1-1-2012

# Growing With The Flow: Planning For Smart Growth In Ontario Through Water & Wastewater Infrastructure Service Provision

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# GROWING WITH THE FLOW:

# PLANNING FOR SMART GROWTH IN ONTARIO THROUGH WATER & WASTEWATER INFRASTRUCTURE SERVICE PROVISION

By

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A Major Research Paper
presented to Ryerson University

in fulfillment of the requirements for the degree of

Master of Planning
In
Urban Development

Toronto, Ontario, Canada, 2012

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## ABSTRACT

Ontario's Greater Golden Horseshoe is experiencing rapid growth that if unchecked could perpetuate "sprawl" and threaten the Region's sustainability. To manage this growth, the Province adopted a program of "Smart Growth" and prepared a regional Growth Plan amidst a suite of complementary legislation. Municipalities are now expected to accommodate high levels of growth with an adequate supply of water and the necessary infrastructure to support increased demand. This invites the question of whether growth can be sustained through infrastructure upgrades, or whether absolute hydrologic limits will reshape regional growth. To investigate this, two strands of research are merged, which have traditionally been carried out individually - Smart Growth and "Planning by the Pipe". This paper argues that Ontario should align its growth management strategy with the servicing capacity and lifespan of water and wastewater infrastructure as well as the finances required for their maintenance and expansion. This consideration must not only reflect preferred areas for growth but the region's hydrological capacity to support the increased demand in these areas.

**Key words**: Smart Growth, Greater Golden Horseshoe, Planning by the Pipe, Water and wastewater infrastructure, regional planning, regional governance

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# 1 INTRODUCTION & RESEARCH OBJECTIVES

## 1.1 Growth Plan Adaptation

Canadian cities are experiencing rapid population growth and development that has increased the urban footprint of the country's largest urban regions. A predominance of this growth is taking place on the urban periphery of many of these cities or "leapfrogging" away from denser developments replacing what was previously natural or agricultural land in the form of low-density, single-use developments, or "sprawl" (Ruth, 2006; Blais, 2011). This pattern of growth and development accelerates the loss of natural areas and farmland, increases resource consumption, and necessitates infrastructure and servicing improvement as well as expansion at great cost (Anderson & Santore, 2002; Burchell, 2005; Tomalty & Alexander, 2005). If unchecked, this growth will perpetuate sprawl and threaten the economic, environmental and social sustainability of Canadian cities.

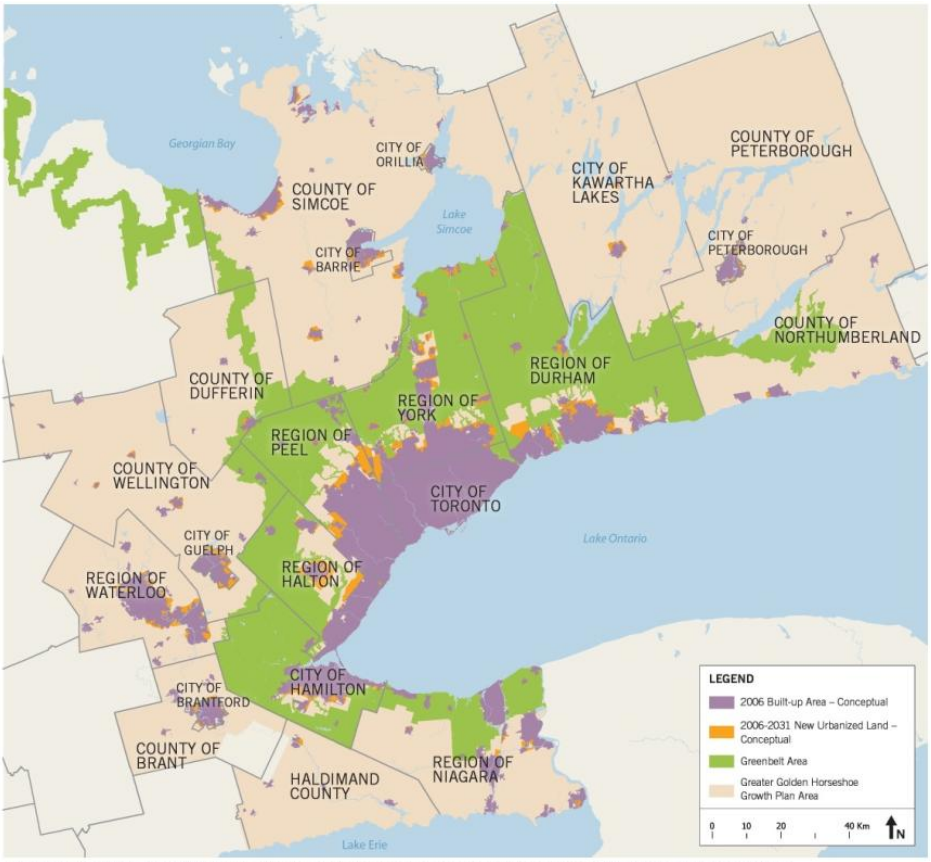
> *"Cities are expensive to build but slow and even more expensive to change. In an era of volatile energy costs, climate change, and water shortages, it is critical that new growth take a different track. Otherwise we will continue to embed severe future problems by building sprawl that will be very difficult and expensive to mitigate."*
> - Pamela Blais

The effects of growth are particularly evident within Ontario's Greater Golden Horseshoe (GGH). Projected to have 11.5 million inhabitants by 2031, the GGH is Canada's fastest growing region (Ontario Ministry of Public Infrastructure Renewal, 2006). Increased growth has made the region's communities more vibrant and diverse, helped maintain a strong economy, and aided in the expansion of community services, arts, culture and recreation facilities. However, growth has adversely affected traffic congestion, the availability of green space, and the cost and quality of public infrastructure (Ministry of Infrastructure, 2011).

In an attempt to mitigate the negative effects of this growth, while preserving the positive, the Government of Ontario adopted a program of "Smart Growth" and introduced a suite of complementary legislative changes to "control" sprawl, build healthy communities, maintain a strong economy, and make more efficient use of land and infrastructure in the region (Ministry of Infrastructure, 2011). An extensive Greenbelt was also established under the *Greenbelt Act* and the *Ontario Places to Grow Act,* both of which became law in 2005 and formed the legislative centrepiece of the 25-year *Growth Plan for the Greater Golden Horseshoe, 2006* (Growth Plan). This planning framework represents the most promising attempt to address sprawl in Canada and realize Smart Growth.

The *Places to Grow Act* gives the Province the statutory authority to designate any geographic region of Ontario as a *growth plan area* and mandates the Ministries of Energy and Infrastructure to prepare specific density targets and planning priorities within them. Local planning decisions, including zoning, must conform to the policies in the Growth Plan otherwise the Provincial Government has the authority to amend municipal decisions. The *Greenbelt Act*, *2005*, authorized the Province to designate a *Greenbelt Area* and establish the *Greenbelt Plan* to protect approximately 1.8 million acres of environmentally sensitive and agricultural land in the GGH from urban development and sprawl. Within this protected area, about 800,000 acres of land is bounded by the areas designated in the *Niagara Escarpment Plan* and the *Oak Ridges Moraine Conservation Plan* (Figure 1) (Ministry of Municipal Affairs and Housing, 2008).

**Figure 1. Urbanized Land: Growth Plan Scenario 2031 (Ontario Ministry of Infrastructure, 2007)**




Note: The information displayed on this map is not to scale, does not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise boundaries, the appropriate municipality should be consulted. For more information on Greenbelt Area boundaries, the Greenbelt Plan 2005 should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.

## 1.2 Potential Limitations of the Growth Plan

Without the Growth Plan unsustainable development patterns would likely expand at a rate that exceeds the ecological capacity of the region. As a result, the Growth Plan and the principles of Smart Growth it encompasses have generally been well-received (Eidelman, 2010). In spite of its perceived success, however, a number of potential weaknesses have been observed (see: Neptis Foundation, 2006; Ontario Greenbelt Alliance, 2009; Genest, 2011). Many of these concerns center on whether sufficient planning instruments exist to achieve the prescribed *density* targets at the local level, essentially arguing that the Growth Plan demands conformity to its policies without properly considering local government's capacity to implement them.

Some critics have also questioned the enforceability of the Growth Plan, contending that multiple municipalities have passed official plan amendments containing growth strategies that directly contradict the intent and spirit of the Growth Plan (Benfield, 2012). If weaknesses exist and are unaccounted for, additional policy recommendations or legislative changes will be required to ensure that Smart Growth can effectively be achieved through the Growth Plan.

Amidst these criticisms, a potential weakness of the Growth Plan that may have been overlooked is the disconnect between directing growth to existing *urban areas* and achieving the prescribed *density* targets, and the policy directions for coordinating investment in water and wastewater infrastructure to support future growth (3.1). Essentially, municipalities are expected to accommodate a high level of rapid growth within their urban peripheries with an adequate supply of water and the necessary water and wastewater infrastructure to support the increased demand. The Growth Plan acknowledges that investment in water and wastewater systems by all levels of government has not kept pace with GGH growth and outlines policies to reflect this (3.2), and contains policies supporting the conservation of water to ensure sustainable services are available to support future growth (2.2.2; 3.2.5; 4.2.4). However, it is unclear as to whether these policies can be implemented in a cohesive manner that conforms to each Provincial policy, in the time span allotted, and in a sustainable way.

Canada's fastest growing region continues to see a greater concentration of population and settlement, while the populations within its boundaries remain highly dependent on engineered or variable water supplies. What happens when the settlement patterns of the GGH confront the limits of natural and engineered hydrologic systems?

Many of the cities and towns within the GGH do not have lake-based water supplies, so as they continue to grow, increased demands on existing infrastructure will develop. This invites the question of whether a long-term supply of water exists to sustain the projected levels of growth within the areas outlined in the Growth Plan, or whether absolute hydrologic limits will reshape the region's population distribution and land use.

With growth comes an inevitable need for utility services, none of which is more essential to human life than water. In addition to providing drinking water, freshwater ecosystems are fundamental elements of water irrigation, wildlife habitat, reserves for biodiversity, flood control and drought mitigation, mechanisms for environmental purification, and sites for recreation (POLIS Project, 2005). With an abundance of lakes (more than 250,000), rivers, streams, and groundwater sources, Ontario has one of the richest freshwater landscapes in the world, yet water is widely treated unrealistically as a virtually limitless resource (Bartoszczuk & Nakamori, 2002; POLIS Project, 2005).

Understanding the importance of water, the Province has, since implementing the Growth Plan, introduced legislation in an attempt to address "water sustainability". This includes: The Great-Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement (2005); Clean Water Act (2006); Safeguarding and Sustaining Ontario's Water Act (Bill 198) (2007); and most recently, the Water Opportunities and Water Conservation Act (Bill 72) (2010). This joint legislation aims to make Ontario a leader in developing and selling water technologies and services; encourage Ontarians to use water more efficiently by creating and implementing new approaches to conserve water; and, strengthen sustainable water planning by helping municipalities identify and plan for long-term infrastructure needs (Ontario Ministry of the Environment, 2010).

It is clear that the Provincial Government is attempting to simultaneously address regional growth, limits to water supply, and the adequate provision of water and wastewater infrastructure through a variety of legislation, plans and policies. It is also evident that new methods of supply augmentation and conservation strategies are emerging. However, the extent to which this combined initiative will effectively satisfy the increasing demand for water within Canada's fastest growing region remains to be seen.

The concept of Smart Growth is heavily infused within the theoretical foundation of the Growth Plan, a merger believed to be capable of reducing the negative hydrologic affects of sprawl without the need to

sacrifice livable space for people to live or disrupt the natural hydrologic process (Pelley, 1999). However, if it can be shown that the Growth Plan does not truly reflect the principles of Smart Growth, or that Smart Growth does not sufficiently account for the negative hydrological effects of sprawl, the Growth Plan could be inherently flawed.

The Growth Plan welcomes growth if it is directed properly - through the principles of Smart Growth. But, given the demand on water service provision and hydrologic environments that growth necessitates, it may not be "smart" to direct millions more people into certain parts of Canada's largest urban region without a regional plan that adequately considers the sustainability of water and water-related infrastructure. Perhaps growth should be limited in accordance with water and wastewater service provision.

## 1.3 Research Objective

This major research project (MRP) intends to merge two strands of research which, despite their convergence as crucial elements of the Growth Plan, with few exceptions (see: McCuen, 2003; Arnold, 2005; Van Lare & Arigoni, 2006; Hinds & Pickering, 2008) have traditionally been carried out individually - Smart Growth and the provision of water and wastewater infrastructure as a tool of guiding development, or "Planning by the Pipe". A convergent literature review of Smart Growth and Planning by the Pipe will be conducted to demonstrate the important connection between the two concepts as well as how they interact with the Growth Plan.

Water and land use are inseparable, yet the need to link growth with water supply in the process of making land use decisions appears to be an overlooked option of achieving Smart Growth in Ontario through implementation of the Growth Plan. Moreover, water quality and supply issues have received little attention in Smart Growth literature (Arnold, 2005), yet the Growth Plan is underpinned by the principles of Smart Growth.

Because the Growth Plan promotes principles of Smart Growth related to infrastructure planning and investment, this MRP investigates whether Smart Growth can be achieved through Planning by the Pipe in the GGH, and if so, whether it is sustainable. Though this analysis could include considerations of a multitude of factors influencing growth, specifically those related to other forms of physical infrastructure such as energy and transportation, research focuses on water and wastewater infrastructure and its link to sound and sustainable growth management plans within the GGH.

Long-term water and wastewater infrastructure plans are a core element of strategic social and physical planning linked to land use, yet long-term Planning by the Pipe is often ignored as a strategy because municipalities have limited sources of raising revenue and do not want to raise taxes to fund new infrastructure developments (Van Lare & Arigoni, 2006). This is evidenced by the fact that in many parts of Ontario, infrastructure is rapidly in need of renewal and is not adequately maintained while new developments necessitate extended infrastructure capacity further stretching the already dispersed urban boundaries of its cities (Fleischer & Visschedyk, 2011).

Population growth and infrastructure servicing constraints are also inter-related and there exists a need to forecast their impact relative to one another so as to maximize long-term efficiency and cost. For instance, per capita costs of municipal water and wastewater infrastructure provision increase with declining density, and are often duplicated in distant locations while existing infrastructure in central or older areas is underutilized or increasingly in need of renewal, with fewer funds for upgrades and maintenance (Tomalty, 2007). Because the life cycle of water infrastructure can last anywhere from 15 to over 100 years, it is more cost effective to accurately align servicing capacity with demand before development in the surrounding area occurs (Coad, 2009; United States Environmental Protection Agency, 2011). If implemented correctly, this can be done in accordance with the principles of Smart Growth to ensure development is compact.

This MRP argues that Planning in Ontario should align its long-term growth management strategy with the long-term servicing capacity or "lifespan" of water and wastewater infrastructure and the finances required for their maintenance and expansion. Moreover, this consideration must not only reflect preferred areas for growth in the GGH as outlined in the Growth Plan, but the region's hydrological capacity to support the increased demand in these areas.

In evaluating whether Planning by the Pipe is an effective tool municipalities can use to intensify under the Growth Plan, this MRP hopes to contribute to ongoing research and evaluation of the Growth Plan's attempt to direct and intensify growth and development within the GGH.

# 2 REVIEW OF LITERATURE

## 2.1 Smart Growth

Despite being entrenched in planning lexicon, there is no universally accepted definition of "Smart Growth" (White, 2007; Ingram, Carbonell, Hong, & Flint, 2009; Daniels, 2010). Generally speaking, it is best understood as the antithesis to sprawl (Wickersham, 2006; Willmer, 2006). Where sprawl is exhibited by low-density, dispersed, auto-dependent energy consumptive land use patterns, Smart Growth is typically characterized by compact, transit-accessible, pedestrian-oriented, mixed-use development patterns and land reuse (Ruth, 2006; State of Maryland, 2011), and aims to conserve natural resources through the efficient use of land, water and air; distribute the costs of development in an equitable manner, and create more livable and healthy communities (Tomalty & Alexander, 2005; State of Maryland, 2011). Distinguishing features between Sprawl and Smart Growth are compared below in Table 1.

**Figure 2. 10 Principles of Smart Growth (Smart Growth Network, 2012)**

**10 Principles of Smart Growth**

- Mix land uses.
- Take advantage of compact building design.
- Create a range of housing opportunities and choices.
- Create walkable neighborhoods.
- Foster distinctive, attractive communities with a strong sense of place.
- Preserve open space, farmland, natural beauty, and critical environmental areas.
- Strengthen and direct development towards existing communities.
- Provide a variety of transportation choices.
- Make development decisions predictable, fair, and cost effective.
- Encourage community and stakeholder

**Table 1. Smart Growth and Sprawl (Litman, 2011)**

| | Smart Growth | Sprawl |
|---|---|---|
| **Density** | Higher-density, clustered activities. | Lower-density, dispersed activities. |
| **Growth Pattern** | Infill (brownfield) development. | Urban periphery (Greenfield) development. |
| **Land use mix** | Mixed. | Single use, segregated. |
| **Scale** | Human scale. Smaller blocks and roads. | Large scale, Larger blocks and wide roads. |
| **Public Services** | Local, distributed, smaller. Accommodates walking Access. | Regional, consolidated, larger. Requires automobile access. |
| **Transport** | Multi-modal transportation and land use patterns that support walking, cycling and public transit. | Automobile-oriented transportation and land use patterns, poorly suited for walking, cycling and transit. |
| **Connectivity** | Highly connected roads, sidewalks and paths, allowing more direct travel by motorized and non-motorized modes. | Hierarchical road network with many unconnected roads and walkways, and barriers to non-motorized travel. |
| **Street design** | Streets designed to accommodate a variety of activities. Traffic calming. | Streets designed to maximize motor vehicle traffic volume and speed. |
| **Planning process** | Planned and coordinated between jurisdictions and stakeholders. | Unplanned, with little coordination between jurisdictions and stakeholders. |
| **Public Space** | Emphasis on the public realm (streetscapes, pedestrian areas, public parks. | Emphasis on the private realm (yards, shopping malls, gated communities. |

As a movement, Smart Growth originated in the United States (US) during the mid 1990s under the auspices of the US Environmental Protection Agency (EPA). In 1996, the EPA created the Smart Growth Network (SGN), a coalition of partnering organizations (EPA, Association of Realtors, Urban Land institute, and American Planning Association) consisting of environmentalists, planners, local officials, developers, and others to research and encourage more sustainable development practices (Ruth, 2006; Reeds, 2011). The SGN created a set of ten principles (Figure 2) to help guide community design and policy decisions related to Smart Growth. Although numerous individuals and organizations have since contributed their voice to its ever-evolving definition, this set of principles is the most universal.

Smart Growth became a more homogeneous concept and received heightened attention when the State of Maryland coined the term through the adoption of a variety of "Smart Growth laws" that addressed sprawl through fiscal policy and incentives, rather than land use regulations (Reeds, 2011; State of Maryland, 2011). Although the concept originated in the US, the idea of building compact, walkable, mixed-use, and transit-friendly cities with a diverse range of housing did not (Knaap & Talen, 2005). The term is often used interchangeably with concepts such as "New Urbanism" or "Neo-traditional Development", which share many similarities but typically address design issues and do so predominantly in traditional neighbourhood environments (Willmer, 2006). Many Smart Growth strategies are also often subsumed under the broad banner of Sustainability, which, like Smart Growth, generally implies an integration of environmental, economic, and social dimensions (Dale, 2001), but demands a more indefinite and balanced approach to its imperative and can be applied to a more expansive range of issues than development (Ruth, 2006; Willmer, 2006).

Since the term was coined and its principles established, some environmental organizations, governmental agencies, and interest groups have altered the definition of Smart Growth to suit their particular missions and goals (Ye, Mandpe, & Meyer, 2005). Proponents of Smart Growth, however, maintain that it cannot be fully realized if its principles are reformulated so as to no longer espouse its intended goals, or if it is affixed to business-as-usual planning processes such as highway expansion alongside transit development (Burda, 2008). As a result of this varied interpretation and the widespread malleability of the label and its principles, many have questioned the value ascribed to Smart Growth as an applicable concept (Ruth, 2006; Ye, Mandpe, & Meyer, 2005).

Although different sectors and communities disagree about the usefulness of the concept, many Smart Growth efforts have received national and international acclaim (Freilich, Sitkowski, & Menillo, 2010).

In spite of this positive recognition, however, the merits of Smart Growth have been debated by a variety of academics, professionals and institutions (see: Gordon & Richardson, 1997; Ewing, 1997; Mills, 1999; Gleaser & Kahn, 2003; Cox, 2004; Ingram, Carbonell, Hong, & Flint, 2009).

In a recent report for the Victoria Transport Policy Institute, Littman (2011) set out to evaluate the most persistent criticisms of Smart Growth: that it increases regulation and reduces freedom; increases the cost of housing by reducing land supply; increases traffic congestion and reduces transport system quality; increases public service costs; and consumers prefer sprawl and automobile dependency. Following this analysis, Littman concluded that the criticism misrepresented Smart Growth through various analytical errors that led to false conclusions; evaluated Smart Growth only on gross regional population density; and ignored interrelationships between city size, density, congestion, travel patterns, income and cost-of-living, and the tendency for Smart Growth to be implemented in areas with rapid economic and population growth (Litman, 2011).

## 2.2 Smart Growth's Northern Migration

Inspired by the Smart Growth movement emerging in the US during the mid 1990s, the concept was soon embraced in Canada by both government and Non-Governmental Sectors (NGOs). Prior to its integration into Ontario's Growth Plan, however, Smart Growth BC, an independent non-profit group, was set up in 1999 to promote compact urban centres, protect resource lands, ensure adequate affordable housing, promote sustainable transportation and maintain environmental integrity (Tomalty & Alexander, 2005; Smart Growth BC, 2008). Shortly thereafter, a wave of Smart Growth initiatives were implemented by municipalities, regions, businesses and NGOs throughout Canada, and Ontario built upon their success when the former Conservative government launched its Smart Growth Ontario initiative and established a Smart Growth Secretariat in 2001 (Ontario Ministry of Municipal Affairs and Housing, 2002).

Though many Smart Growth principles were in place in Ontario as policies in local plans across the Toronto metropolitan region - such as transit supportiveness, higher residential densities, and maintaining urban boundaries, the concept held considerable appeal as Ontario's preferred method of addressing the region's growth problems (White, 2007; Eidelman, 2010). To carry out this initiative, the government set up panels of citizens and elected politicians representing different interests and asked them to find solutions to growth-related problems (White, 2007). The result was a final report from the Smart Growth Secretariat that was, "long on visions and ideals and short on realistic strategies for

achieving them" (White, 2007). In addition, many proponents of Smart Growth believed the government's use of the term was ill-defined given that it included a resumption of provincial transit spending, brownfield redevelopment, and environmental protection, while promoting a major new highway building program (Tomalty & Alexander, 2005). In the end, although efforts were made to introduce Smart Growth, low-density development continued to push outward at the fringes of Toronto's urban area at unprecedented levels, and often into prime agricultural lands (Sewell, 2009).

Regardless of whether Smart Growth was effectively realized at this time, the introduction of the Smart Growth initiative was instrumental in promoting the concept and helped lead to the creation of the Ontario Smart Growth Network (Tomalty & Alexander, 2005). Furthermore, the effort helped manifest a new provincial willingness to manage growth as the newly elected Liberal government introduced a variety of legislative, policy and planning changes embodying the principles of Smart Growth. The new Liberal government showed considerable interest in containing rather than promoting sprawl by introducing Bill 26 which amended the *Planning Act* to require that planning decisions 'be consistent with' provincial policies, where previously they simply had 'to have regard for' them (Sewell, 2009). This provided the necessary legal backing for the *Provincial Policy Statement* (2005), which though absent of any explicit reference to Smart Growth, represents its principles by promoting efficient development while minimizing land consumption and servicing costs (s. 1). The ground was now prepared for the government to realize Smart Growth by developing the first regional plan for the Toronto area in over 30 years in the form of the Growth Plan.

## 2.3 Is water as an oversight of Smart Growth?

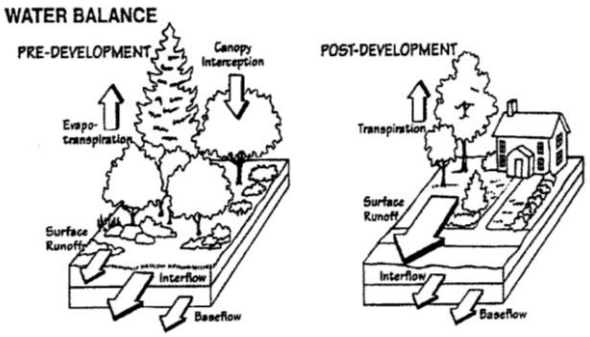
Since the Growth Plan was introduced, a general consensus has emerged that the GGH will, as a result of following the set of "smart" principles outlined, or inadvertently embedded, in the Growth Plan, be successful and prosperous (Sewell, 2009). Because, the Growth Plan is interlaced with Smart Growth principles, however, its success may hinge on the ability of Smart Growth to serve as an effective method of managing growth. Thus, if any weaknesses, such as the role of water, were observed in the concept that so heavily influenced recent government decisions related to growth management, the Growth Plan itself could be inherently flawed.

The water-growth interface in planning, regulation and development is not a current phenomenon. The availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production is, and always has been an essential component of growth and development (Grey & Sadoff,

2007). In spite of this interrelationship, however, water quality and supply issues have, with few exceptions, received little attention in Smart Growth literature (McCuen, 2003; Arnold, 2005; France R. L., 2006).

Given the potentially hazardous impact unchecked growth can have on the hydrology of a region, it is surprising that Smart Growth literature does not devote more attention to the connection. Research indicates that "sprawling" development imposes greater consequences to water quality and supply than Smart Growth development (Frumkin, 2002; Otto, Ransel, Todd, Lovaas, Stutzman, & Bailey, 2002; Western Resource Advocates, 2003; Carter, Kreutzwiser, & de Loe, 2005; Moffett & Hasse, 2006). When it rains, the high rate of impervious cover per person associated with "sprawling" development (roads, parking lots, paved driveways, and rooftops replacing meadows, forests and farmlands) impedes infiltration of surface water and precipitation into groundwater while increasing the volume of stormwater runoff (Randolph, 2004). This enlarges stream channels, increases sediment and pollutant loads, degrades stream habitat, and reduces aquatic diversity (U.S. Environmental Protection Agency, 2009). In other words, when development occurs on land that previously had a filtering function, rainwater can no longer seep into the ground to replenish aquifers (Figure 3), subsequently creating runoff that carries pollutants into the rivers, lakes, streams and oceans that supply water to cities and towns (Otto, Ransel, Todd, Lovaas, Stutzman, & Bailey, 2002).

**Figure 3. Water Balance: Pre vs. Post-Development (Davis & McCuen, 2005)**




Converse to sprawl, Smart Growth development minimizes or reduces impervious land area by devoting less land to roads and parking, fewer acres to buildings, and promotes the utilization of environmental designs such as vegetated open channels that can reduce impervious cover and improve stormwater infiltration and detention (Pelley, 1999; United States Environmental Protection Agency, 2001; Davis & McCuen, 2005).

Concerns over the neglect of water in Smart Growth Literature were popularized by Arnold (2002, 2005), who argued that a concept of "Wet Growth" should be adopted in reference to concerns about the interrelationship between water quality and the availability of water supply, and the density, form, pattern, and location of land development. Arnold suggested the correlation between the sustainability of growth and land use, and aquatic ecosystems and water resources should either be recognized as part of the Smart Growth or Sustainability agendas, or developed into a unique planning and regulatory concept.

This view was echoed by Tarlock & Lucero (2002), who cautioned that cities can no longer afford to ignore the relationship between water supply, land consumption, and growth, yet there exists multiple disconnects between water allocation and land use policy within the Smart Growth paradigm that must be reconciled. McCuen (2003), later expanded on this notion, advocating that the focus of both sprawl and Smart Growth research too frequently concentrates on transportation and roadway related issues, and for Smart Growth to be "intelligent growth" that solves problems associated with sprawl, it is necessary to view sprawl from a hydrological perspective focusing on the effect sprawl has on the physical hydrologic process.

Since the apparent gap in Smart Growth literature was identified, relatively few documents have attempted to focus on the importance of the convergent relationship between Smart Growth development and water. However, the National Association of Local Government Environmental Professional's (NALGEPs) report entitled *Smart Growth for Clean Water* identifies specific barriers and solutions to the effective implementation of Smart Growth for clean water programs, citing specific examples in the US, and recommending five Smart Growth "tools" as key strategies to improve water quality. These include land conservation, brownfield revitalization, urban and community forestry, low impact development, and watershed management.

Perhaps more encompassing of water's direct interrelationship with Smart Growth is the National Resources Defense Council's (NRDCs) 2006 Report, *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies*, which summarizes the challenges of meeting demand for safe drinking water, investigates ways to accommodate growth while minimizing its effects on water consumption and distribution costs, and examines what water policies can support this type of growth (Van Lare & Arigoni, 2006). In addressing the nexus between water and Smart Growth, the

report asserts that Smart Growth promotes more compact development which reduces water and wastewater infrastructure costs by allowing for shorter transmission systems, making them more efficient to operate and less susceptible to water loss through leakage; encourages compact neighborhood design on smaller lots to reduce water demand; and directs development to areas served by existing water and wastewater infrastructure so that resources can be concentrated on system maintenance rather than expansion, thus minimizing the cost of delivering water (Van Lare & Arigoni, 2006).

Both aforementioned reports demonstrate the imperative to link the benefits of Smart Growth with water, but represent two of only a handful of comprehensive documents to have gone into depth to express the explicit connection. Some authors have examined the increasing need to consider the connection between water and growth in a broader sense without making direct reference to the concept of Smart Growth. France (2006) presents a framework to measure, minimize, and manage development from a perspective of understanding the "aquatic consequences" of sprawl, contending that water bodies need to be studied and managed from a landscape perspective; hydrological problems cannot be solved by engineering or "techno-fix" solutions in the absence of addressing ethical concerns; environmental zoning and the prioritization of development sites and aquifer protection are essential, and brownfield redevelopment and integrated water management are effective means of limiting the detrimental effects of sprawl (France 2006).

The debate over water scarcity and growth management in the semi-arid Western US (see: Wilkinson, 1992; Carle 2000, 2003) has also drawn increased attention to the relationship between sustainable growth and the natural limits of water, though Smart Growth is seldom mentioned directly as a remedy. In response to suggestions that growth is inevitable and that it should continue to be facilitated through advancements in water-supply technology, many authors recommend alternative strategies that, more sustainably account for future growth and water supplies. They commend efforts to accommodate growth through conservation techniques, such as groundwater banking, recycling, and desalination, further recommending long-term water-supply planning strategies be in place before allowing growth to continue, such as requiring local governments to review water availability before approving new developments; eliminating "low cost loopholes" in water pricing so as to not promote "off-grid" development; and, introducing water rate reforms to provide incentives for conservation (Hanak & Browne, 2006; Tarlock & Bates, 2008).

More recent and explicit discussion of the interconnectedness between water and Smart Growth has centred upon growing concern that "peak ecological water" is being reached as a result of global population growth. For example, Lucero, 2011 argues that development decisions and responsibility for water supplies are compartmentalized among different regulatory regimes, decision-makers, and administrative processes, and fragmented between various levels of government. A "*planned growth paradigm"* is required to replace "business a-as-usual" practices and reconnect growth and water supplies. To achieve this paradigm shift, rather than asking where to find water to fuel projected growth, communities should determine present and future resource constraints, and discern what level of growth can be supported within them. Next, the vulnerabilities of water supply systems and population projections should be assessed at the level of government best able to "see the big picture" and harmonize the collective planning framework. Lastly, because the prevalence of natural resources varies between communities, there are limits to the amount of growth each community can achieve, thus communities should incorporate water supply projections into local land-use plans and only approve new development if an appropriate level of water supply is available (Lucero, 2011).

The above review of literature presents an array of studies, reports, and opinions addressing the role of water in Smart Growth literature. However, when compared to the extensive studies, reports, and academic attention paid other aspects of Smart Growth, water appears relatively neglected, especially within a Canadian context. This oversight is further compounded by Smart Growth's broad definition and manipulability as a concept. This is a cause for concern given that the Growth Plan is so heavily influenced by the Smart Growth movement. It may be that the interrelationship between water and Smart Growth is widespread throughout the literature but gets lost amidst a plethora of different labels and defining principles. In the past two decades, water and Smart Growth research have generally run parallel, although the two have grown closer, they have not yet converged enough given their significance as catalyst for the sustainable growth and development of cities.

## 2.4 The Historic Relationship between Urban Water Systems & Urban Growth

Water is an indispensible source of life that has, and will continue to play, a central role in human societies (Grey & Sadoff, 2007). It is virtually an element of all production - in agriculture, industry, energy and transport, and is a source of human livelihood, health and prosperity, but is also a cause of death devastation and poverty (Grey & Sadoff, 2007). As such, the provision of adequate quality and quantities of water and reduction of its destructive impact is a challenging and multi-faceted task, but

one that is a prerequisite of enduring, sustainable urban societies and inextricably linked to urban growth.

Formal infrastructure systems for supplying water can be traced back to early human settlements as far back as 16,000 years ago when agriculture developed and permanent settlements were established in close proximity to floodplains of rivers, requiring dams, dykes and irrigation (Ashley & Cashman, 2006). In years prior, human settlements followed the water, settling near rivers, lakes, and springs, and migrating to alternative resources as a result of climate variability (Ashley & Cashman, 2006). It was not until the period between 3000BC, when the Egyptians and Sumerians built the first major water infrastructure systems, and the beginning of *Anno Domini* (AD) when the Romans and Persians built major water supply and sanitation structures, that water supply began to dramatically influence the growth of towns and cities (Ashley & Cashman, 2006).

As human settlements increased in size and water-related infrastructure technology advanced, societies responded to water scarcity simply by developing more supply - moving the water to them. Improved water supply management increased the supply of available potable water, improved irrigation systems for farmers to support growing markets, created a higher-capacity supply for industries (Armstrong, 1976). Perhaps most importantly, technological advances in water filtration, sewage treatment and the supply and disposal of water brought an end to the public health problems associated with poor sanitation within cities and towns until the 20$^{th}$ century as the connection between water and disease was established (Grigg, 1986). As a result, urban mortality rates dramatically decreased. In fact in the US between 1850 and 1925 they fell by approximately forty percent, roughly one quarter of which can be attributed to the introduction of public water supplies (Troesken, 2006). Though the situation still prevails today in many under-developed countries, without these collective advancements in water supply management, cities and towns would continue to suffer and the dramatic urban growth of the 20$^{th}$ century would not be possible.

Water can improve the condition of urban life and propel urban growth only as much as the biophysical carrying capacity of an ecosystem will allow. Finding additional sources of water must only be done when absolutely necessary for the value of water must outweigh the negative environmental consequences that can accompany water extraction (Gleick, 1998). To ensure a sustainable supply of water exists to support continued urban growth, water-supply planning and management must consider the interactions between urban infrastructure, the hydrological environment, and urban development.

Humans cannot always increase the amount of the resource, but they can reduce their dependence and increase the productivity of its delivery. By using water more efficiently, more people can be serviced, less water is wasted and increased growth can be sustained.

## 2.5 Planning by the Pipe

The term "Planning by the Pipe" is often used within the planning profession but lacks, a clear definition. Generally speaking, Planning by the Pipe is a reference to the axiom – "development follows the pipe" – until water and sewage infrastructure are in place, urban growth does not occur (Sewell, 2009). Conventional planning thought maintains that successful city plans must align themselves with the provision and capacity of water and wastewater infrastructure.

It is difficult to disentangle the relationship between physical infrastructure and urban development in Ontario. In fact, since 1946 it has been mandated by law through the Provincial *Planning Act* (PPA), which explicitly requires (Chapter 71, 375-83) that new urban development must have provision for adequate physical services such as water supply and sewage disposal for new urban development to occur (White, 2003). Consequently, Planning by the Pipe has historically been considered a successful method of directing growth in Canada.

## 2.6 Did development "follow the pipe" during the GTA's expansion?

Although Planning by the Pipe has traditionally been deemed a "tried and true" method of directing city growth, many studies have questioned the nature of the notion. Perhaps the most geographically relevant study of this question is Richard White's monograph, *Urban Infrastructure and Urban Growth in the Toronto Region 1950s to the 1990s* (2003), which explores urban land use expansion beyond the boundaries of Metropolitan Toronto over the past fifty years to determine whether "development follows the pipe". White concludes that, for the most part, the inverse was in fact true – the pipe followed development.

As Toronto's infrastructure expanded it allowed, rather than caused the city's growth, for in areas where development pressure was not strong pipe capacity remained unused for some time. However, once pipes were in place, additional urban development soon filled the service area, in which case development did, in a sense, follow the pipe, though only after services were installed to meet existing demand (White, 2003). Although the provision of water and sewer services has not, on its own, had the power to prompt development, the historical record of the region dictates that where development

pressure was strong, full urbanization has unequivocally followed the pipe, and particularly if the pipes are large such as the York Durham Sewage System (YDSS) (White, 2003).

From this conclusion, White hypothesizes (as the staff of the Metropolitan Toronto Planning Board did when the YDSS was initially built) that it would make sense for municipalities to build larger pipe(s) with capacity that would not be reached for thirty or more years, rather than the less economically viable option of incremental expansion, rebuilding or twinning trunk sewers a mere ten years later (White, 2003). The one-time expense of large capacity pipe(s) could theoretically accelerate population growth while per capita charges would decrease through the influx of population being served. But would too much growth occur too quickly, and in what way?

A study conducted by a group of American environmental engineers in the 1970s reveals that, in the US cities they studied, where larger trunk sewers were built into areas outside of the city's urban centre, sprawl resulted, and they suggested planners use smaller pipes to support lower populations (Binkley, Collins, Kanter, Alford, & Shapiro, 1975). One must consider, however, that this study was conducted in the US and not in Canada, a country that has experienced far less urban decline and racial segregation (Tomalty & Alexander, 2005).

In Canada's largest city, Toronto, a number of factors contributed to the city's sprawl. But, were it not for government decisions to construct new reservoirs, expand lake-based water treatment plants and expand the City's trunk sewers 50 kilometres to the north to merge with the utilities of the "liability-ridden" townships adjacent to Toronto's urban fringe, with their small populations and agricultural base, these settlements would not have had the financial capability or capacity to support the necessary expansion of infrastructure that resulted in sprawl (Solomon, 2007; Sewell, 2009). Given that development follows the pipe (once it is installed), it can be argued that if more attention were paid to the cost of servicing and the kind of growth being encouraged through this type of water and wastewater expansion, a more efficient land-use form would have been obtained (Solomon, 2007; Sewell, 2009).

It is worth considering that if the Growth Plan and the legislative framework supporting it had been in place during this pivotal time of urban expansion, the sprawl that took shape beyond the city's urban periphery and into the adjacent regions would not likely have occurred. The decisions made to promote growth through the expansion of infrastructure would not only contradict the core components of

Smart Growth, but would be incongruent with certain policy directions of the PPS (see: 1.1.1 (g); 1.3.2 (a)(2); 1.1.3.3; 1.6; 1.6.4) and the Growth Plan (see: 3.2.5.1; 3.2.5.4) which aim to achieve intensification and compact urban form while ensuring that water and wastewater infrastructure supports growth in ways linked to how they are paid for and administered (3.1).

By implementing the Growth Plan the Provincial Government is attempting to rectify the previous mistake of permitting unchecked urban expansion permitted through the provision of infrastructure. In doing so, however, the Province must ensure that they are not repeating the same mistakes. Directing growth within the urban boundaries of the Region's cities is a necessary step toward achieving Smart Growth and reducing the effects of sprawl. But, if growth is directed to cities without the necessary infrastructure to facilitate an adequate supply of water, one of two results will occur, growth will not happen as the Growth Plan intends, or the Province will be forced to upgrade its infrastructure at great cost to increase capacity. As historical research indicates, this could ultimately result in continued urban expansion that would contradict the intent of the Growth Plan and negate the principles of Smart Growth.

## 2.7 Can growth be contained by restricting water and wastewater capacity?

Given that the existence and capacity of water and wastewater infrastructure permit urban expansion, opponents of sprawl have long been captivated by the question of whether urban expansion can be controlled by restricting water and wastewater servicing or capacity. Of those who have examined this tactic, however, many have found it to be unsuccessful (White, 2003).

In the US, for example, cities have some authority to defer growth through service denials, water districts or moratoria on water service until additional growth can be effectively supported by water and wastewater infrastructure. However, many who have researched this topic believe that such restrictions are successful only if they are location specific and contain local land-use restrictions, and will never be able to be used as a tool to "choke off" growth on any large scale, or for any extended period of time (Arnold, 2005; Tarlock & Van de Wetering, 2007; Tarlock & Bates, 2008; Grumbles, 2008). Research attempts to direct development into already serviced areas by restricting servicing have also found that using water as a growth control lever can lead to an increase in septic tank usage (Tabors, Shapiro, & Rogers, 1976; Duany, Plater-Zyberk, & Speck, 2001), which can further contribute to income-based segregation (Duany, Plater-Zyberk, & Speck, 2001), and be inconsistent with affordable housing mandates (Tarlock & Bates, 2008).

The question of whether growth should be directed through service capacity restraints appears to lie at the vortex of two potentially inconsistent doctrines: public utility's "duty to serve" and land use law's authority for local governments to regulate the timing and manner of development on land (Tarlock & Bates, 2008). The public typically perceives water, not as the commodity that it is, but as a social or public good that should be provided by utilities to customers within a service area at a marginal or average cost, whereas municipalities are entrusted with controlling an appropriate rate and location of development (Ashley & Cashman, 2006).

Unless public utilities begin to charge a rate to cover the cost of water usage, delivery and infrastructure maintenance that more accurately reflects the location, form and density of developments, the two doctrines will continue to remain inconsistent. In Ontario, consumers in less-dense and more distant locations, pay virtually the same rate as those in central locations, regardless of the amount of water consumed (Blais, 2011). This establishes a set of cross-subsidies through the water rate whereby efficient development subsidizes inefficient development (Blais, 2011). Consequently, attempts to introduce Smart Growth and regulate the use of land in a way that considers the provision and supply of water, whether through financial or environmental concerns, are not always well-received. This fact is worsened further by the perception that Ontario's fresh water is a limitless resource that should be provided at a subsidized cost regardless of where and how people chose to live, and that "techno-fix" engineering solutions will compensate future challenges of service delivery.

Absent of any changes to the cost of delivering water, an apparent solution to ensure the two doctrines can fulfil their expected functions is to incorporate water supply planning into land use planning or require that an adequate supply of water be in place before growth and development can occur, ideally through comprehensive plans that ensure future water demands can keep pace with growth in a sustainable manner (Tarlock & Van de Wetering, 2007).

To a certain extent, the Growth Plan sets out a number of requirements for water and wastewater systems in the GGH that fulfil this directive. Policy 2.2.2(j) of the Growth Plan requires that, population and employment growth be accommodated by directing major growth to *settlement areas* that offer *municipal water and wastewater systems* and limiting growth in *settlement areas* that are serviced by other forms of *water and wastewater services* (Ontario Ministry of Public Infrastructure Renewal, 2006). In other words, substantial growth is only permitted within cities, towns, villages and hamlets that are

*built-up areas*, or on lands that have been designated in an official plan for long-term development, and only if full municipal water and wastewater servicing systems are present.

Though not intended to limit growth, this policy does help contain it through infrastructure service provision. However, it may be difficult to enforce given that the term "substantial growth" is somewhat arbitrary and the Growth Plan generally defines a *municipal water and wastewater system* as 'all or part of' a drinking water and sewage works system that is owned by a municipality (Ministry of Public Infrastructure Renewal, 2005). Not only is it difficult to determine what constitutes substantial growth, because the pre-requisite for continued growth is merely the existence of water and wastewater infrastructure and not its long-term capacity, it is entirely possible that growth within *settlement areas* could supersede the hydrological capacity of the area. This would necessitate costly infrastructure expansion or a paradigm shift toward conservation.

The Growth Plan does contain complementary policies encouraging municipalities to plan and develop water and wastewater infrastructure that returns water where it was withdrawn - to the Great Lakes watershed (3.2.5), and requiring municipalities to develop and implement official plan policies and other strategies in support of water conservation, including water demand management, for the efficient use of water; and, water recycling to maximize the reuse and recycling of water (4.2.4). However, there are no concrete definitions of what these conservation measures will consist of, nor any benchmarks to be achieved before infrastructure expansions can be approved (Binstock, 2010).

In accordance with these policies, some upper-tier municipalities have, or are in the process of aligning their preferred water and wastewater servicing strategies with preferred areas of intensification and future growth. Though not in the traditional sense, this approach embodies some of the rationale behind both Smart Growth and Planning by the Pipe. But to what extent is this being done, and how? Will these comprehensive planning strategies ensure that future water demands keep up with growth in a sustainable way?

# 3 PROBLEM INVESTIGATION

In order to establish whether the principles of Smart Growth inherent to the Growth Plan can be achieved through Planning by the Pipe, exactly where growth is being directed must first be established. Then, the challenges of directing the anticipated level of growth to these areas can be analyzed in accordance with the planning tools available to address them.

## 3.1 Where is the Growth Plan directing future growth?

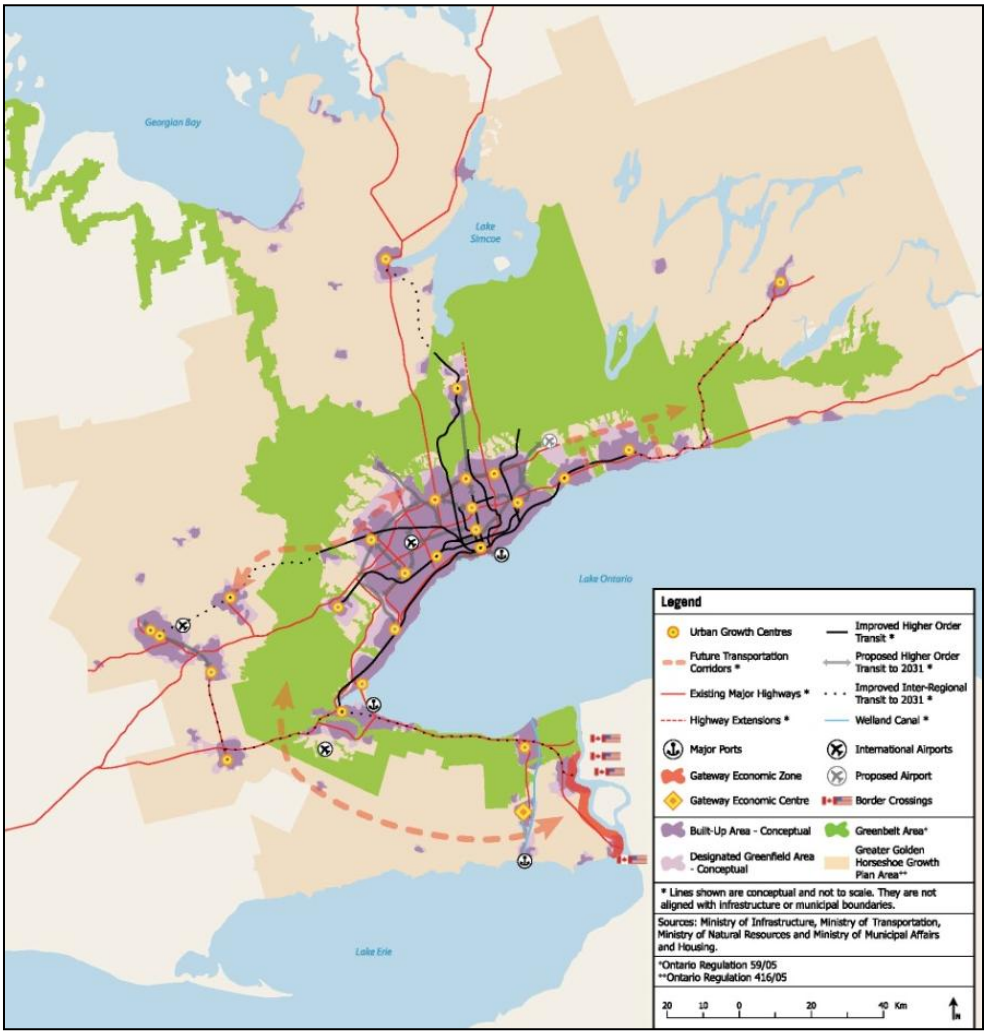
With approximately 3.7 million additional people projected to arrive to the GGH by 2031 (since 2001), it is essential that this influx of growth be planned for in a sustainable manner that avoids sprawl. To ensure communities in the GGH are compact, vibrant, and complete; farmlands and natural resources are preserved; and land and infrastructure are used more efficiently, the Growth Plan outlines a number of policies to direct growth within existing urban areas.

First, by 2015 and for each year thereafter, a minimum of 40 percent of all annual residential growth within each municipality is required to occur within the *built-up area* (2.2.2). Second, through their official plans and supporting documents, all municipalities are required to develop and implement strategies and policies to phase in and achieve *intensification targets* based on the growth forecasts contained in Schedule 3 of the Growth Plan as they are updated every five years (2.2.3). Furthermore, as illustrated in table 2, the Growth Plan identifies twenty five existing or emerging downtown areas as *urban growth centres* where development and revitalization are being encouraged through minimum density targets for 2031 (2.2.4). Figure 4 demonstrates how these targets demand high levels of sustained long-term growth in relatively small designated boundaries, some of which are located outside of the Greenbelt. Lastly, in areas outside of the built-boundary identified as *greenfields*, the Growth Plan requires future development accommodate an average density target of 50 persons and jobs per hectare throughout each upper and single-tier municipality by 2031.

**Table 2. Density of Urban Growth Centres as per Section 2.2.4 of the Growth Plan**

| 400 people & jobs combined per hectare | 200 people & jobs combined per hectare | 150 people & jobs combined per hectare |
|---|---|---|
| Downtown Toronto | Downtown Brampton | Downtown Barrie |
| Etobicoke Centre | Downtown Burlington | Downtown Brantford |
| North York Centre | Downtown Hamilton | Downtown Cambridge |
| Scarborough Centre | Downtown Kitchener | Downtown Guelph |
| Yonge-Eglinton Centre | Uptown Waterloo | Downtown Peterborough |
| | Downtown Milton | Downtown St. Catharine's |
| | Markham Centre | |
| | Mississauga City Centre | |
| | Newmarket Centre | |
| | Midtown Oakville | |
| | Downtown Oshawa | |
| | Downtown Pickering | |
| | Richmond Hill | |
| | Vaughan Corporate Centre | |

**Figure 4. Schedule 2 - Places to Grow Concept**



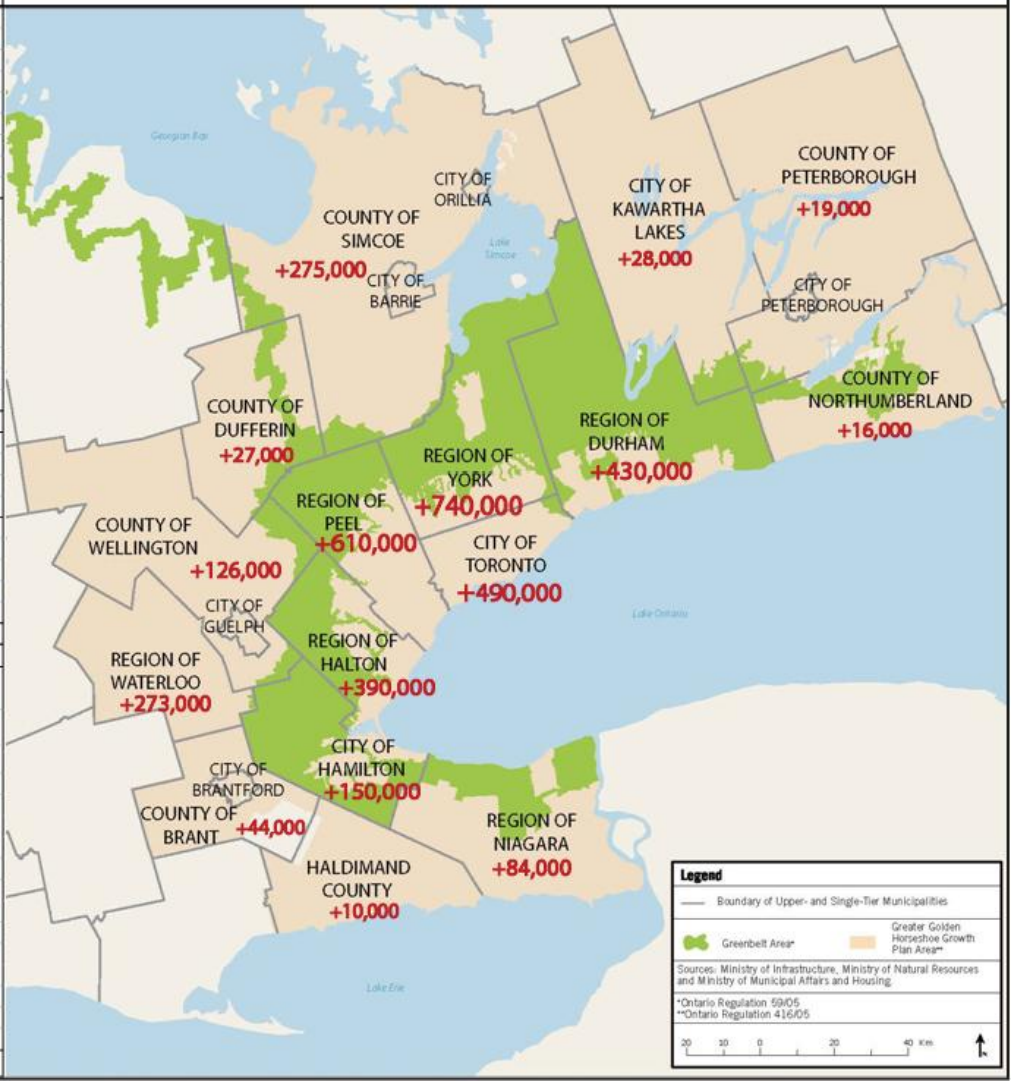

*Places to Grow - Growth Plan for the Greater Golden Horseshoe* © Queen's Printer for Ontario, 2006. Reproduced with permission.

Note: The information displayed on this map is not to scale, does not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise boundaries, the appropriate municipality should be consulted. For more information on Greenbelt Area boundaries, the Greenbelt Plan 2005 should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.

At the present time, the population forecasts of the Growth Plan have been implemented into all of the official plans of the upper-tier municipalities, and the projections for 2031 are displayed in figure 5. Although all 21 of the upper- and single-tier municipalities have created growth management strategies and adopted amendments to conform to the Growth Plan requirements, only half of the 89 lower-tier municipalities have adopted an official plan amendment to do so, and some of those which have are under appeal to the Ontario Municipal Board (Ministry of Infrastructure, 2011).

**Figure 5. Projected Population Distribution for the GGH**

| ACCOMODATED UPPER-TIER GROWTH FORECASTS: 2031 | |
|---|---|
| Ajax | 137,670 |
| Brock | 14,015 |
| Clarington | 140,340 |
| Oshawa | 197,000 |
| Pickering | 225,670 |
| Scugog | 25,390 |
| Uxbridge | 26,965 |
| Whitby | 192,860 |
| **Region of Durham** | **960,000** |
| Aurora | 70,400 |
| East Gwillinbury | 88,000 |
| Georgina | 70,700 |
| King | 35,100 |
| Markham | 423,500 |
| Newmarket | 97,300 |
| Richmond Hill | 242,800 |
| Vaughan | 418,800 |
| Whitchurch-Stoufville | 60,800 |
| **Region of York** | **1,500,000** |
| **City of Toronto** | **3,080,000** |
| Brampton | 727,000 |
| Caledon | 111,000 |
| Mississauga | 807,000 |
| **Region of Peel** | **1,640,000** |
| Oakville | 246,400 |
| Burlington | 186,169 |
| Milton | 228,084 |
| Halton Hills | 91,885 |
| **Region of Halton** | **780,000** |
| **City of Hamilton** | **660,000** |
| **GTAH Total** | **8,620,000** |
| County of Northumberland | 96,000 |
| County of Peterborough<br>City of Peterborough | 149,000 |
| City of Kawartha Lakes | 100,000 |
| County of Simcoe<br>City of Barrie<br>City of Orillia | 667,000 |
| County of Dufferin | 80,000 |
| County of Wellington<br>City of Guelph | 321,000 |
| Region of Waterloo | 729,000 |
| County of Brant<br>City of Brantford | 173,000 |
| County of Haldimand | 56,000 |
| Region of Nagara | 511,000 |
| **Outer Ring Total** | **2,880,000** |
| **TOTAL GGH** | **11,500,000** |




Source: This image was produced by the author from an existing image produced within: *Places to Grow - Growth Plan for the Greater Golden Horseshoe* © Queen's Printer for Ontario, 2006.

*Accommodated municipal growth forecast figures reflect official plan amendments adopted by upper-tier municipalities to conform to the Growth Plan

**Projected Population Growth for the GGH 2001-2031 figures reflect Schedule 3 of the Growth Plan

By requiring municipal plans to conform to the aforementioned policies, the Growth Plan intends to provide a statistical base for comparing present day urban footprints to those expected at 2031 to help municipalities define urban land budgets to the 2031 horizon accordingly. It also provides a sense of the magnitude of growth pressures and related challenges that municipalities in the GGH may face with respect to providing sufficient infrastructure to accommodate this level of growth.

## 3.2 What challenges does directing this level of growth to these areas pose?

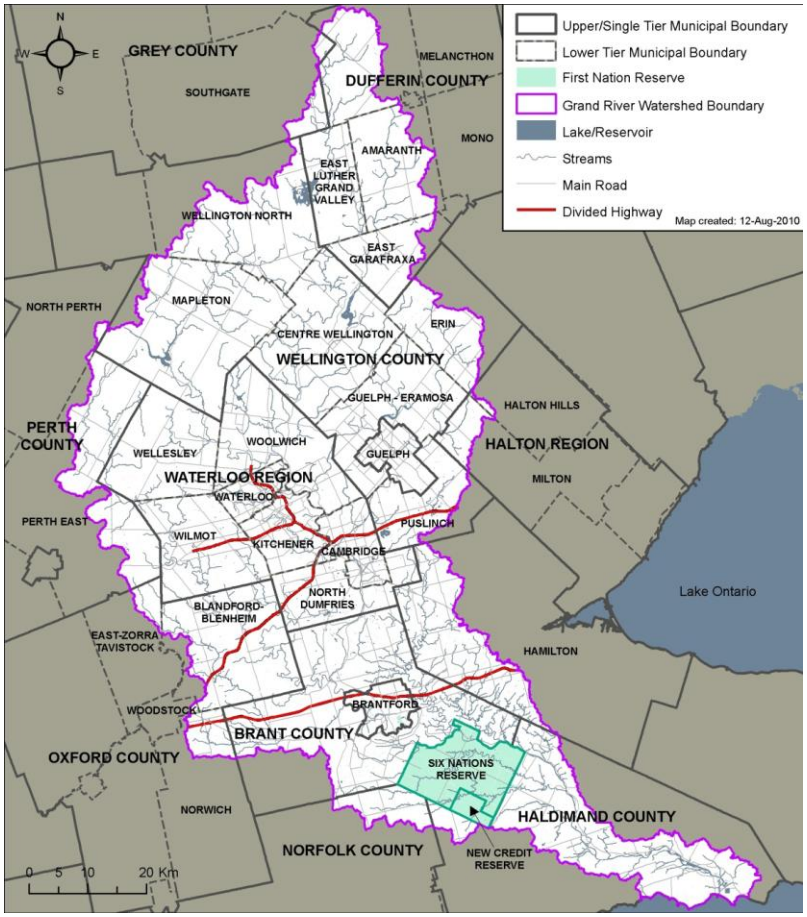
In an attempt to reorient the shape of growth and development throughout the Region until 2031, the Growth Plan is arguably contradicting its goal of accommodating future growth by making the best use of existing infrastructure and living sustainably within local watersheds. Even with requirements for water conservation and demand management strategies firmly in place within the Provincial planning framework, the Growth Plan's intensification and urban growth targets could allocate growth to watersheds without the natural or infrastructural capacity to sustain the future demand for water.

Although these concerns existed in many GGH municipalities before the development of the Growth Plan, they were heightened as a result of its implementation (Binstock, 2010). A 2005 report by Hemson Consulting entitled, *The Growth Outlook for the Greater Golden Horseshoe*, which provided valuable input to the Ministry of Public Infrastructure Renewal in finalizing the growth forecasts for the Growth Plan, warned that the water and wastewater systems in many of the areas of the GGH's "outer ring" could reach the capacity to expand using existing receiving streams and existing infrastructure technology (Matthew, Simpson, Lorius, Macleod, & Sjogren, 2005). In addition, the Environmental Commissioner of Ontario's 2007 report entitled *Reconciling our Priorities,* argued that by establishing population projections for communities before assessing their related water and wastewater infrastructure needs and associated environmental impacts*,* the Province is "putting the cart before the horse" (Environmental Commissioner of Ontario, 2007).

To accommodate the level and direction of growth prescribed by the Growth Plan, major upgrades to water and wastewater infrastructure are required. Not only will this be incredibly costly, but it could negate many of the underlying elements of Smart Growth that underpin the Growth Plan. As Figure 5 demonstrates, the Region of Waterloo, County of Wellington, and to a lesser extent, the Counties of Brant and Dufferin, are designated to accommodate significant growth. Moreover, Growth Plan identifies five *urban growth centres* (Downtown Kitchener, Uptown Waterloo, Downtown Brantford, Downtown Cambridge, and Downtown Guelph) within these areas as targets for intensification. However, unlike the regional municipalities located within the "inner ring" of the GGH, they are

separated from lake-based sources of water. As such, they are largely dependent on groundwater or rely on a limited supply of surface water for drinking water and discharging treated wastewater (Koycheva, 2003; County of Wellington, 2006; Matthew, Simpson, Lorius, Macleod, & Sjogren, 2005; Gold, 2008).

**Figure 6. Grand River Watershed (Stahl, 2010)**




Groundwater has proven to be a reliable and economical resource throughout the GGH, but the size of the resource throughout the Region is not well known (Sharpe, et al., 1996). Some hydrologists have claimed there may be undiscovered sources of groundwater deep underground parts of the GGH that could delay or supplement infrastructure expansion (Swayze, 2011). Although groundwater is a renewable resource, it cannot be solely relied upon to the extent it currently is if growth is to continue as outlined in the Growth Plan. To meet the projected demand, water will likely have to be supplied from outside the local watershed via large pipelines from Lake Ontario, Lake Erie or Georgian Bay.

An area likely to undertake such an expansion in the near future is the Region of Waterloo, which currently relies on groundwater from the Grand River Watershed (Figure 6) to supply approximately 80 percent of its water supply but is projected to have an additional 273,000 new residents between 2001 and 2031 (Gold, 2008). Faced with the task of accommodating a higher level of growth than originally anticipated by regional planners, Waterloo expects to spend an estimated $826 million upgrading and expanding its water and wastewater treatment services (Environmental Commissioner of Ontario, 2007) and is currently considering a planned $1.2 billion pipeline from Lake Erie over concerns that there's not enough water available in underground aquifers (Swayze, 2011).

Waterloo is not alone in facing such considerations. Many of the *urban growth centers* located within the "outer ring" are among the fastest growing cities in Canada but, like most of their respective upper-tier municipalities, are land locked. Consequently, the majority of these locations are primarily dependent on ground or surface water for their municipal drinking water supplies (Environmental Commissioner of Ontario, 2007). Consultants that have examined the potential impact of the Growth Plan on these areas predict that conservation strategies and further infrastructure expansions are required to accommodate the long-term growth expectations of the Growth Plan but not all of the respective municipalities have sufficient funds to do so (Binstock, 2010).

The challenges associated with overcoming natural hydrological limits through the provision of infrastructure to keep pace with growth are not unique to the municipalities located in the "outer ring" of the GGH. Other municipalities, such as those within York Region, have access to lake-based sources of water (Lake Simcoe), but have limited ability to increase stream base flow, and accessible lakes do not provide an adequate supply to support the amount of growth forecast and have limited capacity to accept additional wastewater discharges (Sharpe, et al. 1996; York Region, 2009).

York Region has decided to enhance and expand its existing water and wastewater systems to support their expected growth via Lake Ontario-based servicing at an estimated capital cost of $4.8 billion by 2031 and $6.6 billion by 2051 (York Region, 2009). According to York Region's *Water and Wastewater Master Plan, 2009,* this decision was the result of, "the unprecedented population and economic growth that the Provincial Government has mandated for York Region" in addition to, "direction from the provincial Government about where this growth can take place" (ibid).

Contrary to the situation in Waterloo, approximately 80% of York Region's drinking water is sourced from Lake Ontario (ibid). However, because of its geographic location, a large portion of this water is

purchased from the City of Toronto and Peel Region (ibid). The external operating costs borne by York Region to pay for drinking water and wastewater transfers from and to adjacent municipalities costs upwards of $67 million annually and are projected to reach approximately $813 million by 2051 (Tables 3 & 4) (ibid). This does not include operation and maintenance expenses which currently cost York Region over $45 million and are expected to increase considerably (ibid).

**Table 3. Annual Inter-Regional Water Costs for York Region (York Region, 2009)**

| Year | City of Toronto | Peel Region | Total |
|---|---|---|---|
| 2009 | $20,000,000 | $9,000,000 | $29,000,000 |
| 2011 | $24,000,000 | $10,000,000 | $34,000,000 |
| 2016 | $33,000,000 | $14,000,000 | $47,000,000 |
| 2021 | $46,000,000 | $20,000,000 | $66,000,000 |
| 2026 | $63,000,000 | $27,000,000 | $90,000,000 |
| 2031 | $86,000,000 | $37,000,000 | $123,000,000 |
| 2036 | $117,000,000 | $51,000,000 | $168,000,000 |
| 2041 | $160,000,000 | $69,000,000 | $229,000,000 |
| 2046 | $217,000,000 | $94,000,000 | $311,000,000 |
| 2051 | $296,00,000 | $128,000,000 | $424,000,000 |

**Table 4. Annual Inter-Regional Wastewater Costs for York Region (York Region, 2009)**

| Year | Durham Region | Peel Region | Total |
|---|---|---|---|
| 2009 | $24,000,000 | $4,000,000 | $28,000,000 |
| 2011 | $28,000,000 | $5,000,000 | $33,000,000 |
| 2016 | $39,000,000 | $7,000,000 | $46,000,000 |
| 2021 | $54,000,000 | $9,000,000 | $63,000,000 |
| 2026 | $73,000,000 | $12,000,000 | $85,000,000 |
| 2031 | $99,000,000 | $17,000,000 | $116,000,000 |
| 2036 | $135,000,000 | $23,000,000 | $158,000,000 |
| 2041 | $182,0,000 | $31,000,000 | $213,000,000 |
| 2046 | $246,000,000 | $42,000,000 | $288,000,000 |
| 2051 | $333,000,000 | $56,000,000 | $389,000,000 |

A fundamental objective of the Growth Plan is, where possible, to prevent unchecked growth by focusing it in urban areas with existing servicing that can be maintained or easily upgraded to avoid large capital investments in infrastructure (3.2.5). Investments in infrastructure are intended to be optimized by compact, high-density urban form to more accurately cover the costs of infrastructure, not to expand infrastructure outward. The savings that are supposed to result from making more efficient use of infrastructure are, therefore, negated by the expenses incurred as a result of a longer network of pipes that increase transmission costs.

By increasing water and wastewater capacity through major infrastructure extension projects large amounts of water are artificially transported long distances from outlying hydrological systems. In addition to the high installation, operational and maintenance costs, the amount of energy required to pipe this water in and out of local watersheds to meet the growing demand are inconsistent with both the principles of Smart Growth and the intent of the Growth Plan.

Instead of providing servicing to relatively undeveloped lands to promote growth, as was the case during the GTA's initial expansion, the Province has provided intensification targets through an overriding policy so infrastructure will adapt and growth will be redirected so as to be more efficient. If the history of the Region is any indication, by continuing to finance large water and wastewater infrastructure projects, it is possible that development of the pipe could permit conventional growth patterns much in the same way as previous large-scale infrastructure expansions in the GGH did. Although the Growth Plan contains policies encouraging this not to happen, it is not required so long as intensification targets are met. More importantly, the policies in place do not align themselves with the lifespan of infrastructure developments which have the potential to shape growth far beyond the 2031 timeframe.

Whether or not growth will be accommodated is now a question of timing. Will infrastructure be able to respond to the demands of growth, or will growth exceed the natural and infrastructure capacity of the Region? While it is essential that cities and towns have an adequate water supply, it appears somewhat paradoxical that, in some parts of the GGH, compact, high density Smart Growth is being sought at the expense of an elongated network of water and wastewater infrastructure expansion that will supersede the lifespan of "long-term" planning decisions.

Without adjusting the cost of provision, to make water and wastewater infrastructure expansion economical, density is required. However, in many of the land locked areas of the "outer ring" large pipes are needed to transport water through areas where high-density growth is not being targeted. Further compounding this issue is the fact that such projects would be exempt from the natural heritage protection provisions set out in the PPS even though their construction would impact the environment (Environmental Commissioner of Ontario, 2007). While it is a positive sign that the Province is encouraging water conservation strategies, and in the case of new infrastructure developments, requiring them, as long as water is not priced according to its true cost of delivery, expanding infrastructure to meet future demand will not promote a culture of conservation, it will have an inverse effect.

## 3.3 Do municipalities have the tools to plan for Smart Growth "by the pipe"?

To help mitigate the pressures of rapid growth on the Region's infrastructure and natural environment, and to accommodate the Growth Plan's intensification targets, some upper-tier municipalities have instituted water and wastewater master plans. In accordance with the provincially legislated *Planning Act* and *Environmental Assessment Act*, these planning documents are strategies for the provision of water and wastewater servicing to preferred areas of existing and future land use.

Though not in the traditional sense, water and wastewater master plans present opportunities for municipalities to "plan by the pipe". Municipalities are required to consider the opinions of the public, relevant stakeholders, provincial legislation, and other regional policies governing growth management. As long as water and wastewater master plans are conforming, municipalities can identify future service needs in accordance with existing and anticipated water and wastewater servicing capacity and demand. In doing so, growth can be directed at the local level by aligning land use with the provision and capacity of water and wastewater infrastructure. For this growth to be "smart", however, in addition to infrastructure serving high-density development located within or near developed areas, strategies need to consider the carrying capacity of local and Regional hydrological systems.

Of the upper-tier municipalities within the "inner ring" of the GGH, Halton and York have developed water and wastewater master plans, while Peel, Hamilton, and Durham are in various stages of doing so. Of the nine regional municipalities in the "outer ring" of the GGH, only three (Niagara, Northumberland, and Simcoe) have, or are in the process of developing water and wastewater master plans. Throughout the entire GGH, however, only York Region has formally aligned its growth management strategy with a water and wastewater master plan beyond the timeframe of the Growth Plan (2051).

Due to the strong correlation between population growth and infrastructure servicing constrains, it is essential that long-term planning strategies related to water and wastewater are aligned with the lifespan and demand of existing and future infrastructure. However, the extent to which water and wastewater master plans are presently doing so in accordance with the principles of Smart Growth is difficult to discern. Future research should involve a more in-depth policy analysis of each of the water and wastewater master plans in the GGH.

Water and wastewater master plans offer the opportunity to assess various alternatives to enhancing and expanding existing water and wastewater systems, and can provide the solution that is most appropriate at the local scale to effectively accommodate the long term growth of the region. However,

decisions regarding the supply and delivery of water involve a variety of actors and processes and can become fragmented between the different levels of government, and the choices of one level of government can have tremendous hydrological implications on another. It is, therefore, important to collaborate with stakeholders outside of local jurisdictions, especially, other municipalities that share hydrological systems. Further research could investigate whether a regional plan should be developed to harmonize the collective long-term water supply needs and capabilities of the Region with its growth projections.

# 4 CONCLUSION & FINAL RECOMMENDATIONS

The Growth Plan represents the most promising attempt to address sprawl in Canada. However, it is underpinned by Smart Growth, a concept that has been championed by successive Ontario Governments but does not sufficiently account for the negative hydrological effects of sprawl. Further research on the role of water in Smart Growth literature is needed, particularly within a Canadian context. This will aid in the construction of future policies and legislation.

Water is an indispensible source of life that is inseparable from growth, yet the need to connect the provision and supply of water with the process of directing growth has been somewhat overlooked by the Growth Plan. Water can improve the condition of urban life and propel urban growth only as much as the biophysical carrying capacity of an ecosystem will allow. However, the density targets prescribed by the Growth Plan do not accurately reflect the ecological capacity of many of the GGH's landlocked municipalities which lack direct access to lake-based water supplies. This necessitates extensive infrastructure upgrades which arguably contradict the intent of Smart Growth and the Growth Plan.

The Province should consider making revisions to its growth management strategy to more accurately reflect the lifespan of water and wastewater infrastructure, the finances required for their long-term maintenance and expansion, and the Region's hydrological capacity. Given that the Ontario Growth Secretariat is currently reviewing the population and employment forecasts contained in the Growth Plan, now is an optimal time to consider reducing growth forecasts and redirecting allocations where necessary. In addition, the Province should contribute increased financial support help fund water conservation strategies at the municipal level.

The delivery of water in Ontario must shift from a "hard" engineering approach that favours large infrastructure developments or "techno-fix" solutions to artificially transport water, to a "softer"

approach that considers the hydrological process and environmental capacity of various geographic scales, as well as community management and a diversity of delivery options. When viewed from this perspective, the sustainability of local and regional growth is considered from a more balanced and long-term perspective that considers the environmental, social, and economic dimensions of water and growth in planning.

Although the provision and restriction of water and wastewater services has not, on its own, had the power to control growth, the historical record of the GGH dictates that development has followed the pipe, particularly if they are high capacity. Some municipalities within the GGH have instituted water and wastewater master plans in an attempt to complement the Growth Plan's direction and manage growth "by the pipe".

Water and wastewater master plans are a promising planning tool that can help municipalities plan for Smart Growth under the Growth Plan, but for them to be truly effective, they should anticipate growth past 2031 to more accurately align growth with the servicing capacity and lifespan of water and wastewater infrastructure. When creating these strategies, municipalities should incorporate water supply planning into land use planning and require that a sustainable supply of water be in place before development can occur. If implemented correctly, and where necessary, this can be done in accordance with the principles of Smart Growth to ensure development is compact and expenses are minimized. By using water more efficiently, more people can be serviced, less water is wasted and increased growth can be sustained.

The Growth Plan is an encouraging step toward the creation of a sustainable framework for managing growth in Ontario. However, as Canada's fastest growing region continues to grow, many municipalities encroach upon the limit of their hydrological systems and are increasingly becoming dependent on engineered water supplies to facilitate future growth. An infrastructure-based approach to planning for growth is only a partial solution. For growth strategies to truly be "smart" they must also be complemented by an ecological perspective.

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