UTILITIES KINGSTON

CITY OF KINGSTON MASTER PLAN

BASELINE REVIEW REPORT - WATER

JANUARY30, 2017

WSP

CITY OF KINGSTON WATER MASTER PLAN

BASELINE REVIEW REPORT - WATER

Utilities Kingston

Final Report

Project nº : 151-02944-00
Date : January 30, 2017

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January 30, 2017

Ms. Katie Morrow
Utilities Kingston
1211 John Counter Blvd
Kingston, ON, K7L 4X7

Subject : **City of Kingston Water Master Plan**

Dear Ms. Morrow,

We are pleased to provide our Water Baseline Review Report for the City of Kingston Water and Wastewater Master Plan. The purpose of this report is to present a review of the existing water infrastructure within the City through a summary of background documentation and available data. A Wastewater Baseline Review Report was also completed and has been submitted under a separate cover.

Using the information compiled through the baseline review, System Gap Analysis and Alternative Solution Evaluation were completed as part of the Master Planning process, in order to arrive at a recommended solution to address capacity concerns throughout the City. These studies and recommendations have been included as separate reports.

We would be happy to discuss this report with you at your convenience.

Yours truly,

Matt Morkem, P.Eng.
Manager, Infrastructure

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REVISION HISTORY

VERSION	DATE	DESCRIPTION
1	**SEPTEMBER 2015**	First Draft
2	**FEBRUARY 2016**	Second Draft
3	**JANUARY 2017**	Final Report

SIGNATURES

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1 INTRODUCTION

The City of Kingston retained WSP to undertake a Water and Wastewater Master Plan. The purpose of the Master Plan project is to establish servicing strategies for water infrastructure in the core urban areas and surrounding communities in the City for the next 20 years, per the City's Official Plan.

The Master Plan is being conducted in accordance with the requirements set out in the Municipal Class Environmental Assessment (Class EA) document (June 2000 as amended in 2007 and in 2011).

A key component of the Master Plan is to incorporate the City's Official Plan, as well as the Utilities Kingston Vision, Values and Mission statement into long-term infrastructure planning. The Vision, Values and Mission statement are:

> ***Vision:*** *To be recognized as a company committed to innovation, prosperity and service excellence, valued by our customers and reinvesting in our community's future.*
>
> ***Values:*** *We are a team that is recognized for being; honest, motivated, respectful and reliable.*
>
> ***Mission:*** *We are a community-based corporation, dedicated to the responsibility management of safe, reliable, integrated services.*

This Baseline Review Report compiles and documents available information on the City's existing water infrastructure and establishes the baseline, or starting point, in the assessment of the water systems to service the existing and projected development. The report also includes an overview of the regulatory requirements relevant to the planning and design of water systems in Ontario and a description of the various water supply and distribution systems in the City. A separate baseline review report has been completed for the wastewater systems.

2 REGULATORY REQUIREMENTS

2.1 THE PLANNING ACT (1990)

The Planning Act (1990) establishes the mechanisms and rules for land use planning in Ontario, outlining how land uses may be controlled, and who may control them. The Act sets the basis for the preparation of Official Plans and planning policies for future development, and it provides municipalities with local autonomy to make decisions and streamline the planning process. The Act empowers local citizens to provide their input to their municipal council and, where permitted, to appeal decisions to the Ontario Municipal Board. Through the Act, the Province issues Provincial Policy Statements and plans.

2.2 PROVINCIAL POLICY STATEMENT (2014)

The Provincial Policy Statement (PPS) is a key component of Ontario's planning system as it sets policy direction on matters of provincial interest related to land use planning, growth management, environmental protection, and public health and safety. It aims to provide a stronger policy framework that guides communities in Ontario toward a higher quality of life and a better long-term future.

The PPS establishes the various municipalities' roles in planning for growth, intensification and redevelopment. New settlement area policies will only permit expansions where it is demonstrated that opportunities for growth are not available through intensification, redevelopment or in designated areas. The PPS also requires municipalities to co–ordinate and provide direction on policies with cross municipal boundaries, such as natural heritage systems and resource management.

The PPS states that infrastructure planning must be coordinated and integrated with land use planning so that they are:

- Financially viable over the lifecycle, which may be demonstrated through asset management planning
- Available to meet current and projected needs

The PPS promotes optimizing existing infrastructure and public service facilities as well as using opportunities for adaptive re-use, where feasible.

In addition to the above, requirements for planning water and wastewater infrastructure specified in the PPS are listed below:

Direct and accommodate expected growth or development in a manner that promotes the efficient use and optimization of existing:

- Municipal sewage services and municipal water services
- Private communal sewage services and private communal water services, where municipal sewage services and municipal water services are not available

Ensure that these systems are provided in a manner that:

- Can be sustained by the water resources upon which such services rely
- Is feasible, financially viable and complies with all regulatory requirements and
- Protects human health and the natural environment

Promote water conservation and water use efficiency

Integrate servicing and land use considerations at all stages of the planning process

Be in accordance with the servicing hierarchy outlined in the PPS, which briefly identifies the following in order of descending preference:

- Municipal servicing
- Private communal servicing
- Individual on-site servicing
- Partial servicing

2.3 ONTARIO PLANNING AND DEVELOPMENT ACT (1994)

The Ontario Planning and Development Act, 1994 establishes the general approach by which the Minister of Municipal Affairs and Housing may cause for Development Plans to be undertaken for development planning areas. The Development Plans may include policies for economic, social and physical development with relation to the distribution and density of population within the development area, the location of employment areas, the identification of land use areas, the management of land and water resources, the control of all forms of pollution of the natural environment, the location and development of servicing, communication and transportation systems and the development and maintenance of

educational, cultural, recreational, health and other social facilities. There also may be policies relating to the financing and programming of public development projects and capital works, and policies to co-ordinate planning and development among municipalities or planning boards within an area or within separate areas, among other considerations.

In many respects, a Development Plan under the Ontario Planning and Development Act is similar to an official plan under the Planning Act. The primary differences are: the Province is the authority for both undertaking and approving the Development Plan, and the legislative requirements for the preparation and approval of a Development Plan are unique to the Ontario Planning and Development Act. The CPDP is the first Development Plan created under the Ontario Planning and Development Act.

2.4 CITY OF KINGSTON OFFICIAL PLAN (2012)

The City of Kingston Official Plan is a document that provides planning goals and policies that direct:

- Physical development and redevelopment
- Protection of natural and cultural heritage
- Resource management
- Necessary supporting infrastructure

The Planning Act requires that all municipalities adopt an Official Plan that complies with the Provincial Policy Statement. The Official Plan's purpose is to guide development in Kingston until 2026 and is reviewed every five years. There are 10 main sections:

- Overview
- Strategic Policy Direction
- Land Use Designations and Policy Infrastructure and Transportation
- Protection of Health and Safety
- The Environment and Energy
- Cultural Heritage Resources
- Urban Design
- Administration and Implementation
- Special Policies and Secondary Plans

2.5 PLACES TO GROW ACT (2005)

The Places to Grow Act 2005, provides a framework for the Provincial government to coordinate planning and decision-making for long-term growth and infrastructure renewal in Ontario. It gives the Province the authority to designate geographical growth areas, and to develop growth plans in collaboration with local officials and stakeholders to meet specific needs across the Province. Growth plans developed under the Places to Grow Act integrate and build upon other initiatives such as the Greenbelt Plan, the Niagara Escarpment Plan, the Provincial Policy Statement, the Planning Act, municipal infrastructure planning, and source water protection planning. Growth plans may include population projections and allocations, policies, goals and criteria relating to issues such as intensification and density, land supply, expansions and amendments to urban boundaries, location of industry and commerce, protection of sensitive and significant

lands (including agricultural lands and water resources), infrastructure development, affordable housing and community design.

Municipalities are required to bring their official plans into conformity with the growth plan for their area. Decisions made under the Planning Act and Condominium Act are also required to conform to applicable growth plans.

2.6 ONTARIO WATER RESOURCES ACT (1990)

The Ontario Water Resources Act (OWRA) states that the Ontario Ministry of Environment (MOE) is responsible for the "supervision of all surface waters and ground waters in Ontario." Under the OWRA, the province operates the Permit to Take Water (PTTW) program.

A PTTW is required for any water taking greater than 50,000 litres per day. Generally, all municipal water supply sources require a PTTW. Through the PTTW application, the MOE is able to identify and analyse potential impacts of long term impacts of a proposed water taking. Such impacts include effects on the natural environment, private wells, and recreational water use. The PTTW process allows for responsible management of water resources.

2.7 SAFE DRINKING WATER ACT (2002)

Following the Walkerton Inquiry, the Ontario government enacted the Safe Drinking Water Act (SDWA). This Act covers all matters related to the treatment and distribution of drinking water. Part of the SDWA, O.Reg. 170/03 Drinking Water Systems provides sampling and testing requirements, minimum treatment standards, adverse water quality notification, non–compliance penalties, operator certification, and public reporting requirements.

O.Reg 170/03 also details the requirements for municipalities to comply with the Municipal Drinking Water Licencing (MDWL) program. Formerly, municipal water supply systems were granted Certificates of Approval (Cof A) for individual facilities within a respective supply system. However, following the Walkerton Tragedy in 2000, Justice O'Conner made several recommendations toward improving the approvals process for public water supplies, the outcome of which is the MDWL program. The MDWL consolidates approvals for all facilities in a single water system into a single set of documents, including a Drinking Water Works Permit (DWWP), a Financial Plan, a Quality Management System, and a Permit to Take Water.

2.8 CLEAN WATER ACT (2006)

The Province of Ontario developed the Clean Water Act to protect drinking water through a "source to tap" policy. This policy is intended to provide necessary protection of drinking water resources through a multi barrier approach which includes protection of the source water, such as surface or groundwater, prior to intake into the drinking water system. A key requirement of the Act is development of a Source Protection Plan specific to a respective watershed.

The three main phases of developing a Source Protection Plan include: Assessment, Planning, and Management. Assessment involves taking an inventory of current conditions of and potential threats to drinking water sources. Planning ensures appropriate land use designations to prevent threats of existing and future land use activities to drinking water sources. Finally, Management aims to monitor to prevent threats to drinking water sources.

2.9 CATARAQUI SOURCE PROTECTION PLAN

The Cataraqui Source Protection Plan's (CSPP) purpose is to reduce threats to sources of drinking water. It focuses on the protection of municipal drinking water supplies and includes policies for the entire Cataraqui Source Protection Area. A full download of the CSPP can be found at http://www.cleanwatercataraqui.ca/sourceProtectionPlan.html.

Source protection focuses on municipal intakes and wells, called Intake Protection Zones (IPZ) and Wellhead Protection Area (WHPA) respectively.

There are 12 protection areas in the Cataraqui Region:

Kingston: Cana WHPA

Kingston: Point Pleasant

IPZ Kingston: Central IPZ

Sydenham IPZ

Lansdowne WHPA

Mallorytown: Miller Manor WHPA

Greater Napanee: A.L. Dafoe IPZ and Sandhurst Shores IPZ

Bath IPZ

Brockville IPZ

Amherstview: Fairfield IPZ

Gananoque: James W. King IPZ

There are two local groups responsible for source protection. The Cataraqui Source Protection Authority (CSPA) is made up of 17 members and governs the planning process and availability/distribution of documents. The CSPA collaborates with others to implement specific policies in the Plan. The Cataraqui Source Protection Committee coordinates the development of the Assessment Report and Source Protection Plan.

The Cataraqui Source Protection Plan addresses the following activities:

- Handling and storage of liquid fuel
- On-site sewage systems
-Application of commercial fertilizer
- Application of road salt
- Agricultural/non-agricultural source material
- Handling, storage and transportation of dense non-aqueous phase liquids (NDAPL) and organic solvents

The policies in the Plan specifically focus on:

- Promoting responsible decisions about land use and development
- Improving information availability

- Recommending changes to municipal operations
- Enhancing education and outreach initiatives
- Conducting research

2.10 MOE PROCEDURE D-5 (1996)

The primary purpose of D-5 is to guide municipal planning for sewage and water servicing. It describes an approach for municipal planning for sewage and water services to ensure an acceptable quantity and quality of water supply and the proper collection, treatment and disposal of sewage wastewater for development. It is consistent with the Provincial goal to manage growth and change to foster communities that are socially, economically, environmentally, and culturally healthy, and that make efficient use of land, new and existing infrastructure and public service facilities.

- Procedure D-5-1: Calculating and reporting uncommitted reserve capacity at sewage and water treatment plants
- Procedure D-5-2: Application of Municipal responsibility for communal sewage and water services
- Procedure D-5-3: Servicing options statement
- Procedure D-5-4: Technical guidelines for individual on-site sewage systems: Water Quality impact risk
- Procedure D-5-5: Technical Guidelines for Private Wells; Water supply assessment

Procedure D-5-1 is used to ensure that sanitary flow generation from approved development applications will not exceed the design capacity of the sewage treatment plant(s). In order to ensure that capacity is not exceeded it is necessary to determine what uncommitted reserve capacity is available based on historic flows and existing development.

3 GIS DATA

GIS information and layers were obtained from the City for use throughout the Master Planning process. The main categories of data that was provided are summarized in Table 3-1 below.

Table 3-1 GIS Information Provided

DATA CATEGORY	DESCRIPTION
CofK_Base_Layers	Provided the physical overview of Kingston including roads and buildings.
CofK_Development Layers	Provide the specific zones along with potential development.
CofK_Employment_Land_Strategy_Review	Layers provide a description of land
CofK_Offical_Plan_Layers	Land use designations are provided by these layers
CofK_Planning_Applications	Layers provide locations for builder applications submitted to the Planning Department.

DATA CATEGORY	DESCRIPTION
UK_Sanitary	Layers provide the working sanitary system for the City of Kingston.
UK_Storm	Layers provide the working storm system for the City of Kingston.
UK_Water	Layers provide the working water system for the City of Kingston.
UK_Water_Consumption2014	Water consumption data for individual homes across the City of Kingston.

4 WATER SUPPLY SYSTEMS OVERVIEW

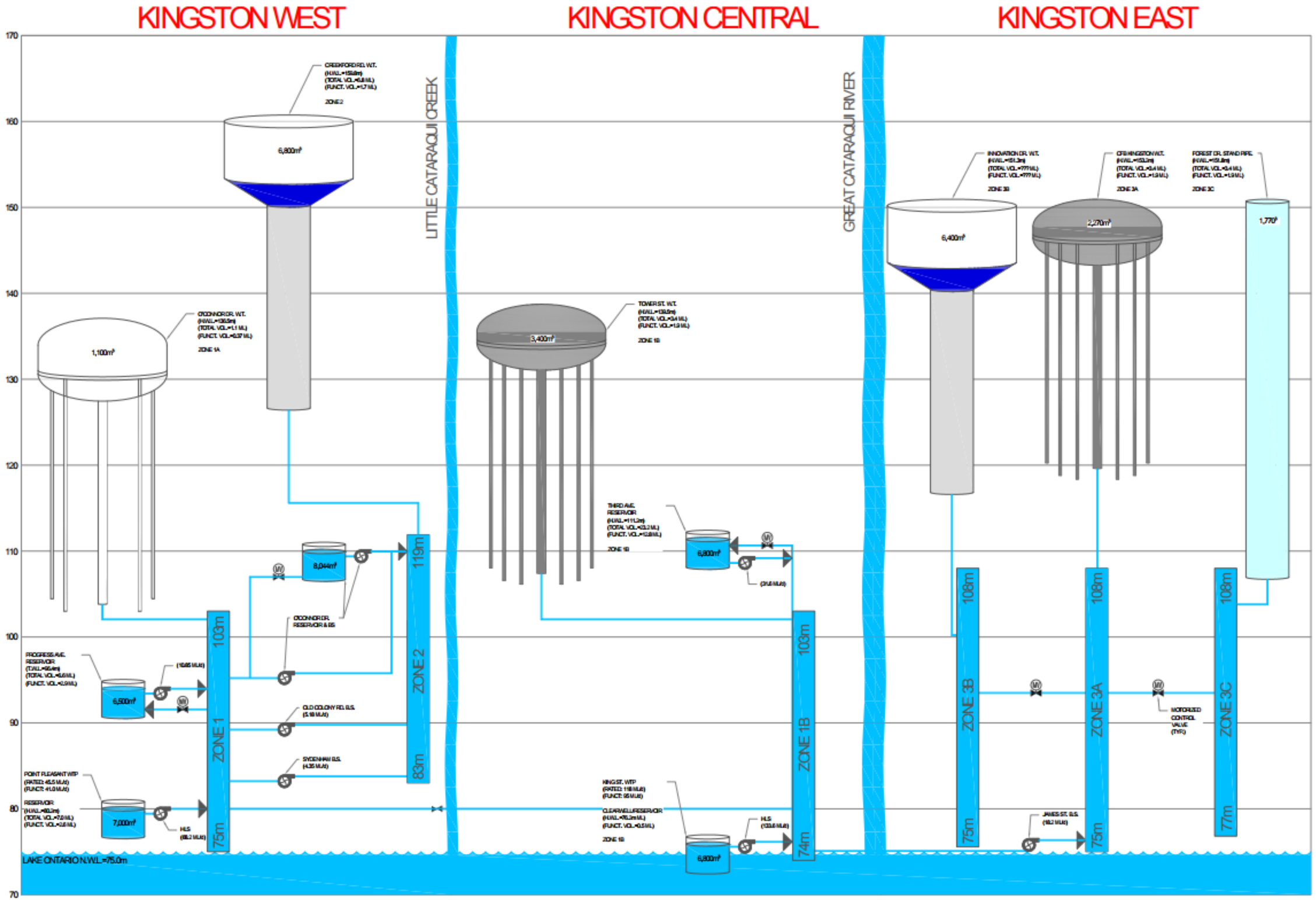
The City of Kingston water distribution system comprises an area of approximately 8258 ha. It is generally bordered by Westbrook Road to the east, Macdonald-Cartier Freeway to the north, and Abbey Dawn Road to the east. It is split between three regions:

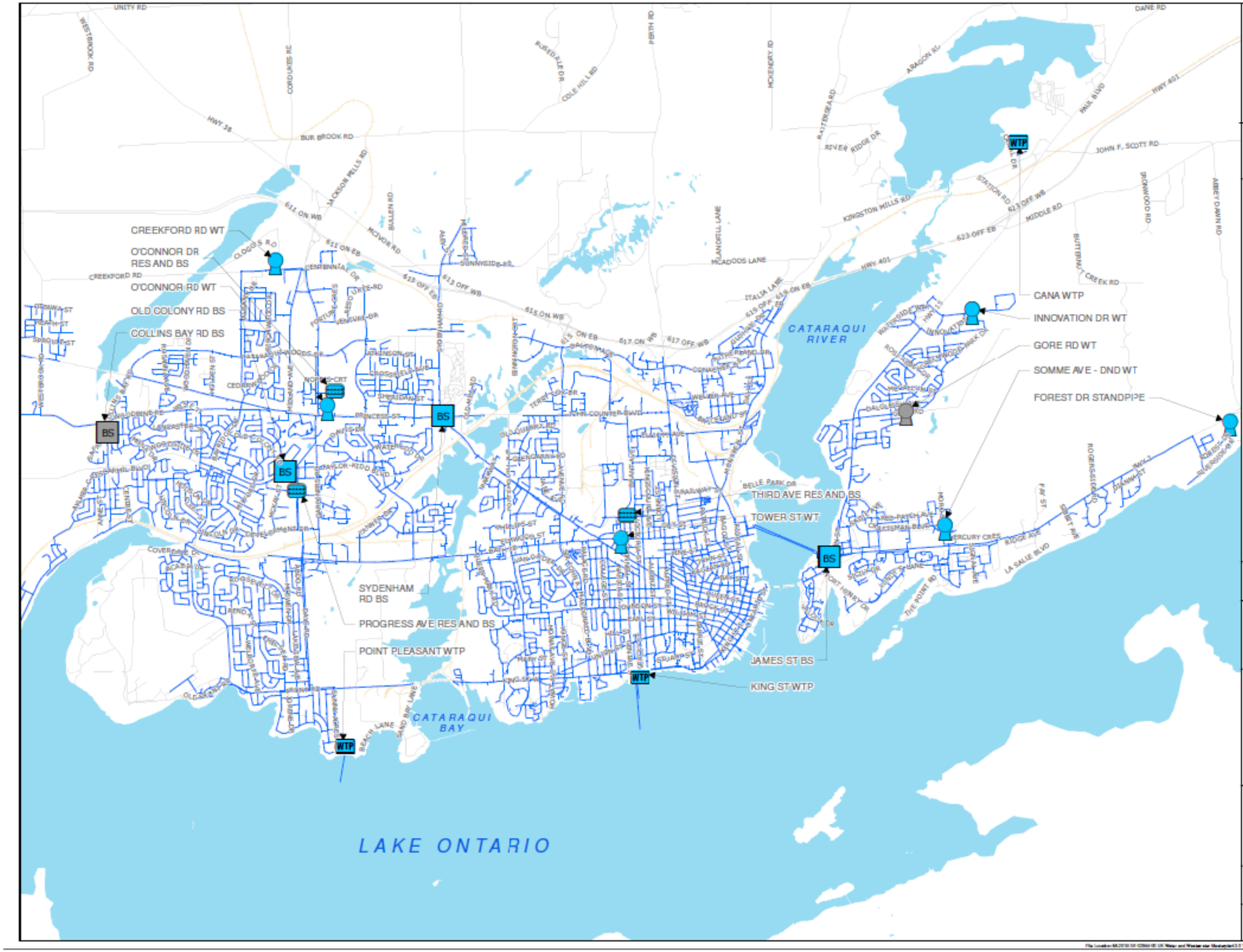
1. Kingston West (3953 ha, 44400 POP)
2. Kingston Central (2919 ha, 54600 POP)
3. Kingston East (1386 ha, 10200 POP)

Kingston West is separated from Kingston Central by the Little Cataraqui River Creek, while Kingston Central is separated by Kingston East by the Great Cataraqui River. Water is supplied to the Point Pleasant WTP from Lake Ontario and pumped to service Kingston West. Water is supplied to the King Street WTP and pumped to service Kingston Central and to the James Street Booster Station (BS) which services Kingston East. Figure 4-1 is a hydraulic schematic of the 2015 City of Kingston water distribution system and Figure 4-2 is a map displaying the main components of the distribution system for the entire system.

The City of Kingston water distribution system has six different pressure zones. Kingston West encompasses pressure zones 1A and 2. Kingston Central encompasses Zone 1B and Kingston East encompasses Zones 3A, 3B and 3C. Figure 4-3 is a map that outlines the above.

Figure 4-1 Water Distribution Schematic





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Legend

- WATER TREATMENT PLANT
- WATER BOOSTER STATION
- WATER BOOSTER STATION (NOT ACTIVE)
- WATER RESERVOIR
- WATER TOWER
- WATER TOWER (NOT ACTIVE)
- WATER PIPE
- WATERBODY

Data Source: Ontario Base Mapping, Ministry of Natural Resources, August 2013. Water and Waste Water Systems, Utilities Kingston, April 2015, City of Kingston.

Scale:
0 350700 1,400 Meters
1:55,000

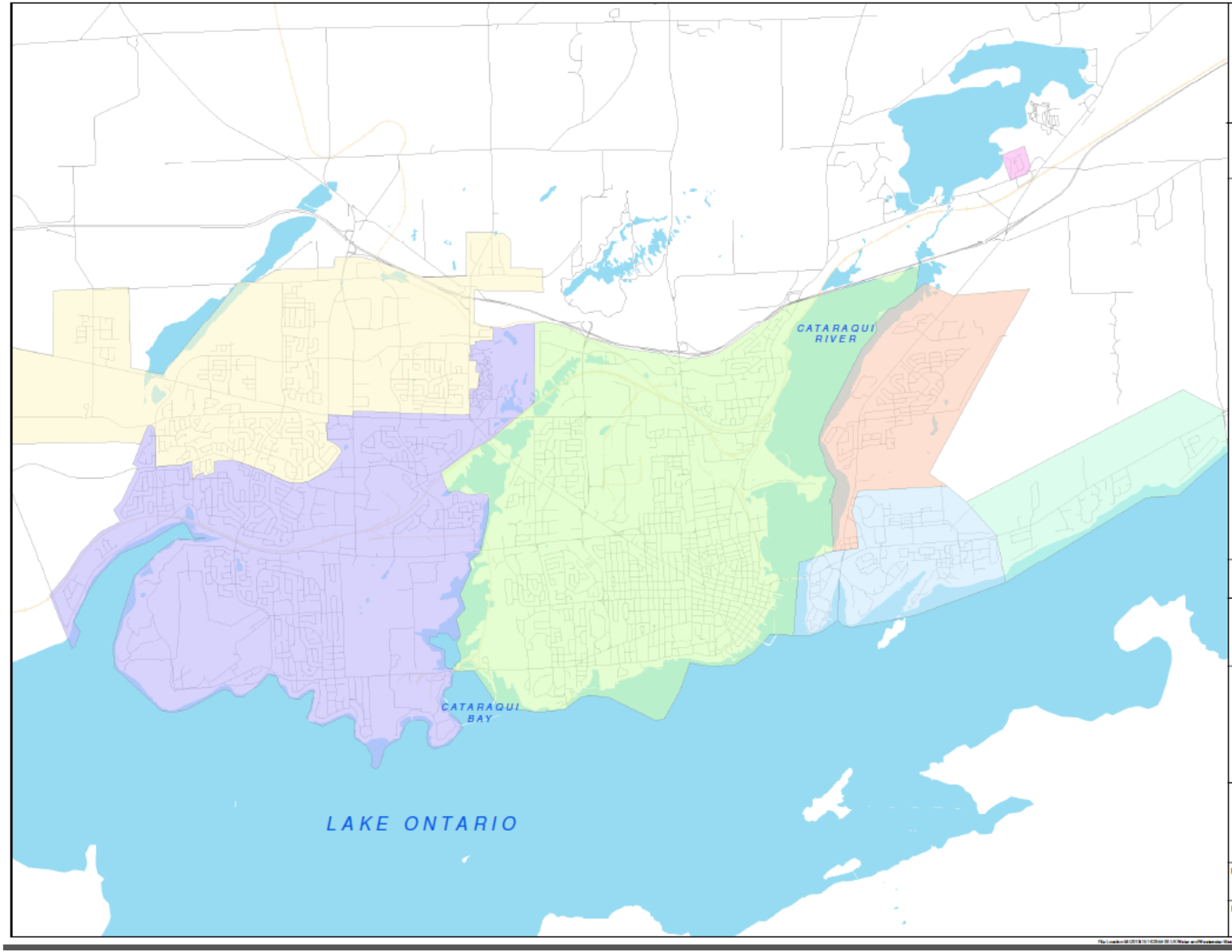
Project:
Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title:
WATER DISTRIBUTION SYSTEM OVERVIEW MAP

Project No.:	Date:
151-02944-00	DECEMBER 2016

Drawn By:	Checked By:	Code:	Figure No.:
CM	MF	BR	4-2



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Legend

WATER ZONE

- 1A
- 1B
- 2
- 3A
- 3B
- 3C
- CANA

Data Source: Ontario Base Mapping, Ministry of Natural Resources, August 2013. Water and Waste Water Systems, Utilities Kingston, April 2015, City of Kingston.

Scale:
0 350700 1,400 Meters
1:58,000

Project:
Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title:
WATER DISTRIBUTION SYSTEM OVERVIEW MAP

Project No.:	Date:		
151-02944-00	DECEMBER 2016		
Drawn By:	Checked By:	Code:	Figure No.:
CM	MF	BR	4-2

4.1 LINEAR INFRASTRUCTURE

The Kingston water distribution system is made up of over 560 km of watermains ranging in diameter from 150 mm to 1200 mm. The various watermain materials present in the system include asbestos cement (AC), cast iron (CI), ductile iron (DI), concrete pressure pipe (CPP), copper (CU), high density polyethylene (HDPE), stainless steel (SSTL), cured in place pipe (CIPP) and polyvinyl chloride (PVC). The age of the pipes in the system vary from 115 years old (installed in 1900) to those installed this year (2015). Figure 4-4, Figure 4-5, and Figure 4-6 illustrate the above.

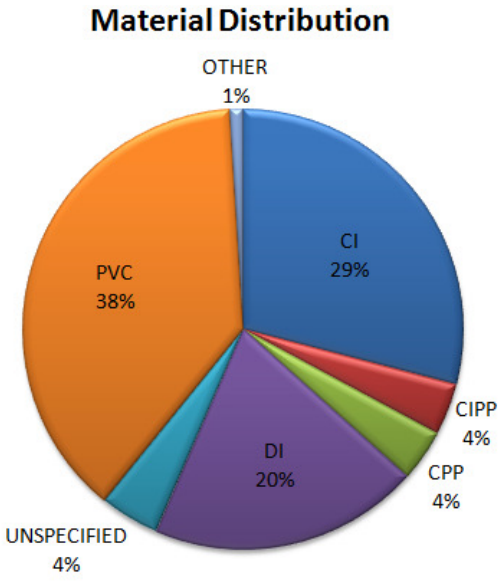


Figure 4-4 Material of Kingston Water Distribution Piping

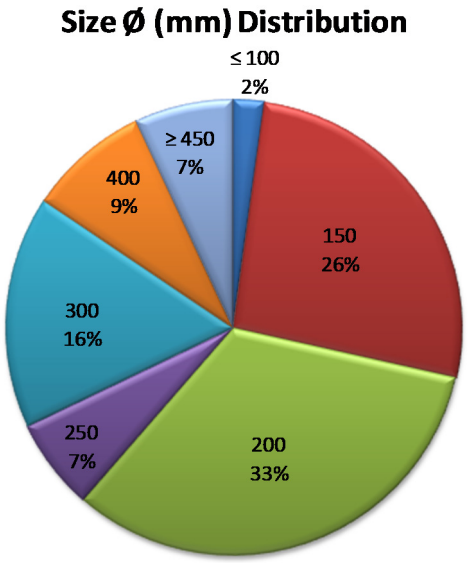


Figure 4-5 Diameters of Kingston Water Distribution Piping

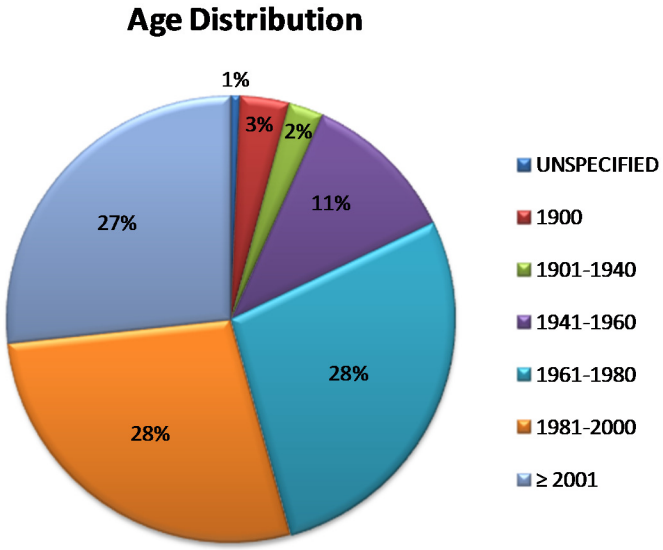


Figure 4-6 Year of Construction of Kingston Water Distribution Piping

4.2 BOOSTER STATIONS AND RESERVOIRS

There are three booster stations and three combined reservoir and booster stations in the Kingston water distribution system. They are listed below under their respective system.

Kingston West System

-Sydenham Road BS

- Old Colony Road BS
- Progress Avenue Reservoir/BS
- O'Connor Drive Reservoir/BS

Kingston Central System

- Third Avenue Reservoir/ BS

Kingston East System

- James Street BS

4.3 ELEVATED STORAGE TANKS

There are five elevated storage tanks (ESTs) and one standpipe that supply water (domestic supply and fire flow requirement) and pressure to the Kingston water distribution system.

Kingston West System

- O'Connor Drive Elevations Storage Tank EST
- Creekford Road EST

Kingston Central System

- Tower Street EST

Kingston East System

- Innovation Drive EST
- Somme Avenue EST
- Forrest Drive Standpipe

4.4 WATER TREATMENT PLANTS

Raw water from Lake Ontario passes through two main water treatment plants that supply the majority of the Kingston water distribution system. A smaller scale water treatment plant serves the Cana subdivision north of the 401 drawing raw water from a well.

The Kingston West water distribution is serviced by water supplied from:

- Point Pleasant Water Treatment Plant

The Kingston Central and East water distribution is serviced by water supplied from:

- King Street Water Treatment Plant

The Cana subdivision is serviced by water supplied from:

- Cana Water Treatment Plant

4.5 FACILITY INFORMATION SUMMARY

As mentioned above, there are currently 21 facilities in the City of Kingston that are owned and operated by Utilities Kingston (UK). The following information related to these facilities was provided:

Table 4-1 Existing Facility Data

FACILITY	LOCATION	C OF A (ECA)	AS-BUILTS	SCADA SCREENSHOT	SCADA FLOW DATA	PUMP DETAILS
Cana WTP	1753 Cana Blvd.	3217-7BJRJH, 0861-54AJKH, 8203-5C3KXM, 3678-6PLPPN	No	Yes	2013 & 2014	No
Collins Bay BS	865 Collins Bay Rd.	N/A	Yes	No	No Data	Yes
Creekford Rd. WT	2754 Creekford Rd.	N/A	Yes	Yes	2013 & 2014	No
DND WT	31 Somme Ave.	N/A	Yes	No	No Data	No
Forest Dr. Standpipe	26 Forest Dr.	N/A	Yes	No	No Data	No
HWY 2 Control Valve	-	N/A	No	Yes	2013 & 2014	No
HWY 15 Control Valve	-	N/A	No	Yes	2013 & 2014	No
Innovation Dr WT	1000 Innovation Dr.	N/A	Yes	Yes	2014	No
James St. BS	229 James St.	7-1324-91-006, 4581-586NWC, 6508-59CQY9, 9708-56Y297	Yes	Yes	2013 & 2014	Yes
King St. WTP	300 King St. W	6199-7CDRWA, 9708-56Y297	No	Yes	2013 & 2014	No
O'Connor Dr. WT	508 O'Connor Dr.	N/A	Yes	No	No Data	No
O'Connor Dr. BS	590 O'Connor Dr.	4224-6HDQD6,	Yes	Yes	2013 & 2014	Yes

FACILITY	LOCATION	C OF A (ECA)	AS-BUILTS	SCADA SCREENSHOT	SCADA FLOW DATA	PUMP DETAILS
O'Connor Dr. Res	590 O'Connor Dr.	N/A	Yes	Yes	2013 & 2014	No
Old Colony BS	901 Old Colony Rd.	7200-4PANHZ	Yes	Yes	2013 & 2014	Yes
Point Pleasant WTP	80 Sunny Acres Rd.	2872-549M8X, 6451-59FQKK, 8219-5LAJB8	Yes	Yes	2013 & 2014	Yes
Progress Ave. BS	725 Progress Ave.	N/A	Yes	Yes	2013 & 2014	No
Progress Ave. Res	725 Progress Ave.	N/A	Yes	Yes	2013 & 2014	No
Sydenham Rd. BS	896 Purdys Crt.	N/A	Yes	No	No Data	Yes
Third Ave. BS	141 Third Ave.	N/A	Yes	Yes	2013 & 2014	No
Third Ave. Res	141 Third Ave.	N/A	Yes	Yes	2013 & 2014	No
Tower St. WT	27 Tower St.	N/A	Yes	No	No Data	No

5 SUMMARY OF EXISTING REPORTS

5.1 MASTER PLAN FOR WATER SUPPLY FOR THE CITY OF KINGSTON URBAN AREA AND THE CLASS ENVIRONMENTAL ASSESSMENT (SIMCOE ENGINEERING GROUP LTD., 2007)

This Master Plan was completed by Simcoe Engineering Group Ltd. in 2007. The Problem Statement was as follows:

"Utilities Kingston has determined the need to develop a Master Plan for the urban area of the City of Kingston's drinking water supply and distribution systems to accommodate the current (2006) drinking water demands for the urban area of the City of Kingston (Central, West and East) and to plan (in an orderly manner) for additional infrastructure (watermains, reservoirs and the associated water pumping stations and drinking water supply facilities) requirements to satisfy the considered short-term (2011), mid-term (2016) and long-term (2026) drinking water requirements for the urban area of the City of Kingston.

The existing City of Kingston water supply and distribution systems incorporates the City of Kingston (Kingston Central), the formal Kingston Township (Kingston West) and the former Pittsburgh Township (Kingston East, supplied by Kingston Central). Utilities Kingston considers Kingston Central and East, and Kingston West as two drinking water supply and distribution systems.

In order to provide an assured drinking water supply to the entire urban area of the City of Kingston from the two existing water treatment plants (the Central Water Purification Plant and the West Water Treatment Plant), it would appear that Kingston Central should be interconnected with Kingston West.

Utilities Kingston wishes to investigate potential methods to provide a unified drinking water supply and distribution system to serve the urban area of the City of Kingston (Central, West and East). These methods could include the logical interconnection of the distribution systems and associated infrastructure additions/upgrades; upgrades/refurbishments to the existing facilities (water treatment plants, elevated water storage tanks, water storage standpipes, ground-level water storage reservoirs, water booster pumping stations); and new facilities (treatment plant, water storage).”

5.1.1 EXISTING SYSTEM DESCRIPTION

5.1.1.1 KINGSTON WEST

Kingston West water supply and distribution system consists of the Kingston West WTP, two pressure zones, two elevated tanks, one ground reservoir, and five booster stations.

5.1.1.2 KINGSTON CENTRAL

Kingston Central water supply and distribution system consists of the Kingston Central WTP, one pressure zone, one elevated tank, one ground reservoir, and one booster station. It also supplies water to the Kingston East distribution system.

5.1.1.3 KINGSTON EAST

Kingston East water supply and distribution system is supplied from the Kingston Central water distribution system from two parallel watermains crossing the Great Cataraqui River supplying the James Street Booster Station. This system is served by one elevated tank and two standpipes.

5.1.2 HISTORICAL FLOW DATA (2003-2005) VS. DEMAND

Table 5-1, Table 5-2, and Table 5-3 summarize historical flow data and facility capacities. Table 5-4 summarizes the 2006 requirements for water storage in the City of Kingston.

Table 5-1 Historical Flow Data (2003, 2004 and 2005)

	Kingston West WTP (m^3/d)					Kingston Central WPP (Central + East) (m^3/d)					Kingston East (m^3/d)		
Year	Avg. Day	Max. Day	Peak Hr.	Max./ Avg.	Peak/ Avg.	Avg. Day	Max. Day	Peak Hr.	Max./ Avg.	Peak/ Avg.	Avg. Day	Max. Day	Max./ Avg.
2003	25,722	41,500	58,400	1.61	2.27	57,824	70,373	90,800	1.22	1.57	7,408	11,708	1.58
2004	22,997	28,900	46,700	1.26	2.03	56,880	71,600	89,160	1.26	1.57	6,641	8,408	1.27
2005	22,143	33,270	54,600	1.50	2.47	56,503	69,600	97,070	1.23	1.72	5,980	9,646	1.61
Average	23,621	34,557	53,233	1.46	2.26	57,069	70,524	92,343	1.24	1.62	6,676	9,921	1.49
Maximum	25,722	41,500	58,400	1.61	2.47	57,824	71,600	97,070	1.26	1.72	7,408	11,708	1.61
Minimum	22,143	28,900	46,700	1.26	2.03	56,503	69,600	89,160	1.22	1.57	5,980	8,408	1.27
Historical Period	**25,722**	**41,500**	**63,533**	**1.61**	**2.47**	**57,824**	**72,858**	**99,458**	**1.26**	**1.72**	**7,408**	**11,927**	**1.61**

Note: The maximum day and peak hour flows for the ‘historical period’ have been calculated by applying the highest observed maximum day and peak hour factors to the highest observed average day flows.

Table 5-2 Maximum Day Flow vs. Plant Capacities

	Max. Day Flow		Plant Rated Capacity	Max. Day / Rated Capacity		Plant Functional Capacity	Max. Day / Functional Capacity
	ML/d		ML/d	(%)		ML/d	(%)
Kingston West	41.5		45.5	91.2%		41.0	101%
Kingston Central + East	72.9		118.0	61.8%		95.0	76.7%
Interconnected System (Kingston West + Kingston Central and Kingston East)	114.4		163.5	69.9%		136.0	84.0%

Table 5-3 City of Kingston Pumping and Booster Station Summary

	Pump #1 (ML/d)	Pump #2 (ML/d)	Pump #3 (ML/d)	Pump #4 (ML/d)	Pump #5 (ML/d)	Pump #6 (ML/d)	Pump #7 (ML/d)	Total Capacity (ML/d)	Firm Capacity (ML/d)	Standby Capacity (ML/d)
Kingston West - Zone 1										
WTP HLPS	13.62	13.62	13.62	27.24	27.24			95.3	68.1	40.9
Industrial Park Reservoir BS	5.43	5.43	8.17					19.0	10.9	8.2
Sub-total								**114.4**	**79.0**	**49.0**
Kingston West – Zone 2										
Gardiners Road BS – 2b	9.85	9.85						19.7	9.9	0.0
Old Colony Road BS - 2a	5.18	5.18						10.4	5.2	0.0
Collins Bay Road BS - 2a	4.35	4.35						8.7	4.4	0.0
Sydenham Road BS - 2c	0.57	0.57	7.60					8.7	1.1	0.0
Sub-total								**47.5**	**20.5**	**0.0**
Kingston Central										
Kingston Central WPP HLPS	19.50	19.50	23.60	31.80	45.50	19.60	19.60	179.1	133.6	84.7
Third Avenue Reservoir	15.80	15.80	31.80					63.4	31.6	31.8
Sub-total								**242.5**	**165.2**	**116.5**
Kingston East										
James Street BS	9.10	9.10	9.10					**27.3**	**18.2**	**18.2**

Notes:
1. Pumping capacities shown are theoretical (i.e. based on nameplate/rated pump equipment capacities).

Table 5-4 2006 City of Kingston Water Storage Requirements

		Kingston West			Kingston Central and East			Combined
		Zone 1	Zone 2	Subtotal	Central	East	Subtotal	Total
Max. Day Demand[1]	ML/d	24.9	16.6	41.5	61.0	11.9	72.9	114.4
Fire Flow Rate[2]	L/s	318	250	378	378	220	378	378.0
Fire Flow Duration[2]	hr	5.0	4.0	6.0	6.0	3.0	6.0	6.0
Storage Requirements								
a) Fire	m^3	5,724	3,600	8,165	8,165	2,376	8,165	8,165
b) Equalization	m^3	6,225	4,150	10,375	15,250	2,975	18,225	28,600
c) Emergency	m^3	2,987	1,938	4,635	5,854	1,338	6,597	9,191
Total	m^3	14,936	9,688	23,175	29,269	6,689	32,987	45,956
Existing Storage	m^3	14,700	6,800	21,500	26,600	5,370	31,970	53,470
("Functional" Storage[3])	m^3	(5,870)	(1,700)	(7,570)	(14,700)	(1,060)	(15,760)	(23,330)
Storage Surplus	m^3	-236	-2,888	-1,675	-2,669	-1,319	-1,017	7,514

Notes:
1. Maximum day flow based on Table 1. Zone 1 and Zone 2 demand assumed as 60% and 40% of Kingston West maximum day flow, respectively.
2. Fire flow rate and duration based on current MOE guidelines and estimated populations; maximum fire flow would be 378 L/s for 6.0 hours for an equivalent population of 40,000.
3. "functional" storage capacity is the existing effective equalization volume based on typical operations and operating set points.

5.1.2.1 2006 DEFICIENCIES

Based on required site processes, the rated capacity of the plants could not be achieved during extended periods therefore functional capacities were used. Functional capacity of the West Water Treatment Plant is less than the year 2006 required max day demand in Kingston West, although when the two water treatment plants are considered interconnected drinking water supplies, the combined functional capacity is greater than the 2006 required max day demand.

There is existing water storage deficit in Kingston West, Central and East. There is an existing surplus only for an interconnected City of Kingston water treatment plants supplies and distribution system. For an interconnected water treatment supply and distribution system, there is a deficit of equalization storage (functional water storage).

5.1.3 DEMAND PROJECTIONS (2006-2026)

Water demands for year 2011, 2016 and 2026 identified in the City of Kingston Urban Growth Strategy Report (2004) were estimated along with an "expanded study area" (2026A) as represented in Figures 4-1, 4-2 and 4-3 of the Urban Growth Strategy Report.

5.1.3.1 RESIDENTIAL

The future residential water demand was based on population growth from The City of Kingston Micro Demographic Model (June 2006).

5.1.3.2 INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)

The development potential for ICI growth identified in the Urban Growth Strategy Report (2004) was an increase of 840 hectares of ICI land (821 ha of ICI growth and 19 ha of Committed Development Area).

5.1.3.3 "UNACCOUNTED FOR" WATER

Based on programs initiated by Utilities Kingston, the future percentages of "unaccounted for" water have been indicated in Table 5-5 below.

Table 5-5 Percentages of "Unaccounted for" Water

	West	Central	East
2011	20%	20%	15%
2016	15%	15%	15%
2026	15%	15%	15%
2026A	15%	15%	15%

5.1.3.4 PROJECTED AVERAGE DAY WATER DEMAND SUMMARY

Table 5-6 Average Day Demand Projections (m^3/day)

Study Year	West	Central	East	Entire City
2011				
Residential	17,997	19,689	2,699	40,385
ICI	8,638	22,103	5,019	35,760
Unaccounted	6,659	10,448	660	17,767
Total	33,294	52,240	8,378	93,911
2016				
Residential	19,720	19,986	3,332	43,038
ICI	11,329	22,675	5,775	39,779
Unaccounted	5,479	7,528	905	13,913
Total	36,528	50,190	10,013	96,730
2026				
Residential	21,745	21,560	4,621	47,926
ICI	15,389	24,287	7,474	47,149
Unaccounted	6,553	8,091	1,432	16,076
Total	43,686	53,937	13,528	111,151
2026A				
Residential	31,554	25,454	9,337	66,345
ICI	20,838	26,458	9,286	56,582
Unaccounted	9,246	9,161	2,584	20,991
Total	61,638	61,073	21,207	143,917

5.1.3.5 PEAKING FACTORS USED (BASED ON 20013-2005 X 110%)

Table 5-7 Peaking Factor Summary

Kingston West		Kingston Central (including Kingston East)		City of Kingston (interconnected system)	
MD	PH	MD	PH	MD	PH
1.77	2.72	**1.39**	1.89	**1.50**	2.12

5.1.3.6 FUTURE WATER SUPPLY REQUIREMENTS

Table 5-8 Maximum Day Demand vs. Existing Plant Capacities (Independent Systems)

Study Year	Maximum Day Demand (ML/d)		Plant Rated Capacity (ML/d)	Plant "Functional" Capacity (ML/d)	"Functional" Capacity Surplus (ML/d)
2006					
West	41.5		45.5	41.0	**- 0.5**
Central + East	72.9		118.0	95.0	22.1
2011					
West	58.9		45.5	41.0	**- 17.9**
Central + East	84.3		118.0	95.0	10.7
2016					
West	64.7		45.5	41.0	**- 23.7**
Central + East	83.7		118.0	95.0	11.3
2026					
West	77.3		45.5	41.0	**- 36.3**
Central + East	93.8		118.0	95.0	1.2
2026A					
West	109.1		45.5	41.0	**- 68.1**
Central + East	114.4		118.0	95.0	**- 19.4**
Notes: Maximum day factor applied for Kingston West: 1.77 Maximum day factor applied for Kingston Central: 1.39					

Table 5-9 Maximum Day Demand vs. Existing Plant Capacities (Interconnected System)

Year	Maximum Day Demand (ML/d)	Plants "rated" Capacity (ML/d)	Plants "Functional" Capacity (ML/d)	Plants "Functional" Capacity Surplus (ML/d)
2006				
	114.3	163.5	136.0	21.7
2011				
	140.9	163.5	136.0	**- 4.9**
2016				
	145.1	163.5	136.0	**- 9.1**
2026				
	166.7	163.5	136.0	**- 30.7**
2026A				
	215.9	163.5	136.0	**- 80**
Note: A maximum day demand factor of **1.5** has been applied for the option of an interconnected water supply system.				

5.1.3.7 FUTURE STORAGE REQUIREMENTS

Table 5-10 Water Storage Requirement Summary (Independent Systems)

	Water Storage Surplus (m^3)	
	Kingston West	Kingston Central (including Kingston East)
2006	-1,675	-1,017
2011	-7,120	-4,568
2016	-8,912	-4,385
2026	-12,872	-7,543
2026A	-22,801	-13,976

Table 5-11 Water Storage Requirement Summary (Interconnected System)

	Water Storage Surplus (m^3)
	Interconnected Water Distribution System
2006	7,514
2011	-756
2016	-2,078
2026	-8,842
2026A	-24,199

5.1.4 FIRE FLOW (2006)

Through fire flow simulations of the H20NET Water Distribution System model, the condition of the max day demand for the year 2006 evaluated was:

- Fire flow requirement = 378 L/s
- Residual Pressure = 150 kPa (recommended by City of Kingston Fire Department)
- Fire flow duration = 6 hours (MOE guidelines)

Areas of concern were Kingston West Pressure Zone 2C where the fuel storage tanks are located on Sydenham Road (105 L/s, 150 kPa, 6 hrs). Other areas of concern were the Kingston Central (Novelis) area due to high head loss in the system (310 L/s, 150 kPa, 6 hrs), Kingston East-Northern portion (220 L/s, 150 kPa, 3hrs).

Due to the fact that for two separate water systems, each system must be capable of supplying water for a fire event. If the two systems were interconnected to form a lager system, the requirement would be for supply of just one fire event (378 L/s, 150 kPa, 6 hrs) which would significantly reduce the required supply and distribution requirements.

5.1.5 SERVICING REQUIREMENTS AND OBJECTIVES

Below is a summary of the objectives that were defined to satisfy the expected water demand in the City of Kingston.

GENERAL OBJECTIVES

WTPs to provide sufficient “functional” capacity to satisfy maximum day demand

Ensure sufficient storage capacity to accommodate peak demand, fire and emergency storage

Consider interconnected water treatment supplies and distribution system to satisfy demands

PRELIMINARY OBSERVATIONS AND RECOMMENDATIONS

Water treatment and storage capacity deficiencies would need to be addressed in the near and long term.

Interconnecting Kingston West, Central and East would reduce total water storage and treatment water supply capacity deficiencies.

“Equalization” storage in Kingston West would be required for Pressure Zone 2 close to Gardiners Road Booster Station in conjunction with high lift pumping capacity to meet the identified flow requirements.

Elevated storage tank at north end of GA2 (East) or a below ground reservoir and high lift pumps would be required to reduce existing storage deficit in an interconnected City of Kingston System to provide equalization water storage and fire flows in Kingston East.

5.1.6 MODELING

An update to the 2002 “Water Distribution System Computer Model” was carried out to reflect the conditions in 2006. This model allowed for the development of scenarios in the years 2011, 2016, 2026, and 2026A. Eight (8) scenarios were created to satisfy the objectives, considering cases where the two water distribution systems remained independent, but also cases in which they were interconnected. The four (4) technically feasible alternatives that addressed the “problem statement” were determined to be as follows:

- Alternative 1 – Independent Kingston West and Kingston Central (including Kingston East) water supplies and distribution systems

- Alternative 2 – Interconnected water supplies (expand the Kingston West WTP and maintain the Kingston Central WPP in operation) and distribution systems servicing the City of Kingston

- Alternative 3 – Interconnected water supply (retire the Kingston Central WPP and provide the total water supply from the Kingston West WTP) and distribution systems servicing the City of Kingston

- Alternative 4 – Interconnected water supplies (retire the Kingston Central WPP and retire the Kingston West WTP and provide a new, “green-field” water treatment plant) and distribution systems servicing the City of Kingston

5.1.7 RECOMMENDATIONS

Alternative 2 was selected as the preferred solution based on the following evaluation criteria:

- System Operations

-Design Considerations

- Economics

- Natural Environment

-Historical Significance

- Public Health
- Social Impact
-Maintenance Cost

Recommendations were made with regards to upgrading/adding facilities including WTP, reservoirs, booster and pumping stations as well as watermains, as per the findings of the modeling process previously described. Below is a list of the suggested modifications.

Water Treatment Plants

- 33 ML/day West WTP expansion

Reservoirs

- New O'Connor Dr. Reservoir (8.8 ML)
- Expansion of the existing Third Ave. Reservoir (7.1 ML)
- New Kingston Highway 15 Reservoir (7 ML)

**Numbers indicated are additional required storage*

Booster and Pumping Stations

- Industrial Park Reservoir Pumping Station (19.9 ML/day)
- Replace pumps at Third Ave. Reservoir Pumping Station (35 ML/day)
- New O'Connor Dr. Pumping Station (35 ML/day)
- Retire existing Booster Stations in Kingston West (4 ML/day)
- Third Ave. Reservoir Pumping Station (35ML/day – replace pumps)
- New Kingston Highway 15 Reservoir Pumping Station (19 ML/day)
- James St. Booster Station (20.3 ML/day)

**Numbers indicated are total required capacity*

Watermains

- WTP 900 mm discharge header (1.1 km)
- Front Rd. (Days Rd to Bayridge Dr.) 600 mm watermain (1.4 km)
- Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.) 600 mm watermain (2.1 km)
- New 600 mm watermain on O'Connor Dr. (from O'Connor Dr. PS to Gardiners Rd.) (0.23 km)
- New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.) (0.63 km)
- New Front Rd. 1050 interconnecting watermain (2 km)
- New 400 mm interconnecting watermain on Princess St. (1 km)
- New 400 mm interconnecting watermain on John Counter Blvd. (1.3 km)
- New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.) (0.40 km)
- New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.) (0.65 km)
- New 300 mm watermain across the Novelis property (east-west) (1.1 km)

New 400 mm watermain on the Novelis property (north) (0.77 km)

5.1.8 EXPANDED STUDY AREA

The study was continued using an expanded study area, based on the City of Kingston's comprehensive secondary planning areas. The three (3) main areas of significant potential development were north of Highway 401, West of service area GA2, and the most eastern portion of Kingston. Four (4) small additional areas were included for review but deemed to have no significant impact.

GENERAL OBJECTIVES

Increased water supply to accommodate increase in demand

Increased water storage to accommodate increase in demand

PRELIMINARY OBSERVATIONS AND RECOMMENDATIONS

Additional required water supply from the Kingston West WTP to the City of Kingston water distribution system (80 ML/day)

"Rated" capacity expansion (86 ML/day)

5.1.8.1 RECOMMENDATIONS

Recommendations were made for the expanded study area with regards to upgrades/additions to the water supply and distribution systems for the City of Kingston, based on the modeling previously described. Below is a summary of the upgrades and additions.

Water Treatment Plants

- Expand by 85 ML/day to the West WTP
- Expand by 95ML/day for the Kingston Central WTP)

Reservoirs

- Expansion of the existing Industrial Park Reservoir (+4.3 ML)
- New O'Connor Dr. Reservoir (+13 ML)
- Expansion of the existing Third Ave. Reservoir (+7.2 ML)
- New GA5 Elevated Tank (6 ML)
- New Kingston Highway 15 Reservoir (7 ML)
- New Rogers Side Road Elevated Tank (6.8 ML)

**Numbers indicated are additional required storage*

Booster and Pumping Stations

- Industrial Park Reservoir Pumping Station (20.7 ML/day – review pumps)
- Replace pumps at Third Ave. Reservoir Pumping Station (35 ML/day)
- New O'Connor Dr. Pumping Station (88.4 ML/day)
- Retire existing Booster Stations in Kingston West (4 ML/day)
- Third Ave. Reservoir Pumping Station (35 ML/day – replace pumps)

- New Benson Street Booster Station (12.1 ML/day)
- New Kingston Highway 15 Reservoir Pumping Station (19 ML/day)
- James St. Booster Station (32.8 ML/day – upgrade pumps)

**Numbers indicated are total required capacity*

Watermains

- West WTP 900 mm discharge header (1.1 km)
- Front Rd. (Days Rd to Bayridge Dr.) 600 mm watermain (1.4 km)
- Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.) 600 mm watermain (2.1 km)
- New 600 mm watermain on O'Connor Dr. (from O'Connor Dr. PS to Gardiners Rd.) (0.23 km)
- New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.) (0.63 km)
- New Front Rd. 1050 interconnecting watermain (4.1 km)
- New 400 mm interconnecting watermain on Princess St. (1 km)
- New 400 mm interconnecting watermain on John Counter Blvd. (1.3 km)
- New 500 mm watermain on Cataraqui Woods Dr. (Gardiners Rd. to Bayridge Dr.) (1.25 km)
- New 400 mm watermain on Cataraqui Woods Dr. (Gardiners Rd. to Centennial Dr.) (0.78 km)
- New 400 mm watermain on Bayridge Dr. (Cedarwood Dr. to Woodbine Rd.) (0.45 km)
- New 500 mm watermain on Collins Bay Rd. (Princess St. to Woodbine Rd.) (0.86 km)
- New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.) (0.40 km)
- New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.) (0.65 km)
- New 300 mm watermain across the Novelis property (east-west) (1.1 km)
- New 400 mm watermain on the Novelis property (north) (0.77 km)
- New 400 mm watermain on Division St. (Weller Ave. to Benson St.) (0.55 km)

5.2 WATER SUPPLY MASTER PLAN – 2031 UPDATE FOR THE KINGSTON EAST WATER SYSTEM (CH2MHILL, 2014)

5.2.1 PROBLEM STATEMENT

"Utilities Kingston has determined the need to update the 2007 Drinking Water Master Plan to accommodate current (2013) drinking water demands and to plan for additional infrastructure requirements to satisfy the short-term (2013), mid-term (2026) and long-term (2033) drinking water requirements for the area of Kingston East. This project will identify the preferred alternative to satisfy the future (2033) water demands in the Kingston East Water System, while considering operation both in the short term and long term through the phasing process towards future infrastructure build out, while minimizing the impacts on the natural and social/cultural environment. The ability of the alternatives to allow for decommissioning of existing infrastructure that has reached the end of its useful life will be incorporated into the evaluation of alternatives, along with the potential for cooperation with Department of National Defence for completion of the project and its impacts on water supply to their facilities.

Water is supplied to the Kingston East System through the James Street Booster Station, which is currently in need of rehabilitation and upgrades. The impact of anticipated changes from the Master Plan update

need to be considered to ensure future requirements are met at the station. Consequently, a study to assess options and develop a strategy to address the current and future operational and capacity needs of the James Street Booster Station is required.

This Study is being undertaken as a “Schedule B” project under the Municipal Class Environmental Assessment process.”

5.2.2 EXISTING EAST WATER SUPPLY AND DISTRIBUTION SYSTEM

5.2.2.1 EXISTING SYSTEM

There are 11,000 customers in Kingston East water system serviced with potable and fire protection by Utilities Kingston. The system is supplied from Lake Ontario, treated from the Kingston Central WTP and pumped across the Cataraqui River to supply the Kingston East water system. The major system components are:

- Two elevated storage towers (Innovation Drive EST, CFB Kingston
- EST Two standpipes (Gore Road SP, Forest Drive SP)
- One booster station (James Street BS)

There are four pressure zones: 3A, 3AX, 3B and 3C (see Map in Appendix A of the CH2MHILL Master Plan (2014)) as detailed in Table 5-12 below.

Table 5-12 Pressure Zones

Pressure Zone	Pressure Zone Type	HGL (mASL)	Elevations Served (mASL)	Pressure Range (psi)	Water System Facilities		
					Pump Stations	Storage Tanks	Control Valves
3A	Open	147.48-158.02	92.59-110.86	53.99-90.51	James Street BPS	CFB Kingston EST	-
3AX	Closed	128.20-128.23	75.78-81.14	66.90-74.60	James Street BPS	-	James Street PRV
3B	Open	147.94-157.41	76.03-112.51	50.83-108.01	-	Gore Road SP Innovation Drive EST	Highway 15 MCV
3C	Open	143.19-156.07	82.96-109.50	47.89-96.77	-	Forest Drive SP	Highway 2 MCV

Detailed information regarding the James Street Booster Station is summarized in Table 5-13 below.

Table 5-13 Pumping Station Facility Details

Pump Station	Pressure Zone	Pressure Zone Type	Existing Total Capacity (ML/d)[1]	Existing Firm Capacity (ML/d)[1]	Effective Capacity (ML/d)[1]	Design Head (m)
James Street	3A, 3AX	Open, Closed	41.5	27.6	13.8	47.2

Note 1: Total capacity includes the flow from all pumps at the BPS. Firm capacity is the total capacity minus the flow from the largest pump at the BPS (assumes that the largest pump is not in service). Effective capacity assumes the maximum number of pumps that can be on while maintaining distribution system pressures within tolerable levels.

There are four water storage facilities as detailed in Table 5-14 below.

Table 5-14 Water Storage Facility Details

Storage Facility	Pressure Zone	Total Volume (ML)	Effective Volume (ML)[1]	Overflow Elevation (m)	Ground Elevation (m)	Typical Operating Range (m)	
CFB Kingston EST	3A	2.27	2.27	151.33	107.44	149.0	150.4
Innovation Drive EST	3B	6.30	5.36	151.30	105.69	144.8	149.8
Gore Road SP	3B	1.33	1.33	151.35	102.25	144.8	149.8
Forest Drive SP	3C	1.77	1.28	151.74	104.24	144.1	148.6

5.2.2.2 SYSTEM CONCERNS AND CONSIDERATIONS:

Pressure Zones 3B and 3C are much lower in elevation and need to be protected from high pressures.

Facility Life Cycle: DND request to decommission CFB Kingston EST.

Distance from James Street BS to far ends of system is long and has large dynamic head losses. Due to the elevation of the BS being low and the system being significantly higher, the BS piping needs to be rated to operate at high pressures.

Existing James Street BS has pumps that are oversized for current demands; the station is small and therefore difficult to maintain equipment. Station is limited to operating one pump at a time due to discharge pressures and much of the mechanical equipment needs to be replaced.

One of the standpipes has become redundant with the new Innovation Drive EST.

5.2.3 MODELING

The existing City of Kingston water distribution system hydraulic model uses Innovyze InfoWater software. The 2013 demands were developed using billing meter data and SCADA flow data from the James Street BS and meter chambers at the pressure zone boundaries. This model was updated for the East water system for 2026 and 2033.

5.2.3.1 MULTIPLIERS

From daily flow data, the multipliers were calculated at:

- Max day multiplier of 1.39 average daily flow
- Min day multiplier of 0.66 average daily flow

Actual multipliers used were:

- Max day multiplier of 1.5 average daily flow
- Peak hour multiplier of 2.25 average daily flow

5.2.3.2 FIRE FLOW REQUIREMENTS

Table 5-15 Suggested Fire Flow Rates

Zoning Classification / Land Use	Building Separation Distance (m)	Fire Flow Target	Fire Flow Reference
Industrial	All	13,200 L/min (220 L/s)	2007 Kingston MPWS
Institutional	All	13,200 L/min (220 L/s)	2007 Kingston MPWS
Medium Density Residential & Commercial	All	13,200 L/min (220 L/s)	2007 Kingston MPWS
Low Density Residential and Commercial	< 3	8,000 L/min (134 L/s)	FUS
Low Density Residential and Commercial	3 – 10	4,000 L/min (67 L/s)	FUS
Low Density Residential and Commercial	> 10	3,000 L/min (50 L/s)	FUS
Low Density Residential and Commercial	> 3	5,676 L/min (94.6 L/s)	KFRS

Table 5-16 Suggested Fire Flow Durations

Demand Scenario	Equivalent Population[1]	Fire Flow Duration (h)[2]
2013 Base Scenario	14,014	3.5
2026 Base Scenario	23,194	4.5
2026 Scenario A	31,417	5.0
2026 Scenario B	39,686	6.0
2026 Scenario C	47,909	6.0
2033 Base Scenario	27,136	5.0
2033 Scenario A	39,787	6.0
2033 Scenario B	52,508	6.0
2033 Scenario C	65,159	6.0

Notes:
1. Assuming 350 L per person per day
2. Fire flow duration from MOE WDG (more conservative than FUS).

5.2.3.3 OPERATING PRESSURES

Table 5-17 Operating Pressures

Pressure Guideline	Value (psi)	Demand Scenario	Reference
Maximum (Distribution System)	100	Minimum Day	WDG
Maximum (Building Plumbing)	80	Minimum Day	OBC
Normal High	70	Average Day and Maximum Day	WDG
Normal Low	50	Average Day and Maximum Day	WDG
Peak Low	40	Peak Hour	WDG
Minimum	20	Maximum Day + Fire Flow	WDG

5.2.4 WATER DEMAND PROJECTIONS

5.2.4.1 GROWTH SCENARIOS

Base Growth Scenario: areas inside the urban boundary and area east of the urban boundary and south of HWY 2 towards Forest Drive Standpipe

Growth Scenario A: all the area in the base growth scenario plus the expansion area from the urban boundary north on HWY 15 to Middle Road

Growth Scenario B: all the area in the base growth scenario plus the expansion area east of the urban boundary and north of Highway 2

Growth Scenario C: all the area in the base growth scenario plus the expansion areas in both growth scenarios A and B

5.2.4.2 HOUSEHOLD SIZE

Table 5-18 Household Size

Year	Citywide Household Size	Decrease in Citywide Household Size	EWS Household Size
2006	2.3	-	2.70
2013	2.2	4.3%	2.58
2026	2.1	4.5%	2.47
2033	2.1	0%	2.47

5.2.4.3 POPULATIONS

Current populations were extrapolated from Census Neighborhood Profiles and obtained from Department of National Defense. The total population for the East water system was estimated to be 11,081 in 2013. Future populations were calculated using various methods as per Table 5-19 below.

Table 5-19 Population Projections

Growth Scenario	Year	Pressure Zone				Total
		3A	3AX	3B	3C	
Base Scenario	2013	2,776	1,000	6,247	1,058	11,081
	2026	2,976	1,000	8,214	1,482	13,672
	2033	3,076	1,000	9,697	1,757	15,530
Growth Scenario A	2013	-				
	2026	2,976	1,000	8,214	18,061	30,251
	2033	3,076	1,000	9,697	27,217	40,989
Growth Scenario B	2013	-				
	2026	2,976	1,000	13,399	1,482	18,857
	2033	3,076	1,000	17,673	1,757	23,506
Growth Scenario C	2013	-				
	2026	2,976	1,000	13,399	18,061	35,436
	2033	3,076	1,000	17,673	27,217	48,966

5.2.4.4 DEMAND

Demand was calculated by multiplying residential populations by 350L/p/day. Institutional demands were estimated to be 15 m^3/ha/day while this was multiplied by 1.25 to obtain an industrial demand of 19m^3/ha/day. The institutional areas in the RMC and CFB institutional areas were calculated using expansion information from DND.

Table 5-20 Base Growth Scenario Demand Projections

Average Day and Maximum Day Demands for 2013, 2026, and 2033 (m^3/d)

Pressure Zone	2013		2026		2033	
	Average Day	Maximum Day	Average Day	Maximum Day	Average Day	Maximum Day
3A	2,376	3,564	3,170	4,755	3,524	5,286
3AX	563	845	657	985	759	1,139
3B	1,616	2,424	3,753	5,629	4,569	6,854
3C	350	525	539	808	645	968
Total	4,905	7,358	8,118	12,177	9,497	14,246

Table 5-21 Growth Scenario A Demand Projections

Average Day and Maximum Day Demands for 2013, 2026, and 2033 (m^3/d)

Pressure Zone	2013		2026		2033	
	Average Day	Maximum Day	Average Day	Maximum Day	Average Day	Maximum Day
3A	2,376	3,564	3,170	4,755	3,524	5,286
3AX	563	845	657	985	759	1,139
3B	1,616	2,424	6,631	9,946	8,997	13,495
3C	350	525	539	808	645	968
Total	4,905	7,358	10,996	16,494	13,925	20,888

Table 5-22 Growth Scenario B Demand Projections

Average Day and Maximum Day Demands for 2013, 2026, and 2033 (m^3/d)

Pressure Zone	2013		2026		2033	
	Average Day	Maximum Day	Average Day	Maximum Day	Average Day	Maximum Day
3A	2,376	3,564	3,170	4,755	3,524	5,286
3AX	563	845	657	985	759	1,139
3B	1,616	2,424	3,753	5,629	4,569	6,854
3C	350	525	6,311	9,467	9,526	14,288
Total	4,905	7,358	13,890	20,835	18,378	27,567

Table 5-23 Growth Scenario C Demand Projections

Average Day and Maximum Day Demands for 2013, 2026, and 2033 (m^3/d)

Pressure Zone	2013		2026		2033	
	Average Day	Maximum Day	Average Day	Maximum Day	Average Day	Maximum Day
3A	2,376	3,564	3,170	4,755	3,524	5,286
3AX	563	845	657	985	759	1,139
3B	1,616	2,424	6,631	9,946	8,997	13,495
3C	350	525	6,311	9,467	9,526	14,288
Total	4,905	7,358	16,768	25,152	22,806	34,208

5.2.5 RECOMMENDATIONS

Pressures, water age, storage and fire flow were modelled for each growth scenario for years 2013, 2026 and 2033. The following were the recommendations presented in the report:

James Street Booster Pumping Station Upgrades:

Addition to the existing pump station complete with two new pumps to provide pumping capacity to the East water system while the existing pump station is renovated. The fully upgraded booster station will have three new pumps with space for a total of four pumps, electrical equipment, standby generator, chlorine booster system

Decommissioning of Gore Road Standpipe

Gore Road standpipe is redundant with the construction of Innovation Drive elevated storage tank, and is contributing to the high water age in the system. This should be decommissioned after the James Street Upgrades have been completed.

Decommissioning of Forest Drive Standpipe

Although the Forest Drive standpipe provides the East system with improved fire flow in the east end and provides storage under emergency situations to maintain water service if a break along HWY 2 400 mm Ø watermain. The standpipe however negatively effects water quality due to the excess storage and as a result the age of the water. It is deemed that the benefits to decommissioning the standpipe outweigh the drawbacks.

Decommissioning of CFB Kingston Elevated Storage Tower

Modelling confirmed that it is possible to decommission the CFB Kingston elevated storage tank if the James Street Booster Station is upgraded. This decommissioning would require that the James Street pumps are controlled using system pressure points with additional pumps turned on if the Innovation Drive elevated storage tower level drops.

Pressure Zone Modifications

With the decommissioning of the standpipes and CFB elevated storage tank, and the motorized control valves on HWY 15 and HWY 2 and 400 mm Ø watermain valves should be set to fully open which will eliminate PZ 3B and 3C.

New Elevated Storage Tank

To meet projected demands beyond 2026, a new elevated storage tank will be required east of CFB Kingston.

Conveyance Upgrades on Highway 15 and Pressure Zone Modifications

When the Innovation Drive elevated storage tank cannot be filled to the required level while maintaining the current maximum pressures (hydraulic grade line required to fill the innovation drive EST and natural topography of HWY 15 results in high pressure in the lower elevation service areas), the conveyance upgrades would be required. The low level areas may need to be protected from high pressures through the creation of sub pressure zones. Due to the HWY 15 400mm Ø being a critical line (if a break were to occur, the southern parts of the system would be cut off from firefighting capacity of the Innovation Drive elevated storage tank. The conveyance upgrades would be a new 500 mm Ø transmission main on HWY 15 between the intersection of HWY15/HWY 2 and the intersection of HWY 15 and Gore Road.

Conveyance Upgrades on Highway 2

Conveyance upgrades along HWY2 could be required to maintain adequate water levels in the new elevated water storage tank.

5.3 CONDITION ASSESSMENT OF WATER AND WASTEWATER PUMPING STATIONS (STANTEC, DECEMBER 2008)

The purpose of the Study was to assess the conditions of the existing water and wastewater pumping stations by conducting field investigations, evaluating the capital improvements and maintenance requirements at each station as well as evaluating a risk assessment. Using this information, a proposed plan was developed to prioritize capital improvements for the necessary station upgrades. Additionally, the assessment included completing operations and maintenance manuals, investigating station capacities and analyzing the costs associated with the rehabilitation or replacement of the stations. After evaluating each of the water and wastewater pumping stations, a twenty-five year capital improvement plan was determined, which includes rehabilitation and replacement works.

5.4 POINT PLEASANT WATER TREATMENT PLANT EXPANSION ENVIRONMETAL STUDY REPORT (J.L. RICHARDS AND CH2MHILL, MAY 2009)

The 2007 Water Supply Master Plan for the City of Kingston's Urban Area identified solutions to the growing water demand in the City including expansion of the Point Pleasant (formerly Kingston West) WTP. The purpose of this Schedule C Class EA Study was to assess potential alternative designs while considering projected water quality and capacity requirements for the plant. The major recommendations outlined in the Study determined the required expansion taking into account the current and future water demand/supply requirements, addressing the existing hydraulic pinch-points that create operator challenges, twinning of the single discharge trunk watermain and providing flexibility for further expansion.

The alternatives that were assessed were:

- Maintaining the status quo of the plant

- Interconnecting the Kingston West and Kingston Central water distribution systems with the expansion of the Point Pleasant WTP while keeping the Central WTP in service

- Interconnecting the two water distribution systems with the expansion of the Point Pleasant WTP to serve both areas without the Central WTP

- Interconnecting the two water distribution systems by creating a new "Greenfield" plant to serve both the West and Central

Interconnecting the Kingston West and Kingston Central water distribution systems with the expansion of the Point Pleasant WTP while maintaining the functionality of the Central WTP was determined to be the preferred solution.

The expansion of the Point Pleasant WTP is currently being commissioned to account for a capacity of 85 ML/day.

5.5 BAYRIDGE DRIVE TRUNK WATERMAIN CLASS ENVIRONMENTAL ASSESSMENT (J.L. RICHARDS AND CH2MHILL, JULY 2008)

This Study built on the 2007 Water Supply Master Plan which recommended the connection of the Kingston Central/East water distribution system and the Kingston West water distribution system by providing additional watermain looping in the West area. The purpose of this Schedule B Class EA was to identify the preferred alignment to connect the two 900 mm watermains located to the north and south of Bath Road. The preferred recommendation was to install a 900 mm diameter watermain extending west along Cloverdale Drive to the access road, north along an existing trail, under Bath Road and the CN Mainline that connected to the existing watermains on Bayridge Drive and Forest Hill Drive East. The construction of the Bayridge Drive trunk watermain was completed in 2014.

5.6 O'CONNOR RESERVOIR AND PUMPING STATION CLASS ENVIRONMENTAL ASSESSMENT (J.L. RICHARDS AND CH2MHILL, JULY 2008)

The 2007 Water Supply Master Plan for the City of Kingston's Urban Area identified the need for additional water storage on O'Connor Drive. The O'Connor Reservoir and Pumping Station Schedule B Class EA was therefore undertaken to identify the location for a new reservoir and pumping station. The Study examines both the capacity required for the new pumping station as well as its proposed location.

The reservoir and pumping station have been designed and implemented (construction concluding in March, 2011). The reservoir was completed with a storage capacity of 13ML and the pumping station with a capacity of 84.4 ML/day. This work also included the installation of a new 600 mm watermain from the new O'Connor Drive Pumping Station to Gardiners Road.

5.7 JAMES STREET BOOSTER STATION – SCHEDULE B ENVIRONMENTAL ASSESSMENT (CH2MHILL, 2014)

The James Street Booster Station Schedule B EA was completed by CH2M Hill in 2014.

5.7.1 PROBLEM STATEMENT

The problem statement developed from both the City of Kingston Official Plan (2011), the Waster Master Plan (SEG, 2007) and the Water Master Plan update (CHTMHILL, 2014) is as follows:

"Utilities Kingston has determined the need to update the 2007 Drinking Water Master Plan to accommodate current (2013) drinking water demands and to plan for additional infrastructure requirements to satisfy the short-term (2013), mid-term (2026) and long-term (2033) drinking water requirements for the area of Kingston East. This project will identify the preferred alternative to satisfy the future (2033) water demands in the Kingston East Water System, while considering operation both in the short term and long term through the phasing process towards future infrastructure build out, while minimizing the impacts on the natural and social/cultural environment. The ability of the alternatives to allow for decommissioning of existing infrastructure that has reached the end of its useful life will be incorporated into the evaluation of alternatives, along with the potential for cooperation with Department of National Defence for completion of the project and its impacts on water supply to their facilities.

Water is supplied to the Kingston East System through the James Street Booster Station, which is currently in need of rehabilitation and upgrades. The impact of anticipated changes from the Master Plan update need to be considered to ensure future requirements are met at the station. Consequently, a study to assess options and develop a strategy to address the current and future operational and capacity needs of the James Street Booster Station is required.

This Study is being undertaken as a "Schedule B" project under the Municipal Class Environmental Assessment process."

5.7.2 ALTERNATIVES

A summary of the alternatives evaluated can be found in Table 5-24.

Table 5-24 Alternative Solution Descriptions

Alternative Number	James St BPS Location	James St BPS Pumping Capacity	Other Pumping	Water Storage Facilities	Conveyance Upgrades
1A	Existing	FPC > Max Day Demand	-	Innovation Dr EST	Conveyance Through Developments Highway 15 Upgrades Highway 2 Upgrades
1B	Existing	FPC = Max Day Demand	-	Innovation Dr EST New EST in PZ 3C	Conveyance Through Developments Highway 15 Upgrades
1C	Existing	FPC = Max Day Demand	New BPS with Reservoir	Innovation Dr EST New Reservoir in PZ 3C	Conveyance Through Developments Highway 15 Upgrades
2A	New	FPC > Max Day Demand	-	Innovation Dr EST	Conveyance Through Developments Highway 15 Upgrades Highway 2 Upgrades
2B	New	FPC = Max Day Demand	-	Innovation Dr EST New EST in PZ 3C	Conveyance Through Developments Highway 15 Upgrades
2C	New	FPC = Max Day Demand	New BPS with Reservoir	Innovation Dr EST New Reservoir in PZ 3C	Conveyance Through Developments Highway 15 Upgrades

Definitions: FPC – Firm Pumping Capacity, BPS – Booster Pumping Station, EST – Elevated Storage Tower, PZ – Pressure Zone

5.7.3 EVALUATION OF ALTERNATIVES

The criteria used in evaluating the alternatives were:

Technical

- Water Pressure
- Water Quality
- Fire Flow
- Operational Complexity
- Flexibility
- Constructability
- Sustainability

Natural Environment

- Terrestrial Systems
- Environmentally Sensitive Area/ Area of Natural and Scientific Interest

- Groundwater
- Cultural and Heritage Resources
- Archeology
- Impact to Residents

Economic

- Capital Costs
- Operating and Maintenance Costs

5.7.4 PREFERRED ALTERNATIVE

After evaluating the alternatives using the above criteria and the Problem/Opportunity Statement for this Class EA, the recommended design solution is:

Phase 1 (Part of this Class EA) - **Upgrade the James Street Booster Station in its existing location** with new pump configuration and capacity to satisfy short and long term growth requirements to a maximum daily flow of 385 L/s (33,264 m^3/day) phased over time starting with a firm capacity of 170 L/s (14,688 m^3/day).

Phase 2 (to be assessed in future Class EAs) - Construct a new elevated storage tower east of CFB Kingston and construct conveyance upgrades on HWY 15.

5.8 JAMES STREET BOOSTER STATION – PRELIMINARY DESIGN REPORT (CH2MHILL, 2014)

The James Street Booster Station Preliminary Design Report was completed by CH2M Hill in 2014.

5.8.1 BACKGROUND

The James Street Booster Station provides water supply and pressure to the East water system. The original station was built in 1956 and refurbished in 1991. Most of the infrastructure is in need of replacement and upgrades. The 2007 Water Supply Master Plan was used in determining the required needs for the present and to provide water service to Kingston East to the year 2033.

5.8.2 MECHANICAL REQUIREMENTS

The upgraded pumping station will included the following main process and mechanical components:

- Three variable speed booster pumps (two firm capacity) and space for one more
- Flow metering
- Piping and valving to allow isolation of pumps for maintenance
- One pressure relief valve at the header
- One pressure reducing valve to supply water to RMC and surrounding area with lower elevation One standby generator for emergency power
- One Chlorine feed to boost chlorine residuals as needed

5.8.3 PUMPING

The initial configuration of the upgraded system will involve two duty and one standby pump with space for an additional pump. The pumps will be single stage horizontal split case, 1800 RPM pumps with approximately 100 hp and 120 hp for the small and large pumps respectively. VFD's will be provided to control the discharge pressure. A summary of the capacities and phasing is as per Table 5-25.

Table 5-25 James Street BPS Pump Phases and Flows

Design Flows and Firm Capacity for Each Pumping Phase

Phase	Pump Design Flow (L/s)				Firm Capacity (L/s)	Total Capacity (L/s)
	Pump 1	Pump 2	Pump 3	Pump 4		
1	85	85	150	-	170	320
2	85	85	150	**150**[1]	320	470
3	**150**[2]	**150**[2]	150	150	450	600

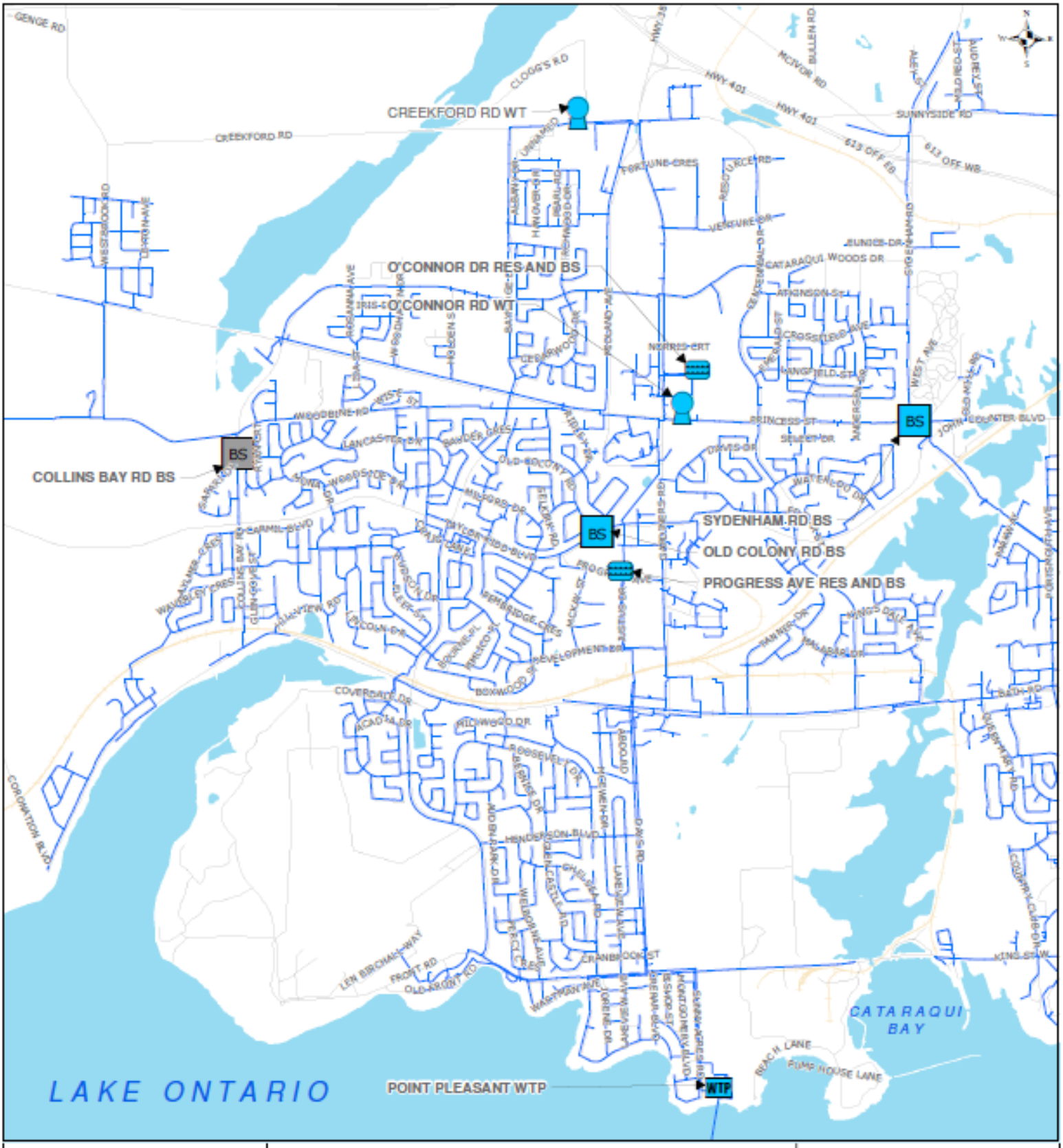
5.8.4 COST ESTIMATE

CH2MHILL provided a cost estimate (excluding HST) of $5,803,000 which included engineering fees.

6 KINGSTON WEST SUPPLY AND DISTRIBUTION SYSTEM

The Kingston West water distribution system comprises an area of approximately 3,953 ha. It is generally bordered by Westbrook Road to the west, Macdonald-Cartier Freeway (401) to the north, Little Cataraqui Creek to the east and Lake Ontario to the south. The Kingston West water distribution serves a population of 44,400 citizens and comprises over 300 km of watermain.

The Kingston West water system includes of one water treatment plant, four reservoirs/booster stations and two elevated storage tanks. Figure 6-1 below shows the system and it's components.



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Legend

- WTP — WATER TREATMENT PLANT
- BS — WATER BOOSTER STATION
- BS — WATER BOOSTER STATION (NOT ACTIVE)
- WATER TOWER
- WATER PIPE
- WATERBODY

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON WEST WATER DISTRIBUTION SYSTEM

Data Source: Ontario Base Mapping, Ministry of Natural Resources, August 2013. Water and Waste Water Systems, Utilities Kingston, April 2015, City of Kingston.

Scale: 0 250 500 1,000 Meters
1:40,000

Project No.:	Date:	Drawn By:	Checked By:	Code:	Figure No.:
151-02944-00	DECEMBER 2016	CM	MF	BR	6-1

6.1 LINEAR INFRASTRUCTURE

6.1.1 SIZE, MATERIAL AND AGE

The diameter of the Kingston West distribution watermains vary from 50 mm to 1200 mm as described in Table 6-1 and Figure 6-2 below. They are made from asbestos cement (AC), cast iron (CI), cured in place pipe (CIPP), concrete pressure pipe (CPP), copper (CU), ductile iron (DI), stainless steel (SSTL) and polyvinyl chloride (PVC). This is summarized in Table 6-2 and Figure 6-3. Finally, the Kingston West distribution watermains are built between the year 1945 and present. This is summarized in Table 6-3 and Figure 6-4.

Table 6-1 Kingston West Watermain Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	32,956
50	1,636
100	1,594
150	58,579
200	106,610
250	30,178
300	50,685
400	19,185
450	1,296
500	3,733
600	3,403
750	195
900	2,007
1050	178
1200	222
Total	**312,457**

**Data was obtained from Kingston GIS.*

Table 6-2 Kingston West Watermain Material

MATERIAL	LENGTH* (m)
Unspecified	55,032
AC	1,920
CI	40,307
CIPP CI	10,826
CIPP DI	217
CIPP PVC	191
CPP	1,972
CU	127
DI	27,409
SSTL	1,101
PVC	173,355
Total	**312,457**

**Data was obtained from Kingston GIS.*

Table 6-3 Kingston West Watermain Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	1,521
1945-1950	127
1951-1960	1,315
1961-1970	24,563
1971-1980	56,197
1981-1990	42,293
1991-2000	48,697
2001-2010	66,012
2011-present	71,732

YEAR INSTALLED	LENGTH* (m)
Total	**312,457**

Data was obtained from Kingston GIS.

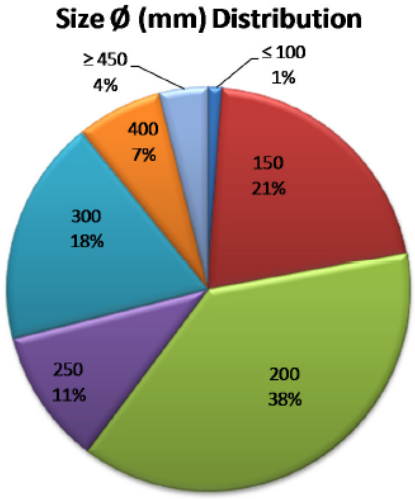

Figure 6-2 Kingston West Watermain Size

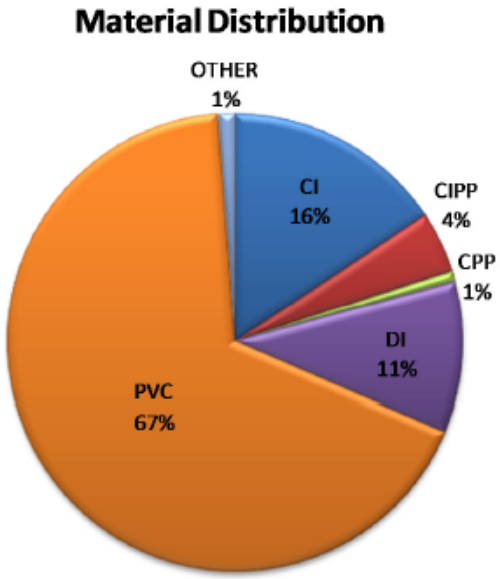

Figure 6-3 Kingston West Watermain Material

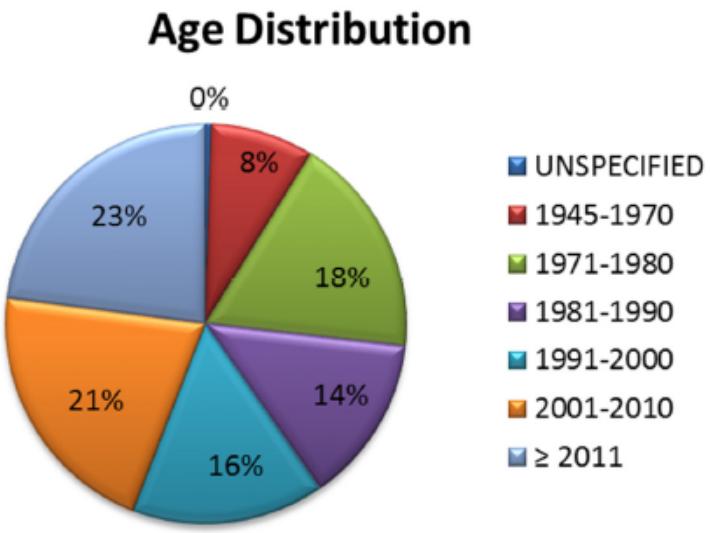

Figure 6-4 Kingston West Watermain Installation Year

6.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects:

Structural Relining of Watermains (UK 15-09)

- Structural relining of 3205 m of watermain
- 18 gate valves, 17 fire hydrants

Bayridge Drive Trunk Watermain EA

- Extending a 900 mm Ø watermain west along Coverdale Drive, north crossing Bath Road and CN tracks to connect to the existing watermain at Bayridge/Forest Hill Drives

6.2 RESERVOIRS AND BOOSTER STATIONS

The Kingston West Water System has three booster stations and one reservoir/booster station. Please refer to Figure 6-1 for a map showing the Kingston West water collection system. Table 6-4 and Table 6-5 provide information for booster stations and reservoirs respectively. Please refer to Figure 4-3 for a pressure zone overview map.

6.2.1 EXISTING INFORMATION

Table 6-4 Kingston West Booster Stations

BOOSTER STATION	LOCATION	NO. OF PUMPS	INLET PRESSURE*	OUTLET PRESSURE*	AVERAGE DAILY FLOW	FEED/ SUPPLY
Collins Bay Rd. BS	865 Collins Bay Road			Not in Operation		
Old Colony Rd. BS	901 Old Colony Road	2	66 psi 64 psi	87 psi 89 psi	5180 m^3/day	PZ1a to PZ2
Sydenham Rd. BS	896 Purdys Court	2	69 psi 69 psi	102 psi 101 psi	4350 m^3/day	PZ1a to PZ2

**Flow Test completed May, 2008*

Table 6-5 Kingston West Reservoir

RESERVOIR	LOCATION	NO. OF PUMPS	TOTAL VOLUME	FUNCTIONAL VOLUME	AVERAGE DAILY FLOW	FEED/ SUPPLY
O'Connor Dr. Res/BS	508 O'Connor Drive	2	8044 m^3		9850 m^3/day	PZ1a to PZ2
Progress Ave. Res/BS	730 Progress Avenue	3	6600 m^3	2900 m3	10850 m^3/day	PZ1 to PZ1

6.2.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for booster stations or reservoirs in Kingston West.

6.3 WATER TOWERS

The Kingston West water system has two water towers. Please refer to Figure 6-1 for a map showing the Kingston West water collection system. Figure 4-1 provides an overview of each water tower. Please refer to Figure 4-3 for a pressure zone overview map.

6.3.1 EXISTING INFORMATION

Table 6-6 Kingston West Water Towers

WATER TOWER	LOCATION	TOTAL VOLUME	FUNCTIONAL VOLUME	HIGH WATER LEVEL	STORAGE AND PRESSURE STABILIZATION	CONTROLS PUMP OPERATIONS
O'Connor Dr. Water Tower	508 O'Connor Drive	1100 m3	370 m^3	136.5 m	PZ1A	PP WTP HLS
Creekford Rd. Water Tower	2754 Creekford Road	6800 m3	1700 m^3	159.8 m	PZ2	O'Connor Dr. BS

6.3.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for water towers in Kingston West.

6.4 KINGSTON WEST WATER TREATMENT PLANT

The Point Pleasant (Kingston West) WTP, located at 80 Sunny Acres Road, supplies water to the Kingston West water distribution system. The Kingston West WTP has a peak capacity of 45.5 MLD. The raw surface water comes from Lake Ontario. The plant uses a direct filtration treatment process as described in Section 6.4.1 below.

6.4.1 UNIT PROCESS DESCRIPTION

The Kingston West WTP is a chemically assisted, direct filtration water treatment plant with a “rated” capacity of 45.5 ML/d. The WTP consists of:

- A 1,220 mm intake and crib resting on the bottom of Lake Ontario approximately 500 m from the low lift pumping station

- A low lift pumping station comprised of an “L-shaped” wet well, measuring 3.8 m x 11.2 m x 5.4 m (SWD) and 5.7 m x 5.7 m x 5.4 m (SWD) equipped with four low lift pumps: two electricity powered pumps rated at 13,308 m^3/d, one (1) electricity powered pump rated at 27,216 m^3/d and one (1) dual fired electricity/diesel pump rated at 27,216 m^3/d

- Two rapid mixing chambers: one with a total volume of 12.6 m^3 which discharges to flocculation tanks 1 and 2 and one with a total volume of 10.9 m^3 which discharges to Flocculation Tank 3

- Three flocculation tanks, each having a retention volume of 174.2 m^3

- Three dual media filters, each having a surface area of 53.2 m^2

- Two clearwells: one measuring 23 m x 16 m x 3 m SWD and one measuring 23 m x 8 m x 3 m SWD

- Two baffled chlorine contact tanks, each measuring 14 m x 24.4 m x 4.3 m (SWD)

- Two Treated Water Reservoirs, each measuring 21.9 m x 39.3 m x 4.1 m (SWD)

- A high lift pumping station comprised of wet well, measuring 9 m x 18.6 m x 5.5 m (SWD) equipped with four low lift pumps: two electricity powered pumps rated at 13,622 m^3/d, one electricity powered pump rated at 27,244 m^3/d and one dual fired electricity/diesel pump rated at 27,244 m^3/d

6.4.2 TREATED WATER CRITERIA

The Kingston West WTP must produce water that complies with the requirements of Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards. Compliance with O.Reg. 169/03 is achieved by implementing the sampling requirements contained in Ontario Regulation 170/03 – Drinking Water Systems.

6.4.3 HISTORICAL FLOWS AND PERFORMANCE

The Kingston West WTP operates under Permit to Take Water. A comparison of the water taking to the PTTW is shown in Figure 6-5.

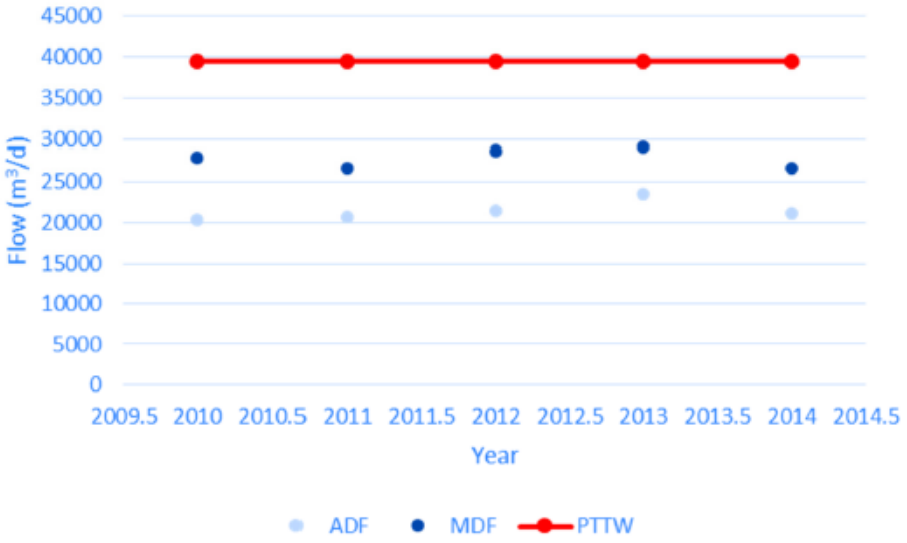

Figure 6-5 Kingston West Water Treatment Plant - Water Taking

The historical water distribution compared to the treatment capacity is shown in Figure 6-6.

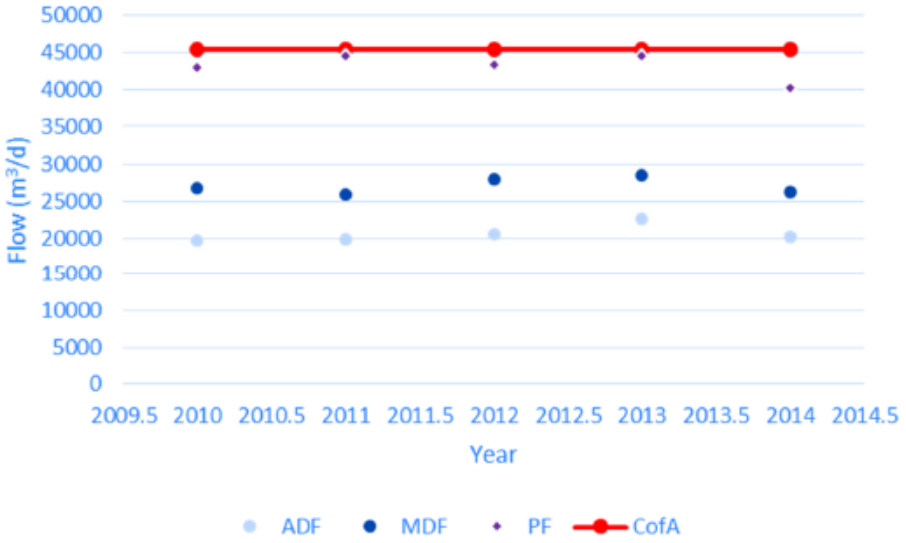

Figure 6-6 Kingston West Water Treatment Plant- Water Distribution

The 2012-2014 Annual Reports all indicated that there were no events within the Kingston West WTP requiring notification during this those reporting periods.

6.4.4 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects:

Kingston West Water Treatment Plant

Doubling plant's capacity

7 KINGSTON CENTRAL SUPPLY AND DISTRIBUTION SYSTEM

The Kingston Central water distribution system comprises an area of approximately 2,919 ha. It is generally bordered by Little Cataraqui Creek to the west, Macdonald-Cartier Freeway (Highway 401) to the north, Cataraqui River to the east and Lake Ontario to the south. The Kingston Central water distribution serves a population of 54,600 citizens and comprises over 300 km of watermain.

Kingston Central comprises of one water treatment plant, one reservoir/booster station and one elevated storage tank. Figure 7-1 provides an overview of the system.

Legend

- WTP — WATER TREATMENT PLANT
- BS — WATER BOOSTER STATION
- WATER TOWER
- WATER PIPE
- WATERBODY

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Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON CENTRAL WATER DISTRIBUTION SYSTEM

Data Source: Ontario Base Mapping, Ministry of Natural Resources, August 2013. Water and Waste Water Systems, Utilities Kingston, April 2015, City of Kingston.

Scale: 0 225 450 900 Meters
1:32,500

Project No.:	Date:	Drawn By:	Checked By:	Code:	Figure No.:
151-02944-00	DECEMBER 2016	CM	MF	BR	7-1

7.1 LINEAR INFRASTRUCTURE

7.1.1 SIZE, MATERIAL AND AGE

The Kingston Central watermains vary in diameter from 25 mm to 1200 mm as described in Table 7-1 and Figure 7-2. They are made from cast iron (CI), cured in place pipe (CIPP), concrete pressure pipe (CPP), copper (CU), ductile iron (DI), high density polyethylene (HDPE) and polyvinyl chloride (PVC). This is summarized in Table 7-2 and Figure 7-3. The watermains were built between the year 1900 and present which is shown in Table 7-3 and Figure 7-4.

Table 7-1 Kingston Central Watermain Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	31,793
25	180
38	456
50	1,206
75	222
50	8,691
100	86,059
150	589
175	589
200	82,215
250	10,101
300	36,119
400	24,186
450	8,981
500	5,423
600	5,108
750	3,021
1200	954
Total	**305,061**

**Data was obtained from Kingston GIS.*

Table 7-2 Kingston Central Watermain Material

MATERIAL	LENGTH* (m)
Unspecified	39,816
CI	122,547
CIPP CI	8,899
CIPP PVC	2
CPP	12,133
CU	862
DI	68,958
HDPE	2,208
PVC	49,636
Total	**305,061**

**Data was obtained from Kingston GIS.*

Table 7-3 Kingston Central Watermain Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	2,306
1900	22,521
1901-1940	16,309
1941-1950	19,175
1951-1960	35,611
1961-1970	34,257
1971-1980	36,413
1981-1990	25,005
1991-2000	22,562
2001-2010	36,418
2011-present	54,485

YEAR INSTALLED	LENGTH* (m)
Total	**305,061**

**Data was obtained from Kingston GIS.*

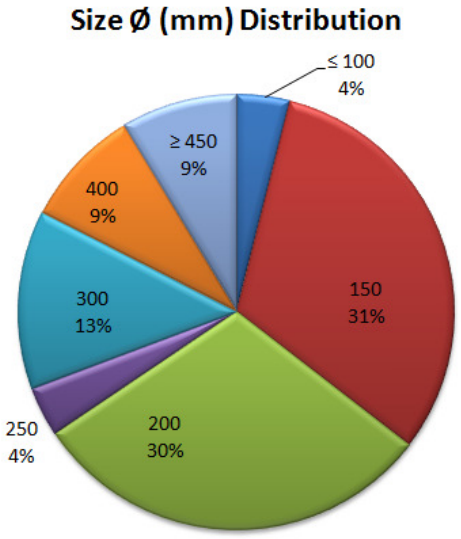


Figure 7-2 Kingston Central Watermain Size

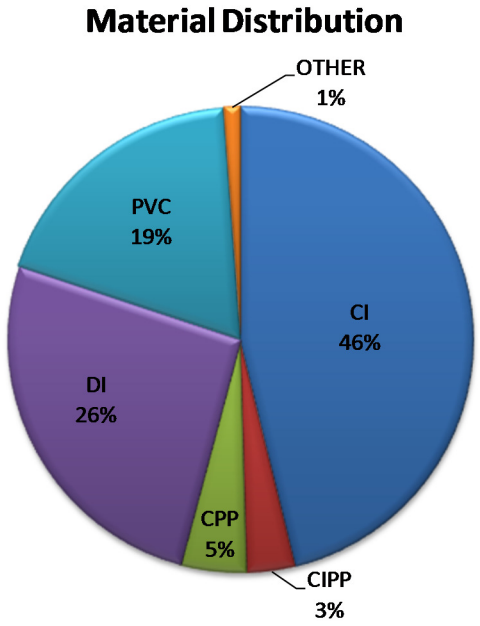


Figure 7-3 Kingston Central Watermain Material

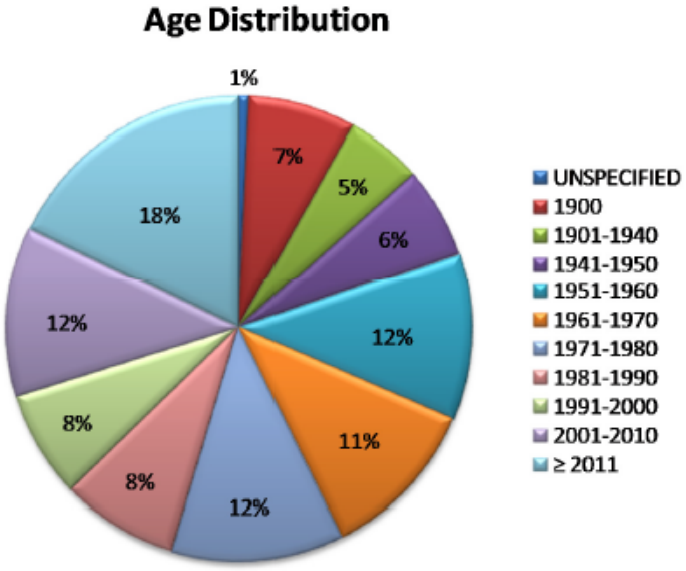


Figure 7-4 Kingston Central Watermain Installation Year

7.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of capital improvement projects currently out for tender:

Avenue Road Watermain Construction (UK 14-07)

- 428 m of 400 mm Ø open cut watermain installation

- 210 m of 25 mm Ø water services

Structural Relining of Watermains (UK 15-09)

- Structural relining of 3205 m of watermain
- 18 gate valves, 17 fire hydrants

7.2 RESERVOIRS AND BOOSTER STATIONS

The Kingston Central Water System has one reservoir/booster station. Please refer to Figure 7-1 for a map showing the Kingston Central Water Distribution system, and Table 7-4 provides information for the reservoir. Please refer to Figure 4-3 for a pressure zone overview map.

7.2.1 EXISTING INFORMATION

Table 7-4 Kingston Central Reservoir

RESERVOIR	LOCATION	NO. OF PUMPS	TOTAL STORAGE VOLUME	FUNCTIONAL STORAGE VOLUME	AVERAGE DAILY FLOW	FEED/ SUPPLY
Third Ave. Reservoir	141 Third Avenue	2	23200 m^3	12800 m^3	31600 m^3/day	PZ1B to PZ1B

7.2.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for booster stations or reservoirs in Kingston Central.

7.3 WATER TOWERS

The Kingston Central Water System has one water tower. Please refer to Figure 7-1 for a map showing the Kingston Central Water collection system, and Table 7-5 provides an overview of each water tower. Please refer to Figure 4-3 for a pressure zone overview map.

7.3.1 EXISTING INFORMATION

Table 7-5 Kingston Central Water Tower

WATER TOWER	LOCATION	TOTAL VOLUME	FUNCTIONAL VOLUME	HIGH WATER LEVEL	STORAGE AND PRESSURE STABILIZATION	CONTROLS PUMP OPERATIONS
Tower St. Water Tower	27 Tower Street	3400 m^3	1900 m^3	139.5 m	PZ1B	King St. WTP HLS

7.4 CENTRAL WATER TREATMENT PLANT

The King Street (Kingston Central) WTP, located at 302 King Street Road, supplies water to the Kingston Central water distribution system, which also in turn supplies the Kingston East water distribution system. The Kingston Central WTP has a peak capacity of 118 MLD. The raw surface water comes from Lake Ontario. The Plant uses a conventional filtration treatment process as described in Section 7.4.1 below.

7.4.1 UNIT PROCESS DESCRIPTION

The Kinston Central WTP is a conventional filtration water treatment plant, with a rated capacity of 118 MLD. The WTP consists of:

- A 1,200 mm intake pipe resting alone the bottom of Lake Ontario approximately 820 m from the low lift pumping station

- A low lift pumping station comprised of a wet well, measuring 14 m diameter by 4.6 m deep, equipped with a removable travelling water screen with a 3.0 mm square mesh. The low lift pumping station also houses four low lift pumps: one electricity powered pumps rated at 40,867 m^3/d, one electricity powered pump rated at 50,026 m^3/d, one electricity powered pump rated at 50,026 m^3/d and one dual fired electricity/diesel pump rated at 77,328 m^3/d

- Three flocculation chambers, each measuring 4.9 m x 4.9 m x 6.8 m (SWD)

- Three settling tanks, each measuring 14.9 m x 25 m x 5.3 m (SWD)

- Six high rate gravity filters, each measuring 6. 4m x 12.8 m providing a surface area of 81.92 m^2 per filter

- One filtered water reservoir, with a storage volume of 1,500 m^3, located below filters 1 through 4

- One filtered water reservoir, with a storage volume of 750 m^3, located below filters 5 and 6

- One baffled chlorine contract tank, measuring 44 m x 49 m x 2.92 m (SWD)

- Seven high lift pumps: two electric pumps rated at 19,528 m^3/d, one electric pump rated at 23,587 m^3/d, one electric pump rated at 31,795 m^3/d, two diesel pumps, each rated at 22,723 m^3/d, and one duel fired electric/diesel pump rated at 45,619 m^3/d

7.4.2 TREATED WATER CRITERIA

The Kingston Central WTP must produce water that complies with the requirements of Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards. Compliance with O.Reg. 169/03 is achieved by implementing the sampling requirements contained in Ontario Regulation 170/03 – Drinking Water Systems.

7.4.3 HISTORICAL FLOWS AND PERFORMANCE

The Kingston Central WTP operates under Permit to Take Water. A comparison of the water taking to the PTTW is shown in Figure 7-5.

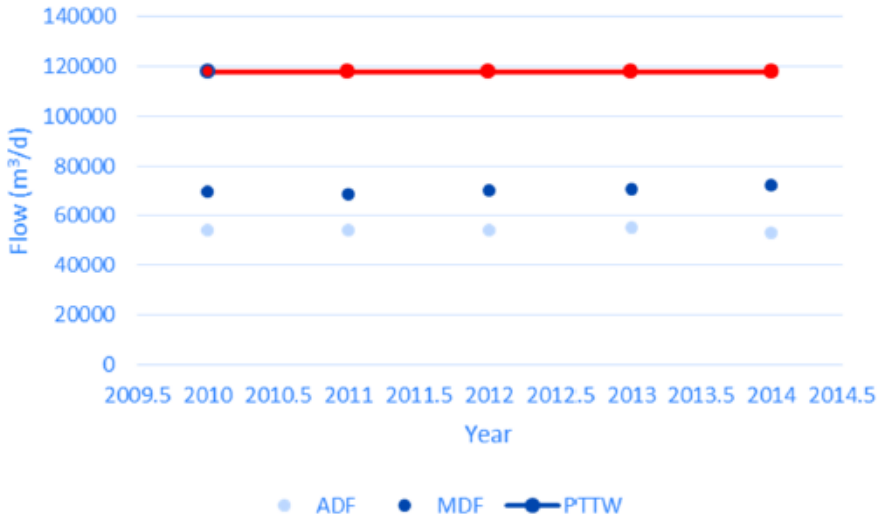


Figure 7-5 Kingston Central Water Treatment Plant- Water Taking

The historical water distribution compared to the treatment capacity is shown in Figure 7-6.

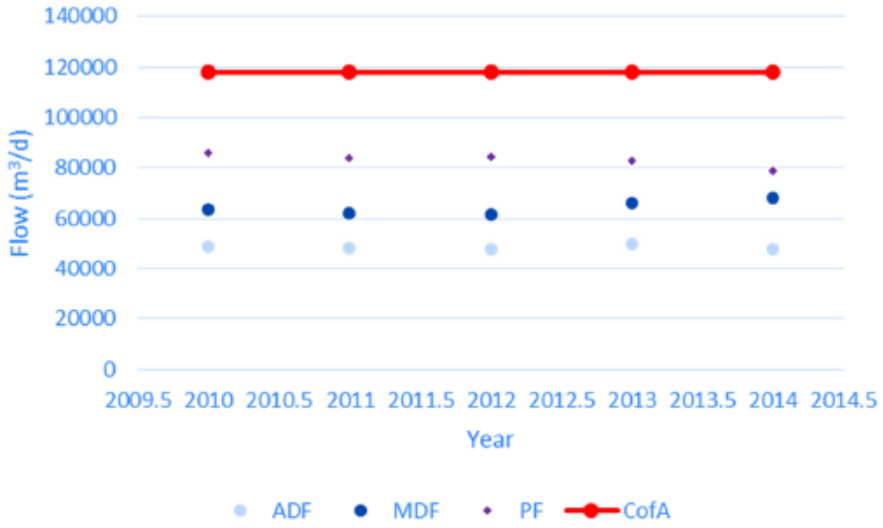


Figure 7-6 Kingston Central Water Treatment Plant- Water Distribution

The 2012-2014 Annual Reports included the following notifications:

Table 7-6 Kingston Central WTP - Notification Summary

YEAR	2012	2013	2014
Lead (mg/L)			1
Total Coliform (cts/100mL)	4	5	5
Free Chlorine (mg/L)		1	

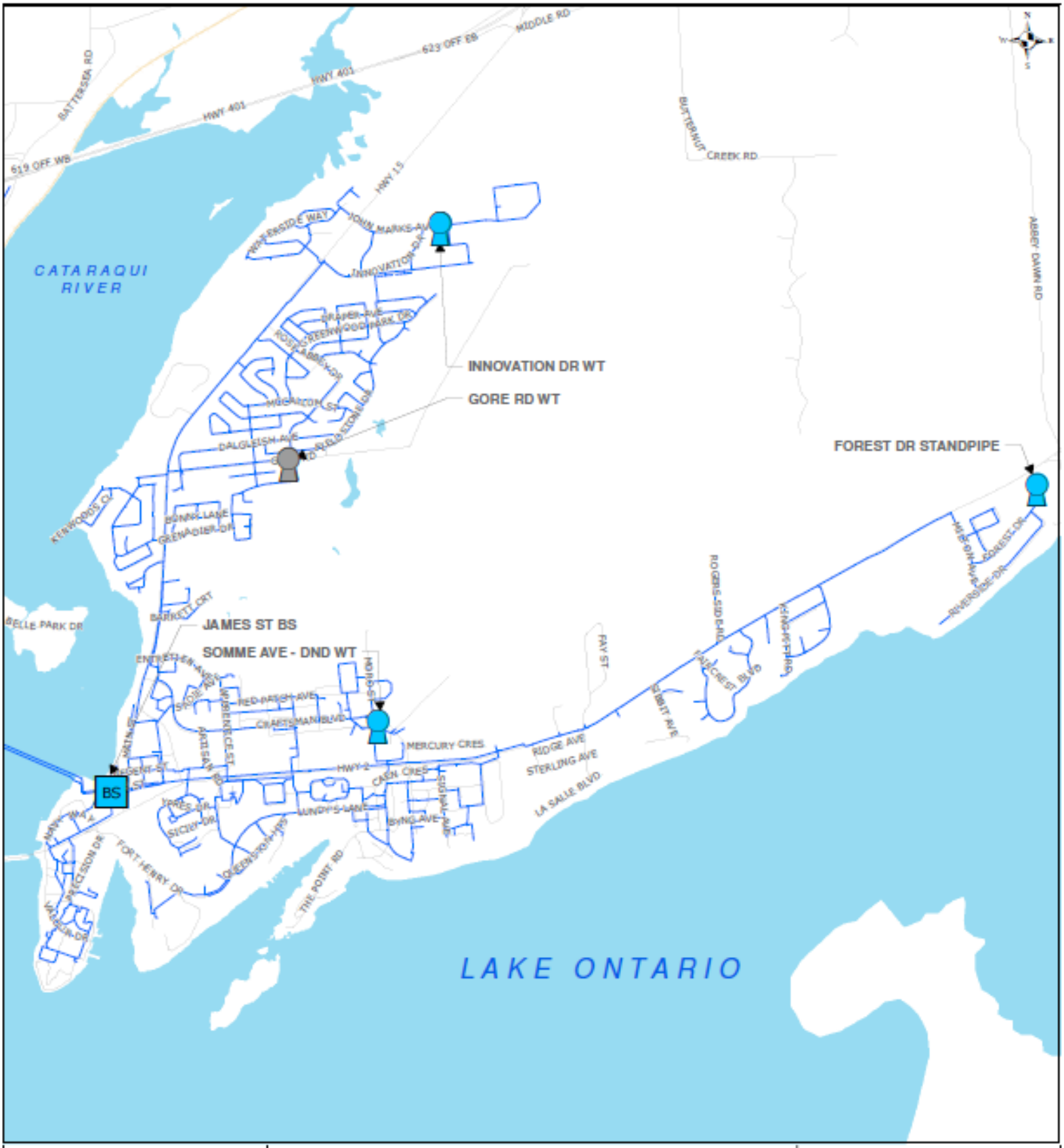
7.4.4 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for King Street Water Treatment Plant.

8 KINGSTON EAST SUPPLY AND DISTRIBUTION SYSTEM

The Kingston East water distribution system comprises an area of approximately 1,386 ha. It is generally bordered by the Cataraqui River to the west, Macdonald-Cartier Freeway (401) to the north, Abbey Dawn Road to the east and Lake Ontario to the south. The Kingston East water distribution serves a population of 10,200 citizens and comprises approximately 90 km of watermain.

Kingston East comprises of one water treatment plant (servicing the Cana community only), one booster station, one elevated storage tank and one standpipe. Figure 8-1 below shows an overview of the system.



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P.O. BOX 790,
KINGSTON, ONTARIO,
K7L 4X7

Legend

- WTP — WATER TREATMENT PLANT
- BS — WATER BOOSTER STATION
- WATER TOWER
- WATER TOWER (NOT ACTIVE)
- WATER PIPE
- WATERBODY

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON EAST WATER DISTRIBUTION SYSTEM

Data Source: Ontario Base Mapping, Ministry of Natural Resources, August 2013. Water and Waste Water Systems, Utilities Kingston, April 2015, City of Kingston.

Scale: 0 250 500 1,000 Meters
1:35,000

Project No.:	Date:	Drawn By:	Checked By:	Code:	Figure No.:
151-02944-00	DECEMBER 2016	CM	MF	BR	8-1

8.1 LINEAR INFRASTRUCTURE

8.1.1 SIZE, MATERIAL AND AGE

The diameter of the Kingston East water distribution system varies from 25 mm to 600 mm as described in Table 8-1 and Figure 8-2. The watermains are made from asbestos concrete (AC), cast iron (CI), cured in place pipe (CIPP), concrete pressure pipe (CPP), copper (CU), ductile iron (DI), high density polyethylene (HDPE) and polyvinyl chloride (PVC). This is summarized in Table 8-2 and Figure 8-3. It is also known that the watermains were built between the year 1948 and present which is summarized in Table 8-3 and Figure 8-4.

Table 8-1 Kingston East Watermain Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	6
25	62
50	65
75	19
100	1,139
150	12,597
200	39,539
250	4,293
300	15,382
400	14,668
450	1,384
600	368
Total	**89,522**

**Data was obtained from Kingston GIS.*

Table 8-2 Kingston East Watermain Material

MATERIAL	LENGTH* (m)
Unspecified	1,725
CI	988
CIPP CI	15,076
CIPP PVC	450
CPP	5,465
CU	127
DI	24,844
HDPE	1,072
PVC	39,775
Total	**89,522**

**Data was obtained from Kingston GIS.*

Table 8-3 Kingston East Watermain Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	2,306
1948-1950	5,133
1951-1960	10,766
1961-1970	774
1971-1980	13,409
1981-1990	13,603
1991-2000	23,338
2001-2010	17,258
2011-present	4,983
Total	**89,522**

**Data was obtained from Kingston GIS.*

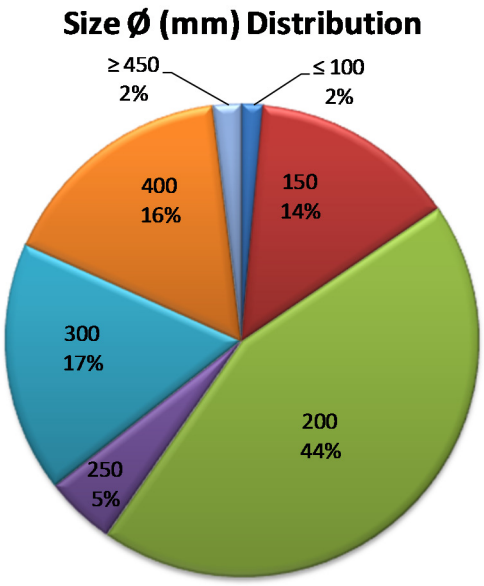

Figure 8-2 Kingston East Watermain Size

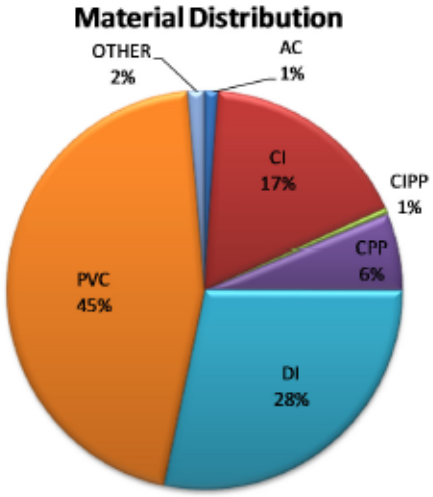

Figure 8-3 Material of Kingston East Water Distribution Piping

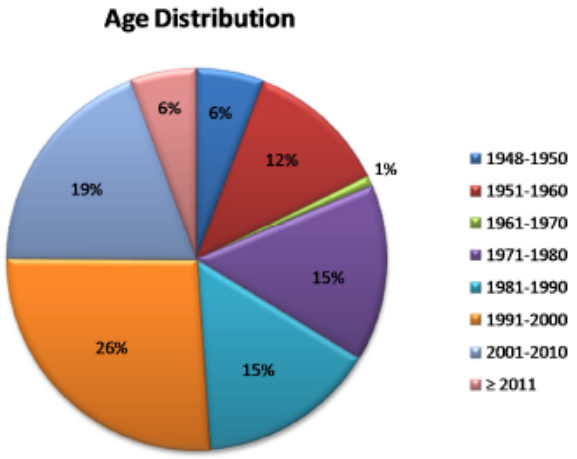

Figure 8-4 Kingston East Watermain Installation Year

8.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects:

Structural Relining of Watermains (UK 15-09)

- Structural relining of 3205 m of watermain
- 18 gate valves, 17 fire hydrants

8.2 RESERVOIRS AND BOOSTER STATIONS

The Kingston East water system has one booster station. Please refer to Figure 8-1 for a map showing the Kingston East water distribution system. Table 8-4 provides information for the James Street booster station. Please refer to Figure 4-3 for a pressure zone overview map.

8.2.1 EXISTING INFORMATION

Table 8-4 Kingston East Booster Stations

BOOSTER STATION	LOCATION	NO. OF PUMPS	INLET PRESSURE*	OUTLET PRESSURE*	AVERAGE DAILY FLOW	FEED/ SUPPLY
James St. BS	James Street	2	70 70	120 120	18200 m3/day	PZ1b to PZ3a

**Flow Test completed May, 2008*

8.2.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects:

James Street Booster Station Upgrades

8.3 WATER TOWERS

The Kingston East water system has one water towers and one standpipe. Please refer to Figure 8-1 for a map showing the Kingston East water collection system. Table 8-5 provides an overview of the elevated storage facilities. Please refer to Figure 4-3 for a pressure zone overview map.

8.3.1 EXISTING INFORMATION

Table 8-5 Kingston East Water Towers

WATER TOWER	LOCATION	TOTAL VOLUME	FUNCTIONAL VOLUME	HIGH WATER LEVEL	STORAGE AND PRESSURE STABILIZATION	CONTROLS PUMP OPERATIONS
Innovation Dr. Water Tower	1000 Innovation Drive			151.3 m	PZ3B	
Somme Ave- DND Water Tower	31 Somme Avenue	3400 m^3	1900 m^3	153.2 m	PZ3A	James St. Booster Station

8.3.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for water towers in Kingston East. The CFB water tower, although not a Utilities Kingston responsibility, is planned to be decommissioned which will affect the operation of the east system.

8.4 CANA WATER TREATMENT PLANT

The Cana WTP, located on lot 40, Concession 4, supplies water to the Cana Subdivision, situated west of Highway 15, east of the Kingston Mills Locks, north of the Kingston Mills Road. The Cana WTP has a peak capacity of 6.5 MLD. The raw surface water comes from a 18.6 m deep drilled groundwater well. The plant uses primary chlorination to achieve its treatment requirements.

8.4.1 UNIT PROCESS DESCRIPTION

The Cana WTP consists of:

- One 150 mm diameter x 18.6 m deep drilled groundwater well, equipped with a submersible pump with a capacity of 75 lpm
- Two cartridge filter housings, each containing a 5 micron filter
- One treated waste reservoir with a storage capacity of 45,000 L, equipment with two submersible pumps, each rated at 92.1 lpm

8.4.2 TREATED WATER CRITERIA

The Cana WTP must produce water that complies with the requirements of Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards. Compliance with O.Reg. 169/03 is achieved by implementing the sampling requirements contained in Ontario Regulation 170/03 – Drinking Water Systems.

8.4.3 HISTORICAL FLOWS AND PERFORMANCE

The Cana WTP operates under Permit to Take Water. Total water flows (raw and treated) were taken from the 2014 Cana Summary Report and are summarized in Table 8-6. Table 8-7 summarizes the plant notifications regarding coliform and pressure.

Table 8-6 Cana Water Treatment Plant Summary Flows

2014 CANA WTP SUMMARY	AVERAGE DAY	YEARLY TOTAL
Raw Water Flows	29.17 m^3	10,654.33 m^3
Treated Water Flows	26.74 m^3	9,765.00 m^3

Table 8-7 Cana Water Treatment Plant Notification Summary

YEAR	2012	2013	2014
Total Coliform (cts/100 mL)	1	1	
Pressure			1

8.4.1 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for the Cana Water Treatment Plant.

9 GROWTH SCENARIO

Below is an outline of the available background studies related to growth and development for the City of Kingston. The information contained in these reports will form the basis for the assumptions related to growth and development used in the Water and Wastewater Master Plan.

9.1 CITY OF KINGSTON AND KINGSTON CMA POPULATION, HOUSING AND EMPLOYMENT PROJECTIONS

In 2013 Meridian Planning and The Center for Spatial Economics completed a report detailing the population, housing and employment projections for the Kingston Census Metropolitan Area (CMA). The report analysed previous growth trends to complete the projections which extended from 2011 to 2041. Three scenarios were evaluated; High Case, Base Case and Low Case. Each scenario used varying assumptions based on economic and environmental factors to estimate the respective impact to the Metropolitan Area. Results included projections for population, housing and employment trends. Population demographics (age, sex), employment statistics (employment status, employment industry, type of

employment) and migration (births, deaths, and in-migration) were identified for each analysis year and scenario.

This report will serve as the basis for the residential growth and development assumptions used in the Water and Wastewater Master Plan, it will also be used to reconcile the data obtained from other background reports as it is the most recent and comprehensive. For example the information regarding institutional, industrial and commercial development obtained from the other background reports should generally correlate to the increased employment identified in the CMA Report.

9.2 EMPLOYMENT LAND STRATEGY REVIEW

An employment land strategy review was completed by Watson & Associates Economists Ltd. in association with Dillon Consulting Ltd. in 2015. The purpose of the report was to develop a long term vision and plan for industrial growth within the City of Kingston. The authors reviewed regional and local economic trends within the last decade to identify the employment and industrial land needs. Twelve industrial/business park areas were identified and characterized for their development potential and future occupancies. The conclusion of the review was that the City of Kingston has adequate land zoned for General Industrial but requires an increase Business Park Industrial zoning.

This report will serve as the basis the for industrial growth and development assumptions for the Water and Wastewater Masterplan.

9.3 COMMERCIAL INVENTORY AND MARKET ANANLYSIS

UrbanMetrics Inc. completed a Commercial Inventory and Market Analysis (2008) to review the supply and need for additional commercial land in the City of Kingston. The analysis reviewed the existing commercial occupancy, vacancy, development applications and anticipated development proposals. The review identified warrant for additional commercial land over the analysis period (2011, 2016, 2021 and 2026).

This report will serve as the basis for the commercial growth and development assumptions for the Water and Wastewater Master Plan.

9.4 REPORT TO COUNCIL ON URBAN GROWTH BOUNDARY UPDATE

In April 2014 Municipal Staff presented a report to council detailing the review and assessment of the current urban boundary. The assessment reviewed background studies, current development rates and the Provincial Policy Statement. It was concluded that there is currently an adequate supply of development opportunities within the urban boundary. Staff recommended that the urban boundary remain unchanged in order to promote infill and intensification within the existing boundary. The City and Utilities Kingston are currently working together to ensure that sufficient water and sewer capacity is in place to support this growth. It was noted that the City should approach the property owners of significant parcels of land within the boundary to begin secondary planning studies. This will ensure that the planning process is complete before the development is required.

9.5 REGIONAL COMMERICAL STUDY UPDATE

The Regional Commercial Study Update was completed by Sorensen Gravely Lowes and UrbanMeterics Inc. in 2005. The study did not complete new analysis; recommendations and conclusions relied on the findings of a 1999 Commercial Systems Study with considerations for new commercial developments. The finds in this study are superseded by the more the recently completed Commercial Market Inventory Analysis (UrbanMeterics Inc., 2008).

10 MODELLING

10.1 MODEL SUMMARY

The water model is an all-pipe representation of the City's distribution system and was originally developed using InfoWater software. WSP received Utilities Kingston's version of the model which was previously developed for the *Master Plan for Water Supply for the City of Kingston Urban Area and the Class Environmental Assessment* as completed by Simcoe Engineering Group Ltd. in 2007.

The model represents the water system which divides the City of Kingston into three main distribution areas (Kingston West, Kingston Central, & Kingston East) via two Water Treatment Plants (WTP) and various booster stations, reservoirs and water towers. The west distribution system area, which generally includes the portion of the City serviced west of Little Cataraqui Creek, is serviced by Point Pleasant WTP. The central and east distribution system areas, which generally include the area east of little Cataraqui Creek, are both serviced by the King St. WTP.

To represent the City's water distribution system the model uses a combination of pipe elements, nodes (junctions, valves), storage nodes (reservoirs, tanks) and pump links (booster stations, pumps) and water zones. The following is an approximate summary of unique InfoWater model elements:

- 12,243 Pipes
- 11,112 Junctions
- 4 Reservoirs
- 36 Pump Links
- 7 Valves

10.2 SUPPORTING MODELING DATA

10.2.1 WATER CONSUMPTION DATA

Water consumption data was provided by Utilities Kingston for all billed water distribution areas in Kingston. This data includes Kingston West, Central and East service area data for both 2013 & 2014. The water consumption information from water meters is used as the main source for demand loading for the all-pipes model and is also used for the development of diurnal patterns and model calibration.

10.2.2 HYDRANT TEST AND WATER LEAKAGE DATA

In addition to water consumption data, hydrant test data and leakage data was also provided via reports and GIS databases. The GIS data included the location of water breaks and address information to link them to reports suitable for identifying their approximate geocoded location. The hydrant report information was linked with Hydrant IDs. Both sets of data spanned numerous

10.2.3 AS-BUILTS, PUMP DETAIL, GIS AND SCADA INFORMATION

For the purposes of updating and validating the existing infrastructure to be represented in the model the combination of available as-builts, pump details, GIS and SCADA information is used. As described in previous sections this information was also provided for various Booster Stations, Reservoirs and Water

Towers. Information from Utilities Kingston Annual Report were also received to supplement to SCADA information.

10.2.4 WATER ZONES AND WATER SYSTEM SCHEMATIC

Water zones originally developed during the last water master plan were provided in GIS format. A Water System Schematic was also included in the provided annual reports for the system and are used to supplement the all-pipe model information.

10.3 MODEL ADDITIONS

As summarized in Table 10-1, Utilities Kingston has provided a list of imminent infrastructure additions/upgrades and model considerations for review. WSP reviewed these with Utilities Kingston and summarized the model development alternatives for consideration in accordance with feedback received.

Table 10-1 Alternatives / Inclusions and Infrastructure Additions

MODEL ALTERNATIVES / INCLUSIONS	
Calibration to 2013/2014 flow and pressure data	
2013/2014 diurnal patterns developed from flow data	
2013/2014 adjusted water consumption loading	
Maximum day flow, average day flow and fire flow alternatives for calibrated conditions	
INFRASTRUCTURE ADDITIONS / UPGRADES	
General	Model element additions identified in RFP and from 2015 GIS Data Update (including watermain and community additions)
Linear Works	Watermain on Gatwick Avenue from Kendal to Creekford (300 mm)
	Watermain from Centennial Drive to Resource Road (400 mm)
	Watermain on Cataraqui Woods Drive from Centennial Drive to Sydenham Road (400 mm)
	Watermain on Agusta Drive from Atkinson Street to Cataraqui Woods Drive (400 mm)
	Watermain on John Counter Boulevard from Indian Road to Princess Street (400 mm)
	Taylor Kidd Watermain Twinning from Bayridge Road to Blackburn Mews
	Front Road Watermain Interconnection (2019)
Facilities	Point Pleasant WTP Upgrades (2016)