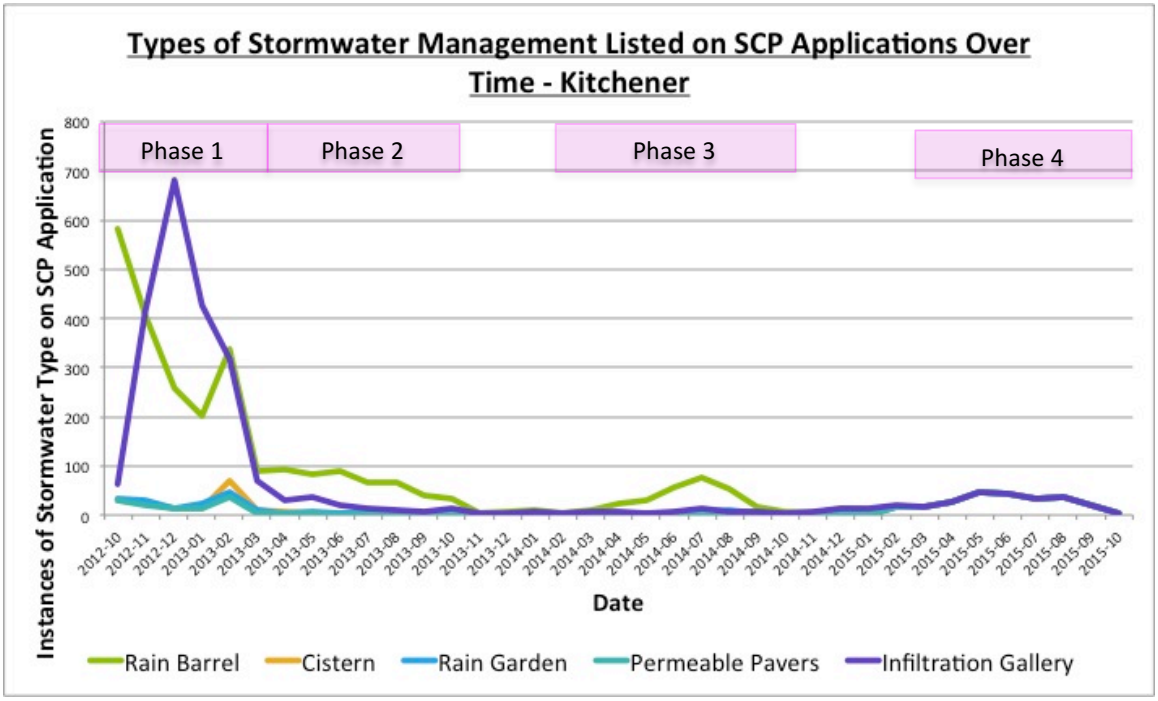
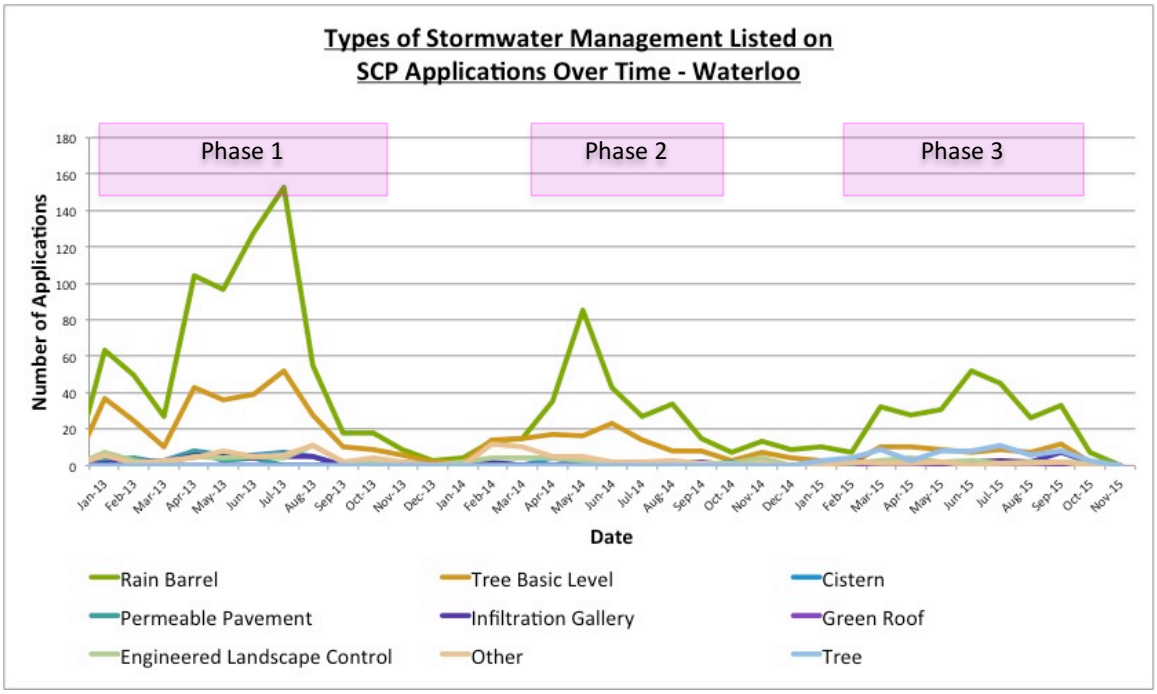
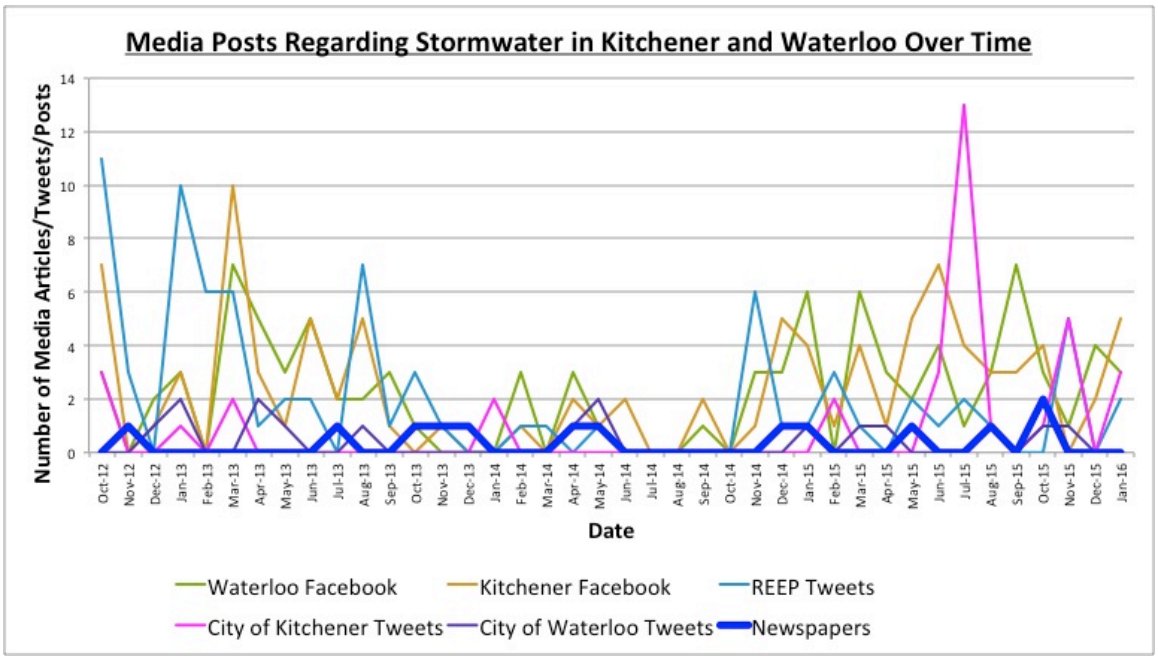


Figure 9: Types of Stormwater Management Installed Over Time - Waterloo



Appendix J– Media Posts Over Time

Figure 10: Media Posts about Stormwater Management in Kitchener and Waterloo



Appendix K - Tone of Newspaper Articles Covering the SCPFr1+

Figure 11: Tone of Local Newspaper Coverage of the SCP in Kitchener and Waterloo