

GEI Consultants Canada

CITY OF BRANTFORD

Water and Wastewater Master Servicing Plan – Development Charges Update
2025 Amendment

Volume II – Plan and Policy

Appendices

June 2026
Project No. 2404322

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APPENDIX A:
Traffic Zone Population and Employment Projections

Existing and Future Planning Details

Water Pressure District	2021 RES	2021 EMP	2021 Total	2051 RES	2051 EMP	2051 Total	2051 ADD-RES (L/s)	2051 ADD-EMP (L/s)	2051 ADD-TOTAL (L/s)
PD 1	47,704	9,346	57,050	99,125	25,518	124,636	27	7	34
PD 2/3	47,262	24,487	71,749	114,130	60,204	174,334	31	16	47
PD 4	8,634	3,160	11,794	15,054	23,428	38,481	4	6	10
Grand Total	**103,600**	**36,993**	**140,593**	**228,309**	**109,150**	**337,451**	**62**	**29**	**91**

Wastewater Catchment*	2021 RES	2021 EMP	2021 Total	2051 RES	2051 EMP	2051 Total	2051 ADWF-RES (L/s)	2051 ADWF-EMP (L/s)	2051 ADWF-TOTAL (L/s)
Brantford WWTP	53,662	13,000	66,662	81,540	45,468	127,004	20.0	12.3	32.3
Johnson Rd. WWPS	2,212	0	2,212	2,328	92	2,419	0.6	0.0	0.6
Empey St. WWPS	23,379	18,227	41,606	59,013	41,846	100,857	14.5	11.3	25.8
Somerset Rd. WWPS	5,303	670	5,973	5,686	1,501	7,184	1.4	0.4	1.8
Woodlawn Rd. WWPS	1,611	0	1,611	1,570	144	1,714	0.4	0.0	0.4
St.Andrew's WWPS	157	0	157	279	82	362	0.1	0.0	0.1
Lawren S. Harris Dr. WWPS	1,310	0	1,310	1,047	61	1,109	0.3	0.0	0.3
Greenwich St. WWPS	10,479	4,341	14,820	18,522	7,647	26,169	4.5	2.1	6.6
Alexander Dr. WWPS	371	245	616	334	338	671	0.1	0.1	0.2
Fifth Ave. WWPS	5,113	510	5,623	8,460	1,159	9,619	2.1	0.3	2.4
Stauffer Rd. WWPS	3	0	3	0	102	102	0.0	0.0	0.0
East WWPS	0	0	0	4,421	3,496	7,916	1.1	0.9	2.0
North WWPS	0	0	0	7,453	771	8,225	1.8	0.2	2.0
Northeast WWPS	0	0	0	5,887	360	6,247	1.4	0.1	1.5
Northwest-1 WWPS	0	0	0	0	1,508	1,508	0.0	0.4	0.4
Northwest-2 WWPS	0	0	0	12,638	4,004	16,644	3.1	1.1	4.2
Tutela Heights WWPS	0	0	0	19,131	571	19,701	4.7	0.2	4.8
Grand Total	**103,600**	**36,993**	**140,593**	**228,309**	**109,150**	**337,451**	**56**	**29**	**85**

* Wastewater catchment only, not including any upstream catchments established from the City's Wastewater model

APPENDIX B:
Principles, Policies, and Level of Service



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CITY OF BRANTFORD

Water and Wastewater Master Servicing Plan – Development Charges Update
2025 Amendment

Volume II – Appendix B

Submitted to:
City of Brantford
58 Dalhousie Street
Brantford, ON N3T 2J2

Submitted by:
GEI Consultants Canada Ltd.
1266 South Service Road, Unit C31
Stoney Creek, ON L8E 5R9
905.643.6688

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1. Introduction

The City of Brantford retained GEI Consultants Canada Inc. (previously GM BluePlan) to complete a Master Servicing Plan Update. The City's Master Servicing Plan Update consisted of a comprehensive Infrastructure Plan that addressed existing and growth-related needs for the City's water, wastewater, and stormwater services; including addressing the trunk and local servicing needs to support the new areas within the City's recently expanded municipal boundary.

The Master Servicing Plan Update was a critical component in the City's planning for growth and will provide the framework and vision for the management, expansion and funding of the water, wastewater, and stormwater servicing needs for the City to support growth to 2051.

The purpose of the 2020 MSP Update was to summarize the recommended water, wastewater, and stormwater Policies, Level of Service Objectives, and Design Criteria that will be used to effectively evaluate the existing and future performance of the water, wastewater, and stormwater systems and further, as rationale in the development of a long-term servicing strategy which meets infrastructure capacity needs and details necessary upgrades.

The 2025 MSP Amendment builds upon the City's previous servicing plans and incorporates updated network information, growth monitoring, and hydraulic modeling. It evaluates the impacts of revised population and employment density targets with both existing and urban areas and the Boundary Expansion Lands. The amendment outlines the proposed capital program and identifies cost implications associated with these changes to inform future updates to the City's Development Charges By-law.

1.1. Background and Objectives

Execution of reasonable Policies and Level of Service (LOS) objectives are essential in ensuring that the proper planning and design principles are followed in the development of detailed servicing strategies, implementation of system capital program, and operations and maintenance practices.

Through the Master Servicing Plan; draft Policies and LOS objectives will be established and used to guide future investment in the water, wastewater, and stormwater systems.

The development of water, wastewater, and stormwater Policies and LOS objectives have been based on existing documentation and related sources, and an assessment of the City's existing infrastructure condition and performance, including:

- The City's Official Plan
- Federal and Provincial Policies and Legislation
- Existing design criteria

    - Criteria required by the Ministry of Environment, Conservation, and Parks (MECP)
    - City of Brantford current design criteria, updated in 2017
    - Design criteria utilized in the 2014 Master Servicing Plan
    - Other local municipal design criteria
- Existing system performance
    - Historic and existing system operations and performance
    - Resiliency to climate change
- Stakeholder feedback
    - City of Brantford staff
- Financially feasible objectives

The objectives of the Principles, Policies, and Level of Service Document include, but are not limited to the following:

- Providing direction for planning and identifying water, wastewater, and stormwater servicing issues that may impact growth options
- Providing direction for normal operation and maintenance of the water and wastewater systems (the policies do not replace normal operation and maintenance procedures or best practices)
- Providing direction for development and evaluation of servicing strategies for the Master Servicing Plan Update
- Ensuring appropriate design and costing criteria are utilized for developing and evaluating servicing strategies for the Master Servicing Plan Update
- Setting policies and Level of Service Objectives that are reasonably implemented
- Setting policies and Level of Service Objectives that are robust, sustainable, and measurable

Although best management practices, criteria, and key performance indicators are updated over time, the context, intent and validity of the Policies and LOS objectives should remain intact.

Policy is the overall guiding principle. Criteria are the tactical implementation of policy.

1.2. Approach

The Policies and LOS discussion is split into four main categories and aims to link the analysis of system needs and replacement triggers with the customer experience.

- **Policy Statements:** communicate the overall guiding principles and objectives of the infrastructure systems.
- **Customer Level of Service objectives**: communicate and translate technical Levels of Service into terminology relevant to customers.
- **Technical Level of Service objectives (Criteria)**: quantitatively measure the system performance and are used to compare potential strategies and solutions.

- **Key performance indicator:** measures the relative system performance against the Technical and Customer Level of Service objectives and validate the beneficial impact of any given investment.

The system performance goals are intended to be used in the medium to long-term and will form the basis of a continuous improvement program by which each system investment is measured.

This approach is in line with the Ontario Regulation 588/17 made under the Infrastructure for Jobs and Prosperity Act, 2015, S.O. 2015.

Through the MSP, initial development of the LOS framework will be completed; however, the focus of the MSP will be on achieving the Technical Level of Service Objectives (Criteria). Refinement and final development of the LOS framework will be completed under future Asset Management Plans, and will require further discussion with Senior Staff and Council to finalize.

2. MSP Vision statement

Through the Municipal Class EA process, Phase 1 requires the identification of the problem and opportunity statement that guides the process of establishing preferred strategies to address the deficiencies observed in the water, wastewater, and stormwater systems. The following vision statement is a driver for the Brantford Master Servicing Plan Update where problems and opportunities are clearly identified through the desire to provide an adequate level of service to users and improve system performance under both current and future conditions.

The Vision Statement is as follows:

Supporting a Strong and Growing Brantford

To establish a preferred servicing plan for the City's water, wastewater, and stormwater systems that:

- Meets current needs
- Supports growth and expansion of the City's urban boundary
- Maintains or improves service levels
- Considers priority areas of climate change, infrastructure optimization and renewal, and system resiliency

3. Policy Statements

Specific servicing principles and policies have been developed to guide and provide direction for the development and evaluation of servicing strategies. In general, the City of Brantford is looking to build and maintain efficient, effective, well managed water, wastewater, and stormwater systems that provide a high level of service to the end users. In order to clearly capture these goals, the servicing principles have been categorized into 4 categories – general, water, wastewater, and stormwater.

Table B-1 presents the general servicing policies which impact water, wastewater, and stormwater servicing. While **Table B-2** to **Table B-4** present the servicing policies for the water, wastewater, and stormwater systems.

Table B-1: General Servicing Principles

Policy No.	Policy Area	Policy Statement	Servicing Implications
G.01	Municipal Servicing	"The City of Brantford shall provide adequate municipal servicing for water, wastewater and stormwater in accordance with the population and employment projections in the time horizon of the Official Plan."	• Planning and design of servicing strategies will optimize use of existing infrastructure where possible. • Infrastructure will be planned and designed in accordance of growth projections in the Official Plan. • Timing of growth will be reviewed with consideration to a reasonable implementation schedule for infrastructure required to meet the projected growth. • Municipal servicing will be implemented under typical standards (MECP Guidelines).
G.02	Environmental Protection	"The City of Brantford shall consider, and endeavour to minimize, the impact to the natural, built and cultural environment and heritage of the community; due to municipal servicing policies and projects."	• Servicing studies shall consider the City's Official Plan Environmental and Heritage Policies • Services will be planned through the appropriate Environmental Assessment process to ensure full regard for the natural and cultural heritage
G.03	Planning Horizon	"The City of Brantford shall ensure that the design of water, wastewater and stormwater infrastructure recognizes the potential for growth beyond the time horizon of the Official Plan."	• Recognize that the service life of infrastructure may be 60 years or more[1]. • Consider, where appropriate, potential for growth beyond the time horizon of the Official Plan for the planning and sizing of infrastructure.
G.04	Reserve Capacity	"The City of Brantford will endeavour to maintain sufficient reserve capacity in its water, wastewater and stormwater infrastructure and facilities to provide operational flexibility and meet potential changes in servicing conditions."	• Recognize the time frame required to implement expansion of the infrastructure and facilities and initiate planning, the Environmental Assessment process, design and construction for expansion with consideration of the in-service date. • Maintain plant operating capacity close to its rated capacity. Inability to maintain adequate operating capacity will trigger future expansions or upgrades of the infrastructure.
G.05	System Reliability and Security	"The City of Brantford shall endeavour to provide reliability, redundancy and security in its water, wastewater and stormwater systems with attention to high risk and critical areas."	• Recognize that all systems are susceptible to some level of failure or breakdown or need to be taken out of service for regular maintenance. It is reasonable to provide a level of reliability to ensure an acceptable level of service is maintained.

[1] While linear infrastructure such as watermains and sewer have an estimated service life of 60-100 years depending on material, location, and construction practices, other infrastructure such as pump station mechanical equipment have an estimated service life of 25 years

Policy No.	Policy Area	Policy Statement	Servicing Implications
G.06	Location of Municipal Services and Facilities	"The City of Brantford shall locate all of its services and facilities on public property or on municipally-owned easements."	• The City will ensure that any new and existing infrastructure be located within road right-of-ways, or on City-owned property (including designated lots and easements, subject to City By-Law property encumbrance rules). Where existing infrastructure is not located within a road right-of-way or on City owned property, the City will look to secure appropriate working easements to facilitate ongoing operation and maintenance and/or look to relocate infrastructure when major rehabilitation and/or upgrades works are required. • Adequate property size will be maintained to facilitate all day-to-day activities and emergency response. • Adequate property will be acquired to meet future infrastructure requirements.
G.07	Climate Change	"The City of Brantford shall be aware of and consider the potential impact of climate change on planning and sizing of infrastructure."	• Water, wastewater and stormwater facilities will be designed with consideration to the potential impacts of climate change.
G.08	Energy Efficiency	"The City of Brantford shall design water, wastewater and stormwater facilities with consideration to energy use."	• Facilities will be planned and designed with consideration to Net Present Value (Capital and Operating Costs) as they relate to energy use (i.e., minimize pumping where possible).
G.09	Integrated Infrastructure Program	"The City of Brantford shall coordinate and integrate the MSP program with City planning, programs and policies where appropriate."	• Coordination and integration will ensure servicing policies and strategies are aligned
G.10	Level of Service	"The City of Brantford shall outline the Level of Service Objectives through the Master Servicing Plan and endeavour to meet/exceed the minimum requirements as outlined in the objectives."	• The City will review and evaluate alternatives developed through the Master Servicing Plan based on their ability to meet requirements outlined in the Level of Service Objectives.
G.11	Sustainability	"The City will endeavor to undertake sustainable planning, operation and maintenance of the water, wastewater, and stormwater."	• The City will strive to plan, operate and maintain Water, Wastewater, and Stormwater Systems that are environmentally, financially, operationally, legislatively, and socially sustainable • Financial Sustainability shall consider and utilize appropriate funding mechanisms including but not limited to Development Charges, local cost to development and rate reserves to provide a long term balanced and equitable plan to fund the delivery of servicing

Table B-2: Water Servicing Principles

Policy No.	Policy Area	Policy Statement	Servicing Implications
W.01	Health & Safety	"The City of Brantford will promote health, productivity and safety of the community through design, construction and maintenance of the City's potable water infrastructure"	• The City will prepare a comprehensive strategy to manage existing and future water servicing needs • Ensure that planning and implementation of the potable water systems are consistent with legislative policies and guidelines • Municipal servicing will be implemented under typical standards (MECP Guidelines).
W.02	Sustainability	"The City of Brantford will endeavour to undertake sustainable planning, operation and maintenance of the Water System."	• The City will strive to plan, operate and maintain a water system that is environmentally, financially, operationally, legislatively, and socially sustainable • Financial Sustainability shall consider and utilize appropriate funding mechanisms including but not limited to Development Charges, local cost to development and rate reserves to provide a long term balanced and equitable plan to fund the delivery of servicing
W.03	Demand Projections	"The City of Brantford shall consider existing water consumption trends when identifying long-term water system needs."	• When estimating long-term water demand needs, existing water consumption rates will be used to account for existing customer demands and future demands will be estimated using the per capita rates identified in the Master Servicing Plan.
W.04	Raw Water Source	"The City of Brantford shall endeavor to enhance, protect and maintain quality, quantity and safety of its raw water source"	• Monitoring of water sources is required to ensure safe yield limit of the water taking is occurring • The City's current Raw Water Source is the Grand River • Consideration should be given to the impacts of short-term raw water intake closures on trunk infrastructure needs
W.05	Treatment & Distribution Water Quality	"The City of Brantford shall meet or exceed legislated water quality criteria"	• Water quality will meet, at a minimum, all legislated criteria • Ensure regularly testing and monitoring for chlorine residual in the system • Implement industry best practices to ensure water quality is maintained • Review the economics, reliability and water quality impacts of implementing new technology
W.06	Distribution Requirements	"The City of Brantford shall provide potable water at adequate pressure and flow to its customers"	• Provide pressures which meet current design criteria and standards. • MECP Guidelines identify a typical recommended operating range of 275-700 kPa (40-100 psi). • Review existing Pressure District Boundaries. • Have an adequate combination of reservoir capacity, pumping capacity, and stand-by power to meet the desired level of service under emergency conditions.
W.07	Fire Flow Requirements	"The City of Brantford shall consider the MECP Guidelines and the Fire Underwriters Guidelines for establishing the acceptable level of fire flow."	• Provide pressures and flows which meet current design criteria and standards.

Policy No.	Policy Area	Policy Statement	Servicing Implications
W.08	Storage Requirements	"The City of Brantford shall consider the MECP Guideline as the minimum acceptable level of water storage."	• Provide adequate level of storage which meets current design criteria and standards, and considers the operational requirements and impacts to pumping firm capacity requirements. • Consider level of storage required under floating versus pumped conditions.
W.09	Operational Flexibility	"The City of Brantford shall consider levels of storage beyond MECP Guidelines where appropriate in order to provide operational flexibility, energy management, and system security"	• Water storage can provide opportunities for optimization of pumping strategies, to consider the operational requirements and impacts to storage capacity requirements. • Water storage can provide additional level of service and security under emergency conditions, particularly for any areas across the City with limited redundancy and/or to protect against a temporary closure of the City's raw water intake • Consideration should be given to optimizing lifecycle costs for the water system as storage can minimize pumping energy costs
W.10	Water Efficiency and Consumption Trends	"The City of Brantford shall be aware of the impacts water efficiency and conservation has on the water network."	• Continue to assess water demand conditions and determine reasonableness of trends (potential lower water use and consumption) • Utilize water efficiency studies where available. • Apply where appropriate demand trends (efficiency) into future design criteria and growth forecasts. • Apply awareness to how it will impact alternatives and scheduling of future infrastructure.
W.11	Water Supply and Distribution Security	"The City of Brantford shall plan, design, construct, operate, and maintain the water system to balance level of service and security of supply to the customers"	• The City shall continue to implement standards, criteria, and standard operating procedures for the water system • There is an awareness and integration between the City water system, local distribution system and water services on private property • The City will maintain appropriate standards for the City water system to protect the public and private infrastructure

Table B-3: Wastewater Servicing Principles

Policy No.	Policy Area	Policy Statement	Servicing Implications
WW.01	Health & Safety	"The City of Brantford will promote health, productivity and safety of the community through design, construction and maintenance of the City's wastewater infrastructure"	• The City will prepare a comprehensive strategy to manage existing and future wastewater servicing needs • Ensure that planning and implementation of the wastewater systems are consistent with legislative policies and guidelines • Municipal servicing will be implemented under typical standards (MECP Guidelines).
WW.02	Sustainability	"The City of Brantford will endeavour to undertake sustainable planning, operation and maintenance of the Wastewater System."	• The City will strive to plan, operate and maintain a Wastewater System that is Environmentally, Financially, Operationally, Legislatively, and Socially Sustainable • Financial Sustainability shall consider and utilize appropriate funding mechanisms including but not limited to Development Charges, local cost to development and rate reserves to provide a long term balanced and equitable plan to fund the delivery of servicing
WW.03	Sewer Use Criteria	"The City of Brantford shall maintain a sewer use program that sets the appropriate limits and procedures to control discharge."	• Review and maintain the sewer use by-law, which is supported by Council. • Maintain a monitoring program to ensure the discharges meet the limits set out in the by-law
WW.04	Receiving Water Bodies	"The City of Brantford shall endeavour to enhance, protect, and maintain quality, quantity, and safety of its receiving water bodies."	• Wastewater effluent discharges will meet, at a minimum, all legislated criteria • The City shall seek to minimize and/or eliminate untreated overflows to the environment • The City shall consider policies related to the International Joint Commission on the Great Lakes
WW.05	Wastewater Treatment and Collection Requirements	"The City of Brantford shall meet as a minimum the requirements of the Environmental Compliance Approvals set out by governing bodies and the appropriate legislated treatment and collection criteria."	• Wastewater quality (air and effluent) will meet as a minimum all legislated criteria. • Manage inflow / infiltration through asset management programs to minimize extraneous flows and maximize efficient use of available wastewater infrastructure. • Review the economics, reliability and water quality impacts of implementing new technology. • Have an adequate combination of pumping capacity and stand-by power to meet the desired level of service under emergency conditions.
WW.06	Wastewater Flow Projections	"The City of Brantford shall utilize a wastewater flow projection methodology that recognizes recent wastewater flow and treatment data and current consumption trends"	• Forward-looking wastewater flow projections in the Master Servicing Plan must appropriately identify future wastewater needs to ensure the best estimate for infrastructure capacity and timing • The City will utilize a starting point methodology based on recent wastewater flow conditions • The City will establish current wastewater design criteria and standards for new growth
WW.07	Overstrength – Discharge	"The City of Brantford shall ensure that all new users adhere to the City's allowable discharge criteria as outlined in the City's existing sewer use by-law"	• All users shall plan and design to meet the sewer by-law. • Where over strength discharge are anticipated, onsite pre-treatment in order to achieve the City's allowable discharge criteria as outlined in the City's sewer use by-law will be required.

Policy No.	Policy Area	Policy Statement	Servicing Implications
WW.08	Separated Wastewater and Stormwater Systems	"The City of Brantford shall plan and maintain separate wastewater and stormwater systems"	• The City will continue to build, maintain, and operate separated wastewater and stormwater systems • The City will endeavor to ensure that new wastewater systems are constructed in a manner that minimize new Inflow and Infiltration contributions • The City will endeavor as part of Inflow and Infiltration reduction measures to identify and remediate existing sanitary sewer cross connections and implement a strategy to prevent future cross connections
WW.09	Wet Weather Flow Criteria	"The City of Brantford shall utilize current wet weather flow criteria to determine peak wet weather flows and size wastewater infrastructure"	• The City will continue to manage system performance under wet weather conditions • The level of service under wet weather conditions will be established through the Master Servicing Plan design criteria • Consideration to environmental, social and financial factors as well as the feasibility for implementation should be given when determining the wet weather criteria • As additional flows from growth are added to the system, the City should look for opportunities to not make overflow conditions worse than the current baseline conditions
WW.10	Wet Weather Strategies	"The City of Brantford shall review a combination of servicing strategies including infrastructure and non infrastructure (i.e. i/i reduction) solutions to meet wet weather level of service and provide sufficient wastewater capacity to support existing users and future growth."	• The City Master Servicing Plan will develop and evaluate a comprehensive list of alternatives against multiple-bottom-line criteria including lifecycle costs • The most cost-effective and beneficial strategy may include not providing additional infrastructure but creating additional capacity through flow reduction methods such as inflow/infiltration control • Where inflow/infiltration control programs secure growth capacity, program cost should be recoverable through Development Charges
WW.11	Capacity Allocation	"The City of Brantford shall review opportunities to allocate capacity gained through implementation of wet weather strategies and system optimization for growth and non growth benefit in compliance with the City's Wastewater Allocation Policy"	• Provision of additional capacity within the wastewater system will need to consider the desired benefit • Additional capacity may be required to meet regulatory requirements or to improve level of service in the system

Table B-4: Stormwater Servicing Principles

Policy No.	Policy Area	Policy Statement	Servicing Implications
SW.01	Health and Safety	"The City of Brantford will prioritize the health and safety of the public and property by implementing a strategy to provide sufficient conveyance and control infrastructure to safely manage stormwater runoff."	• The City will prepare a comprehensive strategy to manage existing and future stormwater related impacts • Ensure that planning and implementation of stormwater management systems are consistent with legislative policies and guidelines • Stormwater Management (SWM) strategies will need to be coordinated with flood plain management strategies and the Grand River Conservation Authority • Municipal servicing will be implemented under typical standards (MECP Guidelines)
SW.02	Sustainability	"The City of Brantford will endeavour to undertake sustainable planning, operation and maintenance of the Stormwater System."	• The City will strive to plan, operate and maintain a Stormwater System that is Environmentally, Financially, Operationally, Legislatively, and Socially Sustainable • Financial Sustainability shall consider and utilize appropriate funding mechanisms including but not limited to Development Charges, local cost to development and rate reserves to provide a long term balanced and equitable plan to fund the delivery of servicing
SW.03	Natural Environment and Hydrologic Cycle	"The City of Brantford, through stormwater servicing strategy and policy implementation, will endeavour to preserve and/or re-establish a more natural hydrologic cycle."	• The City will promote the utilization of facilities and low impact development techniques that mimic the existing hydrologic cycle • Promote and facilitate strategies within existing service areas that implement retrofit programs and no net increase in runoff for infill and redevelopment sites • The City will strive to develop sustainable stormwater management practices
SW.04	Natural Environment and Erosion Control	"The City of Brantford will endeavour to reduce impacts to the natural environment and protect against erosion."	• Require the implementation of stormwater management measures to mitigate the impacts of urban runoff on existing streams' stability and to minimize erosion
SW.05	Water Quality	"The City of Brantford, through its stormwater servicing strategy and implementation, endeavours to improve runoff water quality."	• Require the implementation of stormwater management measures to improve storm water runoff quality • The City is to implement operational activities to improve storm water runoff quality
SW.06	Management Responsibility	"The City of Brantford will develop and implement a stormwater management strategy and program that promotes and implements shared responsibility between the City and property owners."	• Stormwater Management is a Shared Responsibility • The City's Future Development Manual and Linear Design Manual set land use restrictions and specify minimum levels of onsite measures and controls
SW.07	Integrated Planning Approach	"The City of Brantford will improve Management of the Stormwater System through Integrated Stormwater Management Planning."	• The City will agree to a comprehensive stepped approach to developing a robust understanding and delivery plan for stormwater management including: development of master drainage plans, subwatershed studies, area specific stormwater management plan, and storm water management reports. • The City will strive to develop sustainable stormwater management practices
SW.08	Separated Wastewater and Stormwater Systems	"The City of Brantford shall plan and maintain separate wastewater and stormwater systems."	• The City will continue to build, maintain and operate separated wastewater and stormwater systems • The City will endeavor, as part of Inflow and Infiltration reduction measures, to identify and remediate existing sanitary sewer cross connections and implement strategies to prevent future Inflow and Infiltration.

4. Water System

4.1. Water Level of Service Framework

Based on the MSP vision statement and the identified Policy statements, the following customer service statement for the City's water system was developed to guide the selection of Level of Service objectives and design criteria:

"To provide an efficient, sustainable, and safe water system that meets regulatory requirements, minimizes service disruptions, and is capable of accommodating growth"

Table B-6 outlines the draft water system level of service framework, outlining the water system in terms of technical and customer key performance indicators.

4.2. Water System Technical Level of Service Criteria

Table B-5 summarizes the draft water system technical level of service criteria that will be utilized as the decision-making rationale rated to water system capacity needs and triggers for upgrades.

Table B-5: Summary of Water Design Criteria

Criteria		Draft Targets
Water Use	Per Capita Rate	270 Litres/capita/day (residential and employment)
	Max Day Peaking Factor	1.8
System Performance	Pressures	40-100 psi
	Fire flow	Land use/FUS-lite approach
	Velocities	Maintain minimum velocities > 0.3 m/s Flag velocities >1.5 m/s Maintain peak velocities <2.0 m/s
Facility Capacity	Facility Triggers (supply and pumping)	80% Planning and Design 90% Construction

Criteria		Draft Targets
Facility Capacity	Water Storage	Total Storage Needs = Balancing + Fire + Emergency Balancing = 25% MDD Fire = Greater of MECP population-based calculation or the highest landuse based FF needs Emergency = 50% of Balancing + Fire * Each PD to be storage self-sufficient
	Pumping	Firm capacity = largest pump out of service Firm capacity provides MDD if sufficient storage within PD Firm capacity provides largest of MDD+FF or PHD if insufficient storage within PD *FF needs based on highest landuse based FF within the PD

Table B-6: Water Level of Service Objectives

Service Objective	Supporting Policy Statements		Technical Objective	Key Performance Indicators - Technical	Key Performance Indicators - Customer
Efficient	G.08	W.03 W.10	• Full life-cycle costing • Renewal of aging infrastructure • Optimization of system operations • Increased water conservation • Non-revenue water is at a reasonable rate	• Water use including non-revenue water rate, per capita rate, peaking factor • Energy consumption • State of Good Repair (SOGR) program • Watermain headlosses and velocities • Facility needs (supply, storage, and pumping)	• Number of complaints (water bills, cost, pressure, quality etc.) • Default rates • Service interruptions • Compliance with MECP Standards
Sustainable	G.07 G.11	W.02	• Full life-cycle costing • Renewal of aging infrastructure • Resiliency to climate change • Costs associated with water servicing fees	• SOGR program • Age of infrastructure • Number of watermain breaks • Replacement/ rehab costs • O&M costs	
Safe	G.10	W.01 W.05 W.07	• Reliability of the distribution system • Safe Drink Water Act requirements • Maintain chlorine residual in distribution system • Provide adequate fire protection	• Water quality including water age, chlorine residuals, flushing rates, and watermain velocities • Water turnover rate in storage facilities • Available fire flow • Emergency storage	
Reliable	G.04 G.05 G.10	W.04 W.06 W.07 W.08 W.09	• Ability to supply adequate pressures and flows, uninterrupted to the distribution system • Ability to meet daily demands • Minimal service interruptions • Facilities have backup power available	• Water system performance including pressures and fire flows • Facility needs (supply, storage, and pumping) • Backup power at facilities • System redundancies	
Capacity	G.04	W.06 W.07 W.08	• Provide adequate, uninterrupted pressures and flows, to the existing and future distribution system • Ability to meet daily demands • Minimal service interruptions	• Water system performance including pressures and fire flows • Facility needs (supply, storage, and pumping	
Regulatory		W.04 W.05 W.06 W.11	• Safe Drinking Water Act • MECP • Ontario Water Resources Act	• Pressure and emergency pressure • Chlorine residuals • Supply capacity	
Growth	G.03	W.04 W.07 W.08	• Rated capacity of facility can support growth • Pressures, fire flow, and water quality are maintained at or above current performance • Projected demands are applied to areas of planned growth	• Water system performance including pressures and fire flows • Facility needs (supply, storage, and pumping) • Water use including rate, per capita rate, peaking factor	

4.3. Water Technical Level of Service Criteria Context

4.3.1. Water Use Design Criteria

The basis of the growth water system evaluation relies heavily on water per capita consumption and maximum day demand peaking factors as these design criteria will be used to estimate growth demands. An analysis of historic water treatment plant production and water billing records (2008-2023), as detailed in Table B-7, confirmed both a declining trend and that historic values are less than current City of Brantford Linear Design and Construction Manual (2018). The analysis prioritized a 5-year average from 2019-2023. In addition to a historic water use analysis, benchmarking, and comparison with municipalities of similar population and geographic location was made for per capita rates and peaking factors. Generally, the existing and revised design criteria are within an acceptable range with other municipalities.

Table B-7: Historic Water Use

Year	ADD (MLD) [1]	MDD (MLD) [2]	Per Capita Rate (L/c/d)	Peaking Factor
2008	34.2	53.5	247	1.56
2009	33.3	48.0	238	1.44
2010	33.5	50.7	239	1.51
2011	33.6	57.5	243	1.71
2012	37.0	57.2	256	1.55
2013	33.4	47.2	-[3]	1.41
2014	33.1	42.2	225	1.28
2015	32.8	46.9	221	1.43
2016	32.4	46.5	218	1.44
2017	31.5	46.7	227	1.49
2018	32.9	44.7	230	1.36
2019	33.1	47.6	225	1.44
2020	33.3	49.5	219	1.49
2021	32.5	43.9	211	1.35
2022	33.5	50.9	208	1.52
2023	33.0	49.0	201	1.56
Average Historic Water Use	**30.0**	**48.9**	**227**	**1.47**
5-Year Average Historic Water Use (2019-2023)	**33.1**	**48.2**	**213**	**1.46**
Historic Design Criteria (2019)	**-**	**-**	**300**	**2.00**

[1] Average Day Demand

[2] Maximum Day Demand

[3] No billing data provided for 2013.

The recommended design criteria to be utilized for water use is as follows:

- Growth related per capita rate of 270 L/c/d
  - This represents a decrease in the existing design criteria per capita rates of 10% and is in line with the recommended wastewater per capita rate decrease.
  - The recommended per capita rate remains above the observed historic per capita rate; providing reasonable flexibility in the criteria to accommodate potential changes in future usage rates.
  - While there is an observed decreasing trend in per capita rates, a stepped approach to lowering per capita rates is recommended with the next MSP to ensure water conservation measures are maintained.
- Peaking factor of 1.8
  - This represents a decrease in the existing design criteria maximum day demand peaking factor of 10%.
  - The recommended peaking factor remains above the observed historic 10-year maximum day peaking factor, and above the MECP recommended maximum day peaking factor of 1.65 for a population base between 75,001 to 150,000 or 1.5 for a population based greater than 150,000 (2051 Population); providing reasonable flexibility in the criteria to accommodate potential changes in future usage rates.

4.3.2. Starting Point Methodology

The five-year rolling average of average day demands will be used to establish baseline system average day demands. Baseline system max day demand will be calculated using a peaking factor of 1.8.

4.3.3. Growth Demand Projections

Future system demands were developed using a starting point methodology, the standard approach within Southern Ontario for projecting future growth demands. Expected demand due to growth was added to the starting point demand to establish future demands. Example is provided below.

2051 ADD = Baseline ADD + (2051 total equ.pop.[2] – 2016 total equ.pop) * 270 L/c/d

4.3.4. Hydraulic Performance Criteria

An updated and calibrated hydraulic water model (2025) was utilized in the analysis of existing water system performance. This process detailed existing system performance without the application of growth demands and could be used as a guideline for potential system upgrades.

[2] Equ. Pop – Total of the combined people and employment population.

4.3.4.1. Pressures

Pressures within the existing system, detailed as a percent of the system in **Table B-8**, are typically between 40-100 psi under both average day demand (ADD) and maximum day demand (MDD) scenarios.

Recommended design criteria to be utilized for pressure are as follows:

- Maintain pressure design criteria between 40-100 psi, consistent with the MECP Criteria
- Reduction of the pressure bounds would require system operations modifications and water system upgrades with minimal to moderate benefit

Table B-8: Existing System Pressures

Pressure (psi)	ADD	MDD
<40	4%	4%
40-50	<1%	<1%
50-60	10%	11%
60-80	35%	42%
80-90	35%	25%
90-100	13%	14%
>100	2%	2%

4.3.4.2. The Fire Flow – Network Capacity

There is currently an opportunity to define fire flow targets within the existing system and future network as the 2014 MSP did not evaluate fire flows on a local basis and the current design criteria relies on the Fire Underwriters Survey (FUS) for new development only and does not consider impacts on the existing system. Further, the intent of defining these targets:

- Commits a certain level of service for a typical property of a specific land use,
- Provides guidance in the prioritization of the City's State of Good Repair (SOGR) program and clearly identifies upsizing needs, and
- Requires developers to meet City's fire flow targets should they require a higher fire flow based on FUS evaluation

The recommended process of defining fire flow targets is as follows:

- FUS and land use-based approach
- Fire flow at a hydrant is governed by land use with the highest fire flow target
- Due to current uncertainties on the magnitude of water system upgrades as a result of fire flow targets, a sensitivity analysis is to be performed to ensure reasonable targets can be met.

Table B-9 summarizes the range of recommended fire flows, including typical FUS ranges and hydrants used in the event of a fire, which was subjected to a further sensitivity analysis. In consultation with the City, the High Fire Flow (FF) Scenario target will be used as the Fire Flow target when assessing system capacity.

Table B-9: Range of Recommended Fire Flow Targets

Landuse	Typical FUS Range (L/s)	# of Hydrants	Low FF Scenario(L/s)	High FF Scenario(L/s)
Dead End Residential	27-100 L/s	-	50	50
Single/ Semi Family	27-162 L/s	1	75	75
Townhouse/ Row House	82-167 L/s	1-2	90	125
Multi Family	117-368 L/s	2	100	150
Commercial	111-185 L/s	2-3	125	175
Institutional	96-334 L/s	2-3	125	175
Industrial	133-299 L/s	3-4	150	250
City Center	-	3	150	225

4.3.4.3. Peak Velocities

The current Design criteria require new watermains to maintain peak velocities, under peak hour conditions, less than 1.5 m/s with peak velocities exceeding 2.0 m/s to be flagged for review. This methodology is to be used to evaluate the existing system. The majority of the system is currently within these bounds, as detailed in **Table B-10**.

Table B-10: Existing System Peak Velocities

Peak Velocity (m/s)	Distribution (<400 mm)	Transmission (≥400 mm)
<0.5	83%	6%
0.5-1.0	4%	3%
1.0-1.5	1%	<1%
1.5-2.0	<1%	<1%
≥2.0	1%	<1%

4.3.4.4. Water Quality

Based on MECP requirements, the City must maintain total chlorine residuals at 0.25 mg/L; however, as discussed with City staff, there are no existing low residual issues within the City system; as potential problem area are being effectively managed through the City's existing flushing program. The recommended approach to water quality is:

- Water age, as evaluated by the hydraulic water model, is correlated to chlorine residuals
- Areas with high water ages (greater than 98 percentile) will be flagged and reviewed with City staff to confirm any water quality constraints

4.3.5. Water Facilities

Evaluation of facility capacities and future needs was assessed first by historic conditions max day demands and further by growth demands using the per capita rate and peaking factor outlined in **Section 2.3.1**. The evaluation of facility capacity using a starting point methodology and applying varying per capita rates and peaking factor to fully assess the sensitivity and impacts of facility needs by changing these criteria.

4.3.5.1. Facility Upgrade Triggers

Industry best practice and recommended methodology for supply and pumping stations facility upgrade triggers are as follows:

- At 80% utilization of a facility's capacity the planning process will begin to assess upgrade capacity needs.
- At 90% utilization of a facility's capacity the construction process begins through either an upgrade to an existing facility or construction of a new facility.

4.3.5.2. Storage Capacity

Potential short-term loss of City raw water supply due to upstream overflow or spill events has been identified as a risk and is a significant concern based on the following high-risk factors:

- Single supply source for the entire City of Brantford
- Frequency of intake closures due to upstream contaminant spill
- Limited raw water storage capacity

As such, evaluated through the Water Treatment Plant Emergency Water Supply and Canal Upgrades Study (AECOM, 2019), a raw storage capacity of two (2) days will be achieved through upgrades to the Holmedale Canal and raw/partially treated tank storage at the WTP was recommended. Further, system storage will be supplemental to raw storage in the event of the listed high-risk factors occurring.

System (treated) storage will be evaluated on a pressure district by pressure district basis using the approach of:

Total Storage = Fire Storage (A) + Equalization Storage (B) + Emergency Storage (C)

- Fire storage (A) needs for water reservoirs will be sized to be the greater of:

    - FUS fire storage need based on the highest land use needs as identified within the pressure district; or,
    - MECP population-based storage requirement
- Equalization Storage (B) to be based on the MECP 25% of maximum day demand to meet peak demands
- Emergency Storage (C) to be based on the 50% of Fire Storage (A) + Equalization Storage (B)

To mitigate against the interruption of supply capacity each Pressure District Fire Storage is to be calculated independently. Storage capacity can supplemented by a second pressure district; however, the City shall maintain enough storage volume in the system to support each pressure district as if it was independently supplied.

4.3.5.3. Pumping Firm Capacity

The evaluation of pumping firm capacities, at both pumping stations and water treatment plant high lift pumps, considered historic and future pumping needs, current firm capacity definition, and storage within a pressure district. The recommended approach in determination of pumping firm capacities is as follows:

- Firm capacity is defined as the largest pump out of service
- The pump capacity shall be sized to provide
    - Max day demands where sufficient elevated storage is available
    - The greater of peak hour demand or max day demand + fire flow where no/insufficient elevated storage is available; further, fire flow needs are based on the highest land use-based fire flow target within the Pressure District

5. Wastewater System

5.1. Wastewater Level of Service Framework

Based on the MSP vision statement and the identified Policy statements, the following customer service statement for the City's wastewater system was developed to guide the selection of Level of Service objectives and design criteria:

"To provide an efficient, sustainable, and reliable wastewater system that minimizes environmental impacts and is capable of accommodating growth"

Table B-12 details objectives intended to evaluate the existing and future performance of the wastewater system in terms of technical and customer key performance indicators.

5.2. Wastewater System Technical Level of Service Criteria

Table B-11 summarizes the draft wastewater system technical level of service criteria that will be utilized as the decision-making rationale rated to wastewater system capacity needs and triggers for upgrades.

Table B-11: Summary of Wastewater Design Criteria

Criteria		Draft Targets
Wastewater Flows	Per Capita Rate	245 Litres/capita/day (residential) 270 Litres/capita/day (employment)
	Peaking Factor	Harmon's Peaking Factor
	I/I Allowance	0.3 L/s/ha
Facility Capacity	Facility Triggers	80% Planning and Design 90% Construction
	Pumping	Firm capacity • Largest pump out of service (pump capacity); and • Largest forcemain out of service (when multiple forcemains are present) Wastewater Pumping Station (WWPS) to convey peak 100-year flows New WWPS or upgraded WWPS, which support growth, to also provide storage to detail 10-year flows for 1 hour

Criteria		Draft Targets
System Performance	Peak Wet Weather Design Flows	10 Year Design Storm
	Existing Infrastructure (1)	Hydraulic Grade Line (HGL) Target 2.1 m below ground level or depth/Diameter (d/D) <= 1.0
	New/Upgraded Infrastructure (2)	depth/Diameter of pipe (d/D) = 0.7
Extraneous Flow Program		Requirement of the flow monitoring of new developments to ensure development is achieving design flows

(1) Existing sewers with surcharge states will only be flagged for upgrades if the diameter is greater or equal to 250 mm.

(2) Please note that for the greenfield growth areas, this study only assesses new trunk infrastructure. Local infrastructure (linear and vertical) are not assessed and documented.

Table B-12: Wastewater Level of Service Objectives

Service Objective	Supporting Policy Statements		Technical Objective	Key Performance Indicators - Technical	Key Performance Indicators - Customer
Efficient	G.08	WW.05 WW.08 WW.10	• Full life-cycle costing • Renewal of aging infrastructure • Optimization of system operations • Reduction of inflow and infiltration	• Energy consumption • State of Good Repair (SOGR) program • Pumping capacity (actual vs. design) • Inflow and Infiltration (I/I) flows • Performance of treated sewage • Sewer surcharging during wet weather event	• Number of complaints (water bills, cost, odour, etc.) • Basement flooding (due to extraneous flows) • Default rates • Service interruptions • Compliance with MECP Standards
Sustainable	G.07 G.11	WW.02	• Full life-cycle costing • Renewal of aging infrastructure • Resiliency to climate change • Costs associated with Wastewater servicing fees	• SOGR program • Age of infrastructure • Replacement/rehab costs • O&M costs	
Safe	G.10	WW.01 WW.04	• Compliance with Provincial Water Quality Objectives • Canadian Council of Ministers of the Environment (CCME) Wastewater Effluent Regulations • MECP Guideline F-5-5 & F-5-1 (compliance with Effluent Criteria) • Sewer system meeting capacity targets	• I/I flows • Treatment Plant Capacity • System Combined Sewer Overflow (CSO) Volumes	
Reliable	G.04 G.05 G.10	WW.05	• Condition of sewer system (CCTV) • Capacity to meet wastewater production • Minimal service interruptions • Facilities have backup power available	• System capacity is compliant with PACP scores • Percent of system meeting capacity needs • Sewer surcharging during wet weather event	
Capacity	G.04	WW.05 WW.06 WW.09 WW.11	• Availability to service Urban Boundaries • Minimal service interruptions • Ability to convey growth wastewater production	• Treatment Plant Capacity • Pump Station Capacity • Percent of system meeting capacity needs • Sewer surcharging during wet weather event	
Regulatory		WW.03 WW.04 WW.07	• Compliance with Provincial Water Quality Objectives • CCME Wastewater Effluent Regulations • MECP Guideline F-5-5 & F-5-1 (compliance with Effluent Criteria)	• System CSO Volumes • Sewer and forcemain velocities • Pump Station Capacity • Treatment Plant Capacity • Sewer surcharging during wet weather event	
Growth	G.03	WW.06 WW.09	• Rated capacity of facility can support growth (treatment, pumping) • Sewers system can support growth (gravity sewers) • Projected demands are applied to areas of planned growth	• Pump Station Capacity • Treatment Plant Capacity • I/I allowance • Per capita rate • Percent of system meeting capacity needs • Sewer surcharging during wet weather event	

5.3. Wastewater Technical Level of Service Criteria Context

5.3.1. Wastewater Use Design Criteria

Wastewater flows are assessed by means of dry weather flows and peak wet weather flow with growth design flows calculated using the following formula:

Peak Design Flow = Dry Weather Flow × Peaking Factor + Infiltration Allowance

To estimate the growth flow per capita rates, extraneous flow allowance, and peaking factors must be defined.

5.3.1.1. Per Capita Rate

Per capita average dry weather flows, as detailed in **Table B-13**, was assessed on a system scale with further analysis using 2018 - 2022 flow monitoring data. The per capita rates indicate that typical residential and employment per capita rates are generally lower than the existing design criteria on a catchment scale and a system wide scale.

Table B-13: Historic Wastewater Per Capita Rates

Year	Residential Per Capita Rate (L/c/d)	Employment Per Capita Rate (L/c/d)	Combined Per Capita Rate (L/c/d)
2016	214	303	238
2017	239	295	268
2018	217	296	254
2019	216	331	247
2020	216	279	233
2021	206	300	231
2022	272	204	255
2023	333	175	292
Average	**239**	**273**	**252**
Current Design Criteria	**270**	**300**	**-**

The recommended design criteria to be utilized for per capita dry weather flows is as follows:

- Growth related residential per capita rate of 245 L/c/d and employment per capita rate of 270 L/c/d
    - This represents a decrease in the existing design criteria per capita rates of 10% and is in line with the recommended water per capita rate decrease.
    - The recommended per capita rate remains above the observed historic per capita rate; providing reasonable flexibility in the criteria to accommodate potential changes in future usage rates.
    - While there is an observed decreasing trend in per capita rates, a stepped approach to lowering per capita rates is recommended with the next MSP to ensure water conservation measures are maintained as wastewater flows are directly correlated with water consumption.

5.3.1.2. Peaking Factor

The City presently utilizes the Harmon's peaking factor approach in their current design criteria, and it is recommended that this approach be maintained. Using 2018 - 2022 flow monitoring data, observed and design guideline peaking factors were compared where observed peaking factors were lower than design guideline methodology, as detailed in **Table B-14**. Harmon's peaking factor will be used to estimate growth related peak dry weather flows as it provides an additional safety factor in the evaluation of the local system.

Table B-14: Observed and Harmon's Peaking Factors

Flow Monitor	Observed Peaking Factor	Design Guidelines Peaking Factor (Residential)	Design Guidelines Peaking Factor (Employment)
SA03	1.95	2.86	2.97
SA04	1.85	2.63	2.82
SA10	1.67	3.72	3.43
SA11	2.19	3.65	3.59
SA12	1.83	2.83	3.24
SA13	1.63	2.82	2.71
SA14	1.83	2.85	3.15
SA15	1.81	3.03	3.16
SA16	1.93	3.80	3.58

5.3.1.3. Extraneous Flow Allowance

Observed wet weather flows, by means of extraneous flows entering the wastewater system, were evaluated based on the 2018 - 2022 flow monitoring data. This process extrapolated observed extraneous flows to design storms, as detailed in **Table B-15**, such that the performance of the existing wastewater system could be assessed.

Table B-15: Observed Extraneous Flows

Design Storm	Average I/I (L/s/ha)	Min I/I (L/s/ha)	Max I/I (L/s/ha)
2-Year	0.67	0.04	1.89
5-Year	0.89	0.05	2.49
10-Year	1.08	0.07	3.04
25-Year	1.25	0.08	3.50
50-Year	1.42	0.09	3.96
100-Year	1.58	0.09	4.40
Current Design Criteria	**0.30**		

The recommended design criteria to be utilized for extraneous flow allowance are as follows:

- Recommend extraneous flow allowance for new greenfield and infill development be increased to 0.3 L/s/ha.
- Capacity assessment for existing infrastructure to utilize actual existing peak wet weather flow based on the hydraulic model results.

5.3.2. Starting Point Methodology

The five-year rolling average of average day flows will be used to establish baseline system average daily flows.

5.3.3. Growth Flow Projections

Future system demands were developed using a starting point methodology, the standard approach within Southern Ontario for projecting future growth flows. Expected flows due to growth were added to the starting point demand to establish future flows. Example below:

2051 Average Dry Weather Flow (ADWF) = Baseline ADWF + (2051 residentialpopulation – 2021 residential population) * 245 L/c/d + (2051 employment population – 2021 employment population) * 270 L/c/d

5.3.4. Wastewater Facility Capacity

Evaluation of facility capacities and future needs were assessed first utilizing peak wet weather flows under historic conditions and further growth demands utilizing the per capita rate, peaking factor, and extraneous flow allowance outlined in **Section 3.1.1**.

5.3.4.1. Facility Upgrade Triggers

Industry best practice, and recommended methodology, for treatment and sewage pumping stations facility upgrade triggers are as follows:

- At 80% utilization of a facility's capacity the planning process will begin to assess upgrade capacity needs.
- At 90% utilization of a facility's capacity the construction process begins through either an upgrade to an existing facility or construction of a new facility.

5.3.4.2. Sewage Pumping Station Capacity

The evaluation of pumping needs considered the inflow to each pumping station for each design storm using the hydraulic wastewater model. The recommended approach in determination of pumping capacities is as follows:

- Firm capacity is defined as the largest pump out of service, utilizing pump performance data where available, and largest forcemain out of service where there are dual forcemains
- 100-year level of service for existing and new sewage pumping facilities – capable of conveying peak 100-year design storm flows.
- 10-year level of service for new facilities and upgraded facilities – capable of providing 1 hour of onsite storage for the 10-year design storm flows.

5.3.5. Hydraulic Performance Criteria

An updated and calibrated hydraulic wastewater model (2023) was utilized in the analysis of existing wastewater system performance. This process detailed existing system performance without the application of growth demands and could be used as a guideline for potential system upgrades.

5.3.5.1. Gravity Sewer System Capacity

Sewer surcharging conditions will be defined and assessed when peak system hydraulic grade line (HGL) within a pipe satisfies the following conditions under the 10-year design storm:

- Existing Infrastructure
    - The Hydraulic Grade Line (HGL) in the pipe if the pipe obvert is more than 2.1 meters below grade; or
    - The depth of flow in pipe is equal to or less than the obvert elevation (d/D <= 1) [3];

[3] Depth of flow in pipe (d) is equal to or less than the obvert elevation (D)

- New/Upgraded Infrastructure
    - Gravity sewers will achieve a d/D target of 0.7

Please note that existing sewers with surcharge states will only be flagged for upgrades if the diameter is greater or equal to 250 mm. For the greenfield growth areas, this study only assesses trunk new infrastructure, local infrastructure (linear and vertical) are not assessed.

Table B-16 details the existing gravity sewer performance.

Table B-16: Gravity Sewer Performance

Design Storm	d/D				
	<0.5	0.5-0.8	0.8-1	>1	Surcharging <2.1 m
DWF	99%	0.6%	0.0%	0.2%	0%
2-Year	92%	6.5%	0.7%	0%	0%
5-Year	85%	12.6%	0.9%	1%	0%
10-Year	81%	15.2%	1.6%	3%	1%
25-Year	77%	16.3%	2.2%	5%	1%
50-Year	74%	15.8%	3.2%	7%	1%
100-Year	71%	15.6%	3.6%	9%	2%

6. Stormwater System

6.1. Stormwater Level of Service Framework

Based on the MSP vision statement and the identified Policy statements, the following customer service statement for the City's stormwater system was developed to guide the selection of Level of Service objectives and design criteria:

"To provide an efficient, sustainable, and reliable stormwater management system that minimizes environmental impacts and protects public health and property"

Table B-17 details objectives intended to evaluate the existing and future performance of the stormwater system in terms of technical and customer key performance indicators.

6.2. Stormwater System Technical Level of Service Criteria

Table B-17 summarizes the draft stormwater system technical level of service criteria that will be utilized as the decision-making rationale rated to stormwater system capacity needs and triggers for upgrades.

Table B-17: Summary of Stormwater Technical Criteria

Criteria		Draft Targets
Stormwater Flows	Imperviousness %	Parks, Open Space – 35% Low and Medium Density Residential – 65% Downtown, High Density- Residential – 75% Institutional, Commercial – 80% Industrial – 90%
	Depression Storage	1.5 mm for impervious areas 3.5 mm for pervious areas
	Synthetic Design Storm	3-hour Chicago (minor system)
Sewer System Performance	Design Return Period	2 or 5 Year – catchment dependent
	HGL Target (existing)	Below ground level
	d/D Target (new)	$d/D \leq 0.7$

Criteria		Draft Targets
Facility Assessment – Quantity Control/ Erosion Control	Coverage	100% of outfalls to sensitive watercourses have upstream control or downstream control measures. – All new development to implement appropriate controls to manage post development runoff volumes to the greater of: • Match pre development flows under both minor flow system level of service objective (2 year or 5 year design storm) and 100 year design storm • Capture and manage the first 25 mm of site runoff for erosion control. Meet other water quality obligations applicable to the sub-catchment.
Facility Assessment – Quality Control	Coverage (existing)	Minimum 50% of impervious area drains to water quality facility
	Coverage (new)	100% of impervious area drains to water quality facility
	Target	80% Total Suspended Solids (TSS) removal (Typical) 70% Total Suspended solids removal (Direct Outfall to Grand River)
	Thermal Mitigation	Per Subwatershed Studies or individual studies if a subwatershed study is not available
Facility Assessment – Water Balance		Per Subwatershed Studies or individual studies if a subwatershed study is not available

Table B-18: Stormwater Level of Service Objectives

Service Objective	Supporting Policy Statements		Technical Objective	Key Performance Indicators - Technical	Key Performance Indicators - Customer
Efficient	G.08	SW.02 SW.08	• Full life-cycle costing • Renewal of aging infrastructure • Optimization of system operations • Source control • Minimize directly connected downspouts	• State of Good Repair (SOGR) program • Performance of existing conveyance and treatment infrastructure • Prevalence of on-site Stormwater Water Management (SWM) controls • Percent of direct connected rooftops	• Number of complaints (cost, flooding, etc.) • Number of basements flooded • Number of road flooding events with or without road closures • Emergency relief cost • Regular cost (property tax)
Sustainable	G.07 G.11	SW.02	• Full life-cycle costing • Renewal of aging infrastructure • Costs associated with obtaining funding	• SOGR program • Age of infrastructure • Replacement/rehab costs • O&M costs	
Safe and Reliable	G.04 G.05 G.07 G.10	SW.01	• Capacity to meet specified design storm (major and minor systems) • Minimal flooding events • Resiliency to climate change • Condition of sewer system (CCTV) • Minimize cross-connections	• Percent of system meeting capacity needs under minor storm • Percent of system meeting capacity needs under major storm • System's ability to meet performance targets under existing and climate change scenarios • Sufficiency of outlets • Number of cross connections to sanitary system	• Number of complaints (cost, flooding, etc.) • Number of basements flooded • Number of road flooding events with or without road closures • Amount of damage and insurance claims • Emergency relief cost • Regular cost (property tax)
Environmental and Regulatory	G.02	SW.03 SW.04 SW.05 SW.07	• Compliance with Provincial Water Quality Objectives • Ontario Water Resources Act • MECP Stormwater Planning and Design Guidelines, Future LID Guidelines • Adaptability to the effect of climate change • Water balance and provision of baseflow to streams • Protecting aquatic habitat	• Percent of system with adequate flooding and erosion control practices (stabilization or retention/detention) • Percent of system with adequate water quality treatment • Imperviousness • Prevalence of LIDs/ recharge areas • Pond and OGS sediment removal needs • Critical receiver water quality • Critical receiver stability • Critical receiver ecological changes	• Compliance with MECP Standards • Alignment with Grand River Integrated Water Management Plan • Number of complaints: park/trail and watercourse cleanliness, water quality, sport fisheries • Number of severe weather events

6.3. Climate Change Consideration

Several different approaches have been undertaken by municipalities to account for climate change when evaluating or planning their stormwater management system, including the following:

- Undertake a statistical study to update local intensity-duration-frequency (IDF) parameters based on the most up-to-date precipitation data to determine the current impact of climate change. Where old IDF parameters have been found to be more conservative than the updated parameters (which may occur if the old parameters were calculated form a shorter data set including an extreme storm event), old parameters are retained to implicitly account for future climate change.
- Apply an increase factor (e.g., 15%) to existing IDF parameters based on assumptions regarding the effect of climate change on rainfall depths.
- Utilize modified IDF parameters based on specific local predictions of a global climate model, if available.
- Utilize a more conservative return period when designing new infrastructure (e.g., 10 year storm instead of 5 year storm).

Due to the inherent uncertainty and lack of site-specific information regarding the current and future impact of climate change on the City of Brantford, the recommended approach is as follows:

- Conservative IDF parameters (as included in the new Linear Design Guidelines) and design storms will be used to assess existing storm sewer capacity and design new storm sewers
- Target level of service for storm sewer capacity in existing areas will consider financial and technical feasibility of upgrading deficiencies, and major system evaluation study will be recommended to ensure that storms exceeding minor system capacity can be adequately conveyed to outlets
- During MSP process, alternative approaches will be evaluated based on resiliency to climate change by assessing the solutions capacity to accommodate more conservative return period storms.

6.4. Stormwater Technical Level of Service Context

There is no prescribed level of service in the MECP design manual for minor system (storm sewer and ditch) performance. The manual notes that storm sewers are generally sized to convey runoff from storms ranging from 2 year to 10-year return periods, and that during the design phase the Rational Method is typically used to calculate the required capacity of sewers.

The recommended approach to evaluate the existing stormwater system performance is as follows:

- Utilize all-pipes model with catchment characteristics calibrated to observed flow monitoring data and apply 3-hour Chicago design storm of various return periods in

existing and post-development scenarios. For growth and intensification areas, subcatchment parameters typical to the type of land use will be applied.
- Recommend major system evaluation study to ensure that storms exceeding minor system capacity can be adequately conveyed to outlets.

New infrastructure in greenfield areas should follow the City of Brantford Linear Design Standards.

6.4.1. Flood Plain Areas

A special case for minor system performance involves low lying areas near the Grand River which are protected from high river levels by means of a dike system owned and operated by the Grand River Conservation Authority (GRCA). A system of gates at each storm sewer outlet are manually closed at prescribed water levels according to an internal City protocol to prevent water from the Grand River from passing through the dike. However, the storm sewers in these areas have no outlet during periods when the gates are closed. Level of service during these time periods will be investigated as part of the MSP.

6.4.2. Stormwater Hydraulic Performance Criteria

An updated and calibrated hydraulic stormwater model (2017) was utilized in the analysis of existing stormwater system performance. This process detailed existing system performance without the application of growth or climate change and could be used as a guideline for potential system upgrades.

6.4.3. Storm Sewer System Capacity

Storm sewer capacity conditions will be defined and assessed when peak system HGL within a pipe satisfies both of the following conditions:

- The depth of flow in pipe is equal to or less than 70% full (d/D<0.7); and,
- The HGL is maintained below the ground surface elevation (i.e., stormwater system surcharges to the road) at either end of each storm sewer.

Level of service, in terms of design storm return period, for the assessment of upgrade triggers is to be subcatchment specific and based on observed performance/ characteristics, providing an appropriate balance of risk and financial feasibility:

- 2 Year level of service selected where poorer performance observed in the model; typically, older areas constructed to older design standards.
- 5 Year level of service selected where better performance observed, so higher level of service is more reasonably achieved; typically, newer areas with more modern design standards and practices and for existing and greenfield employment areas.

However, wherever feasible and does not negatively impact the downstream system performance, the design of new sewers should strive to achieve the 5 Year level of service.

6.4.4. Stormwater Facilities

There are several types of stormwater management facilities within the City of Brantford:

- End-of-pipe detention ponds, including dry ponds, wet ponds, and wetlands. Typically designed for quantity control (flooding and/or erosion control) and quality control.
- Oil grit separator (OGS) units; quality control only.
- Infiltration facilities designed to promote groundwater recharge. Implicit quantity and quality control benefits.

The recommended approach is to evaluate the existing stormwater system in terms of coverage, with the required amount of coverage and design criteria for various stormwater management objectives to be subcatchment specific depending on the characteristics of the receiver. 100% of outfalls to sensitive watercourses are to have upstream or downstream control measures unless the subwatershed study confirms that they are not required. Further, direct outfalls to Grand River or Mohawk Lake do not require quantity control, however they do require quality control.

- Existing system coverage requires a minimum of 50% of the impervious areas to be captured and treated via a water quality facility
- New system coverage requires 100% of the impervious area drains to have a water quality facility

Further, each quality control facility is to target an 80% suspended solids removal (to be confirmed by subwatershed studies) and 70% suspended solids removal into the Grand River.

6.4.5. New Development Sites

Servicing of new development with the MSP was evaluated using the Standards as outlined below (based on the 2019 version of the City's Linear Design Manual). Approval of future development applications will be subject to the City criteria and policy in place at the time of the application and may differ to those outlined below.

6.4.5.1. Stormwater Runoff and Imperviousness

Table B-19 details the percent impervious, by land use, that was used by the MSP to evaluate the potential runoff rated from greenfield and infill development.

Table B-19: Stormwater Perviousness

Land use	Percent Impervious
Parks and Open Space	35%
Low and Medium Density Residential	65%
Downtown, High Density Residential	90
Institutional, Commercial	80%
Industrial	90%

6.4.5.2. Depression Storage

Table B-20 summarizes the depression storage that was used by the MSP.

Table B-20: Depression Storage Recommendation

Perviousness	Depression Storage
Pervious	3.5 mm
Impervious	1.5 mm

6.4.5.3. Flow Control Targets

Unless otherwise stated under area specific stormwater planning studies, new development / redevelopment areas will be expected to manage stormwater runoff to the following criteria:

- Post development peak flow to match pre development peak flow under both minor flow system level of service objective (2 year or 5 year design storm) and 100 year design storm
- Manage post development runoff volumes to the greater of:
    - Match pre development flows under both minor flow system level of service objective (2 year or 5 year design storm) and 100 year design storm
    - Capture and manage the first 25 mm of site runoff for erosion control.
    - Meet other water quality obligations applicable to the sub-catchment.

Further, allowable peak flows will be subject to the available capacity in the downstream minor and major stormwater conveyance systems.

6.4.5.4. Major Flow System

Unless otherwise stated under area specific stormwater planning studies, new development / redevelopment area will require a clearly defined major storm outlet, with adequate capacity, discharging to the City's riverine system, the Grand River, or Mohawk Lake.

APPENDIX C:
Unit Rates

Unit Rates

Appendix 2C - Table 1:Trenchless construction unit rates for watermains or sanitary sewers

Diameter	Total Unit Cost ($2025)	Diameter	Total Unit Cost ($2025)	Diameter	Total Unit Cost ($2025)
(mm)	($/m)	(mm)	($/m)	(mm)	($/m)
150	$1,872	**500**	$9,288	**1200**	$15,264
200	$1,944	**525**	$9,360	**1350**	$16,560
250	$2,016	**600**	$11,520	**1500**	$17,280
300	$2,088	**675**	$11,664	**1650**	$18,000
325	$2,160	**750**	$11,808	**1800**	$18,720
350	$2,232	**825**	$14,112	**2100**	$20,160
375	$9,072	**900**	$14,400	**2400**	$20,880
400	$9,144	**975**	$14,688	**3000**	$23,040
450	$9,216	**1050**	$14,976		

Anticipated trenchless methodology is as follows:

- 1350 mm – 3000 mm: Microtunnel or TBM
- 825 mm – 1200 mm: Microtunnel, Auger Boring, Guided Auger Boring
- 375 mm – 750 mm: Axis Guided Boring, Auger Boring, Guided Auger Boring
- 150 mm – 350 mm: Axis Guided Boring, Horizontal Directional Drilling

Note: Trenchless Cost estimate table provides estimated high level cost for tunnelling, pipe installation and shafts for ranges of diameter. Tunnelling project costs can vary widely depending on project details that are not fully known at the Master Plan / DC stage (e.g., number of shafts, subsurface conditions, site conditions, contractor preferred tunnelling method, depth, location (urban, greenfield) etc.).

Appendix 2C - Table 2: Facilities

Facility	Unit Rate ($2025)	Unit	Notes
Water Facilities			
Reservoirs - New Construction	$1,296,000	$ per ML	
New Water Pumping Stations ≤ 150L/s	$33,120	$ per L/s	
New Water Pumping Stations > 150 L/s ≤ 600 L/s	$18,720	$ per L/s	
New Water Pumping Stations > 600 L/s	$15,840	$ per L/s	
Wastewater Facilities			
New Wastewater Pumping Stations	$5,600,000	-	Base Cost
	$31,500	$ per L/s	Unit Rate

Notes: Unit rate is intended to provide the base construction cost for a basic pumping facility. These costs are not assumed to account for force mains (for WWPS) or overflow storage tanks (WWPS) or unique items such as deep wet wells (WWPS), extensive architectural features or extensive site works.

Unit Rates

Appendix 2C - Table 3: Sanitary sewer unit rates for 5-meter deep open cut construction

Diameter (mm)	Total Unit Cost (2025$/m)
300	$ 971
375	$ 1037
450	$ 1129
525	$ 1217
600	$ 1,551
675	$ 1,907
750	$ 2,118
825	$ 2,279
900	$ 2,671
975	$ 2,881
1050	$ 3,189
1200	$ 3,603
1350	$ 4,078
1500	$ 4,615
1800	$ 5,941
2100	$ 7,400
2400	$ 9,201
3000	$ 12,995

Appendix 2C - Table 4: Sanitary sewer unit rates for 10-meter deep open cut construction

Diameter (mm)	Total Unit Cost (2025$/m)
300	$ 3961
375	$ 4081
450	$ 4233
525	$ 4372
600	$ 4,777
675	$ 5,271
750	$ 5,539
825	$ 5,764
900	$ 6,302
975	$ 6,546
1050	$ 7,017
1200	$ 7,537
1350	$ 8,162
1500	$ 8,728
1800	$ 10,271
2100	$ 12,049
2400	$ 14,068
3000	$ 18,253

Appendix 2C - Table 5: Watermain and forcemain unit rates for open cut construction

Diameter (mm)	Total Unit Cost (2025$/m)
150	$ 821
200	$ 889
250	$ 964
300	$ 1056
350	$ 1,193
400	$ 1,291
450	$ 1,422
500	$ 1,671
600	$ 1,977
750	$ 2,267
900	$ 2,692
1050	$ 3,160
1200	$ 3726
1350	$ 4536
1500	$ 5041
1650	$ 5837
1800	$ 6,506
2100	$ 7,341