CITY OF GUELPH

WATER CONSERVATION AND EFFICIENCY STRATEGY UPDATE

Final Report

May 25, 2009

RMSi Resource Management Strategies Inc.

Protecting resources for future generations

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1.0 Executive Summary

The City of Guelph has a history of environmental stewardship and leadership. This attitude and action can be observed in the area of water conservation. As one of the largest cities in Canada dependent solely on a groundwater source of water supply, Guelph has been providing water conservation and efficiency education for a number of years and more recently technical programming such as toilet and water efficient clothes washer rebates as well as Industrial, Commercial and Institutional audits and incentive programs.

In June, 1998, the City of Guelph initiated a Water Conservation and Efficiency Study (WC&E) to develop a comprehensive water conservation and efficiency plan for the City's residential, industrial, commercial and institutional sectors. The study established an integrated relationship between the environmental, technical, regulatory and social acceptance of numerous water efficiency alternatives and upon completion in 1999 the Water Conservation and Efficiency study identified the following set of recommendations:

- That City staff accept the Water Conservation & Efficiency Steering Committee's recommended Water Conservation & Efficiency Plan and prepare regular reports on the status of the City's water supply and wastewater treatment capacity.
- That Alternative Day Lawn Watering remain mandatory.
- That a permanent ban on lawn watering not be implemented, however, the ability to temporarily eliminate lawn watering in the event of an emergency be retained.
- That city Staff be directed to require individual metering, where feasible, in all new multi-residential housing.
- That the City continue to track and assess innovations in water conservation and efficiency technology and pursue changes in applicable legislation. Opportunities for inclusion of new or improved technologies should be evaluated on a regular basis.
- That a water rate study, in order to reassess peak period and conservation pricing, be completed by January 1, 2002.
- That the City of Guelph undertake a water audit of City facilities beginning in 1999, and commence installation of required water conservation and efficiency fixtures in order to lead by example.
- That the City continue to pursue opportunities to use the water bill as an educational tool.
- That staff be directed to review processes to regulate automatic lawn water sprinkler installation and maintenance.
- That staff be directed to encourage owners of private distribution system to minimize their unaccounted for water (UFW).
- That staff consider implementing an environmental management system, such as ISO 14000, for the Waterworks and Wastewater Services, and promote similar environmental management systems in the private sector.
- That the City continues its policy of charging full water and wastewater rates for all water used.
- That various funding methods be investigated for the financing of water conservation and efficiency methods.
- That the City establish an implementation committee to oversee the development of the Water Conservation & Efficiency Plan.

To meet future water supply requirements to service and sustain projected community growth, the City initiated the Guelph Water Supply Master Plan in 2004. Through the development of the Water Supply Master Plan, the employment of an enhanced water conservation and efficiency strategy, mitigation of distribution-based water loss, and education/policy/rate based reviews, were identified as the preferred short-term options to reclaim critical supply capacity in concert with optimization and rehabilitation of current supply based infrastructure. With a finite groundwater source, and uncertainty regarding the availability of further groundwater sources or impact of additional water taking from current sources, the finalized 2006 Water Supply Master Plan identified sustainable growth potential in the City contingent upon the success of aggressive water conservation and efficiency programs. As part of the 50 year Master Plan water conservation was recognized as a preferred short term source of water supply and recognized the following time based water reduction targets:

- 10% reduction in 2006 total average day water use by 2010
- 15% reduction in 2006 total average day water use by 2017
- 20% reduction in 2006 total average day water use by 2025

Upon Council's approval of the Water Supply Master Plan, full implementation of the 1999 Water Conservation and Efficiency Study was undertaken with enhanced annual financial support granted to the City's Water Conservation and Efficiency Program in support of pursuing the above targets in the time required to undertake an update to the City's Conservation and Efficiency Strategy.

In 2007, the City Council endorsed the Community Energy Plan which noted the per capita water and energy goal of *Using less energy and water per capita than any Comparable Canadian City.* Later that year, the goal was reiterated and identified through Goal 6 of the City of Guelph 2007 Strategic Plan, noted below:

Natural Environment - A leader in conservation and resource protection/enhancement:

Strategic Objective 6.5 – Use less energy and water per capita than any Comparable Canadian City.

With the emergence of regulatory and technology advancements since the completion of the City's original 1999 Conservation and Efficiency Study, City staff began development of the Water Conservation and Efficiency Strategy Update in February of 2008. For assistance in the development of the strategy, City staff retained project consultant Resource Management Strategies Inc. (RMSi) through a request for proposal process. Included in RMSi's extended consulting team was Leapfrog Energy Technologies, David Pearson Consultancy, Hetek Solutions and B+T Engineering.

The goal of the Water Conservation and Efficiency Strategy Update was to identify preferred program, policy and resource alternatives to best meet the water reduction goals identified in the Guelph Water Supply Master Plan, Community Energy Plan and Council Strategic Plan. In addition, the Water Conservation and Efficiency Strategy Update was to identify preferred program implementation forecasts, and program support staff and maintenance based resources required to meet and sustain the water reduction goals over the planning period.

With the importance of ongoing public consultation throughout the development of the Water Conservation and Efficiency Strategy Update, the formation of a Water Conservation and Efficiency Strategy Public Advisory Committee (PAC) was endorsed by Council. Following Council approval the PAC was formed to work with the staff and project consultant team. A total of 14 members were selected from a variety of stakeholders groups including:

- City Council (1)
- Industry (2)
- Home Builders/Development (1)
- Environmental Interest (3)
- Plumbing (1)
- Academia -University of Guelph (2)
- Grand River Conservation Authority (1)
- Public at Large (3)
- Chamber of Commerce (1)

The PAC met four times throughout the development of the strategy and provided new ideas, direction and initiatives for the consultant team to consider while providing feedback to key findings and progress provided.

To solicit feedback from further members of the public, a series of Public Information Centres (PICs) were held through the Strategy Update process. Through these events, residents and area stakeholders were introduced to the project scope and planned activities, and provided with results to date including: public consultation, market research, residential water use demand analysis, Industrial, Commercial and Institutional water use demand analysis, evaluation of distribution system water loss and water supply demand forecast. As part of each event, a round table discussion was held to obtain input towards the direction of the strategy and to solicit programming ideas.

As a first step to the study, focus groups were held to capture community input to the process through qualitative market research. The data captured does not provide statistically relevant information. However, information gained from the focus groups was used to develop context around water conservation and efficiency, understand issues and local concerns, and explore the appropriate means of communications to achieve success in project development and delivery. In total, three (3) focus groups were conducted on April 22nd, 2008 at a professional focus group facility in Guelph, moderated by a professional market researcher. Each group consisted of 5-7 participants, and lasted approximately 90 minutes. Participants in this research were randomly recruited residents of the City of Guelph.

Finally, a customer survey was completed to capture community input in a quantitative manner, providing statistically significant data that could be extrapolated to the entire community. To accomplish this, 400 randomly selected Guelph residents on municipal water supply were contacted by telephone between June 23rd and June 30th, 2008. Residents were asked a series of questions pertaining to water and water conservation in their community. Through this process, there was a series of scaled (i.e. choose 1- 10), and both open (i.e. how do you feel about…) and closed ended questions (i.e. yes or no).

Information gathered provided data on demographic information, general public knowledge, participation and satisfaction in water efficiency programs offered by the City of Guelph, water use behaviour indoors and outdoors, willingness and desired/required incentives for implementing water saving mechanisms.

The promotion of water conservation and efficiency is not new in the City of Guelph. Since the development of the Water Conservation and Efficiency Study (WC&ES) in 1999 the City has been actively completing a whole range of water efficiency measures including:

- Royal Flush Toilet Program, a rebate program introduced in 2003
- Smart Wash Clothes Washer Rebate Pilot Program, a rebate program launched February 2008
- Industrial, Commercial and Institutional (ICI) Water Capacity Buyback Program, introduced in 2007
- Outside Water Use Program, out water use restrictions introduced in 2001
- Landscape Assessment Pilot Program, launched in May, 2008
- City of Guelph Facility Water Efficiency Retrofits, a program to lead by example
- Public Education and Outreach including
    - Waterloo / Wellington Children's Water Festival
    - Guelph International Resource Centre (GIRC) Water Efficiency Workshop Series (2007/2008)
    - 2008 City of Guelph Water Conservation Breakfast Workshop
    - Green Impact Guelph (GIG) Partner
    - Annual Waterworks Open House
    - Guelph Water Conservation and Efficiency Awards
    - Participation in numerous Community Events and Festivals

These above activities have contributed to significant water savings since 2003 as indicated in the following Table 1.

Table 1: Water Efficiency Results since 2003

Water Conservation Savings by Year 2003 to 2008				
Year	Program	Savings (m3/day)	Savings (m3/yr)	Total Annual Savings (m3/yr)
2003	Royal Flush	80.0	29,200.0	29,200.0
2004	Royal Flush	80.0	29,200.0	29,200.0
2005	Royal Flush	80.0	29,200.0	29,200.0
2006	Royal Flush	80.0	29,200.0	29,200.0
2007	Royal Flush	81.9	29,893.5	
2007	ICI Capacity Buyback - U of G	312.0	113,880.0	143,773.5
2008	Royal Flush	189.1	69,021.5	
2008	ICI Capacity Buyback - Cargill	190.0	69,350.0	
2008	Smart Wash Program	30.0	10,950.0	149,321.5
Total Savings		**1,123.0**		**409,895.0**

In order to develop the strategy, significant investigation and analysis of previous plans and strategies, water system, infrastructure, capital plans, demand forecasts, population projections and housing trends. The key findings are as follows:

- Gross water demand (total billed water supplied divided by population) has declined 17% from 444 litres per capital per day (Lcpd) in 1999 to 370 Lcpd in 2007,
- The City's population increased 14.6% from 101,857 residents in 1999 to 116,766 in 2007;
- The Residential Single Family water demand (total billed residential single family water supply divided by single family population) of 230 Lcpd in 2007 is significantly lower that the Canadian national average of 335 Lcpd and lower than most Ontario communities;
- The Residential Multi Family water demand (total billed residential multi family water supply divided by multi family population) was 153 Lcpd in 2007;
- 5% or 133 Industrial, Commercial and Institutional customers consume 80% of the overall water demand in that sector;
- Based on 2007 data, the City of Guelph has a Infrastructure Leakage Index (ILI) of 2.94 placing it in the Performance Category B with the potential for some improvement;
- The City is currently saving 1,123 m3 per average day (or 409,895 m3/year) of water as a result of its water conservation and efficiency efforts since 2003. These average day savings would represent the equivalent water resources required for approximately 1,600 new homes. A breakdown of daily water savings achieved by the conservation program is provided in Table 1.

The research, technical analysis and public consultation completed as part of the Water Conservation and Efficiency Strategy Update has resulted in the following program recommendations.

Recommended Water Conservation and Efficiency Strategy Components

Single Family Detached Residential Indoor Measures

- Provide rebates to residents who replace inefficient 13L toilets and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to residents who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers.
- Provide rebates to residents who install a grey water reuse system.
- Provide rebates to residents who install a rain water harvesting system.
- Visit homes and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Single Family Detached Residential Summer Demand Measures

- Provide rebates to residents who purchase and install watering timers.
- Visit homes and educate residents on how to maintain their lawns and water less and how to convert their properties to water efficient landscapes.
- Provide rebates or subsidized pricing for residents who purchase a rain barrel or larger water storage unit.

Multi Family Residential Indoor Measures

- Provide rebates to building owners who purchase and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to building owners who purchase and install a water efficient clothes washer in their laundry rooms.
- Visit apartments and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Residential New Development Indoor Measures

- Provide rebates to builders who proactively purchase and install approved high efficiency toilets or dual flush toilets, low flow showerheads and low flow kitchen faucets at the time of new home construction.
- Provide rebates to builders who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers at the time of new home construction.
- Provide rebates to builders who install a grey water reuse system at the time of new home construction.
- Provide rebates to builders who install a rain water harvesting system at the time of new home construction.

  Note: New home owners would realize the benefit of ongoing water savings.

Residential New Development Summer Demand Measures

- Provide rebates to builders who install watering timers.
- Provide rebates to builders who install water efficient landscapes as part of new home construction.

Industrial/Commercial/Institutional Measures

- Provide rebates to facilities who replace inefficient 13L toilets with ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to local businesses who purchase and install a water efficient clothes washer in their operations.
- Visit commercial kitchens and install free of charge low flow pre-rinse spray valves.
- Complete ten comprehensive water audits per year and offer a capacity buy-back rebate to any facility that implements all or some of the water saving recommendations.

Municipal Measures

- Design and implement five (5) district meter areas per year for three years. Locate, quantify and repair the leakage within the water distribution system.
- Complete Property Water Use Audits of existing municipal buildings and implement water efficiency retrofits and public demonstration projects. Identification and priority setting is currently ongoing. A City Building Water Efficiency Plan is anticipated for completion in late 2009 and will include appropriate water reduction targets.

Public Education

- Distribution of booklets, leaflets, and fact sheets at home shows and community and environmental events.
- Distribution of a water efficiency bulletin in the water bills.
- Displays at home shows, fairs and community events.
- Newspaper articles and advertisements.
- Develop and maintain a website to educate the public on water efficiency.
- Provide workshops and seminars to the public on water saving techniques both inside and outside the home.
- Provide water efficient demonstration gardens for the public to visit and learn.

Youth Education

- Develop and deliver a water efficiency education program based on the Ontario curriculum requirements.
- Continue annual participation in the Waterloo Wellington Children's Groundwater Festival.

Policy Based Recommendations (requiring Council approval)

- That the time based average day water reduction goals of the City's Water Supply Master Plan be formally endorsed as;

    - 10% reduction (5,300 m3/day) by 2010, based on 2006 average day water use;
    - 15% reduction (7,950 m3/day) by 2017, based on 2006 average day water use, and;
    - 20% reduction (10,600 m3/day) by 2025, based on 2006 average day water use;

- That the City adopt a water reduction philosophy of maintaining average day water production below the 2006 value (53,000 m3/day) for a 5 year period (2014).
- That the City of Guelph continue operation of the City's Outside Water Use Program in efforts to reduce impacts of Peak Seasonal Demands.
- That the City form a long standing Water Conservation and Efficiency Advisory Committee for purpose of ongoing public consultation throughout the implementation of the 2009 Water Conservation and Efficiency Strategy Update with an appropriate mandate and charter to be developed for the Committee..
- That the City in partnership with the Region of Waterloo continue performance testing research of home water softener technologies and promote through a public educational program technology performance results and related environmental benefits of preferred technologies.
- That the City's Wastewater Effluent Re-use dedicated pipe project, commonly referred to as the "Purple Pipe" project, and Class Environmental Assessment, as approved by Council through the 2008 Guelph Water/Wastewater Master Servicing Plan, evaluate the further potential for a communal wastewater effluent reuse system and design practices for customer serving of the effluent reuse source.
- That the City undertake a feasibility study to evaluate the best practices for multi-unit residential water metering and private servicing condition assessment requirements for current bulk metered multi-unit residential customers.
- That the City's Strategic Urban Forest Management Plan and the Natural Heritage Strategy define the appropriate means for protection and preservation of the City's urban forest in recognition of water conservation and storm water management benefits provided by the urban canopy.

- That staff undertake the immediate development of an enhanced public education water conservation program in 2009 subject to the availability of program funding.
- That staff initiate water loss mitigation activities in 2009 as outlined in the City's Water Loss Mitigation Strategy and investigate the potential for improved water pressure management in distribution system.
- That the City's Waterworks Department undertake a pilot study as part of the City's 2009 Water Loss Mitigation Strategy to evaluate the local implementation of Automated Metering Infrastructure (AMI) for customer water metering.
- That the City's Water/Wastewater Rate Review define customer billing policies for properties possessing Rain Water Harvesting Systems.
- That staff pursue external funding sources, and key partnerships, throughout implementation of the Water Conservation and Efficiency Strategy Update program recommendations.
- That Guelph's Water Conservation and Efficiency Programs be extended to customers located outside the Guelph Municipal boundary whom are individually metered by the City.

The capital budget necessary to implement the ten year strategy is shown in the following Table 2.

Table 2: Ten Year Capital Budget

Ten Year Capital Plan	Total Cost	Total Accumlative Savings (Ml/day)	Cost per Litre
Single Family Detached Residential - Indoor Demand Measures	$ 7,579,870	3,448,980	$ 2.20
Single Family Detached Residential - Summer Demand Measures	$ 2,385,000	996,500	$ 2.39
Multi Family Residential	$ 1,413,316	589,770	$ 2.40
New Development Residential - Indoor Demand Measures	$ 2,272,500	583,650	$ 3.89
New Development Residential - Summer Demand Measures	$ 1,026,000	294,000	$ 3.49
Industrial/Commerical/Institutional	$ 1,987,900	1,135,700	$ 1.75
Distribution Leakage Reduction	$ 238,500	1,725,000	$ 0.14
Public Education	$ 1,420,000		
Youth Education	$ 1,030,000		
Other Municipal Initiatives	$ 940,000		
Total	$ 20,293,086	8,773,600	$ 2.31

Funding Allocation	Total
Approved DC Forecast	$ 2,759,958
Current Water Conservation Funding (Rate Base)	$ 5,835,115
Additional Funding (Rate Base)	$ 11,698,013
Total	$ 20,293,086

The $11,698,013 of additional required funding represents a 4.3% water rate increase in 2010.

The cost-effectiveness of a water efficiency strategy is evaluated by determining the cost per litre for the water saved. The cost per litre for water saved is then compared to the cost per litre to construct new water supply and wastewater infrastructure. If the cost per litre of saved water is less than the cost to construct new capacity, then the water efficiency strategy is deemed cost effective. It is important to note that the calculated cost relating to construction of an additional litre of water and wastewater capacity does not include the cost of debt financing of construction projects. It is also important to note, that this figure does not include the cost of additional infrastructure required for the distribution and conveyance of water and wastewater to and from newly serviced areas such as water/wastewater mains, pumping stations or system reservoirs.

In southern Ontario, the combined water and wastewater construction cost per litre of additional supply/treatment capacity ranges from approximately $2.00 to $8.10. For the purpose of this study, a combined water and wastewater construction cost of $4.00 per litre of additional average day capacity was utilized for the financial analysis of the various conservation measures. Overall, the suite of preferred conservation measures identified in the final Conservation and Efficiency Strategy Update recommendation equalled a total program cost of $2.31 per litre of additional average day capacity (as noted in Table 2 above). Based on this analysis, the total cost per litre for the conservation program is 42% more cost effective than the cost of constructing new water and wastewater capacity.

Water savings generated from the efficiency strategy should be viewed in the same manner as constructing a new water treatment facility. If the City were to design and build a new facility to deliver 8.7 Ml/d, a budget for a maintenance program would be included to ensure that the facility continues to deliver 8.7 Ml d in the future. Water saved from a water efficiency strategy should be viewed similarly.

The strategy has been developed to save a specific amount of water and maintenance will continue to sustain the savings into the foreseeable future. The recommended maintenance budget is included in Table 3.

Table 3: Ten Year Maintenance Budget

Ten Year Maintenance Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Detached Residential - Indoor	$ 16,213	$ 16,426	$ 17,277	$ 17,916	$ 18,554	$ 19,193
Single Family Detached Residential - Summer Demand	$ -	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Multi Family Residential	$ 16,112	$ 16,223	$ 16,670	$ 17,005	$ 17,340	$ 17,674
Industrial/Commercial/Institutional	$ 12,061	$ 12,122	$ 22,867	$ 23,051	$ 28,104	$ 31,881
Distribution Leakage Reduction				$ 47,700	$ 47,700	$ 47,700
Total	$ 44,386	$ 62,771	$ 74,814	$ 123,671	$ 129,698	$ 134,448

Ten Year Maintenance Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	
Single Family Detached Residential - Indoor	$ 19,831	$ 20,470	$ 21,108	$ 21,747	$ 188,733
Single Family Detached Residential - Summer Demand	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 162,000
Multi Family Residential	$ 18,009	$ 18,344	$ 18,679	$ 19,014	$ 175,070
Industrial/Commercial/Institutional	$ 31,907	$ 31,933	$ 31,959	$ 73,985	$ 299,870
Distribution Leakage Reduction	$ 47,700	$ 47,700	$ 47,700	$ 47,700	$ 333,900
Total	$ 135,447	$ 136,447	$ 137,446	$ 180,446	$ 1,159,573

It is important to have a monitoring and evaluation program to ensure that the water savings are achieved initially, and that those savings are sustained over time.

Table 4 below provides the monitoring and evaluation by year for the ten year strategy.

Table 4: Ten Year Monitoring and Evaluation Budget

Ten Year Monitoring and Evaluation Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor	$ 345,000				$ 180,000	
Single Family Residential - Summer Demand	$ 45,000	$ 24,000	$ 24,000	$ 24,000	$ 98,460	
Multi Family Residential	$ 315,000				$ 120,000	
Industrial, Commercial and Institutional	$ 297,000				$ 37,700	
Total	$ 1,002,000	$ 24,000	$ 24,000	$ 24,000	$ 436,160	$ -

Ten Year Monitoring and Evaluation Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor				$ 180,000	$ 705,000
Single Family Residential - Summer Demand				$ 98,460	$ 313,920
Multi Family Residential				$ 120,000	$ 555,000
Industrial, Commercial and Institutional				$ 37,700	$ 372,400
Total	$ -	$ -	$ -	$ 436,160	$ 1,946,320

The reduction of water-use through an efficiency program and the associated energy savings provides significant greenhouse gas reductions. With climate-change in mind, most municipalities have set their own greenhouse gas reduction targets.

Water efficiency can be a positive contributor to meeting those targets. The full implementation of the Water Conservation and Efficiency Strategy Update recommendations provides energy savings and greenhouse gas emissions reduction as indicated in Table 5 below.

Table 5: Estimated Energy Savings and Associated Greenhouse Gas Emission Reductions

	Water Savings per Year (m3/year)	Energy Savings per Year	CO2 Reductions per Year (tonnes/yr)
Overall Water Savings	3,202,364	2,348,934 KWh Electricity	728 tonnes
Low Flow Showerheads and Faucets	Included in above	684,216 m3 Natural Gas	1,294 tonnes
Pre-Rinse Spray Valves	Included in above	206,325 m3 Natural Gas	390 tonnes
Overall CO2 Reductions			2,412 tonnes

Electric savings 2,348,934 KWh for the City of Guelph represents a savings of $140,936 on its electric bill per year

The reduction of 2,412 tonnes in CO2 represents the equivalent of 438 cars removed from the road each year

The final 2006 Water Supply Master Plan identified sustainable growth potential in the City contingent upon the success of aggressive water conservation and efficiency programs and identified the following overall targets in support of growth:

- 10% reduction (5,300 m3/day) by 2010, based on 2006 average day water use;
- 15% reduction (7,950 m3/day) by 2017, based on 2006 average day water use, and;
- 20% reduction (10,600 m3/day) by 2025, based on 2006 average day water use.

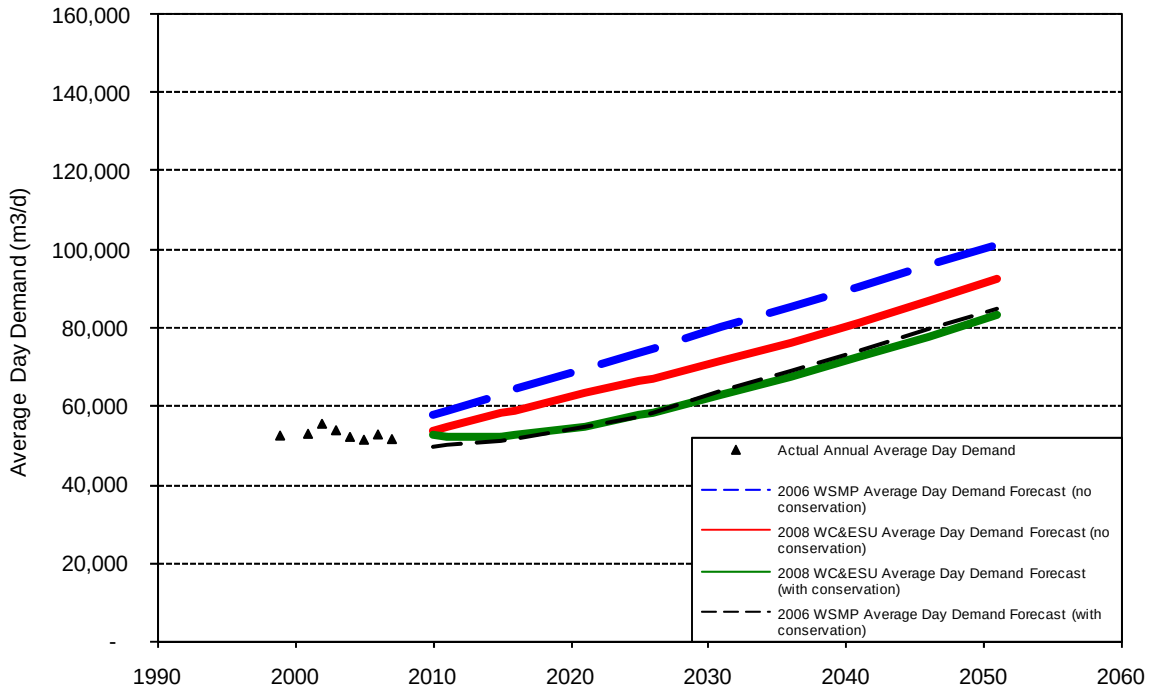
Total Potential Water Savings:

The analysis determined that the total potential for water efficiency is 13,661 m3/average day of water savings. However, meeting this total water efficiency potential assumes 100% participation rate in all conservation programs and would require extensive program funding. This analysis also assumes an overall decrease in residential single family demand from the current 230 Lcpd to 153 Lcpd, which may not be feasible for all vintages of homes in the City.

Total Achievable Water Savings:

Since the 2006 WSMP, the City has achieved 883 m3 per average day in water savings. The recommended ten year strategy in this report indicates an achievable water savings of an additional 8,774 m3 per average day by 2019. The combined savings represents a total of 9,657 m3 per average day water savings, which means that 90% of the 2025 water reduction goal (i.e. 10,600 m3/day) can be achieved by 2019. Not included in this estimate is the additional savings attributed to public and youth education. All would agree that education contributes to water conservation and efficiency but as discussed in the report, the exact savings are not possible to estimate or quantify. The above achievable water savings are predicated on adequate program funding throughout the 25-year timeline.

Figure 1: City of Guelph Average Day Demand Projections



The recommended ten year strategy has been developed to take full advantage of the available market potential. Not all, but most of the inefficient toilets, clothes washers, showers and faucets will have been replaced by the end of the ten year period. Additional savings will be more difficult to generate with traditional water saving technologies and more emphasis will be placed on emerging technologies such as grey water reuse and rain water harvesting.

A summary of water efficiency programs being implemented by municipalities in Ontario can be found in Appendix A. City of Guelph's water conservation and efficiency strategy was developed with these neighbouring municipalities programs in mind, aligning the programming to leveraged known successes.

In addition to the recommended programs, it is anticipated that the City will pursue partnering with other municipalities and government agencies in the pursuit of research and development of new and emerging water efficiency technologies and practices.

Advancements to regulations, codes and standards could go a long way in ensuring water efficient housing and businesses in the future. Currently, the Ontario Building Code requires water efficient fixtures in all new construction; however the retrofit market can still install inefficient toilets. Associations such as the Ontario Water Works Association and the Canadian Water and Wastewater Association, in conjunction with Canadian municipalities are lobbying for the adoption of a regulation that would ban inefficient toilets from all applications. This would assist the municipalities in their pursuit of water efficiency and could reduce or eliminate the need for rebates.

As noted above, water efficiency generates a number of co-benefits including energy savings and reductions in greenhouse gas emissions. Electric and natural gas utilities, with the encouragement of regulators and governments, have been enthusiastic in their promotion of energy efficiency. These agencies are ideal partners for water efficiency programs. By pursuing these types of partnerships the cost of programs can be shared as well as the benefits.

The implementation of this strategy by the City of Guelph will ensure financially and environmentally sustainable water resources for today and future generations.

2.0 Introduction

2.1 Development of Water Efficiency in the City of Guelph

Although water conservation and efficiency has been promoted by the City of Guelph for many years, the changing landscape has brought water efficiency to the forefront. Water Efficiency is recognised as a utility Best Management Practice (BMP) by the Federation of Canadian Municipalities (FCM), National Research Council (NRC) and the American Water Works Association (AWWA). The benefits of water efficiency are numerous:

- Water efficiency is the most cost effective alternative in generating additional water and wastewater capacity, sometimes as low as 25% of the cost of new infrastructure
- It can defer and sometimes eliminate new infrastructure projects
- Water savings from an efficiency program are quite often immediate, and can assist in bridging the gap in a water supply deficit area prior to the construction of a technical solution
- The well sites, pumping stations and distribution system consume significant amounts of energy, water efficiency reduces that energy consumption and thus reduces greenhouse gas emissions
- Water efficiency can contribute to lower water and energy bills for residents and businesses
- Water efficiency is a requirement to the recently amended Permit To Take Water Program administered by the Ontario Ministry of the Environment
- Water efficiency is likely to be a requirement for utilities located within the Great Lakes basin, as a result of the implementation of the Great Lakes Charter Annex

In June, 1998, the City of Guelph initiated a Water Conservation and Efficiency Study (WC&E) to develop a comprehensive water conservation and efficiency plan for the City's residential, industrial, commercial and institutional sectors. The study established an integrated relationship between the environmental, technical, regulatory and social acceptance of numerous water efficiency alternatives and upon completion in 1999 the Water Conservation and Efficiency study identified the following set of recommendations:

- That City staff accept the Water Conservation & Efficiency Steering Committee's recommended Water Conservation & Efficiency Plan and prepare regular reports on the status of the City's water supply and wastewater treatment capacity.
- That Alternative Day Lawn Watering remain mandatory.
- That a permanent ban on lawn watering not be implement, however, the ability to temporarily eliminate lawn watering in the event of an emergency be retained.
- That city Staff be directed to require individual metering, where feasible, in all new multi-residential housing.
- That the City continue to track and assess innovations in water conservation and efficiency technology and pursue changes in applicable legislation. Opportunities for inclusion of new or improved technologies should be evaluated on a regular basis.
- That a water rate study, in order to reassess peak period and conservation pricing, be completed by January 1, 2002.

- That the City of Guelph undertake a water audit of City facilities beginning in 1999, and commence installation of required water conservation and efficiency fixtures in order to lead by example.
- That the City continue to pursue opportunities to use the water bill as an educational tool.
- That staff be directed to review processes to regulate automatic lawn water sprinkler installation and maintenance.
- That staff be directed to encourage owners of private distribution system to minimize their unaccounted for water (UFW).
- That staff consider implementing an environmental management system, such as ISO 14000, for the Waterworks and Wastewater Services, and promote similar environmental management systems in the private sector.
- That the City continues its policy of charging full water and wastewater rates for all water used.
- That various funding methods be investigated for the financing of water conservation and efficiency methods.
- That the City establish an implementation committee to oversee the development of the Water Conservation & Efficiency Plan.

Council voted in the Spring of 1999 to implement the recommendations on a pilot scale. Since 1999 various initiatives identified through this report have been implemented by City staff.

In 2004 the City commenced a Water Supply Master Plan Study with the objective of identifying alternatives for future water supply that accommodates the projected community growth as identified through the Province of Ontario's Places to Grow legislation. Completed in 2006, the Guelph Water Supply Master Plan identified the following alternatives as the preferred short term options to reclaim critical supply capacity, in association with optimization and rehabilitation of the current supply based infrastructure:

- Employment of an Enhanced Water Conservation and Efficiency Strategy
- Mitigation of Distribution-Based Water Loss
- Education, Policy and Rate Based Reviews

With a vulnerable groundwater source, and due to the uncertainty regarding the availability or impact of further groundwater sources or additional water taking from current sources, the Water Supply Master Plan identified sustainable growth potential in the City contingent upon the success of an aggressive water conservation and efficiency program. The following average day water reduction targets were identified:

- 10% reduction in 2006 total average day water use by 2010
- 15% reduction in 2006 total average day water use by 2017
- 20% reduction in 2006 total average day water use by 2025

In April 2008 the City commenced development of the Water Conservation and Efficiency Strategy Update, and retained Resource Management Strategies Inc. (RMSi) to complete the project, which is reported on in this document. The primary objective was to complete a comprehensive update that would define preferred program alternatives, associated water savings, program implementation forecasts, and resources required to

meet the water reduction goals identified in the Guelph Water Supply Master Plan within a 20 year planning horizon.

2.2 Water Efficiency Activities Undertaken by the City of Guelph since the 1999 WC&E Study

Since the development of the Water Conservation and Efficiency Study (WC&ES) in 1999 the City has been actively completing a wide range of water efficiency measures which are summarised below:

Royal Flush Toilet Program

- Program introduced in 2003
- Rebates provided for the replacement of the 13 litre per flush toilets with approved water efficient models
- Rebates are $40 for the 6 litre Ultra Low Flush (ULF) toilet, and $60 for the High Efficiency Toilet (HET)
- Rebates available for residential, multi residential and ICI customers
- Over 6,700 rebates issued since 2003

"Smart Wash" Clothes Washer Rebate Pilot Program

- City of Guelph and Guelph Hydro partnership
- Pilot program with 500 rebates at $100 available
- Rebates for Front loading ENERGY STAR rated models
- Launched on February 1, 2008
- 500 rebates were reached on June 25, 2008, and the program was then closed

Industrial, Commercial and Institutional (ICI) Water Capacity Buyback Program

- Program introduced in 2007 for large ICI water users
- Program provides engineering services for detailed water use audits and water reduction based one time incentives ($300 per m^3 / average day reduction)
- Water savings quantified through detailed pre and post monitoring of water use
- Facilities participating include:
  - University of Guelph
  - Cargill Meat Solutions
  - The Elliot Community

Outdoor Water Use Program

- Introduced in 2001
- Ability to implement outdoor water use restrictions under environmental and operational thresholds
- Program restriction levels linked to Watershed based level changes of the Province of Ontario Low Water Response Procedure
- The City of Guelph has a peaking factor of 1.28, one of the lowest peaking factors in Ontario.

Landscape Assessment Pilot Program

- Launched in May, 2008
- Pilot program to provide 500 complimentary home landscape visits
- Focus on water efficient landscape design, plant selection and proactive maintenance best practices to mitigate effects of drought and impacts of common turf pests

City of Guelph Facility Water Efficiency Retrofits

- The City wants to lead by example
- Water efficiency retrofits completed within washrooms of high volume of use public facilities
- Program includes the water savings from the retrofits and also public education
- Retrofit sites completed to date include:
  - Victoria Road Recreation Centre
  - Exhibition Arena
  - Centennial Arena

Public Education and Outreach

- Waterloo / Wellington Children's Water Festival
- City of Guelph/Guelph International Resource Centre (GIRC) Water Efficiency Workshop Series (2007/2008)
- 2008 Water Conservation Breakfast Workshop
- Green Impact Guelph (GIG) Initiative Partner
- Annual Waterworks Open House
- Displays at numerous public events

Guelph Water Conservation Awards:

- Newly introduced in February 2008
- Set of recognition of awards for community leaders in water efficiency
- 3 award categories: Residential; Business; Community / Educational

Summary of Water Savings Results from Previous Activities

Table 6: Overall Water Savings by Year since 2003

Water Conservation Savings by Year 2003 to 2008				
Year	Program	Savings (m3/day)	Savings (m3/yr)	Total Annual Savings (m3/yr)
2003	Royal Flush	80.0	29,200.0	29,200.0
2004	Royal Flush	80.0	29,200.0	29,200.0
2005	Royal Flush	80.0	29,200.0	29,200.0
2006	Royal Flush	80.0	29,200.0	29,200.0
2007	Royal Flush	81.9	29,893.5	
2007	ICI Capacity Buyback - U of G	312.0	113,880.0	143,773.5
2008	Royal Flush	189.1	69,021.5	
2008	ICI Capacity Buyback - Cargill	190.0	69,350.0	
2008	Smart Wash Program	30.0	10,950.0	149,321.5
Total Savings		**1,123.0**		**409,895.0**

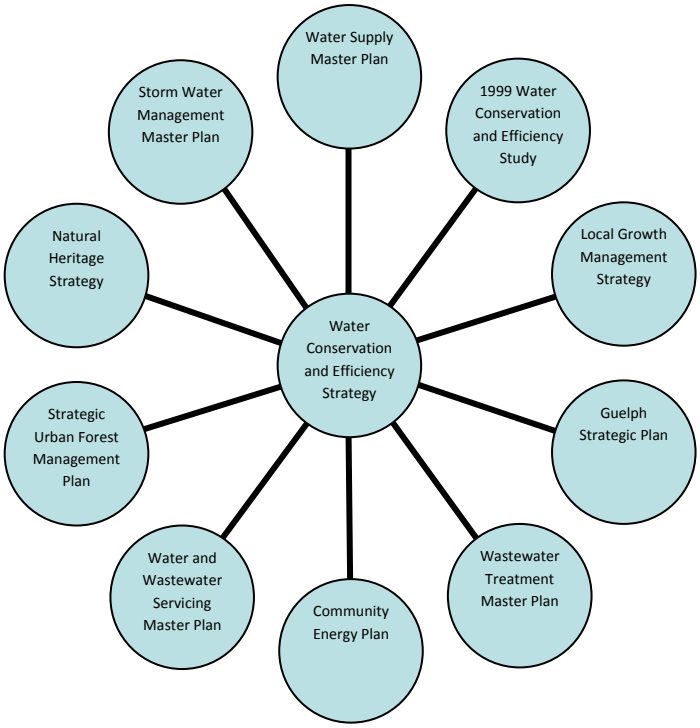
Table 7: Breakdown of Water Savings by Program

Royal Flush Program (Res/Multi-res)		
Year	Total Rebates	Savings (m3/day)
2006	800	80
2007	819	81.9
2008	840	84
Total:	**2,459**	**245.9**
2008 Royal Flush ICI Rebates		
Retrofits	Toilets Replaced	Savings (m3/day)
Mail In	1,021	102.1
Sifton Properties	640	64
U of G Residences	90	9
Ramada Inn	140	14
Total:	**1,891**	**189.1**
ICI Capacity Buyback Program		
Retrofits		Savings (m3/day)
U of G 2007		312
Cargill 2008		190
Total:		**502**
2008 Smart Wash Program		
Total Rebates	Total Rebates	Savings (m3/day)
500	500	30
Total:	**500**	**30**

2.3 Linkages to Other City Initiatives

The City is undertaking, or has recently undertaken, a number of planning initiatives and strategies that examine the changing demographics and regulatory environments in the City, and these changes' impacts on municipal services. The master planning studies develop long-range frameworks to assist the City in future planning decisions. While each of these studies are separate initiatives, the approach to and results of each will influence the others. Figure 2 illustrates the major planning initiatives that will be integrated into the Water Conservation and Efficiency Strategy Update. A brief description of each study is included within this section of the report. The following information has been provided from the City's 2009 Wastewater Treatment Master Plan.

Figure 2: Linkages to Other City of Guelph Initiatives



2.3.1 City of Guelph Strategic Plan

The 2007 strategic plan reflects the community's long term vision for the future and the City's role in supporting the vision. The plan includes a new vision, mission, six goals and related strategic objectives that will position the City well to meet its future challenges and the many opportunities that will arise.
The vision, mission, and goals for the City of Guelph are as follows:

Vision: To be the City that makes a difference

Acting locally and globally to improve the lives of residents, the broader community and the world.

Mission: To achieve excellence through leadership, innovation, partnerships and community engagement.

Goals:

1. An attractive, well functioning and sustainable city
2. A healthy and safe community where life can be lived to the fullest
3. A diverse and prosperous local economy
4. A vibrant and valued arts, culture and heritage identity
5. A community-focused, responsive and accountable government
6. A leader in conservation and resource protection/enhancement

The City's strategic plan is an ongoing priority setting, decision-making and management tool. The purpose of the plan is to enhance organizational effectiveness and continue to demonstrate accountability to the community. Water Conservation and Efficiency is identified explicitly within Goal 6 Objective 5 of the strategic plan is noted below:

'6.5 Less energy and water per capita use than any comparable Canadian city.'

2.3.2 Community Energy Plan

The City produced the final versions of its Community Energy Plan (CEP) in April 2007. The City recognized the growing importance of effective energy and water management, so, in 2004, formed a consortium to develop their CEP. The implementation of the CEP will ensure the City's long-term competitiveness and environmental performance through the five goals which are supported by specific recommendations in the plan:

1. Guelph will be the place to invest, supported by its commitment to a sustainable energy future.
2. Guelph will have a variety of reliable, competitive energy, water, and transport services available to all.
3. Guelph energy use per capita and resulting greenhouse gas emissions will be less than the current global average.
4. Guelph will use less energy and water per capita than comparable Canadian cities.
5. All publicly funded investments will visibly contribute to meeting the other four CEP goals.

2.3.3 Water Supply Master Plan

In September 2006, the City released its Water Supply Master Plan (WSMP) final report. As stated in the final report the WSMP's purpose was to "carry out a study to identify a strategy that will increase the capacity of the City's existing water system and provide additional security of supply." The WSMP was developed to ensure that water will be provided in a "safe, reliable and cost-effective manner to satisfy current and long-term municipal demand requirements" (Earth Tech, 2007).

As part of the WSMP, water supply projections were developed based on existing and projected population forecasts and observed water consumption. These projections were revisited as part of the Water Conservation and Efficiency Strategy Update to reflect population projections of the City's Local Growth Management Strategy and more recent water consumption data.

The WSMP concluded that, depending on the success of conservation and demand management programs, the existing groundwater supply system will be at or close to its maximum servicing capability by approximately 2010 to 2015. To address supply demands, the WSMP developed recommendations that were categorized according to short-, mid- and long-term implementation timeframes. The recommendations are summarized as follows:

Water Conservation and Demand Management – This involves implementing the recommendations from the Water Conservation and Efficiency Study, including ongoing peak demand management, as well as expansion of conservation efforts resulting in a 10 percent decrease in average use and a 3 percent reduction in unaccounted for water. Other recommendations included undertaking a rate study to address Bill 175 (Sustainable Water and Sewerage Systems Act) and examining the viability of wastewater reuse.

Expand Existing Groundwater Supply System – Recommendations from this area include: 1) implementation of the recommendations from the Arkell Class EA, which could increase water supply by up to 14 Percent, and 2) investigating optimization of the existing groundwater supply collection system by increasing the capacity of existing wells, returning existing wells to service, and investigating new well locations.

Establish New Surface Water Supply – Local – This recommendation includes discussions with surrounding municipalities, the MOE, and the Grand River Conservation Authority (GRCA) regarding local surface water sources and aquifer storage and recovery. Feasibility and related costs are to be investigated by the City.

The investigation portion of these recommendations is to be undertaken during the short-term timeframe, with implementation commencing during the mid- to long-term timeframes.

2.3.4 Growth Management Strategy

The City, which has experienced considerable growth over the past decade and anticipates significant future growth, has been designated by the provincial government as an Urban Growth Centre under the Places to Grow Act. To address the challenges associated with managing growth, the City completed a Growth Management Strategy (GMS).

The GMS began in 2006 and was completed over a two-year period in four phases. Each of the phases is described in Table 8.

Table 8: Phases of the City of Guelph's Growth Management Strategy

Strategy Phase	Description
Phase I	Assess growth pressures in Guelph, compile public input
Phase II	Identify, plan, design, and evaluate alternative urban form options
Phase III	Analyze the alternative urban form options in terms of their financial, environmental, transportation, and servicing implications and evaluating the options
Phase IV	Determine how the preferred option will work and develop an implementation strategy

All four phases of the GMS have been completed with the Phase IV report going to Council in January 2009. Guelph City Council adopted the GMS recommendations on June 23, 2008 which included:

1. That the City of Guelph plan for a population target of 169,000 people to the year 2031 (equivalent to Places to Grow population of 175,000). The variance between the two projections is based on adding an additional 3.6% which represents the typical undercount of residents in the census data.
2. That the City plan for a steady rate of population increase.

3a. That employment growth in the City should be planned to keep pace with population growth.

3b. That in addition to the GMS recommendation, the current 'Employment Lands Strategy' will inform future additional employment requirements and opportunities.

4a. That within the 'Built-up" area of the City, residential intensification opportunities will be identified in the Downtown 'Urban Growth Centre'.

4b. That in addition to the 'residential intensification opportunities' within the 'Built-up' area, opportunities to provide higher density residential in the 'Mixed use Nodes' of the Official Plan will be examined.

4c. That all development including higher residential density and mixed-use development be planned within the 'Greenfield' areas of the City based on the implementation of the Community Energy Plan.

4d. That a provision for affordable housing be planned within the City.

5. That development to meet the objectives of the Provincial Growth Plan and the GMS will be accommodated on lands contained within the existing corporate boundaries for the City of Guelph

6. That in order to meet the objectives of the Provincial Growth Plan and the City's GMS, that the province be asked to address the provision of health care needs in the City of Guelph.

2.3.5 Wastewater Treatment Master Plan

The purpose of the Master Plan is to develop a strategy to provide direction for wastewater infrastructure planning, investment and implementation to the year 2054. The study includes a review of the City's current wastewater treatment infrastructure and an analysis of alternative solutions to accommodate future wastewater treatment needs. As part of the Master Plan the potential benefits of water conservation initiatives on the Wastewater Treatment Plant and process train will be examined as well as the potential for the wastewater reuse. A recommendation for a separate study for the wastewater reuse has been included in the Draft report. The ongoing Wastewater Treatment Master Plan is anticipated for completion in spring 2009.

2.3.6 Water and Wastewater Master Service Plan

In 2008 the City completed the Guelph Water and Wastewater Servicing Master Plan (W&WW SMP). The purpose of the W&WW SMP is to determine how best to service the water distribution/storage and wastewater conveyance needs for the City. An additional goal is to enable a better understanding of the water distribution and sewer network infrastructure and the systems' characteristics for the purpose of enhancing the reliability, operational efficiency, and capability of the water distribution and sewer network systems in meeting existing and future water and wastewater needs.

As a short-term recommendation of this study the City is currently undertaking the development and calibration of a robust water distribution system hydraulic model. The model upon completion will greatly assist in Water Loss Mitigation activities and provide other essential water loss based benchmarking and performance indicator based information. Based on further short-term recommendations of the study a budget allowance for to implementation of a large scale wastewater reuse initiative was also identified.

2.3.7 Stormwater Management Master Plan

The City has initiated a Stormwater Management Master Plan (SWM MP). The SWM MP is a long-term plan for safely and effectively managing stormwater runoff from urban areas, while improving the ecosystem health and ecological sustainability of the Eramosa and Speed Rivers and their tributaries. Improvements to the City's stormwater management will contribute to the overall improvement of watershed health and could impact assimilative capacity on the Speed River. The SWM MP is anticipated to be completed in 2009.

2.3.8 Strategic Urban Forest Management Plan

The Strategic Urban Forest Management Plan provides a long-term (20+ year) framework for the City to proactively and adaptively manage the urban forest on both public and private land. The urban forest provides shade and thereby reduce the urban heat sink as well as conserve and cleanse water resources, particularly within the numerous wetlands throughout the City.

2.3.9 Natural Heritage Strategy

The Natural Heritage Strategy aims to identify Guelph's significant natural areas and features to ensure their long-term protection and enhancement. A significant component of the Natural Heritage System is the protection of water resources including portions of the Paris Galt moraine which plays an important role in ensuring recharge of the groundwater aquifer.

2.4 Tasks Completed by the Consulting Team

Tasks completed as part of the Water Conservation and Efficiency Strategy Update are as follows:

- Public Consultation
  - Participation in three public meetings – Public Information Centres (PICs)
  - Residential market research in form of focus groups and telephone survey
  - Participation in Water Conservation and Efficiency Public Advisory Committee Meetings (WCEPAC)
- Residential Water Use Demand Analysis
- Industrial, Commercial and Institutional (ICI) Water Use Sector Demand Analysis
- Evaluation of Distribution System Water Loss
  - International Water Association / American Water Works Association (IWA / AWWA) Water Audit and Water Balance
  - Water Loss Mitigation Strategy
- Water Supply Demand Forecasts
- Identification and Evaluation of Water Efficiency and Conservation Program Alternatives
- Strategy Implementation Plan
- Maintenance Plan
- Monitoring and Evaluation Plan
- Preparation of Draft and Final Reports

3.0 Public Consultation

Consulting with the public and being open to meaningful input towards the development of strategy has ultimately resulted in a strategy that is inclusive of the general public's vision for water conservation and efficiency in Guelph. Figure 3 illustrates how the many components of the project were fed back into the consultation process.

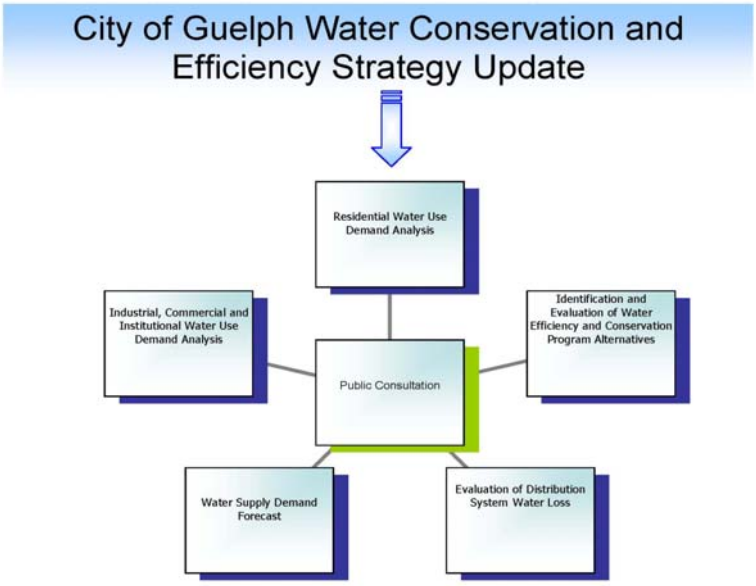


Figure 3: Water Conservation and Efficiency Strategy Update Activities Flowchart

3.1 Residential Focus Groups

Focus groups were held in an effort to capture community input to the process through qualitative market research. The data captured does not provide statistically relevant information. The focus groups are used to develop context around water conservation and efficiency, understand concerns and hot buttons, and explore means of communications to achieve success.

In total, three (3) focus groups were conducted on April 22nd, 2008 at a professional focus group facility in Guelph, moderated by a senior Metroline team member. Each group consisted of 5-7 participants, and lasted approximately 90 minutes. Participants in this research were residents of Guelph, randomly recruited and meeting the following specifications:

- men and women
- 25 years and older
- home owners
- responsible for monitoring and paying the utility bills
- at least half of the group were practicing some form of water conservation/efficiency

Please refer to Appendix B for copies of the recruiting screener, discussion guide and complete results.

The objectives of this research were to determine the importance Guelph residents place on water efficiency in their homes; understand current behaviour relating to water efficiency and how this behaviour has changed/developed over the past 5 years; and to determine awareness and knowledge of Guelph programs and communications.

Key insights from the focus groups:

- Guelph residents are placing considerable emphasis on water efficiency and water conservation in their households
- Water conservation has become more important over the past several years
- Significant improvements in water efficiency involve modifying societal values and behaviours as much or more as the individual residents
- Guelph residents are well along a path relating to becoming more water efficient, and seem ready to continue the trend

3.2 Residential Telephone Surveys

This market research was completed to capture community input in a quantitative manner, providing statistically significant data that could be extrapolated to the entire community. To accomplish this, 400 randomly selected Guelph residents with municipal water supply were contacted by telephone between June 23rd and June 30th, 2008.

Residents were asked a series of questions pertaining to water and conservation in their community. Questions were a series of scaled (i.e. choose 1- 10), open ended (i.e. how do you feel about…) and closed questions (i.e. Yes or no). Information gathered provided data on demographic information, knowledge, participation and satisfaction in water efficiency programs offered by the City of Guelph, water use behaviour indoors and outdoors, willingness and desired/required incentives for implementing water saving mechanisms.

Below are some of the key findings from this research (for completed details please refer to Appendix C.

What comes to mind when you think about conservation or the environment in the City of Guelph?

- Water, water conservation or water restrictions was the most named response with 282 mentions.
- Followed by Waste management – 103, and energy efficiency/conservation with 51 mentions.

Using a scale of 1-10, where 1 means "Not Important" and 10 means "Very Important" how important is water conservation to your household?

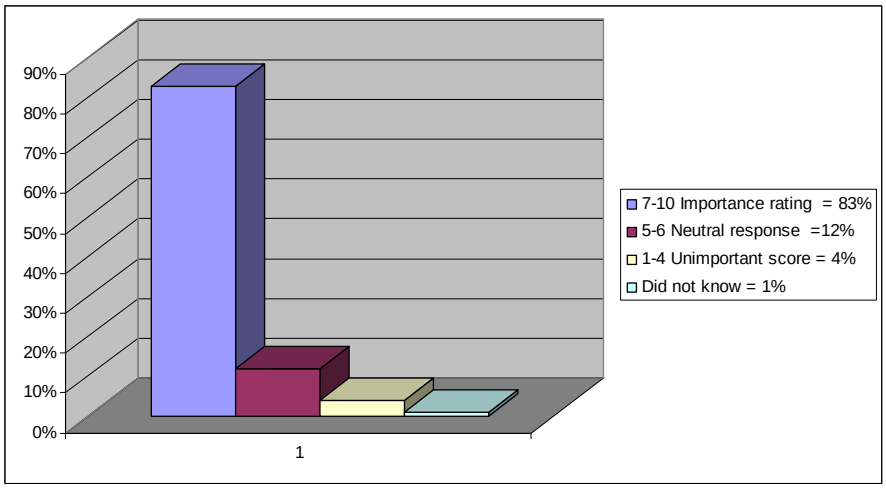


Figure 4: How important is water conservation to you?

Compared to 5 years ago, do you think water conservation has become…..

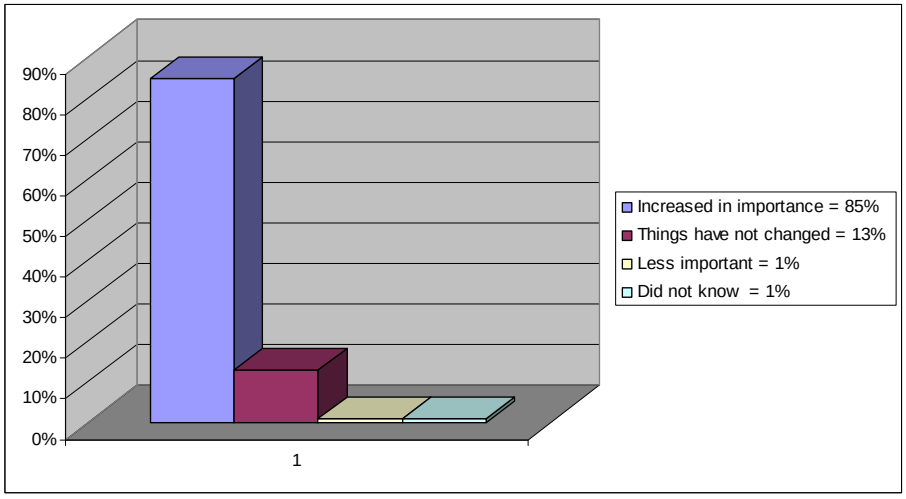


Figure 5: Has water conservation become more important to you?

The reasons most named for increased importance…

- Shortages, droughts, low water levels or a finite supply - 126 mentions
- Greater media awareness, attention or hype – 99 mentions
- Growth, development or sprawl – 62 mentions.

Household Fixtures/Appliances

Does your household have or use any of the following?

Water softener – 72%
Home water treatment system – 48%
Water cooler/large water bottles for household drinking– 25%
A power humidifier attached to your furnace – 21%
Swimming Pool - 11%
Backyard skating rink in the winter – 2%
Pumped irritation from a river or pond – 0%

Household toilets

- Most of the respondents have two toilets in their homes (44%)
- 27% of respondents had three toilets in their homes
- 18% only had one toilet
- 11% had four or more toilet in their homes.

Royal Flush Program

- 70% of Guelph residents surveyed were aware of the Royal Flush Toilet Rebate Program and 84% of those that participated in the program were satisfied (7-10 rating)
- 40% of people surveyed had replaced their toilet with a water efficient model.

Smart Wash Washing Machine Rebate Program

- 50% of residents surveyed were aware of the Smart Wash Front Loading Washing Machine Program.
- 37% said the $100 rebate would influence their decision to replace an existing washing machine with a water and energy efficient model.

Outside Water Use Program

- 95% of those surveyed were aware of the City's Outside Water Use Program.
- Most familiar with watering days (250 mentions), watering times (147 mentions, signs posted (115 mentions) and levels tied to rivers and streams (75 mentions).
- 42% of those surveyed reported having water efficient landscaping on their property.

New Water Conservation Measures

Respondents that have not incurred costs or do not plan to were asked if they would be willing to do so if the City covered part of their costs.

Fixture replacement – 44%
Water Audits – 40%
Water reuse/recycling systems – 37%
Rain Barrels – 36%

Rain Water harvesting/cisterns – 34%
Low water use landscaping – 27%
Appliance replacement – 33%

Communication Initiatives

- 48% would like the City to provide the same amount of information to residents about water conservation
- 47% say the City should provide more
- 32% of residents claimed they use the internet to gather information on water conservation
- 64% of them said they would visit the City of Guelph site to access this information

3.3 Public Information Centres (PICs)

Three Public Information Centres were held during the development of the Water Conservation and Efficiency Strategy Update (WCESU). The first was held on August 27th and the second on November 20th, 2008 and the third on February 4th 2009. These meetings were open to the public in an effort to provide an opportunity to be part of the water conservation planning process. A copy of the full report for all PICs, including agendas, presentations and detailed comments from participants is included in Appendix D.

3.3.1 Public Information Centre #1

The first PIC was held August 27th, 2008. The turnout for this PIC was much less than anticipated, with only six non-PAC members attending. Although the numbers were low, the feedback provided was excellent. Residents were introduced to the consultant team working on the WCESU, project scope and flow chart of planned activities, and the results to date including: public consultation, market research, residential water use demand analysis, Industrial, Commercial and Institutional water use demand analysis, evaluation of distribution system water loss and water supply demand forecast.

A round table discussion was held with participants to gather feedback on the materials presented. There were several points that were common to the discussions, summarized below:

- Youth education is important
- There is a need for water efficiency fixture retrofits of older buildings and condominiums/apartments
- Consider individual water meters for condominiums and apartments. When the residents don't see a water bill, or pay for it, they are less likely to think about water efficiency.
- Provide rewards or incentives for those already conserving water
- Need to improve infrastructure; fix leaks, adjust pressure, and general upgrades.

A copy of the full report for the first PIC, including agenda, presentations and detailed comments from participants is included in Appendix D.

3.3.2 Public Information Centre #2

The second PIC was held on November 20th, 2008. Similar to the first one, the attendance numbers were lower than expected. In total, 15 residents attended. Residents were presented with an update of the WCESU, including the list of measures that had passed the feasibility and financial screening. After, participants joined in a round table discussion about the presentation. Below is a summary of that discussion:

What barriers exist that would limit the City's objective of achieving water savings as a result of implementing a Water Conservation and Efficiency Strategy?

- There are still perception barriers to water efficient fixtures, i.e. low flush toilets and xeriscaping.
- Water rates are not high enough to act as an incentive. Having a base fee does not reward low water users.

Are there any other water efficiency or conservation measures that the consultant's team has missed?

- We need a better understanding of the technology of water softeners and the water they use.
- There needs to be changes in the water rate structure to promote water conservation.
- Grey water and rain water systems need to be incorporated into new construction. New homes that can be built ready for water reuse.

Do you think that the City of Guelph's Water Conservation and Efficiency Strategy Update should include a goal of maintaining current annual water taking levels in spite of future population growth?

- It was generally accepted that this was possible, but it would need a big budget and an extensive education program. When this plan was started, it was acknowledged that Guelph is a very environmentally aware community. The PIC process is usually not very well attended. We were told that we could expect a large turn out. Where is everyone?
- There is a lot going on in the community and people's time is limited. Community members can provide input without having to attend the meetings.

3.3.3 Public Information Centre #3

The final PIC was held on Wednesday, February 4th 2009. There were 18 residents in attendance in addition to media coverage. Residents were presented with the final outcomes of the WCESU, including the final measures theat had passed the screening. The strategy update was well received; however there was some concern over the protection of natural heritage, in particular, forest canopy.

3.4 Water Conservation and Efficiency Public Advisory Committee (WCEPAC)

A Public Advisory Committee was formed to work with the staff and project consultant team throughout the development of the WCESU. A total of 14 members were selected from a variety of stakeholder groups including:

- City Council (1)
- Industry (2)
- Home Builders/Development (1)
- Environmental Interest (3)
- Plumbing (1)
- Academia -University of Guelph (2)
- Grand River Conservation Authority (1)
- Public at Large (3)
- Chamber of Commerce (1)

The PAC met four times during the development of the strategy and provided new ideas, direction and initiatives for the consultant team to consider while providing feedback to key findings and progress provided. All meetings were held in the evenings at the Guelph Waterworks Woods Pumping Station Building. A copy of the full report for all of the PAC meetings, including agendas, presentations and minutes is included in Appendix E.

3.4.1 PAC Meeting #1

This meeting was held on August 12th, 2008 from 6pm to 9pm. The meeting was an introduction to the process of the WCESU including: public consultation, market research, residential water use demand analysis, Industrial, Commercial and Institutional water use demand analysis, evaluation of distribution system water loss and water supply demand forecast.

From the options you have seen this evening, what are your thoughts?

- Guelph is recognized as a leader in environmental initiatives. This should continue with the WCESU.
- Education is extremely important.
- United Kingdom uses 150 Lcpd; Guelph's target should be closer to that.
- Higher water rates
- There needs to be incentives for builders to incorporate new water savings technologies.
- The community is not accepting of the water savings being directed towards new development.

What level of subsidies do you think would be appropriate?

- Must be based on business case and could be based on subsidized consumption.

If $100 million is paid for a pipeline, what are you prepared to pay for water efficiency?

- The cheaper the solution, the bigger the problem, therefore be really cautious to get good quality investment.
- Water efficiency is not a quick fix – must be prepared to take time – hard battle.
- There is a possibility of higher water rates if there is not water efficiency

- Infrastructure is in a bad state – this is a big factor with people and needs to be addressed.

3.4.2 PAC Meeting #2

This meeting was held September 30th from 5pm to 8pm. The meeting was an update of the WCESU processes to date including updates on the Public Information Centres, an update of the Water rate structure review, and a review of the water saving alternatives and the shortlist of measures that would undergo financial screening.

A round table discussion was held to discuss the incorporation of grey and rain water harvesting systems.

- When the financial screening is completed, rain water harvesting and grey water will probably not pass. How do we include these technologies into the strategy?
  - Every new home should be as efficient as possible.
  - Only one type of grey water units available and only two rain water units.
  - The City needs to determine if we are charging for reduced sewage.
  - May be too early to launch mandatory rain water harvesting and grey water fits to new homes, but we can build grey water ready homes. Encourage innovation without locking in any one technology or system.
  - Any developer exceeding environmental standards should get bumped to first priority for approvals. Right now developers are almost penalized for new technologies as they take forever to get passed.
  - Having dual plumbing would allow for future adaptations. There may be opportunities for additions to infrastructure and repairs to add purple pipes for future grey water reuse for water supply systems.

3.4.3 PAC meeting #3

This meeting was held November 26th from 5pm to 8pm. The meeting was a review of the WCSEU to date, including the second Public Information centre and the final list of water conservation measures. The methodologies for screening Industrial, Commercial and Institutional water saving measures were presented as well as a look at the difference for water saving screening for peak day costs versus average day. This review did not change any of the passed measures.

The savings include both demand and supply savings, how do we add this together to meet the target savings outlined in the Water Supply Master Plan?

- Get rid of the percent savings and look at the added capacity, so savings are listed as how many new homes can be built through savings.
- It was cautioned to present this as the growth potential as some people do not want to see more development.

3.4.4 PAC meeting #4

The final PAC meeting was held on January 14th, 2009 from 5pm to 8 pm. The meeting was the final review of the draft strategy update as well as an update on issues arising from previous meetings.

A presentation of the draft report recommendations was provided to the group. The presentation highlights were:

- Gross water demand had declined by 17% between 1999 and 2007, and population had increased by 14.6% over the same period.
- ICI focus was on the high water using customers
- The single family residential rebates proposed in this update are higher than those typically used in Ontario
- Multi-family measures are similar to single family, except the clothes washers are the commercial type, and the rebate is larger
- ICI rebates for toilets were similar to the current Royal flush program.

As part of the City's ongoing Water/Wastewater Rate Review, consultation on water conservation rate structure alternatives was completed with the Water Conservation and Efficiency Strategy Update Public Advisory Committee. Upon discussion of potential rates structures, and in consideration of potential consumption reductions associated with already planned annual rate increases during the current economic times, a conservation rate structure was ultimately not recommended by the Committee at this time.

Although the PAC group's original involvement was to be limited to the strategy update, it was decided that this group could provide important input to the development and execution of the strategy.

4.0 Overall Water Use Analysis

The following Figure 6 illustrates water use and population growth trends for the past ten years. Of interest is the declining average day water demand (pink line), average day production (light blue line) and the peak day water demand (purple line) while the population (green line) of Guelph has been increasing.

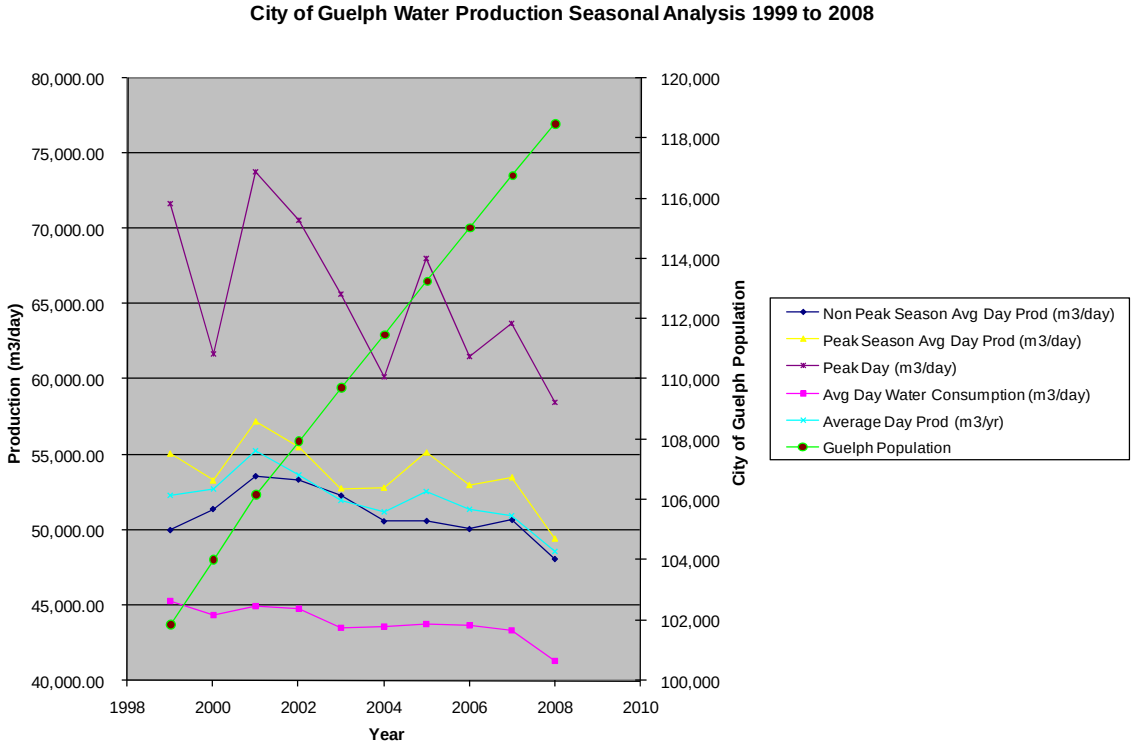


Figure 6: City of Guelph Water Production Seasonal Analysis 1999 - 2008

5.0 Residential Water Use Demand Analysis

An analysis was completed to segregate water use into several categories, so that water use by single family properties, multi family units and the ICI sector could be identified. Two data bases were provided by the City as follows:

- Customer billing data for the period from 2001 to 2007 from Guelph Hydro
- Property type data from the Tax Assessment Housing Data Base

The two data bases were merged in order to identify the number of properties in each category, and to allocate a volume of use. Due to discrepancies between the two data bases, a 100% match was not possible however a match of over 85% was completed providing a high representation of data.

Based on the data provided, a breakdown of the 2007 customer billed consumption is shown in the following Table 9.

Table 9: Guelph 2007 Customer Billed Consumption

Category	2007 Billed (m^3)	Population	Water Use – Litres per Capita per Day (Lcpd)
Single Family	7,967,457	94,745	230
Multi Family	1,135,560	20,295	153
Total Residential	9,103,017		
ICI	6,660,534		
Total 2007 Billed Consumption	15,763,551		

The more detailed residential analysis for the years 2001 to 2007 is provided in Appendix F, and summarised in the following Table 10. The analysis provides a representation of the billed customer consumption of just over 85%.

Table 10: Residential Billed Consumption 2001 - 2007

Year	Low Density		Medium Density		High Density					
	Detached		Townhouse, Semi etc.		Multi Family		Condominium		Other	
	No	Usage	No	Usage	No	Usage	No	Usage	No	Usage
		M^3		M^3		M^3		M^3		M^3
2001	22,740	5,680,627	3,475	841,357	178	1,129,273	3,818	830,431	20	258,098
2002	23,356	5,573,113	3,852	858,060	178	1,102,891	4,075	802,485	22	242,853
2003	23,934	5,534,082	4,022	880,453	178	1,071,256	4,237	830,818	53	283,696
2004	24,636	5,526,170	4,224	886,992	178	1,044,489	4,237	821,359	52	356,613
2005	25,042	5,730,313	4,271	882,396	178	981,979	4,319	844,367	53	370,179
2006	25,169	5,662,909	4,324	891,472	182	992,242	4,548	965,837	63	231,571
2007	25,295	5,595,313	4,393	883,931	185	919,677	4,777	1,087,307	59	202,406

Figure 7: Breakdown of Housing Sector by Density (Number of units and Percentage) 2007

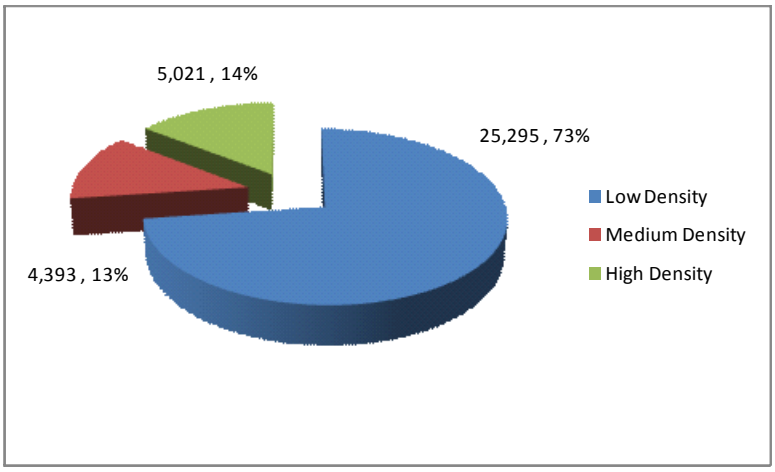
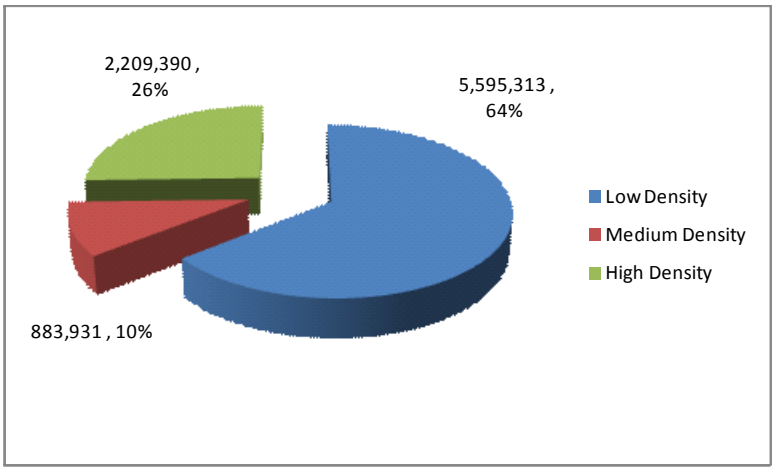


Figure 8: Breakdown of Water Consumption in Housing Sector (Cubic metres/year Water Consumption and Percentage) 2007



A detailed analysis of the single family, multi residential family and industrial, commercial and institutional sectors follows.

5.1 Detached Single Family Water Use Demand Analysis

Per Capita Water Use

The detached single family market sector includes housing which are detached, semi-detached, duplex and row or town housing. Each premise in this market sector is served with its own water meter. For 2007 the City of Guelph detached single family water use was 230 litres per capita per day (Lcpd).

Table 11: 2007 Detached Single Family Residential Per Capita Consumption

Single Family Sector	2007 Billable Consumption (m3)	Population	Per Capita Consumption (Lcpd)
	7,967,457	94,745	230

In order to compare this consumption level with other municipalities in Southern Ontario, and around the world, the following Figure 9 has been prepared:

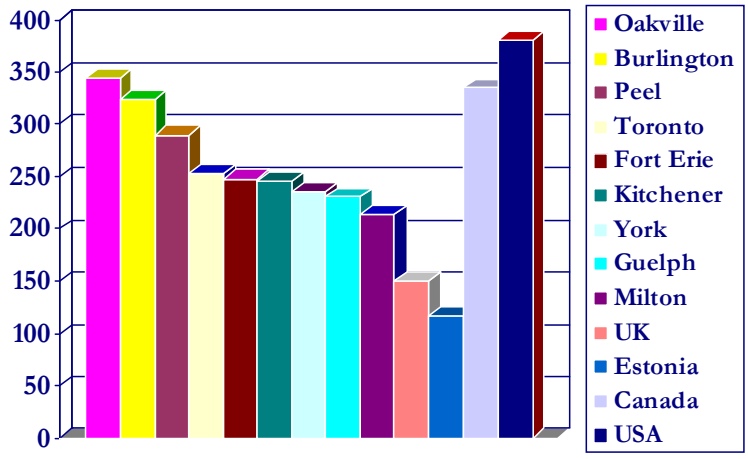


Figure 9: Comparison of Residential Per Capita Demand

The City of Guelph has one of the lowest detached single family water demands in Canada at 230 Lcpd. This is approximately 32% below the national average of 335 Lcpd. Guelph's detached single family water demand is just 7% higher than the Town of Milton, another groundwater community with a demand of 214 Lcpd and slightly lower than the Region of York at 236 Lcpd, a community that has had an aggressive water efficiency program over the past 10 years.

Property Types

Based on the two data bases provided from Guelph Hydro and the City, the following is a summary of the breakdown of property types, and category of customer, for those properties where identification was provided in the data bases and analysis completed:

2007 Single Family:

Table 12: Breakdown of Housing by Housing Type – City of Guelph 2007

Detached	Semi-Detached	Townhouse	Duplex	6 or Less Units	Other	Total
25,295	2,562	903	400	322	206	29,688

Seasonal Water Use Variation

Due to the 90 day billing cycle, and bi-monthly billing for the single family sector, it was not possible to develop a seasonal trend chart with the available data. The City of Guelph has a very low peaking factor of 1.28 as compared to other southern Ontario communities with peaking factors[1] ranging from 1.40 to 1.95.

[1] Analyses completed in Halton Region, York Region, Toronto and London

The peaking factor is determined by dividing the maximum day water demand by the average day water demand. A low peaking factor indicates a community with relatively low summer outdoor water use.

Single Family Detached Housing Starts by Decade

The housing starts by decade are shown in the following Figure 10. It can be seen that the rate of construction of new homes increased significant following in the 1940's.

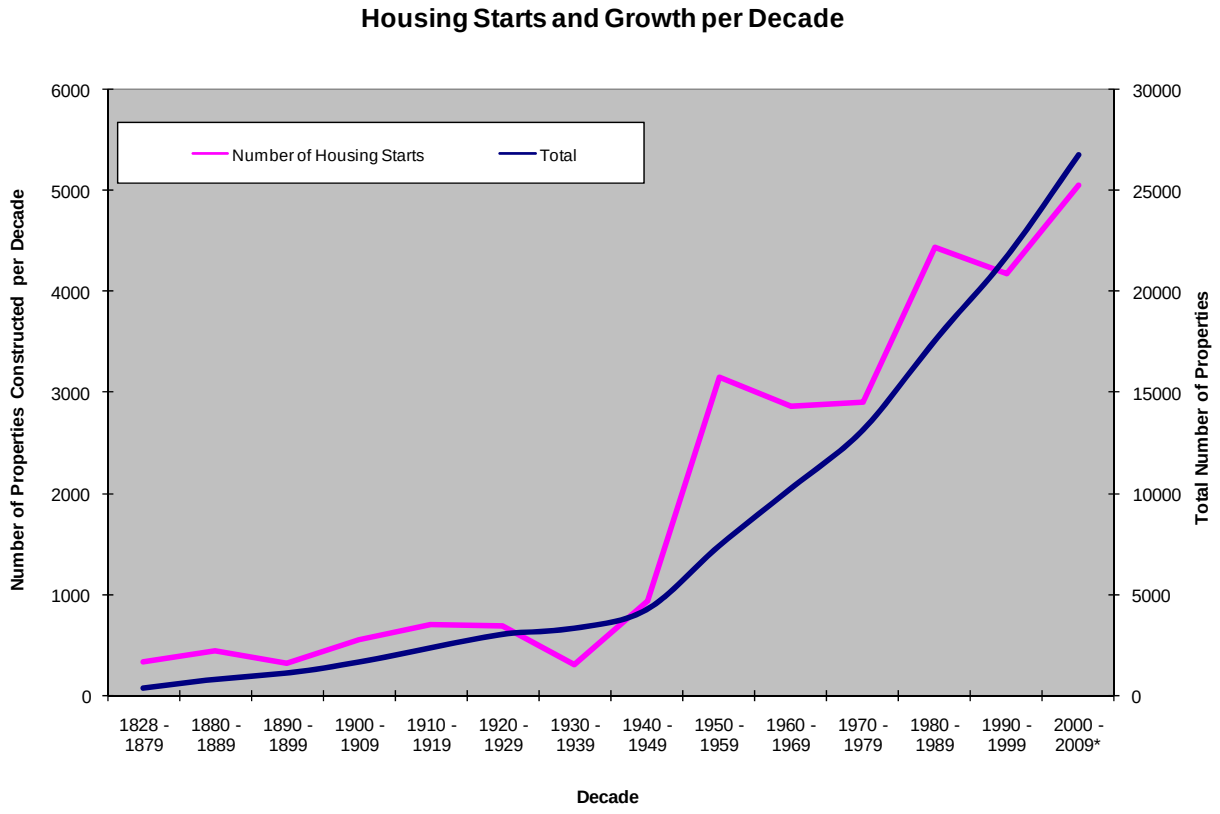


Figure 10: Single Family Detached Housing Starts by Decade

Single Family Detached Average Water Use by Decade

The following Figure 11 shows average water use for the year 2007, but is shown by the age of the property in increments of decades. It is important to note low points in consumption per day amongst homes built in the period of 1940 to 1959. With recognition to fixture and appliance life cycles it is expected that this decrease in daily household consumption represents the large scale natural replacement of these household items.

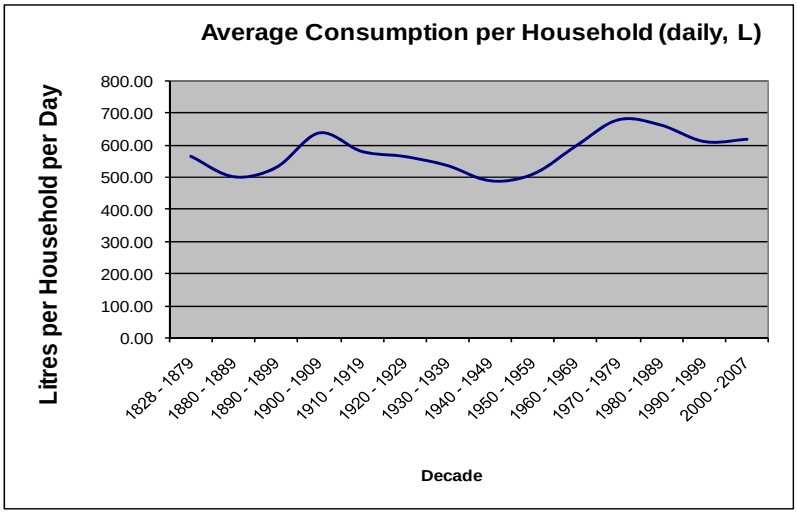


Figure 11: 2007 Average Annual Water Use by Single Family Housing Vintage

Ontario Building Code Influence on Toilet Flush Volumes

An analysis was completed to identify the number of homes and their corresponding 2007 water use that were built since the Province of Ontario introduced maximum flush volumes for toilet flushing in new construction. The following Table 13 shows the breakdown by the three periods for single family detached homes.

Table 13: Ontario Building Code Influence on Toilet Flush Volumes

Period	Toilet Flush Volume	Number of Single Detached Homes	2007 Billed Volume (m^3)	Use Per Property Per Day (Litres)
Prior to August 1, 1993	≥ 20 litre	18,592	4,148,463	611
August 1, 1993 to December 31, 1995	13.25 litre	804	204,551	698
January 1, 1996 to Date	6.0 litre	5,899	1,270,640	590

In addition to the building code's influence on the efficiency toilets, the code has had similar influence on the efficiency of showerheads and faucets in new construction. Showerheads having a flow rate of less than 9.5 litres per minute and faucets having a flow rate of less than 8.35 litres per minute have been required in new construction since January 1, 1991.

5.2 Multi Family Water Use Demand Analysis

Per Capita Water Use

The multi family market sector includes housing units within high rise buildings including condominiums and rental apartments. Individual premises in this market sector do not have individual water meters. Each high

rise building has one main water meter for billing purposes. Typically per capita demand in this sector is lower than the single family detached sector since there is less summer outdoor use and laundry demand since some residents would use off site laundry facilities. For 2007 the City of Guelph multi family water use was 153 litres per capita per day (Lcpd).

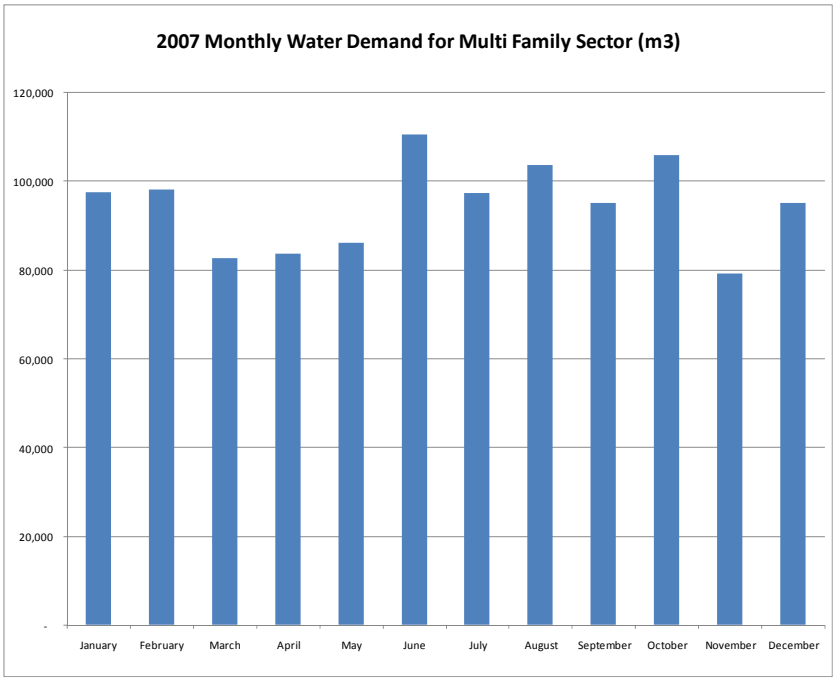
Table 14: 2007 Multi Family Residential Per Capita Consumption

Multi Family Sector	2007 Billable Consumption (m3)	Population	Per Capita Consumption (Lcpd)
	1,135,560	20,295	153

Multi Family Seasonal Water Use Variation

The monthly water demand for the multifamily sector for 2007 is shown in Figure 12 below. Although demand varies month to month, it can be seen that there is no marked seasonal variation.

Figure 12: 2007 Multi Family Sector Monthly Water Demand



6.0 Industrial, Commercial and Institutional (ICI) Water Use Demand Analysis

6.1 Approach

The industrial, commercial, and institutional (ICI) sector represents approximately 42% of Guelph's water consumption.

For this task, Guelph's ICI customer billing data was analyzed for the 2007 calendar year. As part of the analysis method, outlier, and intuitively incorrect data points (e.g. negative consumption values, or records with estimated readings) were ignored.

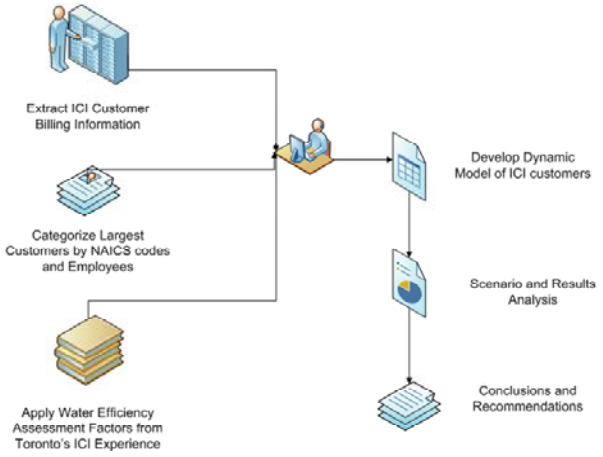
Generally, the 20:80 rule can be applied in order to identify and prioritize the largest water consuming ICI accounts. That is, that 20% of the ICI customers consume 80% of the water demand in that sector. Following an analysis of the ICI billing data, it was determined that only 204 (or 5%) of the largest accounts consumed 80% of the water in Guelph. This group included 133, industrial, institutional, and commercial customers. It also included 71 of the largest multi residential accounts; however, these customers were regrouped with the residential analysis section of this report.

From business registration information, the corresponding North American Industry Classification System (NAICS) code and number of employees was appended to the corresponding customer record. Knowing the nature of each customer's business and the number of its employees enabled the development of a spreadsheet model to estimate the domestic use, process use, and product use for each ICI customer. Domestic and process water use, together with equipment cost factors, and water savings potential was estimated using industry standards and previous experience gained from the City of Toronto's ICI water efficiency program.

Recognizing that in some instances, customers may require financial incentives to implement water efficiency, a provision was made to fund certain measures based on a payback buy-down incentive. These included prescriptive incentives for domestic fixtures, and a capital contribution percentage for process use. The results were updated in the database, and a summary was developed for the overall customer base.

The database is dynamic in that the City of Guelph's water efficiency team can adjust potential incentives to analyse various scenarios in order to prioritize or target specific customer segments. A spreadsheet that was developed is provided in Appendix G.

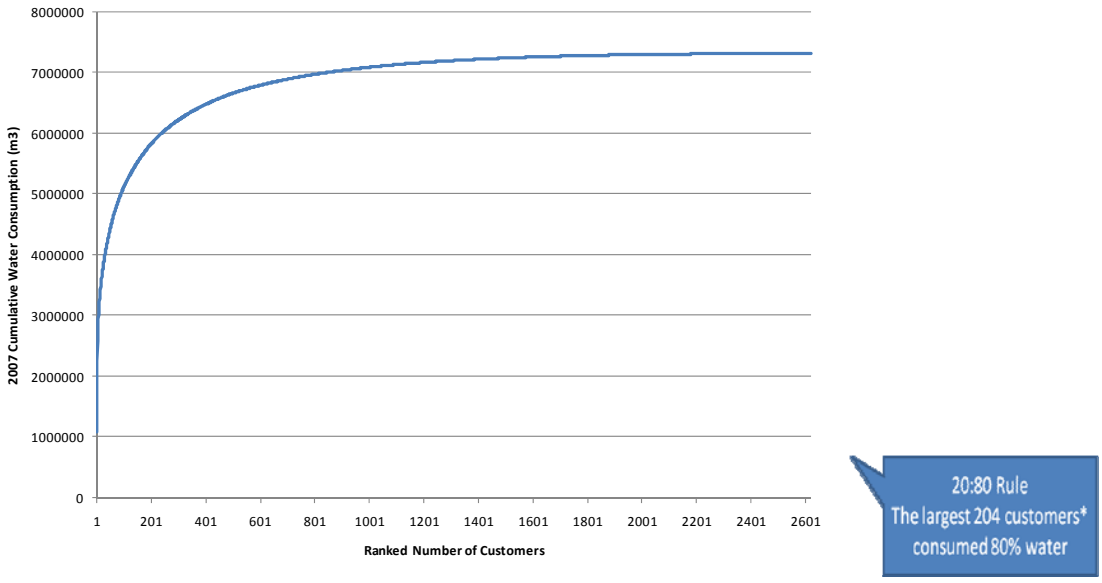
Figure 13: Approach



6.2 Data Analysis of Customers

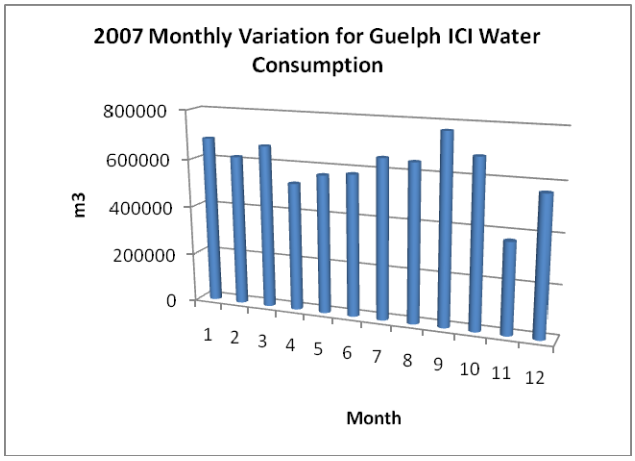
The first part of this analysis includes both ICI and multi family accounts. There were approximately 2,620 ICI and multi family customer accounts collectively consumed 7,326,000 m³ of water in 2007. The largest 204 customers collectively used 80% of the total ICI consumption as shown in Figure 14.

Figure 14: 2007 Cumulative ICI and Multi Family Water Consumption Ranking of Customers



Many municipal water systems have pronounced seasonality patterns. Typically there is higher water consumption during the summer months for uses like irrigation and cooling towers; however, in analyzing monthly water consumption for the ICI customer base, a summer peak did not appear to be predominant, as shown in Figure 15.

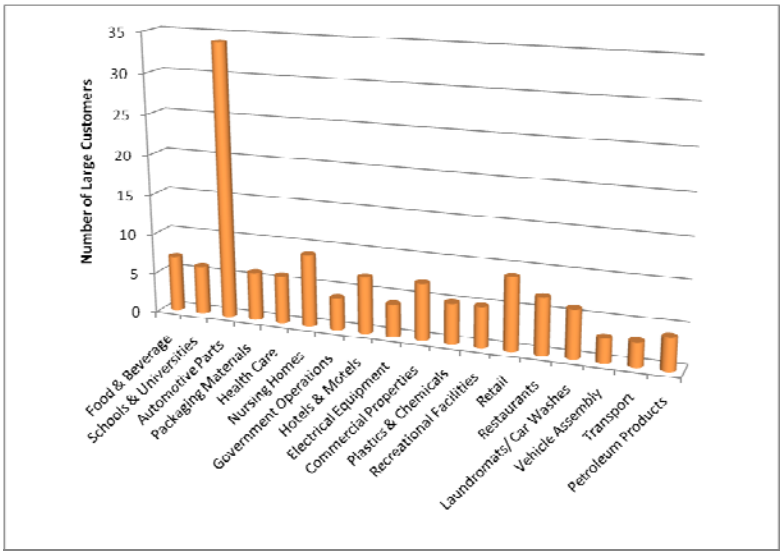
Figure 15: 2007 Monthly ICI and Multi Family Water Consumption (m3)



Note: Numbers 1 through 12 correspond to January through to December

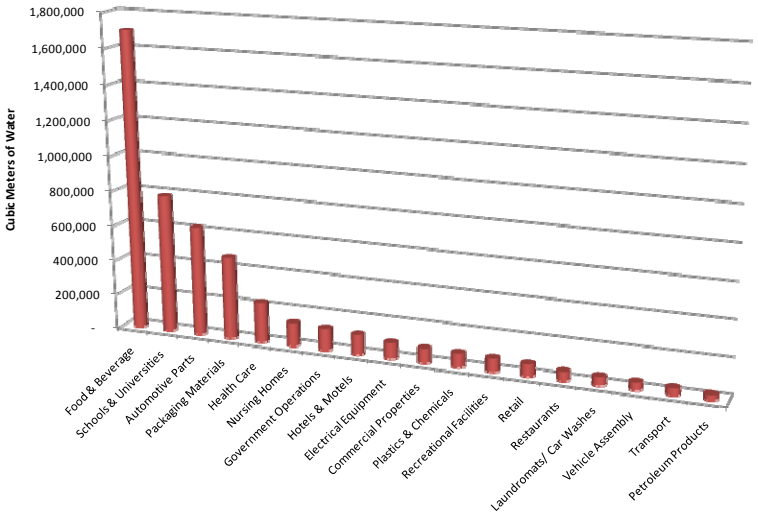
Guelph's largest 133 ICI customers are collectively segmented in Figure 16. The automotive parts manufacturing sector has by far the largest presence of customer accounts, followed by nursing homes and retail.

Figure 16 – Largest ICI Water Customer Sectors by number of Customer Accounts



However, in terms of water consumption by segment, food and beverage, followed by schools and universities, followed by automotive parts consume the most amount of water. Figure 17 below illustrates total water consumption and water savings potential by individual segment.

Figure 17 – Overall ICI Water Consumption by Segment



* Based on 133 largest ICI customers

Statistical Summary of Large ICI Customers

1. The largest 133 ICI customers collectively consumed 4,766,000 m³ of water in 2007.
2. It was estimated that approximately 208,000 m³ was used for material for products. This primarily occurred in the food and beverage sector.
3. According to data from the Guelph Chamber of Commerce, there were approximately 29,300 people employed at these organizations
4. Annual domestic water use by ICI employees (toilets, urinals, hand washing stations and showers) was estimated to be approximately 360,000 m³.
5. The annual amount estimated for process use was 4,198,000 m³.

7.0 Evaluation of Distribution System Water Loss

An International Water Association / American Water Works Association (IWA / AWWA) Water Audit and Water Balance was completed in order to evaluate the distribution system water loss, and identify measures that could be completed to reduce that loss.

7.1 Introduction and Approach

As part of its ongoing efforts to control water loss in their distribution system and to reduce the levels of non-revenue water, the City of Guelph completed water balances on their water distribution system in 2006 and 2007. Using the American Water Works Association (AWWA) and International Water Association (IWA) water audit and balance methodology, an in depth analysis on these water balances was completed to identify and obtain the areas where additional information can be included, as well as to provided confidence limits on the gathered data. The full report is included as Appendix H, which also includes a number of spreadsheets which provide the full detail of the data gathered and analysis completed.

Through a series of meetings with City staff, the AWWA / IWA water audit approach and methodology was established and a series of questions for the missing data was distributed to the appropriate people. City staff was extremely supportive of the project, and provided excellent data in a very timely manner. The efforts of Wayne Galliher, John-Paul Palmer, Walter Maggiola, Vince Suffolletta, Gerry Best, Brian van Nostrand, and John Michalofsky was very much appreciated.

The process of gathering data was multi-staged, and as information was obtained it was recorded on the questionnaire, and areas where more information was required were identified. Subsequent data provided by City staff was again recorded on the questionnaire until all the required information was eventually obtained.

The gathered data for both 2006 and 2007 was next entered into a series of spreadsheets. In each annual spreadsheet the individual areas of water use were identified and the volumes of water use were recorded. Finally the total volume of water use per year was calculated for each of the AWWA / IWA water balance categories.

Two AWWA / IWA water balance software programs were used, along with Software developed by Dave Pearson, to analyse the gathered data:

- AWWA Water Loss Control Committee (WLCC) Water Audit Software v3.0
- WB-EasyCalc version 1.18 by Liemberger & Partners

For each software program, the data from the series of spreadsheets was entered into the appropriate fields. The results obtained from the two software programs were similar.

7.2 Standard Water Balance

The first step in the assessment of the actual losses on a system is to use a consistent and reliable methodology. To this end the IWA Water Loss Task Force (WLTF) defined a standard methodology. This methodology is summarised in Table 15 shown on the following page. The methodology has now been recommended by the AWWA and is being adopted across North America as the standard method for assessing losses. The standard IWA water balance approach and methodology has been used to assess the real and apparent losses from the distribution system at the City of Guelph. In addition the standard IWA performance measures, and in particular the Infrastructure Leakage Index, have also been assessed.

Table 15: IWA Standard Methodology

<table>
<tr><td rowspan="2">Volume from Own Sources</td><td rowspan="10">System Input Volume

(corrected for known errors)</td><td rowspan="10">Water Supplied</td><td rowspan="7">Authorised Consumption</td><td rowspan="5">Billed Authorised Consumption</td><td rowspan="5">Revenue Water</td><td>Billed Water Exported</td></tr>
<tr><td>Billed Metered Consumption</td></tr>
<tr><td rowspan="3">Water Imported</td><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="3">Unbilled Authorised Consumption</td><td rowspan="5">Non-Revenue Water</td><td>Unbilled Metered Consumption</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="3">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorised Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td rowspan="2">Real Losses</td><td>Leakage on Mains</td></tr>
<tr><td>Leakage and Overflows at Storages</td></tr>
<tr><td colspan="3"></td><td colspan="2">Leakage on Service Connections up to point of customer metering</td></tr>
</table>

Note 1: The IWA Task Force on Performance Indicators recommends that the term 'Unaccounted For Water' (UFW) is not used.

Note 2: The 'WaterBal&Pls', 'Consumption' and 'Running Costs' Worksheets are designed for volume data to be entered in Ml and Ml/d

Definitions of Terms

OWN SOURCES: the volume of water input to a system from the Water Supplier's own sources

WATER IMPORTED OR EXPORTED: the volumes of bulk transfers across operational boundaries

SYSTEM INPUT: the volume input to that part of the water supply system to which the water balance calculation relates, allowing for known errors. Equal to OWN SOURCE + WATER IMPORTED

WATER SUPPLIED: SYSTEM INPUT minus WATER EXPORTED

AUTHORISED CONSUMPTION: volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are implicitly authorised to do so by the water supplier, for residential, commercial and industrial purposes.

Note: Authorised consumption may include items such as fire fighting and training, flushing of mains and sewers, street cleaning, water of municipal gardens, public fountains, frost protection, building water etc. These may be billed or unbilled, metered or unmetered.

WATER LOSSES: the difference between SYSTEM INPUT and AUTHORISED CONSUMPTION. Water losses can be considered as a total volume for the whole system or for partial systems such as raw water mains, transmission or distribution systems, or individual zones.

Note: In the above definition of Water Losses, 'Authorised Consumption' includes bulk exports of water across operational boundaries. When doing the water balance calculation, a convenient alternative method of calculating Water Losses is 'Water Supplied - (Authorised Consumption - Water Exported)'

APPARENT LOSSES: includes all types of inaccuracies associated with customer metering, plus unauthorised consumption (theft or illegal use).

Note: Over-registration of customer meters, leads to under-estimation of REAL LOSSES. Under-registration of customer meters leads to over-estimation of REAL LOSSES.

REAL LOSSES: physical water losses from the pressurized system, up to the point of measurement of customer use. The annual volume lost through all types of leaks, bursts, and overflows depends on frequencies, flow rates, and average duration of individual leaks, bursts and overflows.

Note: Although physical losses after the point of customer flow measurement or assumed consumption are excluded from the assessment of REAL LOSSES, this does not necessarily mean that they are not significant or worthy of attention for demand management purposes.

REVENUE WATER: those components of SYSTEM INPUT which are billed and produce revenue (also known as BILLED AUTHORISED CONSUMPTION). Equal to BILLED WATER EXPORTED, BILLED METERED CONSUMPTION and BILLED UNMETERED CONSUMPTION

NON-REVENUE WATER: those components of SYSTEM INPUT which are not billed and do not produce revenue. Equal to UNBILLED AUTHORISED CONSUMPTION, APPARENT LOSSES and REAL LOSSES.

UNBILLED AUTHORISED CONSUMPTION: those components of AUTHORISED CONSUMPTION which are not billed and do not produce revenue. Equal to UNBILLED METERED CONSUMPTION and UNBILLED UNMETERED CONSUMPTION

7.3 Summary of Gathered Data

Data was gathered for the years 2006 and 2007, and are shown in full in Appendix H. For 2007, a summary of the data is shown in the following Table 16.

Table 16: Summary of Gathered Data - IWA

2007 IWA Balance Item	Volume / Year (m^3)
Annual Water Pumped	18,616,944
Source Meter Inaccuracies (0.93% under registering)	173,138
Bulk Water Supply Export and Import	0
Billed Metered Consumption	15,763,551
Billed Unmetered Consumption	20,800
Unbilled Metered Consumption	0
Unbilled Unmetered Consumption	71,930
Unauthorised Consumption (0.50%)	93,950
Number of Customer Meters	34,971
Customer Meter Inaccuracies (under registering)	4.63%
Length of Network - Mains	524 km
Avg. Length of Services (Curb Stop to Customer Meter)	9.8m
Pressure - in Distribution System	60 psi / 42.21 m
Financial Data - Customer Rate / m^3 of water	$0.75
Water Production Cost per m^3	$0.1889 / m^3
Variable Production Cost per m^3 of water	$0.0612
Fixed Production Cost per m^3 of water	$0.1277
Total Annual Cost of Operating Water System	$3,516,606

7.4 IWA Software Analysis 2007

Software analysis was completed for the years 2006 and 2007, and is included in the attached report. The results for 2007 are as follows:

Table 17: AWWA (WLCC) Water Audit Software v3.0 Results

Parameter	Value
Current Annual Real Losses (CARL)	2,073 ML
Unavoidable Annual Real Losses (UARL)	705 ML
Infrastructure Leakage Inde200x (ILI)	2.94 ILI
System Input Volume	18,790 ML
Revenue Water	15,784 ML
Non-Revenue Water	3,001 ML
Volume of Non-Revenue Water - % of System Input Volume	16%

Table 18: WB-EasyCalc Version 1.18 by Liemberger & Partners Results

Parameter	Value
Current Annual Real Losses (CARL)	2,073,352 m^3
Unavoidable Annual Real Losses (UARL)	704,823 m^3
Infrastructure Leakage Index (ILI)	2.9 ILI
System Input Volume	18,790,082 m^3
Revenue Water	15,784,351 m^3
Non-revenue Water	3,005,731 m^3
Volume of Non-revenue Water - % of System Input Volume	16%

7.5 IWA Software Analysis Summary

In any water system there will be a volume of leakage that includes small leaks and weeps that is either undetectable in practice or not economic to find and repair – this is the Unavoidable Annual Real Losses (UARL). The IWA software uses the physical characteristics of the water distribution system (length of water mains and services, number of connections, average pressure) to make an estimate of UARL. The Current Annual Real Losses (CARL) are also calculated by the software, by taking the water supplied and deducting the calculated authorized consumption and apparent losses, to give CARL. The ratio of UARL to CARL is the Infrastructure Leakage Index (ILI).

The analysis from the two software programs has provided very similar results for each year. The performance indicator, Infrastructure Leakage Index (ILI) for 2006 is a value of between 3.0 and 3.01. For 2007, the City's ILI was in a slightly lower range value of 2.9 and 2.94. These performance indicators provide an indication of the level of real losses in the water distribution system as described above.

The World Bank Target Matrix for ILI shows the City of Guelph to be in the performance B category - Potential for marked improvements; consider pressure management, better active leakage control practices, and better network management, as indicated in the following Table 19.

Table 19: World Bank Target Matrix for ILI

ILI Range	Performance Category	Real Loss Management
1-2	A	Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identify cost effective improvement
2-4	B	Potential for marked improvements; consider pressure management, better active leakage control practices, and better network management
4-8	C	Poor leakage record, tolerable only if water is plentiful and cheap; even then, analyse level and nature of leakage and intensify leakage reduction efforts
>8	D	Very inefficient use of resources; leakage reduction programs imperative and high priority

7.6 Active Leak Detection Program

7.6.1 Principles of Active Leak Detection

A major initiative to understand leakage was carried out in the UK in the early 1990's. As a result of this and subsequent research work, the factors behind the processes leading to real losses are now fairly well understood. The most significant step taken to develop this understanding was to break leakage into a number of components and then look at the factors that influenced the losses from each of these components. Leakage was split into three types; namely:

Background Leakage
This is leakage below the level of detection (by currently available techniques). It will be primarily weeps from joints and gaskets rather than holes in pipes

Leakage from Reported Bursts/Leaks
Reported bursts/leaks are those that come to the attention of the utility operator from customer reports. This may be due to the fact that the leak is surfacing or is causing supply problems such as low pressure or no water.

Leakage from Unreported Bursts/Leaks
If a leak neither comes to the surface nor causes a supply problem then it will not come to the attention of the operating organization. In this case these leaks can accumulate on the system and the losses from leakage will rise with time. In order to control this rise in leakage (often referred to as the Natural Rate of Rise of Leakage or NRR) it is necessary to proactively look for these leaks.

Assets types:

- Trunk Mains/Service Reservoirs
- Distribution Mains
- Service pipes up to the edge of street
- Service pipes from edge of street (to meter)

The reason for splitting the network into different asset types is because many of the factors influencing leakage will be different for the different asset types - for example:

- Flow rates will be higher on mains than on service pipes
- The level of customer reporting tends to be higher on mains because the flows are higher
- Company policy on repair may be different between asset types
- Repair times for leaks on the customer part of the service pipe will be longer as they are usually carried out by customers and can be dependent on company policy on enforcement

7.6.2 Influences on Leakage

The main influences and therefore the way that leakage can be managed can be illustrated as in Figure 18. In the diagram the size of the box in the centre represents the volume of water lost from leakage. The four arrows show that the size of the box (and leakage) can be influenced by changing these main items, namely:

- ***Pressure*** – reducing pressure will reduce the level of background leakage, the rate at which water is lost from leaks and the frequency at which leaks break out
- ***Speed and Quality of Repair*** – reducing the time taken to repair known leaks will reduce the quantity of water lost from leaks. The quality at which these repairs are carried out will ensure that leaks do not break out again
- ***Speed of Detection*** – the water lost from unreported leaks is heavily dependent on the policy on proactive leakage control
- ***Infrastructure Renewal*** – renewing the assets should reduce the frequency at which leaks break out

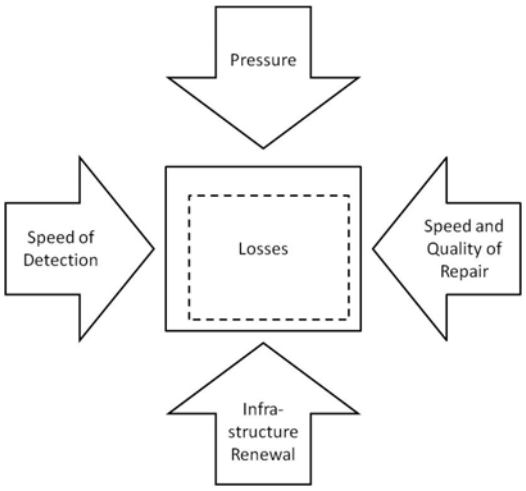


Figure 18 The four influences on leakage (D Pearson)

7.6.3 Sectorisation, Active Leakage Control, and Pressure Management

The main difficulties in leakage management are being sure that the losses are in fact leakage and not unidentified use or other data problems such as meter error, and also identifying where leakage is occurring so that it can be located and repaired efficiently. One of the most reliable and long established methodologies to help with these problems is to split the network into small sectors often referred to as District Meter Areas (DMAs). In this approach areas of the network are identified of preferably between 1000 to (at most) 3000 connections. Where possible these are designed so that they can be fed through one meter throughout the day and night. Once these areas have been established then it is possible to use the data on flow and pressures collected throughout the 24 hour period, and knowing the likely makeup of consumption, to more accurately estimate losses on that area. The estimated losses can be compared and decisions made on prioritizing these sectors for further investigation be it for meter error, unidentified use or real losses of water. DMAs have been used to great effect within the UK for the last 20 years.

Active Leakage Control (ALC) is the process of proactively looking for unreported leaks. This can in its simplest form be dictated by a program of sweeping the network on a regular basis – say once every 12 months. This can be inefficient in that large areas of the network may be swept where there are no unreported leaks running. If the network has been sectorised by setting up DMAs, then information from these sectors on relative levels of losses can be used to priorities and initiate the leakage detection activity. Initially the DMAs are operated temporarily, often by using insertion flowmeters to measure the flow into the DMA, and after the leaks have been identified and repaired, the temporary meter is used to measure the leakage reduction. As experience is gained, these DMAs can be converted into permanent areas, by the installation of permanent flowmeters. It is proposed that temporary DMAs be set up initially, and as part of the next Master Plan update, permanent DMAs be considered.

When temporary DMA leak detection is carried out it is often found that some areas of the network (generally the older and/or higher pressure areas) are probably swept every six months or more frequent and the newer calmer areas may only be swept only once every 3 years. The more often an area is swept the lower will be the average leakage. But more frequent surveys will cost more money. This relationship is often referred to as the active leakage control curve.

Furthermore, leakage levels are highly dependent on pressure. Reducing pressure will reduce the level of leakage because it will reduce:-

- the rate at which water escapes from any leak
- the level of background leakage
- the frequency at which leaks break out on the system

At the time the permanent DMAs are considered, opportunity should be taken establish pressure reduction. This will minimize any excess pressures above those needed to maintain levels of service, be that for firefighting or for customers.

7.6.4 System Backlog Leakage Removal

If a water distribution system has not been subjected to an active leak detection program, there will be a significant number of leaks on watermains and service pipes that are running undetected, as they do not come to the surface or causes a supply problem. These leaks are often referred to as backlog leakage. The first time that active leak detection is practiced on the water distribution system, this backlog leakage is removed, as the leaks are found and repaired.

The process of removal of system backlog and setting up a process of regular proactive leakage detection is illustrated in Figure 19.

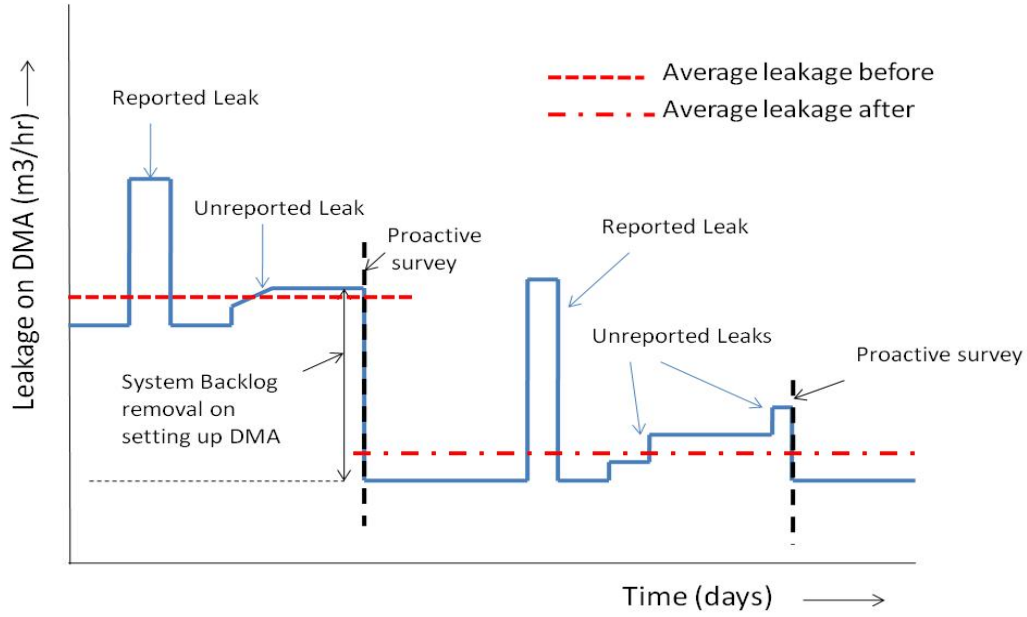


Figure 19: Process of Removal of System Backlog

As shown earlier in this report, the Current Annual Real Losses (CARL) in Guelph is 5.7 Ml/d. The removal of system backlog will result in an increase in the number of leaks repaired during the period over which the DMAs are set up and backlog is reduced. It is estimated that system backlog is of the order of 2.7Ml/d. Using default values for average sizes of leaks of 6m3/hr for mains and 1.6m3/hr for service leaks, it is estimated that this could represent of the order of an additional 50 leaks. Some of these are likely to be on the customer's part of the network

7.6.5 Summary

It is recommended that:

- Temporary DMAs should be established
- As DMAs are established the nightline on the area should be reduced to the minimum achievable, checked against expected levels of background leakage on these areas.

- A program of proactive leakage control should be adopted on established DMAs responding to entry levels or volumes that are consistent with the agreed economic level of leakage for the network
- Once experience is gained with the operation of the temporary DMAs, which could be at the next update of the Master Plan, permanent DMAs should be considered. These permanent DMAs will be operated to continuously monitor leakage levels, and provide a targeted approach to active leak detection. In addition pressure reduction should be considered in some of the permanent DMAs at that time

7.7 Water Loss Mitigation Strategy

As part of the Conservation and Efficiency Strategy a Water Loss Mitigation Action Strategy was developed for the City. A separate report on this task has been provided however the main recommendations from the analysis are as follows:

- District Meter Areas (DMAs) should be established across the City of Guelph water distribution system
- As DMAs are established, the nightline flows in the area should be reduced to the minimum levels achievable, checked against expected levels of background leakage on these areas.
- A program of proactive leakage control should be adopted on established DMAs responding to entry levels or volumes that are consistent with the agreed economic level of leakage for the network
- Detailed evaluation of the potential for pressure management should be carried out in recommended areas
- Mains rehabilitation is not economic on leakage grounds alone
- A more detailed analysis of the economic level of leakage should be completed taking into account new data as it becomes available.
- Continue annual field calibration of the thirteen existing source meters.
- Consider the replacement of the existing large ICI meters over a 5 year time frame to reduce under-registration and enhance revenue.
- Consider the replacement of the existing residential meters over a 15 year time frame to reduce under-registration and enhance revenue.
- Complete a business case analysis to determine if automatic meter reading (AMR) technology is appropriate for any future meter replacement program.

With this strategy it is estimated that real losses could be reduced to 2.6Ml/d, representing a reduction just over 3Ml/d on existing levels of real losses.

8.0 Water Supply Demand Forecasts

8.1 Approach and Methodology

The objective of this activity is to evaluate the demand forecasts completed through the 2006 Water Supply Master Plan and summarize the expected water supply demand forecast(s) for the planning period, including any updates as required to reflect the Local Growth Management Strategy.

The methodology adopted for the water demand projection applies unit consumption rates and peaking factors based on historical statistics, and is illustrated in Figure 20 below:

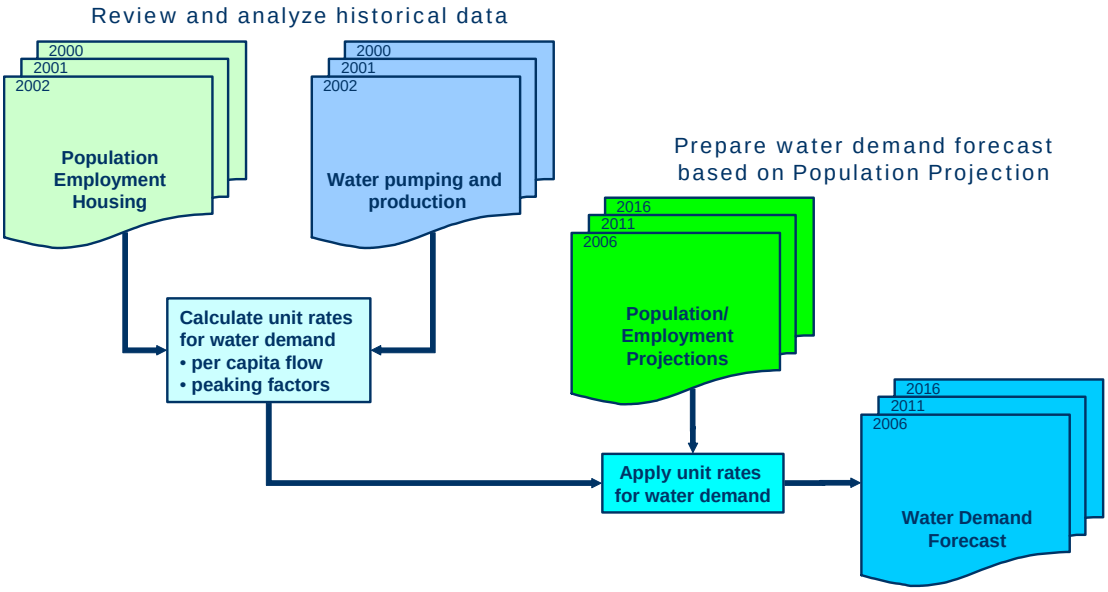


Figure 20: Water Demand Forecasting Methodology

8.2 Background

1999 Water Conservation and Efficiency Study

The Water Conservation and Efficiency Study (WC&ES) was completed in 1999 to develop a comprehensive Water Conservation and Efficiency Plan for the City's residential, industrial, commercial and institutional customers. The study followed an integrated approach considering not only water use objectives, but also technical and regulatory requirements and public acceptability.

Demographic and population growth data were derived from current reports at the time, and a water demand model was prepared to predict potential changes in water demand from 1999 to 2023 for a range of conservation measures for both residential and non-residential customers. The population forecast and base case water demand projection developed for the 1999 WC&ES are shown in Table 20.

.

Table 20: 1999 WC&ES Population and Base Case Water Demand

Year	Population	w/ Students	Total m³/y	Ave Day m³/d	Max Day m³/d
1996	97,339	101,539	18,085,750	49,550	79,280
1997	99,065	103,265	18,392,350	50,390	80,642
1998	100,821	105,021	18,702,600	51,240	81,984
1999	102,606	106,806	19,020,150	52,110	83,376
2000	104,422	108,622	19,330,400	52,960	84,736
2001	106,269	110,469	19,640,650	53,810	86,096
2002	107,926	112,126	19,918,050	54,570	87,312
2003	109,608	113,808	20,199,100	55,340	88,544
2004	111,315	115,515	20,483,800	56,120	89,792
2005	113,048	117,248	20,775,800	56,920	91,072
2006	114,807	119,007	21,067,800	57,720	92,352
2007	116,354	120,554	21,323,300	58,420	93,472
2008	117,921	122,121	21,582,450	59,130	94,608
2009	119,509	123,709	21,841,600	59,840	95,744
2010	121,117	125,317	22,108,050	60,570	96,912
2011	122,746	126,946	22,374,500	61,300	98,080
2012	124,269	128,469	22,622,700	61,980	99,168
2013	125,811	130,011	22,874,550	62,670	100,272
2014	127,371	131,571	23,126,400	63,360	101,376
2015	128,950	133,150	23,385,550	64,070	102,512
2016	130,548	134,748	23,644,700	64,780	103,648
2017	132,125	136,325	23,900,200	65,480	104,768
2018	133,720	137,920	24,159,350	66,190	105,904
2019	135,334	139,534	24,422,150	66,910	107,056
2020	136,967	141,167	24,699,550	67,670	108,272
2021	138,619	142,819	24,984,250	68,450	109,520
2022	140,290	144,490	25,268,950	69,230	110,768
2023	141,981	146,181	25,557,300	70,020	112,032
2024	143,691	147,891	25,849,300	70,820	113,312

Analysis of the data revealed the following key water demand factors:

- Average unit consumption: about 500 Lcpd (including non-residential demand)
- Maximum day peaking factor: 1.60

The primary elements of the recommended water efficiency program included toilet fixture and clothes washer replacement programs, ICI water audits and a significant effort in public education.

The water demand reduction anticipated as a result of this program is shown in Table 21 together with the resultant average day and maximum day water demand projections.

Table 21: 1999 WC&ES Water Demand Reductions

Year	Res m³/d	ICI m³/d	Peak m³/d	Ave Day m³/d	Max Day m³/d
1996	-	-	-	49,550	79,280
1997	-	-	-	50,390	80,642
1998	-	-	-	51,240	81,984
1999	(152)	(132)	(591)	51,826	82,785
2000	(305)	(264)	(1,182)	52,391	83,554
2001	(457)	(396)	(1,773)	52,957	84,323
2002	(609)	(528)	(2,364)	53,433	84,948
2003	(761)	(660)	(2,956)	53,918	85,588
2004	(914)	(792)	(3,547)	54,414	86,245
2005	(1,066)	(924)	(4,138)	54,930	86,934
2006	(1,218)	(1,056)	(4,729)	55,446	87,623
2007	(1,370)	(1,188)	(5,320)	55,861	88,152
2008	(1,523)	(1,320)	(5,911)	56,287	88,697
2009	(1,523)	(1,320)	(5,911)	56,997	89,833
2010	(1,523)	(1,320)	(5,911)	57,727	91,001
2011	(1,523)	(1,320)	(5,911)	58,457	92,169
2012	(1,523)	(1,320)	(5,911)	59,137	93,257
2013	(1,523)	(1,320)	(5,911)	59,827	94,361
2014	(1,523)	(1,320)	(5,911)	60,517	95,465
2015	(1,523)	(1,320)	(5,911)	61,227	96,601
2016	(1,523)	(1,320)	(5,911)	61,937	97,737
2017	(1,523)	(1,320)	(5,911)	62,637	98,857
2018	(1,523)	(1,320)	(5,911)	63,347	99,993
2019	(1,523)	(1,320)	(5,911)	64,067	101,145
2020	(1,523)	(1,320)	(5,911)	64,827	102,361
2021	(1,523)	(1,320)	(5,911)	65,607	103,609
2022	(1,523)	(1,320)	(5,911)	66,387	104,857
2023	(1,523)	(1,320)	(5,911)	67,177	106,121
2024	(1,523)	(1,320)	(5,911)	67,977	107,401

2006 Water Supply Master Plan

The Water Supply Master Plan (WSMP) was completed in 2006 to update its Water Supply Strategy and identify water supply options for the City considering other studies and work activities completed in recent history. The WSMP included population and water demand projections to the planning year 2054 to confirm 25 and 50-year water supply requirements.

The population projections were used to estimate future water demand based on per capita consumption with allocations for industrial, commercial and institutional uses. Three population growth scenarios were considered:

- Scenario 1 – Low Growth Scenario: 1.50% annual growth rate
- Scenario 2 – Medium Growth Scenario: 2.00% growth rate
- Scenario 3 – High Growth Scenario: 2.50% annual growth rate

The low growth scenario is the growth rate endorsed by Council; also used in the Guelph Development Charges Background Study and in the City's Official Plan.

The population and water demand forecast developed for the 2006 Water Supply Master Plan is shown in Table 22.

Table 22: 2006 WSMP Population and Water Demand Forecast

Year	Population	ICI Ratio	Equiv Pop	Ave Day m³/d	Max Day m³/d
2004	114,200	57.1%	179,408	53,822	80,733
2009	124,600	59.0%	198,114	59,434	89,151
2014	133,600	58.6%	211,889	63,566	95,349
2019	141,300	58.0%	223,254	66,976	100,464
2024	148,600	57.5%	234,045	70,213	105,319
2029	158,200	57.0%	248,374	74,512	111,768
2034	172,200	56.8%	270,009	81,002	121,503
2039	186,200	56.4%	291,216	87,364	131,046
2044	200,200	56.3%	312,912	93,873	140,809
2049	214,200	56.1%	334,366	100,309	150,463
2054	228,100	55.8%	355,379	106,613	159,919

This forecast is based on the following key water demand factors:

- Average unit consumption: 300 Lcpd on equivalent population
- Maximum day peaking factor: 1.60
- Population growth rate: 1.50%
- Local Growth Management Strategy

"Equivalent population" includes a non-residential population equivalent based on the proportion of non-residential land area to residential land area through the planning horizon. Minor variations are attributed to rounding of calculated values.

The 2006 WSMP recommended full implementation of the 1999 WC&ES including:

- Ongoing implementation of peak demand management efforts to maintain a maximum day factor of not more than 1.50 at all times
- Expansion of average day conservation and efficiency measures to achieve 10% reduction in average day use by 2010, a 15% reduction by 2017 and a 20% reduction by 2025
- Reduction of unaccounted-for water use from 13% to less than 10%

Local Growth Management Strategy

The *Places to Grow Act*, approved in June 2006, provided policy direction to communities in the Greater Golden Horseshoe, directing growth to built-up areas where capacity exists to best accommodate expected population and employment growth.

The Growth Plan also provided population and employment forecasts for the City of Guelph and County of Wellington. Based on the current 57% share of population, the City's portion of the overall allotted population would be approximately 183,000 by 2031. The corresponding level of employment expected in 2031 is 104,000.

The Local Growth Management Strategy was prepared in response to the Provincial Growth Plan and provides background for the preparation of the 2009 Official Plan Update. The recommendations approved by Council in June 2008 include:

- Plan for a population target of 169,000 in 2031. This corresponds to a "Places to Grow" population of 175,000.
- Plan for a steady rate of population increase equivalent to a long term average of 1.5%.
- Plan for employment growth to keep pace with population growth, adding about 31,000 jobs over the next 25 years.

It is significant to note that the wastewater assimilative capacity of the Speed River severely constrains the long-term population projection. Current reports indicate that, based on existing treatment technologies and stream flow monitoring, growth can be sustained only to a population target of 165,000 to the year 2031.

8.3 Historical Water Demand Analysis

Historical Water Use

Historical water use in the City is summarized in Table 23 and illustrated in Figure 21.

Table 23: Historical Population and Water Use

Year	Population[1]	ICI Equivalent Population [2]	Ave Day m³/d [3]	Max Day m³/d [2]	Max Day Factor
1997	97,400		50,818	67,080	1.32
1998	99,592		52,511	69,315	1.32
1999	101,784		52,283	70,059	1.34
2000	103,976		52,747	61,187	1.16
2001	106,168		55,290	73,744	1.33
2002	107,900		53,654	70,568	1.32
2003	109,700		51,945	65,647	1.26
2004	111,500	65,224	51,229	60,103	1.17
2005	113,200	66,883	52,579	67,975	1.29
2006	115,000	68,542	51,387	61,456	1.20
2007	117,000	70,202	51,005	63,652	1.25

1. Not including students (about 4,200).
2. From 2006 WSMP projection.
3. Production data provided by City staff.

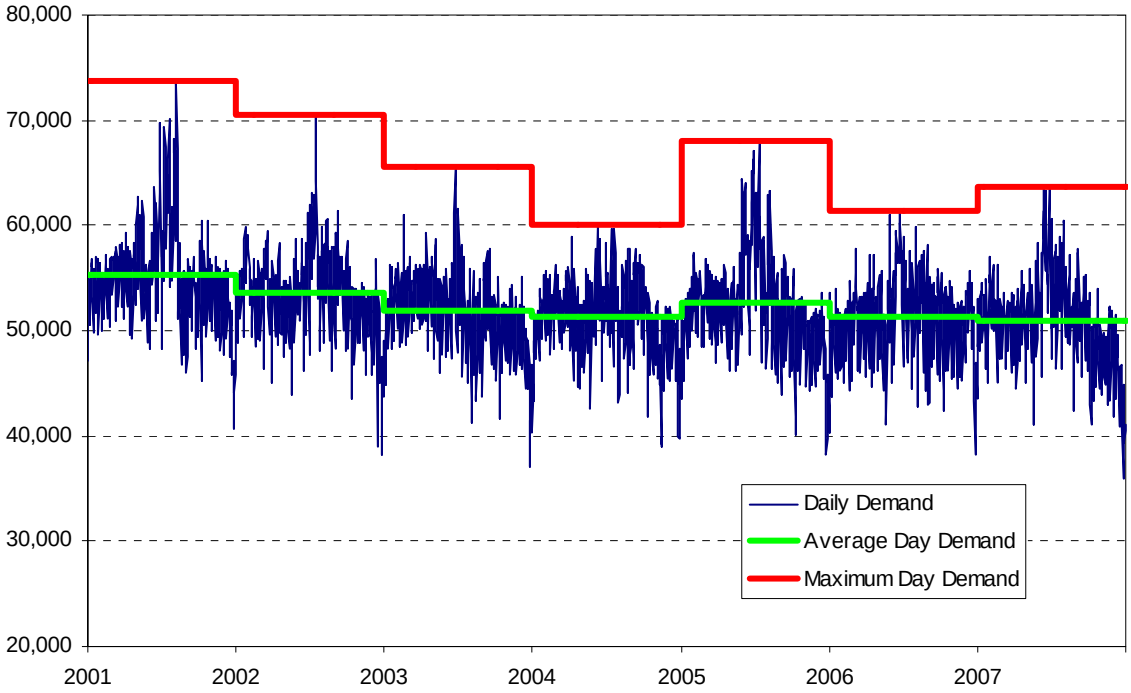


Figure 21: Historical Water Use

Customer Sector Analysis

Water demand by customer sector is shown in Table 24. Breakdown is provided for Residential and Non-residential or Industrial/Commercial/Institutional (ICI) sectors.

Table 24: Residential/ICI Billing Summary

Year	Billed Residential Consumption m³/yr	Billed ICI Consumption m³/yr	Total Billed Consumption m³/yr	% Res	% ICI
2001	7,477,889	8,920,613	16,398,502	45.6%	54.4%
2002	7,435,122	8,909,358	16,344,480	45.5%	54.5%
2003	6,082,598	9,787,988	15,870,587	38.3%	61.7%
2004	7,614,457	8,344,607	15,959,064	47.7%	52.3%
2005	7,680,282	8,273,299	15,953,581	48.1%	51.9%
2006	7,427,339	8,496,016	15,923,355	46.6%	53.4%
2007	8,012,964	7,750,587	15,763,551	50.8%	49.2%

Table 24 shows that historically ICI demand typically exceeded Residential demand, while water demand is currently split almost equally.

Water Loss Summary

The historical water loss summary is shown in Table 25. Basic water loss is calculated as the difference between the total billed consumption and the total production volume. Water loss is also shown as a percent of the total production volume.

Table 25: Water Loss Summary

Year	Total Production m3/yr [1]	Total Billed Consumption m3/yr [2]	Basic Water Loss m3/yr	% UFW [3]
2001	20,180,994	16,398,502	3,782,492	18.7%
2002	19,583,543	16,344,480	3,239,063	16.5%
2003	18,960,091	15,870,587	3,089,504	16.3%
2004	18,749,923	15,959,064	2,790,859	14.9%
2005	19,191,319	15,953,581	3,237,738	16.9%
2006	18,756,338	15,923,355	2,832,983	15.1%
2007	18,616,944	15,763,551	2,853,393	15.3%

1. From pumping records.
2. From billing records.
3. Unaccounted for Water as a percent of total production.

Table shows that the %UFW varied from 14-19% in recent years. Following discussion with City staff it was determined and agreed that a value of 14% would be used as the baseline for UFW for the demand projection.

Population vs. Demand Analysis

Analysis of Table 25 reveals that the average annual billed consumption over the most recent 5-year period (2003-2007) is 15,894,028 m^3/yr or 43,545 m^3/day for Residential and ICI uses combined, not including unaccounted-for water losses.

Analysis of Table 26 reveals that the corresponding average population size for the same 5-year period is 113,280 persons (residential only) and 181,888 persons (including ICI equivalent population).

Therefore, for the purposes of this water demand forecast:

- Residential unit consumption rate 384 Lcpd (not including UFW)
- Combined equivalent unit consumption rate 239 Lcpd (not including UFW)
- Unaccounted-for Water loss factor 14%, or 33 Lcpd
- Equivalent capital demand unit rate 272 Lcpd
- Peak Day Factor (PDF) 1.34

Population and Employment Growth Forecast

Population and employment growth in the City is assumed to follow the direction of the Local Growth Management Strategy. Accordingly, the baseline population forecast used for this water demand projection is as shown in Table 26. The ICI population was assumed unchanged from the 2006 Water Supply Master Plan.

Table 26: Baseline Population and Employment Growth Forecast

Year	Residential Population [1]	ICI Equivalent Population [2]	Total Population
2006	115,000	68,542	183,542
2011	125,000	75,445	200,445
2016	137,000	79,795	216,795
2021	149,000	83,397	232,397
2026	159,000	87,392	246,392
2031	169,000	93,253	262,253
2036	182,000	97,248	279,248
2041	196,000	101,832	297,832
2046	211,000	106,416	317,416
2051	227,000	111,000	338,000

1. Based on Guelph Development Charges 2008 Update (draft) forecasting, Watson Associates, August 2008.
2. Based on 2006 WSMP forecast.
3. Post 2031 growth is assumed at a rate of 1.50% per year.

8.4 Average Day Water Demand Projection

The baseline average day water demand projection, based on water use statistics and the Local Growth Management Strategy is shown in Table 27.

Table 27: Average Day Water Demand Projection

Year	Population	ICI Equiv Pop	Res Ave Day m³/d	ICI Ave Day m³/d	Ave Day m³/d
2006	115,000	68,542	31,620	18,846	51,387
2011	125,000	75,445	34,125	20,597	54,722
2016	137,000	79,795	37,401	21,784	59,185
2021	149,000	83,397	40,677	22,767	63,444
2026	159,000	87,392	43,407	23,858	67,265
2031	169,000	93,253	46,137	25,458	71,595
2036	182,000	97,248	49,686	26,549	76,235
2041	196,000	101,832	53,508	27,800	81,308
2046	211,000	106,416	57,603	29,052	86,655
2051	227,000	111,000	61,971	30,303	92,274

The average day demand projection is illustrated in Figure 22, which also shows the forecast prepared for the 2006 WSMP as well as the targets established for the 1999 WC&ES.

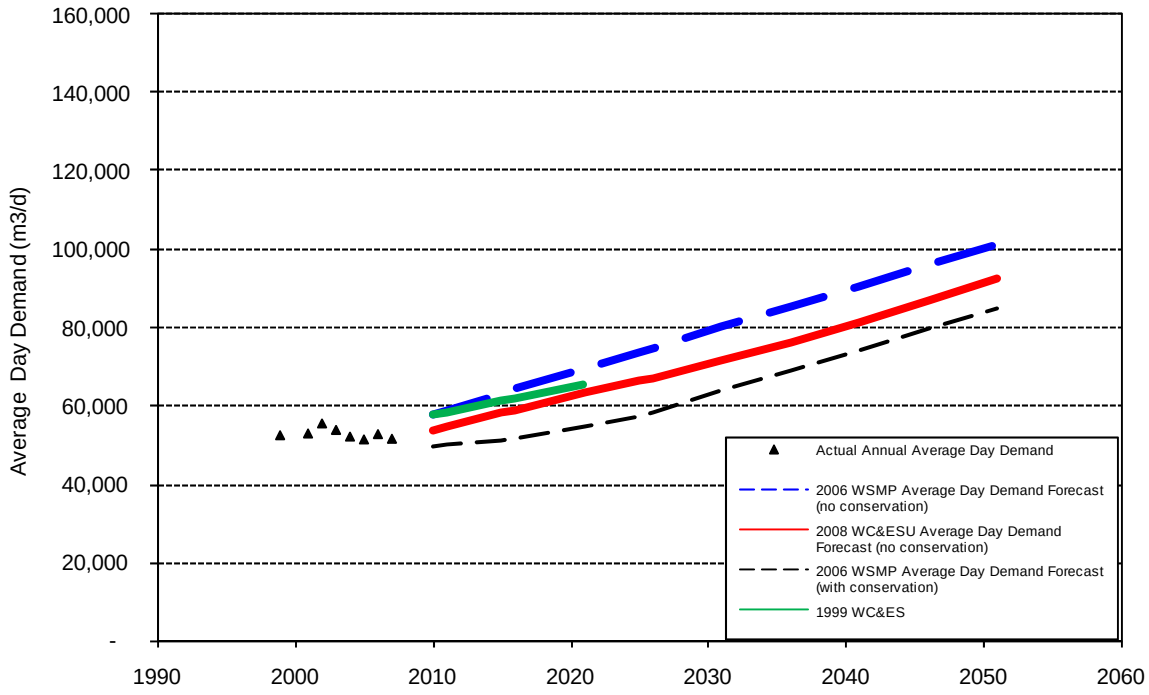


Figure 22: Average Day Demand Projection

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8.5 Maximum Day Water Demand Projection

The baseline maximum day water demand projection, based on observed water use statistics and the Local Growth Management Strategy is shown in Table 28.

Table 28: Maximum Day Water Demand Projection

Year	Population	ICI Equiv Pop	Res Max Day m³/d	ICI Max Day m³/d	Max Day m³/d
2006	115,000	68,542	37,816	22,539	61,456
2011	125,000	75,445	45,728	27,599	73,327
2016	137,000	79,795	50,117	29,190	79,308
2021	149,000	83,397	54,507	30,508	85,015
2026	159,000	87,392	58,165	31,970	90,135
2031	169,000	93,253	61,824	34,114	95,937
2036	182,000	97,248	66,579	35,575	102,155
2041	196,000	101,832	71,701	37,252	108,953
2046	211,000	106,416	77,188	38,929	116,117
2051	227,000	111,000	83,041	40,606	123,647

The maximum day demand projection is illustrated in Figure 23, which also shows the forecast prepared for the 2006 WSMP as well as the targets established for in 1999 WC&ES.

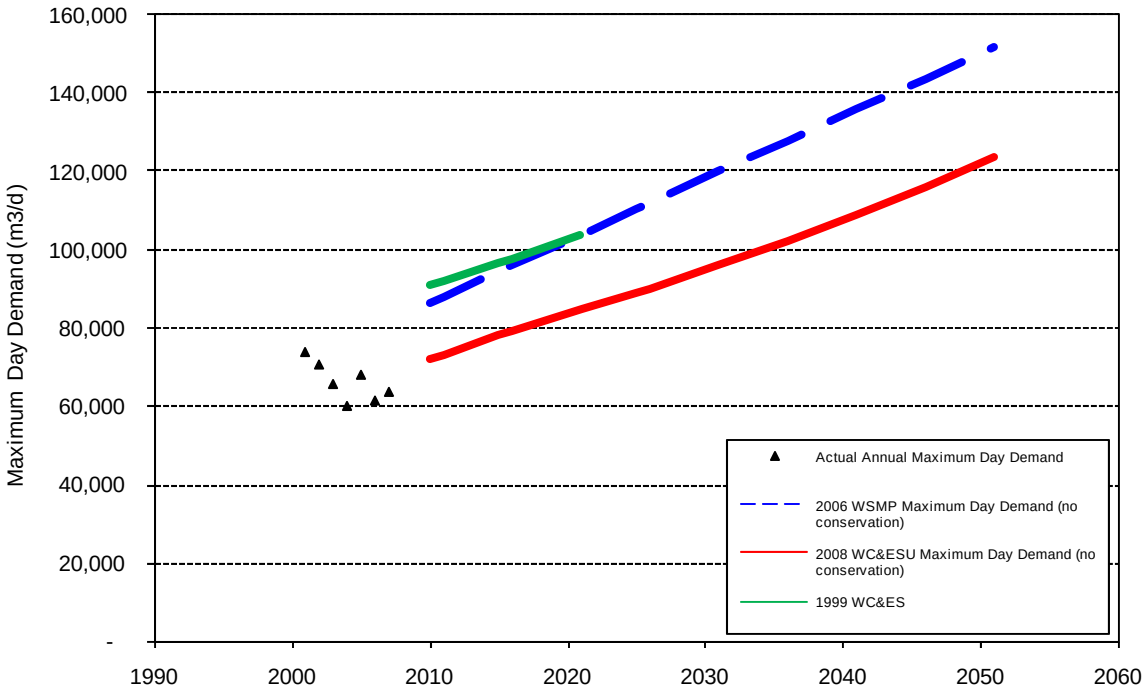

Figure 23: Maximum Day Demand Projection

8.6 References

- Braun Consulting Engineers Ltd., "Water Conservation and Efficiency Study", February 1999.
- Earthtech Canada Inc., "City of Guelph Water Supply Master Plan Draft Final Report", September 2006
- City of Guelph Community Design and Development Services Department, Council Report (08-83) "Addendum Report – Guelph's Local Growth Management Strategy Recommendations", June 23, 2008.
- City of Guelph Community Design and Development Services Department, Council Report (08-14) "Guelph's Local Growth Management Strategy Recommendations in Response to the Growth Plan for the Greater Golden Horseshoe", April 10, 2008.
- City of Guelph, Provincial Regulation 170/03 Summary Report for the period January 1 to December 31, 2004.
- City of Guelph, Provincial Regulation 170/03 Summary Report for the period January 1 to December 31, 2005.
- City of Guelph, Provincial Regulation 170/03 Summary Report for the period January 1 to December 31, 2006.
- City of Guelph, Provincial Regulation 170/03 Summary Report for the period January 1 to December 31, 2007.

9.0 Identification and Evaluation of Water Conservation and Efficiency Program Alternatives

9.1 Water Demand

Utilizing 2007 municipal billing data, a simple water balance for the City was developed as shown in Figure 24 and Table 29.

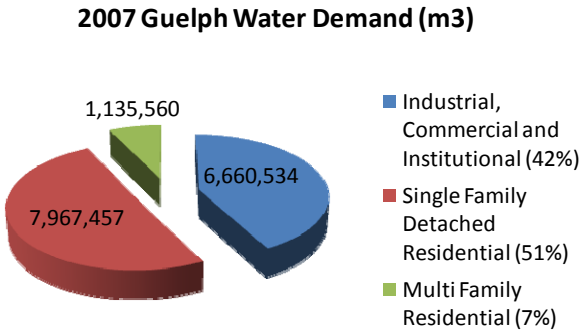

Figure 24: 2007 Guelph Water Demand by Sector

Table 29: 2007 Guelph Water Demand by Sector

Sector	2007 Billed(m^3)	% of Total Billed	Population	LCPD
Single Family	7,967,457	51%	94,745	230
Multi Family	1,135,560	7%	20,295	153
Total Residential	9,103,017			
Industrial, Commercial, Institutional (ICI)	6,660,534	42%		
Total 2007 Billed Consumption	15,763,551			

9.2 Single Family Detached Residential Water Efficiency Potential

The largest use of water inside the home is toilet flushing. As discussed earlier the efficiency of toilet flushing has improved by 70% over the past 15 years. Prior 1993, toilets flushed with a volume of water greater than 20 litres. On August 1st, 1993, the Ontario Building Code (OBC) mandated 13.25 litre flush toilets in all new construction. The OBC was updated once again on January 1st, 1996 mandating 6.0 litre (ultra low flush or ULF) flush toilets in all new construction. Although mandated in new construction, ULF toilets were slow to make any significant market penetration in the retail replacement market. Early ULF toilet models were notorious for flushing with more than 6.0 litres and often times requiring double flushing to do the job. As such 13.25 litre flush toilets remain popular in the retail market throughout the 1990's. More recently, due to third party performance testing, most ULF toilet models are now tested and rated for performance and the

amount of water flushed. The listing of tested toilets is used by municipalities and consumer groups for promoting ULF toilets.

Over the past five years, some toilet manufacturers have developed and introduced 4.8 litre (high efficiency toilets or HET) flush toilets and dual flush toilets that flush at 3.0 litres for liquids and 6.0 litres for solid wastes. These toilets have been third party tested for performance and as such have gained significant market share in the toilet replacement market. During 2008 sales events held in Guelph, Hamilton, Peel Region, York Region and Toronto, these lower flush volume toilets had over 50% market share.

The second largest user of water inside the home is the clothes washer. Older top loading models can use anywhere from 100 to 150 litres per wash cycle. Although not mandated in the OBC, more efficient front loading models have gained market acceptance and currently enjoy over a 30% market share. The front loading models can use on average approximately 55 litres per cycle.

Most of the remaining water used in a typical home is from showers and faucets. As with the toilets, these water consuming fixtures have been influenced by the OBC. Since 1991, the OBC has required showerheads with a 9.5 litre per minute flow rate and faucets with a flow rate less than 8.35 litres per minute.

In order to determine the overall water efficiency potential in the single family detached housing sector, the consultant team developed three models of homes based on the vintage of the home and the water efficiency requirements of the OBC. Data collected from the Residential End Uses of Water Study completed by the American Water Works Association Research Foundation in 1999 and more recent studies completed in Ontario were also used.

The houses built prior to 1996 have the following water consuming fixtures and appliances:

- Toilets that flush on average at 15 litres (an average between 13.5 and 18 litre flush toilets)
- Showerheads with flow rates of 13 litres per minute
- Faucets with flow rates of 13 litres per minute
- Top loading clothes washers that use 62% more water than water efficient front loading machines
- Other in-efficient appliances such as water softeners and humidifiers
- Due to older plumbing materials and techniques, leaks are more prevalent

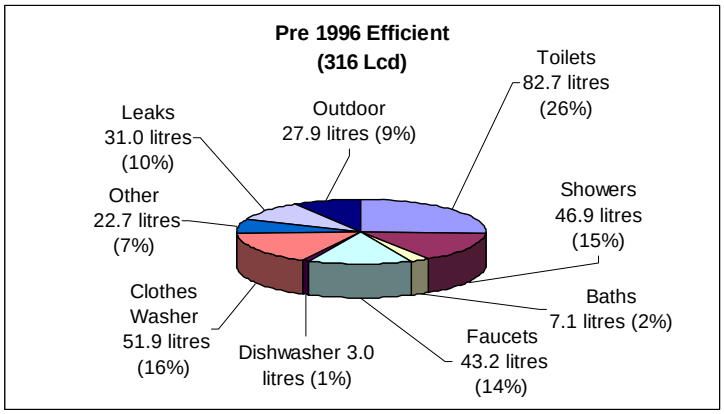

Figure 25: Water Demand for a Pre-1996 Vintage House

The houses built after 1996 have the following water consuming fixtures and appliances:

- Toilets that flush on average at 7.5 litres (an average between 6 and 9 litre flush toilets)
- Showerheads with flow rates of 9.4 litres per minute
- Faucets with flow rates of less than 8.35 litres per minute
- Generally water consuming top loading clothes washers with approximately 10% water efficient front loading machines
- Some market penetration of more efficient water softeners and humidifiers
- Less leaks due to newer plumbing materials and techniques

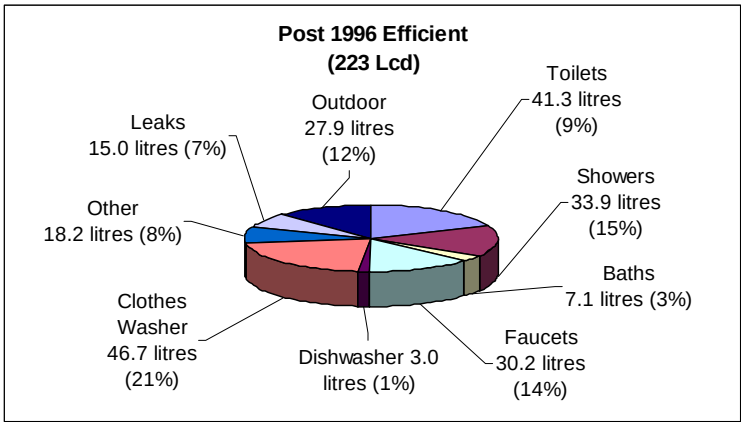

Figure 26: Water Demand for a Post 1996 Vintage House

The most efficient house model was developed using data from a 2008 study completed by the Region of Durham at a water efficient new development. The finding of that study was that the per capita demand of a water efficient home would be 149 litres per capita per day. The Durham did not have water softeners, as such the results were adjusted to include efficient water softeners. The most efficient home would have the following water consuming fixtures and appliances:

- Toilets that flush on average at 4.8 litres
- Showerheads with flow rates of 9.4 litres per minute
- Faucets with flow rates of less than 8.35 litres per minute
- All clothes washers are water efficient Energy Star front loading machines
- All water softeners and humidifiers are water efficient models
- Less leaks due to newer plumbing materials and techniques
- All homes have water efficient landscaping and use minimal outdoor water

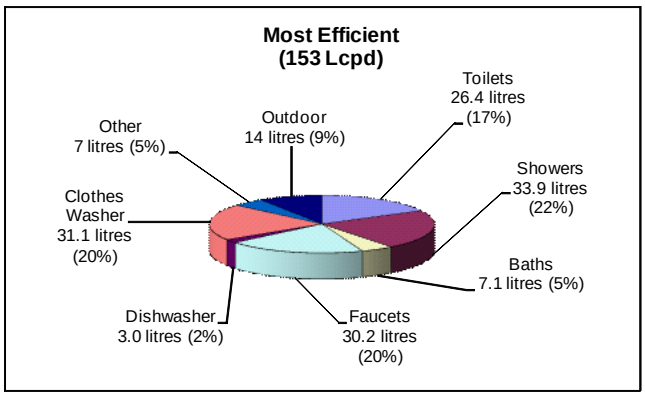

Figure 27: Water Demand for the Most Efficient House

Figure 27, illustrates the most efficient home utilizing market available technology which meets existing codes and standards. In the future as greywater and rain water harvesting technology and regulations develop there will be an opportunity for even more water savings. Figures 28 and 29 illustrates demand profiles for these future homes.

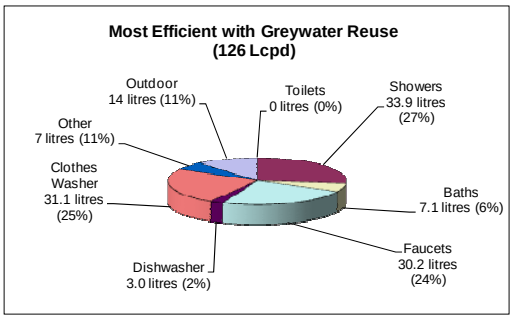

Figure 28: Water Demand with Greywater Reuse

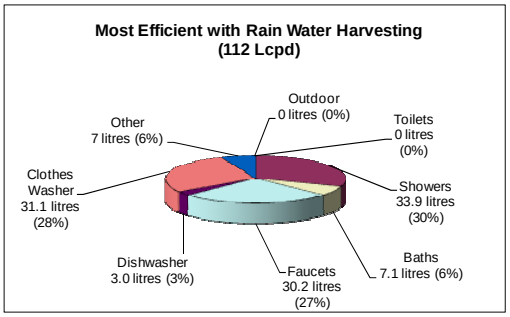

Figure 29: Water Demand with Rain Water Harvesting

The residential per capita consumption of 153 litres per day is a level that is attainable if all water consuming fixtures in the home were the most efficient available, that the landscaping was water efficient and that the habits and attitudes of the residents were very water conscious. It is technically achievable and a goal to strive for but extremely difficult to reach from a cost and delivery perspective especially in the existing home market. The 153 Lcpd is used to calculate the overall water efficiency potential in the residential sector. Using the existing residential per capita consumption of 230 Lcpd based on 2007 billing data and the most efficient model home consumption of 153 Lcpd, a water efficiency potential of 77 Lcpd or a 33% percentage reduction was calculated.

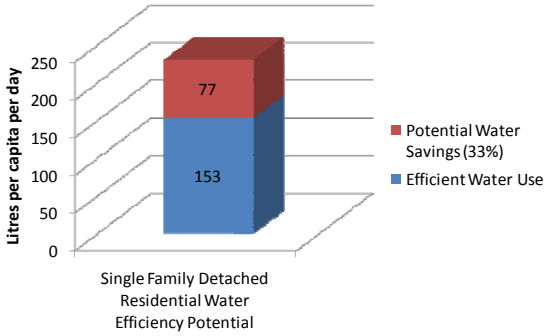

Figure 30: Water Efficiency Potential, Single Family

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The overall water efficiency potential for the single family detached residential market is 249,342 m3/year or 683.1 m3 per average day as indicated in Table 30 below. This assumes a 100% participant rate in retrofit programs.

Table 30: Single Family Detached Residential Overall Water Efficiency Potential

2007 Single Family Detached Current Demand (Lcpd)	Estimated Potential Savings (33%) per Analysis (Lcpd)	2007 Single Family Detached Population	Potential Single Family Detached Water Savings per Year (m3)	Potential Single Family Detached Water Savings per Average Day (m3)
230	77	94,745	2,662,808	7,295

9.3 Multi Family Residential Water Efficiency Potential

Water use in the multi family residential sector is similar to the single detached residential market. The primary water consuming appliances and fixtures include toilets, showers, faucets and clothes washers. There could be some additional demand from cooling towers and boiler make up water.

A thorough analysis of 71 multi family buildings representing over 96% of the entire sector was completed. The buildings were reviewed in terms of existing water consuming technology and the ability to retrofit or replace that technology with new water efficient appliances and fixtures. A spreadsheet model was developed and populated with information from the billing system and municipal tax assessment information. The model determined a potential of 22% water reduction in the 71 buildings analysed.

Table 31: Multi Family Residential Water Efficiency Potential

	2007 Overall Billable Volume (m3)	Existing Efficient Water Volume (m3)	Potential Water Savings (m3)	Potential Percentage Savings
71 Multi Family Buildings	1,090,053	850,661	239,392	22%

As reported earlier, the multi family residential per capita consumption in 2007 was 153 Lcpd. Based on the analysis of the 71 buildings the lowest potential residential per capita is 22% lower or 119 Lcpd.

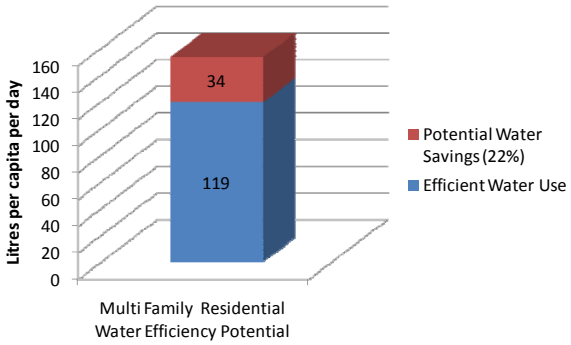


Figure 31: Water Efficiency Potential, Multi Family

The overall water efficiency potential for the multi family market is 249,342 m3/year or 683.1 m3 per average day as indicated in the table below. This assumes a 100% participant rate and unlimited funding.

Table 32: Multi Family Overall Water Efficiency Potential

2007 Multi Family Current Demand (Lcpd)	Estimated Potential Savings (22%) per Analysis (Lcpd)	2007 Multi Family Population	Potential Multi Family Water Savings per Year (m3)	Potential Multi Family Water Savings per Average Day (m3)
153	34	20,295	249,342	683.1

9.4 Industrial, Commercial and Institutional (ICI) Water Efficiency Potential

Water use in the industrial, commercial and institutional (ICI) sector includes both water that is used for industrial processes and domestic use such as flushing toilets and washing hands. Process water primarily is used for cooling towers, boilers, cleaning, once through cooling and as a component of the product such as in the beverage industry. As reported earlier in the report a thorough analysis was completed on the top 133 ICI user accounts which represent in excess of 80% of the water use in this sector. A spreadsheet model was developed to segregate the water used by these companies between domestic and process use and efficient and inefficient use.

The largest 133 ICI companies consumed 4,766,000 m3 of water in 2007 of which 88% or 4,198,000 m3 was used for process water. Domestic use was estimated at 7.5% or 306,000 m3 for the year and water used in the product accounted for 4.5% or 208,000 m3 in 2007.

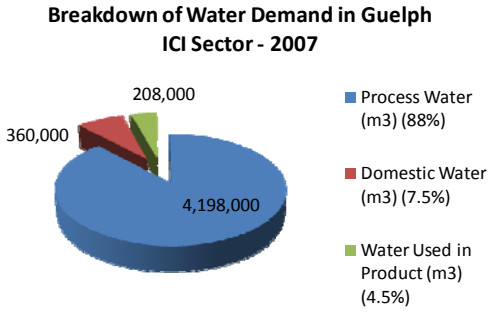
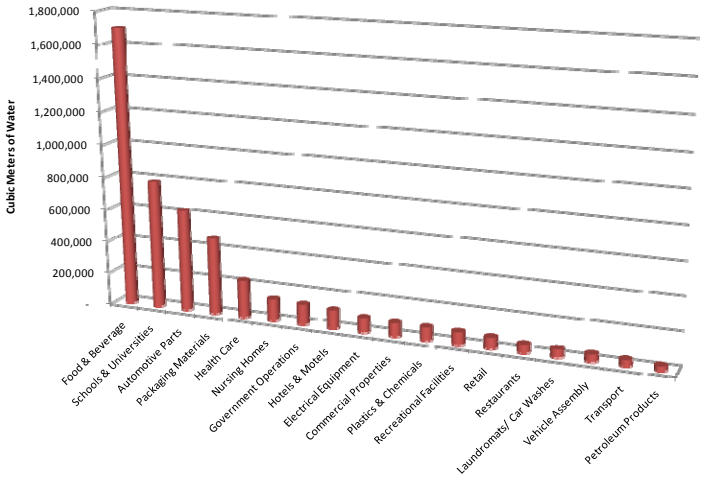


Figure 32: Breakdown of ICI Water Demand 2007

The 133 companies and their associated water use were segmented into sectors as defined by their corresponding North American Industry Classification System (NAICS) codes and shown in the following Figure 33.



* Based on 133 largest ICI customers

Figure 33: 2007 Annual ICI Water Consumption by Sector

Following the segmentation, water efficiency factors were applied to determine the potential for water efficiency. The factors were developed based on data from the City of Toronto ICI Audit and Capacity Buyback Program. The potential savings are associated with both process and domestic water use.

The results of this analysis indicating potential water savings for each ICI sector is shown in the following Figure 34.

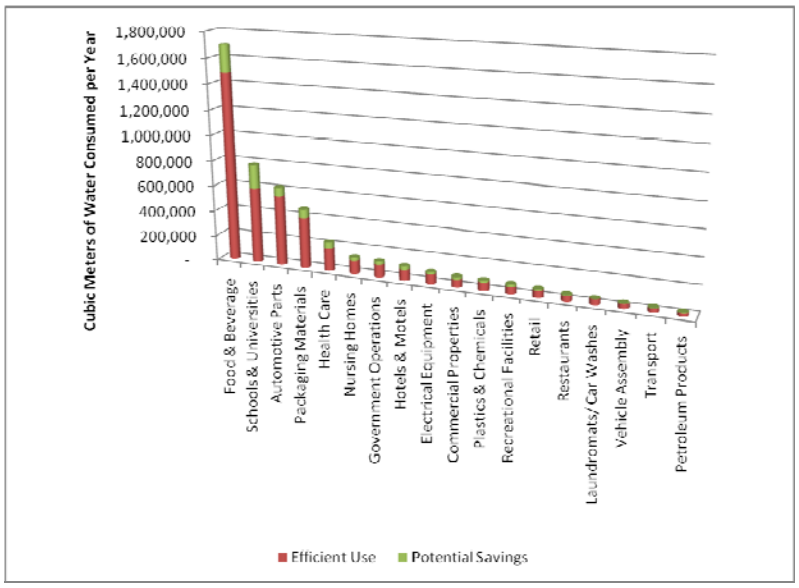


Figure 34: ICI Overall Water Use and Potential Water Savings by Sector

The following Figure 35 shows the potential for water efficiency in each ICI sector.

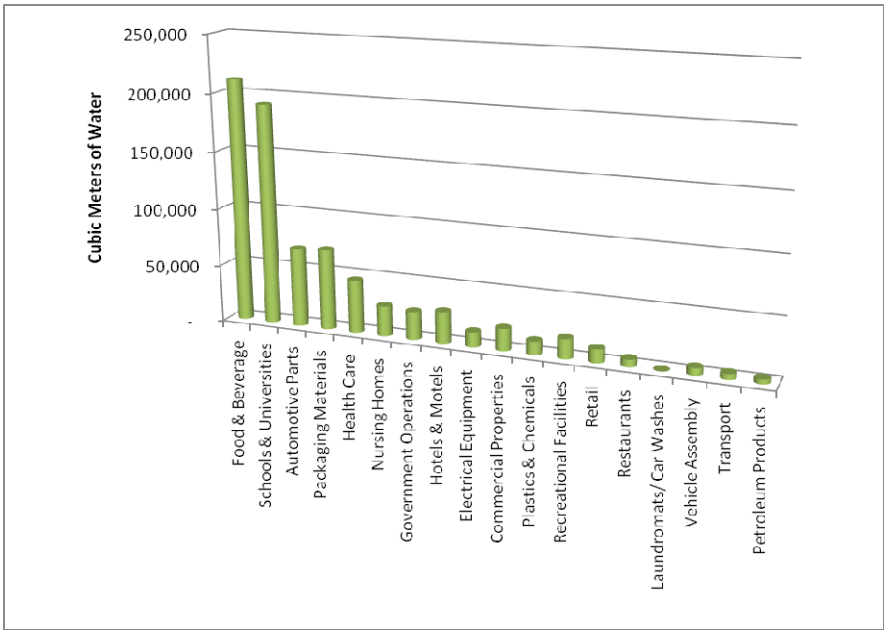


Figure 35: ICI Potential Water Savings by Sector

The following Table 33 provides the estimated potential water savings for 133 ICI companies included in the analysis. The overall average estimated percentage potential reduction for the ICI sector is 15%.

Table 33: ICI Potential Water Savings by Sector

Sector	Count	2007 Water Consumption (m3)	Efficient Use (m3)	Potential Savings (m3)	Percent Savings
Food & Beverage	7	1,695,605	1,494,432	201,173	12.5%
Schools & Universities	6	782,494	603,344	179,150	24.5%
Automotive Parts	34	621,455	557,913	63,542	11.0%
Packaging Materials	6	468,885	408,542	60,343	15.0%
Health Care	6	227,920	185,634	42,286	20.3%
Nursing Homes	9	132,568	107,854	24,714	20.0%
Government Operations	4	123,572	100,720	22,852	20.0%
Hotels & Motels	7	112,133	86,878	25,255	24.8%
Electrical Equipment	5	88,950	75,666	13,284	14.9%
Commercial Properties	7	80,525	60,985	19,540	24.3%
Plastics & Chemicals	5	78,616	66,824	11,792	15.0%
Recreational Facilities	5	74,779	57,599	17,180	23.0%
Retail	9	67,194	55,342	11,852	17.6%
Restaurants	7	50,570	44,034	6,536	12.9%
Laundromats/ Car Washes	6	47,820	47,663	157	0.3%
Vehicle Assembly	3	42,577	36,190	6,387	15.0%
Transport	3	36,279	31,352	4,927	13.6%
Petroleum Products	4	26,873	22,842	4,031	15.0%
Total	133	4,758,815	4,043,815	715,000	15.0%

Table 34: ICI Overall Potential Water Savings

2007 ICI Demand (m3)	Estimated Potential Savings (15%) per Analysis (m3)	Potential ICI Water Savings per Year (m3)	Potential ICI Water Savings per Average Day (m3)
6,660,534	990,080	990,080	2,737

The potential ICI water savings assumes 100% participation and implementation of all potential efficiency measures. It has been estimated that the industrial sector would have to invest $7.8 million in order to achieve the full identified potential. Approximately $2.5 million dollars in incentives would be required to improve the corresponding payback to 2.5 years.

9.5 Distribution Leakage Reduction Potential

With Guelph's existing 34,971 service connections it is expected that 23 District Meter Areas (DMAs) with an average of 1,500 service connections would be required to effectively reduce distribution system water loss. It is difficult to determine the exact level of leakage in the existing distribution system since many factors have influence including linear infrastructure age, pipe materials, varying system pressure, soil conditions and potential customer metering errors. Based on other successful leakage projects implemented by the Consultant Team, it is estimated that an average DMA could yield 115 m3 per day of recovered leakage as a result of an active leakage program. In addition, there is a long term opportunity to reduce background leakage by controlling system pressure in some selected DMAs. Potential for distribution system pressure management can only be identified after completion of an active leakage program. However, a preliminary analysis of the existing pressure zones in the City's distribution and potential leakage reduction opportunities has provided an estimated yield of 300 m3 per day in recovered leakage as of a result of a pressure management program.

As indicated in the following Table 35, the total distribution leakage reduction potential is 2,945 m3 per average day.

Table 35: Total Distribution Leakage Reduction Potential

Number of DMAs	Total Active Leakage Potential based on 115 m3/day per DMA (m3)day	Total Background Leakage Potential (m3/day)	Potential Distribution Leakage Water Savings per Year (m3)	Potential Distribution Leakage Water Savings per Average Day (m3)
23	2,645	300	1,074,925	2,945

The IWA Water Audit and Water Balance indicated that the current Infrastructure Leakage Index (ILI) for the Guelph water distribution system is 2.94. By achieving 100% of the full potential savings from leakage reduction, the ILI would be reduced to 1.45.

9.6 Overall Water Efficiency Potential

The following Table 36 illustrates the potential water savings for single family detached residential, multi family residential, industrial, commercial and institutional sectors and distribution leakage reduction. In total, the potential water savings for the City of Guelph is 13,661 m3 per average day or 4,986,156 m3 annually. The noted below represents 100% participation in all program alternatives identified through the study. It is important to note that the savings stated below do not include water savings estimates attributed to public education or water use reductions associated with increases in water/wastewater user rates.

Table 36: Overall Water Efficiency Potential

Residential Single Family Detached				
Current Demand (2007) lcpd	230			
Potential Demand (end use studies) lcpd	153			
Potential Savings lcpd	77			
2007 population	94,745			
Potential Single Family Savings	2,662,808	m3/year	7,295	m3/day
Residential Multifamily				
Current Demand (2007) lcpd	153			
Estimated savings 22% per analysis	34			
2007 population	20,295			
Potential Multifamily Savings	249,342	m3/year	683.1	m3/day
Industrial, Commericial and Institutional				
Current Demand (2007) m3	6,660,534			
Estimated savings 15% per analysis	999,080			
Potential ICI Savings	999,080	m3/year	2,737	m3/day
Total Potential Water Efficiency Savings	3,911,231	m3/year	10,716	m3/day
Distribution Leakage Reduction				
Active Leakage reduction per analysis	965,425	m3/year	2,645	m3/day
Background Leakage reduction per analysis	109,500	m3/year	300	m3/day
Total Potential Leakage Savings	1,074,925	m3/year	2,945	m3/day
Total Potential Water Efficiency and Leakage Savings	4,986,156	m3/year	13,661	m3/day

10.0 Achievable Water Efficiency

As previously defined, the Potential Water Efficiency analysis assumes 100% participation at significant costs. It is theoretically possible to achieve the Potential Water Efficiency level but it is not possible to achieve in practical terms. It is not realistic to set a target to achieve full potential, however knowing the full potential assists in setting an achievable target. The Achievable Water Efficiency analysis takes into consideration codes, regulations, market trends, environmental and social considerations as well as program related costs.

The following Table 37 provides a comprehensive list of water efficiency alternatives evaluated as part of the Water Conservation and Efficiency Strategy Update.

10.1 Table 37: Comprehensive List of Water Saving Measures

Indoor Measures	Common Practice with North American Municipal Programs	Description
Toilet flapper valve replacement	No	This measure is easy to promote and has been used in the past as an alternative to the ULF Toilet program. These flappers require maintenance to ensure water savings are sustained. The early closing flapper can be adjusted to save different amounts of water, but generally save anywhere from 2 to 4 litres/flush. The major issue is that you are altering an engineered product and as such may affect performance and warranty.
Toilet variable flush device	No	These adjustable devices are usually attached to the over flow tube in the toilet tank. The flush device moves up and down with the level of the water in the tank. When the toilet is flushed the device travels down with the water level until it pushes the flapper down causing it to close early thus saving 2 to 4 litres of water per flush.
Toilet tank displacement devices	Yes	Tank displacement devices consist of toilet dams, tank bags or bottles filled with sand. These devices displace the equivalent volume of water in the toilet tank saving usually 2 to 3 litres per flush.
6L toilet installation	Yes	This is a very popular residential water efficiency measure. Many homes still use 20 and 13 litre/flush toilets. This measure would replace those with 6 litre/flush toilets. Early model Ultra Low Flush (or ULF) toilets have faced many customer complaints about quality and reliability. The newer model ULF toilets have taken those complaints into consideration and are much more accepted than the previous models. As with many in-home water efficiency measures ongoing proactive maintenance is the key to sustaining water efficiency and savings. This measure would only apply to homes and buildings built before 1996 when the Ontario Building Code was revised requiring ultra-low flush toilets in all new construction.
High Efficiency (HET) toilet	Yes	Relatively new in the North American market and similar to ultra-low flush toilets; high efficiency flush toilets are designed to flush with 4.8 litres of water. Generally these toilets are tamper-proof so that the flush volumes cannot be increased.
Dual flush toilet installation	Yes	The popularity of this residential water efficiency measure is ever increasing. Also popular in Australia, the largest percentage of new toilet installations in Europe and the UK are dual flush toilets. This measure would replace the regular flush (13 to 20 litre flush volume) toilets with dual flush toilet that either flushes 3 litres for liquids or 6 litres for solids. Dual flush toilets are primarily manufactured in Australia and Europe. This measure would only apply to homes and buildings built before 1996 when the Ontario Building Code was revised requiring ultra-low flush toilets in all new construction.
Showerhead replacement	Yes	Older showerheads can use as much as 20 litres of water/minute. Low flow models use less than 9.5 litres per minute providing a substantial saving in both water and energy. This measure would only apply to homes and buildings built before 1991 when the Ontario Building Code was revised requiring low flow showerheads in all new construction.

Indoor Measures	Common Practice with North American Municipal Programs	Description
Showerhead flow restrictors	No	Flow restrictors are commonly small plastic inserts, which replace the rubber washer in the threaded connector of the showerheads to restrict flow.
Showerheads in-line regulator	No	Requiring a plumber for installation, in-line regulators are fitted into the existing water line to the showerhead. Flow regulators can decrease the flow rate from 20 litres per minute to as low as 5 litres per minute.
Water efficient clothes washer	Yes	Traditional top-loading washing machines use 132 to 240 litres of water per wash. The water efficient front-loading washing machines use 50 to 120 litres of water per wash. This amounts to a 40% reduction in water use. Top loading washing machines have made water-saving improvements in this last few years, but the front loading washers are still recognized as the most water and energy efficient. This measure is often promoted with educational material and incentives, as price is often a limiting factor for most consumers, although the price has been reducing in recent years.
Water efficient dish washer	No	The water savings between older automatic dishwashers and newer models is insignificant. Interestingly, studies have shown that families use less water for dish washing with an automatic washer as compared to hand washing.
Faucet aerator installation	Yes	Faucets can account for 23% of the overall water consumption per capita. Regular faucets can easily flow at 20 litres per minute with some as high as 40 litres per minute. Aerators can bring the flow down below 8.35 litres per minute also providing significant energy savings. Simple threaded devices that add air to the water flowing from a faucet.
Faucet flow restrictor installation	No	Flow restrictors are commonly small plastic inserts, which replace the rubber washer in the threaded connector of the faucet to restrict flow.
Automatic motion sensor faucet	No	There is no evidence that these faucets save water. They are equipped with infrared sensors which sense when the hand is under the tap and when it is pulled away from the tap. This type of faucet is popular in public areas where hygiene can be a concern because the person does not need to touch the tap at any time. Normally found in institutional settings.
Automatic push and touch faucet	No	Push or touch faucets can save a significant amount of water. They work by simply pressing or in the case of the more sophisticated models by touching the faucet to allow water to run. Water will flow for a pre-set time period, which is adjustable. Found mainly in institutions and commercial settings.
Faucet in-line regulator	No	Requiring a plumber for installation, in-line regulators are fitted into the existing water line to the faucet. Flow regulators can decrease the flowrate from 20 litres per minute to as low as 5 litres per minute.
Leakage repair	Yes	The A.W.W.A. (American Water Works Association) Residential End Use Study completed in 1999 concluded that 24 litres/capita/day is associated with indoor home leakage. The recent data logging study indicated that leakage has increased as high as 47 litres/capita/day. The major cause was toilet flappers. Residential audits as well as new water-efficient fixtures can reduce residential leakage. A leakage reduction program for the ICI sector includes auditing, leak detection and repairs.

Indoor Measures	Common Practice with North American Municipal Programs	Description
Garburator restrictions	No	Garburators, or sink waste disposal units, use water from the kitchen faucet every time they are operated, and can potentially increase organic loads at wastewater treatment plants. The best solution for the environment is to remove these units and encourage composting. Effective methods to encourage this are public education and in some cases offering an incentive for removed garburators. By-laws can also deter newly constructed facilities and homes from installing garburators in the first place.
Hot water recirculation	No	When a hot water faucet is turned on it can sometimes take several seconds to several minutes before hot water actually comes out of the tap. This can waste a lot of water. A hot water recirculating system uses a small pump to decrease the amount of time it takes for hot water to reach the faucet.
Water efficient water softener	Yes	Water Softeners are common in areas where groundwater is used to service the community. Many people install water softeners to reduce the calcium and magnesium bicarbonates. This is generally an aesthetic preference that many people have. Water softeners need to recharge on a regular basis, sometimes as much as once per day using from 140-400 litres of water at a time. Water-efficient models are available as well as magnetic types of water softeners. These can be encouraged through educational material and incentives.
Humidifier controller	No	Most older style flow through humidifiers can use up to 400 litres/day. This style has water constantly running to help keep the humidifier's mechanism clear of minerals and sediment. This older style of humidifier has an efficiency range of about 20-30%. Efficient models are available that will operate whenever the blower fan is on and not during the cooling season.
Air conditioning condensate	No	The water captured in air conditioning units and dehumidifier units can easily be used for non-potable purposes.
Grey water reuse	No	Grey water is the wastewater from bathing, doing laundry and dishes. This water can be reused to water lawns or flush toilets. Grey water reuse systems are generally not very well accepted in Ontario due to fear of cross contamination and hygiene reasons. The biggest barriers against this measure are regulatory and cost effectiveness.
Floor drain primer water	No	In the last 20 years a very common practice in the residential construction industry has been the installation of a bleed line from a tap to drip water into a basement floor drain trap. This was done to keep the drain trap full of water so hazardous gases cannot seep up through the drain into the house. There are drain covers available that will let water drain through but not let gases escape into the house. This can eliminate the constantly flowing bleed line.

Indoor Measures	Common Practice with North American Municipal Programs	Description
Metering and sub-metering	Yes	A water-metering program for all customers is one of the first and most important programs that should be undertaken to account for all water used in a distribution system. Because a metering program can take years to complete it is suggested that high volume users and new development be metered first. Financial planning should accompany a metering program. Sub-metering involves metering individual units in a multi-residential or multi-user location. In apartment buildings, for example, the whole building is usually metered and then the resident only pays a percentage of the monthly bill rather than the actual amount they used. Sub-metering makes water users more aware of how much water they actually use, and in turn, tenants who use less water can benefit from lower water costs.
Household indoor audits	No	An indoor household audit conducted by an experienced water efficiency practitioner can identify cost effective water saving opportunities within the home. The audit itself does not save water but by implementing the recommendations, water savings can be realized. In some cases, the auditor can install the measures during the actual audit thus reducing overall costs.
Commercial food rinse nozzle	Yes	This measure consists of the installation low-flow, high efficiency, high-pressure pre-rinse spray valves typically found in restaurants, cafeterias and institutions. Based on the success of the Rinse & Save program implemented by the California Urban Water Conservation Council in 2003, many Ontario municipalities have launched similar programs. In addition to water savings, the pre-rinse valve can provide significant energy savings and greenhouse gas reductions.
Urinal Flush Controls	Yes	Urinals with flush valves can be either adjusted to flush with lower volumes or the flush valves replaced with water efficient, sometime motion sensor type valves. Urinals with tank type flushing can be retrofitted with automatic flush controls that save significant water.
Low Water Urinals	Yes	Waterless urinals described below can save a very large amount of water but are relatively new on the market. Further research is required but some property managers have reported a build up of uric acid deposits in the urinal drains, which can block flushing. Low water urinals, while using some water, provide significant savings while providing enough drain water to prevent the buildup of deposits.
Waterless Urinals	No	Waterless urinals can save a very large amount of water each year (upwards of 45,000 gallons). They are designed to operate and function without any water whatsoever while maintaining a sanitary standard. The urine drains through a liquid chemical trap eliminating odours. Ongoing maintenance is required to ensure that the liquid chemical is replenished. Further research is required but some property managers have reported a build up of uric acid deposits in the urinal drains, which can block flushing.
Process water reuse	Yes	Many ICI facilities have water uses that can be met with non-potable water. For many processes, filtered but otherwise untreated water can be used. Rinse water from laundry, car wash rinses and cooling towers could all be used again in the same process, or if applicable, could be used on applications like irrigation.

Indoor Measures	Common Practice with North American Municipal Programs	Description
Eliminate once through cooling	Yes	Single-pass or once through cooling systems are an excellent opportunity to save water. In systems with single-pass cooling the water is circulated through a piece of equipment once and then disposed of down a drain. These systems can be modified to eliminate the use of water al together. Some municipalities restrict the use of once through cooling with bylaws.
Cooling tower optimization	Yes	Cooling towers help regulate temperature by rejecting heat from air conditioning systems or by cooling hot equipment. Water is lost through evaporation and bleed-off. Often, water from other equipment within a facility can be reused for cooling tower purposes with little or no treatment.
Car wash rinse water reuse	Yes	Depending on the type of recycling system, reclaiming and filtering wash water for reuse reduces the amount of fresh water needed by 50-60% in bay washes, 50-90% in conveyor touch washes, and 20-90% in conveyor touch-less washes. This measure can save a significant amount of water.
ICI audits	Yes	Industrial, commercial and institutional audits are completed by competent consultants with experience in industrial processes and water use. The audits are designed to provide the facility manager with a report of water use in the facility and a list of cost effective water saving measures (previously described above) that can be implemented. Audits in themselves do not save water. The measures implemented as a result of an audit save water. As such, indoor audits provide an excellent delivery mechanism.
Public and Youth Education	Yes	This measure can be targeted at many different sectors such as: residential, ICI (Industrial, Commercial, Institutional), and school programs. It is an attempt to alter people's attitudes and habits about water use in hope that they adopt a water efficient behaviour. Some of the habits that can be affected include; turning faucets off when washing dishes or brushing teeth, fixing leaking fixtures quickly, and reducing lawn-watering frequency. Public education and awareness can also increase the effectiveness of other measures when paired together. For example, most residents will be more willing to install a water-efficient showerhead after a city wide "Water Conservation Week" has taken place. Public education can include school programs, workshops, newspapers and flyers, audits, websites, television and much more.

Outdoor Measures	Common Practice with North American Municipal Programs	Description
Rainwater harvesting	No	Rainwater harvesting is the collection and storage of rainwater to be used at a later time. Barrels and cisterns (above ground and below) can be used to store rainwater directed off roofs and buildings. Most rain barrel owners use the water for non-potable applications like irrigation and toilet flushing. The installation of cisterns has grown in popularity in countries like Australia, Germany and United States. It is estimated that over 200,000 cisterns are in use in the United States. In Canada, and in usually rural areas, cisterns have been used to store either truck delivered water or rain water where other water supplies were not available. A Rainwater Harvesting Workshop sponsored by Canada Mortgage and Housing Corporation and the City of Toronto was held on May 24 2005. The workshop provided numerous examples of projects, programs and techniques in other countries but few in Canada. Significant research is required prior to the design and implementation of an advanced rain-harvesting program. Areas of concern include existing codes and regulations, health and safety and property rights. There is a great interest by Canadian municipalities in the area of rain harvesting and joint research projects are now being developed.
Water efficient landscaping	Yes	Drought tolerant landscaping can save a significant amount of water during the high water demand season. Planting alternatives to turf such as native groundcover and more garden areas, which contain water-efficient plants, reduce the amount of watering needed. This measure can be encouraged with audits, workshops, demonstration gardens and community partners.
Lawn water gauges and timers	Yes	Many residents have a poor understanding of how much water their lawns and gardens need. Rain gauges or lawn watering gauges can provide a method of measurement to accurately tell how much water to apply to the lawn. Once a homeowner knows how long it takes to apply the right amount of water to their lawns they can use a timer. A timer also ensures that the water will be shut off if forgotten by the resident.
Automatic rain gauges for irrigation systems	No	Automatic rain gauges for irrigation systems will sense rain flow and will automatically shut off irrigation systems if a substantial amount of rain has fallen. Irrigation systems without these sensors will waste water when they automatically come on to water the grounds a few hours after a rain shower.
ET technology for irrigation systems	No	Evapotranspiration (ET) technology for irrigation systems is the management of large irrigation systems through the Internet and computer based programs. These programs account for weather conditions at the site in real-time and can make program changes accordingly.
Irrigation head replacement	No	Oversize heads that spray too much water and not on the targeted area can be replaced with more appropriate sized heads that are more effective and reduce water use. Irrigation heads can also be optimized depending on the available water pressure.
Irrigation distribution leakage reduction	No	This measure involves seeking out areas of leakage in large irrigation systems (golf courses, etc.) and actively fixing problems.
Green roof technology	No	Green roof technology has many benefits that span well beyond water savings. This measure provides storm water retention, water filtration, and delay of runoff water.

Outdoor Measures	Common Practice with North American Municipal Programs	Description
Swimming pool management	Yes	This measure requires pool owners to cover swimming pools/spas when not in use to minimize the effects of evaporation. An average sized pool can lose as much as 3785 litres of water per month if it is left uncovered. It also requires lowering the level of the pool water to prevent water loss due to splashing.
Decorative ponds and water gardens	No	This measure involves reducing or limiting the amount of decorative ponds and water gardens within a community. The ponds and gardens can lose a significant amount of water by evaporation or leakage. Leakage surveys can be implemented to locate leaks. Biodegradable oil films are available to reduce evaporation. The introduction of rock gardens is an acceptable substitute.
Rain barrels	Yes	Rain barrels can be an effective public education tool. Large and visible, they provide a constant reminder to the resident to reduce summer outdoor water use. On their own as a dedicated water saving measure they do not save a significant amount of water due to their limited capacities; and financial paybacks could range as high as 20 years depending on rainfall. Some municipalities where downspouts are connected directly to sanitary and storm sewers have found rain barrels very effective and financial viable as a downspout disconnect initiative.
ICI and Residential outdoor visits	Yes	Outdoor water use audits can be very effective in providing significant summer outdoor water use reductions. A trained landscape advisor can provide valuable water saving turf maintenance advice while encouraging the homeowner or property manager to replace some or all of its water consuming landscape to water efficient landscaping.

10.2 Feasibility Screening of Measures

Technical - Some water efficiency measures are not suitable for local conditions and programming. They may not meet local codes, standards or regulations. They may not be performance tested or proven technology. They may not be market ready or available. For instance, replacing an existing toilet flapper valve with a more efficient model alters an engineered product and could negatively affect performance and the toilet's ability to remove waste.

Potential – Is there a large enough potential in the market sector to justify a program? For example, newly constructed homes generally do not have a central humidifier and as such there would be no market for a water efficiency humidifier program in the new construction sector.

Achievable – Once it has been identified that there is a large potential market for a particular measure, is there an expectation that a large percentage will implement the measure based on reasonable incentives and program delivery? For example, although there may be a large potential for the installation of in-line regulators for showers, homeowners would be reluctant to install them since the wall would have to be opened at significant cost and inconvenience.

Social Impact – Once it has been established that there is a significant achievable opportunity for a particular measure, are there any elements of the program that would affect society negatively. For instance, would implementing a particular program affect local employment? Put an undue financial burden on a family?

Environmental Impact – Are there any environmental impacts attributed to a particular measure? For instance if a particular measure used batteries for operating would there be an issue with disposing of the used batteries.

A decision tree, shown in following Figure 36, was developed to illustrate the screening process.

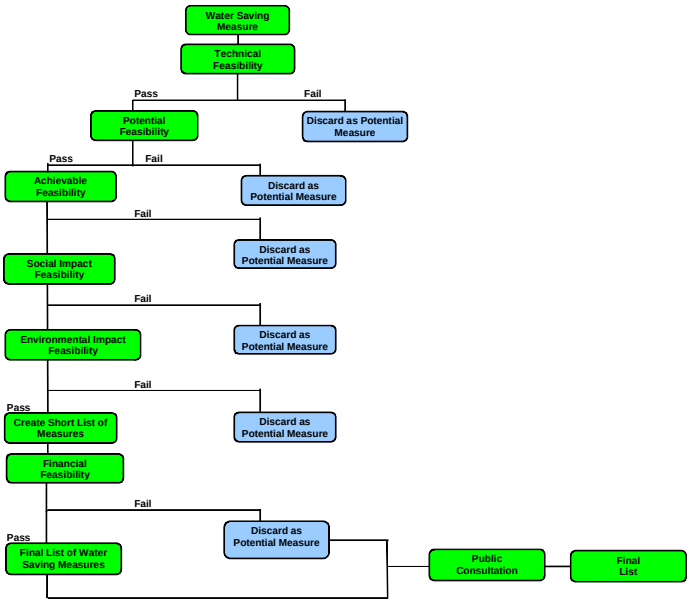


Figure 36: Decision Tree for Screening Water Efficiency Measures

10.2.1 Results of Preliminary Screening

The results of the preliminary screening are shown in the following Table 38. Those measures that passed the screening are highlighted in green.

Table 38: Preliminary Screening Results

Residential Single Family	Technical	Potential	Achievable	Social	Environmental
Toilet flapper valve replacement	x	x	x	x	x
Toilet variable flush device	x	x	x	x	x
Toilet tank displacement devices	x	x	x	x	x
6L toilet installation	√	√	√	√	√
High efficiency (HET) toilet installation	√	√	√	√	√
Dual flush toilet installation	√	√	√	√	√
Showerhead replacement	√	√	√	√	√
Showerhead flow restrictors	x	x	x	x	x
Showerheads in-line regulator	√	√	x	x	x
Water efficient clothes washer	√	√	√	√	√
Water efficient dish washer	√	√	√	√	√
Faucet aerator installation	√	√	√	√	√
Faucet flow restrictor installation	x	x	x	x	x
Automatic motion sensor faucet	x	x	x	x	x
Automatic push and touch faucet	√	√	x	x	x
Faucet in-line regulator	√	√	x	x	x
Leakage repair	√	√	√	√	√
Garburator restrictions	x	x	x	x	x
Hot water recirculation	x	x	x	x	x
Water efficient water softener	√	√	√	√	√
Humidifier controller	√	√	√	√	√
Air conditioning condensate recovery	x	x	x	x	x
Grey water reuse	√	√	√	√	√
Floor drain primer water	√	√	√	√	√
Metering and submetering	√	x	x	x	x
Rainwater harvesting	√	√	√	√	√
Water efficient landscaping	√	√	√	√	√
Lawn water gauges and timers	√	√	√	√	√
Automatic rain gauges for irrigation systems	√	x	x	x	x
ET technology for irrigation systems	√	x	x	x	x
Irrigation head replacement	√	x	x	x	x
Irrigation distribution leakage reduction	√	x	x	x	x
Green roof technology	x	x	x	x	x
Swimming pool management	√	√	√	√	√
Rain barrels	√	√	√	√	√

New Residential Single Family Development	Technical	Potential	Achievable	Social	Environmental
Toilet flapper valve replacement	x	x	x	x	x
Toilet variable flush device	x	x	x	x	x
Toilet tank displacement devices	x	x	x	x	x
6L toilet installation	x	x	x	x	x
High efficiency (HET) toilet installation	√	√	√	√	√
Dual flush toilet installation	√	√	√	√	√
Showerhead replacement	√	√	√	√	√
Showerhead flow restrictors	x	x	x	x	x
Showerheads in-line regulator	x	x	x	x	x
Water efficient clothes washer	√	√	√	√	√
Water efficient dish washer	√	√	√	√	√
Faucet aerator installation	√	√	√	√	√
Faucet flow restrictor installation	x	x	x	x	x
Automatic motion sensor faucet	x	x	x	x	x
Automatic push and touch faucet	x	x	x	x	x
Faucet in-line regulator	x	x	x	x	x
Leakage repair	x	x	x	x	x
Garburator restrictions	x	√	x	x	x
Hot water recirculation	x	x	x	x	x
Water efficient water softener	√	√	√	√	√
Humidifier controller	x	x	x	x	x
Air conditioning condensate recovery	x	x	x	x	x
Grey water reuse	√	√	√	√	√
Floor drain primer water	√	√	√	√	√
Metering and submetering	x	x	x	x	x
Rainwater harvesting	√	√	√	√	√
Water efficient landscaping	√	√	√	√	√
Lawn water gauges and timers	√	√	√	√	√
Automatic rain gauges for irrigation systems	√	x	x	x	x
ET technology for irrigation systems	√	x	x	x	x
Irrigation head replacement	√	x	x	x	x
Irrigation distribution leakage reduction	√	x	x	x	x
Green roof technology	x	x	x	x	x
Swimming pool management	√	x	x	x	x
Rain barrels	√	x	x	x	x

Residential Multi-family	Technical	Potential	Achievable	Social	Environmental
Toilet flapper valve replacement	x	x	x	x	x
Toilet variable flush device	x	x	x	x	x
Toilet tank displacement devices	x	x	x	x	x
6L toilet installation	√	√	√	√	√
High efficiency (HET) toilet installation	√	√	√	√	√
Dual flush toilet installation	√	√	√	√	√
Showerhead replacement	√	√	√	√	√
Showerhead flow restrictors	x	x	x	x	x
Showerheads in-line regulator	√	√	x	x	x
Water efficient clothes washer	√	√	√	√	√
Water efficient dish washer	√	√	√	√	√
Faucet aerator installation	√	√	√	√	√
Faucet flow restrictor installation	x	x	x	x	x
Automatic motion sensor faucet	x	x	x	x	x
Automatic push and touch faucet	√	√	x	x	x
Faucet in-line regulator	√	√	x	x	x
Leakage repair	√	√	√	√	√
Garburator restrictions	x	x	x	x	x
Hot water recirculation	x	x	x	x	x
Water efficient water softener	√	√	√	√	√
Humidifier controller	x	x	x	x	x
Cooling tower optimization	√	√	√	√	√
Air conditioning condensate recovery	x	x	x	x	x
Grey water reuse	√	√	√	√	√
Floor drain primer water	√	√	√	√	√
Metering and submetering	x	x	x	x	x
Rainwater harvesting	√	√	√	√	√
Water efficient landscaping	√	√	√	√	√
Lawn water gauges and timers	√	√	√	√	√
Automatic rain gauges for irrigation systems	√	√	√	√	√
ET technology for irrigation systems	√	√	√	√	√
Irrigation head replacement	√	√	√	√	√
Irrigation distribution leakage reduction	√	√	√	√	√
Green roof technology	x	x	x	x	x
Swimming pool management	√	√	√	√	√
Rain barrels	x	x	x	x	x

Industrial, Commercial and Institutional	Technical	Potential	Achievable	Social	Environmental
Toilet flapper valve replacement	x	x	x	x	x
Toilet variable flush device	x	x	x	x	x
Toilet tank displacement devices	x	x	x	x	x
6L toilet installation	√	√	√	√	√
High efficiency (HET) toilet installation	√	√	√	√	√
Dual flush toilet installation	√	√	√	√	√
Showerhead replacement	√	√	√	√	√
Showerhead flow restrictors	x	x	x	x	x
Showerheads in-line regulator	√	√	x	x	x
Water efficient clothes washer	√	√	√	√	√
Water efficient dish washer	√	√	√	√	√
Faucet aerator installation	√	√	√	√	√
Faucet flow restrictor installation	x	x	x	x	x
Automatic motion sensor faucet	√	√	√	√	√
Automatic push and touch faucet	√	√	√	√	√
Faucet in-line regulator	√	√	x	x	x
Leakage repair	√	√	√	√	√
Garburator restrictions	x	x	x	x	x
Pre-rinse spray valve	√	√	√	√	√
Hot water recirculation	√	√	√	√	√
Water efficient water softener	√	√	√	√	√
Humidifier controller	√	√	√	√	√
Process water	√	√	√	√	√
Cooling tower optimization	√	√	√	√	√
Air conditioning condensate recovery	√	√	√	√	√
Grey water reuse	√	√	√	√	√
Floor drain primer water	√	√	√	√	√
Metering and submetering	√	√	√	√	√
Rainwater harvesting	√	√	√	√	√
Water efficient landscaping	√	√	√	√	√
Lawn water gauges and timers	√	√	√	√	√
Automatic rain gauges for irrigation systems	√	√	√	√	√
ET technology for irrigation systems	√	√	√	√	√
Irrigation head replacement	√	√	√	√	√
Irrigation distribution leakage reduction	√	√	√	√	√
Green roof technology	x	x	x	x	x
Swimming pool management	√	√	√	√	√
Rain barrels	x	x	x	x	x

Municipal	Technical	Potential	Achievable	Social	Environmental
Distribution leakage reduction	√	√	√	√	√

For reference, the additional rationale for conservation and efficiency programs not passing the screening process are noted below:

Residential Single Family

Toilet flapper valve replacement - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet variable flush device - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet tank displacement device - Technical

- Alters an engineered product which could adversely affect the product's performance. Can cause operational issues with flush mechanism. Replacement of the existing toilet with a water efficient model is considered the best practice.

Showerhead flow restrictors - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing showerhead with a water efficient model is considered the best practice.

Showerhead in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Faucet flow restrictor installation - Technical

- Flow restrictor decreases the flow rate and performance of the faucet as compared to an aerator which adds to air to improve performance.

Automatic motion sensor faucet - Technical

- More appropriate for commercial applications for hygienic reasons. No evidence of water savings.

Automatic push and touch faucet - Achievable

- More appropriate for schools and other institutions. Not marketable in a residential sector.

Faucet in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Garburator restrictions - Technical

- Not enough data to justify as a water efficiency measure.

Hot water recirculation - Technical

- Studies in the Region's of Waterloo and York have indicated that savings would be minimal for this measure.

Air conditioning condensate recovery - Technical

- Not enough data to justify as a water efficiency measure.

Metering and sub metering - Potential

- The City of Guelph is fully metered.

Automatic rain gauges for irrigation - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

ET technology for irrigation systems - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Irrigation head replacement -Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Irrigation distribution system leakage reduction - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Green roof technology - Technical

- The costs, benefits and technological issues of green roof technologies continue to be studied. Limited data currently exists.

New Residential Single Family

Toilet flapper valve replacement - Technical

- 6 Litre flush toilets are installed in new homes as part of the Ontario Building Code since 1996

Toilet variable flush device - Technical

- 6 Litre flush toilets are installed in new homes as part of the Ontario Building Code since 1996

Toilet tank displacement device- Technical

- 6 Litre flush toilets are installed in new homes as part of the Ontario Building Code since 1996

6 litre toilet installation - Technical

- 6 litre flush toilets are installed in new homes as part of the Ontario Building Code since 1996

Showerhead flow restrictors - Technical

- Low flow showerheads are installed in new homes as part of the Ontario Building Code since 1996

Showerhead in-line regulator - Technical

- Low flow showerheads are installed in new homes as part of the Ontario Building Code since 1996

Faucet flow restrictor installation - Technical

- Low flow faucets are installed in new homes as part of the Ontario Building Code since 1996

Automatic motion sensor faucet - Technical

- Low flow faucets are installed in new homes as part of the Ontario Building Code since 1996. No evidence that automatic motion sensor faucets would save additional water.

Automatic push and touch faucet - Technical

- Low flow faucets are installed in new homes as part of the Ontario Building Code since 1996

Faucet in-line regulator - Technical

- Low flow faucets are installed in new homes as part of the Ontario Building Code since 1996

Garburator restrictions - Technical

- Not enough data to justify as a water efficiency measure. Very rare for a new home developer to install garburators.

Hot water recirculation - Technical

- Studies in the Region's of Waterloo and York have indicated that savings would be minimal for this measure. Best plumbing practices are more important.

Humidifier controller - Potential

- Humidification is generally not needed in the air tight newly constructed homes.

Air conditioning condensate recovery - Technical

- Not enough data to justify as a water efficiency measure.

Metering and sub metering - Potential

- The City of Guelph is fully metered.

Automatic rain gauges for irrigation - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

ET technology for irrigation systems - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Irrigation head replacement - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Irrigation distribution system leakage reduction - Potential

- A very small percentage of homes in Guelph have automatic irrigation systems.

Green roof technology - Technical

- The costs and benefits of green roof technologies continues to be studied. Limited data currently exists. Smaller, sloping roofs on homes are not suitable for green roof technology. Perhaps will be more applicable to larger buildings once studies are completed.

Swimming pool management - Potential

- Swimming pools are generally an after-market product as such there would not be enough potential in the new development sector to justify a program.

Rain barrels - Potential

- Rain barrels are generally an after-market product as such there would not be enough potential in the new development sector to justify a program**?**

Residential Multi-family

Toilet flapper valve replacement - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet variable flush device - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet tank displacement device - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Showerhead flow restrictors - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing showerhead with a water efficient model is considered the best practice.

Showerhead in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Faucet flow restrictor installation - Technical

- Flow restrictor decreases the flow rate and performance of the faucet as compared to an aerator which adds to air to improve performance.

Automatic motion sensor faucet - Technical

- More appropriate for commercial applications for hygienic reasons. No evidence of water savings.

Automatic push and touch faucet - Achievable

- More appropriate for schools and other institutions. Not marketable in a residential sector.

Faucet in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Garburator restrictions - Technical

- Not enough data to justify as a water efficiency measure.

Hot water recirculation - Potential

- A requirement of the Ontario Building Code and common practice in multi-residential buildings.

Humidifier controller - Technical

- A requirement of the Ontario Building Code and common practice in multi-residential buildings.

Air conditioning condensate recovery - Technical

- Not enough data to justify as a water efficiency measure.

Metering and sub metering - Technical

- The City of Guelph is fully metered. The installation of sub metering of individual suites can be very difficult due to the complexity of the pipe work. Easier in new developments but still expensive. More research is necessary on the costs and benefits of sub metering in apartment buildings.

Green roof technology - Technical

- The costs and benefits of green roof technologies continue to be studied. Limited data currently exists.

Industrial, Commercial and Institutional

Toilet flapper valve replacement - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet variable flush device - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Toilet tank displacement device - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing toilet with a water efficient model is considered the best practice.

Showerhead flow restrictors - Technical

- Alters an engineered product which could adversely affect the product's performance. Replacement of the existing showerhead with a water efficient model is considered the best practice.

Showerhead in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Faucet flow restrictor installation - Technical

- Flow restrictor decreases the flow rate and performance of the faucet as compared to an aerator which adds to air to improve performance.

Faucet in-line regulator - Achievable

- Requires a plumber to cut the existing water line and insert regulator. Difficult to access existing plumbing and as such would have very low uptake.

Garburator restrictions

- Not enough data to justify as a water efficiency measure.

Green roof technology

- The costs and benefits of green roof technologies continue to be studied. Limited data currently exists.

Rain barrels

- Cannot accommodate the heavy flows of an ICI roof drainage system.

10.2.2 Table 39: Water Efficiency Measures Short List

Single Family Detached Residential Indoor Demand Measures		
6L toilet installation	Water efficient clothes washing machines	Water softener
High Efficiency (HET) toilet installation	Water efficient dishwashers	Humidifier
Dual flush toilet installations	Kitchen faucet aerator installation	Rain water harvesting
Showerhead replacement	Leakage repair	
Floor drains	Grey water reuse	
Single Family Detached Residential Summer Demand Measures		
Water efficient landscaping	Swimming pool management	Watering timers
Rain barrels		
Multi Family Residential Indoor Demand Measures		
6L toilet installation	Water efficient clothes washing machines	Showerhead replacement
High Efficiency (HET) toilet installation	Water efficient dishwashers	Leakage repair
Dual flush toilet installations	Kitchen faucet aerator installation	
Residential New Development Indoor Demand Measures		
High Efficiency (HET) toilet installation	Water efficient clothes washing machines	Water softener
Dual flush toilet installations	Water efficient dishwashers	Humidifier
Showerhead replacement	Kitchen faucet aerator installation	Rain water harvesting
Floor drains	Grey water reuse	
Residential New Development Summer Demand Measures		
Water efficient landscaping	Watering timers	
Industrial/Commercial/ Institutional Measures		
6L toilet installation	Dual flush toilet installations	Commercial food rinse nozzle
High Efficiency (HET) toilet installation	Water efficient clothes washing machines	ICI audits
Municipal		
Distribution leakage reduction		

10.2.3 Financial Feasibility of Water Efficiency Measures

Utilizing a spreadsheet model, water savings and implementation costs were derived for each measure displayed on the short list. The savings and costs were then used to determine the cost effectiveness of each measure. The cost-effectiveness of a measure, or its cost/benefit ratio, is determined by comparing the program cost to the cost of future infrastructure expansion to deliver a similar quantity of water. The water savings for each measure was determined using a number of resources from engineering estimates to actual verified results from water efficiency programs in North America. Much information was gathered from programs that have been implemented and monitored for the last five to ten years in the Region of Waterloo, Region of York and the City of Toronto.

Depending on the measure and delivery mechanism program costs may include; equipment, installation, rebates, training, program marketing and project management as applicable. Based on related program costs a cost per litre of water per average day saved was determined for each conservation and efficiency alternative. This cost was then compared to the cost of constructing additional infrastructure to gain one litre per average day of additional water and wastewater capacity. It is important to note that calculated cost relating to construction of an additional litre of water and wastewater capacity does not include the cost of debt financing of construction projects. It is also important to note, that this figure does not include the cost of additional infrastructure required for the distribution/conveyance of water and wastewater to and from newly serviced areas such as water/wastewater mains, pumping stations or system reservoirs. In southern Ontario, the combined water and wastewater construction cost per litre per average day of additional capacity ranges from approximately $2.00 to $8.10. For the purpose of this financial analysis the combined water and wastewater construction cost of $4.00 per litre per average day of additional capacity was utilized.

The Guelph 2006 Water Supply Master Plan provided the following estimates for the cost of additional water supply capacity.

Table 40: 2006 Guelph Water Supply Master Plan – Study Recommendation Water Supply Costs

WSMP Recommendations	WSMP Recommendation Term	Capital Cost of Water Capacity Gained ($/litre/day of supply capacity)
Groundwater in City	Short (2006-2010), Medium (2010 - 2025)	**$ 0.80**
Groundwater Outside City	Medium (2010 - 2025)	**$ 1.78**
New Local Surface Water	Medium (2010 - 2025), Long (2025 - 2054)	**$ 3.04**
Great Lakes Water Supply	Medium (2010 - 2025), Long (2025 - 2054)	**$ 3.71**

At the time of writing this report, the City was had initiated a Wastewater Master Plan Study. The cost for additional wastewater capacity specifically for Guelph was not available.

The outcome of the financial analysis is shown in the following Table 41. The measures that did not pass the financial test are highlighted in yellow.

Table 41: Results of Financial Screening of Water Efficiency Measures

Single Family Detached Residential Indoor		Cost per Participant	Savings per Participant (L/d)	Cost per litre
Rebates	ULF 6 Litre Flush ($60)	$ 261.00	120	$ 2.18
Rebates	HET Toilets ($75)	$ 290.00	138	$ 2.10
Rebates	Dual Flush Toilets ($75)	$ 290.00	156	$ 1.86
Rebates	Clothes Washer ($80)	$ 150.00	77	$ 1.95
Rebates	Humidifier ($75)	$ 105.00	51	$ 2.06
Rebates	Floor Drain ($60)	$ 90.00	43	$ 2.09
Rebates	Grey Water ($1,000)	$ 5,000.00	90	$ 55.56
Rebates	Rain Water ($2,000)	$ 6,000.00	171	$ 35.09
Rebates	Dish Washers ($60)	$ 88.00	2	$ 44.00
Rebates	Water Softener ($100)	$ 160.00	23	$ 6.96
Installation	Low Flow Showerheads	$ 111.00	110	$ 1.01
Installation	Kitchen Faucets	$ 62.00	29	$ 2.14
Installation	Leakage Repair	$ 216.00	108	$ 2.00
Single Family Detached Residental Summer Demand				
Rebates	Watering Timers ($20)	$ 49.00	24	$ 2.04
Rebates	Swimming Pool ($50)	$ 210.00	26	$ 8.08
Other	W.E. Landscape Visits	$ 127.00	74	$ 1.72
Other	Rain Barrels	$ 133.85	21	$ 6.37
Multi- Family Residential				
Rebates	ULF 6 Litre Flush ($60)	$ 175.00	60	$ 2.92
Rebates	HET Toilets ($75)	$ 198.00	69	$ 2.87
Rebates	Dual Flush Toilets ($75)	$ 198.00	78	$ 2.54
Rebates	Clothes Washer ($200)	$ 2,200.00	1,120	$ 1.96
Rebates	Dish Washer ($60)	$ 78.00	2	$ 39.00
Installation	Low Flow Showerheads	$ 70.00	55	$ 1.27
Installation	Kitchen Faucets	$ 54.00	29	$ 1.86
Installation	Leakage Repair	$ 216.00	108	$ 2.00
Residential New Development - Indoor				
Rebates	HET Toilets ($10)	$ 60.00	18	$ 3.33
Rebates	Dual Flush Toilets ($10)	$ 60.00	36	$ 1.67
Rebates	Clothes Washer ($80)	$ 108.00	33	$ 3.27
Rebates	Humidifier ($75)	$ 125.00	51	$ 2.45
Rebates	Floor Drain ($60)	$ 105.00	43	$ 2.44
Rebates	Grey Water ($1,000)	$ 3,500.00	90	$ 38.89
Rebates	Rain Water ($2,000)	$ 5,500.00	171	$ 32.16
Rebates	Low Flow Showerheads ($10)	$ 35.00	16	$ 2.19
Rebates	Kitchen Faucets ($5)	$ 18.00	8	$ 2.25
Rebates	Dish Washer ($60)	$ 88.00	2	$ 44.00
Rebates	Water Softener ($100)	$ 150.00	23	$ 6.52
Residential New Development - Summer Demand				
Rebates	W.E. Landscaping ($200)	$ 285.00	74	$ 3.85
Rebates	Watering Timers ($20)	$ 57.00	24	$ 2.38
Industrial/Commercial/Institutional				
Rebates	ULF 6 Litre Flush ($60)	$ 1,280.00	590	$ 2.17
Rebates	HET Toilets ($75)	$ 1,400.00	710	$ 1.97
Rebates	Dual Flush Toilets ($75)	$ 1,550.00	830	$ 1.87
Rebates	Clothes Washer ($200)	$ 10,000.00	4,095	$ 2.44
Installation	Pre-Rinse Spray Valves	$ 1,158.00	368	$ 3.15
Other	ICI Audit and Capacity Buyback	$ 54,000.00	40,000	$ 1.35
Distribution Leakage Reduction				
Other	DMAs (5)	$ 15,900.00	115,000	$ 0.14

10.2.4 Recommended List of Measures to include in Strategy

Three measures were removed from the short list of measures due to failing the financial screening. The measures include dish washers, water softeners and swimming pool management. It is recommended that these measures be reviewed upon reiteration of this study, or upon the availability of enhanced technical information, to see if any of their attributes have changed which would result in a positive financial screening.

Three other measures including grey water reuse, rain water harvesting and rain barrels did not pass the financial screening but were included on the short list for inclusion in the strategy. As indicated by the decision tree on page 78 for screening measures, measures that do not pass the financial screening can be considered for retention if they offer other benefits. With the peak day reduction benefits of rain water harvesting through rain barrels, and the need to embrace innovative practices such as rain water harvesting and grey water reuse in residential indoor applications, these alternatives were identified as preferred measures in disregard of the financial screening undertaken. Furthermore, extensive feedback was received through the public consultation as part of the Water Conservation and Efficiency Strategy Update, indicating public support for this initiatives and the need for further capacity building on a local level.

Grey water reuse and rain water harvesting are measures that are receiving a lot of attention across Canada and around the world. The City of Guelph, and in particular, the University of Guelph, are viewed as leaders in research and promotion of these technologies. As these technologies evolve from a cost and a water savings perspective, and as water rates continue to increase, it is thought that these measures will prove to be recommended water saving measures in the future.

Rain barrels, although limited in the total capacity of water they are available to capture during rain events, have proven to be an effective education and promotion mechanism. They are big, bold and visible and remind residents of our fragile water resource each and every time they are looked upon. Rain barrels can be combined into a rain water harvesting program quite effectively. In addition, these measures work to reduce peak day demands and provide those installing rain barrels at their homes with a free source of water for outdoor water use. With the recent market availability of above ground cistern systems for rainwater harvesting there is great potential to capture larger volumes of water for outdoor water use. These cistern systems, which include a small pump, have great potential to replace a large variety of peak time water demands due to the water collected being later pressurized for use and the large volume of water collected during rain events. With this in mind, it is recommended that a rain barrel program would include both customary residential rain barrels as well as larger above ground cisterns.

11.0 Strategy Implementation Plan

The recommended components of the ten-year plan include:

Single Family Detached Residential Indoor Measures

- Provide rebates to residents who replace inefficient 13L toilets and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to residents who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers.
- Provide rebates to residents who install a grey water reuse system.
- Provide rebates to residents who install a rain water harvesting system.
- Visit homes and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Single Family Detached Residential Summer Demand Measures

- Provide rebates to residents who purchase and install watering timers.
- Visit homes and educate residents on how to maintain their lawns and water less and how to convert their properties to water efficient landscapes.
- Provide rebates or subsidized pricing for residents who purchase a rain barrel or larger water storage unit.

Multi Family Residential Indoor Measures

- Provide rebates to building owners who purchase and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to building owners who purchase and install a water efficient clothes washer in their laundry rooms.
- Visit apartments and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Residential New Development Indoor Measures

- Provide rebates to builders who proactively purchase and install approved high efficiency toilets or dual flush toilets, low flow showerheads and low flow kitchen faucets at the time of new home construction.
- Provide rebates to builders who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers at the time of new home construction.
- Provide rebates to builders who install a grey water reuse system at the time of new home construction.
- Provide rebates to builders who install a rain water harvesting system at the time of new home construction.

  Note: New home owners would realize the benefit of ongoing water savings.

Residential New Development Summer Demand Measures

- Provide rebates to builders who install watering timers.
- Provide rebates to builders who install water efficient landscapes as part of new home construction.

Industrial/Commercial/Institutional Measures

- Provide rebates to facilities who replace inefficient 13L toilets with ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to local businesses who purchase and install a water efficient clothes washer in their operations.
- Visit commercial kitchens and install free of charge low flow pre-rinse spray valves.
- Complete ten comprehensive water audits per year and offer a capacity buy-back rebate to any facility that implements all or some of the water saving recommendations.

Municipal Measures

- Design and implement five (5) district meter areas per year for three years. Locate, quantify and repair the leakage within the water distribution system.
- Complete Property Water Use Audits of existing municipal buildings and implement water efficiency retrofits and public demonstration projects. Identification and priority setting is currently ongoing. A City Building Water Efficiency Plan is anticipated for completion in late 2009 and will include appropriate water reduction targets.

Public Education

- Distribution of booklets, leaflets, and fact sheets at home shows and community and environmental events.
- Distribution of a water efficiency bulletin in the water bills.
- Displays at home shows, fairs and community events.
- Newspaper articles and advertisements.
- Develop and maintain a website to educate the public on water efficiency.
- Provide workshops and seminars to the public on water saving techniques both inside and outside the home.
- Provide water efficient demonstration gardens for the public to visit and learn.

Youth Education

- Develop and deliver a water efficiency education program based on the Ontario curriculum requirements.
- Continue annual participation in the Waterloo Wellington Children's Groundwater Festival.

Policy Based Recommendations (requiring Council approval)

- That the time based average day water reduction goals of the City's Water Supply Master Plan be formally endorsed as;

    - 10% reduction (5,300 m3/day) by 2010, based on 2006 average day water use;
    - 15% reduction (7,950 m3/day) by 2017, based on 2006 average day water use, and;
    - 20% reduction (10,600 m3/day) by 2025, based on 2006 average day water use;

- That the City adopt a water reduction philosophy of maintaining average day water production below the 2006 value (53,000 m3/day) for a 5 year period (2014).
- That the City of Guelph continue operation of the City's Outside Water Use Program in efforts to reduce impacts of Peak Seasonal Demands.

- That the City form a long standing Water Conservation and Efficiency Advisory Committee for purpose of ongoing public consultation throughout the implementation of the 2009 Water Conservation and Efficiency Strategy Update with an appropriate mandate and charter to be developed for the Committee..
- That the City in partnership with the Region of Waterloo continue performance testing research of home water softener technologies and promote through a public educational program technology performance results and related environmental benefits of preferred technologies.
- That the City's Wastewater Effluent Re-use dedicated pipe project, commonly referred to as the "Purple Pipe" project, and Class Environmental Assessment, as approved by Council through the 2008 Guelph Water/Wastewater Master Servicing Plan, evaluate the further potential for a communal wastewater effluent reuse system and design practices for customer serving of the effluent reuse source.
- That the City undertake a feasibility study to evaluate the best practices for multi-unit residential water metering and private servicing condition assessment requirements for current bulk metered multi-unit residential customers.
- That the City's Strategic Urban Forest Management Plan and the Natural Heritage Strategy define the appropriate means for protection and preservation of the City's urban forest in recognition of water conservation and storm water management benefits provided by the urban canopy.
- That staff undertake the immediate development of an enhanced public education water conservation program in 2009 subject to the availability of program funding.
- That staff initiate water loss mitigation activities in 2009 as outlined in the City's Water Loss Mitigation Strategy and investigate the potential for improved water pressure management in distribution system.
- That the City's Waterworks Department undertake a pilot study as part of the City's 2009 Water Loss Mitigation Strategy to evaluate the local implementation of Automated Metering Infrastructure (AMI) for customer water metering.
- That the City's Water/Wastewater Rate Review define customer billing policies for properties possessing Rain Water Harvesting Systems.
- That staff pursue external funding sources, and key partnerships, throughout implementation of the Water Conservation and Efficiency Strategy Update program recommendations.

For reference individual business cases for each recommended water conservation and efficiency measure are provided in Appendix I of this report.

11.1 Table 42: Ten Year Capital Budget and Water Savings (Litres per average day) and Schedule

Ten Year Capital Plan	2010	2010	2011	2011	2012	2012	2013	2013	2014	2014	2015	2015
	Costs	Savings	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings
Residential Single Family - Indoor	$ 757,987	344,898	$ 757,987	689,796	$ 757,987	1,034,694	$ 757,987	1,379,592	$ 757,987	1,724,490	$ 757,987	2,069,388
Residential Single Family - Summer Demand	$ 238,500	99,650	$ 238,500	199,300	$ 238,500	298,950	$ 238,500	398,600	$ 238,500	498,250	$ 238,500	597,900
Residential Multi-Family High Rise	$ 141,332	58,977	$ 141,332	117,954	$ 141,332	176,931	$ 141,332	235,908	$ 141,332	294,885	$ 141,332	353,862
Residential Single Family New Development - Indoor	$ 227,250	58,365	$ 227,250	116,730	$ 227,250	175,095	$ 227,250	233,460	$ 227,250	291,825	$ 227,250	350,190
Residential Single Family New Development - Summer Demand	$ 102,600	29,400	$ 102,600	58,800	$ 102,600	88,200	$ 102,600	117,600	$ 102,600	147,000	$ 102,600	176,400
Industrial/Commerical/Institutional	$ 198,790	113,570	$ 198,790	227,140	$ 198,790	340,710	$ 198,790	454,280	$ 198,790	567,850	$ 198,790	681,420
Distribution Leakage Reduction	$ 79,500	575,000	$ 79,500	1,150,000	$ 79,500	1,725,000		1,725,000		1,725,000		1,725,000
Public Education	$ 142,000		$ 142,000		$ 142,000		$ 142,000		$ 142,000		$ 142,000	
Youth Education	$ 103,000		$ 103,000		$ 103,000		$ 103,000		$ 103,000		$ 103,000	
Other Municipal Initiatives	$ 90,000		$ 50,000		$ 50,000		$ 50,000		$ 250,000		$ 50,000	
Total	$ 2,080,959	1,279,860	$ 2,040,959	2,559,720	$ 2,040,959	3,839,580	$ 1,961,459	4,544,440	$ 2,161,459	5,249,300	$ 1,961,459	5,954,160

Funding Allocation	2010		2011		2012		2013		2014		2015	
Approved DC Forecast	$ 315,537		$ 304,575		$ 304,575		$ 304,575		$ 304,575		$ 304,575	
Current Water Conservation Funding (Rate Base)	$ 509,000		$ 524,270		$ 539,998		$ 556,198		$ 572,884		$ 590,071	
Additional Funding (Rate Base)	$ 1,256,422		$ 1,212,114		$ 1,196,386		$ 1,100,686		$ 1,284,000		$ 1,066,813	
Total	$ 2,080,959		$ 2,040,959		$ 2,040,959		$ 1,961,459		$ 2,161,459		$ 1,961,459	

Ten Year Capital Plan	2016	2016	2017	2017	2018	2018	2019	2019	Total	Total	Cost
	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings	Costs	Acc.Savings	per Litre
Residential Single Family - Indoor	$ 757,987	2,414,286	$ 757,987	2,759,184	$ 757,987	3,104,082	$ 757,987	3,448,980	$ 7,579,870	3,448,980	$ 2.20
Residential Single Family - Summer Demand	$ 238,500	697,550	$ 238,500	797,200	$ 238,500	896,850	$ 238,500	996,500	$ 2,385,000	996,500	$ 2.39
Residential Multi-Family High Rise	$ 141,332	412,839	$ 141,332	471,816	$ 141,332	530,793	$ 141,332	589,770	$ 1,413,316	589,770	$ 2.40
Residential Single Family New Development - Indoor	$ 227,250	408,555	$ 227,250	466,920	$ 227,250	525,285	$ 227,250	583,650	$ 2,272,500	583,650	$ 3.89
Residential Single Family New Development - Summer Demand	$ 102,600	205,800	$ 102,600	235,200	$ 102,600	264,600	$ 102,600	294,000	$ 1,026,000	294,000	$ 3.49
Industrial/Commerical/Institutional	$ 198,790	794,990	$ 198,790	908,560	$ 198,790	1,022,130	$ 198,790	1,135,700	$ 1,987,900	1,135,700	$ 1.75
Distribution Leakage Reduction		1,725,000		1,725,000		1,725,000		1,725,000	$ 238,500	1,725,000	$ 0.14
Public Education	$ 142,000		$ 142,000		$ 142,000		$ 142,000		$ 1,420,000		
Youth Education	$ 103,000		$ 103,000		$ 103,000		$ 103,000		$ 1,030,000		
Other Municipal Initiatives	$ 50,000		$ 50,000		$ 50,000		$ 250,000		$ 940,000		
Total	$ 1,961,459	6,659,020	$ 1,961,459	7,363,880	$ 1,961,459	8,068,740	$ 2,161,459	8,773,600	$ 20,293,086	8,773,600	$ 2.31

Funding Allocation	2016		2017		2018		2019		Total
Approved DC Forecast	$ 273,375		$ 257,775		$ 244,841		$ 145,555		$ 2,759,958
Current Water Conservation Funding (Rate Base)	$ 607,773		$ 626,006		$ 644,786		$ 664,130		$ 5,835,115
Additional Funding (Rate Base)	$ 1,080,311		$ 1,077,678		$ 1,071,832		$ 1,351,774		$ 11,698,013
Total	$ 1,961,459		$ 1,961,459		$ 1,961,459		$ 2,161,459		$ 20,293,086

Table 43: Water Conservation and Efficiency Strategy Update Program Phasing Overall

Program	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Residential Indoor	Status Quo and Planning										
Residential Summer Demand	Status Quo and Planning										
Residential Multi-Family High Rise	Status Quo and Planning										
Residential New Development Indoor	Planning										
Residential New Development Outdoor	Planning										
Industrial/Commercial/Institutional	Status Quo and Planning										
Distribution Leakage Reduction	Planning										
Broadscale Public Education	Status Quo and Planning										
Youth Education	Status Quo and Planning										
Municipal Buildings Retrofit Demos	Planning										
Multi-Family Metering Study	Planning										
WC&ES Updates	Completion of 2009 Strategy										
Annual Costs		$ 2,080,959	$ 2,040,959	$ 2,040,059	$ 1,961,459	$ 2,161,459	$ 1,961,459	$ 1,961,459	$1,961,459	$ 1,961,459	$ 2,161,459
Accumulated Savings (litres/day)		1,279,860	2,559,720	3,839,580	4,544,440	5,249,300	5,954,160	6,659,020	7,363,880	8,068,740	8,773,600

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It is recommended that the above capital plan be supported by ongoing monitoring, evaluation and maintenance in order to initially verify the water savings and then to sustain them into the future.

The overall best practices 10-year capital program is budgeted at $20,293,086 commencing in 2010 and is expected to save just over 8.7 million litres of water per average day (Ml/d). Based on Guelph's per capita water consumption this volume of water could potentially provide the residential servicing demands of a community with a population of approximately 38,000 residents.

The cost per litre per day for the proposed 10-year plan is $2.31. This compares well to the average cost per litre per average day capacity for new infrastructure, which is $4.00. To add new infrastructure to deliver the equivalent capacity of 8.7 Mld would cost $34.8 million based on the average $4.00 per litre capacity cost.

It is proposed that the 10 year capital plan will be funded as follows:

Developments Charges	$2,759,958
Base Funding previously approved	$5,835,115
Additional Funding	$11,698,013
Total	$20,293,086

The additional funding would require a 4.3% increase in the water and wastewater rates.

Although some program measures did not meet the cost analysis, which includes grey water reuse, rain water harvesting and rain barrels, these program alternatives have been included due to other benefits that they bring to the overall plan. However, it is important to note that even with the inclusion of these programs the overall plan remains more cost-effective than the cost of constructing future water and wastewater supply/treatment capacity.

Due to the difficulty in measuring water savings generated by education, there have been no savings attributed to the Broadscale Public or Youth Education programs in the 10yr plan. Technical solutions, such as low flush toilets and low flow showerheads will only achieve a portion of the potential water savings. Education designed to change habits and attitudes or residents towards water use will achieve the remaining savings. The American Water Works Association suggests that education programs can generate up to a 4 to 5% reduction in water demand by long-term education initiatives. In addition, education is necessary to ensure that water savings generated by the capital program are sustained.

In addition, water use reductions associated with conservation based water rate user pay structures or elasticity in demand have not been included as part of the water savings identified through the 10 yr plan. As part of the City's ongoing Water/Wastewater Rate Review, consultation on water conservation rate structure alternatives was completed with the Water Conservation and Efficiency Strategy Update Public Advisory Committee. Upon discussion of potential rates structures, and in consideration of potential consumption reductions associated with already planned annual rate increases during the current economic times, a conservation rate structure was ultimately not recommended by the Committee at this time.

Included in the costs for the plan are:

- Equipment
- Installation
- Rebate
- Marketing
- Program management and administration
- Project management

A breakdown of annual costs by market sector is provided in the table on the following page.

11.2 Table 44: Annual Water Conservation and Efficiency Strategy Costs Breakdown

Single Family Indoor		Number of Rebates or Participants	Rebates,Equipment & Installation	Training	Marketing	Program Management & Administration	Project Management	Total Annual Cost	Total Program Savings (L/d)	Cost per litre
Rebates	ULF 6 Litre Flush ($60)	828	$ 49,680.00		$ 13,680.00	$ 21,600.00	$ 9,000.00	$ 93,960.00	43,200	$ 2.18
Rebates	HET Toilets ($75)	311	$ 23,287.50		$ 5,062.50	$ 8,100.00	$ 2,700.00	$ 39,150.00	18,630	$ 2.10
Rebates	Dual Flush Toilets ($75)	932	$ 69,862.50		$ 15,187.50	$ 28,350.00	$ 4,050.00	$ 117,450.00	63,180	$ 1.86
Rebates	Clothes Washer ($80)	1,090	$ 109,042.50		$ 10,904.25	$ 32,712.75	$ 10,904.25	$ 163,563.75	84,121	$ 1.94
Rebates	Humidifier ($75)	928	$ 69,620.80		$ 9,282.77	$ 13,924.16	$ 4,641.39	$ 97,469.13	47,342	$ 2.06
Rebates	Floor Drain ($60)	1,000	$ 60,000.00		$ 10,000.00	$ 15,000.00	$ 5,000.00	$ 90,000.00	43,000	$ 2.09
Rebates	Grey Water ($1,000)	10	$ 10,000.00		$ 8,000.00	$ 24,000.00	$ 8,000.00	$ 50,000.00	900	$ 55.56
Rebates	Rain Water ($2,000)	10	$ 20,000.00		$ 8,000.00	$ 24,000.00	$ 8,000.00	$ 60,000.00	1,709	$ 35.11
Installation	Low Flow Showerheads	693	$ 18,553.05	$ 1,822.50	$ 5,503.95	$ 10,935.00	$ 3,645.00	$ 40,459.50	40,090	$ 1.01
Installation	Kitchen Faucets	58	$ 524.88	$ 291.60	$ 583.20	$ 1,749.60	$ 466.56	$ 3,615.84	1,715	$ 2.11
Installation	Leakage Repair	11	$ 284.31	$ 328.05	$ 109.35	$ 1,312.20	$ 328.05	$ 2,361.96	1,178	$ 2.01
Single Family - Summer Demand										
Rebates	Watering Timers ($20)	500	$ 10,000.00		$ 6,000.00	$ 6,000.00	$ 2,500.00	$ 24,500.00	11,836	$ 2.07
Other	W.E. Landscape Visits	1,000	$ 80,000.00		$ 30,000.00	$ 12,000.00	$ 5,000.00	$ 127,000.00	74,000	$ 1.72
Other	Rain Barrels	650	$ 22,500.00		$ 22,500.00	$ 37,500.00	$ 4,500.00	$ 87,000.00	13,634	$ 6.38
Multi- Family Highrise										
Rebates	ULF 6 Litre Flush ($60)	202	$ 18,000.00		$ 6,000.00	$ 8,000.00	$ 3,000.00	$ 35,000.00	12,000	$ 2.92
Rebates	HET Toilets ($75)	113	$ 8,437.50		$ 2,287.50	$ 3,000.00	$ 1,125.00	$ 14,850.00	5,175	$ 2.87
Rebates	Dual Flush Toilets ($75)	338	$ 25,312.50		$ 6,862.50	$ 9,000.00	$ 3,375.00	$ 44,550.00	17,550	$ 2.54
Rebates	Clothes Washer ($200)	60	$ 12,000.00		$ 2,400.00	$ 9,600.00	$ 2,400.00	$ 26,400.00	13,440	$ 1.96
Installation	Low Flow Showerheads	224	$ 5,905.43	$ 860.85	$ 4,304.25	$ 5,165.10	$ 1,721.70	$ 17,957.33	9,468	$ 1.90
Installation	Kitchen Faucets	28	$ 247.92	$ 137.74	$ 275.47	$ 550.94	$ 275.47	$ 1,487.55	810	$ 1.84
Installation	Leakage Repair	5	$ 134.29	$ 154.95	$ 51.65	$ 619.81	$ 154.95	$ 1,115.66	556	$ 2.01
Residential New Development - Indoor										
Rebates	HET Toilets ($10)	228	$ 6,750.00		$ 1,125.00	$ 4,500.00	$ 1,125.00	$ 13,500.00	4,050	$ 3.33
Rebates	Dual Flush Toilets ($10)	675	$ 6,750.00		$ 1,125.00	$ 4,500.00	$ 1,125.00	$ 13,500.00	8,100	$ 1.67
Rebates	Clothes Washer ($80)	225	$ 18,000.00		$ 1,125.00	$ 4,500.00	$ 675.00	$ 24,300.00	7,368	$ 3.30
Rebates	Humidifier ($75)	270	$ 20,250.00		$ 5,400.00	$ 5,400.00	$ 2,700.00	$ 33,750.00	13,770	$ 2.45
Rebates	Floor Drain ($60)	270	$ 16,200.00		$ 2,700.00	$ 8,100.00	$ 1,350.00	$ 28,350.00	11,610	$ 2.44
Rebates	Grey Water ($1,000)	10	$ 10,000.00		$ 8,000.00	$ 12,000.00	$ 5,000.00	$ 35,000.00	900	$ 38.89
Rebates	Rain Water ($2,000)	10	$ 20,000.00		$ 6,000.00	$ 24,000.00	$ 5,000.00	$ 55,000.00	1,709	$ 32.18
Rebates	Low Flow Showerheads ($10)	452	$ 8,550.00		$ 1,350.00	$ 4,500.00	$ 1,350.00	$ 15,750.00	7,387	$ 2.13
Rebates	Kitchen Faucets ($5)	450	$ 2,250.00		$ 2,250.00	$ 2,250.00	$ 1,350.00	$ 8,100.00	3,780	$ 2.14
Residential New Development - Summer Demand										
Rebates	W.E. Landscaping ($200)	300	$ 63,000.00		$ 9,000.00	$ 12,000.00	$ 1,500.00	$ 85,500.00	22,200	$ 3.85
Rebates	Watering Timers ($20)	300	$ 6,000.00		$ 3,600.00	$ 6,000.00	$ 1,500.00	$ 17,100.00	7,101	$ 2.41
Industrial/Commercial/Institutional										
Rebates	ULF 6 Litre Flush ($60)	232	$ 13,920.00		$ 8,700.00	$ 11,600.00	$ 2,900.00	$ 37,120.00	17,110	$ 2.17
Rebates	HET Toilets ($75)	88	$ 6,600.00		$ 3,300.00	$ 4,400.00	$ 1,100.00	$ 15,400.00	7,810	$ 1.97
Rebates	Dual Flush Toilets ($75)	144	$ 10,800.00		$ 5,400.00	$ 9,000.00	$ 2,700.00	$ 27,900.00	14,940	$ 1.87
Rebates	Clothes Washer ($200)	30	$ 6,000.00		$ 4,000.00	$ 8,000.00	$ 2,000.00	$ 20,000.00	8,190	$ 2.44
Installation	Pre-Rinse Spray Valves	23	$ 3,045.00	$ 1,200.00	$ 3,000.00	$ 9,000.00	$ 1,125.00	$ 17,370.00	5,520	$ 3.15
Other	ICI Audit and Capacity Buyback	1.5	$ 18,000.00			$ 53,000.00	$ 10,000.00	$ 81,000.00	60,000	$ 1.35
Distribution Leakage Reduction										
Other	DMAs	5	$ 66,500.00			$ 8,000.00	$ 5,000.00	$ 79,500.00	575,000	$ 0.14
Education										
Public Education					$ 80,000.00	$ 50,000.00	$ 12,000.00	$ 142,000.00		
Youth Education					$ 37,500.00	$ 60,000.00	$ 5,500.00	$ 103,000.00		
Other Municipal Initiatives										
Study	WC&ES Updates					$180K in 2014 & 2019	$20K in 2014 & 2019	$200K in 2014 & 2019		
Study	Multi-Res Metering Study					$36 K in 2010	$4K in 2010	$40K in 2010		
Demonstrations	Municipal Building Demonstrations		$30K every year			$15K every year	$5K every year	$50K every year		

11.3 Staff Resources

The implementation of the ten year plan would require the following permanent staff resources which has been included in the budget.

Position	Annual Expense
Project Manager (x1)	$130,000
Program Coordinator (x2)	$200,000
Resource Specialist (x2)	$160,000
Administration (x2)	$140,000
Additional Expenses	$83,869*
Total Annual Expenses	$703,869

* Additional expenses include office space, desks, cabinets, phones, computers, printers, internet service, business mileage expense and other out of pocket expenses.

It is recommended that the project management position be City staff. This position would be responsible for the delivery of the entire strategy. Currently there are two permanent staff dedicated to the City's Water Conservation and Efficiency Program, most notably a Water Conservation Project Manager and a Water Conservation Program Co-ordinator. These positions have been included in the above budget. The remaining five (5) proposed positions could be either City staff or contracted out to a consulting firm. These positions are responsible for the design, implementation, tracking and evaluation of the individual programs.

Responsibilities and duties of recommended staff:

Project Manager – responsible for overall development, implementation, evaluation and reporting of the Water Conservation and Efficiency Strategy. Staff recruitment, training, coaching and evaluation.

Program Co-ordinator – responsible for the development, implementation and evaluation of:

- Detached single family residential indoor rebate program
- Detached single family residential installation program
- Detached single family residential summer demand program
- Residential new development program

Program Co-ordinator – responsible for the development, implementation and evaluation of:

- Multi-family residential rebate program
- Multi-family residential installation program
- ICI rebate program
- ICI pre-rinse spray valve installation program
- ICI audit and capacity buyback program

Public Education Resource Specialist – responsible for the development, delivery and evaluation of the broad-scale public education and the youth education program.

Program Evaluation Specialist – responsible for the development, collection, analysis and reporting of data pertaining to program participants, program monitoring and evaluation, water use analysis, demand reporting, industry benchmarking and maintenance activities.

Administrative Support (2) – responsible for:

- Managing telephone and email enquires to all programs
- Booking appointments for installation programs and summer landscape program
- Supporting maintenance activities
- Receiving and processing of all rebate applications

Resource staff costs noted above represent funding required to outsource staff positions should internal staffing not be preferred in the delivery of the 10 yr plan. It is important to note that the delivery of these programs through internal full-time or part-time staff would introduce a significant annual cost savings to the City in comparison to contracting external services.

11.4 Updated Demand Forecast with Influence of Proposed Water Conservation and Efficiency Strategy

11.4.1 WC&ES Average Day Water Demand Projection

The average day water demand projection, including expected results from implementation of the WC&ES Strategy is shown in Table 45.

Table 45: WC&ES Average Day Water Demand Projection

Year	Population	ICI Equiv Pop	Ave Day m³/d	WC&ES m³/d	WC&ES Ave Day m³/d
2006	115,000	68,542	51,387		51,387
2011	125,000	75,445	54,722	2,560	52,162
2016	137,000	79,795	59,185	6,659	52,526
2021	149,000	83,397	63,444	8,774	54,671
2026	159,000	87,392	67,265	8,774	58,491
2031	169,000	93,253	71,595	8,774	62,822
2036	182,000	97,248	76,235	8,774	67,461
2041	196,000	101,832	81,308	8,774	72,535
2046	211,000	106,416	86,655	8,774	77,881
2051	227,000	111,000	92,274	8,774	83,500

The average day demand projection is illustrated in Figure 37, which also shows the forecast prepared for the 2006 WSMP as well as the base forecast prepared for this assignment.

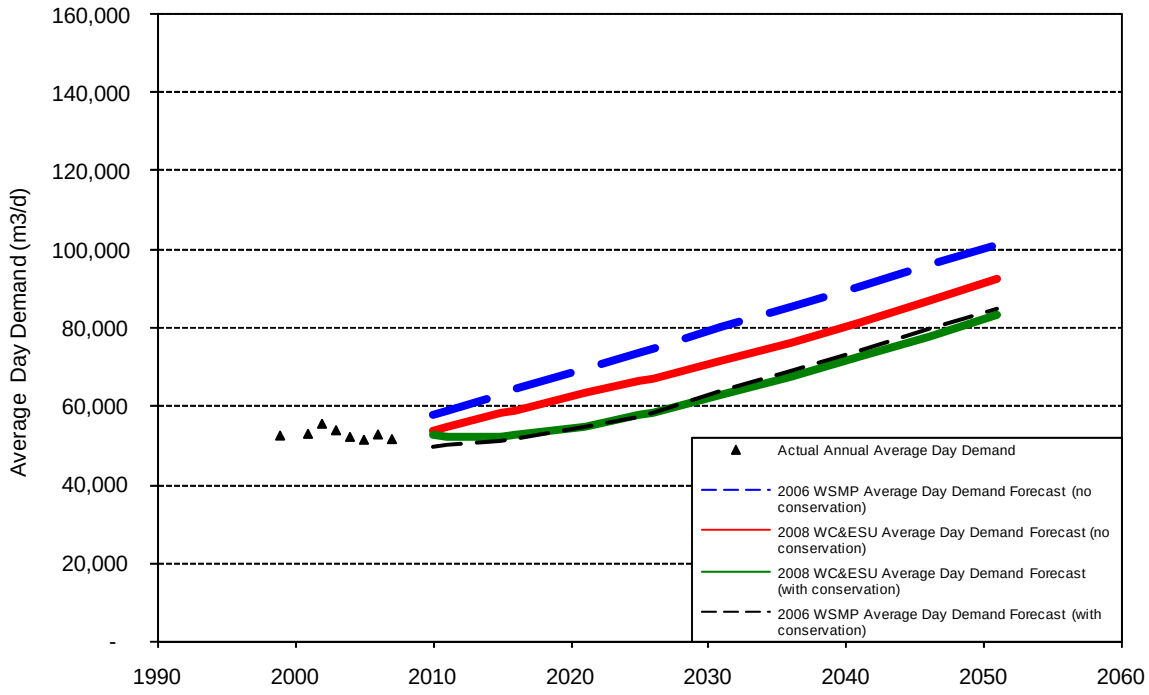


Figure 37: Average Day Demand Projection

Based on the average day water demand projection including the effect of the Water Conservation and Efficiency Strategy, it is noted that the 2006 average day production level of 52,579 m3/day would not be reached until the year 2017.

11.4.2 WC&ES Maximum Day Water Demand Projection

The maximum day water demand projection, including the expected results from implementation of the WC&ES Strategy is shown in Table 46.

Table 46: WC & ES Maximum Day Water Demand Projection

Year	Population	ICI Equiv Pop	Max Day m³/d	WC&ES m³/d	WC&ES Max Day m³/d
2006	115,000	68,542	61,456		61,456
2011	125,000	75,445	73,327	2,560	70,767
2016	137,000	79,795	79,308	6,659	72,649
2021	149,000	83,397	85,015	8,774	76,241
2026	159,000	87,392	90,135	8,774	81,361
2031	169,000	93,253	95,937	8,774	87,163
2036	182,000	97,248	102,155	8,774	93,381
2041	196,000	101,832	108,953	8,774	100,179
2046	211,000	106,416	116,117	8,774	107,343
2051	227,000	111,000	123,647	8,774	114,873

The maximum day demand projection is illustrated in Figure 38, which also shows the forecast prepared for the 2006 WSMP as well as the base forecast prepared for this assignment.

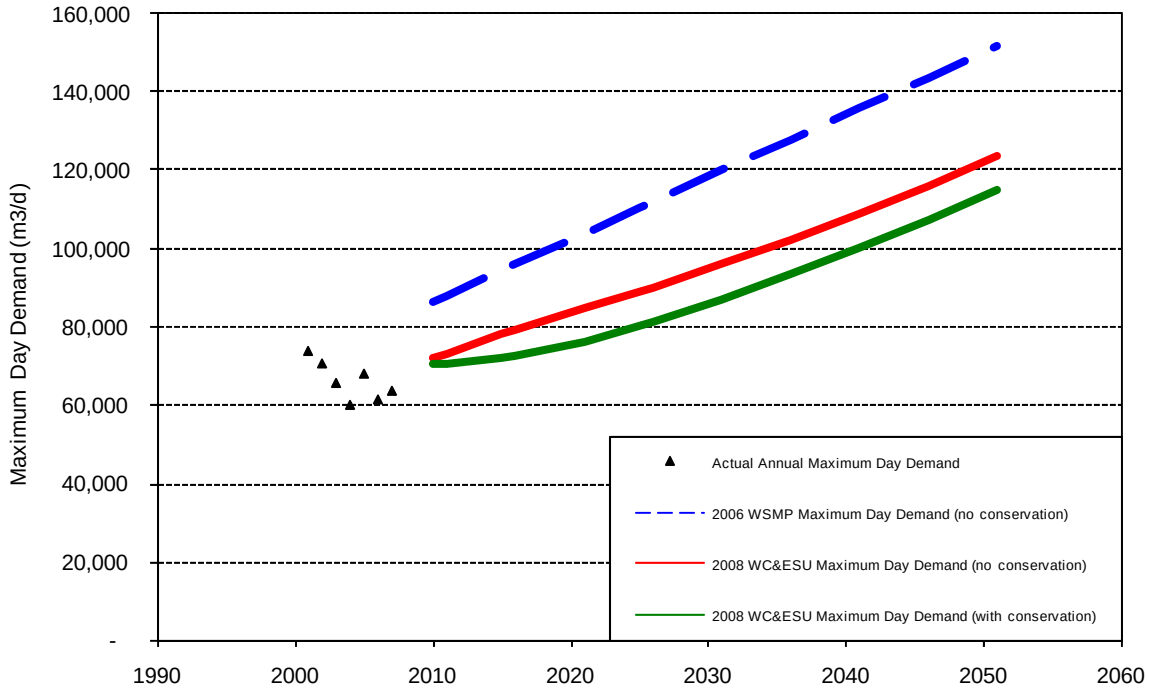


Figure 38: Maximum Day Demand Projection

12.0 Maintenance

Water savings generated from the efficiency program should be viewed in the same manner as constructing a new water treatment facility. If Guelph were to design and build new infrastructure to deliver 8.7 Ml/d, a budget for a maintenance program would be included to ensure that the facility continues to deliver 8.7 Ml/d in the future. The City of Guelph's water conservation and efficiency strategy is no different. If it was designed to save 8.7 Ml/d, maintenance would be required to sustain the savings into the foreseeable future.

Water efficiency has been identified by the City as a viable cost-effective supply of water. Maintenance will be essential to ensure that the savings are sustained. Each component of the water efficiency strategy should have three basic elements; tracking of activity, savings validation and finally maintenance of products and services provided.

The largest components of the proposed conservation and water efficiency strategy, from both a savings and budget perspective, are the programs related to the residential sector. The City would implement these programs through incentives or direct installation in qualifying homes, apartments, condominiums and new developments within the City.

The maintenance element of the program will ensure that if a water efficiency program participant has a performance problem with the new equipment installed, new replacement products will be available to the participant.

To sustain water savings within the ICI sector, follow up visits should be scheduled periodically to ensure that the water saving capital equipment that was installed and any procedural changes made as a result of the water efficiency program are still in place, working effectively and saving the same amount of water as originally verified.

Just like a new treatment plant, water efficiency measures have to be maintained. This will be in several formats, including:

- Education of water users
- Tracking of all participants and non-participants
- Customer call centre to respond to enquiries
- Recommendations for replacement products or service

A comprehensive maintenance program is an integral part of the strategy during the ten-year capital program and beyond. It is recommended that a Customer Service Centre be established that would field incoming calls regarding the program. A customer with a problem will simply contact the Service Centre then be directed to speak with a program representative directly. The program representative will have access to a database which contains participant information such as name, address, phone numbers, number of showers in the home, number of toilets in the home, products installed, date of installation and name of installer.

The importance of tracking activity from a customer satisfaction perspective, from a product performance perspective to a program performance perspective cannot be over-emphasized. Just like it pays to put that

front-end time investment in the development of the scope of work...the same holds true for a tracking system. Two levels of tracking, ATS and SRS will be developed for the installation activity. ATS or the Activity Tracking System monitors the day-to-day activity. It will be located and maintained by the City's Water Efficiency Program customer service representatives. On a daily basis, all calls received, all installs completed, any maintenance work completed will be tracked in ATS. A number of management reports will be able to be called up at any time or ad hoc queries can be generated. Each month, the information gathered in ATS will be downloaded into SRS, the Summary Reporting System. Just as its name implies, this will be a high level reporting system used for management reports indicating costs, participants, estimated water savings and variance to budgets and forecasts.

Few utilities implement maintenance, monitoring and evaluation programs to the extent that is recommended. Most utilities implement water efficiency capital programs with no thought to sustaining the savings into the long term or without any serious evaluation research. They quite often rely on engineering estimates for calculating savings while not considering the significant number of externalities that effect water savings. The energy sector has done a much better job in monitoring and evaluation but even they fall short on maintenance. Few, if any, energy utilities maintain the savings that they have achieved from their capital programs.

The elements included in the maintenance program would include:

Single Family Detached and Multi-Family Residential Indoor

Significant water savings products will be installed by Guelph's water conservation and efficiency strategy. These products should be maintained through a mail out service. If a resident or business requires a replacement product they simply call the Guelph customer service centre who would mail out the appropriate products same day by priority post or direct the customer to where they can get a replacement. It is recommended that this service also include the flappers of toilets that residents will be installing through a toilet rebate program and faucet aerators. A product failure rate of 3% per annum has been assumed starting in Year 3 of the capital program. This is based on the failure rate observed in other toilet flappers programs.

Single Family Detached Residential Outdoor

Managing maximum day demand is a challenge for any utility whether it concerns water or energy. To ensure that the savings are sustained from the landscape visit program it is recommended that follow up surveys and/or visits made to reinforce the educational message.

Industrial/Commercial/Institutional

In addition to maintaining the products installed in small commercial businesses it is anticipated that 15 large volume customers will participate in the water saving audits and capacity buy-back program. Over the course of the ten year capital plan, a consultant who will be similar to a key-account manager will visit each of the facilities periodically. The purpose of the visit will be to ensure that the water measures implemented are still in place and still providing savings as designed. In addition the consultant will meet with the facility staff to

ensure proper operating procedures design to achieve maximum savings are being practiced. The budget allows for 3 site visits per year during the ten year capital plan with 15 visits scheduled for Year 10.

Distribution Leakage Reduction

It is recommended as good practice to complete an AWWA / IWA Water Audit and Water Balance every year – this is often referred to as the "Top Down" approach to water loss management.

It is also recommended that the temporary District Meter Areas (DMAs) be operated on a regular basis, which can be either every year, or every two to three years. It is also recommended that with the information gathered as part of the operation of the temporary DMAs, that consideration be given to establishing permanent DMAs, for either continuous water loss monitoring, or the next stage of flow modulation to reduce background leakage (small leaks that are nor economic to find and repair). The DMA approach is often referred to as the "Bottom UP" approach.

The maintenance budget has been established to accommodate five (5) DMA maintenance runs each year of the ten year strategy. This will ensure that no DMA goes without maintenance for more the three years.

The recommended maintenance budget is found in Table 47 below.

Table 47: Recommended Maintenance Budget

Ten Year Maintenance Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Detached Residential - Indoor	$ 16,213	$ 16,426	$ 17,277	$ 17,916	$ 18,554	$ 19,193
Single Family Detached Residential - Outdoor	$ -	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Multi Family Residential	$ 16,112	$ 16,223	$ 16,670	$ 17,005	$ 17,340	$ 17,674
Industrial/Commercial/Institutional	$ 12,061	$ 12,122	$ 22,867	$ 23,051	$ 28,104	$ 31,881
Distribution Leakage Reduction				$ 47,700	$ 47,700	$ 47,700
Total	$ 44,386	$ 62,771	$ 74,814	$ 123,671	$ 129,698	$ 134,448

Ten Year Maintenance Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	
Single Family Detached Residential - Indoor	$ 19,831	$ 20,470	$ 21,108	$ 21,747	$ 188,733
Single Family Detached Residential - Outdoor	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 162,000
Multi Family Residential	$ 18,009	$ 18,344	$ 18,679	$ 19,014	$ 175,070
Industrial/Commercial/Institutional	$ 31,907	$ 31,933	$ 31,959	$ 73,985	$ 299,870
Distribution Leakage Reduction	$ 47,700	$ 47,700	$ 47,700	$ 47,700	$ 333,900
Total	$ 135,447	$ 136,447	$ 137,446	$ 180,446	$ 1,159,573

13.0 Monitoring and Evaluation

It is important to have a monitoring and evaluation program to ensure that the water savings are achieved initially, and that those savings are sustained over time.

In the residential and small commercial markets it is recommended that on-site monitoring be carried out 30 days before the measure installation and 30 days after the measure has been installed. Monitoring can be accomplished with the installation of data loggers on the water meters. These units are small and unobtrusive. The data logging study will verify the actual savings attributed to the water saving measures. This analysis should be completed in the first year of the capital program to verify the expected water savings.

In regards to the measuring the effect of residential outdoor measures it is recommended that a district meter area (DMA) approach be implemented. This approach has been used in the past during a joint study with York, Halton and Durham Regions and the City of Toronto to determine the water savings attributed a water-efficient landscape visit program. Two small DMAs are established each consisting of approximately 500 homes and in similar neighbourhoods. One DMA is used as the test sample where a program for example, like the water efficient landscape audit, is implemented. The other DMA is the control sample where no program is implemented. By monitoring the flows going into each area it can be determined the impact that the program is having on water use.

Also of importance is the ongoing monitoring for persistence or sustainability. All products wear out or fail in time. Participants may have the tendency to install a high water consuming device when their water saving device fails. This may happen due to lack of knowledge or the availability of water saving products at retail stores. In order to measure this erosion in savings it is recommended that statistically valid audits of participants be carried out throughout the ten year plan. The auditor would visit the home or business and inspect the water savings products that were installed. The auditor would observe if the products are still installed, working properly and saving water. Audits could be completed in Year 5 and 10.

The Table 48 below provides the monitoring and evaluation by year for the ten year strategy.

Table 48: Monitoring and Evaluation Budget

Ten Year Monitoring and Evaluation Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor	$ 345,000				$ 180,000	
Single Family Residential - Outdoor	$ 45,000	$ 24,000	$ 24,000	$ 24,000	$ 98,460	
Multi Family Residential	$ 315,000				$ 120,000	
Industrial, Commercial and Institutional	$ 297,000				$ 37,700	
Total	$ 1,002,000	$ 24,000	$ 24,000	$ 24,000	$ 436,160	$ -

Ten Year Monitoring and Evaluation Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor				$ 180,000	$ 705,000
Single Family Residential - Outdoor				$ 98,460	$ 313,920
Multi Family Residential				$ 120,000	$ 555,000
Industrial, Commercial and Institutional				$ 37,700	$ 372,400
Total	$ -	$ -	$ -	$ 436,160	$ 1,946,320

The Table 49 below provides the activities to be undertaken from the Monitoring and Evaluation plan.

Table 49: Recommended Monitoring and Evaluation Activity

	Number of Participants to be Monitored	Number of Persistence Audits in Year 5 &10
Single Family Detached Residential - Indoor		
ULF Toilets	30	400
HET Toilets	30	400
DF Toilets	30	400
Clothes Washers	30	400
Humidifiers	30	400
Floor Drain Seals	30	400
Grey Water Reuse	10	0
Rain Water Harvesting	10	0
Showers, Faucets, Leakage	30	200
Single Family Detached Residential - Outdoor		
Watering Timers	30	400
Landscape Visits	2 DMAs x 3 years	400
Rain Barrels	0	400
Multi Family Residential		
ULF Toilets	30	400
HET Toilets	30	400
DF Toilets	30	400
Clothes Washers	30	400
Showers, Faucets, Leakage	30	200
Industrial, Commercial and Institutional		
ULF Toilets	30	400
HET Toilets	30	400
DF Toilets	30	400
Clothes Washers	30	60
Pre Rinse Spray Valves	30	100
Capacity Buy Back	Included in Capital Program	

It is important to note that the long-term costs of water savings monitoring could be drastically reduced with the introduction of automated meter ready (AMR) technology in place of the collection of the City's current customer water use reading system. The introduction of AMR technologies would provide the Guelph utility with enhanced customer water use data (based on the frequency of water use reporting) and added customer services tools to proactively identify private side leakage or meter reading errors. With the introduction of this technology it is expected that the required monitoring program would be less labour intensive for staff and be less intrusive for sites being monitored through the process.

14.0 Energy Savings and Greenhouse Gas Emissions Reductions

The overall energy savings generated from water efficiency is in most cases more significant than the water savings. Water utilities are typically the largest consumer of electricity in a municipality. Electricity is used in the water and wastewater treatment processes but more significantly in the pumping/conveyance of water and wastewater. A recent study[2] completed by the Polis Project on Ecological Governance, University of Victoria evaluated historical data relating to water production and energy consumption from 7 municipalities in Ontario. The study completed case studies on the Town of Collingwood, the Regional Municipality of Durham and the city of Guelph. The study reported, for the City of Guelph that it takes 0.7336 KWh of electricity for every cubic metre of water delivered to a customer and then returned through the wastewater process. The findings from this study were used to develop the energy savings and greenhouse gas emission reductions reported below.

Many of the water saving measures recommended in the strategy also reduce energy consumption at the customer's premise. For example, a low flow showerhead reduces not only water but reduces hot water. Natural gas or electricity has been used by the customer to generate the hot water. The Guelph Water Conservation and Efficiency Strategy illustrates that a customer installing low flow showerheads in their home will save 40 cubic metres of water per year. A portion of that water saved would have been hot water which translates into a savings of 104 cubic metres of natural gas per year for the customer. Energy savings will also be generated from the faucet aerators, leakage reduction, pre-rinse spray nozzles and the ICI Audit programs.

Typically a residential customer who participates in the water efficiency program will see greater dollar savings in their energy bill as compared to their water bill. This is also an important linkage to emphasize when promoting the water efficiency programs to the public.

The reduction of water-use through an efficiency program and the associated energy savings provides significant greenhouse gas reductions. With climate-change in mind, most municipalities have set their own greenhouse gas reduction targets. Water efficiency can be a positive contributor to meeting those targets. The full implementation of the strategy provides energy savings and greenhouse gas emissions reduction as indicated in Table 50 below.

Table 50 – Estimated Energy Savings and Associated Greenhouse Gas Emission Reductions

	Water Savings per Year (m3/yr)	Energy Savings per Year	CO2 Reductions per Year (tonnes/yr)
Overall Water Savings	3,202,364	2,348,934 KWh Electricity	728 tonnes
Low Flow Showerheads, Faucets	Included in above	684,216 M3 Natural Gas	1,294 tonnes
Pre-Rinse Spray Valves	Included in above	206,325 M3 Natural Gas	390 tonnes
Overall CO2 Reduction			2,412 tonnes

[2] Maas, Carol. Greenhouse Gas and Energy Co-Benefits of Water Conservation, Polis Discussion Series Paper 08-01, November 2008, Polis Project on Ecological Governance, university of Victoria, Victoria, BC.

As observed in Table 50, although significant greenhouse gas emissions reductions are provided by the electrical savings associated with the utility delivering less water, significantly more reductions are provided by reducing the hot water consumed in houses and businesses. With these co-benefits to certain water efficiency measures it is recommended that the City pursue strategic partnerships with Energy providers in the delivery of the program.

Assuming an electric rate of $ 0.06 per KWh, the City of Guelph would reduce its electrical bill by approximately $141,000 per year upon completion of the ten year strategy. In addition, the greenhouse gas emissions reduction is equivalent to removing 438 cars from the road.

14.1 Additional Water Conservation Co-benefits

With recognition of increased global attention to "carbon footprinting", and "intrinsic water" in goods and services, it recommended that further evaluation be undertaken through future revisions to the City's Conservation and Efficiency Strategy to quantify additional co-benefits of local water conservation achievements in these respective areas. Currently "carbon footprinting" and "intrinsic water" researchers are in the early stages of developing robust models, and accurate benchmarking criteria, in these respective areas and it is hoped that the outcomes of these initiatives will work to quantify and realize additional future co-benefits of water conservation.

15.0 Conclusions

The City of Guelph has a history of environmental stewardship and leadership. This attitude and action can be observed in the area of water conservation. As one of the largest cities in Canada dependent solely on a groundwater source of water supply, Guelph has been providing water conservation and efficiency education for a number of years and more recently technical programming such as toilet and water efficient clothes washer rebates as well as Industrial, Commercial and Institutional audits and incentive programs.

In June, 1998, the City of Guelph initiated a Water Conservation and Efficiency Study (WC&E) to develop a comprehensive water conservation and efficiency plan for the City's residential, industrial, commercial and institutional sectors. The study established an integrated relationship between the environmental, technical, regulatory and social acceptance of numerous water efficiency alternatives and upon completion in 1999 the Water Conservation and Efficiency study identified the following set of recommendations:

- That City staff accept the Water Conservation & Efficiency Steering Committee's recommended Water Conservation & Efficiency Plan and prepare regular reports on the status of the City's water supply and wastewater treatment capacity.
- That Alternative Day Lawn Watering remain mandatory.
- That a permanent ban on lawn watering not be implemented, however, the ability to temporarily eliminate lawn watering in the event of an emergency be retained.
- That city Staff be directed to require individual metering, where feasible, in all new multi-residential housing.
- That the City continue to track and assess innovations in water conservation and efficiency technology and pursue changes in applicable legislation. Opportunities for inclusion of new or improved technologies should be evaluated on a regular basis.
- That a water rate study, in order to reassess peak period and conservation pricing, be completed by January 1, 2002.
- That the City of Guelph undertake a water audit of City facilities beginning in 1999, and commence installation of required water conservation and efficiency fixtures in order to lead by example.
- That the City continue to pursue opportunities to use the water bill as an educational tool.
- That staff be directed to review processes to regulate automatic lawn water sprinkler installation and maintenance.
- That staff be directed to encourage owners of private distribution system to minimize their unaccounted for water (UFW).
- That staff consider implementing an environmental management system, such as ISO 14000, for the Waterworks and Wastewater Services, and promote similar environmental management systems in the private sector.
- That the City continues its policy of charging full water and wastewater rates for all water used.
- That various funding methods be investigated for the financing of water conservation and efficiency methods.
- That the City establish an implementation committee to oversee the development of the Water Conservation & Efficiency Plan.

To meet future water supply requirements to service and sustain projected community growth, the City initiated the Guelph Water Supply Master Plan in 2004. Through the development of the Water Supply Master Plan, the employment of an enhanced water conservation and efficiency strategy, mitigation of distribution-based water loss, and education/policy/rate based reviews, were identified as the preferred short-term options to reclaim critical supply capacity in concert with optimization and rehabilitation of current supply based infrastructure. With a finite groundwater source, and uncertainty regarding the availability of further groundwater sources or impact of additional water taking from current sources, the finalized 2006 Water Supply Master Plan identified sustainable growth potential in the City contingent upon the success of aggressive water conservation and efficiency programs. As part of the 50 year Master Plan water conservation was recognized as a preferred short term source of water supply and recognized the following time based water reduction targets:

- 10% reduction in 2006 total average day water use by 2010
- 15% reduction in 2006 total average day water use by 2017
- 20% reduction in 2006 total average day water use by 2025

Upon Council's approval of the Water Supply Master Plan, full implementation of the 1999 Water Conservation and Efficiency Study was undertaken with enhanced annual financial support granted to the City's Water Conservation and Efficiency Program in support of pursuing the above targets in the time required to undertake an update to the City's Conservation and Efficiency Strategy.

In 2007, the City Council endorsed the Community Energy Plan which noted the per capita water and energy goal of *Using less energy and water per capita than any Comparable Canadian City.* Later that year, the goal was reiterated and identified through Goal 6 of the City of Guelph 2007 Strategic Plan, noted below:

Natural Environment - A leader in conservation and resource protection/enhancement:

Strategic Objective 6.5 – Use less energy and water per capita than any Comparable Canadian City.

With the emergence of regulatory and technology advancements since the completion of the City's original 1999 Conservation and Efficiency Study, City staff began development of the Water Conservation and Efficiency Strategy Update in February of 2008. For assistance in the development of the strategy, City staff retained project consultant Resource Management Strategies Inc. (RMSi) through a request for proposal process. Included in RMSi's extended consulting team was Leapfrog Energy Technologies, David Pearson Consultancy, Hetek Solutions and B+T Engineering.

The goal of the Water Conservation and Efficiency Strategy Update was to identify preferred program, policy and resource alternatives to best meet the water reduction goals identified in the Guelph Water Supply Master Plan, Community Energy Plan and Council Strategic Plan. In addition, the Water Conservation and Efficiency Strategy Update was to identify preferred program implementation forecasts, and program support staff and maintenance based resources required to meet and sustain the water reduction goals over the planning period.

With the importance of ongoing public consultation throughout the development of the Water Conservation and Efficiency Strategy Update, the formation of a Water Conservation and Efficiency Strategy Public Advisory Committee (PAC) was endorsed by Council. Following Council approval the PAC was formed to work with the staff and project consultant team. A total of 14 members were selected from a variety of stakeholders groups including:

- City Council (1)
- Industry (2)
- Home Builders/Development (1)
- Environmental Interest (3)
- Plumbing (1)
- Academia -University of Guelph (2)
- Grand River Conservation Authority (1)
- Public at Large (3)
- Chamber of Commerce (1)

The PAC met four times throughout the development of the strategy and provided new ideas, direction and initiatives for the consultant team to consider while providing feedback to key findings and progress provided.

To solicit feedback from further members of the public, a series of Public Information Centres (PICs) were held through the Strategy Update process. Through these events, residents and area stakeholders were introduced to the project scope and planned activities, and provided with results to date including: public consultation, market research, residential water use demand analysis, Industrial, Commercial and Institutional water use demand analysis, evaluation of distribution system water loss and water supply demand forecast. As part of each event, a round table discussion was held to obtain input towards the direction of the strategy and to solicit programming ideas.

As a first step to the study, focus groups were held to capture community input to the process through qualitative market research. The data captured does not provide statistically relevant information. However, information gained from the focus groups was used to develop context around water conservation and efficiency, understand issues and local concerns, and explore the appropriate means of communications to achieve success in project development and delivery. In total, three (3) focus groups were conducted on April 22nd, 2008 at a professional focus group facility in Guelph, moderated by a professional market researcher. Each group consisted of 5-7 participants, and lasted approximately 90 minutes. Participants in this research were randomly recruited residents of the City of Guelph.

Finally, a customer survey was completed to capture community input in a quantitative manner, providing statistically significant data that could be extrapolated to the entire community. To accomplish this, 400 randomly selected Guelph residents on municipal water supply were contacted by telephone between June 23rd and June 30th, 2008. Residents were asked a series of questions pertaining to water and water conservation in their community. Through this process, there was a series of scaled (i.e. choose 1- 10), and both open (i.e. how do you feel about…) and closed ended questions (i.e. yes or no).

Information gathered provided data on demographic information, general public knowledge, participation and satisfaction in water efficiency programs offered by the City of Guelph, water use behaviour indoors and outdoors, willingness and desired/required incentives for implementing water saving mechanisms.

The promotion of water conservation and efficiency is not new in the City of Guelph. Since the development of the Water Conservation and Efficiency Study (WC&ES) in 1999 the City has been actively completing a whole range of water efficiency measures including:

- Royal Flush Toilet Program, a rebate program introduced in 2003
- Smart Wash Clothes Washer Rebate Pilot Program, a rebate program launched February 2008
- Industrial, Commercial and Institutional (ICI) Water Capacity Buyback Program, introduced in 2007
- Outside Water Use Program, out water use restrictions introduced in 2001
- Landscape Assessment Pilot Program, launched in May, 2008
- City of Guelph Facility Water Efficiency Retrofits, a program to lead by example
- Public Education and Outreach including
    - Waterloo / Wellington Children's Water Festival
    - Guelph International Resource Centre (GIRC) Water Efficiency Workshop Series (2007/2008)
    - 2008 City of Guelph Water Conservation Breakfast Workshop
    - Green Impact Guelph (GIG) Partner
    - Annual Waterworks Open House
    - Guelph Water Conservation and Efficiency Awards
    - Participation in numerous Community Events and Festivals

These above activities have contributed to significant water savings since 2003 as indicated in the following Table 51.

Table 51: Water Efficiency Results since 2003

Water Conservation Savings by Year 2003 to 2008				
Year	Program	Savings (m3/day)	Savings (m3/yr)	Total Annual Savings (m3/yr)
2003	Royal Flush	80.0	29,200.0	29,200.0
2004	Royal Flush	80.0	29,200.0	29,200.0
2005	Royal Flush	80.0	29,200.0	29,200.0
2006	Royal Flush	80.0	29,200.0	29,200.0
2007	Royal Flush	81.9	29,893.5	
2007	ICI Capacity Buyback - U of G	312.0	113,880.0	143,773.5
2008	Royal Flush	189.1	69,021.5	
2008	ICI Capacity Buyback - Cargill	190.0	69,350.0	
2008	Smart Wash Program	30.0	10,950.0	149,321.5
Total Savings		**1,123.0**		**409,895.0**

In order to develop the strategy, significant investigation and analysis of previous plans and strategies, water system, infrastructure, capital plans, demand forecasts, population projections and housing trends. The key findings are as follows:

- Gross water demand (total billed water supplied divided by population) has declined 17% from 444 litres per capital per day (Lcpd) in 1999 to 370 Lcpd in 2007,
- The City's population increased 14.6% from 101,857 residents in 1999 to 116,766 in 2007;
- The Residential Single Family water demand (total billed residential single family water supply divided by single family population) of 230 Lcpd in 2007 is significantly lower that the Canadian national average of 335 Lcpd and lower than most Ontario communities;
- The Residential Multi Family water demand (total billed residential multi family water supply divided by multi family population) was 153 Lcpd in 2007;
- 5% or 133 Industrial, Commercial and Institutional customers consume 80% of the overall water demand in that sector;
- Based on 2007 data, the City of Guelph has a Infrastructure Leakage Index (ILI) of 2.94 placing it in the Performance Category B with the potential for some improvement;
- The City is currently saving 1,123 m3 per average day (or 409,895 m3/year) of water as a result of its water conservation and efficiency efforts since 2003. These average day savings would represent the equivalent water resources required for approximately 1,600 new homes. A breakdown of daily water savings achieved by the conservation program is provided in Table 1.

The research, technical analysis and public consultation completed as part of the Water Conservation and Efficiency Strategy Update has resulted in the following program recommendations.

Recommended Water Conservation and Efficiency Strategy Components

Single Family Detached Residential Indoor Measures

- Provide rebates to residents who replace inefficient 13L toilets and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to residents who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers.
- Provide rebates to residents who install a grey water reuse system.
- Provide rebates to residents who install a rain water harvesting system.
- Visit homes and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Single Family Detached Residential Summer Demand Measures

- Provide rebates to residents who purchase and install watering timers.
- Visit homes and educate residents on how to maintain their lawns and water less and how to convert their properties to water efficient landscapes.
- Provide rebates or subsidized pricing for residents who purchase a rain barrel or larger water storage unit.

Multi Family Residential Indoor Measures

- Provide rebates to building owners who purchase and install ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to building owners who purchase and install a water efficient clothes washer in their laundry rooms.
- Visit apartments and install free of charge low flow showerheads, low flow kitchen aerators and repair any water leaks while there.

Residential New Development Indoor Measures

- Provide rebates to builders who proactively purchase and install approved high efficiency toilets or dual flush toilets, low flow showerheads and low flow kitchen faucets at the time of new home construction.
- Provide rebates to builders who purchase and install water efficient clothes washers, water efficient central humidifiers and floor drain covers at the time of new home construction.
- Provide rebates to builders who install a grey water reuse system at the time of new home construction.
- Provide rebates to builders who install a rain water harvesting system at the time of new home construction.

  Note: New home owners would realize the benefit of ongoing water savings.

Residential New Development Summer Demand Measures

- Provide rebates to builders who install watering timers.
- Provide rebates to builders who install water efficient landscapes as part of new home construction.

Industrial/Commercial/Institutional Measures

- Provide rebates to facilities who replace inefficient 13L toilets with ultra low flow toilets, high efficiency toilets or dual flush toilets.
- Provide rebates to local businesses who purchase and install a water efficient clothes washer in their operations.
- Visit commercial kitchens and install free of charge low flow pre-rinse spray valves.
- Complete ten comprehensive water audits per year and offer a capacity buy-back rebate to any facility that implements all or some of the water saving recommendations.

Municipal Measures

- Design and implement five (5) district meter areas per year for three years. Locate, quantify and repair the leakage within the water distribution system.
- Complete Property Water Use Audits of existing municipal buildings and implement water efficiency retrofits and public demonstration projects. Identification and priority setting is currently ongoing. A City Building Water Efficiency Plan is anticipated for completion in late 2009 and will include appropriate water reduction targets.

Public Education

- Distribution of booklets, leaflets, and fact sheets at home shows and community and environmental events.
- Distribution of a water efficiency bulletin in the water bills.
- Displays at home shows, fairs and community events.
- Newspaper articles and advertisements.
- Develop and maintain a website to educate the public on water efficiency.
- Provide workshops and seminars to the public on water saving techniques both inside and outside the home.
- Provide water efficient demonstration gardens for the public to visit and learn.

Youth Education

- Develop and deliver a water efficiency education program based on the Ontario curriculum requirements.
- Continue annual participation in the Waterloo Wellington Children's Groundwater Festival.

Policy Based Recommendations (requiring Council approval)

- That the time based average day water reduction goals of the City's Water Supply Master Plan be formally endorsed as;

    - 10% reduction (5,300 m3/day) by 2010, based on 2006 average day water use;
    - 15% reduction (7,950 m3/day) by 2017, based on 2006 average day water use, and;
    - 20% reduction (10,600 m3/day) by 2025, based on 2006 average day water use;

- That the City adopt a water reduction philosophy of maintaining average day water production below the 2006 value (53,000 m3/day) for a 5 year period (2014).
- That the City of Guelph continue operation of the City's Outside Water Use Program in efforts to reduce impacts of Peak Seasonal Demands.
- That the City form a long standing Water Conservation and Efficiency Advisory Committee for purpose of ongoing public consultation throughout the implementation of the 2009 Water Conservation and Efficiency Strategy Update with an appropriate mandate and charter to be developed for the Committee..
- That the City in partnership with the Region of Waterloo continue performance testing research of home water softener technologies and promote through a public educational program technology performance results and related environmental benefits of preferred technologies.
- That the City's Wastewater Effluent Re-use dedicated pipe project, commonly referred to as the "Purple Pipe" project, and Class Environmental Assessment, as approved by Council through the 2008 Guelph Water/Wastewater Master Servicing Plan, evaluate the further potential for a communal wastewater effluent reuse system and design practices for customer serving of the effluent reuse source.
- That the City undertake a feasibility study to evaluate the best practices for multi-unit residential water metering and private servicing condition assessment requirements for current bulk metered multi-unit residential customers.
- That the City's Strategic Urban Forest Management Plan and the Natural Heritage Strategy define the appropriate means for protection and preservation of the City's urban forest in recognition of water conservation and storm water management benefits provided by the urban canopy.

- That staff undertake the immediate development of an enhanced public education water conservation program in 2009 subject to the availability of program funding.
- That staff initiate water loss mitigation activities in 2009 as outlined in the City's Water Loss Mitigation Strategy and investigate the potential for improved water pressure management in distribution system.
- That the City's Waterworks Department undertake a pilot study as part of the City's 2009 Water Loss Mitigation Strategy to evaluate the local implementation of Automated Metering Infrastructure (AMI) for customer water metering.
- That the City's Water/Wastewater Rate Review define customer billing policies for properties possessing Rain Water Harvesting Systems.
- That staff pursue external funding sources, and key partnerships, throughout implementation of the Water Conservation and Efficiency Strategy Update program recommendations.
- That Guelph's Water Conservation and Efficiency Programs be extended to customers located outside the Guelph Municipal boundary whom are individually metered by the City.

The capital budget necessary to implement the ten year strategy is shown in the following Table 52.

Table 52: Ten Year Capital Budget

Ten Year Capital Plan	Total Cost	Total Accumlative Savings (Ml/day)	Cost per Litre
Single Family Detached Residential - Indoor Demand Measures	$ 7,579,870	3,448,980	$ 2.20
Single Family Detached Residential - Summer Demand Measures	$ 2,385,000	996,500	$ 2.39
Multi Family Residential	$ 1,413,316	589,770	$ 2.40
New Development Residential - Indoor Demand Measures	$ 2,272,500	583,650	$ 3.89
New Development Residential - Summer Demand Measures	$ 1,026,000	294,000	$ 3.49
Industrial/Commerical/Institutional	$ 1,987,900	1,135,700	$ 1.75
Distribution Leakage Reduction	$ 238,500	1,725,000	$ 0.14
Public Education	$ 1,420,000		
Youth Education	$ 1,030,000		
Other Municipal Initiatives	$ 940,000		
Total	$ 20,293,086	8,773,600	$ 2.31

Funding Allocation	Total
Approved DC Forecast	$ 2,759,958
Current Water Conservation Funding (Rate Base)	$ 5,835,115
Additional Funding (Rate Base)	$ 11,698,013
Total	$ 20,293,086

The $11,698,013 of additional required funding represents a 4.3% water rate increase in 2010.

The cost-effectiveness of a water efficiency strategy is evaluated by determining the cost per litre for the water saved. The cost per litre for water saved is then compared to the cost per litre to construct new water supply and wastewater infrastructure. If the cost per litre of saved water is less than the cost to construct new capacity, then the water efficiency strategy is deemed cost effective. It is important to note that the calculated cost relating to construction of an additional litre of water and wastewater capacity does not include the cost of debt financing of construction projects. It is also important to note, that this figure does not include the cost of additional infrastructure required for the distribution and conveyance of water and wastewater to and from newly serviced areas such as water/wastewater mains, pumping stations or system reservoirs.

In southern Ontario, the combined water and wastewater construction cost per litre of additional supply/treatment capacity ranges from approximately $2.00 to $8.10. For the purpose of this study, a combined water and wastewater construction cost of $4.00 per litre of additional average day capacity was utilized for the financial analysis of the various conservation measures. Overall, the suite of preferred conservation measures identified in the final Conservation and Efficiency Strategy Update recommendation equalled a total program cost of $2.31 per litre of additional average day capacity (as noted in Table 2 above). Based on this analysis, the total cost per litre for the conservation program is 42% more cost effective than the cost of constructing new water and wastewater capacity.

Water savings generated from the efficiency strategy should be viewed in the same manner as constructing a new water treatment facility. If the City were to design and build a new facility to deliver 8.7 Ml/d, a budget for a maintenance program would be included to ensure that the facility continues to deliver 8.7 Ml d in the future. Water saved from a water efficiency strategy should be viewed similarly.

The strategy has been developed to save a specific amount of water and maintenance will continue to sustain the savings into the foreseeable future. The recommended maintenance budget is included in Table 53.

Table 53: Ten Year Maintenance Budget

Ten Year Maintenance Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Detached Residential - Indoor	$ 16,213	$ 16,426	$ 17,277	$ 17,916	$ 18,554	$ 19,193
Single Family Detached Residential - Summer Demand	$ -	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Multi Family Residential	$ 16,112	$ 16,223	$ 16,670	$ 17,005	$ 17,340	$ 17,674
Industrial/Commercial/Institutional	$ 12,061	$ 12,122	$ 22,867	$ 23,051	$ 28,104	$ 31,881
Distribution Leakage Reduction				$ 47,700	$ 47,700	$ 47,700
Total	$ 44,386	$ 62,771	$ 74,814	$ 123,671	$ 129,698	$ 134,448

Ten Year Maintenance Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	
Single Family Detached Residential - Indoor	$ 19,831	$ 20,470	$ 21,108	$ 21,747	$ 188,733
Single Family Detached Residential - Summer Demand	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 162,000
Multi Family Residential	$ 18,009	$ 18,344	$ 18,679	$ 19,014	$ 175,070
Industrial/Commercial/Institutional	$ 31,907	$ 31,933	$ 31,959	$ 73,985	$ 299,870
Distribution Leakage Reduction	$ 47,700	$ 47,700	$ 47,700	$ 47,700	$ 333,900
Total	$ 135,447	$ 136,447	$ 137,446	$ 180,446	$ 1,159,573

It is important to have a monitoring and evaluation program to ensure that the water savings are achieved initially, and that those savings are sustained over time.

Table 54 below provides the monitoring and evaluation by year for the ten year strategy.

Table 54: Ten Year Monitoring and Evaluation Budget

Ten Year Monitoring and Evaluation Plan	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Costs	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor	$ 345,000				$ 180,000	
Single Family Residential - Summer Demand	$ 45,000	$ 24,000	$ 24,000	$ 24,000	$ 98,460	
Multi Family Residential	$ 315,000				$ 120,000	
Industrial, Commercial and Institutional	$ 297,000				$ 37,700	
Total	$ 1,002,000	$ 24,000	$ 24,000	$ 24,000	$ 436,160	$ -

Ten Year Monitoring and Evaluation Plan	Year 7	Year 8	Year 9	Year 10	Total
	Costs	Costs	Costs	Costs	Costs
Single Family Residential - Indoor				$ 180,000	$ 705,000
Single Family Residential - Summer Demand				$ 98,460	$ 313,920
Multi Family Residential				$ 120,000	$ 555,000
Industrial, Commercial and Institutional				$ 37,700	$ 372,400
Total	$ -	$ -	$ -	$ 436,160	$ 1,946,320

The reduction of water-use through an efficiency program and the associated energy savings provides significant greenhouse gas reductions. With climate-change in mind, most municipalities have set their own greenhouse gas reduction targets.

Water efficiency can be a positive contributor to meeting those targets. The full implementation of the Water Conservation and Efficiency Strategy Update recommendations provides energy savings and greenhouse gas emissions reduction as indicated in Table 55 below.

Table 55: Estimated Energy Savings and Associated Greenhouse Gas Emission Reductions

	Water Savings per Year (m3/year)	Energy Savings per Year	CO2 Reductions per Year (tonnes/yr)
Overall Water Savings	3,202,364	2,348,934 KWh Electricity	728 tonnes
Low Flow Showerheads and Faucets	Included in above	684,216 m3 Natural Gas	1,294 tonnes
Pre-Rinse Spray Valves	Included in above	206,325 m3 Natural Gas	390 tonnes
Overall CO2 Reductions			2,412 tonnes

Electric savings 2,348,934 KWh for the City of Guelph represents a savings of $140,936 on its electric bill per year

The reduction of 2,412 tonnes in CO2 represents the equivalent of 438 cars removed from the road each year

The final 2006 Water Supply Master Plan identified sustainable growth potential in the City contingent upon the success of aggressive water conservation and efficiency programs and identified the following overall targets in support of growth:

- 10% reduction (5,300 m3/day) by 2010, based on 2006 average day water use;
- 15% reduction (7,950 m3/day) by 2017, based on 2006 average day water use, and;
- 20% reduction (10,600 m3/day) by 2025, based on 2006 average day water use.

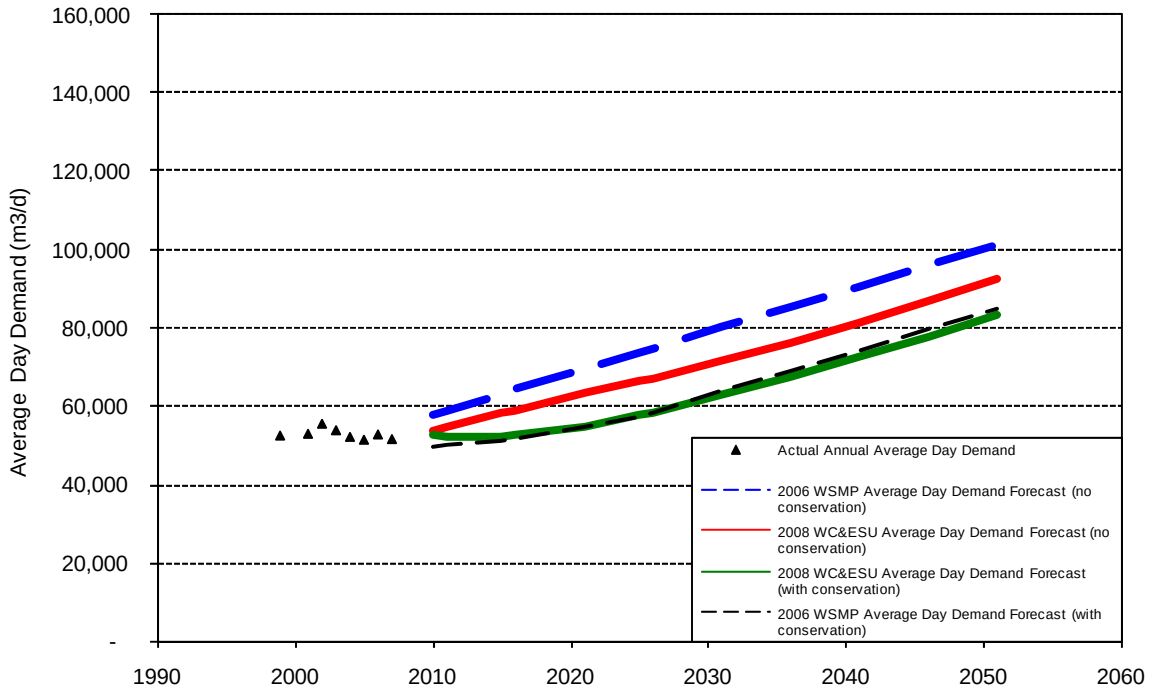
Total Potential Water Savings:

The analysis determined that the total potential for water efficiency is 13,661 m3/average day of water savings. However, meeting this total water efficiency potential assumes 100% participation rate in all conservation programs and would require extensive program funding. This analysis also assumes an overall decrease in residential single family demand from the current 230 Lcpd to 153 Lcpd, which may not be feasible for all vintages of homes in the City.

Total Achievable Water Savings:

Since the 2006 WSMP, the City has achieved 883 m3 per average day in water savings. The recommended ten year strategy in this report indicates an achievable water savings of an additional 8,774 m3 per average day by 2019. The combined savings represents a total of 9,657 m3 per average day water savings, which means that 90% of the 2025 water reduction goal (i.e. 10,600 m3/day) can be achieved by 2019. Not included in this estimate is the additional savings attributed to public and youth education. All would agree that education contributes to water conservation and efficiency but as discussed in the report, the exact savings are not possible to estimate or quantify. The above achievable water savings are predicated on adequate program funding throughout the 25-year timeline.

Figure 37: City of Guelph Average Day Demand Projections



The recommended ten year strategy has been developed to take full advantage of the available market potential. Not all, but most of the inefficient toilets, clothes washers, showers and faucets will have been replaced by the end of the ten year period. Additional savings will be more difficult to generate with traditional water saving technologies and more emphasis will be placed on emerging technologies such as grey water reuse and rain water harvesting.

A summary of water efficiency programs being implemented by municipalities in Ontario can be found in Appendix A. City of Guelph's water conservation and efficiency strategy was developed with these neighbouring municipalities programs in mind, aligning the programming to leveraged known successes.

In addition to the recommended programs, it is anticipated that the City will pursue partnering with other municipalities and government agencies in the pursuit of research and development of new and emerging water efficiency technologies and practices.

Advancements to regulations, codes and standards could go a long way in ensuring water efficient housing and businesses in the future. Currently, the Ontario Building Code requires water efficient fixtures in all new construction; however the retrofit market can still install inefficient toilets. Associations such as the Ontario Water Works Association and the Canadian Water and Wastewater Association, in conjunction with Canadian municipalities are lobbying for the adoption of a regulation that would ban inefficient toilets from all applications. This would assist the municipalities in their pursuit of water efficiency and could reduce or eliminate the need for rebates.

As noted above, water efficiency generates a number of co-benefits including energy savings and reductions in greenhouse gas emissions. Electric and natural gas utilities, with the encouragement of regulators and governments, have been enthusiastic in their promotion of energy efficiency. These agencies are ideal partners for water efficiency programs. By pursuing these types of partnerships the cost of programs can be shared as well as the benefits.

The implementation of this strategy by the City of Guelph will ensure financially and environmentally sustainable water resources for today and future generations.

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