



Technical Memo 1 - Situational Analysis
The Blueprint: Guelph's One Water Plan
City of Guelph

Prepared for: **City of Guelph**

Prepared by: **Montrose Environmental Solutions Canada Inc.**

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Table of Contents

1	Introduction.....	1
1.1	Water Resources in the City of Guelph.....	1
1.2	Integrated Water Management Strategy	1
1.3	Study Goals and Scope.....	2
1.4	History of Water Conservation, Efficiency and Operational Optimization	3
2	Modelled Water Balance for the City and Surrounding Watershed	4
3	Population, Growth, and Projections	7
3.1	Population Distribution and Projections.....	7
3.1.1	Water Supply Master Plan Assumptions	8
3.1.2	Official Plan Assumptions	8
3.1.3	Population Growth Scenario	9
4	Water Supply and Distribution System	9
4.1	Water Distribution System Infrastructure.....	12
4.2	City of Guelph Water Use.....	13
4.2.1	Water Balance Methodology	14
4.2.2	Infrastructure Leakage	16
4.2.3	Residential Water Demand	18
4.2.4	Industrial, Commercial, Institutional (ICI) Water Demand	23
4.2.5	Commercial	26
4.2.6	Institutional	29
4.3	Drinking Water Source Protection	30
4.4	Water Supply Master Plan.....	31
4.4.1	Water Supply Master Plan Demand Projections.....	32
4.4.2	Water Demand Projections	33
4.4.3	WSMP Water Conservation and Efficiency Alternative (Scenario 5)	34
4.5	Water Conservation and Efficiency Initiatives	34
4.5.1	Water Efficiency Strategy (2016).....	34
4.5.2	Current WC&E Strategy – Active Initiatives	36
4.5.3	Direct Water Savings Programs	39
4.5.4	Indirect Water Savings Programs	43
4.5.5	2016 WES – Recommendations Not Implemented.....	45
4.5.6	WC&E Strategy -Studies and Research Programs	46
4.5.7	Other Water-Related City Rebate Programs	48
4.5.8	A Salt-free Alternative to Residential Water Softeners: Market Research Study	49
4.5.9	Cooling Technologies Project Summary.....	49
4.5.10	Conservation-Oriented Pricing Analysis for City of Guelph	50
4.5.11	Evaluation of Conservation Rate Structures	50
5	Wastewater	51
5.1	Existing Wastewater Treatment Process	51

5.2	Wastewater Flows	52
5.3	Review of Historical Wastewater Studies	52
5.3.1	Area 1 Downtown Inflow and Infiltration Study	53
5.3.2	Assimilative Capacity Study for the Speed River Downstream of the Guelph WRRC	53
5.3.3	Sanitary Flow Monitoring	53
5.3.4	Inflow and Infiltration (I&I) Reports	54
5.3.5	Water and Wastewater Education Program	54
5.3.6	Sewer Abatement Credit Policy.....	55
5.3.7	Wastewater Conclusion.....	55
6	Stormwater.....	56
6.1	Existing Stormwater System.....	56
6.2	Stormwater Programs	58
6.3	Summary of Stormwater Master Plan.....	59
6.3.1	Infiltration Policy Recommendations	63
6.3.2	LID Implementation Strategy	64
6.3.3	Innovation Strategy	64
7	Other Studies.....	65
7.1	Natural Heritage Action Plan.....	65
7.2	City of Guelph Natural Assets Inventory, Condition, Risk and Service Attribution (Green Analytics 2022).....	66
7.3	Water and Wastewater Servicing Master Plan.....	66
7.4	Aquifers as Natural Assets	66
7.5	Climate Adaptation Plan.....	67
7.6	York Trunk Sewer and Paisley-Clythe Feedermain Municipal Class Environmental Assessment ..	67
7.7	Clair-Maltby Master Servicing Plan	68
7.8	Water Reclamation Feasibility Study Report (B&V 2020)	69
7.9	Water Reuse and Demand Substitution Technologies Report (2015)	70
8	Gap Analysis, Opportunities	71
8.1	Gaps Analysis: Guelph's Water Conservation & Efficiency (WC&E) Initiatives in Adopting a One Water Approach	71
8.2	Wastewater Program Gaps in Adopting a One Water Approach.....	72
8.3	Stormwater Program Gaps in Adopting a One Water Approach	72
9	Conclusion	72
10	References.....	73

In-Text Tables

Table 1	Project Work Plan	2
Table 2	History of Water Conservation	3
Table 3	City of Guelph Historical Served Population and Employment Population	8
Table 4	Water Supply Sources and Capacity	10
Table 5	Summary of Guelph’s Drinking Water System	13
Table 6	Water Use Consumption By Municipal Property Assessment Corporation (MPAC) Property Category (2023)	13
Table 7	Trend in Annual Residential Water Use.....	19
Table 8	2023 Water Consumption for Industrial Property Types.....	26
Table 9	2023 Water Consumption for Commercial Property Types.....	28
Table 10	2023 Water Consumption for Institutional Property Types	30
Table 11	Vulnerable Areas Mapped Out with the City of Guelph.....	31
Table 12	Projected Average Annual Day Water Demand – “Reference” Growth Scenario, m ³ /day	33
Table 13	Total Projected Average Annual Day and Maximum Day Water Demands – Reference Growth Scenario	33
Table 14	Water Conservation and Efficiency Scenarios (WSMP).....	34
Table 15	Summary of Active and Yet to Be Enacted Water Efficiency Programs in the City (WES, 2016)	35
Table 16	Water Efficiency Strategy Program Progress (WES, 2023)	37
Table 17	Water Efficiency Program Descriptions (WES, 2023)	38
Table 18	City of Guelph Blue Built Home Options (City Website, 2025)	40
Table 19	Summary of City of Guelph Outdoor Water Use Program	43
Table 20	City of Guelph Wastewater Flow Data 2024 (Annual Report, 2024)	52
Table 21	City Subwatersheds.....	57
Table 22	Stormwater Programs.....	59
Table 23	Estimated Reclaimed Water Demand for Sewer Flushing.....	69
Table 24	Reclaimed Water Alternatives for Sewer Flushing - High-Level Capital Cost Estimates	70

In-Text Figures

Figure 1	Water Balance and City of Guelph Water Supply	5
Figure 2	City of Guelph Drinking Water Servicing System	12
Figure 3	Water Consumption and Loss Categories, City of Guelph (AWWA Water Balance Methodology) 14	
Figure 4	Total Water Supplied Compared to Revenue and Non-Revenue Water (City of Guelph Water Balance, 2024)	15
Figure 5	NRW Water Trend (City of Guelph, 2012-2022)	16
Figure 6	Infrastructure Leakage Index (ILI) (City of Guelph, 2008-2022).....	17
Figure 7	Annual Residential Water Use	18
Figure 8	Trends in Annual Residential Water Use (City of Guelph, 2006-2023).....	20
Figure 9	Histogram of Low-density Residential Water Consumption (City of Guelph, 2023)	21
Figure 10	Histogram of Medium-density Residential Water Consumption (City of Guelph, 2023)	22
Figure 11	Histogram of High-density Residential Water Consumption (>2,000 m ³ /day)	23
Figure 12	Annual ICI Water Use.....	23
Figure 13	Annual Water Demand (City of Guelph, 2006-2023).....	24
Figure 14	Histogram of Annual Water Consumption for Industrial Sector (2023)	25
Figure 15	Histogram of Annual Water Consumption for Commercial Sector (2023)	27
Figure 16	Histogram of Water Consumption for Institutional Customers (>5,000 m ³ /year)	29
Figure 17	Stormwater Management System and Subwatersheds.....	57
Figure 18	Existing Conditions Subwatershed Health Scores (SWM MP, 2023).....	60
Figure 19	Subwatersheds Priority Rating Graphic	61
Figure 20	Summary of Recommended Projects Across the City.....	62

Technical Memo #1 – Situational Analysis

1 Introduction

The City of Guelph (City) retained Montrose Environmental Solutions Canada Inc. (Montrose; formerly Matrix Solutions Inc.), to update the Water Efficiency Strategy (WES) with an integrated water management approach. The updated strategy is named The Blueprint: Guelph's One Water Plan. This Technical Memorandum serves as a background review and situational analysis for the City, providing an overview of the City's water management history, current practices, and future goals.

1.1 Water Resources in the City of Guelph

The City is known for its commitment to sustainable water management. The City operates three water-based municipal services: water, wastewater, and stormwater. These utilities are key components of the City's infrastructure, ensuring clean water supply, effective wastewater treatment, and proper stormwater management. They play a vital role in supporting residents and businesses while protecting and enhancing the environment. In developing The Blueprint: Guelph's One Water Plan, various studies and projects related to water management were reviewed and are referenced in this Technical Memorandum.

1.2 Integrated Water Management Strategy

The Blueprint: Guelph's One Water Plan follows the One Water approach, which refers to an integrated planning and implementation strategy that considers the urban water cycle as a single, interconnected system. Rather than treating drinking water supply, groundwater, stormwater, and wastewater as separate entities, it aims to balance the needs of humans and the environment by managing water resources in a sustainable, equal, and efficient manner.

One Water acknowledges the interactions between:

- the natural water cycle including precipitation, runoff, evapotranspiration, streamflow, and groundwater recharge;
- human impacts to the hydrologic cycle including water supply, wastewater discharge, and urban runoff;
- natural features including wetlands and watercourses, and
- built infrastructure (sewers, watermains, bridges, stormwater ponds)

The One Water philosophy emphasizes the importance of reducing the need for new infrastructure construction and longevity of current infrastructure by optimizing the use of existing systems. This approach also places an emphasis on water conservation and the implementation of water reuse strategies, which create opportunities to, among others, consider the use of treated wastewater and stormwater. These practices not only identify cost-effective solutions but also reduce the dependence on existing water sources, while minimizing the impacts on the natural environment.

The City has embraced water conservation and efficiency, as reflected in its Official Plan (2022a) and 2024-2027 Strategic Plan (2024a). As outlined in the City’s Strategic Plan objective 10.3, the City will aim to conserve and protect Guelph’s drinking water. A key part of this objective is the development of an integrated water management strategy, designed to meet the water demand reduction goals outlined in the City’s Water Supply Master Plan (AECOM 2022).

The Official Plan outlines a vision for Guelph by 2051, at which point the City is projected to house approximately 208,000 residents and provide 116,000 jobs. The City plans to accommodate this population growth within its current urban boundaries, while ensuring the sustainability of its water supply and wastewater treatment systems. The Blueprint: Guelph’s One Water Plan will support the City’s efforts to manage its water resources in an effective and sustainable manner, aligning with the principles of integrated water management.

1.3 Study Goals and Scope

The goal of this study is to:

- review the City’s current water management strategies,
- identify areas for improvement, and
- propose solutions that align with the principles of Integrated Water Management

A summary of the full project work plan scope is summarized in Table 1.

Table 1 Project Work Plan

Task	Work Plan
Task 1: Situational Analysis	Assess the City’s current water resources, management strategies, and related plans, considering both qualitative and quantitative aspects. Identify and understand the interconnections between water, wastewater, and stormwater services, and pinpoint common initiatives or projects that influence these disciplines.
Task 2: Review of Initiatives	Review integrated water management programming, initiatives, and best management practices (BMPs) at a local, regional, provincial, national, and international scale.
Task 3: Strategic Direction	Outline the vision, goals, objectives, target water demand reductions, actions (short-, medium-, and long-term), and key performance indicators (KPIs) for the recommended actions. Align the planning initiatives across all the water-related departments/divisions within the City.
Task 4: Implementation Plan	Develop an implementation plan including a 10-year budgetary plan, monitoring and evaluation framework, and business case for each action.
Task 5: Stakeholder Engagement	Conduct staff workshops, external stakeholder workshops, and public engagement activities throughout Tasks 1 through 6.
Task 6: Final Report	Prepare the Final Report.

1.4 History of Water Conservation, Efficiency and Operational Optimization

Since 1998, the City has been actively pursuing community water efficiency and conservation programming and continues to be a Canadian leader in this field. The City is one of the largest in Canada dependent primarily on a groundwater source of water supply and has a long-standing commitment to environmental stewardship, particularly in the area of water conservation and efficiency. As presented in Table 2, this commitment has been demonstrated through various initiatives implemented over the years.

Table 2 History of Water Conservation

Year	Water Conservation Initiatives and Progress
1998	The City launched a Water Conservation and Efficiency Study (WCES) to create a comprehensive plan for water conservation and efficiency for the City’s residential, industrial, commercial, and institutional sectors.
2001	Guelph first enacts an Outdoor Water Use Bylaw which restricts some non-essential water uses during times of water stress. This was Guelph’s first foray into the management of water use during times of peak usage.
2007	The City developed a Water Supply Master Plan (WSMP) to ensure that an adequate water supply would be available to support future growth in the City. The City continued to adapt its strategies in response to regulatory and technological advancements.
2008	An update to the Water Conservation and Efficiency Strategy (WCES) was initiated to define preferred programs for achieving the water reduction goals outlined in the 2007 Water Supply Master Plan. The success of these programs has led to daily reductions in water demand, ensuring more water is available for future use. The water savings from the programs have exceeded the targets that were established in the 2007 Water Supply Master Plan.
2016	The City updated its Water Efficiency Strategy (WES), focusing on identifying preferred water conservation and efficiency program alternatives for implementation over a 10-year planning horizon. The water savings from the programs, pilots and incentives exceeded the target of 176 litres per capita per day (Lcd) which deferred an estimated cost of over \$82,510,00 for the construction of a local surface water intake at Guelph Lake.
2022	The 2022 Water Supply Master Plan (WSMP) provided several recommendations for water conservation, efficiency, optimization and demand management. Potential targets were assessed through four scenarios, described further in Section 4.2.1.1, each considering potential reductions associated with various combinations of alternatives. The aim was to set a reasonable and publicly supported reduction target. It was a fifth scenario that was developed and selected through analysis of the previous scenarios that led to a water efficiency and optimization target of 3, 683 m ³ /day. The details of the reduction scenario, including the preferred initiatives to reach proposed targets, will be further developed in the upcoming stages of the Integrated Water Management project. Although the update to the Water Efficiency Strategy was initially planned for 2021, the rescheduled update in 2024 broadens the ambit to encompass both water efficiency and integrated water management.

Guelph's efforts have not only protected its water supply but also fostered community participation in water conservation programs. As shown in Figure 1, a significant decline in residential water usage, especially between 2007 and 2012, highlights the success of these initiatives. The effectiveness of the water conservation and efficiency programs has played a key role in reducing water demand, which is the first step toward source protection and ensuring a sustainable water supply now and in the future.

2 Modelled Water Balance for the City and Surrounding Watershed

An understanding of the water balance within the City of Guelph is critical to inform water management strategies. Figure 1 illustrates the various elements of both the natural water balance and that imposed by the City relating to stormwater management, water supply, and wastewater collection and discharge back into the Speed River.

An understanding of the water balance within the Speed River watershed that the City of Guelph is a part of is critical to inform water management strategies. This analysis, conducted through a modelling exercise using historical rainfall and a MIKE SHE model developed for the City of Guelph (Montrose Environmental, in progress). This model has been developed as part of the City's current program to update its Tier Three Groundwater Flow Model (Matrix 2017). The Tier Three Groundwater Flow Model was originally developed by the City to meet its requirements under the Province of Ontario's Drinking Water Source Protection Program and has been applied by the City for the 2022 Water Supply Master Program update and various water supply and subwatershed studies.

The water balance is meant to be an illustrative example of the water cycle in the Guelph area, showing where water flows and how it's interconnected. Figure 1 illustrates the various elements of both the natural water balance and those imposed by the City, relating to stormwater management, water supply, and wastewater collection and discharge back into the Speed River. The diagram helps visualize how water moves through the entire watershed and the municipal system—drinking water, wastewater, and stormwater. At this moment a One Water approach is not being utilized in the City of Guelph, and we can see underutilized opportunities for reuse, and where improvements can be made to optimize water management. By providing a clear, integrated view of water flows, the diagram supports the "One Water" approach and helps communicate key insights to stakeholders.

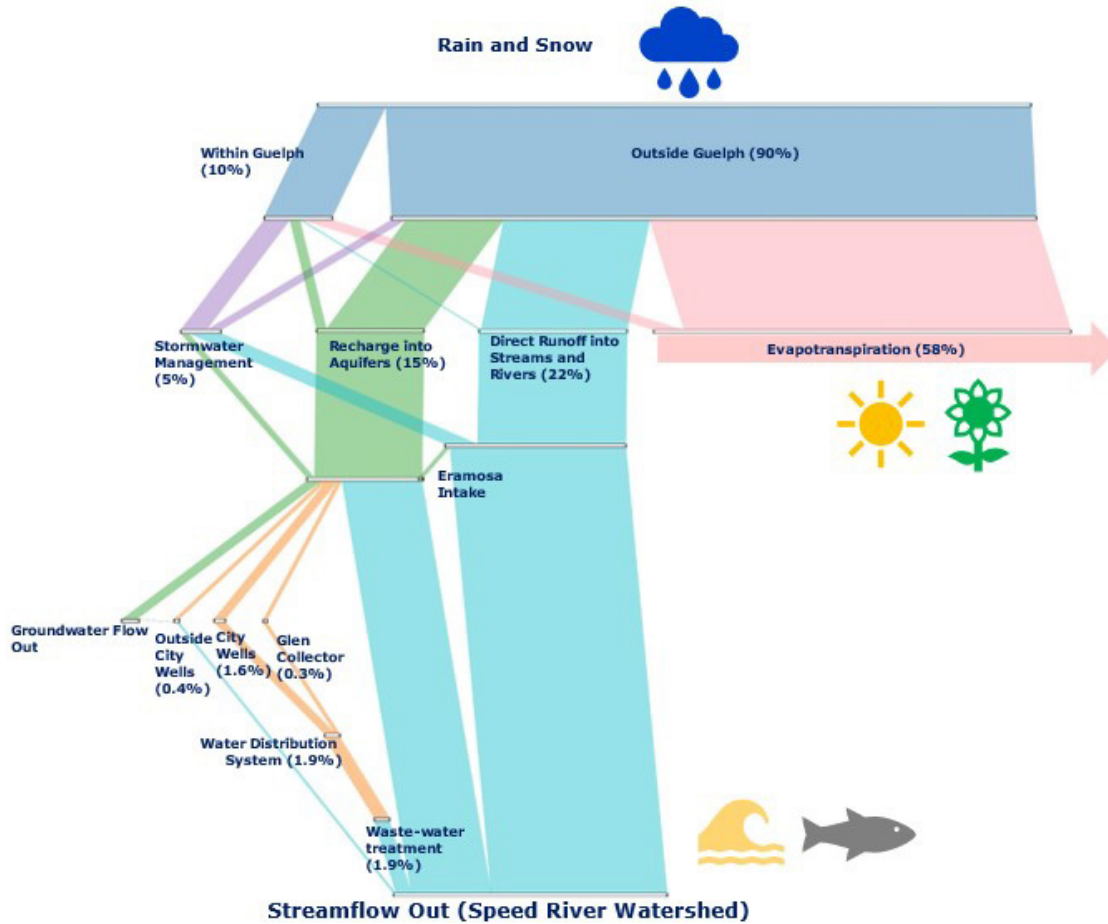


Figure 1 Water Balance and City of Guelph Water Supply

A breakdown of the key components and flows depicted in Figure 1 is provided below:

- **Rain and Snow:** This is the total inflow from precipitation and equates to approximately the volume of 1,000 Olympic sized swimming pools each day. Approximately 10% falling within Guelph's boundaries and 90% outside the city within the watershed area.
- **Evapotranspiration (58%):** A significant portion of the precipitation (58%) is lost to evapotranspiration, the process by which water evaporates from the watershed and is transpired by plants.
- **Recharge into Aquifers (15%):** About 15% of the total precipitation infiltrates the ground from within and outside of the City boundaries and recharges local aquifers, providing a sustainable source of groundwater for the area.
- **Direct Runoff into Streams and Rivers (22%):** This portion of precipitation flows directly into streams and rivers, contributing to the surface water within the watershed.
- **Capture by Stormwater Management (5%):** A small fraction (5%) of the water is captured by the stormwater management systems within the City to control runoff and mitigate flooding.

- **Groundwater Flow Out:** A small proportion of groundwater exits the watershed through subsurface flow, though the exact percentages are not certain.
- **City Wells and Water Distribution:**
 - City of Guelph Wells (1.6%). Average daily pumping from the City's wells represents approximately 1.6% of the precipitation on the watershed.
 - Glen Collector (0.3%): The City pumps water from a system called the Glen Collector as part of its water supply.
 - Water Distribution System (1.9%): This is the percentage of water that is distributed to the City through its water distribution system.
 - Other Wells (0.4%): A small amount of water is drawn by land owners and small communities located outside Guelph.
- **Wastewater Treatment (1.9%):** After use, water is treated in wastewater facilities and then discharged to the Speed River.
- **Streamflow Out:** A large proportion of groundwater discharges back into the Speed River watershed to combine with surface water and flows out of the watershed into the Grand River.

Understanding this water balance is critical for the City because it directly informs sustainable water management strategies, which are essential for several reasons:

- **Limited Local Water Supply:** As noted, Guelph relies primarily on groundwater for its municipal water supply, rather than surface water sources like lakes or rivers. The City's reliance on aquifer recharge makes it essential to understand how much precipitation contributes to groundwater, as well as how much is lost to evapotranspiration and runoff.
- **Vulnerability to Climate Change:** Changes in precipitation patterns and temperature can affect evapotranspiration rates, aquifer recharge, and the availability of water. For example, hotter temperatures might increase evapotranspiration resulting in less water being available for surface water or groundwater. Although previous investigations suggest that groundwater recharge will increase under future climate change scenarios, stresses on surface water systems and natural resources will occur. Understanding the balance can help Guelph prepare for and adapt to climate changes that could impact water availability and sustainability.
- **Population Growth and Urban Development:** As Guelph grows, increased water demand puts more pressure on local natural resources. An accurate water balance helps the City evaluate how much water is needed to support natural systems, what infrastructure is required, and where conservation efforts should focus. It also aids in managing stormwater effectively, reducing potential for flooding or contamination of water supplies.
- **Protection of Aquifers and Ecosystems:** Since groundwater recharge is essential for both water supply and maintaining stream flow, understanding the water balance helps the City avoid over-extraction from

aquifers. This protects both drinking water supplies and the ecological health of rivers and streams that depend on steady groundwater inputs.

- **Regulatory Compliance and Resource Management:** Guelph must adhere to existing water management regulations, and an accurate water balance is key to demonstrating responsible stewardship of water resources. By understanding the flow of water through the watershed, the city can develop informed policies to meet regulatory requirements while ensuring a sustainable water supply.
- **Cost-Effective Infrastructure Planning:** Knowing how much water flows through different parts of the system (like stormwater management, groundwater recharge, and wastewater treatment) helps the City optimize infrastructure investments. This minimizes costs and ensures efficient water distribution and treatment processes.

In summary, the water balance provides a comprehensive picture of how water moves through Guelph's environment and infrastructure. This knowledge is foundational to ensuring the City's long-term water security, ecological health, and resilience in the face of growing demand and environmental change.

3 Population, Growth, and Projections

The City of Guelph's population projections are a key part of its long-term planning strategy, currently shaped by provincial housing mandates. These projections are reflected in Official Plan Amendment (OPA) 80. The purpose of OPA 80 is to revise the Official Plan's vision, population and employment figures, density and intensification targets, as part of the City's municipal comprehensive review, ensuring conformity with the provincial plan: A Place to Grow: The Growth Plan for the Greater Golden Horseshoe. It also updates the Official Plan to reflect recent amendments to the Planning Act, Clean Water Act, and the Provincial Policy Statement (2020). Population projections to 2051, based on the Places to Grow Act, have been used for the City's Master Plans.

As the population grows, there will be increased demands on the City's water supply, potential impacts on water quality, and greater volumes of stormwater runoff and wastewater output, all of which require careful management to ensure the sustainability of Guelph's water resources and infrastructure.

3.1 Population Distribution and Projections

Guelph is home to a residential population of 153,400 (2023 Planning Services, City of Guelph), which is projected to reach 208,000 by the year 2051 (City of Guelph 2022a). This population is dispersed over a total urban area of 87.2 km².

Table 3 shows the historical residential and employment populations in the City from 2010 to 2023. The residential population includes households connected to the municipal water system.

Table 3 City of Guelph Historical Served Population and Employment Population

Year	Population	Employment
2010	125,332	74,200
2011	127,305	75,000
2012	128,599	76,000
2013	130,669	77,000
2014	133,231	78,000
2015	134,654	79,000
2016	136,325	79,600
2017	138,375	80,500
2018	140,015	81,150
2019	144,300	82,250
2020	147,100	76,800
2021	149,900	84,850
2022	151,300	85,200
2023	153,400	86,400

3.1.1 Water Supply Master Plan Assumptions

In the process of updating the Water Supply Master Plan (WSMP, 2022), two potential scenarios for future population and employment growth in the City were considered. The Water Supply Master Plan’s assumptions are based on the population growth rates outlined in the “Long-term Population and Housing Growth Shaping Guelph: Growth Management Strategy (2022).” The first scenario is referred to as the “reference” growth scenario, is based on the Province of Ontario’s August 28, 2020 report, “A Place to Grow Growth Plan for the Greater Golden Horseshoe (P2G).” This scenario anticipates a residential population of 203,000 and an employment population of 116,000 in the City by 2051. The second scenario, known as the “low” growth scenario, predicts slightly lower rates of population and employment growth. This scenario is based on Hemson Consulting Ltd.’s August 26, 2020, technical report, “Greater Golden Horseshoe: Growth Forecasts to 2051.” According to this scenario, the City’s residential and employment populations are expected to reach 198,000 and 115,000, respectively, by 2051. The City’s population and employment have been steadily increasing and the trend is projected to continue under both scenarios.

3.1.2 Official Plan Assumptions

The Official Plan and approved Secondary Plans, including the Clair-Maltby and Guelph Innovation District plans also consider the distribution and projections of population as key factors in their development strategies. The Official Plan projects that by 2031, Guelph will be home to approximately 175,000 people (2022). The City’s growth strategy is designed to be moderate and steady, maintaining a compact and human-scale city form conducive to living, working, shopping, and recreation. The plan includes:

- A steady growth rate equivalent to an average population growth rate of 1.5% annually, aligning growth with the planning of future physical and community infrastructure.

- A plan for employment growth to keep pace with population growth, aiming for a minimum of 92,000 jobs by 2031.

3.1.2.1 OPA 80 - City of Guelph's Official Plan Amendment

OPA 80 update Guelph's Official Plan in 2023 to guide the city's growth and development in alignment with Ontario's policies for managing growth.

To support this growth, OPA 80 encourages more housing and businesses in existing urban areas, reducing the need to expand outward. This approach supports better public transit and helps protect Guelph's natural areas and groundwater, which is the city's main source of drinking water. According to OPA 80, by 2051, Guelph's population is expected to grow to:

- A population of 208,000 people, and
- Provision for 116,000 jobs.

3.1.3 Population Growth Scenario

Two key sets of population projections—the Official Plan Amendment 80 (OPA 80; City of Guelph 2022b) projections and those used in the Water Supply Master Plan (WSMP)—offer insights into future water needs and challenges.

The OPA 80 projections, adopted in 2023, are more recent and estimate that Guelph's population will reach 208,000 by 2051. This figure reflects Ontario's updated growth management policies and encourages higher-density development within existing urban areas.

The Water Supply Master Plan (WSMP) utilizes earlier population projections, with the "reference" scenario forecasting a population of 203,000 by 2051. These projections have informed several of the City's current programs, including water conservation and efficiency initiatives. However, with the updated OPA 80 projections showing higher population growth, the water supply targets and conservation goals set by the WSMP may no longer be sufficient to meet the demands of Guelph's expanding population.

This discrepancy between the population projections means that the City will need to consider this in its water management strategies. Moving forward, water conservation and efficiency programs will likely need to establish more ambitious targets to account for the larger population anticipated under OPA 80. Without this adjustment, current water management efforts may fall short of ensuring a sustainable water supply for future growth, necessitating new initiatives and programs to further reduce water consumption. For this study, the OPA 80 reference population of 208,000 people and 116,000 jobs will be used as a population growth scenario.

4 Water Supply and Distribution System

The City effectively manages its groundwater resources and is a leader in groundwater management among Canadian cities. The City has 25 municipal groundwater wells (22 are operational, three are offline), one shallow groundwater collector system, and one surface water intake partially supporting the groundwater collector system.

The City’s primary water sources are the Arkell wells and the Glen Collector system. These sources feed into the F.M. Woods Water Treatment Plant (Woods WTP) through the Arkell Aqueduct. The existing water supply sources, along with their respective Permits to Take Water (PTTW), operating capacities are summarized in Table 4 below and illustrated on Figure 2.

Table 4 Water Supply Sources and Capacity

Water Supply Source	PTTW ⁽¹⁾ (m ³ /s)	Operating Capacity Demand ⁽²⁾ (m ³ /s)	% of Average Total Water Supply	Permitted Rates and Point of Entry Capacities (2023)			
				Permitted Daily Maximum Rate ⁽³⁾ (m ³ /s)	Permitted Daily Maximum Rate ⁽⁴⁾ (m ³ /day)	Point of Entry Firm Capacity ⁽⁵⁾ (m ³ /s)	Point of Entry Firm Capacity ⁽⁶⁾ (m ³ /day)
Zone 1							
Arkell 1 (Woods)	38	23	2.51	3,273	37.9	1,640	19.0
Arkell Springs Wellfield ⁵ (Woods)	333	333	36.31	28,800	333.3	28,800	333.3
Arkell Infiltration Gallery Glen Collector (Woods)	289	59	6.43	25,000	290	5,908	59
Emma Well	36	32	3.49	3,100	35.9	2,330	27.0
Park 1 and Park 2	119	93	10.14	10,300	119.2	9,500	110.0
Water St. Well	39	22	2.40	3,400	44.4	1,702	19.7
Dean Well	27	17	1.85	2,300	34.6	1,500	17.4
Carter 1 and Carter 2	70	60	6.54	7,855	75.8	5,184	60.0
Membro Well	70	60	6.54	6,050	78.0	3,200	37.0
Queensdale Well	61	13	1.42	5,237	60.6	501	5.8
University Well	38	28	3.05	3,300	38.2	1,500	17.4
Downey Well	61	61	6.65	5,237	60.6	2,592	30.0
Burke Well	76	75	8.18	6,546	75.8	5,790	60.0

Water Supply Source	PTTW ⁽¹⁾ (m ³ /s)	Operating Capacity Demand ⁽²⁾ (m ³ /s)	% of Average Total Water Supply	Permitted Rates and Point of Entry Capacities (2023)			
				Permitted Daily Maximum Rate ⁽³⁾ (m ³ /s)	Permitted Daily Maximum Rate ⁽⁴⁾ (m ³ /day)	Point of Entry Firm Capacity ⁽⁵⁾ (m ³ /s)	Point of Entry Firm Capacity ⁽⁶⁾ (m ³ /day)
Zone 2							
Calico Well ^{6.}	61	16	1.74	5,237	60.6	1,040	12.0
Helmar Well ^{6.}	38	9	0.98	3,273	37.9	804	9.3
Paisley Well	15	16	1.74	3,200	37.0	804	9.3
System Summary							
Zone 1	1257	876	95.53				
Zone 2	114	41	4.47				
Total System	1371	917	100				

Notes:

- (1) PTTW (Permit to Take Water): Permitted amount to take water from the Ministry of Environment (MECP).
- (2) Operating Capacity Demand: The amount of water the City’s municipal system is designed to supply to meet the demand of the City’s service area.
- (3) Permitted Daily Maximum Rate: The permitted pumping rate is the rate of pumping allowed as identified in the Permits to Take Water.
- (4) Point of Entry Firm Capacity: The firm capacity rate is the actual rate of pumping that can be sustainably achieved at each well.
- (5) The Calico and Helmar Wells are not in service at this time. Additionally, the wells at Admiral, Edinburgh, Sacco, and Smallfield are currently disconnected from the drinking water system.
- (6) The Arkell Springs Wellfield is comprised of five (5) municipal drinking water production wells: Arkell 6, Arkell 7, Arkell 8, Arkell 14, and Arkell 15. All these wells fall under the Permit to Take Water. Despite the daily maximum permitted extraction limit per day, any combination of these wells can be utilized to obtain the permitted rate.

Source: Water and Wastewater Servicing Plan (City of Guelph 2024b) and 2023 Water Services Annual Report (City of Guelph 2023b)

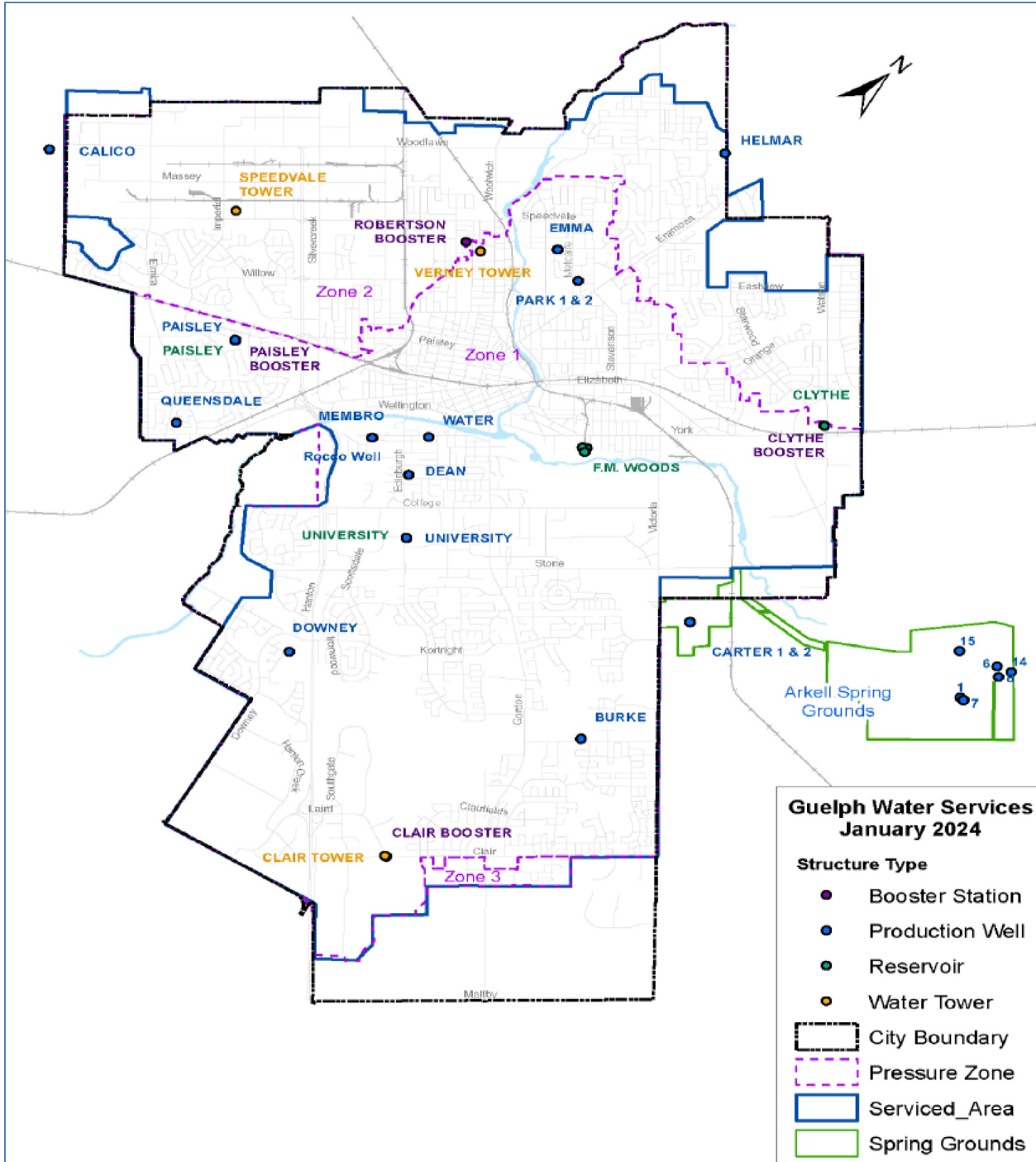


Figure 2 City of Guelph Drinking Water Servicing System

4.1 Water Distribution System Infrastructure

The City operates a water distribution system subdivided into three pressure zones as illustrated on Figure 3. These zones are serviced by three booster pumping stations that supply water from Zone 1 into Zone 2 and one pump station that supplies water from Zone 1 into Zone 3. Table 5 summarizes each component of the City’s water supply and distribution system.

Table 5 Summary of Guelph’s Drinking Water System

Component	Details
Groundwater Wells and Surface Water Intake	<ul style="list-style-type: none"> • 22 operational groundwater wells • Three (3) offline groundwater wells • One (1) shallow groundwater collector system (Glen Collector). • One surface water intake (Eramosa Intake)
Pressure Zones	Three (3) pressure zones.
Booster Pumping Stations	Three (3) pumping stations supply water from Zone 1 into Zone 2 and one (1) pump station supplies water from Zone 1 into Zone 3.
Storage	A total available storage of 54,505 m ³ , with 39,800 m ³ in Zone 1 and 14,700 m ³ in Zone 2.
Underground Storage Reservoirs	Five (5) underground storage reservoirs with a combined approximate capacity of 48,000 m ³ .
Water Towers	Three (3) water towers with a combined approximate capacity of 11,200 m ³ .
Water Supply Aqueduct	6.38 km of a 900-1,050 mm diameter water supply aqueduct.
Watermain	Approximately 600 kilometres of buried watermain with a diameter <900 mm, along with 4,286 watermain valves.
Fire Hydrants	2,809 fire hydrants.
Water Services and Water Meters	44,000 water services and water meters.

4.2 City of Guelph Water Use

The City of Guelph supplies more than 16,000 ML/year from its groundwater wells and the Glen Collector. Out of this total, slightly less than 15,000 ML/year is supplied to residents and organizations within the City, as summarized in the following table.

Table 6 Water Use Consumption By Municipal Property Assessment Corporation (MPAC) Property Category (2023)

Property Category	Total Consumption (m3/y)	% of Total Consumption	Average Consumption (m3/y)	No. Customers	Total Revenue (\$/y)
100s Municipal park	20,108	0.14%	1,117	18	\$42,629
301 Low Density Residential	5,081,273	34.17%	177	28,656	\$10,772,299
302-336 Medium Density Residential	1,178,811	7.93%	181	6,502	\$2,499,079
340-380 High Density Residential	2,814,479	18.93%	451	6,236	\$5,966,695
400s Commercial	1,052,027	7.08%	684	1,539	\$2,230,297
500s Industrial	3,475,967	23.38%	4,678	743	\$7,369,050
600s Institutional	1,072,940	7.22%	8,867	121	\$2,274,633
700s Institutional Special&Exempt	140,857	0.95%	1,423	99	\$298,617
800s Institutional Government	8,327	0.06%	1,190	7	\$17,653
ICI - Staff populated	361	0.00%	72	5	\$765
Residential - Staff Populated	24,348	0.16%	150	162	\$51,618
Grand Total	14,869,498	100.00%	337	44,088	\$31,523,336

4.2.1 Water Balance Methodology

The City follows a water balance methodology documented and supported by the American Water Works Association (AWWA) to report water use according to the above MPAC property categories in order to prepare estimates of water quantities that cannot easily be measured. The AWWA Water Balance framework includes a standardized spreadsheet that manages water use information and allows for the analysis and review of trends over time.

The water balance process for the City calculates the total water supplied, which is the total water production from all sources. Authorized consumption includes billed and unbilled authorized consumption. Unbilled authorized consumption includes water used for activities such as sewer flushing, water main flushing, and repairs. Water losses, which include apparent losses and real losses, are assessed and benchmarked against the International Water Association (IWA) standards. Apparent and real water losses are calculated using the AWWA Water Audit Software, which estimates these losses as a percentage of the total water supplied. Finally, system data are calibrated, including the length of all pipes, service connections, fire hydrants, private customer lines, and system operating pressures, and the operating and maintenance cost data are added. A water audit data validity score is then assigned and key performance indicators and NRW components can be viewed for the system.

Figure 3 illustrates the components of the water balance and the main categories of authorized consumption and water losses.

WATER SUPPLIED	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION *Actual Adjusted Consumption - Active Accounts (based on meter readings) *Billed but \$ not received in year *Billed Inactive Accounts *Bulk Water Sales *Seasonal Parks & Rec. Meters + Other	REVENUE WATER	
			BILLED UNMETERED CONSUMPTION *Manual back bills (e.g. DNRs; meter malfunctions)		
		UNBILLED CONSUMPTION	UNBILLED METERED CONSUMPTION <i>City Operations:</i> *Bulk Filling Station - water use by other municipal departments *Water Services Supply - Reservoir Cleaning / Tower Draining / Water Wagon <i>Customers:</i> *Remotes that under-registering - no data available *Special billing arrangements for large water users - none currently *Inactive Accounts using water *Frozen Services - Volume of water metered and credited - applies to 2014 and 2015 only. *High Water Use bills whose fees have been waived		NON-REVENUE WATER
			UNBILLED UNMETERED CONSUMPTION *Water Operations *City-wide Operations *Fire Training and Incidents		
	UNAUTHORIZED CONSUMPTION 0.25% of Production				
	CUSTOMER METER INACCURACIES				
	SYSTEMATIC DATA HANDLING ERRORS 0.25% of Production				
	LEAKAGE ON MAINS				
	WATER LOSSES	APPARENT LOSSES	LEAKAGE ON RESERVOIR OVERFLOWS		
			LEAKAGE ON SERVICE CONNECTIONS UP TO POINT OF CUSTOMER METERING		
	REAL LOSSES				

Figure 3 Water Consumption and Loss Categories, City of Guelph (AWWA Water Balance Methodology)

Non-revenue water (NRW) refers to water that is produced and lost before it reaches the customer, primarily due to unbilled water consumption, leaks, theft, or metering inaccuracies. The amount of NRW recorded by the City is an indicator of water system efficiency and reducing NRW is an obvious target for improving water efficiency.

Figure 4 illustrates the trend from 2012 to 2022 of total water supplied versus RW and NRW. As illustrated on this chart, total RW has increased slightly over recent years while NRW has had a decreasing trend since 2015.

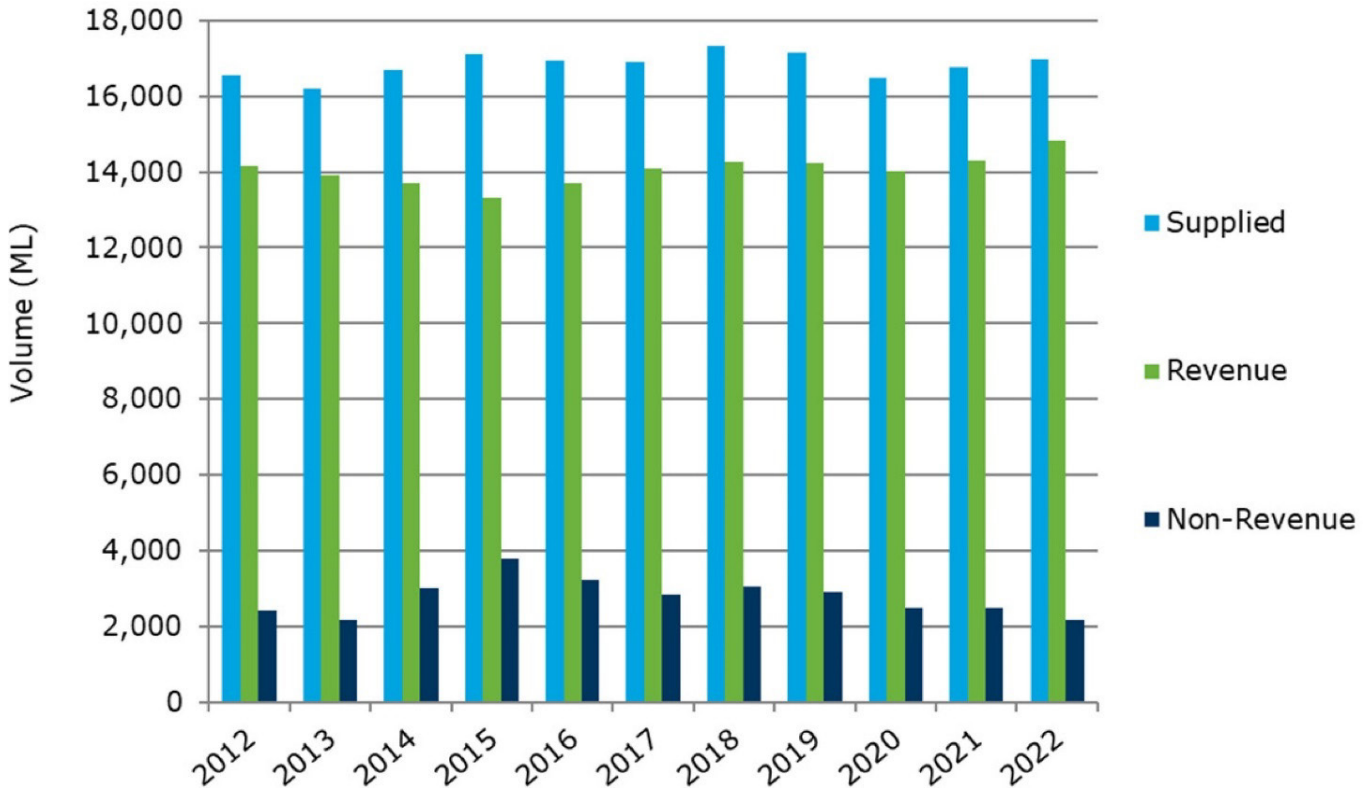


Figure 4 Total Water Supplied Compared to Revenue and Non-Revenue Water (City of Guelph Water Balance, 2024)

Figure 5 illustrates the trend in NRW categories from 2012-2022. In 2022 the total NRW recorded by the City was approximately 2,200 ML. At a current (2024) water price of \$2.12/m³ the cost of NRW is approximately \$4,700,000/year. As illustrated on this figure, the City experienced an increase in water main breaks in 2014 resulting in an increase in real losses from the water distribution system. The City responded to this trend by aggressively implementing its leak detection program. In 2022, the real losses decreased to less than 1,500 ML/year; approximately the same amount experienced prior to the 2014 period +/- increase in water main breaks.

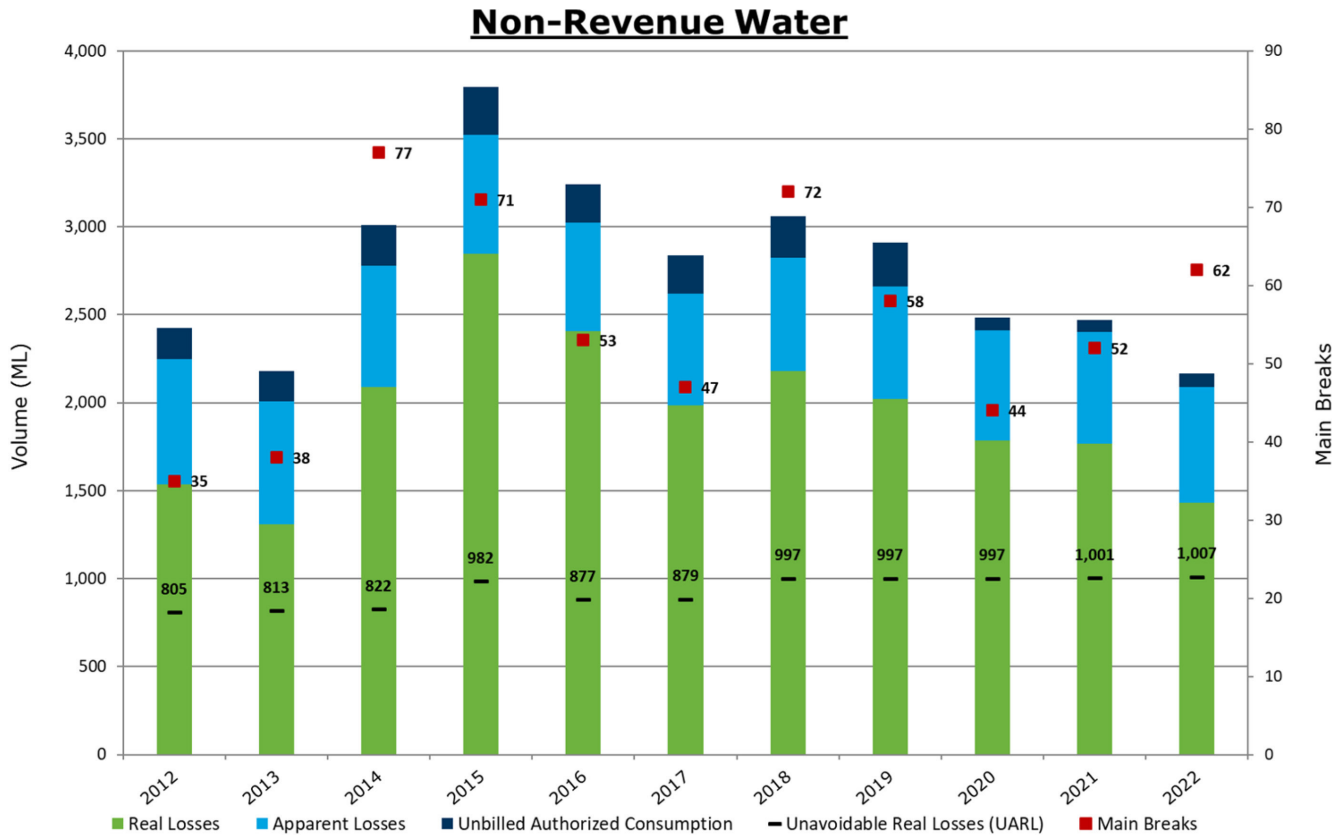


Figure 5 NRW Water Trend (City of Guelph, 2012-2022)

4.2.2 Infrastructure Leakage

The Infrastructure Leakage Index (ILI) is a widely used performance indicator for water loss. The index measures the ratio of annual real losses (ARL) to unavoidable annual real losses (UARL). ARL is estimated using the water balance methodology, and UARL is calculated using standard industry equations. An ILI of 1.0 is considered ideal and indicates that further reduction in real losses is unlikely to be economically achieved. Figure 4 illustrates the City’s calculated ILI from 2008 to 2022. This chart illustrates that the City reduced its ILI from nearly 3.5 to below 1.5 in 2021 which is considered very good. The trend and the current low ILI suggest that the City’s leakage control program has achieved its goal of addressing aging leaks and that the current leak detection program is locating new leaks or small leaks that have increased in size.

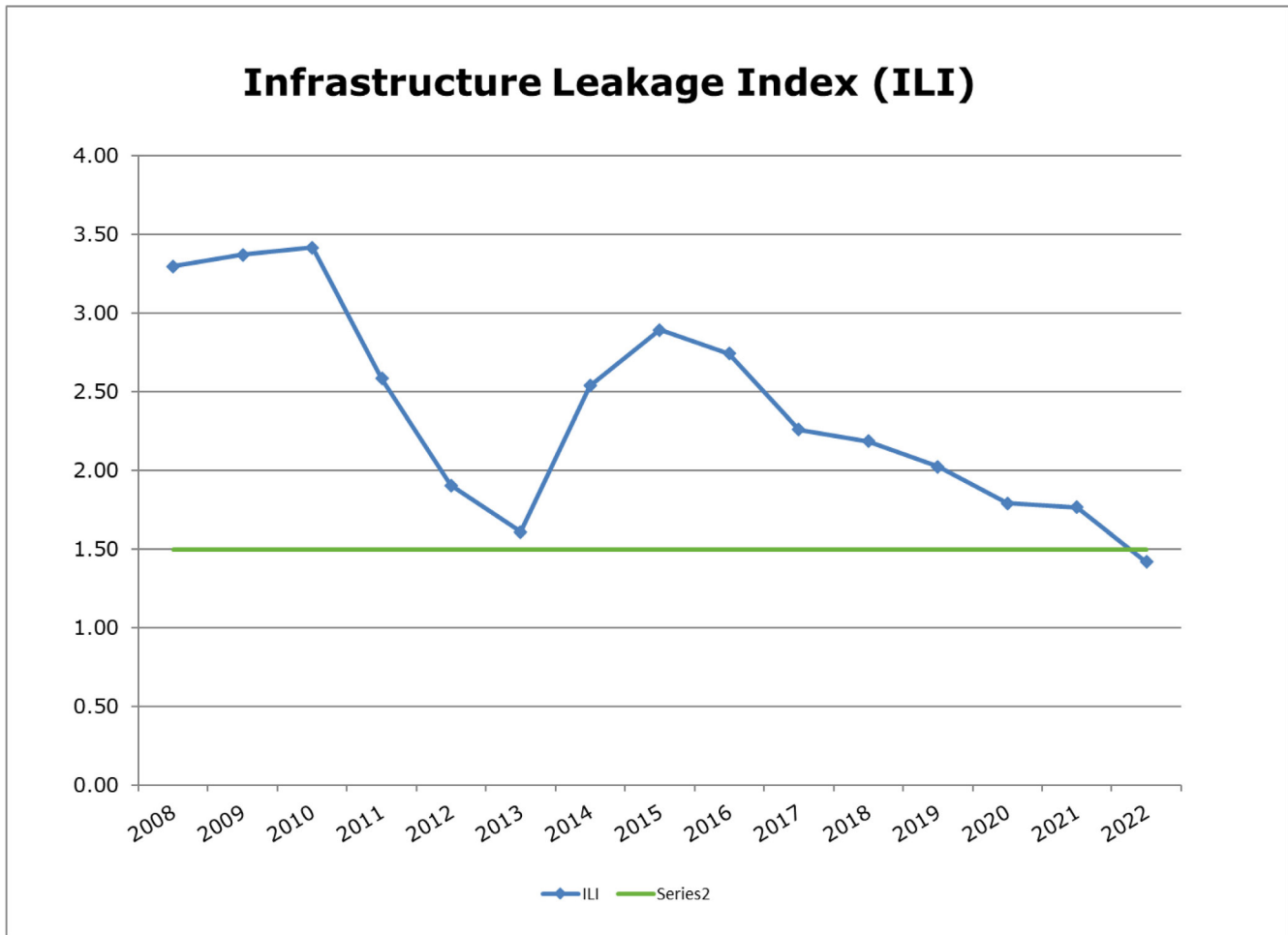


Figure 6 Infrastructure Leakage Index (ILI) (City of Guelph, 2008-2022)

As part of the 2022 Water Supply Master Plan, AECOM (2022) completed a review of the City’s Loss Management Strategy and provided recommendations for this program in the future. In this review, AECOM concluded that the City has done well in managing and controlling real losses, as compared to ILI statistics collected by other municipalities globally. AECOM concluded that the City of Guelph could be at, or close to, the economic level of leakage (ELL); the unit cost of leakage for the City was relatively low and it may not be economical to reduce real losses further. AECOM made the following conclusions and recommendations based on its review:

- Water Auditing.** The City should continue to complete its water audit using the AWWA software and recommendations. The City should consider documenting water meters used for the water volume input into the system for the water audit and adjust the data based on annual accuracy testing. The City should continue with its program, which it started before the COVID-19 pandemic, to replace approximately 26,000 water metres which may improve the water audit accuracy. Finally, the City should complete the water audit by pressure zone.

- Active Leakage Control.** AECOM concluded that the current active leakage control policy (regular leak detection survey and repair) has been effective in reducing real losses and should be continued. AECOM concluded that the annual recoverable real losses in 2019 were 1,023 ML; however, this would be decreased to approximately 750 ML given that the calculated ILI has reduced since 2019. AECOM did recommend exploring enhancements to the leakage management strategy using satellite leak detection, acoustic loggers, and focused leak detection.
- District Metered Area (DMA) Program.** AECOM concluded that the cost of continuing with a DMA Program could not be recommended based solely on savings due to a reduction in real losses; however, DMAs have other advantages for the operation and maintenance of a water system and the cumulative benefits of DMAs should be considered.

4.2.3 Residential Water Demand

Water consumption for residential water use by address density across different housing densities is illustrated in Figure 7 from 2006 to 2021. Low density residential areas exhibit the highest water consumption compared to the medium density, high density and unclassified residential use.

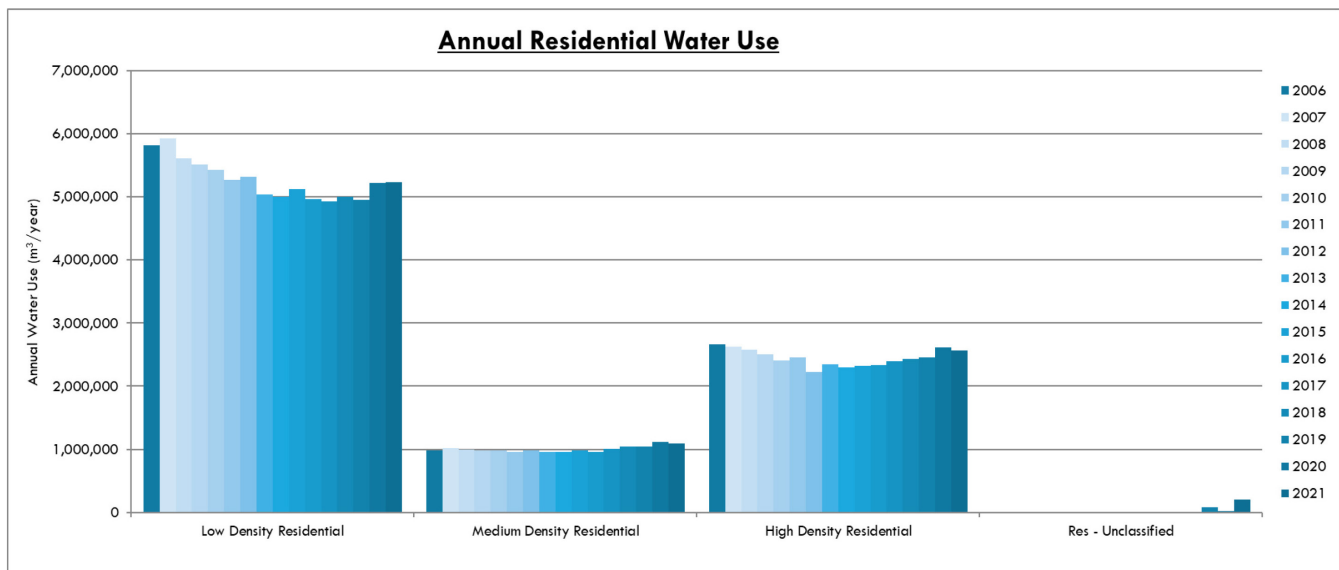


Figure 7 Annual Residential Water Use

In 2023, the average water use for residential properties (low, medium, and high-density) was approximately 25,000 m³/day. Differences in property/home size, swimming pools, lawns, gardens, and vegetation likely drive the higher levels of water usage. The following summarizes the trend in average annual water use since 2006. Table 7 includes a calculation of per capita residential water use, which has decreased from 218 lcd in 2006 to 162 lcd in 2023. Finally, Table 7 includes average Water Conservation and Efficiency water savings, calculated as the amount of additional water that would be needed to serve residential customers based on 2006 per capita water use rates.

Table 7 Trend in Annual Residential Water Use

Year	Population (including Census undercount)	Average Residential Water Use (m ³ /day)	Per Capita Residential Water Use (lcd)	Average WC&E Savings (m ³ /day)
2006	119,066	25,952	218	0
2007	120,852	26,245	217	101
2008	122,638	25,174	205	1,561
2009	124,708	24,702	198	2,484
2010	125,332	24,160	193	3,162
2011	127,305	23,843	187	3,910
2012	128,599	23,388	182	4,647
2013	130,669	22,875	175	5,611
2014	133,231	22,655	170	6,390
2015	134,654	23,084	171	6,270
2016	136,325	22,626	166	7,093
2017	138,375	22,843	165	7,323
2018	140,015	23,233	166	7,290
2019	141,963	23,381	165	7,567
2020	144,750	24,583	170	6,973
2021	149,900	24,910	166	7,768
2022	151,150	25,150	166	7,800
2023	153,000	24,860	162	8,494

Figure 8 illustrates the trends in Table 7.

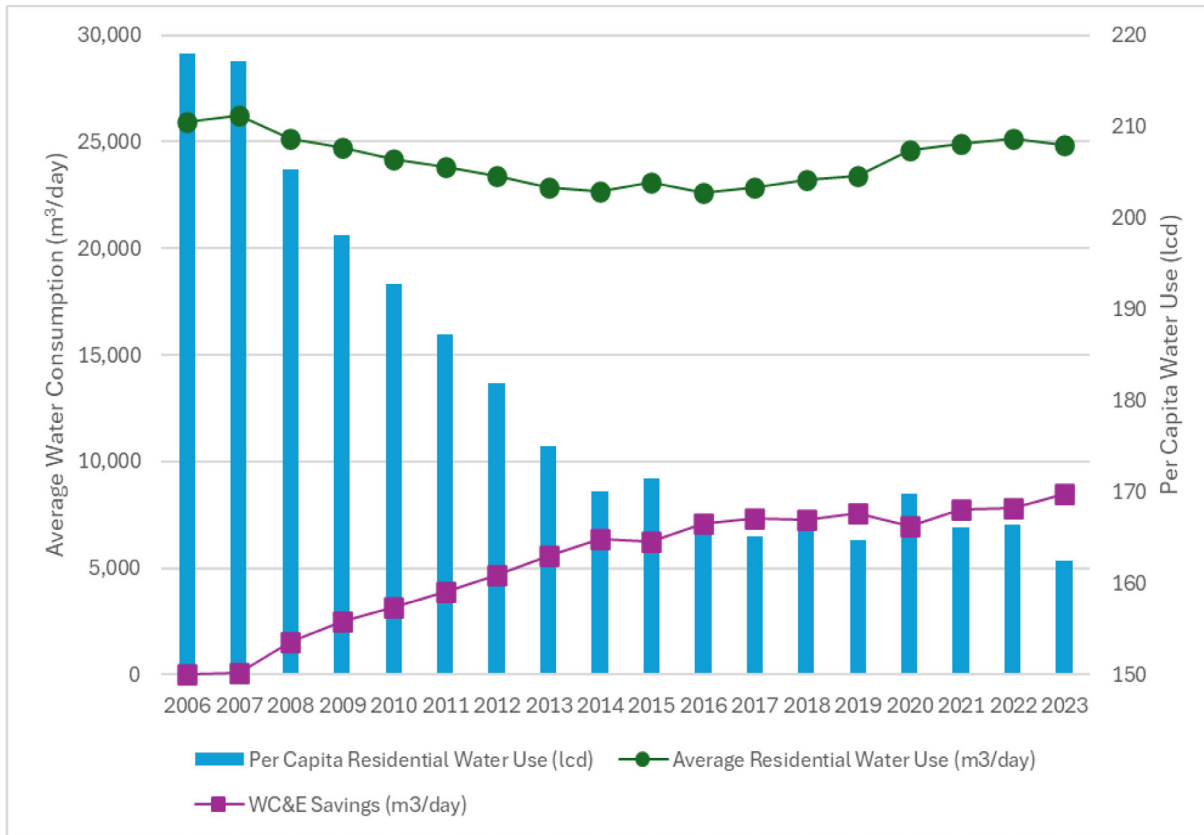


Figure 8 Trends in Annual Residential Water Use (City of Guelph, 2006-2023)

As noted, per capita water use dropped from 218 lcd to 162 lcd between 2006 and 2023. The City introduced its first Water Efficiency Strategy in 2001 establishing goals for reducing water demand. The strategy included public awareness campaigns and fixture replacement initiatives and was expanded in the mid-2000s to include outdoor water use restrictions, the rain barrel program, and leak detection and repair. In 2011, the City introduced an update to the Water Conservation and Efficiency Strategy, setting ambitious targets for water reduction. The updated strategy included plans for smart metering, water reuse, and an ICI focus.

As illustrated in Figure 8, the City’s Water Conservation and Efficiency Strategy was extremely successful, with per capita water use decreasing by 24% from 2006 to 2017. Water use increased during the COVID pandemic and then maintained a steady trend at approximately 166 lcd. Recent consumption values for 2023 show that residential water demand has decreased further to 162 lcd. These results are positive when compared to the national and provincial averages of 223 and 187 lcd (Statistics Canada 2023a), respectively. The above table and figure also illustrate water consumption savings that can be attributed to the WC&E program. Based on the 2023 population estimate, residential water demand would be approximately 8,500 m³/day greater using the 2006 per capita water use rate. This savings translates to an annual revenue of \$6,580,000 using the City’s (2024) retail price of \$2.12/m³.

Guelph’s water savings achievements are commendable, particularly when considering the provincial and national average per capita residential water consumption. As mentioned above, the water consumption trends clearly illustrate that the historically declining trend in per capita water use cannot be expected to continue, as

most of the realized savings in water consumption were achieved 10 years ago. There remains a potential for per capita water use to increase again without having the various direct and indirect WC&E programs in place.

The above analysis is based on assumptions relating to average water use, which may be misleading considering that actual residential water use will vary considerably across residential customers. Figure 9 illustrates a histogram of the number of customers in low-density residential properties categorized by annual water consumption. The average annual consumption for low-density residential properties is 177 m³/year. As illustrated on this figure, approximately 23% of the customers consume more than 200 m³/year of water. These customers consume more than half of the total for low-density residential properties. According to the most recent census data (202?), the average occupancy for low-density residential is 2.9 residents/property. Using the assumption for occupancy, annual consumption of 200 m³/year for a low residential property translates to approximately 250 lcd.

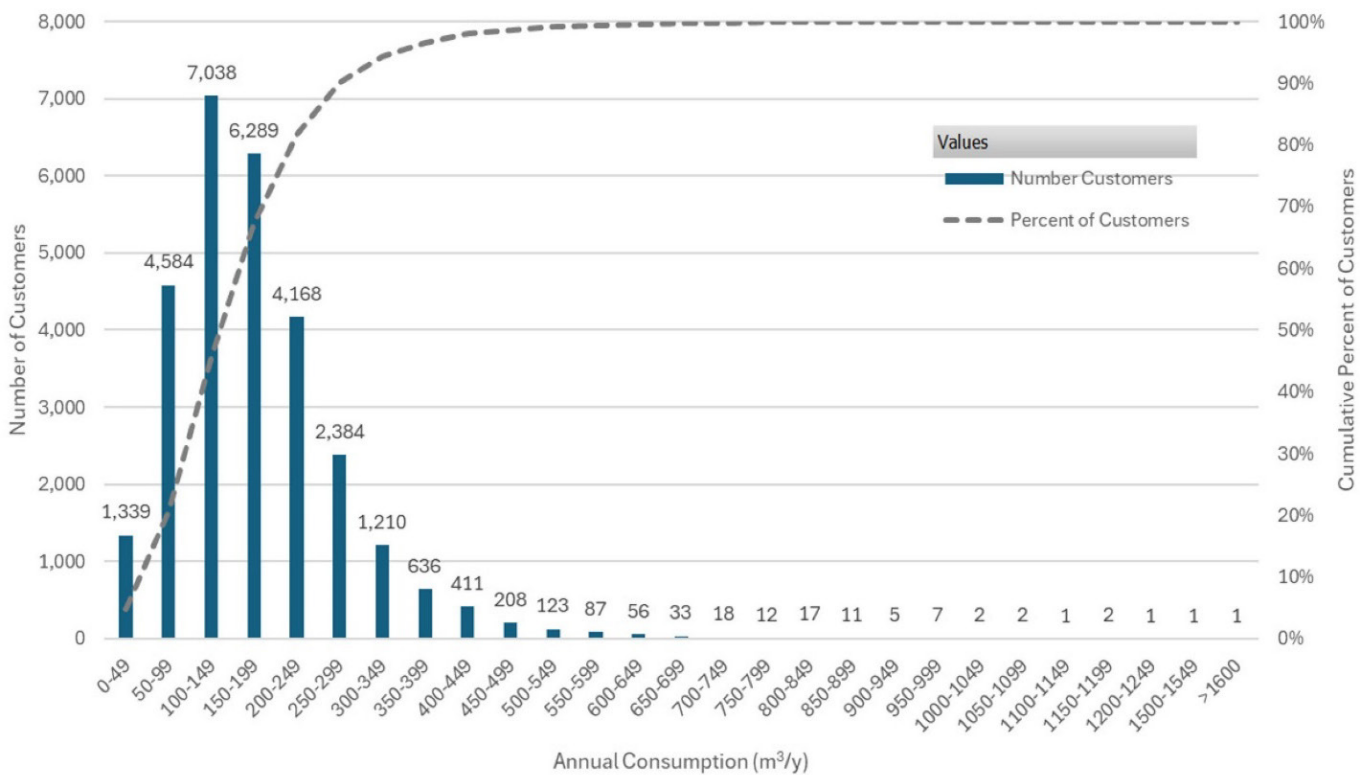


Figure 9 Histogram of Low-density Residential Water Consumption (City of Guelph, 2023)

There are various factors that might affect a residential property’s water consumption, including; personal water use habits, outdoor water use, fixture and appliance efficiency, metering errors, and leaks. More significantly, the City has a large number of multigenerational households and university and college student homes. According to the 2021 Census (Statistics Canada 2023b), Guelph had 1,695 multigenerational households, 415 multiple-census- family households (multiple unrelated families), 1,980 one-census-family households with additional persons (possibly basement apartments), and 3,340 two-or-more-person non-census-family households (possibly student housing). These census categories combine to 7,430 properties having the potential for much higher occupancy and therefore a greater amount of personal-related water consumption.

Figure 10 illustrates a histogram of the number of customers in medium-density residential properties categorized by annual water consumption. The average annual consumption for medium-density residential properties is 181 m³/year. Due to some of the details regarding MPAC coding and servicing with the City, medium-density properties may reflect a home with single servicing or may reflect a single-serviced property with multiple units. As a result, per capita water usage for medium-density residents cannot readily be calculated from the currently available data. As illustrated on this figure, approximately 28% of the medium-density customers consume more than 200 m³/year of water.

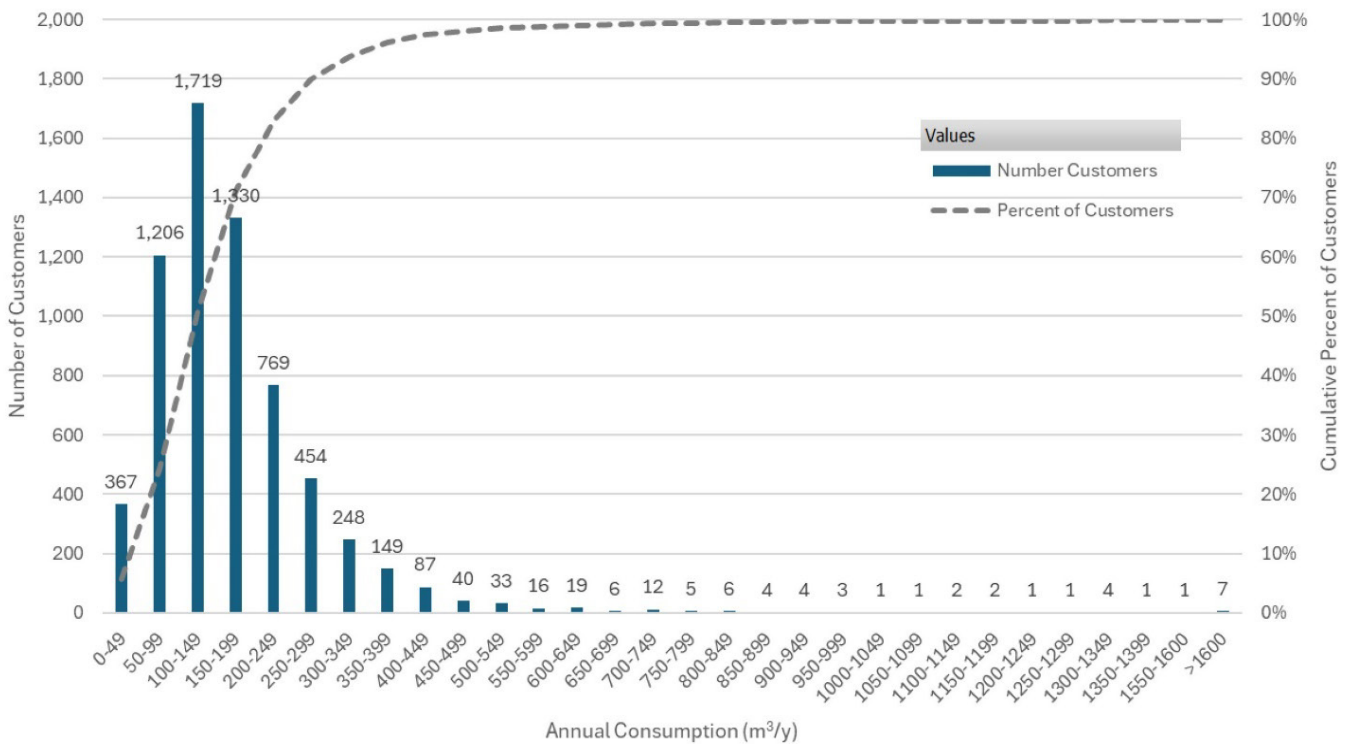


Figure 10 Histogram of Medium-density Residential Water Consumption (City of Guelph, 2023)

High-density residential properties include many different MPAC categories ranging from row-housing with 7 or more units to condominiums to multi-floor apartment buildings. Figure 8 illustrates a histogram of the number of customers for high-density residential properties categorized by annual water consumption greater than 2,000 m³/year for each property. Referring to Figure 11, high-density residential customers consume approximately 2,800,000 m³/year of water, 19% of the City’s total consumption. Half of the high-density customers consume more than 5,000 m³/year which translates to water consumption needs of 85 people based on the City’s average per capita consumption rate. The dataset includes 135 customers using more than 5,000 m³/year and 10 customers using more than 20,000 m³/year which would result in annual retail water cost of more than \$40,000. Based on the information provided, it cannot be used to gather further insight into per capita water use.

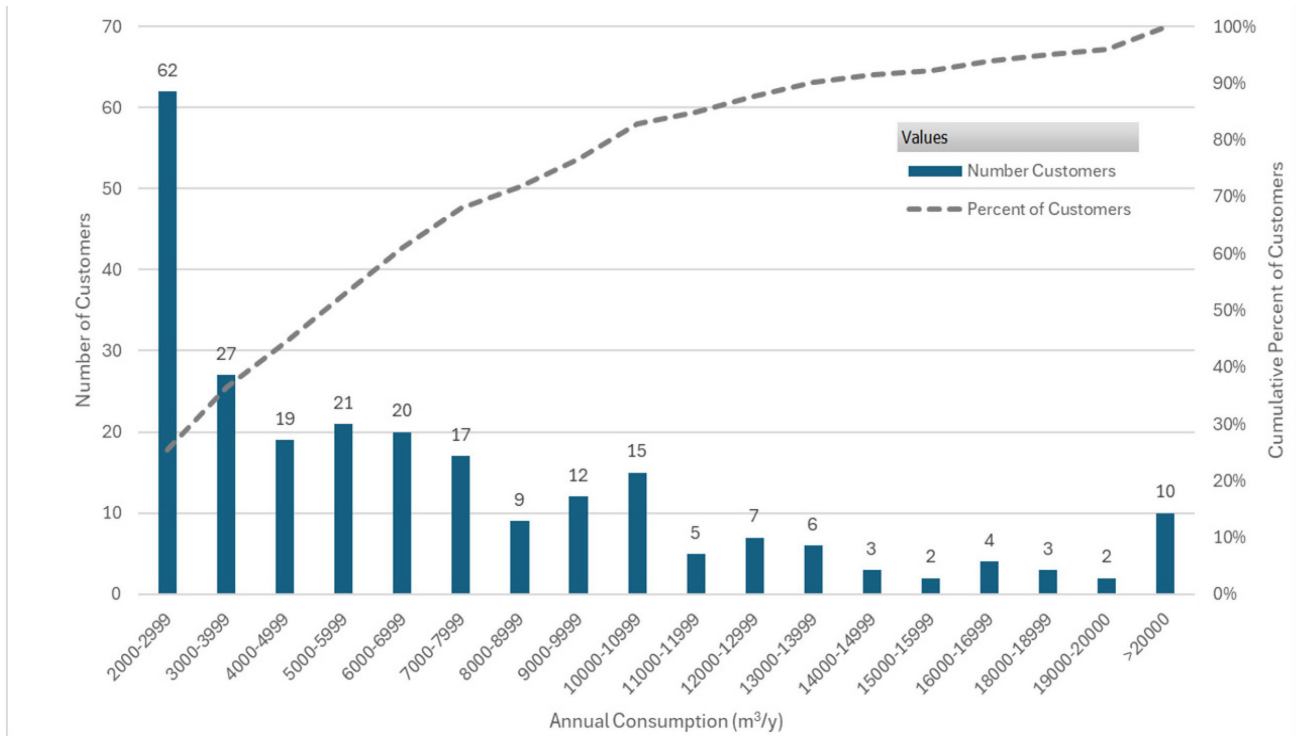


Figure 11 Histogram of High-density Residential Water Consumption (>2,000 m³/day)

4.2.4 Industrial, Commercial, Institutional (ICI) Water Demand

Water consumption for ICI water use by address zoning/building type across different employment sectors is illustrated in Figure 6 over the same period from 2006 to 2021. The industrial water users have the highest water consumption compared to the other ICI users.

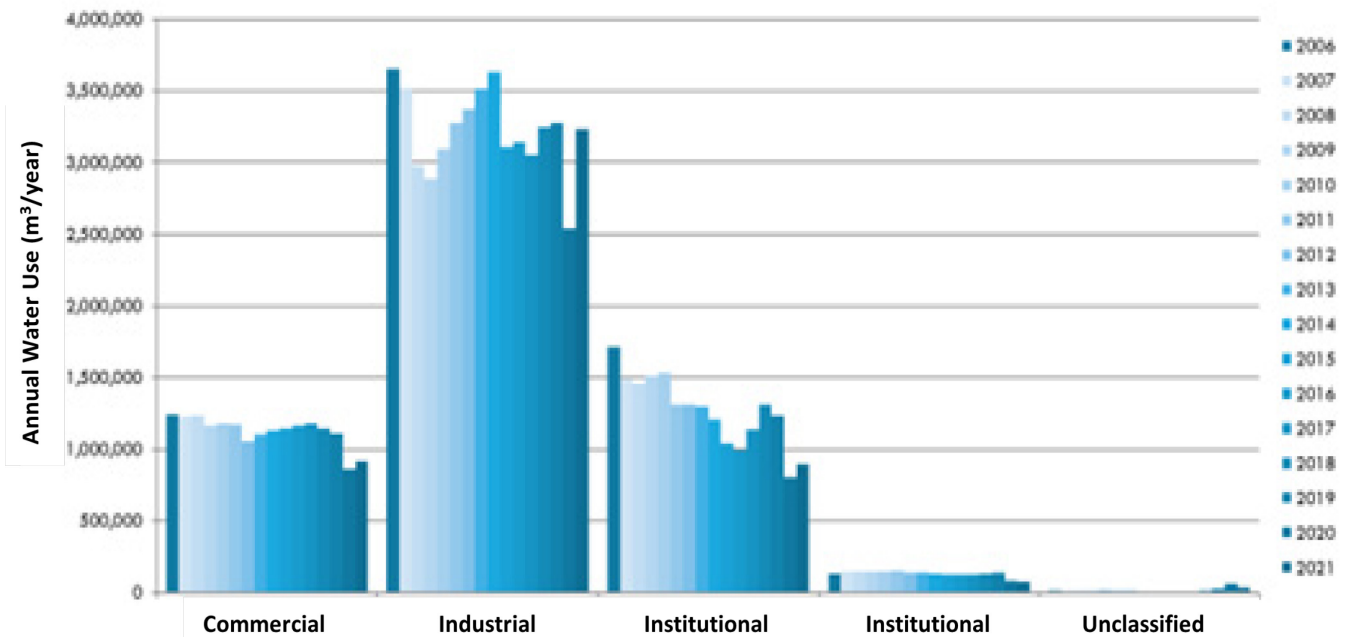


Figure 12 Annual ICI Water Use

As illustrated on Table 8, annual water demand from the ICI sectors was approximately 6,700,000 m³ in 2023. The longer-term trend in ICI water use is illustrated on the following Figure 13.

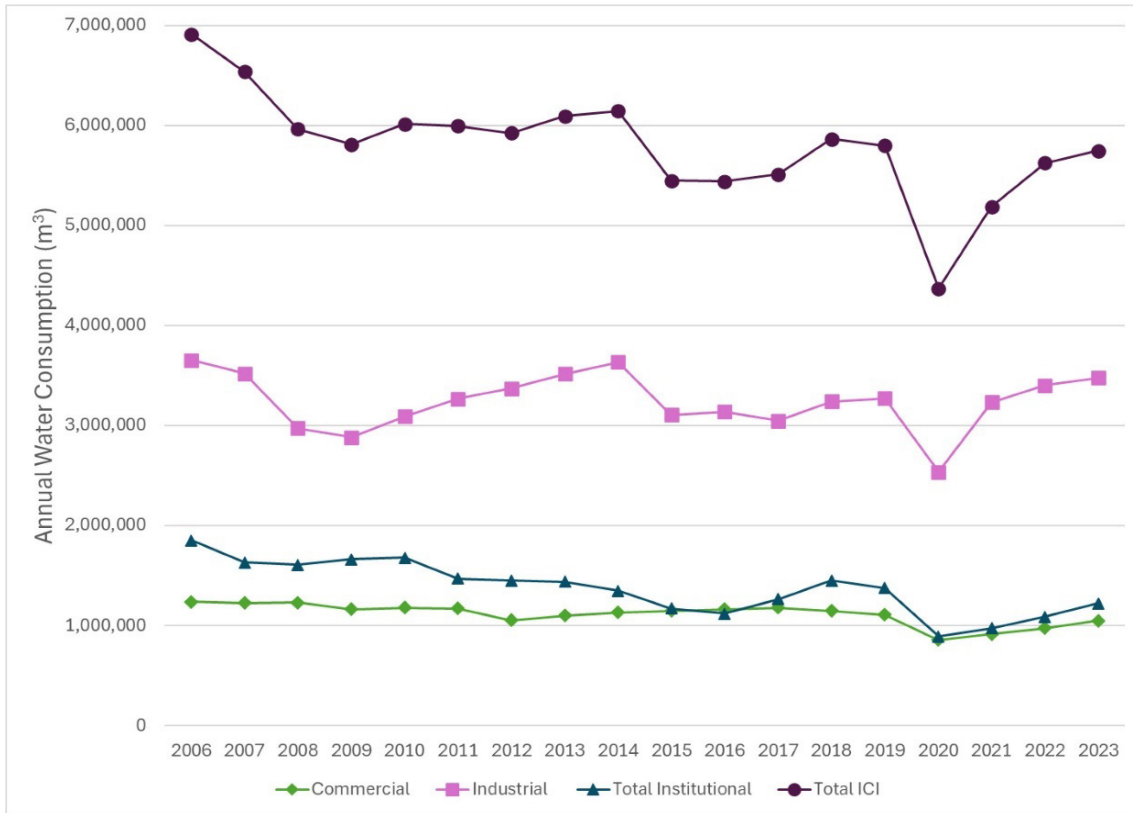


Figure 13 Annual Water Demand (City of Guelph, 2006-2023)

This chart highlights how Guelph’s ICI water use has evolved, influenced by economic activity, conservation initiatives, and external factors like the COVID-19 pandemic. The total ICI water consumption shows a gradual decline from 2006 to around 2019. A sharp dip occurred around 2020, likely reflecting reduced water use during the COVID-19 pandemic. ICI water use rebounds after 2020 and returns to pre-pandemic levels by 2023. Trends observed for each sector include:

- The industrial sector shows a noticeable decline in water consumption from 2006 to 2010. After 2010, the trend stabilizes, with relatively minor fluctuations up to 2019. Similar to the total ICI trend, there is a significant drop in 2020 followed by a recovery in 2023 that is greater than experienced since 2014.
- The institutional sector exhibits a steady and slight downward trend in water use over the entire period. Fluctuations are less pronounced compared to the industrial and commercial sectors; however, the reduction in water consumption during the COVID-19 pandemic was significant and as of 2023 had not yet recovered to pre-pandemic levels. Most of the larger Guelph institutions have not changed significantly within the City (e.g., University of Guelph), and long-term reductions in water consumption may be more attributable to water conservation and efficiency efforts than the other sectors.
- The commercial sector shows the least variation in water use, with a relatively stable trend throughout the period. There is a minor dip in 2020, but recovery is evident by 2022.

Except for the impact of COVID-19, detailed conclusions regarding the factors affecting ICI water use trends are difficult to make. The downward trends in industrial and institutional water use may reflect the success of water efficiency programs in Guelph; however, they may also reflect less desirable factors including downsizing or closure of businesses. The commercial sector's stable consumption suggests less room for reduction or less variability in operational water needs.

4.2.4.1 Industrial

In 2023, the industrial sector consumed 3,476,000 m³ of water, representing 23% of the City's total consumption. As illustrated on Figure 10, there are 44 industrial customers within the City consuming more than 10,000 m³/year, and there are 9 customers who consumed more than 50,000 m³ in 2023 (\$106,000 retail cost). The top 9 industrial properties consumed 2,250,000 m³ of water in 2023 at a retail cost of \$4,770,000.

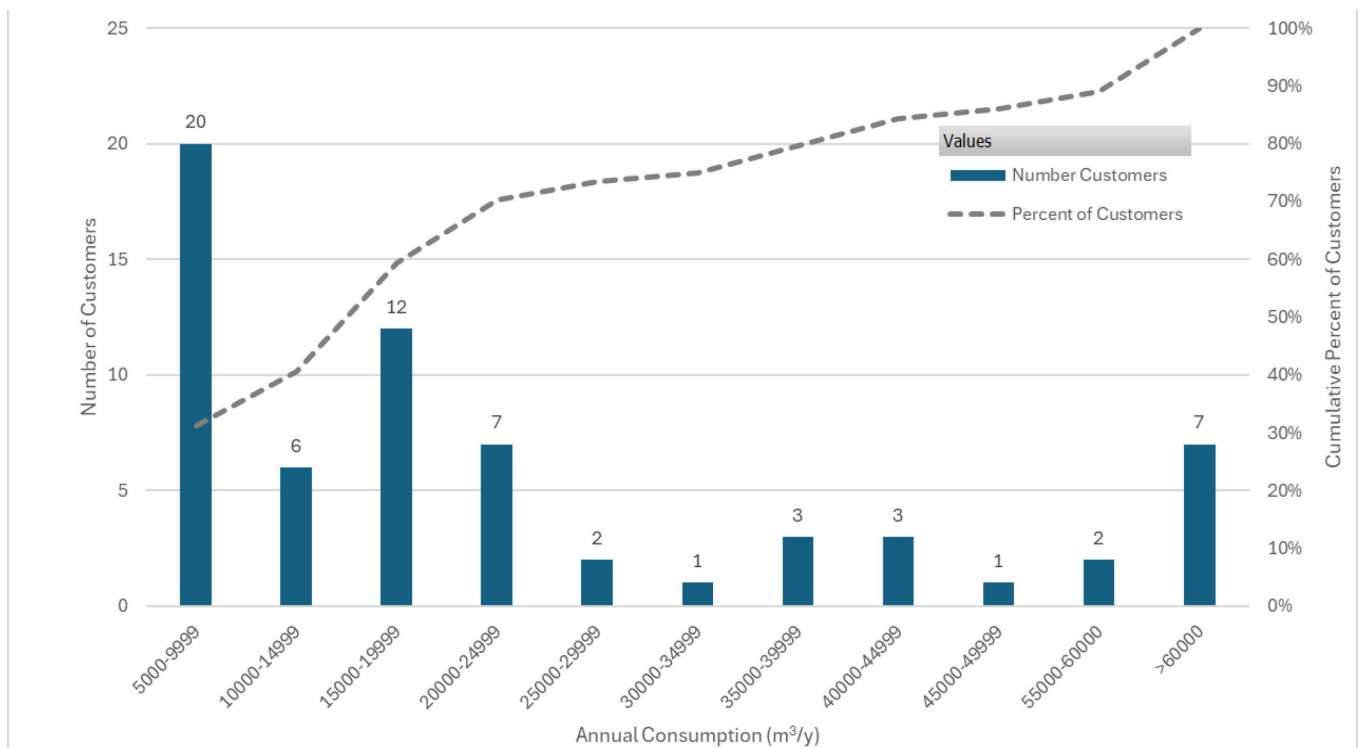


Figure 14 Histogram of Annual Water Consumption for Industrial Sector (2023)

Table 8 summarizes total annual water use for each of the MPAC property types within the industrial sector.

Table 8 2023 Water Consumption for Industrial Property Types

MPAC Property Type	Total Consumption (m ³ /y)	Average Consumption (m ³ /y)	No. Customers
Food processing	1,205,105	241,021	5
Standard industrial properties not specifically identified	571,784	3,267	175
Distillery/brewery	448,207	112,052	4
Automotive parts production	438,038	29,203	15
Heavy manufacturing (non-automotive)	214,890	21,489	10
N/A (e.g., new development or unassessed property)	140,960	14,096	10
Industrial mall	135,490	500	271
Other industrial (all other types not specifically defined)	118,092	862	137
Abattoir/slaughterhouse/rendering	93,768	93,768	1
Research and development facilities	48,096	9,619	5
Pulp and paper mill	29,196	29,196	1
Warehouse	15,654	540	29
Industrial condominium	13,319	202	66
Cold storage facility	9,343	9,343	1
Water treatment/filtration/water towers/pumping station	514	257	2
Mini-warehousing	441	63	7
Bulk oil/fuel distribution terminal	71	71	1
Printing plant	40	40	1
Grand Total	3,475,967	4,678	743

As illustrated in Table 8, water use by food processing plants is by far the most significant of all industrial water use activities. Some property types are not accurately labelled (e.g., N/A, Other Industrial) and as a result, this table may not accurately reflect total water use in all industrial categories. A number of Guelph industrial businesses operate on multiple properties each of which has separate servicing with the City. As a result, some industrial businesses would have much larger water consumption and water costs when combining all operations.

4.2.5 Commercial

Customers in the commercial sector include many types of businesses including office buildings, stores and shopping malls, restaurants, and hotels. In 2023, the commercial sector consumed 1,052,000 m³ of water, or 7% of the total consumption in the City of Guelph. Thirty-nine, or approximately 12% of the serviced commercial customers used more than 5,000 m³ of water in 2023 as illustrated in Figure 15.

400s Commercial (>1000 m³/day)

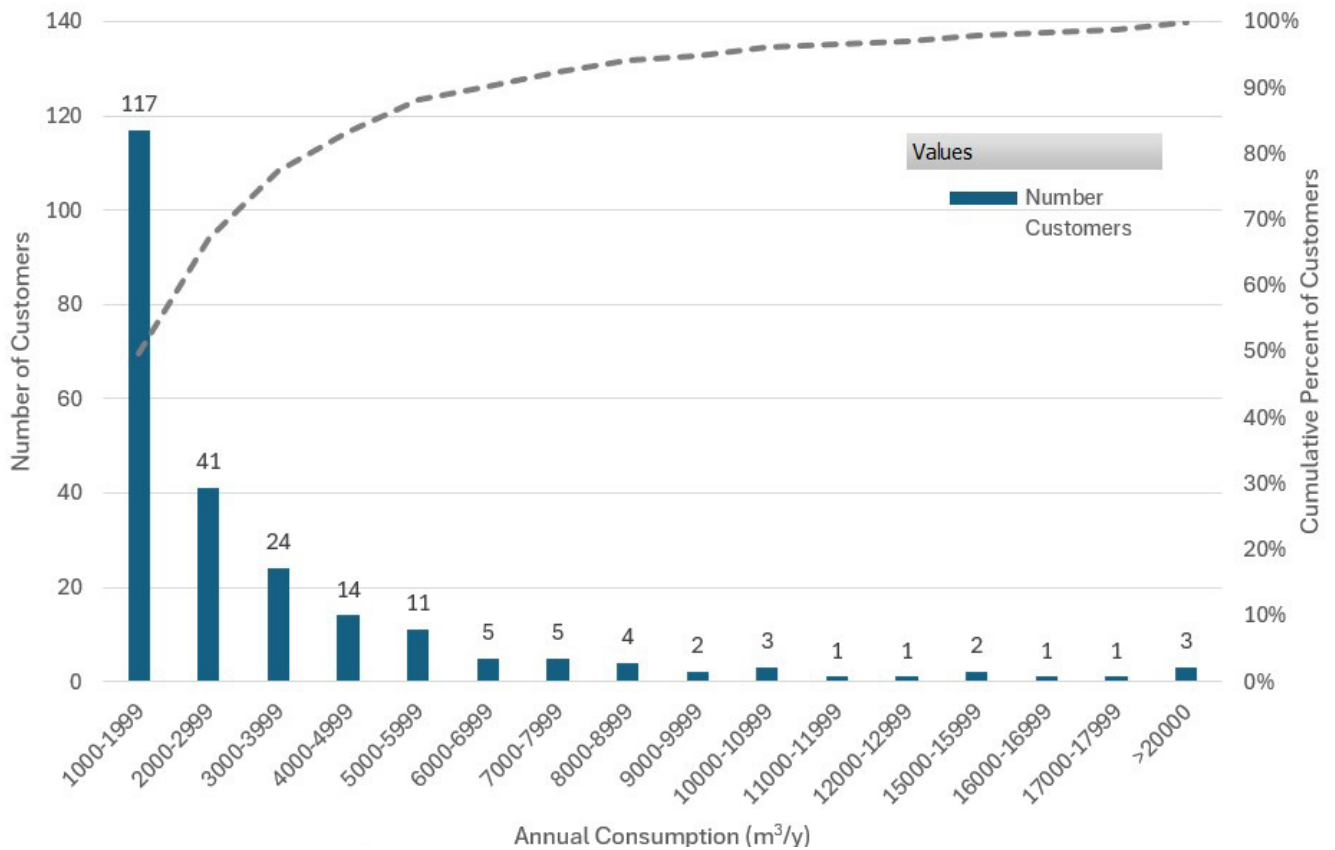


Figure 15 Histogram of Annual Water Consumption for Commercial Sector (2023)

Table 9 summarizes water consumption for commercial property categories having a total of 10,000 m³/year or more of water consumption.

Table 9 2023 Water Consumption for Commercial Property Types

Commercial Property Description	Total Consumption (m ³ /y)	Average Consumption (m ³ /y)	No. Customers
Neighbourhood shopping centre - with more than 2 stores attached, under one ownership, without anchor - generally less than 150,000 s.f.	257,214	518	497
Large office building (generally multi - tenanted, over 7,500 s.f.)	114,906	1,127	102
Neighbourhood shopping centre - with more than two stores attached, under one ownership, with anchor - generally less than 150,000 s.f.	112,713	777	145
Specialty automotive shop/auto repair/ collision service/car or truck wash	69,534	1,122	62
Limited service hotel	58,251	6,472	9
Retail or office with residential unit(s) above or behind - less than 10,000 s.f. gross building area (GBA)	36,086	198	182
Regional shopping centre	35,252	2,938	12
Retail or office with residential unit(s) above or behind - greater than 10,000 s.f. GBA, street or onsite parking, with 7 or more apartments, older downtown core	34,870	646	54
Entertainment complex - with a large cinema as anchor tenant	24,265	4,853	5
Retail - one storey, generally under 10,000 s.f.	23,282	295	79
Automotive fuel station with or without service facilities	22,681	1,418	16
Freestanding large retail store, national chain - generally greater than 30,000 s.f.	22,382	11,191	2
Neighbourhood shopping centre with offices above	22,346	972	23
Retail with office(s) - greater than 10,000 s.f., GBA with offices above	21,436	893	24
Restaurant - conventional	21,280	967	22
Auto dealership	16,688	927	18
Full service hotel	16,402	16,402	1
Multi-type complex - defined as a large multi-use complex consisting of retail/office and other uses (multi res/condominium/hotel)	14,447	1,111	13
Restaurant - conventional, national chain	13,605	4,535	3
Small Office building (generally single tenant or owner occupied under 7,500 s.f.)	12,464	244	51
Office use converted from house	12,452	166	75
Restaurant - fast food, national chain	11,309	1,414	8
Big box shopping/power centre greater than 100,000 s.f. with 2 or more main anchors	11,135	619	18
Large retail building centre, generally greater than 30,000 s.f.	10,096	3,365	3

As illustrated in the above table, water use for many types of commercial properties is relatively low, with most commercial properties using less than 1,000 m³/year. However, a few of the notably larger water users include:

- Hotels
- Conventional, national chain restaurants
- Large retail stores and building centres
- Entertainment complex with movie theatres

4.2.6 Institutional

In 2023, the total water consumption for institutional properties was 1,222,000 m³, approximately 8% of the total water consumption in the City of Guelph. Figure 12 shows a histogram of annual consumption for institutional customers using more than 5,000 m³/year. As shown on this figure, 23 customers used more than 5,000 m³ in 2023. Total consumption for these customers was 1,043,000 m³.

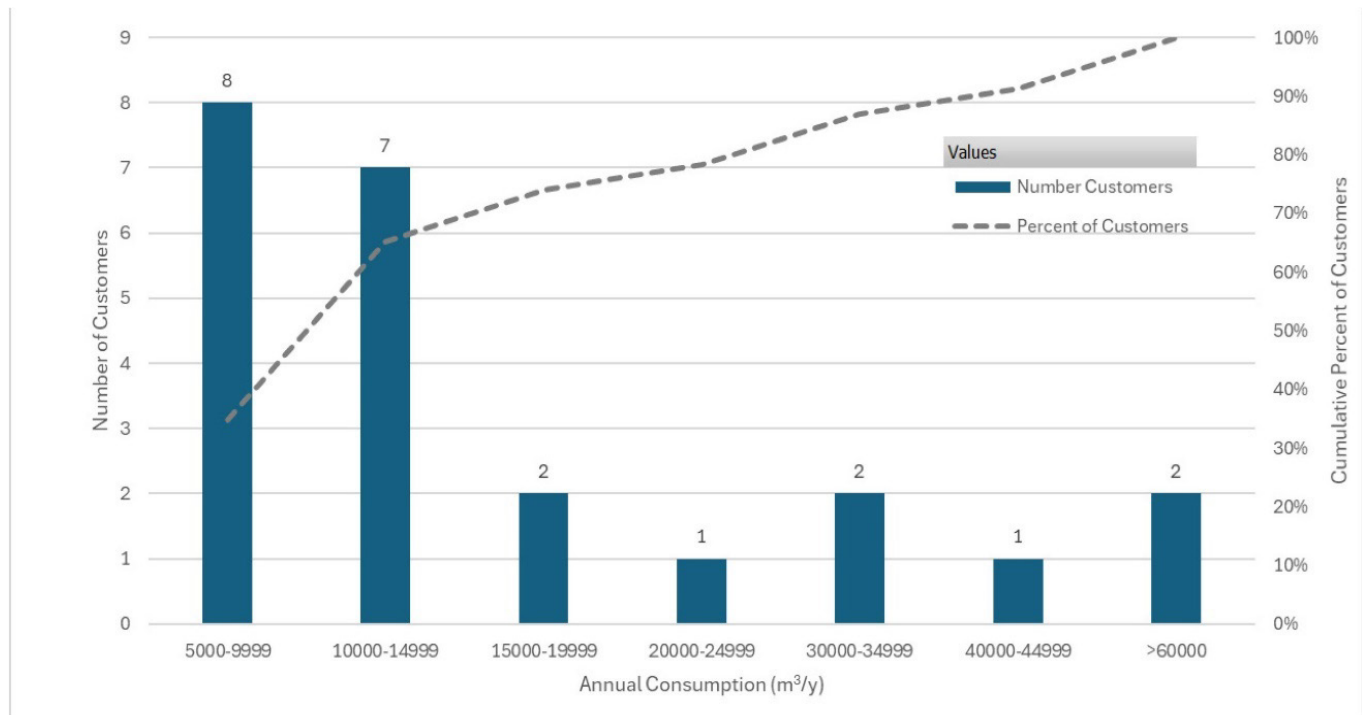


Figure 16 Histogram of Water Consumption for Institutional Customers (>5,000 m³/year)

Table 10 summarizes water consumption for each type of institutional property. Post secondary education (university, college) is the largest segment, followed by hospitals then schools. Notably, the University of Guelph is the largest institutional water user, with a consumption of 638,697 m³ in 2023 on the main campus.

Table 10 2023 Water Consumption for Institutional Property Types

Institutional Property Type	Total Consumption (m ³ /y)	Average Consumption (m ³ /y)	No. Customers
Post secondary education - university, community college, etc.	692,794	36,463	19
Hospital, private or public	163,846	23,407	7
School (elementary or secondary, including private)	84,415	1,535	55
Retirement/nursing home (combined)	60,460	20,153	3
Old age/retirement home	47,682	1,907	25
Nursing home	10,449	10,449	1
Other health care facility	5,125	1,708	3
Multiple occupancy educational institutional residence located on or off campus	4,944	2,472	2
Day care	2,841	947	3
Other institutional residence	529	529	1
Other correctional facility	198	198	1
Grand Total	1,072,940	8,867	121

4.3 Drinking Water Source Protection

Ontario's Drinking Water Source Protection Program, established under the Clean Water Act, 2006, aims to protect drinking water sources across the province by managing risks and preventing contamination. The program was introduced in response to the Walkerton tragedy in 2000, where contaminated drinking water led to a major public health crisis, underscoring the need for stronger protection measures. The program is designed to protect both surface water and groundwater sources and is overseen by the Ministry of the Environment, Conservation and Parks.

The City's Drinking Water Source Protection Program falls under the jurisdiction of the Lake Erie Source Protection Region (LESPR). The LESPR is tasked with managing and implementing source water protection policies to safeguard drinking water sources within its jurisdiction, which spans several watersheds that ultimately drain into Lake Erie. This region includes the Grand River, Catfish Creek, Kettle Creek, and Long Point Region watersheds.

The City's Drinking Water Source Protection Program is designed to safeguard the City's water sources, which are primarily groundwater-based. Key elements of Guelph's program include:

1. **Vulnerability Mapping:** Mapping and assessing the vulnerability of the City's water supply to water quantity and water quality threats; identifying areas where water sources are most susceptible to contamination or water quantity stress. Table 11 summarizes the various types of vulnerable areas mapped out and regulated as part of the source protection program.
2. **Risk Management:** Implementing risk management strategies to prevent contaminants from entering the water supply. This involves working with local businesses, agricultural operations, and residents to mitigate potential contamination risks.

3. **Education and Outreach:** Educating the public on best practices to protect groundwater, such as responsible disposal of hazardous materials and the importance of conserving water.
4. **Monitoring and Reporting:** Regular monitoring of water quality and quantity, along with periodic reporting to ensure the program's effectiveness and adherence to provincial requirements.
5. **Collaboration with Local Agencies:** Guelph collaborates with the source protection authority, neighbouring municipalities, and other stakeholders to address regional and local water protection concerns.

Table 11 Vulnerable Areas Mapped Out with the City of Guelph

Vulnerable Area	Description
Wellhead Protection Areas (WHPAs)	Zones around municipal wells where groundwater is drawn for drinking water. These areas are particularly sensitive as contaminants can quickly reach the water supply through the soil and into the aquifer.
Intake Protection Zones (IPZs)	Areas surrounding surface water intakes where water is drawn from lakes, rivers, or other bodies for municipal water systems.
Highly Vulnerable Aquifers (HVAs)	Areas where the aquifer (underground water-bearing rock or gravel) is highly vulnerable to contamination due to factors like shallow depth or permeable soil.
Significant Groundwater Recharge Areas (SGRAs)	Regions where a large amount of precipitation or surface water infiltrates into the ground and replenishes the groundwater supply. These areas are essential for maintaining groundwater levels, which feed municipal wells and other water systems.
Issues Contributing Areas (ICAs)	Specific areas around drinking water sources where known contaminants, such as nitrates or pathogens, have been identified and pose a risk to water quality.

The City's source protection plan, including the policies and strategies used to protect Guelph's water supply sources, is provided within the Grand River Source Protection Plan. The plan includes maps of vulnerable areas, risk assessments, and measures for risk mitigation. Digital copies of the plan are available on the Lake Erie Source Protection Region's website.

4.4 Water Supply Master Plan

The updated Water Supply Master Plan (AECOM, 2022) is in part intended to shape the integrated water management strategy and future water conservation efforts for the City. The plan is aimed at ensuring a safe and reliable water supply for the city's growing population. The plan is updated approximately every five years and aligns with provincial growth plan projections, spanning a 30-year period from 2021 to 2051. The 2022 WSMP confirmed that the existing water supply capacity would not meet future demands, prompting the exploration of new water sources and the feasibility of connecting these to the City's existing water supply system. Furthermore, the plan also serves as a guide for sustainable water use, highlighting the importance of conservation and efficiency measures. It also sets benchmarks for future water demand, which will guide the development and implementation of more targeted and effective water-saving initiatives.

The plan considers two future population and employment growth scenarios as discussed in Section 3.1.1, “reference” and “low,” from the Province of Ontario when developing water demand forecasts. The existing water supply system was assessed for its current maximum capacity and potential risks. The water demand projections are summarized in Section 4.3 and the total sustainable capacity is 79,422 m³/day under normal operating conditions. The plan also explores various water supply alternatives to optimize existing, and develop new, water supplies, with a focus on local sustainability. These alternatives include new well facilities, upgrades to the groundwater recharge system, and mediation with Dolime Quarry regarding its operations and impact on local groundwater. A summary list of the options to expand the City’s current groundwater supply system is as follows:

- Alternative 2A: Optimize existing municipal sources.
- Alternative 2B: Restore off-line municipal sources.
- Alternative 2C/D: Develop municipal test wells (including the Dolime Quarry).
- Alternative 2E: Develop new sources inside the City.
- Alternative 2F: Install new Aquifer Storage and Recovery wells inside the City to optimize excess Arkell Collector system volumes.
- Alternative 2G: Develop new wells outside the City.

The plan also proposes a new local surface water supply strategy. Two local surface water sources were assessed as potential supplies: the Speed River at Guelph Lake and the Eramosa River at the Arkell Spring Grounds. The Grand River Conservation Authority (GRCA) has recognized the Speed River at Guelph Lake as a reasonable source, but not the Eramosa River.

In the scenario of continued growth and no proactive measures (“do nothing” scenario), the City is projected to face a water supply shortfall by 2051. An additional water supply capacity of approximately 26,000 m³/day would be required to meet the maximum day demand (MDD), with an additional 15 percent allowance factored in for security of supply. Therefore, water conservation, efficiency, and demand management were recommended to continue as integral components of the preferred sustainable water supply solution. The plan further recommends that the total water budget be re-evaluated each time a new supply source is developed to ensure that additional groundwater extraction does not lead to adverse environmental effects. It also advocates for the implementation of additional surface water and groundwater monitoring programs, and the maintenance of the City’s source protection programs.

4.4.1 Water Supply Master Plan Demand Projections

The average day demand (ADD) and maximum day demand (MDD) are summarized in Tables 12 and 13 (WSMP). The per capita water demand values from 2020 to 2051, along with the “reference” growth rate population and employment values, were used to project the Average Annual Day (AAD) residential, employment, and Non-Revenue Water (NRW) demands until 2051. The total demand projections represent the estimated future total daily volume of water required on an average day.

Table 12 Projected Average Annual Day Water Demand – “Reference” Growth Scenario, m³/day

Demand Type	2021	2026	2031	2036	2041	2046	2051
Residential	24,282	25,871	27,459	29,048	30,637	32,225	33,814
ICI	16,112	17,119	18,126	119,133	20,140	21,148	22,155
NRW	8,860	9,439	10,019	10,559	11,178	11,758	12,338
Total Demand	49,254	52,429	55,605	58,780	61,955	65,131	68,306

The Maximum Day Factor (MDF), defined as the ratio between the water production rate on the highest single production day each year (maximum day) and the AAD production rate for the entire year, was used to project future maximum day water demands. The average MDF in Guelph between 2010 and 2019 was 1.24, and the highest ratio of 1.34 occurred in 2011. To be conservative, a Maximum Day Factor of 1.34 was used when projecting future maximum day water demands.

Table 13 Total Projected Average Annual Day and Maximum Day Water Demands – Reference Growth Scenario

Parameter	2021	2026	2031	2036	2041	2046	2051
Average Annual Day Demand (m ³ /day)	49,254	52,429	55,605	58,780	61,955	65,131	68,306
Maximum Day Demand using Maximum Day Factor of 1.34 (m ³ /day)	66,000	70,255	74,510	78,765	83,020	87,275	91,530

4.4.2 Water Demand Projections

The average per capita rates from 2015-2019 were used as a conservative basis for projecting water demand rates to 2051 (WSMP, 2022). These projected demands assume that further reductions in litres per capita per day (Lcd) customer demands will not occur.

- Residential demand rate: 167 Lcd
- Employment demand rate: 191 Lcd
- Non-Revenue Water (NRW) demand rate: 61 Lcd

It is assumed that NRW projected demand values will remain consistent with historical data. In previous Water Supply Master Plans (WSMP), the projected maximum day demand included residential, employment, NRW, and a “safety factor” for the projected demand. For the current WSMP, the projected water demands do not include a safety factor, making the total future demand projections appear 10 to 15% lower than those in previous master plans.

4.4.3 WSMP Water Conservation and Efficiency Alternative (Scenario 5)

The WSMP Scenario 5 (Table 14) aims to achieve a water saving reduction of 3,638 m³/day through a combination of initiatives by 2051. Scenario 5 involves adjusting the programming throughout the planning period (2021 to 2051). Initially, it builds on the success of demand reductions achieved under Scenario 2 in the short-term. As progress is made, the focus of the programming shifts to the strategies outlined in Scenarios 3 and 4 for the mid- and long-term periods, respectively.

Table 14 Water Conservation and Efficiency Scenarios (WSMP)

Time Period	Description	Actions
2021-2051	WSMP Scenario #1	<ul style="list-style-type: none"> No further reductions – ceasing non-provincially mandated water efficiency measures (baseline scenario)
2021-2031	WSMP Scenario #2	<ul style="list-style-type: none"> Reduce per capita residential and ICI water use by 7.9% (2051). Maintain NRW demand Implement the existing water conservation and efficiency (WC&E) strategy as usual.
2031-2041	WSMP Scenario #3	<ul style="list-style-type: none"> Assumes Scenario #2 reductions will diminish Move focus of programming to high-water users Achieve 50% of the reduction target set in Scenario #2
2041-2051	WSMP Scenario #4	<ul style="list-style-type: none"> Implement water reuse initiatives, using treated wastewater for various applications such as street sweeping, sewer flushing, urban applications, construction, municipal irrigation, and golf course irrigation. Potential to use appropriately treated savings of 5,678 m³/year (average of 15.6 m³/day).
2021-2051	WSMP Scenario #5	<ul style="list-style-type: none"> Blended scenario that achieves demand reductions under Scenario 2 in the short-term and subsequently shifting the focus of programming as described in Scenarios 3 and 4 in the mid- and long-term

4.5 Water Conservation and Efficiency Initiatives

This section provides a short description of each of the existing, planned, and potential water conservation initiatives. Existing initiatives are those in place as of the end 2024. Planned initiatives are those new initiatives that the City is planning to start in 2025. Potential initiatives are proposed as initiatives that are neither existing nor planned but may be modified versions of existing or planned initiatives.

4.5.1 Water Efficiency Strategy (2016)

The Water Efficiency Strategy (WES) is a detailed 10-year (2017-2026) plan to reclaim drinking water capacity through conservation, efficiency and optimization within the City’s drinking water system. The WES detailed programs (both direct and indirect water savings), pilots and research that promoted the value and importance of Guelph’s drinking water supply, promote innovation and research in water efficiency technologies, to ultimately achieve a reduction in annual average day production of 6,265 m³/day by 2027, contributing to the 2014 WSMP reduction target of 9,147 m³/day. This strategy was expected to provide a financial net benefit of approximately \$15.7 million by deferring water and wastewater capacity expansion and assisting in keeping water rates low through efficiencies within Water Services.

As of 2023, the cumulative direct water savings achieved since 2017 is 2,259 m³/day. Further, indirect savings have been achieved through the reduction of water loss due to leaks in infrastructure and on the private side, as well as compliance with the City’s Outdoor Water Use Program, education programming and outreach initiatives. The environmental benefits of these water efficiency measures include the source water protection benefit of drawing less water from the aquifer to meet the needs of the growing community, and an overall reduction in the energy consumption for water treatment and distribution. This has led to an anticipated reduction of 0.63 tonnes/day in greenhouse gas emissions and an expected savings of over \$2,500 in electricity costs per day due to water conservation and efficiency efforts.

Table 15 summarizes the list of water efficiency programs and outlines their program category and water savings type. Sections 8.2.1 and 8.2.2 summarize each program.

Table 15 Summary of Active and Yet to Be Enacted Water Efficiency Programs in the City (WES, 2016)

Savings Type	Program Category	Program
Direct Water Savings	Residential Sector	Royal Flush Toilet Rebate Program ⁽¹⁾
		Blue Built Home Water Efficiency Standards and Rebate Program
		Water Use Home Visit and Audit Program
		Water softener study and rebate
	Multi-Residential Sector	Multi-Residential Water Audit Program
		Residential Sub-Water Meter Rebate Program
		All-Season Rainwater Harvesting Rebate Program
	Industrial, Commercial and Institutional Sector	Water Smart Business Program
		Industrial, Commercial, and Institutional Capacity Buyback Program
	Municipal Operations	Municipal Facility Water Efficiency Upgrades
		Water Loss Management Program
		Automated meter reading installation
Indirect Water Savings	Peak Season Water Demand Management Initiatives	Outside Water Use Program
	Public Outreach and Education	Curriculum-Linked Education Programming
		Mobile Water(Water Wagon)
		Drinking water promotion
	Mobile Apps	Mobile water use app
	Research and Innovation ⁽³⁾	Water softener study and rebate
		Automated Meter readings study and installation
		Water Energy/Nexus study
		Water conservation and rebound effects study
		Water reuse and demand management study
		Municipal upgrades best practices study
		Cooling tower audit/rebate study
Irrigation system audit and rebate		
Distribution system pressure management		

Notes:

(1), (2), (3) These programs apply to the residential, multi-residential and municipal program categories.

4.5.2 Current WC&E Strategy – Active Initiatives

In 2014, Guelph City Council endorsed the updated Water Supply Master Plan (WSMP). The 2014 WSMP established a reduction target of 9,147 cubic metres in average daily production by 2038 to guide the City's water efficiency programming. Much of the City's current WC&E Strategy was conceived in the 2016 Water Efficiency Strategy Update (2016 WES) based on stakeholder engagement, community feedback, technical reviews, and research with the intention of implementing the program over the following 10-year period. Council approved the 2016 Strategy which defined programs, policies, and resources to help the City meet its water use reduction targets. The following is a summary of each of the active programs implemented by the City as part of the WC&E Strategy.

The goals for implementing and maintaining the City's WC&E are two-fold; firstly, to create the opportunity for the current water supply to serve as large a population and employment base as possible, and secondly, to delay new capital projects needed for growth as far into the future as possible. The City's 2024 retail price of water is \$2.12/m³ which is sufficient to cover O&M costs for the current system. As part of the 2022 WSMP Update (AECOM 2022), the estimated cost of bringing on new groundwater water supplies is approximately \$5,000 per m³/day of water.

The 2016 WES identified a 10-year water savings goal of 6,265 m³/day between 2017 and 2026 and introduced a series of programs and policies to be operationalized over the 10-year program to meet the goal. Overall, the programs are categorized as A) Direct Water Savings Programs, B) Indirect Water Savings Programs, and C) Research Projects. Table 16 lists the eight direct water savings programs that have been operationalized to date. The table summarizes estimated water savings for each of the programs in 2023 and for the program over the 2017-2023 period (City of Guelph 2023c).

Based on community uptake and participation in direct-savings water efficiency programs, the total water savings achieved for 2023 was 84.8 m³/day. Since the implementation of the 2016 WES, the estimated cumulative water savings achieved to date is 2,258.9 m³/day (2017-2023). As described in the previous sections, much of the City's significant achievement in direct water savings was realized prior to 2017 with the per capita water consumption falling from 218 lcd to 165 lcd in 2017. There have not been notable savings in residential water consumption from 2017 to present. Most of the recent savings (78%) are attributed to the reduction in Non-Revenue Water and the success of the Water Loss Management program.

The City has recognized that the goal of operationalizing the 2016 WES programs was hindered by organizational and engagement challenges resulting from the COVID-19 pandemic. The City has maintained its Indirect Water Savings programs, with the combined effect being that the City's per capita water consumption was 162 lcd in 2024 – and as noted earlier, this is amongst the lowest of any Canadian municipality.

Table 16 Water Efficiency Strategy Program Progress (WES, 2023)

Water Efficiency Program	WES Target, 2023 Average Daily Water Savings (m ³ /day)	Achieved Average Daily Water Savings (m ³ /day), 2023	Number of Rebates/Audits, 2023	WES Combined Target: Average Daily Water Savings (m ³ /day), 2017-2023	Achieved Average Daily Water Savings (m ³ /day), 2017-2023	Total Number of Rebates/Audits, 2017-2023
Royal Flush	18	21.4	560	168	166	4,339
Blue Built Home	1	1.3	5	15	13	49
Home Visit/Audit	N/A	1.1	15	65	30	869
Multi-Residential Audit	7	18.6	9	66	107	42
Residential Sub-Water Meter	2	0	0	7	9	26
Water Smart Business	250	0	3	1,050	138	11
Municipal Facility Upgrades	33	2.2	5	154	40	11
Water Loss Management	475	40.2	35	2,336	1,755	120
Totals	674	84.8	632	3,861	2,259	5,467

Table 17 Water Efficiency Program Descriptions (WES, 2023)

Water Efficiency Program	Details
	Achievements: Identified and potentially replaced leaking and/or inefficient faucet aerators, showerheads, and toilets. Verified other water-using fixtures such as hot water distribution systems, dishwashers, and washing machines.
Multi-Residential Sector	
Multi-Residential Audit	Updates: In 2023, the City contracted Reep Green Solutions to conduct detailed water audits of multi-residential buildings. 9 buildings participated in the program. Achievements: Participants received detailed reports on daily water demand patterns, leak presence, and potential water-saving opportunities. Assumed a 10% reduction in daily water use following the audit.
Residential Sub-Water Meter Rebate	Updates: Open to single and multi-family residential sectors in Guelph. Achievements: No water savings. No applicants in 2023. Challenges: Poor participation in 2023. Staff will promote the program more widely in 2024.
Industrial, Commercial and Institutional	
Water Smart Business	Updates: Annual speaker series featured 3 virtual talks. Over 30 participants attended the 2023 speaker series. Achievements: 3 businesses participated in the program. Although no direct savings were reported, the audits identified 18 m ³ of water per day attributed to leaks. These identified leaks were promptly resolved by the businesses. Challenges: Staffing gaps and transitions. Needed to adapt programs post-pandemic.
Municipal Operations	
Municipal Facility Water Efficiency Upgrades	Updates: Retrofitted washrooms at four facilities with WaterSense-certified showerheads, saving 2.18 m ³ /day. Upgraded the irrigation controller at Lyon Park, resulting in an additional 0.10 m ³ /day of water savings during the summer season. Actively repaired leaking infrastructure following best practices.
Water Loss Strategy	Achievements: Achieved continuous improvement in minimizing non-revenue water. Low infrastructure leakage index at 1.4, approaching a theoretical lower limit. Cumulative savings since program launch in 2018: 106.64 m ³ /day. Challenges: Further reductions may not be economically feasible due to potential costs exceeding water lost from leaks. The consultant's review recommends not exceeding an additional expenditure of \$97,000 to \$116,000 per year.
Leak Detection Program	Achievements: Identified 35 possible leaks.
Indirect Water Savings Programs	
Peak Season Water Demand Management Initiatives	
Outside Water Use Program	Updates: Two level changes in 2023: June 7 - Changed from Level 0 Blue to Level 1 Yellow. August 2 - Changed back from Level 1 Yellow to Level 0 Blue. In the season, 99 permits were issued: 65 new lawn watering permits, 0 treated lawn watering permits, 34 time shift permits.
Healthy Landscapes Program	Achievements: Completed 216 complimentary one-hour visits by trained staff. Held 5 virtual talks. Over 1,095 participants in the 2023 speaker series. Landscape Vegetable Garden Design Course had 180 participants. Lawn Science Day had 25 attendees with a hands-on seminar, partnership with Guelph Turfgrass Institute. Sold 600 rain barrels to Guelph residents in 2023. Distributed an additional 30 rain barrels to City facilities and community gardens.

4.5.3 Direct Water Savings Programs

This section describes each of the City's active Direct Water Savings programs.

4.5.3.1 Royal Flush Toilet Rebate Program

Summary: The Royal Flush program offers a \$50 rebate to residents who replace older toilets (6 litres per flush or more) with WaterSense®-certified models using 4.8 litres or less. The goal is to reduce indoor water use by encouraging adoption of high-efficiency fixtures.

Progress Made (2017–2023): Between 2017 and 2023, the City processed approximately 4,300 rebates—progress that is close to the original forecast of 6,500 rebates in the first five years outlined in the 2016 Water Efficiency Strategy (WES). The program has resulted in an estimated savings of 166 m³ of water per day.

Impacts to Success: While the program has achieved notable uptake, estimating the remaining number of inefficient toilets in Guelph remains challenging. Improved tracking through homeowner or property manager surveys, especially in multi-residential buildings, could help refine future program targeting. The program's originally estimated benefit:cost ratio of 1.6 supports continued implementation.

4.5.3.2 Blue Built Home Water Efficiency Standards and Rebate Program

Summary: The Blue Built Home Program aims to reduce indoor water demand through the use of high-efficiency fixtures and appliances in new and existing homes, including multi-residential buildings. Homeowners can choose from three certification pathways that promote water-efficient technologies and practices as illustrated in Table 18.

Progress Made (2017–2023): From 2017 to 2023, the program supported the certification of several properties totaling 49 homes, reducing water consumption by an estimated 13 m³/day. Four single-family homes and one six-unit multi-residential building achieved Blue Built certification in 2023. Three of these homes accessed City rebate programs to meet certification, with two also installing all-season rainwater harvesting systems. The estimated average water savings in 2023 was 1.3 m³/day. While initial uptake has been lower than the 50 homes anticipated in year one of the 2016 WES, the program continues to support innovation in water conservation.

Impacts to Success: Participation has been modest, partly due to the voluntary nature of the program and potentially limited awareness. Despite a benefit:cost ratio of less than 1, the program plays an important role in demonstrating and encouraging adoption of advanced water-saving technologies in the residential sector.

Table 18 City of Guelph Blue Built Home Options (City Website, 2025)

About options A and B

Options	Certification requirements	Rebate
Option A	Install a greywater reuse system to flush your toilets and you could save more than \$300 a year	\$1,000
Option B	Install and all-season indoor/outdoor rainwater harvesting system to flush your toilets and water lawns and gardens and you could save more than \$400 a year	\$2,000

About option C

Option C	Choose at least two primary, and one other requirement	Rebate (each)
Primary	Install an EnergyStar® rated washing machine that uses 5,500 gallons per year or less.	\$50
Primary	Install a WaterSense® toilets* (less than or equal to 4.0 litres per flush, all of these items in the home or unit must qualify.)	\$50
Primary	Install an Energy Star® dishwasher	n/a
Primary	Install an efficient hot water distribution system	Up to \$100
Primary	Install WaterSense® showerheads (less than or equal to 6.6 litres per minute, all of these items in the home or unit must qualify.)	\$10
Secondary	Install WaterSense® bathroom faucets or faucet aerators (less than or equal to 5.7 litres per minute, all of these items in the home or unit must qualify.)	n/a
Secondary	Install a permanent water sub-meter	\$100
Secondary	Install a temporary water sub-meter	\$100
Secondary	Install a waterless floor drain trap primer	\$20
Secondary	Complete a Healthy Landscape visit for Blue Built Home	n/a
Secondary	Other water saving product or technology as approved by the City of Guelph	As approved by the City of Guelph

4.5.3.3 All-Season Rainwater Harvesting Rebate Program

Program Summary: The All-Season Rainwater Harvesting Rebate Program encourages the use of captured rainwater for non-potable purposes such as toilet flushing, laundry, or irrigation. The goal is to reduce demand on the City’s drinking water supply by promoting sustainable water reuse practices in homes and businesses.

Progress Made (2017–2023): In 2023, two installations were approved under this program as part of Blue Built Home certifications. The associated water savings are captured within the Blue Built Home Program reporting, contributing to overall reductions in daily water use.

Impacts to Success: Adoption has been limited, likely due to the higher cost and complexity of installing all-season systems. However, integration with programs like Blue Built Home may improve uptake by bundling incentives and demonstrating long-term value.

4.5.3.4 Home Visits and Audits

Program Summary: This program provides residents with a free one-hour in-home water audit to identify opportunities for improving water efficiency through retrofits and behavioral changes. The audit includes checks for leaks, assessment of fixtures, and recommendations for upgrades to appliances and plumbing features.

Progress Made (2017–2023): From 2017 to 2023, 869 home audits were completed, initially delivered through a partnership with eMerge, a Guelph-based nonprofit. In 2023, the City transitioned delivery to Greenbrain Inc., completing 15 audits that year. Estimated water savings for 2023 were 1.13 m³/day, with an overall average of 30.23 m³/day saved since the program began.

Impacts to Success: While the program has achieved substantial savings, results from previous years were based on estimates provided by eMerge and were not verified through monitoring. Audit completion has fallen short of the initial five-year target of 1,500 homes.

4.5.3.5 Multi- Residential Audit Program

Program Summary: Launched through the 2016 Water Efficiency Strategy (WES), this program aims to identify water savings opportunities in multi-residential buildings through detailed audits. It involves data logging of the main water meter to develop a 24-hour demand profile, assess per-suite water use, detect leaks, and evaluate potential savings from fixture upgrades. Participating buildings may also be eligible for rebates through the Royal Flush Program.

Progress Made (2017–2023): As of 2023, nine buildings participated in the program, with audits delivered by Reep Green Solutions. Each received a report outlining water demand patterns, leak detection results, and recommended retrofits. The estimated water savings for 2023 were 18.60 m³/day, contributing to a total program savings of 106.64 m³/day since its launch in 2018.

Impacts to Success: Uptake remains below the initial targets of 40 buildings in 5 years and 55 in 10 years, as set in the 2016 WES. However, the audits continue to provide insight into building water performance and identifying conservation actions. Realizing the full potential of savings depends on building owners acting on audit recommendations.

4.5.3.6 Multi-Residential Sub-Metering Program

Program Summary: Recommended in the 2016 Water Efficiency Strategy (WES), this pilot program provides financial support to companies for the installation of permanent sub-meters in multi-residential buildings. The goal is to promote water conservation by enabling individual unit-level water monitoring, working in alignment with the Multi-Residential Water Audit Program.

Progress Made (2017–2023): Since the program's launch, a total of 26 sub-meters have been installed, resulting in an estimated water savings of 9.2 m³/day. The 2016 WES had projected an installation rate of 20 metres per year, with expected savings of 54 litres per day per unit.

Impacts to Success: Verifying actual water savings remains challenging due to variability in unit occupancy, unknown building populations, and limited access to usage data. These factors have constrained the ability to fully quantify program impact, despite the potential benefits of sub-metering in encouraging behavior change and leak detection.

4.5.3.7 Water Smart Business

Program Summary: A large proportion of this water is consumed by a small number of customers. This program supports water conservation in the ICI sector, which accounts for nearly 40% of the City's total water demand. It funds water audits for facilities and offers financial rebates for implementing water-saving measures. Facilities receive up to \$0.75 per litre per day of verified and sustained water savings, with audits averaging \$7,000 per site.

Progress Made (2017–2023): Since 2016, water audits have been completed and rebates issued for 11 facilities. Although the 2016 WES set a target of 15 audits per year with expected average savings of 10 m³/day per site, total estimated savings from participating facilities amount to 138 m³/day.

Impacts to Success: While the program shows strong potential for high-impact savings from a relatively small number of participants, it is unclear whether the reported water savings have been verified through monitoring. Tracking and verification remain important for demonstrating long-term program effectiveness.

4.5.3.8 Municipal Facility Upgrades

Program Summary: This program aims to improve water efficiency within City-managed facilities by identifying and implementing water-saving measures. Beginning with audits of 16 high-use municipal buildings in 2014, the program uses site visits, historical and real-time water data analysis, and logging to evaluate savings potential and guide retrofits. The 2016 Water Efficiency Strategy (WES) recommended continued municipal leadership in conservation through upgrades and pilot initiatives, such as rainwater harvesting and wastewater reuse.

Progress Made: (2017–2023): Since 2017, 11 City facilities have been upgraded—exceeding the 2016 WES target of one facility per year. These improvements have contributed to an estimated total water savings of 40.27 m³/day as of 2023.

Impacts to Success: The program has successfully demonstrated municipal leadership in water conservation. Continued investment and internal coordination remain key to maintaining progress, particularly for implementing innovative technologies and supporting research within public facilities.

4.5.3.9 Water Loss Management (Leak Detection and DMAs)

Program Summary: The Water Loss Management Program aims to minimize leakage in the City's water distribution system by implementing District Metering Areas (DMAs), leak detection technologies, and industry best practices. The program seeks to maintain leakage at the Economic Level of Leakage (ELL)—the point at which the cost of reducing leaks is balanced with the value of water saved. Recognized as a leading initiative in the municipal water sector, the program is guided by data analysis, acoustic leak detection, and targeted infrastructure upgrades.

Progress Made (2017–2023): The City continued to advance the program following the 2016 Water Efficiency Strategy (WES) recommendations. In 2023, sounding and correlation surveys were completed across the full water distribution network, identifying 35 potential leaks. Leak remediation reclaimed approximately 40.19 m³/day in servicing capacity for the year. From 2017 to 2023, cumulative water savings totaled an estimated 1,755 m³/day—surpassing the 2016 WES target of reducing leakage by 1,433 m³/day.

Impacts to Success: Results from 2023 indicate that the City has effectively reached its ELL, as reflected by an Infrastructure Leakage Index (ILI) of 1.4. This suggests the program is successfully maintaining leakage at optimal economic levels. Ongoing monitoring and maintenance will be essential to sustain performance and maximize cost-efficiency over time.

4.5.4 Indirect Water Savings Programs

The City has made tremendous progress in reducing per capita residential and ICI water consumption. This progress has allowed for both population and economic growth while maintaining relatively consistent average and peak water demand. While the direct water savings programs result in quantifiable benefits, the City’s indirect water savings programs are critical to driving community engagement, and cultural and behavioural change needed to reduce water consumption and maintain consumption at such low levels.

The City continues to offer a variety of successful programs as described below to increase awareness about and influence attitudes and habits regarding water use, as well as inform the public on how the City invests their rate dollars.

4.5.4.1 Outdoor Water Use Programs

Program Summary: The Outside Water Use Program (OWUP) aims to reduce peak summer water demand by regulating outdoor water use during high-demand periods. Guided by the City’s Outside Water Use Bylaw, the program sets water use restrictions on activities such as lawn watering and car washing during hot, dry weather or when local river flows are low. The program operates under three levels, each with specific restrictions, as summarized in Table 19.

Progress Made (2017–2023): The OWUP has remained a core component of the City’s strategy to manage seasonal demand and protect drinking water resources. By implementing staged restrictions as needed, the program helps reduce strain on water infrastructure during critical summer months.

Impacts to Success: The program’s effectiveness depends on enforcement, public awareness, and cooperation during periods of water use restriction. This has pushed the maximum day demand into the shoulder seasons flattening seasonal demand. Continued enforcement, communication and education are important to ensure compliance and maintain reductions in peak water use.

Table 19 Summary of City of Guelph Outdoor Water Use Program

Level	Restrictions
Level 0 Blue – Careful Use	<ul style="list-style-type: none"> • Lawn Watering: Permitted between 7 to 9 a.m. and 7 to 9 p.m. Residents with even- numbered addresses may water on even-numbered calendar days; those with odd- numbered addresses may water on odd-numbered days. • Car Washing: Allowed at home using a hose equipped with a shut-off nozzle. • Watering Ornamental Gardens: Permitted at any time. • Watering Vegetable Gardens, Trees, and Shrubs: Permitted at any time. • Enforcement: A \$250 fine or court summons may be issued for repeat violations. • Water Supply Status: No significant concerns regarding storage, rainfall, or streamflow.

Level	Restrictions
Level 1 Yellow – Moderate Restrictions	<ul style="list-style-type: none"> • Lawn Watering: Permitted between 7 to 9 a.m. and 7 to 9 p.m., following the odd/even address schedule as in Level 0. • Car Washing: Allowed at home with a shut-off nozzle. • Watering Ornamental Gardens: Permitted at any time. • Watering Vegetable Gardens, Trees, and Shrubs: Permitted at any time. • Enforcement: A \$350 fine or court summons may be issued for violations. • Water Supply Status: Indicators such as reduced rainfall, low river flow rates, or decreased water storage levels suggest emerging concerns.
Level 2 Red – Severe Restrictions	<ul style="list-style-type: none"> • Lawn Watering: Not permitted. • Car Washing: Not permitted. • Watering Ornamental Gardens: Allowed only between 7 to 9 a.m. and 7 to 9 p.m., adhering to the odd/even address schedule. • Watering Vegetable Gardens, Trees, and Shrubs: Permitted at any time. • Enforcement: A \$550 fine or court summons may be issued for violations. • Water Supply Status: Significant concerns due to factors like substantially below-average precipitation, critically low river flows, or markedly reduced water storage levels.

4.5.4.2 Healthy Landscapes Home Visit

Program Summary: The Healthy Landscapes Program promotes sustainable yard care practices that balance attractive landscaping with water conservation and environmental protection. The program offers education, hands-on learning, and personalized support to help residents adopt low-impact landscaping techniques.

Progress Made (2017–2023): In 2023, the program featured a five-part virtual speaker series on outdoor water conservation, drawing over 1,095 participants. An additional 180 residents participated in a three-part vegetable garden design course, while 25 attended an in-person lawn care seminar. The City also completed 216 complimentary one-hour Healthy Landscape Visits, offering tailored advice to homeowners. Since 2017, approximately 1,600 visits have been delivered. In collaboration with Stormwater Engineering, 600 rain barrels were sold in 2023 through a discounted program.

Impacts to Success: The program continues to be well-received, with high participation in educational events and steady demand for landscape consultations.

4.5.4.3 Public Outreach and Education

Program Summary: The City’s public education and outreach initiatives aim to build community awareness and support for water conservation and sustainability efforts. Programs include school-based education, facility tours, public events, and targeted campaigns that align with the City’s broader water efficiency goals.

Progress Made (2017–2023): In 2023, the City delivered 38 school presentations to 1,418 students, along with 46 facility tours (20 water, 26 wastewater) engaging 700 students. Four guest speaker events between World Water Day and Earth Day reached 1,625 students, while World Toilet Day programming engaged 400 more. The City also participated in the Waterloo-Wellington Children’s Groundwater Festival, connecting with 4,000 students—1,300 from Guelph.

Public outreach events included Fix-A-Leak Week (1,300 participants), Girl Guides and Scouts badge programming (15 participants in a pilot), and summer camp activities reaching 314 youth. Public Works Week drew over 300 attendees, while EcoMarket saw more than 5,000 visitors, with 300+ engaging directly with City staff. Speaking engagements with new residents and a World Toilet Day hardware store event further supported public awareness and rebate uptake.

Impacts to Success: High participation across age groups reflects the program’s strong reach and relevance. Success is supported by strong interdepartmental coordination and strategic timing around environmental awareness days. Continued engagement through schools, festivals, and newcomer services helps build lasting awareness of water conservation practices and available City programs.

4.5.4.4 Drinking Water Promotion

Program Summary: The City promotes the use of tap water and reduction of single-use plastics through its “Bring. Fill. Drink.” campaign. This message is also shared by the Water Wagon, Water Services trailers, and prominently displayed on public fountains and bottle fill stations, which are mapped on the City’s website. At community centres, vending machines offer reusable water bottles near fountains and fill stations instead of selling bottled water.

Progress Made (2017–2023): From 2017 to 2023, the City expanded promotion of “Bring. Fill. Drink.” across public events and facilities. Refill stations were made easier to find through the City website, and community centres were equipped with vending machines offering reusable bottles. The City also joined the Blue W program (bluew.org), increasing access to free refill locations through partnerships with local businesses and organizations.

Impacts to Success: Program success depends on continued public awareness, easy access to refill stations, and community support. Ongoing promotion and investment will be key to maintaining and growing the initiative.

4.5.4.5 Mobile Applications (Water)

The 2016 WES recommended that the City continue developing the Watr mobile water engagement application with the local startup company Focus21. This app will allow users to see their water consumption data and compare it to their peer grouping. Challenges to reduce consumption will be presented along with conservation messaging through push notification. The Watr app was tested in 2017; however due to the complexities of which the datamart availability through Guelph Hydro and subsequent Alectra acquisition, this application was retired. It did not have the uptake nor useability intended at development.

4.5.5 2016 WES – Recommendations Not Implemented

The 2016 WES recommended a number of water efficiency initiatives that have not yet been implemented by the City as a program. Implementation of many of these programs was interrupted by impacts of the COVID-19 pandemic. These initiatives are summarized below:

4.5.5.1 Irrigation Audit (Water Smart Irrigation Professional) Program

The 2016 WES recommended that the City implement a Water Smart Irrigation Professional program involving offering qualified irrigation professionals in-class training and access to a proprietary software program to help them optimize irrigation schedules of automatic irrigation systems.

4.5.5.2 Irrigation System Rebate Program

The 2016 WES recommended that the City begin offering customers with automatic irrigation systems a \$300 rebate towards the purchase of smart weather-based controllers to prevent automatic irrigation systems from operating when supplemental irrigation is not needed.

4.5.5.3 Distribution System Pressure Management

The 2016 WES recommended that the City investigate the potential for pressure management when designing future pressure zones (5-10 years). This proactive approach is seen to reduce implementation costs and allow the City to reduce the amount of unavoidable water loss during periods of low customer demand.

4.5.6 WC&E Strategy -Studies and Research Programs

The 2016 Strategy recommended a series of research projects and pilot studies to better understand the feasibility and technical practicality of a series of projects. Implementation of many of these programs was interrupted by impacts of the COVID-19 pandemic. Each of these recommended projects and their status are summarized below.

4.5.6.1 Water Reuse and Demand Management Study

- **Rainwater Harvesting Pilot**

The 2016 WES recommended a study into the feasibility of rainwater harvesting. The study would include research and pilot new technology and verify savings by sub-metering or monitoring the billing data of participants.

- **Rainwater Collection Network Regulations**

The 2016 WES recommended a study into Rainwater Collection Network Regulations. The study would facilitate a review of rainwater harvesting solutions to allow for potential changes to regulatory documents.

- **Greywater Reuse**

The 2016 WES recommended a study into Greywater Reuse. The study would research and pilot new technologies and verify savings by sub-metering or monitoring billing data of participants.

- **Municipal Water Reuse**

The 2016 WES recommended a study into Municipal Water Reuse. The study would investigate the potential for water reuse pilot projects, including increasing social acceptability, potential management frameworks, communal systems and large-scale deployments.

4.5.6.2 Water Conservation and Rebound Effects Study

In 2018, the City completed a Rebound Effects Study which was broken up into several tasks, which included (i) Billing Data Analysis, (ii) Hydraulic Modelling, (iii) rebounding of outdoor demand, (iv) automatic irrigation systems, (v) land use change, and (vi) bulk meter impacts.

4.5.6.3 Water/Energy Nexus

The 2016 WES recommended further investigation to leverage federal/provincial energy programming to provide educational materials to customers on the connection between water demands and energy use.

4.5.6.4 Municipal Upgrades Best Practices Study

The Best Municipal Building Practices - Compliance, Programs, and Performance policy was created in 2017, following a review of water demand data for City-managed facilities. Water audits were completed at 16 City facilities, which included site visits, historical water demand data analysis, and water demand data logging to identify potential water efficiency measures, estimated water/cost savings, and implementation costs.

The best practices document considers indoor/outdoor water use needs and considerations for new construction, renovations, renewals, and upgrades. The policy considers criteria including, but not limited to fixture, appliance, and building system purchase/replacement/optimization, data monitoring, operational needs, and stormwater management considerations. The policy is reviewed yearly and updated as required.

4.5.6.5 Automated Meter Research Study

The 2016 WES recommended a pilot study to install automated meter reading in new developments to assess preferred technology alternatives and define a business case for larger deployment. The recommended installation of automated meter reading technology was to start in 2022 if the recommended research supported this program. A business case was developed by Diameter Services in 2021. However, due to budgetary constraints, roll-out of upgraded technology has since been delayed. Anticipated consideration for future capital upgrade.

4.5.6.6 Cooling Tower Audit Research Program

In 2017, the City partnered with the Alliance for Water Efficiency to fund the Cooling Technologies Project. The project aimed to:

1. Develop a practical guide to increase the effectiveness of cooling water use efficiency and outreach programs.
2. Understand the water savings potential of alternative cooling technologies.
3. Estimate consumptive and non-consumptive water demand for cooling.

The study was completed in October, 2022.

4.5.7 Other Water-Related City Rebate Programs

The programs described above are mostly directed towards the Water Efficiency Strategy. The city currently offers a number of additional programs that provide co-benefits between stormwater, water supply, and wastewater.

It is important to acknowledge these co-benefits even though it may be difficult to quantify water and cost savings to one or all of the broader water categories. As an example, rain barrel discounts promote the capture of stormwater and reducing direct discharge to the stormwater system. Water captured by rain barrels is then typically used for domestic garden watering; therefore, reducing residential water demand.

The city offers the following rebate programs in addition to those directed specifically at the Water Efficiency Strategy.

4.5.7.1 Subsidized Rain Barrel Sale

The City's Rain Barrel Discount Program encourages residents to conserve water by offering discounts on rain barrels. These barrels collect and store rainwater from roofs, which can then be used for outdoor watering and gardening. This initiative helps reduce the demand on the municipal water system, especially during peak usage periods, and promotes sustainable water practices. By using captured rainwater, residents can lower their water bills and contribute to the city's broader water conservation goals. The program supports Guelph's commitment to environmental stewardship and resource efficiency.

4.5.7.2 Seasonal Rainwater Harvesting System Rebate

The City of Guelph offers rebates of up to \$2,000 for residents who install approved rainwater harvesting systems, calculated by \$0.50 per litre of tank. Seasonal systems, used mainly in spring and summer for outdoor purposes like gardening and car washing, must include a 500-litre tank and specific safety features. All-season systems, which can be used year-round for indoor uses like toilet flushing and laundry, require professional design and installation, a building permit, and may qualify for Blue Built Home certification. These systems help conserve groundwater, reduce infrastructure strain, and lower water bills.

4.5.7.3 Rain Garden Rebates

The City of Guelph's Rain Garden Rebate Program offers financial incentives to residents (up to \$2,000) who install rain gardens on their properties. Rain gardens help manage stormwater by absorbing and filtering rainwater, reducing runoff, and improving water quality. This program supports Guelph's efforts to promote sustainable landscaping practices and enhance local stormwater management. By creating rain gardens, residents can contribute to reducing the strain on the city's drainage systems while beautifying their properties and promoting the infiltration of groundwater.

4.5.7.4 Subsidized Tree Planting Program

The City of Guelph's Subsidized Tree Planting Program provides a free tree on City-owned property in front of homes and businesses. This program aims to increase the city's tree canopy, enhance biodiversity, and improve air quality. Guelph residents can request a tree consultation with a qualified arborist, order trees at a subsidized price and receive full-service delivery, planting, mulch and care guide. Program runs in partnership with Reep Green Solutions who provide on-site arborist services to homeowners, the goal is to get the right tree in the

right place so that it can eventually reach maturity and the maximum stormwater management. By encouraging tree planting, the program helps mitigate the urban heat island effect, manage stormwater, and promote a healthier, greener environment.

4.5.7.5 Stormwater Credit for Business

The City of Guelph's Stormwater Credit Program for businesses offers financial incentives (up to 50% reduction of the stormwater service fees) to commercial and industrial property owners who implement stormwater management practices on their properties. These credits are applied to their stormwater service fees, rewarding efforts such as installing permeable pavement, green roofs, or onsite retention systems. The program encourages businesses to reduce runoff, improve water quality, and alleviate pressure on the city's stormwater infrastructure, contributing to Guelph's overall sustainability and flood mitigation goals. Depending on the technology implemented, the projects may also promote infiltration of groundwater to better support the drinking water supply.

4.5.8 A Salt-free Alternative to Residential Water Softeners: Market Research Study

The Salt-Free Alternative to Residential Water Softeners: Market Research Study was conducted to evaluate the effectiveness of NAC/TAC (Nucleation/Template Assisted Crystallization) water conditioners as an alternative to traditional salt-based water softeners in Waterloo Region and the City of Guelph. The study focused on reducing the environmental impact of water softeners, which discharge large amounts of salt and wastewater. The primary goals were to assess user perceptions, understand the performance of NAC/TAC units in real homes, and explore opportunities for transitioning away from salt-based softeners.

Water efficiency and water reuse are highly relevant in this context. NAC/TAC technology offers water-saving benefits as it requires no backwashing, unlike traditional softeners, which use large amounts of water during the regeneration process. By using less water and eliminating salt discharge, NAC/TAC systems can support more sustainable water management practices. This aligns with broader water efficiency and reuse strategies, reducing the burden on both water treatment facilities and the environment. The study's results suggest that further promotion of NAC/TAC technology could help reduce water use while improving water quality in local watersheds.

4.5.9 Cooling Technologies Project Summary

The Cooling Technologies Project Summary outlines efforts to improve water efficiency in cooling systems, especially cooling towers, which are significant water consumers in urban and industrial facilities. The project, led by the Alliance for Water Efficiency (AWE) in partnership with Pacific Northwest National Laboratory (PNNL), aimed to identify water-saving opportunities by improving existing cooling tower systems and adopting alternative technologies. Cooling towers are responsible for a large portion of a building's water use because they rely on water evaporation to remove heat. The study identified best practices for managing cooling systems, assessed the water savings potential of various technologies, and developed practical tools to help utilities plan and implement water efficiency programs.

This report addresses the need to reduce the large volumes of water consumed by cooling towers. It presents alternative technologies like adiabatic coolers, thermal membrane distillation, and hygroscopic cooling that can significantly reduce water use by recirculating or reusing water in cooling systems. By promoting the adoption of these water-efficient technologies, utilities can minimize the strain on potable water supplies and reduce the overall demand for fresh water in cooling applications, contributing to sustainable water management.

4.5.10 Conservation-Oriented Pricing Analysis for City of Guelph

The paper titled "Conservation-Oriented Pricing Analysis for City of Guelph" examines how conservation-oriented pricing strategies can promote water use efficiency while ensuring the financial stability of water service providers. Conservation-oriented pricing is designed to recover the full costs of providing water services and encourage water conservation by relying on volumetric charging, where consumers are billed based on their actual water usage. A key tool in this system is the increasing block rate (IBR) structure, where the price per unit of water increases as consumption rises. This pricing method provides a financial incentive for consumers to reduce water use, particularly for those with higher consumption levels.

The paper presents an economic model developed for Guelph that analyzes how households respond to changes in water prices, with factors like income, household size, and current water usage influencing their behavior. The findings reveal that water prices have a direct impact on usage, with the average household reducing water consumption by 0.7% for every 10% price increase. However, the degree of responsiveness varies, households with higher water usage tend to be more responsive to price changes. The study also shows that wealthier households generally consume more water, though the rate of increase slows as incomes grow higher.

When considering the potential impact of inclining block rates, the analysis indicates that a graduated price structure, where the price increases with higher water consumption, would likely result in greater water use reductions compared to a uniform price increase. This is particularly true for households that use larger amounts of water, as they would face steeper price increases under an IBR system. This system may disproportionately affect lower-income households if not carefully designed. The report suggests that IBR can include a lifeline rate (a lower rate for basic water needs) to ensure affordability and mitigate the impact on vulnerable communities.

In terms of water conservation and efficiency, the paper concludes that conservation-oriented pricing can be a powerful tool for reducing water demand, especially when the price structure sends clear signals to consumers about the cost of their water use. Households that use more water are more likely to reduce their consumption in response to price increases, making IBR an effective strategy for promoting efficiency. However, the paper also emphasizes that price increases alone may not be sufficient. To achieve meaningful water conservation, pricing reforms should be part of a broader water management strategy that includes incentives, education, and regulatory measures such as outdoor water use restrictions.

4.5.11 Evaluation of Conservation Rate Structures

"Evaluation of Conservation Rate Structures" for the City of Guelph (May 2016) explores different water rate structures designed to encourage water conservation and efficiency. It reviews data from 2006 to 2014 to understand water demand by various customer classes and evaluates alternative pricing models to promote more sustainable water use.

The analysis looks at several customer types, including residential, multi-residential, and industrial-commercial-institutional (ICI) users. It provides insights into how factors like household size, property characteristics, and participation in water conservation programs impact water consumption.

The report primarily investigates how different rate structures, such as increasing block rates (IBR), seasonal rates, excess use rates, and uniform rates, could impact water demand. The study also considers principles for designing rate structures, such as water efficiency, equity, affordability, and cost recovery.

The increasing block rate structure, where customers pay higher rates as they use more water, is highlighted as having the potential to encourage conservation, especially for residential customers. However, it is noted that the effectiveness of such a structure may be limited if the price increases are not substantial enough to significantly alter consumer behavior. The report also compares the impacts of uniform and seasonal rates, finding that price changes alone might not lead to large reductions in water use without additional public engagement and education. The report notes that some rate structures, like seasonal or excess use rates, could increase costs for vulnerable households, especially those with larger families or specific water needs. It recommends considering affordability as a core principle when designing rate structures to avoid undue burdens on low-income households.

The report concludes that conservation-oriented rate structures, particularly the increasing block rate for residential users, can promote water conservation by targeting high water users with steeper price increases. However, the impact on overall water demand may be modest unless combined with other conservation efforts, such as public education and restrictions on outdoor water use. Moreover, price-based incentives should be part of a broader strategy that includes efficiency programs and infrastructure improvements. For non-residential users, a uniform rate may be preferable, as their water use patterns are less responsive to price changes.

See Section 5.3.5 for Water and Wastewater Education Program and Rebates

5 Wastewater

The wastewater system for the City is primarily gravity based, is supported by five sewage pumping stations, and discharges to the Guelph Water Resource Recovery Centre (WRRC), on the Speed River in the west area of the city. The Guelph Wastewater Treatment and Biosolids Management Master Plan (WTBMMP; Jacobs 2023) emphasized the resource recovery value of wastewater and renamed the former Guelph Wastewater Treatment Plant to the Guelph Water Resource Recovery Centre (WRRC) in 2022. The wastewater system also accepts flows from the Gazer Mooney subdivision (Centre Wellington) and the Township of Guelph Eramosa (Rockwood).

5.1 Existing Wastewater Treatment Process

The wastewater treatment process includes a liquids and solids train. The liquid process begins with preliminary screening and grit removal, followed by primary treatment through sedimentation. Secondary treatment is carried out using both conventional and extended aeration activated sludge methods. The waste activated sludge is thickened before it is pumped into the primary digesters. The treatment process then advances to a two-stage tertiary treatment, which employs rotating biological contactors (RBC) and is succeeded by sand filtration. The final effluent is disinfected through the addition of sodium hypochlorite. Prior to being discharged

into the receiving water, de-chlorination is achieved by adding sodium bisulphite. The solids train includes digesters, belt filter presses, a side stream dewatering filtrate treatment process (Anammox) to remove ammonia loading and is completed by all biosolids being land applied as a CFIA approved fertilizer.

The WRRRC and collection system, are governed by the Environmental Compliance Approval (ECA) 8835- 9QJKSD and Consolidated Linear Infrastructure (CLI) ECA 017-W601. The WRRRC is classified as a Class IV plant and is rated at 64,000 m³/d. The average daily wastewater flow for 2023 was 53,769 m³/day, marking a 6.2% increase from 2022. The highest daily flow recorded was 96,064 m³/day on April 2, 2023.

5.2 Wastewater Flows

Wastewater flow data are reported in the City Wastewater Services Annual Performance Report, Table 20 below provides a summary. Monitoring wastewater flow rates allows the City to plan for capacity needs, seasonal variations, and improve operational efficiency. In the context of a One Water approach, reducing water consumption has a direct impact on wastewater flows, subsequently decreasing the capacity requirements at the wastewater treatment stage. Decreased wastewater flows may also have the potential of increasing the cost of treatment of the remaining sewage as costs increase to treat higher concentration effluent.

Table 20 City of Guelph Wastewater Flow Data 2024 (Annual Report, 2024)

Month	Average Total Flow (MLD)	Maximum Total Daily Flow (ML)
January	58.929	852.582
February	57.743	66.770
March	59.456	68.517
April	65.455	75.173
May	59.674	69.853
June	52.328	60.962
July	59.294	87.320
August	52.916	61.779
September	50.427	55.685
October	47.718	52.924
November	48.34	53.423
December	47.854	55.829
Annual Average	55.011	-
Winter Average	54.464	-
Summer Average	55.402	-

5.3 Review of Historical Wastewater Studies

This section provides an overview of the key historical studies conducted on the City’s wastewater system. The findings from these studies have informed the City’s approach to infrastructure upgrades, system assessments, and performance metrics, influencing the city’s infrastructure planning.

5.3.1 Area 1 Downtown Inflow and Infiltration Study

The study was conducted between 2019 and 2020 to understand potential sources of extraneous flow into the wastewater system, identify deficiencies, and develop a capital improvement list for City infrastructure planning. The study found that the downtown drainage system, primarily comprised of vitrified clay sewers installed before the 1940s, is susceptible to settlement, joint displacement, and cracking, increasing infiltration potential. Two defects identified were considered for immediate remediation to improve the conveyance capacity of the sanitary sewer system. The study also developed a System Inflow & Infiltration (I&I) Remediation Plan to guide the next steps, considering the cost to complete works, the type of implementation programs, and flow estimates for each individual defect.

5.3.2 Assimilative Capacity Study for the Speed River Downstream of the Guelph WRRC

The Assimilative Capacity Study for the Speed River Downstream of the Guelph WRRC investigates the health of the river and includes any effects of effluent from the City of Guelph's Water Resource Recovery Center (WRRC) on the water quality and ecology of the Speed River. The study models potential impacts of increased WRRC discharge due to future city growth and recommends effluent limits. It found that while the plant is performing well and within regulatory limits, downstream water quality is enriched with phosphorus, nitrate, and chloride compared to upstream conditions. The low dilution capacity of the Speed River exacerbates these effects, particularly during low-flow conditions. The recommended effluent limits resulting from this study designed to protect aquatic life and improve water quality have been shared with the MECP and are being used for future limits and targets as additional WRRC capacity is approved. Wastewater initiatives influencing the City's urban water balance, reducing water usage to decrease the water system demand, would decrease the volume of wastewater flows produced. Wet weather infiltration and inflow (I/I) is a major contributor to elevated flows during wet weather and spring melt conditions impacting the WRRC. Flow monitoring programs help to provide supporting data to characterize relative system performance during dry and wet weather conditions.

5.3.3 Sanitary Flow Monitoring

Annual flow monitoring study is completed to verify existing sanitary flows in the City's network, focusing on development priority areas. The study involves eight (8) flow monitors and two (2) rainfall gauges across several catchments. In 2019 and 2020, 16 additional flow meters were installed to assist in the recalibration of the new sanitary sewer model. The data collected support the understanding of the wastewater system's response to different weather conditions and infiltration levels.

A Flow Monitoring Study conducted for the City from 2016 to 2020 was undertaken to verify existing sanitary flows within the City's sanitary network. The study involved eight sanitary sewer flow monitors and two rainfall gauges, distributed across two areas: the Clair-Gordon Study Area and the Downtown Focus Area. Data from the past three years revealed limited infiltration due to groundwater levels in both areas. However, the older Downtown sewer network showed significant rain-derived inflow and infiltration (RDII), attributed to factors like cross connections, foundation drains, and roof drains linked to the older network. Six additional flow meters were installed in late 2019 and early 2020, the data from which will be used to recalibrate the City's new sanitary sewer model.

5.3.4 Inflow and Infiltration (I&I) Reports

The City has been actively monitoring inflow and infiltration impacts to the wastewater system. Past servicing studies and historical data have indicated elevated levels of wet weather flows in various parts of the system. These findings have necessitated further investigation and action to mitigate these impacts. As a result, the City initiated an update to the original 2012 Inflow and Infiltration (I/I) program, with the intent of targeting these critical areas, starting with Area 1 (the downtown core).

The primary objective of this program was to provide capacity assurance to support both near and long-term growth objectives, including intensification and new growth. Field investigations and reviews, including lot drainage inventories, smoke and dye-testing, and review of CCTV data took place in 2019.

In 2023, Wastewater Services initiated a five-year program to capture a full condition assessment of the sanitary system consisting of approximately 530km of pipe. As well as capturing the current condition, this program that entails flushing ahead of CCTV work to address operational risks such as sewer back-up and related operating costs.

A Flow Monitoring Study conducted for the City from 2016 to 2020 was undertaken to verify existing sanitary flows within the City's sanitary network. The study involved eight sanitary sewer flow monitors and two rainfall gauges, distributed across two areas: the Clair-Gordon Study Area and the Downtown Focus Area. Data from the past three years revealed limited infiltration due to groundwater levels in both areas. However, the older Downtown sewer network showed significant rain-derived inflow and infiltration (RDII), attributed to factors like cross connections, foundation drains, and roof drains linked to the older network. Six additional flow meters were installed in late 2019 and early 2020, the data from which will be used to recalibrate the City's new sanitary sewer model.

5.3.5 Water and Wastewater Education Program

The City of Guelph's Water and Wastewater Education Program engages students to learn about Guelph's water systems and their role in water conservation. The program is offered for different grade levels, featuring classroom visits and facility tours.

Components of the Program:

Grade 2 Classroom Visits: These are 40-minute sessions to engage students through games and storytelling. Students learn about the water cycle, where Guelph's water comes from (groundwater), and the importance of conserving water for future generations. They are also introduced to wastewater management, following water's journey from homes to the treatment plant and back to the environment.

Grade 8 Classroom Visits: The program for older students focuses on critical thinking and problem-solving. Students learn about both drinking water and wastewater systems, and how human actions affect water quality and quantity. Scenarios related to stormwater management and source water protection encourage teamwork and highlight how professionals manage these water challenges.

Facility Tours for Grades 5 to 12: Students can tour the City’s water and wastewater facilities to see firsthand where their water comes from and what happens after it goes down the drain. These tours cover the treatment processes and the infrastructure required to maintain reliable water services.

The One Water approach integrates all aspects of water management, recognizing the interconnectedness of water systems and emphasizing sustainability. Guelph’s education program aligns with this approach by fostering awareness of the entire water cycle, from source to tap and back to source.

5.3.6 Sewer Abatement Credit Policy

The Sewer Abatement Credit Policy in Guelph offers financial relief to industrial, commercial, and institutional (ICI) customers who reduce the amount of wastewater sent to the City’s Wastewater Collection System. The policy provides a credit on wastewater fees when water is either evaporated or used in processes that prevent it from being discharged as wastewater. The amount of the credit is based on the volume of water that is diverted away from the wastewater system and applied retroactively for the previous year.

To be eligible for the credit, ICI properties must be located within Guelph and serviced by the City’s water and wastewater systems and meet the requirements of the policy.

This policy is directly tied to the One Water approach, which views all water resources—drinking water, wastewater, and stormwater—as interconnected. This credit program recognizes the reduced flow to the sanitary system based on an existing process that results in far less wastewater being discharged to the sanitary than what is measured through the water meter. This program could also incentivize firms to look into internal water reuse to also reduce their volumetric discharge to the sanitary system.

5.3.7 Wastewater Conclusion

The City of Guelph’s wastewater system is characterized by its advanced and multi-stage treatment processes, which include primary, secondary, and tertiary methods, ensuring high-quality effluent that exceeds regulatory discharge limits. By utilizing a One Water approach, the City can enhance water reuse strategies to support sustainable urban functions. On site reuse is already implemented on site at the WRRC while additional opportunities for reuse may include high-quality effluent for non-potable applications such as sewer main flushing and irrigation.

Moreover, reclaimed water can be utilized for irrigation in parks, sports fields, and golf courses, which would not only conserve freshwater resources but also mitigate the risk of eutrophication due to careful management of phosphorus and nitrates. The possibility of using treated wastewater for aquifer storage and recovery (ASR) is particularly relevant for Guelph, given its reliance on groundwater. This approach would help enhance water supply resilience while supporting sustainable groundwater management.

These opportunities align with the One Water approach by integrating wastewater reuse and maximizing water resources through closed-loop systems, thereby reducing the need for fresh potable water while addressing urban needs like irrigation, cleaning, and aquifer management.

6 Stormwater

6.1 Existing Stormwater System

The City's municipal area is approximately 88 km² comprised of 23 subwatersheds with approximately 90 km of watercourses. A subwatershed in the municipal context is a smaller section of a larger watershed that is defined to help manage stormwater and other environmental factors within a specific area of a municipality. Some of these subwatersheds are well-established natural areas with distinct water flow patterns, while others are created for planning purposes, such as identifying priority areas for stormwater management. In some cases, they are simply grouped catchment areas—zones where rainfall collects and drains into a common water body. These divisions help cities focus their water management efforts effectively.

Municipal stormwater management infrastructure includes SWM facilities (dry ponds, wet ponds, wetlands, hybrid facilities, greenways, and end-of-pipe infiltration facilities), oil and grit separators (OGS) and holding tanks, the City's storm sewer pipe networks and associated appurtenances, (i.e., maintenance holes, catch basins, leads, and outfalls). Figure 9 presents an overview of the stormwater management system.

Based on the SWM-MP (2023), the City has 124 municipally owned SWM facilities (SWMF) and 150 City- owned Oil Grit Separators (and 42 private OGS) within the city which control runoff (either quantity, quality or both) for 2,899 ha of the City, with:

- 1,746 ha (28.1 percent) controlled for water quality,
- 2,335 ha (37.6 percent) controlled for water quantity,
- 3,318 ha (53.4 percent of urban area) with no water quality or quantity control, as this area was built before current SWM requirements/ policies.

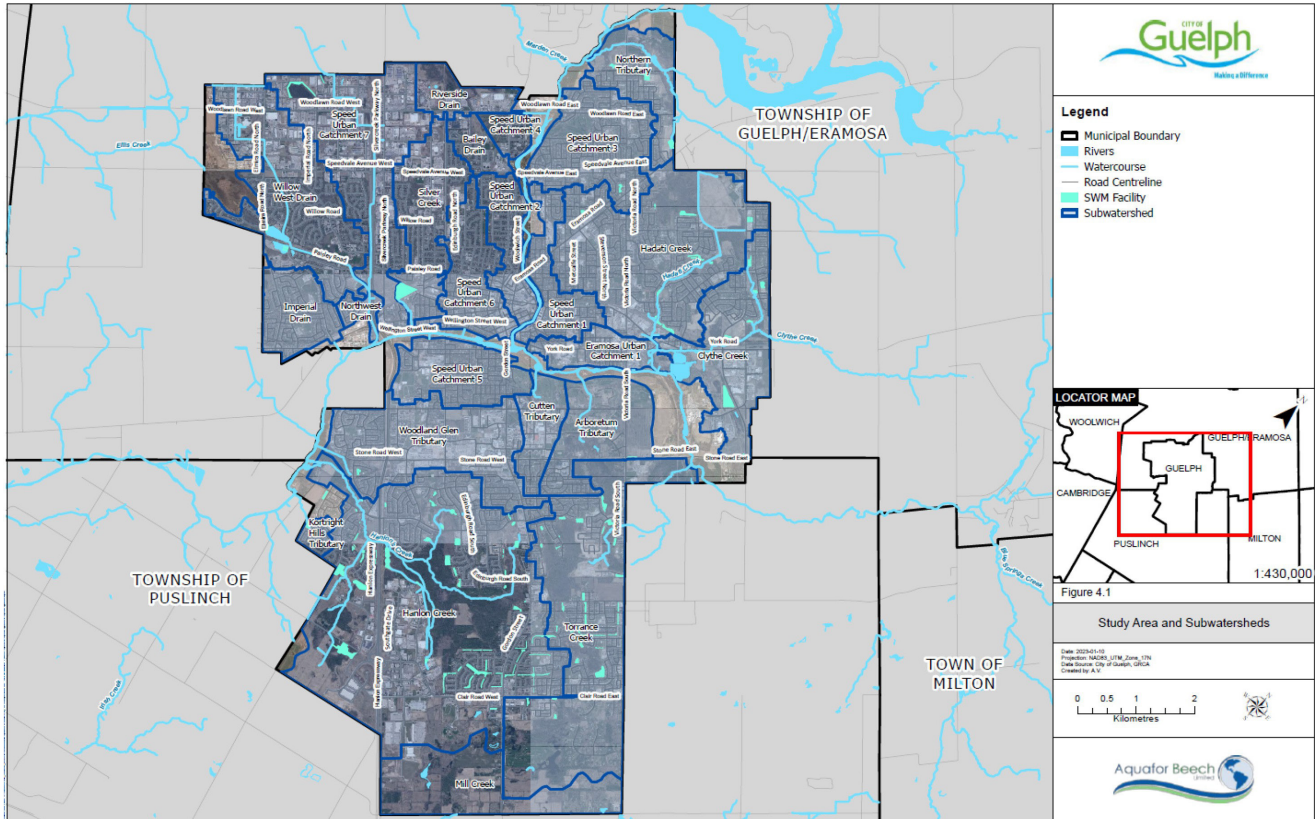


Figure 17 Stormwater Management System and Subwatersheds

The City has storm sewers that are owned by the City, Province, Township of Guelph-Eramosa, or privately owned. Table 21 summaries over 420 km of storm sewers in the City. The City’s stormwater management system, with the exception of SWMF that treat runoff from municipally-owned facilities, is regulated under a Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA) issued by the Ontario Ministry of the Environment, Conservation and Parks (MECP) in 2022.

Table 21 City Subwatersheds

Subwatershed	Drainage Area (ha) within Municipal Boundaries	Stream Length (km) within Municipal Boundaries
Arboretum Tributary	259	1,519
Bailey Drain	74	0*
Clythe Creek	382	6,110
Cutten Tributary	123	681
Eramosa Urban Catchment 1	124	1,515
Hadati Creek	759	6,385
Hanlon Creek	1,654	20,052
Imperial Drain	166	0*
Kortright Hills Tributary	31	248
Mill Creek	341	8

Subwatershed	Drainage Area (ha) within Municipal Boundaries	Stream Length (km) within Municipal Boundaries
Northern Tributary	203	4,023
Northwest Drain	37	1,204
Riverside Drain	107	2
Silver Creek	287	1,298
Speed Urban Catchment 1	165	0*
Speed Urban Catchment 2	151	0*
Speed Urban Catchment 3	322	0*
Speed Urban Catchment 4	52	0*
Speed Urban Catchment 5	219	6
Speed Urban Catchment 6	215	0*
Speed Urban Catchment 7	556	6,089
Torrance Creek	870	2,343
Willow West Drain	521	8,649
Woodland Glen Tributary	466	926
Total	8,083	61,058

Flooding risk generally comes in two forms associated with stormwater – riverine and urban. For riverine, numerous open watercourse hydraulic studies have been conducted and the GRCA regulates the affected lands accordingly. For urban or pluvial flooding there are generally two types, storm sewer (or minor system) surcharging, and overland or major system flooding. The SWM-MP identified chronic flooding areas or neighbourhoods in the City including at: Division Street and Exhibition Street, Waverly Drive and Stevenson Street North, Grove Street, Lowes Road West, and Dawn Avenue and Knevitt Place.

6.2 Stormwater Programs

The City has developed several stormwater programs aimed at improving managing stormwater runoff quantity and quality through increased on-site infiltration and stormwater reuse. These programs were described in Section 4.5.7 and summarized below in Table 22. While these programs are still relatively new and the quantity of their rainwater diversion impacts are still being developed, they show promising potential for the future water conservation strategy.

Since its establishment in 2017, the City has issued Stormwater credits to 25 ICI applicants as part of its stormwater credit program. Since 2019, the City approved 112 residential rain gardens through the rain garden rebate program.

Table 22 Stormwater Programs

Program	Description	
Stormwater Fees and Rebate	Uses a fee structure to fund stormwater management. Property owners can apply for rebates by implementing on-site stormwater management practices.	Property owners can receive up to 50% off their stormwater service fees. Credits are available in four categories: <ul style="list-style-type: none"> • peak flow reduction (15%) • runoff volume reduction (40%) • water quality treatment (15%) • operations and activities (15%)
Rainwater Harvesting	Encourages the collection and use of rainwater for non-potable purposes, such as flushing toilets, laundry, or watering gardens.	The City offers a rebate of up to \$2,000 for installing an all-season rainwater harvesting system. For seasonal systems, the rebate is \$0.50 per litre of tank storage, up to a maximum of \$2,000.
Rain Barrel and Raingarden Initiatives	Provides residents with rain barrels and supports the creation of raingardens to manage stormwater naturally. It is limited to 50 spaces per year.	Reep Green Solutions manages the program and offers up to \$2,000 to residents who install a rain garden. The rebate amount is based on the number of litres of water the rain garden holds and the cost of installation
Tree Planting	Promotes the planting of trees to improve green infrastructure, improve air quality, and manage stormwater by increasing infiltration and reducing runoff.	The Take Root program, in partnership with Trees for Guelph, provides free native trees to residents. The program aims to distribute 1,000 trees annually.
Seasonal Outdoor Rainwater Harvesting Rebate	A seasonal rebate that encourages residents to install systems for collecting and using rainwater outdoors during the spring and summer.	Residents can receive a one-time rebate of \$0.50 per litre of tank storage, up to a maximum of \$2,000, for installing a qualifying seasonal rainwater harvesting system.

6.3 Summary of Stormwater Master Plan

The City completed its Stormwater Management Master Plan (SWM-MP) in March 2023. This Class EA constituted a comprehensive update to its earlier SWM-MP prepared in 2012. In large part, the SWM-MP made recommendations around projects and programs based on a prioritization process. Furthermore, the SWM-MP also provided a basis for recommendations associated with several related policies, all conducted under a lens of climate change. Over time, it is expected that the City will implement the SWM-MP recommendations in order to achieve its vision associated with sustainable SWM. As noted by staff and acknowledged in the report, the implementation timing will be contingent on City finances and the Council’s strategic priorities.

The SWM-MP has six (6) elements:

- Municipal Pollution Prevention, Operations & Maintenance Practices

- Private Property Strategies (Source Controls)
- Stormwater for the Capital Roads Program
- SWM Facilities
- Watercourse and Erosion Restoration
- Urban Flood Management & Stormwater Infrastructure

The SWM-MP prioritized stormwater management retrofit and maintenance work based on those subwatersheds with the greatest need and those where the SWM recommendations align with opportunities in the respective subwatersheds to improve environmental conditions. A hierarchical approach was adopted to maximize the ‘net-benefit’ to the City, the environment and the community.

Subwatershed health was determined for twenty-three (23) subwatersheds within the City according to four (4) categories and their associated metrics, including:

- Terrestrial Ecology: wetland habitat; forest habitat; natural cover; and connectivity
- Aquatic Ecology: SWM quality control; SWM quantity control; and imperviousness
- Stormwater Management: erosion sites; management sites; and maintenance sites
- Erosion Condition: species richness; species intolerant of disturbance; habitat sensitivity; and channel habitat type

Figure 18 provides a graphic of the Subwatershed Health scores and Figure 19, geographically depicts the subwatershed health scores. Figure 20 presents the recommended SWM projects.



Figure 18 Existing Conditions Subwatershed Health Scores (SWM MP, 2023)

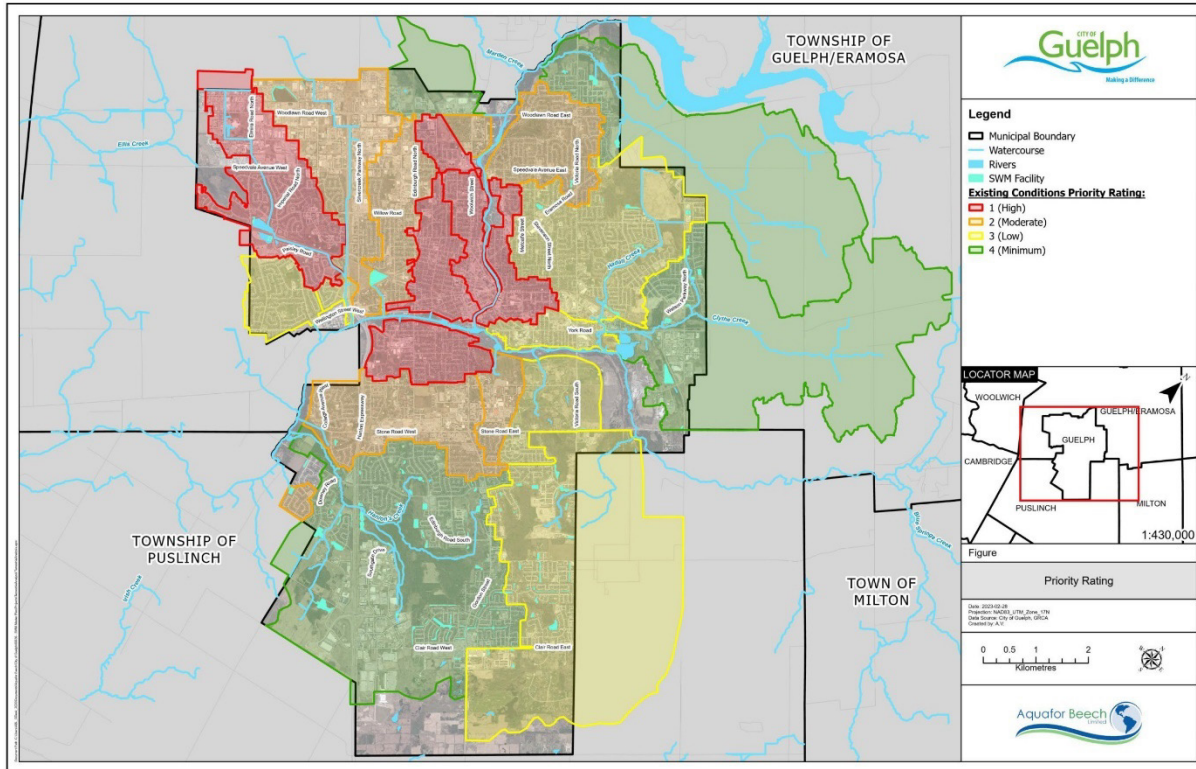


Figure 19 Subwatersheds Priority Rating Graphic

Some highlights from the SWM-MP include the following:

- For new developments, redevelopment and intensification – applicants are to store/retain a minimum of the first 5 mm of runoff on-site. Note that the CLI ECA requires that new developments and retrofit projects must infiltrate enough water to meet pre-development water balance conditions, control the runoff from the 90th percentile storm event (which is about 27 mm of infiltration in Guelph), or control runoff as specified in a site specific assessment (e.g., subwatershed study, SWM-MP, etc.). In the case of retrofit projects, infiltrating to the maximum extent possible is also acceptable.
- For municipal road projects, the City shall store/retain the greater of: 5 mm runoff for the new and reconstructed pavement surface, or 5 mm of runoff from the net increase in imperviousness (subject to a 0.25 ha increase in road surface). Under the CLI ECA, the infiltration requirements are as noted above.
- For SWMF, the SWM-MP recommends strategic maintenance, retrofits to several existing SWMF and fifteen (15) new end-of-pipe facilities constructed
- Watercourse flooding and erosion restoration and improvement works (25+/- locations)
- Targeted urban sewer upgrades based on hydraulic assessment and calibrated dual drainage model; principally to address sewer surcharges in key areas at risk
- Monitoring plan (subwatershed based to align with pending guidance from MECP re: CLI ECA) and priority-based water quality and quantity subwatersheds as well as to fill gaps
- Innovation strategy to improve uptake of LID measures by local property owners (i.e., social media)

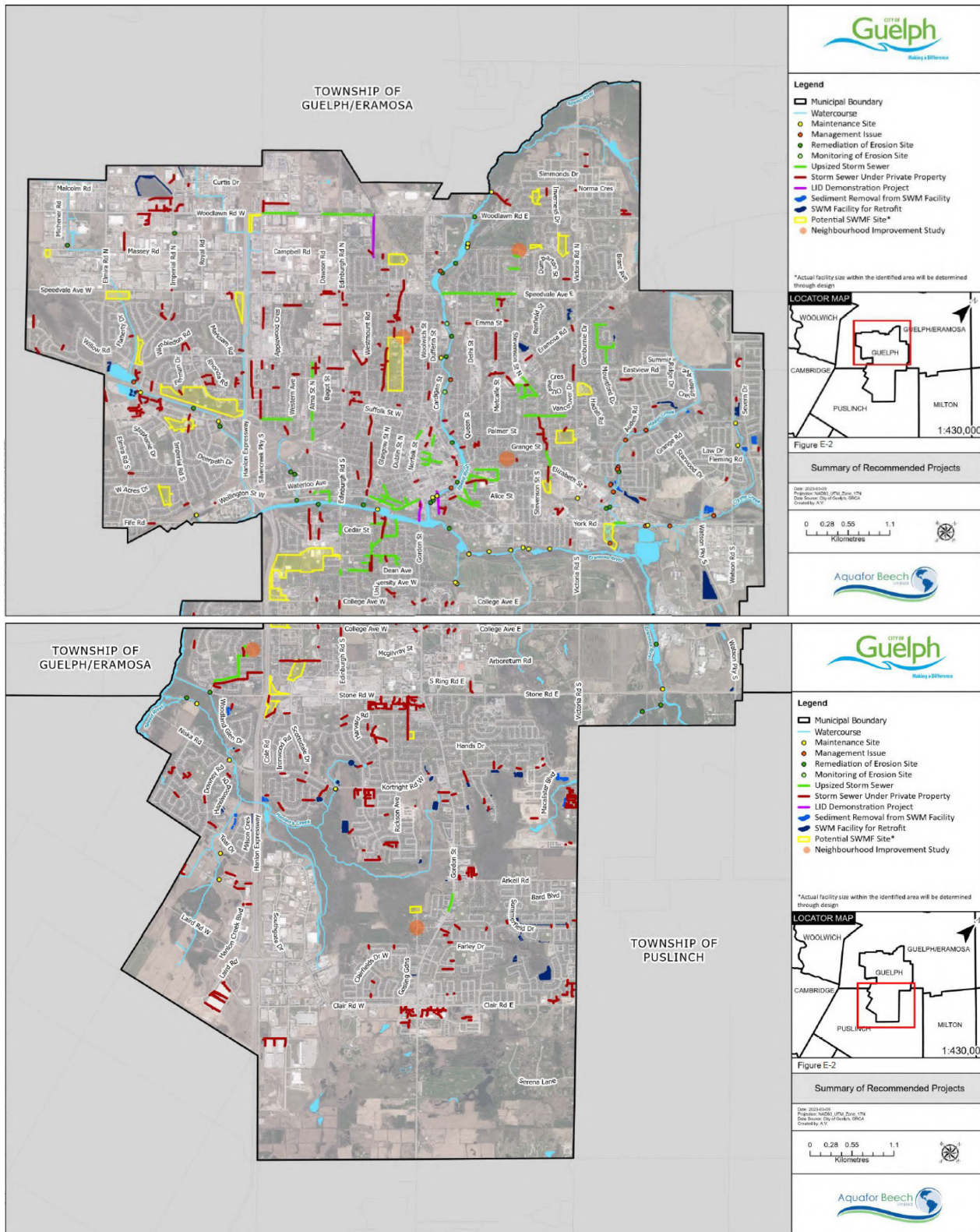


Figure 20 Summary of Recommended Projects Across the City

Through the SWM-MP several other policies and strategies were developed which have the potential to influence the future of integrated water management in Guelph, including:

- Infiltration Policy
- LID Policy Recommendations
- Innovation Strategy
- Action items that influence Blueprint (e.g., water reuse, sewer flushing)

The SWM-MP also recommends a refocused stormwater monitoring program to identify any existing or emerging water quality and quantity issues, allowing the City to identify when maintenance and/or infrastructure upgrades are required.

6.3.1 Infiltration Policy Recommendations

This document, which was prepared as an appendix to the SWM-MP (Nov. 2022), offers an outline of existing City practices and makes recommendations related to improved practices to support environmental features and functions and also address projected climate change impacts, premised on a risk-based approach.

The infiltration policy recommendations are focused on retrofit opportunities related to the redevelopment of land within the City's current built-up area, since existing SWM infrastructure in this area of the city has generally not been sized to account for intensification (infill and redevelopment). Thus, the proposed infiltration practices would be intended to prevent the existing stormwater system infrastructure from being overwhelmed. Greenfield development would be guided by the specifics associated with area subwatershed studies.

As noted, the recommendations were established using a risk-based approach with due consideration of the following:

- High-risk Site Activities
- Wellhead Protection Areas
- Issue Contributing Areas
- Sodium and Chloride
- Sources of Water
 - Rooftops
 - Landscaped areas and lawns
 - Driveways
 - Parking Lots
 - Other paved surfaces

An "Infiltration Decision Flow Chart" was prepared to illustrate the steps required by practitioners to advance infiltration on a particular site. In areas of the City where infiltration practices are prohibited (in order to protect groundwater), filtration practices can be considered which would filter and release runoff to the municipal sewer network, overland drainage network, or directly to a receiver such as a watercourse or wetland, at a prescribed rate and volume (i.e., stormwater management design criteria).

Furthermore, a hierarchical approach has been proposed for managing the road runoff through infiltration practices. This approach is based on the class of roadway and its specific location in the city. A decision matrix table has been prepared which summarizes the approach and acceptable practices by road and location in the city.

6.3.2 LID Implementation Strategy

The LID Implementation Strategy (March 2023) introduces the policy context for LID practice implementation and provides recommendations for how the City can integrate LID practices into existing processes. The LID Strategy acknowledges the current and pending guidance from the MECP including the draft 2022 LID Manual and the Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA), both of which advocate for a treatment train approach to stormwater management underpinned by source controls. The LID Implementation Strategy outlines those practices which are supported in the City based on private and public land types. The Strategy also indicates where the use of permeable pavement would be feasible.

The LID Implementation Strategy provides various recommendations to further the implementation of LID practices in the City including the following:

- Update the Development Engineering Manual (DEM) to:
 - Endorse current and emerging standards
 - Align with Complete Streets Design Guide
 - Consider support for a cash-in-lieu program
 - Study direct discharge to Receiver policy
- Update and Establish an Approvals process including LID practice tracking
- CLI ECA tracking and documentation
- Assumption protocols
- Private Property LID practices oversight requirements
- Operations and Maintenance

The LID Strategy also outlines the need for additional staff to support the program and indicates potential timelines and budgets. As part of this, there is also consideration for LID ROW Pilot Projects across the City.

6.3.3 Innovation Strategy

This appendix to the SWM-MP presents a series of potential innovations that the City could consider through its current or proposed programming. The process of integrating these innovations into the City's routine operations is steered by an Innovation Framework. The SWM-MP Innovation Strategy contains many of the components already discussed including the Subwatershed Health Analysis, LID Implementation Strategy and the Infiltration Policy. Numerous other related innovations are discussed, with several having direct relevance to the Blueprint; these include:

- Leveraging infrastructure – multi-functional approach to SWM design (e.g. SWM and trail systems)
- Technological Innovations – real-time controls; predictive modelling; Smart City Opportunities (adaptive flow management like blue roofs)

- Social Innovations – Equity, Diversity and Inclusion (e.g.; Clair Maltby SWCAs)
- Circular Economy – currently City offers rebates to residents who install rainwater harvesting systems; the need to diversify these opportunities into multifunctional applications
- Public Education – innovative means of public outreach (e.g. Rain Parks)
- Policy Innovations –
 - Asset Management – strengthen links between Stormwater Level of Service (LOS,) climate change risks and watershed plan recommendations
 - Integrated Subwatershed Monitoring program – broader more holistic monitoring on a subwatershed basis, aligning with CLI ECA
 - Credit Taking – part of current Stormwater Rate to reduce charge by up to 50% with on-site measures; innovation could consider a credit trading program
- Social Marketing – current uptake of LID practices on private lands is low; leverage social marketing to improve understanding and awareness/behaviour
- One Water – while currently potable, waste and stormwater are considered under separate structures in the City, advocating for integrated planning for “water” is at the core of the principles which underpin the “The Blueprint”
- Non-traditional policy Alternatives including (among others):
 - Economic value for ecological services
 - Green development standards
 - GRID/Communal LID (Aggregation Methodology)
 - Private SWM for employment lands

7 Other Studies

The City has completed additional studies and plans which may influence the integrated water management plan that include for example: the Natural Heritage Action Plan, Natural Assets Inventory, and Climate Adaptation Plan. These studies and plans provide an outlook of the City’s approach towards sustainable water resource management. Brief summaries of other studies are offered in the following sections.

7.1 Natural Heritage Action Plan

The City has an extensive Natural Heritage System (NHS), that covers a substantial portion of the City’s land, particularly in the south and east end. The NHS includes two major rivers, the Speed and the Eramosa, which flow through the north to south part of Guelph, along with many locally and provincially significant wetlands and woodlands. Integrated water management must consider these habitats to ensure that water resources are managed sustainably and maintain ecological health and biodiversity.

The City’s Heritage Action Plan outlines policies for the NHS, including significant natural areas, natural areas, and wildlife crossing areas. These environmental features help maintain the health of the watershed, protect

water quality, and support biodiversity. Clythe Creek subwatershed was identified as the highest priority for a subwatershed study update in the City's Natural Heritage Action Plan in 2018, and the Subwatershed Study is currently underway for this subwatershed.

7.2 City of Guelph Natural Assets Inventory, Condition, Risk and Service Attribution (Green Analytics 2022)

This report provides an inventory and assessment of publicly-owned natural assets in the City. The report includes an overview of the Natural Assets Inventory (NAI) structure, condition assessments of various natural assets including street and park trees, watercourses, and terrestrial natural features (including wetlands). It also includes risk assessments for these assets, and in terms of water management, it provides a detailed condition and risk assessment of the City's watercourses. The report highlights the value of the GIS dashboard and database provided to the City, which includes a city-wide inventory, condition assessment, risk assessment, and identification of key ecological services, including stormwater management, carbon sequestration and storage, air quality regulation, urban heat reduction, recreation opportunities, and aesthetic appreciation.

Building on this, the report also highlights that the methodology used for the natural asset inventory and assessment is consistent with the requirements of the Asset Management Planning for Municipal Infrastructure Regulation (O. Reg. 588/17) introduced by the Province of Ontario. This ensures the City's compliance with this regulation, which mandates municipalities to incorporate green infrastructure into their asset management processes as part of comprehensive asset management plans by July 1, 2025.

7.3 Water and Wastewater Servicing Master Plan

The City's Water and Wastewater Servicing Master Plan was updated in 2023; the plan recommends infrastructure upgrades to meet the City's targeted service level and growth projections, based on the results of calibrated hydraulic models. The plan considers existing and future growth areas up to 2051 to identify opportunities and constraints in the existing water and wastewater systems. The report suggests several ongoing activities to refine the system assessments and increase confidence in the model results. These activities include regular updates to the City's hydraulic models, continuation of annual strategic sewer flow monitoring, correlation of basement flooding reports with hydraulic modelling findings, and confirmation of the location and distribution of building lateral connections to the City's sewers. The report also recommends aligning the City's development review tracking methods with the hydraulic model, refining the City's leak detection program, and leveraging the City's data collection system for performance metrics.

7.4 Aquifers as Natural Assets

In 2018, a natural asset inventory was completed for the City, encompassing all forests, wetlands, meadows, successional habitats, and watercourses. This inventory included condition assessments and service valuations for these assets. However, the groundwater in the aquifer was not part of the initial natural asset assessment. The report specifically addressed the groundwater in the aquifer as a natural asset. To date, hydrologic modelling and analysis of the Hanlon Creek subwatershed, have been carried out to inform the valuation of water supply management in the City. Out of the 25 municipal wells that currently exist, seven (7) are situated outside the City's limits, highlighting the shared nature of this asset.

There are several complexities associated with treating groundwater as an asset, including a complex mix of interacting subsurface water flows. The aquifer is not owned by the City, and water is regulated for takings by the provincial Ministry of Environment, Conservation, and Parks (MECP) through the permit to take water (PTTW) process. Despite these complexities, the City has a responsibility to manage extraction to ensure the long-term sustainability of water supply service provision, considering the provincially mandated growth targets that need to be implemented through the City's Official Plan.

The report noted that the asset level of service is challenging to define since the water is constantly being recharged and flowing through the bedrock formation below ground, leaving no standing "stock" of water that can be defined as the asset. The report noted that Guelph's current maximum daily capacity of 79,422 m³/day already exceeds the assumed long-term sustainable capacity of 66,740 m³/day. In addition, the likelihood of groundwater asset failure was rated "rare" for the three (3) hazards identified, i.e., drought, increased demand, and reduced recharge, since individually these risks do not put enough pressure on any wells to consider them stressed. However, the combination of increased demand and drought occurring together triggers a stress rating on nine (9) wells, representing almost 77% of the total pumping capacity. Based on this information, the likelihood of the asset failure was rated as "likely".

Given the City's growth projections, Guelph has the potential to surpass long-term sustainable projections for water supply from wells. The aquifers that supply water to Guelph are crucial to securing the City's water supply and ensuring sustainable water use for future generations, reinforcing the importance of The Blueprint.

7.5 Climate Adaptation Plan

The City's Climate Adaptation Plan (2023) outlines a strategy to manage and reduce the risk of climate change impacts on the city and its infrastructure. The plan is the result of extensive research and collaboration, aiming to ensure the city can withstand and recover from climate change effects. It aligns with the city's goal to become a net-zero carbon community by 2050 and demonstrates its commitment to environmental stewardship and social responsibility.

The plan identifies climate hazards that could potentially impact City infrastructure assets and service delivery. For instance, droughts, extreme cold, heat, and freeze/thaw cycles could impact the performance of the water and wastewater infrastructure, including impacting the delivery of potable water to residents and businesses. The plan then developed adaptation measures within each City department/division to reduce the climate risk to the City's infrastructure. The City's Asset Management group manage the implementation of the Climate Adaption Plan.

7.6 York Trunk Sewer and Paisley-Clythe Feedermain Municipal Class Environmental Assessment

In 2011, the York Trunk Sewer and Paisley-Clythe Feedermain study for a proposed "purple pipe" was evaluated for its economic feasibility. Purple pipes are a system used to distribute reclaimed or recycled water, they carry treated wastewater, for reuse in lower-end uses (do not require high-quality potable water) such as flushing toilets, street sweeping, sewer flushing or irrigation.

The conclusions from the study indicated that the system was not economically viable at the time and there was limited potential for larger scale utilization of effluent for non-potable uses. The demand was limited, with the total estimated demands in the report accounting for only 4% of the total potential non-potable water demand for the entire City. Major nearby users, such as the Cutten Fields Golf Course, would have had to incur additional costs to connect and use the system, and there was no incentive to change from their current supply. The lifecycle costs were approximately three times the cost of developing existing groundwater supplies in the City, making it economically unfeasible at the time and a low priority until the City was required to search for additional water supplies, which was estimated to be in the longer term (20 years). Although the city was to proceed with a pilot scale system that would provide effluent to a bulk filling depot located at the WWTP, this recommendation was not implemented.

The study noted that the City's treated wastewater effluent quality was among the highest quality released by any wastewater treatment plant in Canada. The Purple Pipe system would still be a viable option because it only requires minimal additional treatment to provide effluent reuse within the City. The report noted there was a need to provide supplemental disinfection to achieve the highest quality of effluent reuse; however, this could be done off-line from the main wastewater flows to service only the effluent reuse system. Potential consumers within the City included the Guelph Innovation District, The Cutten Fields Golf Course, and sports fields. The implementation of the Purple Pipe system could be reconsidered for future infrastructure planning in the GID area.

The estimated total cost of the Purple Pipe system was \$2.9 million (+50%-30%) at the time of the report. A summary of the costs that contributed to the amount were as follows:

- The infrastructure requirements of the non-potable distribution system (similar to those of a potable water distribution system).
- Additional treatment required to lower the Fecal Coliform levels by using UV and Ozone treatment.
- The optimal distribution main size was proposed to be 200 mm in diameter as it would provide a minimum velocity of greater than 1.0 m/s at peak flow of 35.3 L/s.
- The installation of a bulk filling station was required for street cleaning, flower irrigation, and dust control applications of reclaimed water.
- operation of the new treatment system and high lift pumping.

7.7 Clair-Maltby Master Servicing Plan

The Clair-Maltby Master Environmental Servicing Plan (MESP) is a part of the City of Guelph's vision for developing the Clair-Maltby Secondary Plan Area (SPA), which will support approximately 16,300 residents and create 1,250 jobs. The MESP outlines how the city will provide essential services like water, wastewater, stormwater management, and transportation for this new urban community. Developed alongside an environmental impact study, the plan ensures that growth will protect the area's natural resources, especially groundwater systems. Clair-Maltby is located on the Paris Moraine, an important area for groundwater recharge. The MESP includes specific measures to manage both surface and groundwater resources, focusing on maintaining water quality and ensuring that development does not negatively impact the natural water balance.

One of the plan's innovative features is the potential use of a purple pipe system to reuse treated wastewater for non-drinking purposes like irrigation, street cleaning, and sewer flushing. This water reuse system would help reduce pressure on the potable water supply, promoting sustainability. Additionally, the MESP includes recommendations for enhancing groundwater recharge. It suggests using Low Impact Development (LID) techniques, such as permeable surfaces and green infrastructure, to allow rainwater to naturally filter back into the ground.

7.8 Water Reclamation Feasibility Study Report (B&V 2020)

The Water Reclamation Feasibility Study assessed the feasibility of using reclaimed water, from the Guelph Wastewater Treatment Plant (WWTP), for sewer flushing in the City. The use of reclaimed water was proposed as a means to lessen the demand on the city's potable water resources and provide an alternative to discharging wastewater effluent to Speed River. The study aimed to understand the technical, regulatory, economic, and societal implications of reclaimed water use in both the short-term and the long-term. Reclaimed water regulation and policies at various levels around the world were reviewed to support the report.

The Water Reuse and Demand Substitution Technologies (C3 and Gauley 2015) report cited a 2009 report estimating that reclaimed water demand in the city could be 54 m³/d in the short term and is expected to grow to 3,850 m³/d in the long term. The study focused on sewer flushing as a potential end use for reclaimed water. The demand for reclaimed water for sewer flushing operations was estimated based on information gathered through discussions with City staff. The daily and yearly estimated reclaimed water demand for sewer flushing presented in the report is summarized in Table 23.

Table 23 Estimated Reclaimed Water Demand for Sewer Flushing

Scenario	Number of Refills Per Day	Truck Volume (L)	Daily Volume		Yearly Volume	
			(L/D)	(m ³ /D)	(ML)	(m ³)
Low (2019)	2	5,678	11,356	11.34	2.84	2,839
Average (2019)	3	5,678	17,034	17.03	4.26	4,259
Maximum (2019)	4	5,678	22,712	22.71	5.68	5,678

City staff also noted operational limitations with the effluent water pumps, stating that only two out of three pumps could be operated simultaneously. There was also a concern that if effluent water was diverted to fill the sewer flushing truck, the plant might temporarily face issues in meeting the effluent water demand.

Sewer flushing is currently performed year-round, three to four times a day and the sewer flushing truck is filled at a potable water hydrant in the septage receiving area and is stored in the fleet storage facility. The City's effluent quality met or exceeded reclaimed water quality and treatment standards for sewer flushing compared to other municipalities. Table 24 presents four alternatives developed to supply reclaimed water for sewer flushing.

Table 24 Reclaimed Water Alternatives for Sewer Flushing - High-Level Capital Cost Estimates

Alternative	Description	Cost
Alternative 1A: Submersible Pump	A submersible pump drawing water from the chlorine contact tank and delivering it to a yard hydrant connection.	\$178,000
Alternative 1B: Pump + Storage Tank	Supplying reclaimed water by a connection to the upgraded effluent water system and piped to an elevated storage tank.	\$473,000
Alternative 2A: Direct Connection to Effluent Water System	Reclaimed water is supplied by a connection to the upgraded effluent water system and piped to a yard hydrant connection.	\$1,744,000
Alternative 2B: Effluent Water System Connects to Storage Tank	A consistent (24-hour) stream of reclaimed water to be diverted from the effluent water system and treated, stored in a storage tank and drawn upon as required	\$2,078,000

Alternative 1A was considered the preferred alternative for the short term and Alternative 2B for the long-term. The short-term plan involved amending the existing Guelph WRRC ECA to allow for the installation of Alternative 1A. In addition to public education, outreach, and data collection to gauge the impacts of reclaimed water use on sewer flushing operations. The long-term reclaimed water program included the installation of Alternative 2B, preceded by upgrades to the effluent water system. The long-term option could provide reclaimed water for end users beyond the City’s sewer flushing operations. Further upgrades to the Guelph WRRC reclaimed water system would be required to meet selected end user quality requirements. If end users or customers beyond the city were being engaged in the reclaimed water program expansion, a mechanism to allow delivery of the water from the plant to the customer would need to be developed, without impacting normal WRRC operations.

7.9 Water Reuse and Demand Substitution Technologies Report (2015)

This report provides an overview of water reuse and demand substitution strategies for the City, emphasizing that public acceptance is a key factor for implementation.

In terms of potable water reuse, the City currently uses water from the Eramosa River to recharge the shallow aquifer at the Carter Wells. There is potential for this water to undergo further treatment at the City’s WRRC, which could serve to replace or supplement the current removals from the Eramosa River. For aquifer recharge in Guelph, two methodologies have been proposed: surface infiltration and direct injection.

Non-potable reuse is another area of focus, with residential greywater reuse systems that collect, filter, and treat water from showers and baths for subsequent use where potable water is not required. The City has established a greywater reuse system rebate program, offering a \$1,000 incentive for households that install this system, subject to completion and inspection.

Rainwater harvesting is also actively promoted, with the City providing rebates for approved seasonal and all-season systems. Despite these initiatives, a study conducted by LURA Consulting revealed that only 1.5 percent of respondents had a rainwater system in place. The Guelph Transit facility is an example of

municipal-level implementation, using a rainwater harvesting system to wash buses and capture up to 13,500 litres of stormwater per rain event. This practice not only reduces water demand but also mitigates surges and associated impacts on local infrastructure.

The report also noted that only 10 percent of the potable water supply is consumed by residents. The majority is used for non-drinking purposes such as toilet flushing, laundry, dishwashing, bathing, cooling, and irrigation. The situation is similar for manufacturing and industrial processes. While water reuse can significantly reduce the demand for potable municipal water, the initial set up and ongoing costs of water reuse systems often lead to prolonged return on investment periods. Therefore, it was recommended that the City focus on implementing larger-scale projects involving rainwater harvesting or greywater reuse. These projects offer greater water savings and lower costs per litre saved.

8 Gap Analysis, Opportunities

As Guelph continues its efforts to develop and implement water management programs, it is essential to identify and address existing gaps to ensure these initiatives achieve their full potential. The following analysis examines gaps across Guelph's Water Conservation & Efficiency (WC&E), wastewater, and stormwater programs, with a focus on how these areas can transition towards a more integrated "One Water" approach. Addressing these gaps will enhance the city's ability to meet its long-term water conservation, reuse, and environmental sustainability goals.

8.1 Gaps Analysis: Guelph's Water Conservation & Efficiency (WC&E) Initiatives in Adopting a One Water Approach

Royal Flush Toilet Rebate Program: While the Royal Flush program has been highly successful in encouraging water conservation, advancements in plumbing technology have made inefficient toilets increasingly rare. The program's continued effectiveness is questionable as its target fixtures are now uncommon, potentially reducing the program's overall impact. Based on program uptake, inefficient toilet stock remaining in older homes should have been mostly addressed to date; remaining 20lpf/13lpf toilet stock are not likely incentivized by this program as it stands.

Lower-than-Expected Participation in Multi-Residential Programs: The Multi-Residential Audit and Sub-Metering Programs (including single family homes) have struggled to meet participation targets. For example, the audit program was below the initial target of 40 buildings in 5 years and 55 in 10 years, as set in the 2016 WES.

Insufficient Engagement with ICI Customers: The Water Smart Business program has had lower-than-expected participation and impact. Despite a target of completing 15 audits per year with anticipated savings of 10 m³/day per facility, only 11 facilities have received rebates since the program's launch in 2018.

These gaps indicate the need for improved monitoring and verification processes, increased participation rates, enhanced outreach efforts, and a more targeted approach to identifying remaining inefficient fixtures. Addressing these challenges will help Guelph better achieve its long-term water conservation goals.

8.2 Wastewater Program Gaps in Adopting a One Water Approach

Lack of Full Integration: While the wastewater treatment process is well-structured, it currently lacks integration into a broader One Water framework. The current focus remains on treatment and discharge rather than maximizing resource recovery and reuse within the system.

Limited Water Reuse: Although there is potential for using treated wastewater in non-potable applications like irrigation and street cleaning, Guelph has no significant initiatives or infrastructure (e.g., a purple pipe system) in place to support city-wide reclaimed water use. This could start with trialing the recommendations of the Water Reclamation Feasibility Study.

Lack of Policy Alignment with One Water: The Sewer Abatement Credit Policy promotes water conservation through financial incentives but does not currently incorporate reuse and recycling initiatives. Expanding this policy could encourage more sustainable water management practices across various sectors.

These gaps suggest that while Guelph's wastewater system is effective in treatment, it does not yet fully capitalize on a One Water approach that integrates reuse, recycling, and sustainable management across all water systems.

8.3 Stormwater Program Gaps in Adopting a One Water Approach

Lack of Circular Water Use: Guelph's stormwater program promotes rainwater harvesting, but opportunities to reuse treated stormwater are limited. A One Water approach would promote maximizing treated stormwater reuse, reducing dependency on potable water for non-potable uses, and recycling water for urban, environmental, and agricultural needs.

9 Conclusion

Guelph's per capita water use remains lower than provincial and national averages, and the City's leak detection and non-revenue water reduction efforts have been highly successful. There is still a pressing need to increase participation in water conservation and efficiency programs to fully reclaim capacity within present infrastructure. Programs like the Water Loss Management initiative have delivered measurable success, but others, such as the Water Smart Business Program and Residential Sub-Water Meter Rebate Program, have struggled with engagement and participation. Expanding outreach efforts and rethinking these programs will be crucial to achieving the City's long-term water conservation goals.

Additionally, with Guelph's population expected to grow significantly in the coming decades and the impacts of climate change intensifying, the pressure on the City's water resources will continue to increase. This emphasizes the need not only to strengthen existing conservation programs but also to adopt a broader, more integrated approach to water management. Integrating wastewater and stormwater systems into a "One Water" framework is vital for achieving this. Currently, wastewater programs have gaps in resource recovery, water reuse, and policy alignment, while the stormwater system lacks circular water use.

The "One Water" approach offers Guelph a holistic framework that connects conservation efforts across drinking water, wastewater, and stormwater systems, encouraging reuse, ecological benefits, and sustainable water management. By leveraging this approach, Guelph can more effectively balance the needs of its growing

community with environmental requirements, optimizing the city's water systems to enhance resilience to future water stresses. This integrated strategy will be key to ensuring a sustainable water supply for generations to come.

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