UTILITIES KINGSTON

CITY OF KINGSTON WASTEWATER MASTER PLAN

BASELINE REVIEW REPORT - WASTEWATER

JANUARY 30, 2017

WSP

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BASELINE REVIEW REPORT - WASTEWATER

Utilities Kingston

Final Report

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

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January 30, 2017

Mr. Mike Fischer
Utilities Kingston
1211 John Counter Blvd
Kingston, ON, K7L 4X7

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

Dear Mr. Fischer,

We are pleased to provide our Wastewater 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 Water 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 and wastewater infrastructure for the core urban areas and surrounding communities in the City for the next 20 years, per the City's Official Plan.

It 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 wastewater infrastructure and establishes the baseline, or starting point, in the assessment of the wastewater 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.

2 REGULATORY REQUIREMENTS

2.1 THE PLANNING ACT (1990)

The Planning Act 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 (e.g. Greenbelt Plan and Growth Plan for the Greater Golden Horseshoe, 2006).

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:
  1. Municipal sewage services and municipal water services
  2. 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:
  1. Can be sustained by the water resources upon which such services rely
  2. Is feasible, financially viable and complies with all regulatory requirements and

3. 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:
  1. Municipal servicing
  2. Private communal servicing
  3. Individual on-site servicing
  4. 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 ten 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, 1990, was passed for the purposes of conservation, protection and management of Ontario's waters by determining requirements for water works, including wells, and sewage works in relation to planning, design, siting, public notification and consultation, establishment, insurance, facilities, staffing, operation, maintenance, monitoring and record-keeping. The Act is a general water management statute which applies to both groundwater and surface water. This Act specifies the requirements that the community must satisfy in order for the provincial government to grant approval for establishing, altering, extending, or replacing water and wastewater system components.

2.7 SAFE DRINKING WATER ACT (2002)

The Safe Drinking Water Act, 2002, is in place to provide protection for human health and prevent drinking water health hazards. This is intended through the control and regulation of drinking water systems and drinking water testing. Regulations made under the Act, such as Regulation 268/03 – Ontario Drinking Water Quality Standards, stipulate detailed requirements regarding drinking water systems, testing services, drinking water quality standards, certification of drinking water system operators and drinking water quality analysts and compliance and enforcement. This Act specifies the quality of the drinking water that any community is responsible for producing and delivering as well as how the area's drinking water treatment systems must be operated and managed.

2.8 SAFEGUARDING AND SUSTAINING ONTARIO'S WATER ACT (2007)

The Province passed the Safeguarding and Sustaining Ontario's Water Act to enable implementation of the Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement and other amendments to the Permit to Take Water program.

The principles of the Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement, signed in 2005, include the Premiers of Ontario and Quebec and the Governors of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin. This agreement recognizes the following:

- The water of the Basin are a shared public treasure and the parties to the Agreement have a shared duty to protect, conserve and manage the waters;
- Conserving and restoring the waters and water dependent natural resources of the Basin will improve them; and,
- Continued sustainable, accessible and adequate water supplies for the people and economy of the Basin are important.

2.9 CLEAN WATER ACT (2006)

Ontario's developed Clean Water Act, to protect drinking water through a "source to tap" policy. This policy is expected to provide necessary protection of the drinking water resources through a multi barrier approach which includes protection of the source water prior to its intake into the drinking water system via a surface water intake or groundwater wells. The Clean Water Act received Royal Assent on July 3, 2007.

Implementation of the objectives of the Clean Water Act will be a large undertaking conducted on a watershed scale. The three main phases will involve: Assessment, Planning, and Management. Assessment will involve assessing the current conditions of sources of drinking water and threats to their condition. Planning is needed to ensure appropriate land use decisions so existing and future activities do not threaten drinking water sources. Once these measures have been implemented, Management will be needed to minimize and prevent threats to drinking water sources.

2.10 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

2.11 WASTEWATER SYSTEMS EFFLUENT REGULATIONS (2012)

On June 29 2012, amendments to the Fisheries Act received Royal Assent. The changes focus on protecting the productivity of recreational, commercial and Aboriginal fisheries. Of particular importance to this Master Plan is the Wastewater System Effluent Regulations, 2012, which is one of the regulations created under the Fisheries Act.

The Wastewater System Effluent Regulations are applicable to wastewater systems that collect, or are designed to collect, an average volume of 100 m^3/d or more of influent. The Regulations require wastewater treatment plant (WWTP) effluents to meet average concentration limits of 25 mg/L for $CBOD_5$ and TSS and 0.02 mg/L for total residual chlorine (TRC), and a maximum concentration limit of 1.25 mg/L for un-ionized ammonia (expressed as nitrogen) at 15°C +/- 1°C. The effluent must also not be acutely lethal (based on the rrainbow trout acute lethality test). The Regulations also specify effluent sampling frequencies, recordkeeping and reporting requirements.

The requirements set in the Regulations are to be enforced in a phased fashion. The Regulations require the measurement of wastewater volume treated and the monitoring of deleterious substances in the effluent ($CBOD_5$, TSS, TRC, and un-ionized ammonia) starting January 2013. Acute lethality monitoring begins January 1, 2015 for systems treating over 2,500 m^3/d. An Identification Report needs to be submitted by May 15, 2013. An Annual Monitoring Report has to be submitted annually or quarterly depending on the size of treatment facility. Quarterly reporting is required starting May 15, 2013 for continuous plants with capacity greater than or equal to 2,500 m^3/d and then within 45 days of the end of each quarter. Annual reporting is required starting February 14, 2014 and then 45 days after the end of each calendar year for intermittent systems and for continuous systems with capacities less than 2,500 m^3/d. A Combined Sewer Overflow Report has to be submitted for systems with at least one CSO point by February 15 of every year starting February 15, 2014.

Transitional authorization may be obtained if a facility does not meet the effluent limits established by the Regulation. Particularly, a transitional authorization to discharge un-ionized ammonia may be obtained if un-ionized ammonia 100 m from discharge point is less than or equal to 0.016 mg/L N and it is found that acute toxicity is caused by ammonia (i.e. the effluent fails the acute toxicity test and the effluent un-ionized ammonia concentration is over 1.25 mg/L N). The initial application for transitional authorization is required within 30 days of the acute toxicity result.

The various wastewater systems in the CGS will need to be reviewed to determine whether they can meet the effluent treatment requirements set by the Regulations.

2.12 MOE GUIDELINES B-1 AND B-2

Under Guideline B-1, the MOE establishes specific receiving water quality objectives (that is, Provincial Water Quality Objectives, or PWQO) for many pollutants, and the requirements intended to ensure that the objectives are maintained or achieved. These objectives are used as the basis for establishing specific effluent requirements (design objectives and non-compliance criteria) for sewage works proposed for approval under Section 53 of the Ontario Water Resources Act (OWRA). Guideline B1 also identifies Surface Water Quality Management “Policy 2”, which is a policy stating that no further water quality degradation shall be allowed in areas with water quality not meeting the PWQOs.

Guideline B-2 elaborates on the Ministry’s practices concerning deviations from Policy 2. Deviation from “Policy 2” refers to instances where in areas with water quality not meeting PWQOs, it is not possible to prevent further degradation of existing water quality. The Guideline identifies the situations in which a request for a deviation may be considered and the procedures to be followed in order to obtain a deviation.

Both Ravensview and Cataraqui Bay WWTPs discharge to Lake Ontario which is a Policy 1 receiver. The existing Cana WWTP receiving stream is within the wellhead protection zone of the Cana Water Treatment Plant’s well. The Cana WWTP Environmental Study Report recommends a new outfall to Colonel By Lake which has been characterized as a Policy 1 receiver with respect to BOD5, Dissolved Oxygen, pH, Un-ionized Ammonia, and Chlorine, and a Policy 2 receiver with respect to Total Phosphorous.

2.13 MOE GUIDELINES 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.

2.14 MOE GUIDELINES F-5

The Ontario Ministry of the Environment (MOE) requires that municipal and private sewage treatment works, outfall structures and emergency overflow facilities be located designed, constructed and operated so as to minimize pollution of receiving waters and interference with water uses.

The primary purpose of Guideline F-5 is to describe the levels of treatment required for municipal and private sewage treatment works discharging to surface waters. This Guideline is supported by Guideline B-1, which is described in Section 2.12, as well as:

- Procedure F-5-1: Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters
- Procedure F-5-2: Relaxation of Normal Level of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters
- Procedure F-5-3: Derivation of Sewage Treatment Works Effluent Requirements for the Incorporation of Effluent Requirements into Certificates of Approval for New or Expanded Sewage Treatment Works
- Procedure F-5-4: Effluent Disinfection Requirements for Sewage Works Discharging to Surface Waters
- Procedure F-5-5: Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems

Guideline F-5 states that the level of treatment for new or expanded sewage treatment works must be in accordance with Procedures F-5-1 and F-5-2. Effluent requirements, including both waste loadings and concentrations, must be derived in accordance with Procedure F-5-3 or those established in the Wastewater System Effluent Regulations (See Section 2.11), whichever are stricter.

Requirements for the mitigation of Combined Sewer Overflows (CSOs) are dictated by Procedure F-5-5. Pollution Prevention and Control Plans (PPCPs) are required to address CSO issues. The PPCPs will ultimately provide the City, Ministry of the Environment, and the community with a long term plan for managing combined sewer overflows and bypasses in the City of Kingston.

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.
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 WASTEWATER SYSTEMS OVERVIEW

4.1 COLLECTION SYSTEM

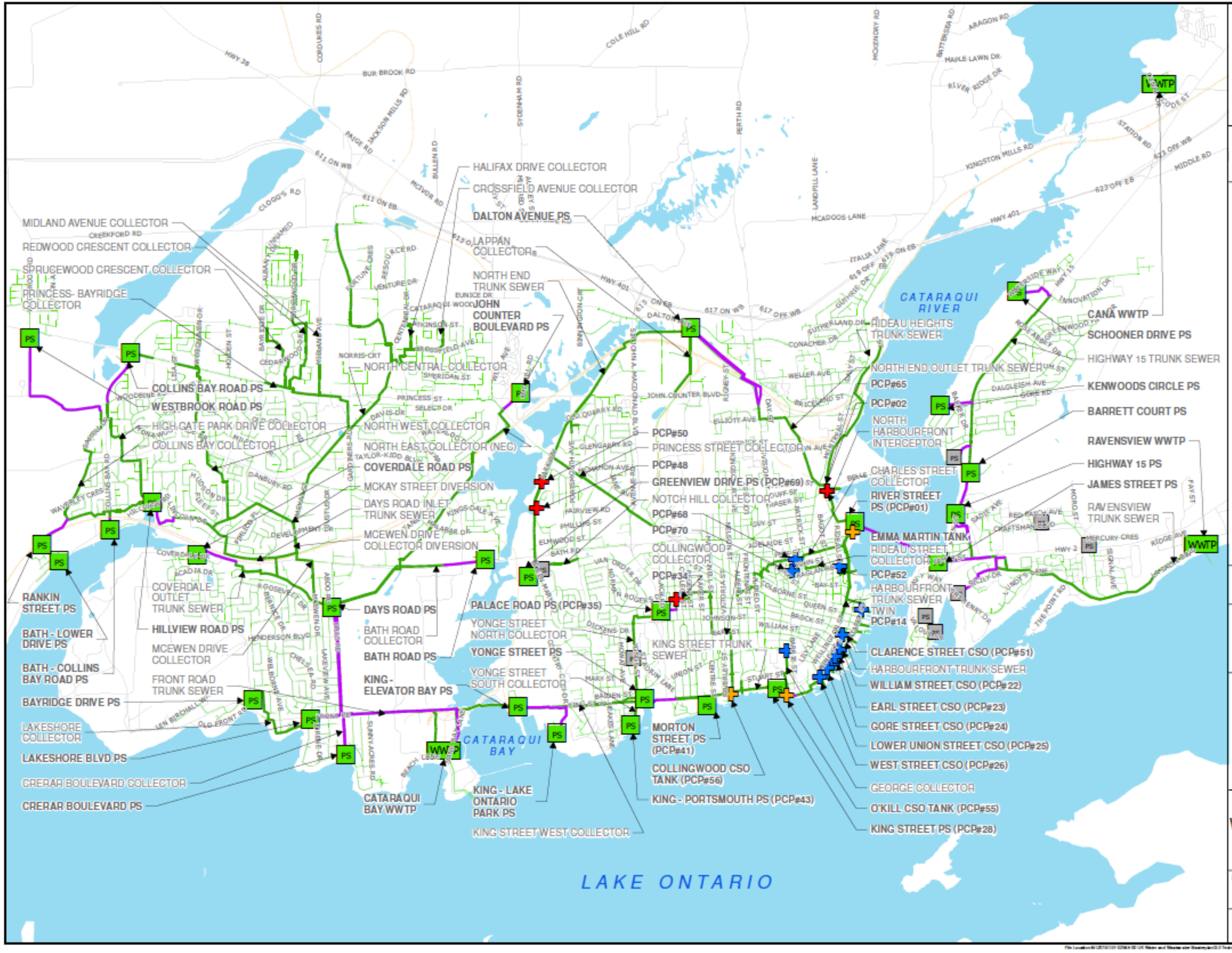
The City of Kingston wastewater collection system comprises an area of approximately 8258 ha. It is generally bordered by Westbrook Road to the west, Macdonald-Cartier Freeway to the north, Ravensview WWTP access road to the east and Lake Ontario to the south. It is split between three regions:

1. Kingston West (3953 ha, 44,400 POP)
2. Kingston Central (2919 ha, 54,600 POP)
3. Kingston East (1386 ha, 10,200 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. The collection system consists of separated, potentially partially separated and combined sewers.

Combined sewers are those that collect and convey both sanitary and stormwater runoff. They are predominantly located in the older areas of the City, installed before wastewater treatment was widely used by municipalities. Partially separated sewers are sanitary sewers that additionally collect and convey stormwater from roof leaders, downspouts, subdrains and building sump pumps. The City does not permit stormwater connection to the sanitary system, however there are many areas of the City where this occurs. Accurate and complete records of these areas are not available. Separated sanitary sewers convey only sanitary wastewater, however are still subject to infiltration and inflow (I&I). All new development is serviced with separate sanitary and storm sewers.

Wastewater flow is collected from Kingston West and conveyed via gravity and pump stations to Cataraqui Bay WWTP. Wastewater and combined sewer flow is collected from Kingston Central and East and conveyed via gravity and pump stations to Ravensview WWTP. Additionally the Cana WWTP located north of the 401 services the Cana subdivision. Figure 4-1 is a map of the 2015 City of Kingston wastewater collection system.



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Legend

- WWTP — WASTEWATER TREATMENT PLANT
- PS — SANITARY PUMPING STATION
- PS — SANITARY PUMPING STATION (NOT MODELLED)
- COMBINED SEWER OVERFLOW (CSO)
- TANK OVERFLOW (TO)
- SANITARY SEWER OVERFLOW (SSO)
- FORCEMAIN
- EXISTING SANITARY SEWER
- MODEL CONDUIT
- 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:
0 300 600 1,200 Meters
1:47,500

Project:
Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title:
WASTEWATER COLLECTION SYSTEM OVERVIEW MAP

Project No.:	Date:		
151-02944-00	DECEMBER 2016		
Drawn By:	Checked By:	Code:	Figure No.:
CM	MF	BR	4-1

4.2 LINEAR INFRASTRUCTURE

The Kingston wastewater collection system is made up of over 490 km of watermain ranging in diameter from 25 mm to 1200 mm. The various sewer materials present in the system include asbestos cement (AC), cast iron (CI), Clay, concrete (CON), high density polyethylene (HDPE), cured in place pipe (CIPP), polyvinyl chloride (PVC) and stone. The material of a large portion of the pipes is unspecified due to an incomplete asset inventory for material. The age of the pipe in the system vary from 115 years old (installed in 1900) to those installed this year (2015). Due to incomplete as-built information for several pipes, the construction year category "unspecified" is included in the age distribution for pipes. Additionally, the category "1900" was assigned to pipes that were old but had no specific construction date. The following charts illustrate the above. For further details on the existing collection system refer to Sections 6, 7, and 8.

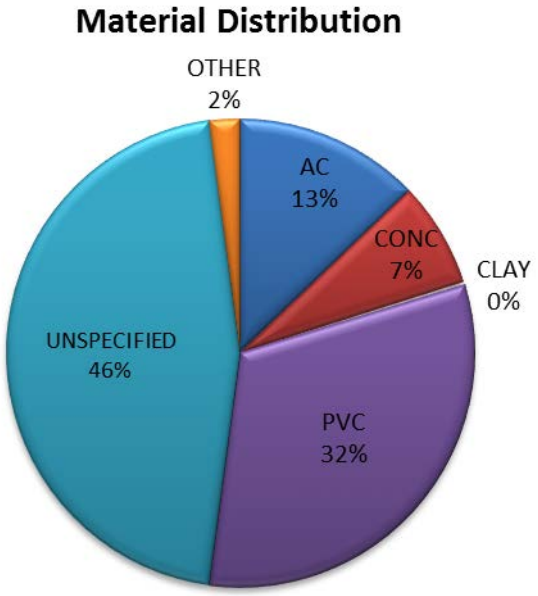


Figure 4-2 Material of Kingston Wastewater Collection Piping

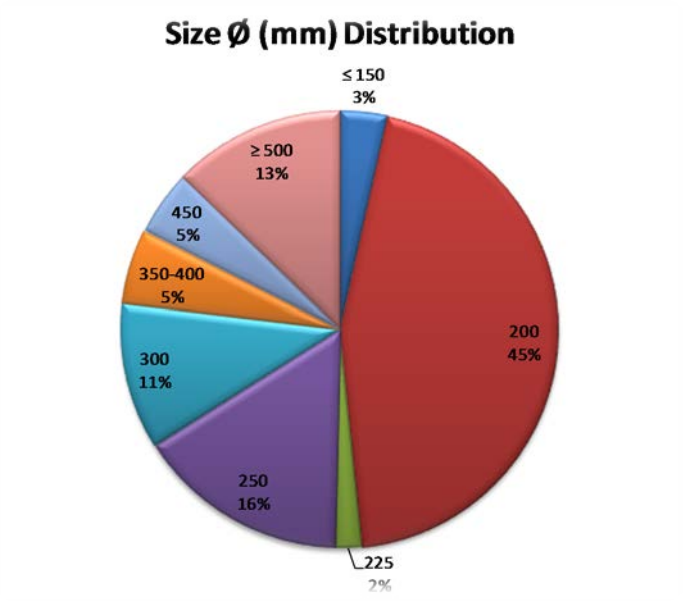


Figure 4-3 Kingston Wastewater Sewer Size

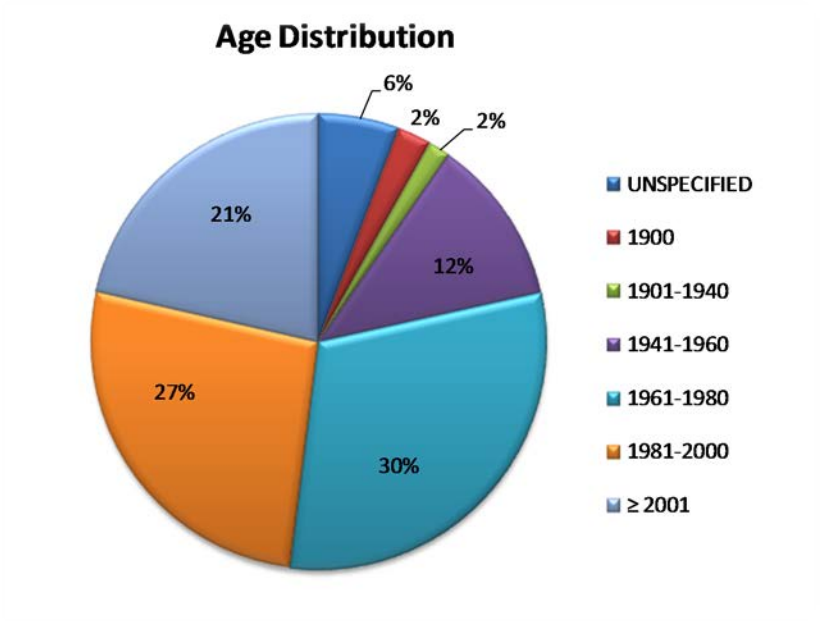


Figure 4-4 Kingston Wastewater Sewer Installation Date

4.3 PUMP STATIONS

The City of Kingston has many challenging topographical and geotechnical conditions, which make conveying the City's sewage solely by gravity unfeasible at many locations. As a result, pump stations were constructed to overcome these challenges and avoid deep sewers built in rock. There are 30 sewage pump stations in the City of Kingston that are owned and operated by Utilities Kingston (UK), 16 of which include overflow infrastructure. Table 4-1 in Section 4.4 includes pump station bypass information. There are

additional private pump stations in the City that also contribute to the UK collection system; however these will not be analyzed in detail as part of this master plan. Figure 4-5 and Figure 4-6 provide flow diagrams of the pump station network in Kingston West and Central/East respectively. For a detailed description of the pump stations in Kingston West, Central and East refer to Sections 6.2, 7.2, and 8.2 respectively.

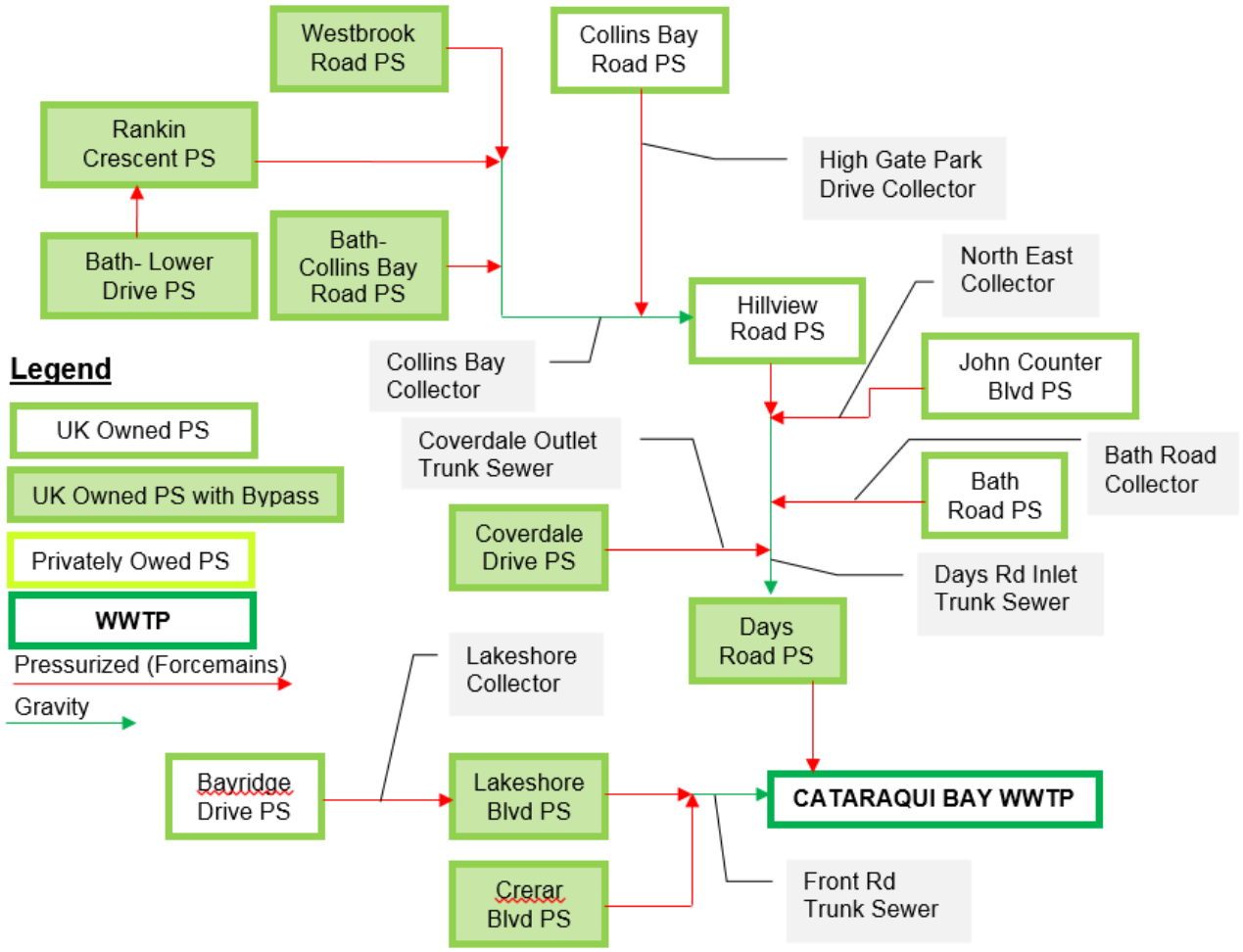


Figure 4-5 UK Kingston West Pump Stations

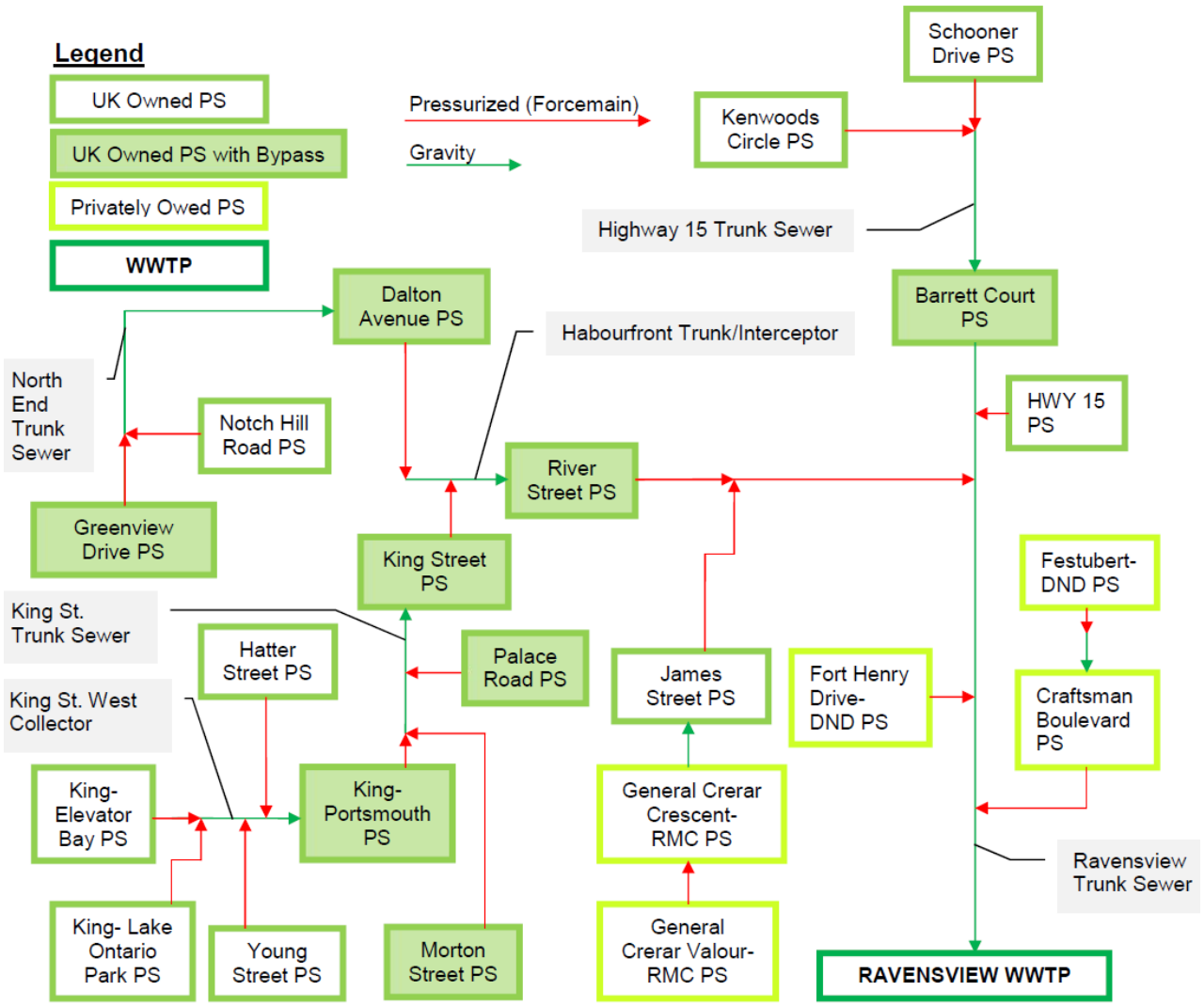


Figure 4-6 UK Kingston Central/East Pump Stations

4.4 COMBINED SEWER OVERFLOW AND BYPASS CHAMBERS

There are currently 36 active overflows in the City of Kingston that range from manholes with weirs to elaborate multi-chamber tanks. The purpose of these overflows is to divert flow from combination sewers to sanitary sewers (under regular conditions) and to storm outlets under high flows. The infrastructure includes 13 combined sewer overflows (CSO), five sanitary sewer overflows (SSO), 16 pumping station overflows and two tank overflows (TO). Table 4-1 below summarizes the overflow infrastructure, status, locations, type of overflow and associated monitor. For a detailed description of the CSO's for Kingston Central refer to Section 7.5.

Table 4-1 Combined Sewer Overflow Summary

PCP #	STATUS	REASON IF STATUS = INACTIVE	MANHOLE NUMBER	TYPE	LOCATION	MONITOR
PCP# 01	Active	-	7114-003	PSO	River Street Pump Station	Kingston03
PCP# 02	Active	-	9227E-030	SSO	Belle Park Chamber, Trunks	Kingston20, Kingston02
PCP# 05	Active	-	NEPS	PSO	North End Pumping Station	SCADA
PCP# 08	Inactive	Temporary Plug	0812-010	CSO	Princess St E of Frontenac	Kingston24
PCP# 09	Inactive	Temporary Plug	5211-010	CSO	Frontenac St S of Princess	Kingston33
PCP# 10	Inactive	Permanent Plug	7106-020	CSO/Storm	North and Wellington Extension	Kingston29
PCP# 14	Active	-	7050-121	CSO	Ontario and Barrack	SCADA
PCP# 15	Active	-	7051-020	CSO	Queen and Ontario	Kingston01
PCP# 21	Inactive	Permanent Plug	6650-011	CSO/Storm	Johnson and Ontario	
PCP# 22	Active	-	6551-010	CSO	William St Vortex	Kingston21
PCP# 23	Active	-	6451-020	CSO	Earl d/s of vortex	Kingston08
PCP# 24	Active	-	6351-010	CSO	Gore St vortex	Kingston35
PCP# 25	Active	-	6251-010	CSO	Lower Union d/s of vortex	Kingston28
PCP# 26	Active	-	6001-010	CSO	West and Ontario	Kingston10
PCP# 28	Active	-	0034-210	PSO	King St (O'Kill) pump station	SCADA
PCP# 29	Redirected	Redirected to Tank	5050-010	CSO Captured	George and O'Kill	

PCP #	STATUS	REASON IF STATUS = INACTIVE	MANHOLE NUMBER	TYPE	LOCATION	MONITOR
PCP# 30	Redirected	Redirected to Tank	5002-110	CSO Captured	George N of O'Kill	
PCP# 31	Active	-	5302-020	SSO	Albert N of King	Kingston11
PCP# 32	Redirected	Redirected to Tank	0037-010	CSO Captured	Collingwood at King	
PCP# 34	Active	-	4356-011	SSO	Helen and Mack	Kingston30
PCP# 35	Active	-	PRPS	PSO	Palace Road pump station	SCADA
PCP# 36	Redirected	Redirected to Tank	0038-010	CSO Captured	King E of Beverly	
PCP# 37	Redirected	Redirected to Tank	9502-020	CSO Captured	Beverly N of King	
PCP# 41	Active	-	MSPS	PSO	Morton Street pump station	SCADA
PCP# 43	Active	-	KPPS	PSO	King-Portsmouth pump Station	SCADA
PCP# 48	Active	-	2284E-130	SSO	NETS at Sherwood	Kingston04
PCP# 50	Active	-	2284-080	SSO	NETS at Parkway S	
PCP# 51	Active	-	6752-010	CSO	d/s of Clarence St in-line CSO	Kingston27
PCP# 52	Active	-	7455-020	CSO	Raglan and Rideau	Kingston07
PCP# 53	Active	-	9802-020	CSO	Division and Union	Kingston38
PCP# 55	Active	-	0033-002	TO	O'Kill CSO Tank	SCADA
PCP# 56	Active	-	x	TO	Collingwood CSO Tank	SCADA
PCP# 57	Active	-	31021-010	PSO	Crerar Pump Station	SCADA

PCP #	STATUS	REASON IF STATUS = INACTIVE	MANHOLE NUMBER	TYPE	LOCATION	MONITOR
PCP# 58	Active	-	0070-006	PSO	Front Road Pump Station (Lakeshore)	SCADA
PCP# 59	Active	-	31501-004	PSO	Coverdale Pump Station	SCADA
PCP# 61	Active	-	0777-004	PSO	Bath and Collins Bay	
PCP# 62	Active	-	34216-002	PSO	Rankin Pump Station	
PCP# 63	Active	-	0779-010	PSO	Bath Rd West Pump Station	
PCP# 64	Redirected	Redirected to Tank	0038-030	CSO Captured	King at Beverly	
PCP# 65	Active	-	9227E-046	CSO	Belle Park Local SA1200	Kingston20
PCP# 66	Redirected	Redirected to Tank	0039-020	CSO Captured	King at Edgehill ROW	
PCP# 67	Inactive	Temporary Plug	5115-020	CSO	Chatham at Elm St	Kingston34
PCP# 68	Active	-	7759-020	CSO	Quebec at Barrie St	Kingston32
PCP# 69	Active	-	GDPS	PSO	Greenview Drive Pump Station	SCADA
PCP# 70	Active	-	7608-010	CSO	Carlisle & Chest Nut	Kingston37
PCP# 71	Inactive	Temporary Plug	9413-010	CSO	Alfred St, north of Princess	Kingston36
PCP# 72	Inactive	Temporary Plug	5304-010	SSO	Albert St at Queen's Cres	
PCP# 73	Active	-	DRPS	PSO	Days Road Pump Station	SCADA
PCP# 74	Active	-	BCPS	PSO	Barrett Court Pump Station	Kingston17

PCP #	STATUS	REASON IF STATUS = INACTIVE	MANHOLE NUMBER	TYPE	LOCATION	MONITOR
PCP# 75	Active	-	9853-020	PSO	Westbrook Pump Station	

4.5 WASTEWATER TREATMENT PLANTS

The City's Sewage Treatment Facilities include three wastewater treatment plants. Wastewater and combined sewer flow is collected from Kingston West and conveyed via gravity and pump stations to Cataraqui Bay WWTP. Wastewater and combined sewer flow is collected from Kingston Central and East and conveyed via gravity and pump stations to Ravensview WWTP. Additionally the Cana WWTP located north of the 401 services the Cana subdivision. Figure 4-1 is a map of the 2015 City of Kingston wastewater collection system and demonstrates the location and collection zone for each WWTP.

For a detailed description of each WWTP for Kingston West, Central and East refer to Sections 6.4, 8.4, and 8.5 respectively.

4.6 FACILITY INFORMATION SUMMARY

As indicated above, there are currently 42 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 4-2 Existing Facility Data

FACILITY	LOCATION	C OF A (ECA)	AS - BUILTS	SCADA SCREEN	SCADA FLOW DATA	PUMP(S) DETAILS
Barret Ct. PS	723 Barret Ct.	N/A	YES	YES	2013 & 2014	Yes
Bath Rd. PS	1298 Bath Rd	3344 – 7BR43, 2387-789JTA	YES	YES	2013 & 2014	Yes
Bath - Collins Bay Rd. PS	4054 Bath Rd.	N/A	NO	NO	No Data	Yes
Bath - Lower Dr. PS	4146 Lower Drive	N/A	YES	YES	2013 & 2014	Yes
Bayridge Dr. PS	200 Bayridge Dr.	N/A	NO	NO	No Data	Yes
Collins Bay Rd. PS	1205 Collins Bay Rd.	N/A	YES	NO	No Data	Yes
Coverdale Rd. PS	1066 Coverdale Rd.	30498-91-006	YES	YES	2013 & 2014	Yes

FACILITY	LOCATION	C OF A (ECA)	AS - BUILTS	SCADA SCREEN	SCADA FLOW DATA	PUMP(S) DETAILS
Crerar Blvd. PS	46 Crerar Blvd.	6824-7BSQAV	YES	YES	2013 & 2014	Yes
Dalton Ave. PS	266 Dalton Av	N/A	YES	YES	2013 & 2014	Yes
Days Rd. PS	419 Days Rd.	3-0156-87-007	YES	YES	2013 & 2014	Yes
Greenview Dr. PS	38 Greenview Dr.	N/A	YES	YES	2013 & 2014	Yes
Hatter St. PS	91 Hatter St.	N/A	YES	YES	2013 & 2014	Yes
Hillview Rd. PS	740 Hillview Rd.	N/A	YES	YES	2013 & 2014	Yes
Highway 15 PS	Highway 15	N/A	YES	YES	2013 & 2014	Yes
James St. PS	213 James St.	N/A	YES	YES	2013 & 2014	Yes
John Counter Blvd. PS	1871 John Counter Blvd.	1110-8FMHYB	YES	YES	2013 & 2014	Yes
Kenwoods Circle PS	84 Kenwoods Circle	N/A	YES	NO	No Data	Yes
King St. PS	62 King St. West	N/A	YES	YES	2013 & 2014	Yes
King – Elevator Bay PS	1100 Elevator Bay	N/A	NO	YES	2013 & 2014	Yes
King – Lake Ontario Park PS	920 Lake Ontario Park	N/A	NO	NO	2013 & 2014	Yes
King – Portsmouth PS	621 King St. West	N/A	YES	YES	2013 & 2014	Yes

FACILITY	LOCATION	C OF A (ECA)	AS - BUILTS	SCADA SCREEN	SCADA FLOW DATA	PUMP(S) DETAILS
Lakeshore Blvd. PS	187 Lakeshore Blvd	N/A	YES	YES	2013 & 2014	Yes
Morton St. PS	1 Morton St.	7501-659PLJ	YES	YES	2013 & 2014	Yes
Notch Hill Rd. PS	60 Notch Hill Rd.	N/A	NO	NO	2013 & 2014	Yes
Palace Rd. PS	270 Palace Rd.	3798-699KEZ	YES	YES	2013 & 2014	Yes
Rankin St. PS	602 Rankin St.	3-1916-90-913	Yes	NO	No Data	Yes
River St. PS	12 River St.	1388-5S6LAN, 2885-67MMWR, 2372-6MWSYZ, 0270-6QBMJ8, 7645-8UDP2S	YES	YES	2013 & 2014 Flow Data & 2014 Annual Report	Yes
Schooner Dr. PS	22 Schooner Dr.	N/A	NO	NO	No Data	Yes
Westbrook Rd. PS	11434 Westbrook Rd.	3-0420-93-006	NO	NO	No Data	Yes
Yonge St. PS	20 Yonge St.	N/A	YES	NO	No Data	N/A
Clarence St. CSO	0 Clarence St.	N/A	YES	NO	No Data	N/A
Collingwood CSO	270 King St.	2414-63TQET	YES	YES	2013 & 2014 Flow Data & 2014 Annual Report	Yes
Earl St. CSO	0 Earl St.	N/A	YES	NO	No Data	N/A
Emma Martin CSO	7 Orchard St.	1172-64EMDR	YES	YES	2013 & 2014 Flow Data & 2014 Annual Report	Yes

FACILITY	LOCATION	C OF A (ECA)	AS - BUILTS	SCADA SCREEN	SCADA FLOW DATA	PUMP(S) DETAILS
Gore St. CSO	0 Gore St.	N/A	YES	NO	No Data	N/A
Lower Union St. CSO	0 Lower Union St.	N/A	YES	NO	No Data	N/A
O`Kill St. CSO	62 King St. West	3-0076-96-006, 0210-8RFRCQ,	YES	YES	2013 & 2014	N/A
West St. CSO	0 West St.	N/A	YES	YES	2013 & 2014	N/A
William St. CSO	0 William St.	N/A	YES	NO	No Data	N/A
Cana WWTP	1756 Cana Blvd.	0-0288-070-731116	YES	NO	No Data	N/A
Cataraqui Bay WWTP	409 Front Rd.	4341-7H4R6Y, 2114-87TJY8	YES	YES	2013 & 2014 Flow Data & Annual Report	N/A
Ravensview WWTP	947 Highway 2	5604-63QLWB, 3-1531-92-936, 3861-68CK9P, 4097-6QDMTW	NO	YES	2013 & 2014 Flow Data & Annual Report	N/A

5 SUMMARY OF EXISTING REPORTS

5.1 SEWAGE INFRASTRUCTURE MASTER PLAN FOR THE CITY OF KINGSTON URBAN AREA (CH2MHILL, 2010)

A Sewage Infrastructure Master Plan was completed for the City of Kingston by CH2M Hill in 2010. The following sections provide a summary of the report.

5.1.1 OBJECTIVE

The objectives for this master plan process were as follows:

- Advance the goal of containment/virtual elimination of combined sewer overflows
- Maximize the effectiveness of the existing sewer system
- Provide adequate system capacity to meet growth-based demand to year 2026
- Prioritize large scale capital improvements to the sewer system

- Provide information to stakeholders on issues and challenges associated with Kingston's unique sewer system

5.1.2 EXISTING SYSTEM DESCRIPTION

The purpose of the wastewater collection system is to safely convey sanitary flows to the central treatment facilities. The Kingston system consists of:

- 33 Pumping Stations
- Inline Storage Elements
- Three CSO Storage Tanks
- Combined Sewers
- Partially Separated Sewers
- Separated Sewers
- Cataraqui Bay WWTP

  This WWTP is a conventional activated sludge plant providing Secondary Treatment and anaerobic digestion for sludge treatment with rated treatment capacities.

- Ravensview WWTP

  This WWTP is uses primary sedimentation, secondary treatment (using Biological Aerated Filters) and chlorine disinfection. Sludge treatment is provided by two-stage digestion followed by dewatering for land application.

5.1.3 MODELING

A computer simulation model of the Kingston trunk sewer system has been developed by UK and updated, calibrated and verified. This was the model used for the Master Plan in analyzing the system, planning for future and examination of alternatives for overflow reduction.

The model was developed using InfoSWMM modeling platform, using the US EPA's Stormwater Management Model Version 5 for wet weather simulation.

5.1.4 SERVICING REQUIREMENT STANDARDS AND OBJECTIVES

GENERAL OBJECTIVES

- Provide sufficient capacity to convey wastewater to the receiving wastewater treatment facilities without backups in the trunk conveyance system
- Ensure adequate pumping station capacity for dry and wet weather
- Provide adequate capacity at the WWTPs under dry and wet weather and during peak flows

DESIGN STANDARDS (CITY OF KINGSTON):

- 350 L/p/day
- Design density based on gross population/ha
- Industrial, commercial and institutional design flows considered on case by case basis

- Infiltration of 0.14 L/s/ha
- Peaking factor of 2.75 max flow and 4.0 min flow (Harmon formula)
- Low Density: 30 units/ha
- Medium Density: 30-75 units/ha
- High Density: 76 units/ha
- Cataraqui West low density: 14-45 dwelling units/ha
- Cataraqui West medium density: 25-75 dwelling units/ha
- Cataraqui North low density: 14-56 dwelling units/ha
- Cataraqui North medium density: 25-45 units/ha
- Cataraqui North high density: 27-75 units/ha
- Rideau Community low density: 10-30 units/ha
- Rideau Community low density: 25-45 units/ha
- Rideau Community low density: <60 units/ha

GROWTH PROJECTIONS:

- The City's Draft Official Plan was used for assessing future sanitary flows. Key facts are:
  - Medium growth scenario projects the 2026 population at 133,100
  - Average household size for 2026 is 2.3
  - Growth focused within the urban boundary

SEWER SYSTEM SERVICING OBJECTIVES:

- Pumping Stations to provide minimum firm capacity equal to the projected 10-year wet weather flow
- Trunk sewers to provide capacity such that the hydraulic grade line does not exceed 0.3 m above the pipe obvert, and remains 2 m below ground surface
- WWTPs to provide adequate capacity for present and future development to satisfy MOE Procedure D5-1 with the impact of wet weather

5.1.5 RECOMMENDED GROWTH RELATED CAPITAL PROJECTS FOR TRUNK SEWERS

- Collins Bay Collector (by 2026)
  - Upgrade P555 to P563 to 300 mm Ø (539 m)
  - Upgrade P564 TO P568 to 375 mm Ø (367 m)
- Northwest Collector (by 2026)
  - Upgrade from 450 mm Ø to 525 mm Ø from Mayfair Crescent to Mackay Street (1,043 m)
- HWY 15 Trunk (beyond 2026)
  - Upgrade 350 mm Ø to 450 mm Ø (1048 m)
  - Upgrade 400 mm Ø to 450 mm Ø (652 m)

- Ravensview Trunk with Proposed Long-Term CSO Reduction Strategy in Place (now - 2010)
  - Twinning of existing pipe to provide redundancy and allow for temporary shut down and maintenance of existing pipe
- Princess Street Collector (now - 2010)
  - Upgrade existing 300 mm Ø and 375 mm Ø from Kingston Centre to Hillendale Avenue to 450 mm Ø (843 m)
  - Upgrade existing 375 mm Ø to 600 mm Ø from Hillendale Avenue to connection of North End Trunk Sewer at Parkway (885 m)

5.1.6 RECOMMENDED GROWTH RELATED CAPITAL PROJECTS FOR PUMPING STATIONS

- Days Road Pumping Station (by 2026)
  - Wet weather inflow reduction of up to 120 L/s capacity increase to ensure no surcharge to the 10 year level at Future 2026 and beyond
- Mona Drive Pumping Station (beyond 2026)
  - Increase firm capacity by approximately 10 L/s to handle 10-year peak flow to future build out condition
- Front Road Pumping Station (by 2026)
  - Increase firm capacity by 33 L/s to meet minimum requirement to handle 10-year peak flow up to future build out condition
- Westbrook Pumping Station (when required based off flow monitoring)
  - Increase firm capacity to meet minimum requirement to handle 10-year peak flow, up to future build-out condition
- Butternut Creek Pumping Station (by 2026)
  - Upgrade to handle projected urban growth in Rideau Community beyond year 2026 - increase firm capacity by 40 L/s
- B40 Pumping Station (now)
  - Increase firm capacity by 30 L/s to meet 10-year capacity under existing conditions
- Portsmouth Pumping Station (now or deferred based on I&I reduction)
  - Increase firm capacity by 80-90 L/s to ensure 10-year capacity under existing and future build-out conditions

5.1.7 RECOMMENDED GROWTH RELATED CAPITAL PROJECTS FOR WASTEWATER TREATMENT PLANTS

- Cataraqui Bay WWTP Expansion
  - Upgrade to Average Day Flow Rate of 45000 m^3/day and address wet weather bypass (Initiate EA now to address uncommitted capacity and wet weather peak flows)

- Upgrade from 45000 m^3/day to Average Day Flow Rate of 58000 m^3/day (beyond 2026)

5.1.8 COMBINED SEWER SYSTEM REQUIREMENTS

→ Guiding Principles

The guiding principles used in evaluating alternatives for future servicing included:

- Environmental Protection
- Best Use of Infrastructure
- Adaptability
- Integration with Urban Core Improvements

→ MOE Procedure F-5-5

This procedure outlines the treatment requirements for municipal and private combined and partially separated sewer systems with the following goals:

- Eliminate dry weather overflows from sewage collection systems
- Minimize potential impacts on human health and aquatic life resulting from CSOs
- Control overflows from remaining combined-sewer systems to the following minimum requirements:
  1. April - October period of a year with typical average rainfall, capture 90% of wet weather flow
  2. Achieve body contact recreation water quality objectives at beaches for 95% of the June - September period for an average year

→ Long Term Goals

The City of Kingston would like “virtual elimination” of CSOs.

5.1.9 POLLUTION CONTROL RECOMMENDED PROJECTS

An order of preference for alternatives was established for interim measures and long-term projects to achieve project objectives:

1. Long term sewer separation
2. Operational changes and improvements
3. Structural changes and improvements
4. Capacity and conveyance system upgrades
5. Storage

SEWER SEPARATION

Refer to Figure 2-2 of the Sewage Infrastructure Master Plan report for a map showing the areas below:

→ Area 1 is the area bordered primarily by Sir John A MacDonald to the west, Johnson Street to the north, Collingwood Street to the east and Lake Ontario to the south.

→ Area 2 is the area bordered primarily by Albert Street to the west, Princess Street to the north, Barrie Street to the east and King Street to the south

→ Area 3 is the area bordered primarily by Nelson Street to the west, Third Avenue to the north, Montreal Street to the east and York Street to the south.

- Area 4 is the area bordered primarily by Division Street to the west, Queen Street to the north, Ontario Street to the east and Johnson Street to the south.
- Area 5 is the area bordered primarily by Barrie Street to the west, Johnson Street to the north and Ontario Street to the east and south.
- Area 6 is the area bordered primarily by Patrick Street to the west, River Street to the north, Rideau Street to the East and Bay Street to the south.

CONVEYANCE CONTROLS

- North Harbourfront Trunk Sewer twinning – 1220 mm Ø sewer (840 m)
- West Street CSO improvements – raise overflow weir to HTS at West Street, boat ramp by 0.8 m
- River Street Forcemain Twining completion (960 m)

END OF PIPE OPTIONS

- O'Kill Street CSO Screening and flow monitoring
- West Street Outfall replacement
- West Street CSO screening

5.1.10 ADDITIONAL RECOMMENDED INITIATIVES

MONITORING

Existing system monitoring programs should be maintained to monitor and confirm results of modifications and provide additional information to assist with final planning and design of recommended works. Special attention should be made to high wet-weather inflow problems. Based on existing monitoring information and modeling, the tributary area for the Portsmouth PS should be a primary candidate for investigating I&I.

MODELLING

With new monitoring data, the model should continue to be updated. The model should be expanded for additional pipe links for reviewing local street level problems, or analyzing site specific CSO elimination. Climate change information should revise existing rainfall data as it is observed and forecasted.

WET WEATHER INFLOW REDUCTION

Several areas were shown to have high I&I rates and further investigations into these locations should be completed:

- North End PS Service Area (continue with 2008/2009 program)
- Portsmouth PS Service Area (New program)
- B-64 PS Service Area (New Program)
- North West Collector Service Area (New Program)

PROGRAM AND POLICY RECOMMENDATIONS

The following items we recommended system-wide policies and programs that should either be continued or additional program and policy that should be considered:

1. Sources Control
   - Toilet Replacement Program
   - Rain Barrel Program
   - Roof Leader and Foundation Drain Disconnection Program
   - Pet Litter Control
   - Pesticide Management
   - Citizen's Reports
   - Floatables Control
   - CSO Regulator Inspections and Maintenance
   - Closed Circuit Television (CCTV) inspections
   - Maintenance Hole Rehabilitation
   - Extraneous Flow Reduction
   - Infiltration Measures On site
   - Rooftop Gardens/Green Roofs
   - Porous Pavement
   - Used Oil Recycling
   - Household Hazardous Waste Collection
   - Yellow Fish Road Program
   - Pool Drainage
   - Erosion and Sediment Control
   - Street Cleaning
   - Catchbasin Cleaning
   - Sewer Flushing
   - Inlet Control / Flow Reducers
2. Conveyance System Improvements
   - Sewer Rehabilitation – Lining: Using lining technologies to reduce I&I in identified sections
   - Sewer Rehabilitation – Internal Grouting: Using pressure-injected grouting to repair small joint leaks and cracks to reduce I&I in identified sections

5.1.11 POLLUTION CONTROL PLAN (PCP) UPDATE FOR CITY OF KINGSTON

As part of the master plan, an update to the PCP was completed with the following objectives:

→ Review pertinent documentation and summarize works completed to date

→ Quantify the impacts of significant improvements to the sewer system as implemented by UK since the 2000 PCP Update

- Update, calibrate, and validate the existing hydraulic model of the trunk sewer system using recent monitoring data
- Evaluate performance against the requirements of MOE Procedure F-5-5
- Define and evaluate alternatives to reach the City's ultimate goal of "virtual elimination" of CSOs and identify preferred alternatives

Recommendations from the updated PCP are included in Sections 5.1.9 and 5.1.10.

5.2 CONDITION ASSESSMENT OF WATER AND WASTEWATER PUMPING STATIONS (STANTEC, 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.

5.3 RIVER STREET PUMPING STATION TWIN – FORCEMAIN EXTENSION AND RAVENSVIEW TRUNK SEWER TWINNING CLASS ENVIRONMENTAL ASSESSMENT (CH2MHILL, 2012)

The purpose of this Schedule B Class EA was twofold: to evaluate the potential alternatives to twin the River Street Pumping Station forcemain as well as rehabilitate or replace the original sections of the forcemain, and to assess the potential alternatives available for improving quality and increasing the capacity of the sewage infrastructure to provide safe, continuous and reliable conveyance.

The preferred recommended solution for River Street Pumping Station forcemain involved rehabilitation of the existing forcemain as well as installation of a new, parallel forcemain to provide redundancy and additional capacity. The route that was considered to be the best solution for the forcemain was to follow the same alignment as the existing forcemain from the east side chamber of the Cataraqui River to the James Lane and James Street intersection. The forcemain would then run east along James Street to the intersection of Highway No. 15 and Highway No. 2 and connect to the existing chamber approximately 110 m west of the Highway No. 2 and Niagara Park Drive intersection where it would connect into the existing gravity sewer. The recommended solution to improve sewage conveyance through the Ravensview Trunk Sewer was to install a new trunk sewer for additional capacity. The preferred route for this trunk sewer would connect to the same chamber as the existing trunk sewer and would direct east along Highway No. 2. The trunk sewer would then align south along Gates Boulevard and east along LaSalle Boulevard towards the WWTP.

The River Street twin-forcemain extension has been completed, however the Ravensview trunk sewer twinning still has not been scheduled for commissioning.

5.4 CATARAQUI BAY WASTEWATER TREATMENT PLANT UPGRADE CLASS ENVIRONMENTAL ASSESSMENT (J.L. RICHARDS, 2012)

The upgrades identified for the Cataraqui Bay WWTP were considered a priority project in the City's 2010 Sewer Infrastructure Master Plan, based on capacity requirements. The purpose of this Schedule C Class

EA was to evaluate the current conditions of the plant, investigate the challenges of meeting a more strict effluent quality, accommodate the needs of the projected urban development, and to provide recommendations regarding the plant's next expansion. The recommended solutions included: expanding the treatment plant's liquid train process with the use of Biological Aerated Filters (BAFs), expanding the solids train process with the use of anaerobic digestion and an enclosed biosolids cake storage facility, implementing a system to recirculate digester gas to the boilers for heat production and investigating the potential to implement a congestion facility.

The Cataraqui Bay WWTP is currently in design and will be going into construction during the first or second quarter of 2016.

5.5 CANA WASTEWATER TREATMENT PLANT CLASS ENVIRONMENTAL ASSESSMENT (2013)

The purpose of the Schedule C Class EA was to focus on the Cana community and its wastewater servicing needs. The Study considered alternatives that were economically sustainable, environmentally sound and reflective of the current and projected needs of the community. It also considered the challenges associated with providing a more strict effluent quality, evaluated alternative conveyance and treatment strategies for the area, selected the preferred treatment and conveyance strategies and determined the probable costs associated with the proposed treatment plant.

At the time that the Study was being completed, the Cana WWTP and collection system was aging and needed repairs and upgrades in order to accommodate projected capacity needs and reliable, effective and up to date infrastructure. The recommendations for the treatment plant upgrades included replacing the plant with a new and improved WWTP that would use a Sequencing Batch Reactor, equalization tanks, screening, chemically assisted tertiary filtration and a UV disinfection for the liquid train process. The WWTP is anticipated to be completed in 2016.

5.6 THE PORTSMOUTH PUMPING STATION FLOW DIRECTION ENVIRONMENTAL ASSESSMENT (WSP, 2014)

The Portsmouth Pumping Station, which is centrally located in the City of Kingston, was projected to experience larger volumes of wastewater flow as development continues in the downtown core. The purpose of this Class EA was to investigate the potential to direct portions of the wastewater flow towards the Cataraqui Bay WWTP located in West Kingston. This would help to decrease the volumes of wastewater flow through the central and eastern portions of the wastewater network, thereby eliminating the need for additional linear infrastructure upgrades through the densely populated downtown area. Additionally, this Study also addressed opportunities to reduce CSOs within the central (downtown) wastewater network.

The preferred servicing solution was to pump the entire distance to the west using a new forcemain. Additional wastewater flows from sewer catchment areas located between the WWTP and the Portsmouth Pumping Station would be conveyed to the Portsmouth Pumping station. The preferred routing option was to implement a forcemain from the Portsmouth Pumping Station along the Kennedy Street, Union Street West and King Street West rights-of-way to Portsmouth Avenue where it would follow King Street West and Front Road until Sand Bay Lane where it would connect to Cataraqui Bay WWTP. These preferred alternatives were chosen based on the evaluation of the impacts posed to the natural, social and cultural, and economic environments by all considered alternatives.

5.7 KINGSTON EAST – RIDEAU COMMUNITY SANITARY SYSTEMS UPGRADES MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT (D.M. WILLS ASSOCIATES LTD., ONGOING)

The purpose of this Study was to provide recommendations for the sanitary sewer system upgrades required for the current and projected development in Kingston East within the boundary limits north of Gore Road to the Great Cataraqui River and Highway No. 15. Based on the analysis, it was expected that one or more sewage pumping stations will be required to produce effective and reliable servicing where new developments have been approved. Currently, the alternative that has been identified as a viable solution is to have a new sewage pumping station constructed; however, the recommended location for the facility is still being determined through an evaluation process. Additionally, a new sanitary forcemain will be required to transfer the sewage from the new pumping station to the existing trunk sewer located on Highway No. 15.

5.8 PORTSMOUTH SEWERSHED INFLOW AND INFILTRATION REDUCTION ENVIRONMENTAL ASSESSMENT (D.M. ROBICHAUD ASSOCIATES, ONGIONG)

This Study was initiated to address the high levels of I&I from groundwater and other clean water that were noted in the sewage collection area for the Portsmouth Pumping Station in Aberdeen Park. The increased I&I flow contribute to surcharging sewers, basement flooding and sewage bypassing in the Portsmouth Sewershed during peak rainfalls and snowmelt. The purpose of the Study is to identify the major sources of I&I in the system and implement repairs and upgrades to mitigate the levels of leakage in the system.

5.9 SEWER SEPARATION PROGRESS UPDATE (UK, 2015)

The purpose of this memorandum was to present information on the rate of progress towards the ultimate goal of full sewer separation, taking into consideration the 2015-2018 Capital Plan as ‘committed’ conditions to end-of 2018. The report also provided an estimate beyond 2022 with recommended future capital improvement projects.

6 KINGSTON WEST WASTEWATER SYSTEM

The City of Kingston West wastewater collection system comprises an area of approximately 3953 ha. It is generally bordered by Westbrook Road to the west, Macdonald-Cartier Freeway to the north, Little Cataraqui Creek to the east and Lake Ontario to the south. There are approximately 44,400 people living in Kingston West.

Wastewater is collected from Kingston West and conveyed via gravity and pump stations to Cataraqui Bay WWTP. Refer to Figure 6-1 for a map of the Kingston West Wastewater System.

WSP
1224 GARDINERS RD, SUITE 201
KINGSTON, ONTARIO,
CANADA, K7P 0G2
WWW.WSPGROUP.COM

Utilities Kingston
UTILTIES KINGSTON
P.O. BOX 790,
KINGSTON, ONTARIO,
K7L 4X7

Legend

- WWTP — WASTEWATER TREATMENT PLANT
- PS — SANITARY PUMPING STATION
- PS — SANITARY PUMPING STATION (NOT MODELLED)
- FORCEMAIN
- EXISTING SANITARY SEWER
- MODEL CONDUIT
- COMBINED SEWER OVERFLOW
- TANK OVERFLOW
- SANITARY SEWER OVERFLOW
- WATERBODY

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON WEST SANITARY COLLECTION 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
1:37,500

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 wastewater sewer system varies from 75 mm Ø to 1500 mm Ø as described in Table 6-1 and Figure 6-2. It should be noted that due to incomplete as-built information for several pipes, the construction year category “unspecified” is included in the age distribution for pipes. Additionally, the category “1900” was assigned to pipes that were old but had no specific construction date.

Table 6-1 Kingston West Wastewater Sewer Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	1,373
75	288
100	137
125	25
150	6,223
200	137,335
250	32,827
300	18,251
350	1,820
375	7,759
400	1,609
450	10,961
500	1,533
525	3,132
600	5,473
750	1,400
825	951
900	9,487
1050	990

DIAMETER (mm)	LENGTH* (m)
1200	970
1350	176
1500	322
Total	**243,042**

**Data was obtained from Kingston GIS*

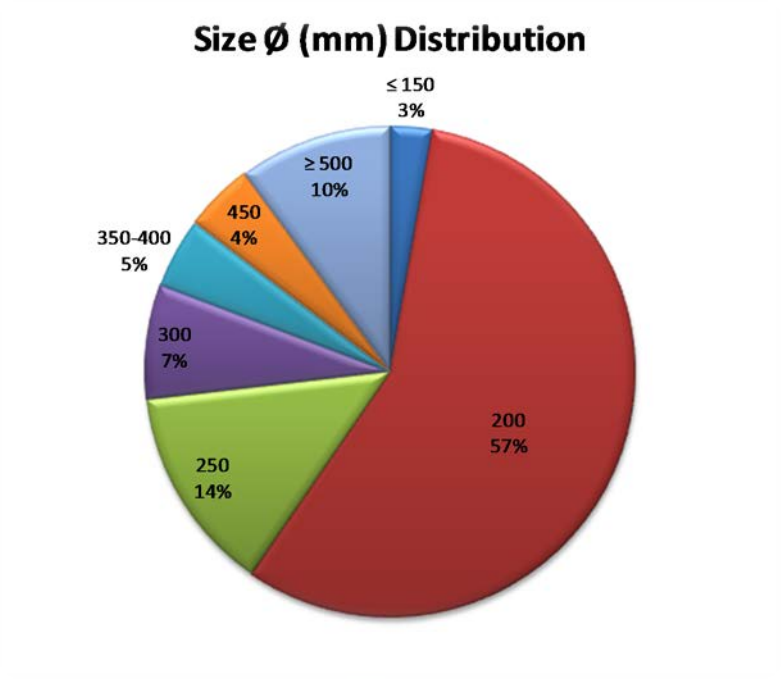


Figure 6-2 Kingston West Wastewater Sewer Size

The Kingston West collection system is made from asbestos cement (AC), cured in place pipe (CIPP), clay, concrete (CONC), high density polyethylene (HDPE) and polyvinyl chloride (PVC). This is summarized in Table 6-2 and Figure 6-3. It should be noted that the material of several pipes is unspecified due to an incomplete asset inventory for material.

Table 6-2 Kingston West Wastewater Sewer Material

MATERIAL	LENGTH* (m)
Unspecified	55,032
AC	1,920
CIPP	10,826
CLAY	1,972

MATERIAL	LENGTH* (m)
CONC	127
HDPE	27,409
PVC	173,355
Total	**243,042**

**Data was obtained from Kingston GIS*

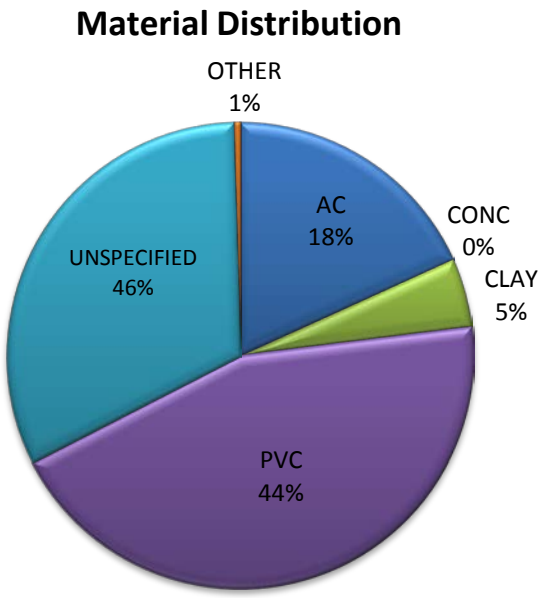


Figure 6-3 Kingston West Wastewater Sewer Material

The Kingston West collection system was built between the year 1941 and present. This is summarized in Table 6-3 below, as well as in Figure 6-4.

Table 6-3 Kingston West Wastewater Collection System Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	11,425
1941-1950	110
1951-1960	597
1961-1970	33,159
1971-1980	68,648

YEAR INSTALLED	LENGTH* (m)
1981-1990	32,942
1991-2000	39,912
2001-2010	46,120
2011-present	10,129
Total	**243,042**

**Data was obtained from Kingston GIS*

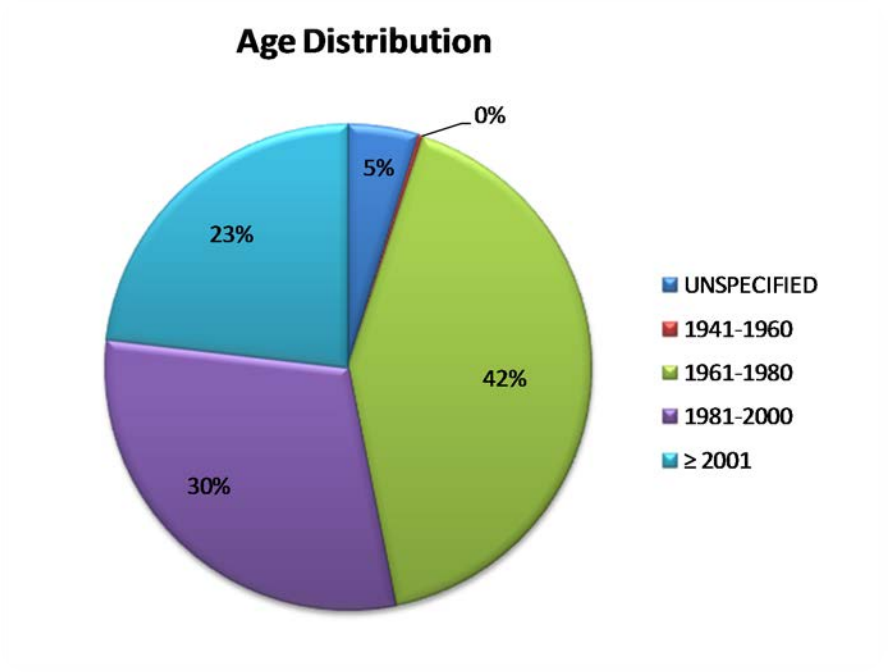


Figure 6-4 Kingston West Wastewater Sewer Installation Year

6.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston projects out for design or tender for linear infrastructure in Kingston West.

6.2 PUMP STATIONS

The Kingston West Wastewater System has 13 pump stations. Please refer to Figure 4-5 for a flow chart outlining the pump station organization and Figure 6-1 for a map showing the Kingston West wastewater collection system. Table 6-4 provides information regarding each pump station.

Table 6-4 Kingston West Pump Stations

PUMP STATION	LOCATION	NO. OF PUMPS	RATED CAPACITY	DRAWDOWN TEST CAPACITY (2008)	AVERAGE FLOW (2013)
Bath- Lower Dr PS	4146 Lower Drive	2	6.3 L/s @ 10.3m	8 L/s 9 L/s	30 m^3/day
Rankin Cr. PS	602 Rankin Crescent	2	15.1 L/S @ 13.4m	61 L/s 73 L/s	33 m^3/day
Westbrook Rd PS	1143 Westbrook Road	2	14.6 L/s @ 15.6m	8 L/s 14 L/s	197 m^3/day
Bath- Collins Bay Rd PS	4054 Bath Road	2	No Data	18 L/s 25 L/s	49 m^3/day
Collins Bay Rd PS	1205 Collins Bay Road	2	22 L/s @ 18.3m	8 L/s 20 L/s	60 m^3/day
Hillview Rd PS	740 Hillview Road	2	192 L/s @ 26m	141 L/s 142 L/s	2474 m^3/day
John Counter Blvd PS	1871 John Counter Boulevard	2	50.6 L/s @ 9.6m	No Data	7 m^3/day
Bath Rd PS	1298 Bath Road	2	51.4 L/s @ 16.4m	No Data	432 m^3/day
Coverdale Dr PS	1066 Coverdale Drive	2	52.6 L/s @ 19.9m	71 L/s 75 L/s	474 m^3/day
Days Rd PS	419 Days Road	4	(3) 336 L/s @ 23m (1) 748 L/s @23m	No Data	14539 m^3/day
Bayridge Drive PS	200 Bayridge Drive	2	23 L/s @ 9.6m	19 L/s 142 L/s	43 m^3/day
Lakeshore Blvd PS	187 Lakeshore Boulevard	2	126 L/s @ 12.7m	112 L/s 101 L/s	1153 m^3/day

PUMP STATION	LOCATION	NO. OF PUMPS	RATED CAPACITY	DRAWDOWN TEST CAPACITY (2008)	AVERAGE FLOW (2013)
Crerar Blvd PS	46 Crerar Boulevard	2	77 L/s @ 25m	No data	1337 m^3/day

6.2.1 PROPOSED CAPITAL IMPROVEMENT PROJECTS

- Greenview Pumping Station
  - Upgrades

6.3 COMBINED SEWER OVERFLOW

There are no active combined sewer overflows in Kingston West.

6.4 CATARAQUI BAY WASTEWATER TREATMENT PLANT

The Cataraqui Bay WWTP is located at 409 Front Street in the City of Kingston. The treatment plant is operated under amended Environmental Compliance Approval (ECA) number 2144-87TJY8.

The raw wastewater entering the Cataraqui Bay WWTP is primarily of domestic origin. The plant is a conventional activated sludge plant. It has a rated capacity of 38,800 m^3/d and a peak capacity of 134,400 m^3/d (primary treatment facilities) and 69,200 m^3/d (secondary treatment facilities). The following sections will provide a description of the plant's process, criteria and historical information.

6.4.1 UNIT PROCESS DESCRIPTION

Sewage enters the Cataraqui Bay WWTP via a 450 mm diameter forcemain from the Days Road Pumping Station and a 250 mm diameter gravity sewer which flows into the On-Site Pumping Station. Preliminary treatment consists of two aerated grit tanks and two mechanically cleaned coarse bar screen.

Primary treatment consists of four twin-pass rectangular settling tanks. Primary effluent is directed by gravity to the secondary treatment system and settled sludge is pumped to the sludge digestion system. Alum is dosed into the primary clarifiers to assist with the removal of phosphorus and the settling of solids.

Secondary treatment consists of four rectangular aeration tank equipped with fine bubble diffusers. Air is supplied by four turbo blowers. Secondary clarification of the mixed liquor occurs in four twin-pass rectangular clarifiers. Return activated sludge (RAS) is pumped to the front of the aeration tank and mixed with primary effluent. Waste activated sludge (WAS) is thickened in rotary drum thickeners prior to being pumped to the sludge digestion system.

Secondary effluent is disinfected year-round using chlorine gas. Sodium bisulphite is used as a dechlorination agent prior to discharge into the natural environment. The treated effluent from the facility is discharged to Lake Ontario.

Waste sludge generated at the site are processed through an anaerobic digestion system consisting of a primary digester, secondary digester and a holding tank. Stabilized Biosolids are dewatered using a centrifuge and the Biosolids cake is spread on agricultural lands as a nutrient and soil conditioner. Temporary storage of Biosolids cake is provided at the site.

A process flow schematic of the liquid treatment train is presented in Figure 6-5.

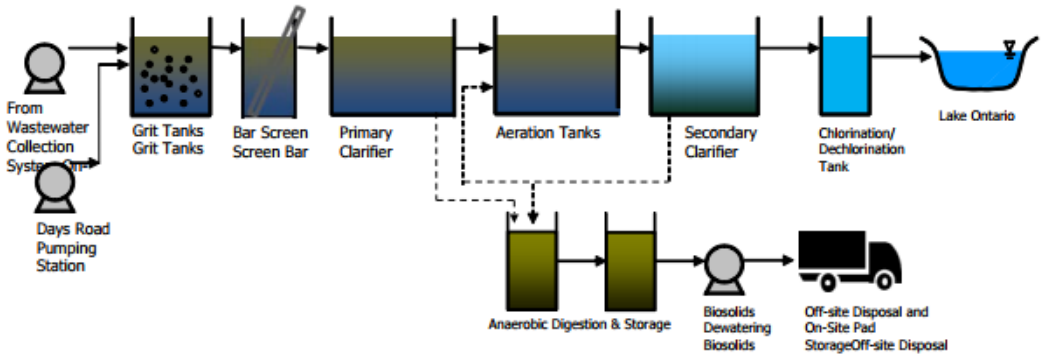


Figure 6-5 Cataraqui Bay WWTP Process

A description of the unit processes is provided in Table 6-5 below.

Table 6-5 Cataraqui Bay WWTP Unit Process Design Data

UNIT PROCESS	DESCRIPTION
Inlet Works	One 600 mm and 900 mm diameter forcemains from the Days Road PS One 250 mm diameter gravity sewer entering On-Site PS One On-Site PS containing three dry pit, non-clog pumps, each having a rated capacity of 173 L/s. Two aerated grit tank (12.5 m x 5.0 m x 4.5 m SWD) Two coarse bar screen
Septage Receiving Station	Septage Receiving System consisting of → One holding tank, measuring 3.7 m x 3.5 m x 1.0 m, housing a trash rack and septage grinder having a capacity of 4.2 m^3/min. → Two septage equalization tanks, measuring 18.3 m x 6.0 m x 4.2 m deep, equipped with mechanical mixers and two submersible pumps, each rated at 8.3 L/s.
Primary Treatment Facilities	Rectangular clarifiers consisting of: → Four two pass clarifiers, each measuring 19 m x 12.3 m (6.0 m per pass) x 3.75 m SWD → Four positive displacement progressive cavity raw sludge pumps, each rated at 12.6 L/s to transfer primary sludge to the sludge digestion process.
Secondary Treatment Facilities	Rectangular aeration tanks consisting of: → Four double cell fine bubble aeration tanks measuring 24.9 m x 12.3 m (6.0 m per pass) x 6.0 SWD, with an active volume of 1,793 m^3 per cell. → Total Volume = 7,172 m^3

UNIT PROCESS	DESCRIPTION
	→ Four 112.5 KW turbo blowers providing approximately 5,100 cubic metres per hour to the aeration tanks. → Two three-pass rectangular secondary clarifiers, measuring 29 m x 15.6 m (5.0 m per pass) x 3.75 m SWD → Three RAS/WAS pumps each with a capacity of 79.9 L/s → One three-pass rectangular secondary clarifier, measuring 33.5 m x 20.7 m (6.9 m per pass) x 3.8 m SWD. → Four RAS pumps each with a capacity of 159.8 L/s → Two WAS pumps each with a capacity of 34.7 L/s
Phosphorus Removal	Two chemical feed pumps adding alum at a rate of up to 5.4 m^3/d.
Disinfection	One six pass concrete chlorine contact chamber (1.75 m wide (per pass) and 29.95 m long inlet chamber. Total effective volume = 1,101 m^3 Two gas chlorinator Two chemical feed pumps adding sodium sulphite at the rate up to 20 L/hr and chemical storage of 5.5 m.
Outlet Works	Two outfalls, with diameters of 900 mm and 1,500 mm.
Sludge Digestion Process	A WAS thickening process consisting of: → Two aerated WAS holding Tanks, measuring 12.5 m x 12.5 m x 3.8 m, with two positive displacement blowers providing air to the fine bubble membrane diffusers within the tank → Two WAS sludge pumps, each rated at 34.7 L/s → Two Rotary Drum Thickeners rated at 125 m^3/hr → Two TWAS Pumps rated at 600 m^3/hr → Four thickened WAS Storage Tanks, measuring 6.8 m x 6.8 m x 5 m An anaerobic digestion system consisting of: → Primary Digester with an effective volume of 3,060 m^3 → Secondary Digester with an effective volume of 1,620 m^3 → Digested Sludge Holding Tank with an effective volume of 1,540 m^3 → Two Digested Sludge Pumps rated at 12.6 L/s → One Dewatering Centrifuge rated at 638 L/min → Biosolids Storage Pad with a capacity of 8,200 m^3

6.4.2 EFFLUENT CRITERIA

The plant is required to meet average monthly concentration and annual average loading limits for BOD_5, total suspended solids, and total phosphorus. The effluent compliance limit for E. Coli is 200 organisms per 100 mL based on a monthly geometric mean density. The effluent objectives and limits are summarized in Table 6-6 as per ECA requirements.

Table 6-6 Cataraqui Bay WWTP Effluent Objectives and Compliance Criteria

PARAMETER	EFFLUENT OBJECTIVES	NON-COMPLIANCE LIMIT CONCENTRATION	NON-COMPLIANCE LIMIT TOTAL LOADING
BOD_5	15 mg/L	25 mg/L	970 kg/d
TSS	15 mg/L	25 mg/L	970 kg/d
Total P	1.0 mg/L	1.0 mg/L	39 kg/d
Total Chlorine Residual	0.5 mg/L	0.5 mg/L	NA
E. Coli	200 organisms per 100 mL	N/A	N/A

6.4.3 HISTORICAL FLOWS AND PERFORMANCE

Historical average and maximum day flows to the Cataraqui Bay WWTP from 2010 to 2014 are shown in Figure 6-6, along with the ECA effluent flow rate limits. Flow data was obtained from the 2010 to 2014 Wastewater Annual Reports. Historically, the plant has remained in compliance with the average day flow limit of 38,800 m^3/d.

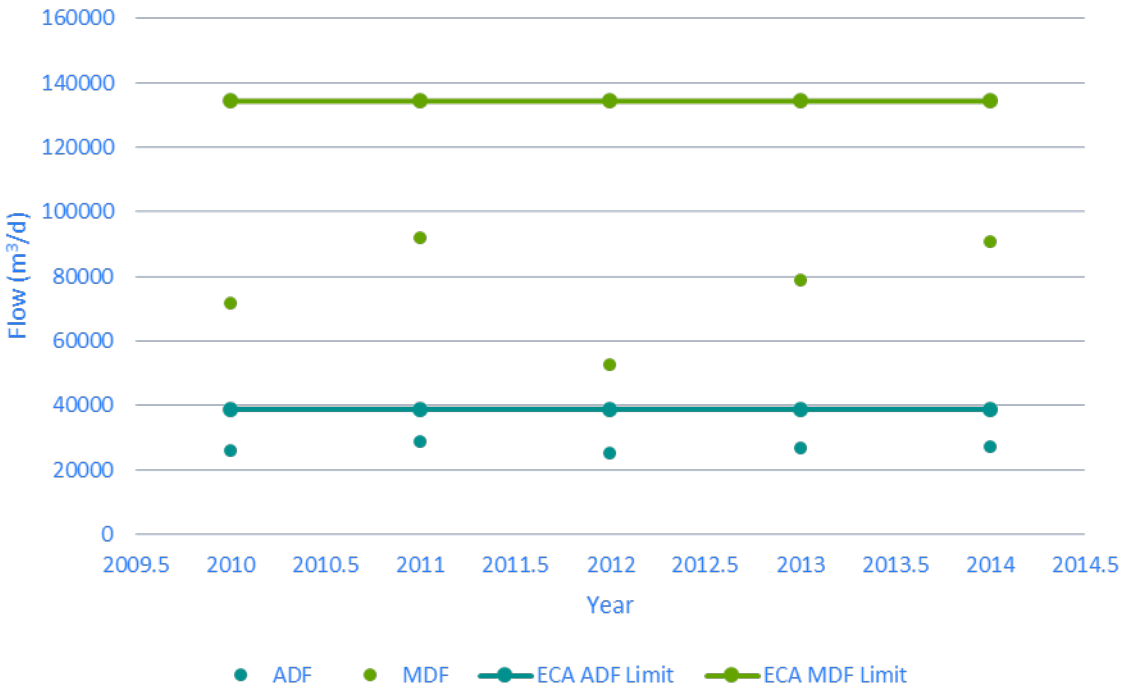


Figure 6-6 Cataraqui Bay WWTP Historical Flows

Historical effluent quality, obtained from the Wastewater Annual Reports, is summarized in Table 6-7. On average, limits were not exceeded for any of the effluent parameters from 2010 to 2014.

Table 6-7 Cataraqui Bay WWTP Effluent Quality

PARAMETER	2010	2011	2012	2013	2014	LIMIT
BOD_5 (mg/L)	7.75	6.9	7.86	19.34	6	25
Suspended Solids (mg/L)	4.65	5.1	5.21	5.53	6.2	25
Total Phosphorus (mg/L)	0.49	0.56	0.53	0.57	0.61	1
Total Chlorine (mg/L)	NA	0.019	0	0.01	0.01	0.02

6.4.4 EXISTING DEFICIENCIES AND CAPACITY LIMITATIONS

In 2012, an Environmental Assessment was completed based on the recommendations in The Wastewater Master Plan (2010) which identified the needs to confirm site configuration, approach to wet weather flow management, treatment approach, and outfall requirement at the Cataraqui Bay WWTP.

6.4.5 PROPOSED CAPITAL IMPROVEMENT PROJECTS

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

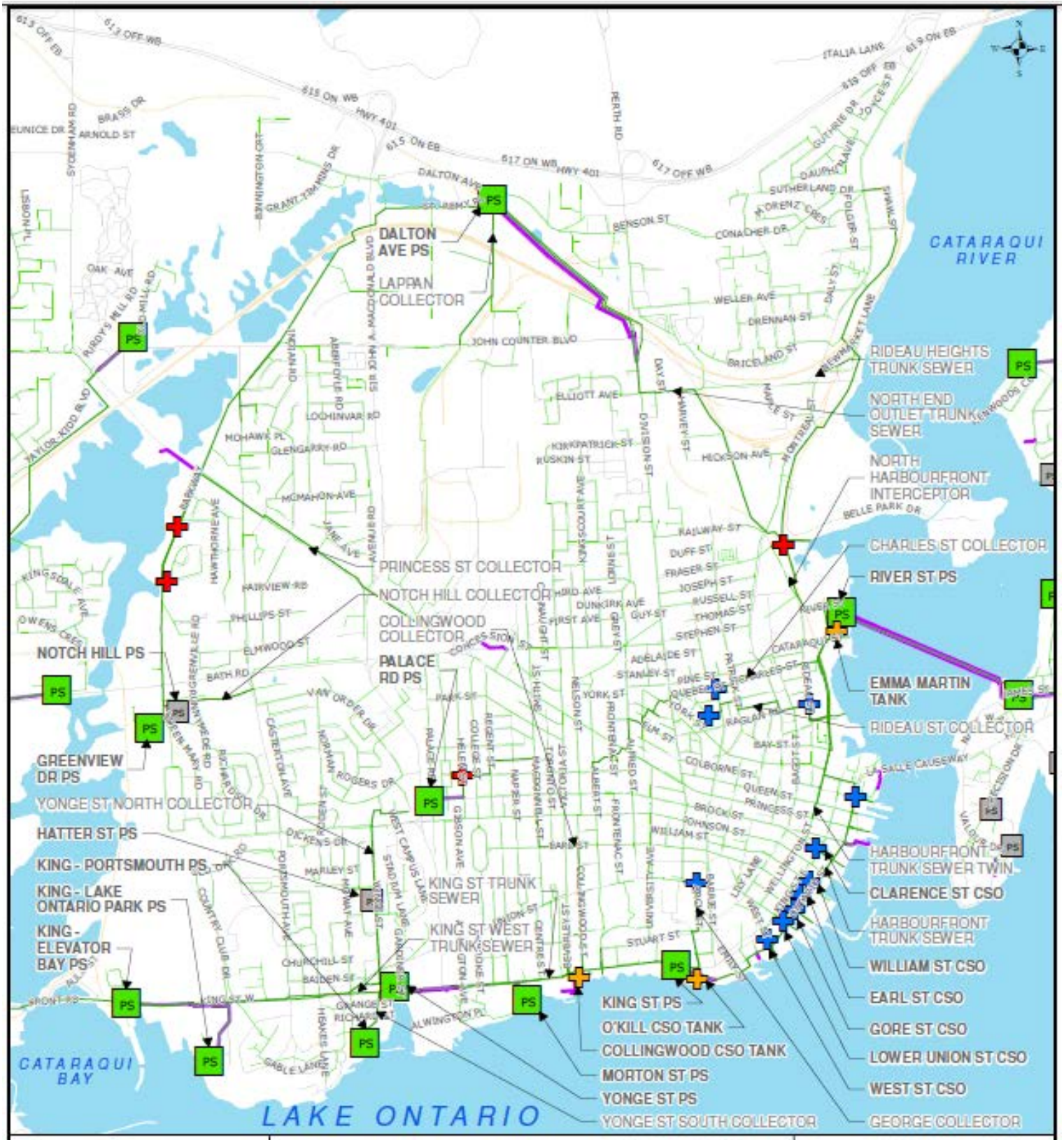
→ Cataraqui Bay Waste Water Treatment Plant

- Class Environmental Assessment (EA) to upgrade and expand treatment capacity completed
- Portsmouth service area redirection to Cataraqui Bay WWTP
- Design is currently underway and is scheduled to start construction in 2016

7 KINGSTON CENTRAL WASTEWATER SYSTEM

The City of Kingston Central wastewater collection system comprises an area of approximately 2919 ha. It is generally bordered by Little Cataraqui Creek to the west, Macdonald-Cartier Freeway to the north, Cataraqui River to the east and Lake Ontario to the south. There are approximately 54,600 people living in Kingston Central.

Wastewater flow from Kingston Central is pumped to the Kingston East collection system via the River Street Pumping Station and conveyed to Ravensview WWTP. Figure 7-1 shows the wastewater collection system overview.



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Legend

- WWTP — WASTEWATER TREATMENT PLANT
- PS — SANITARY PUMPING STATION
- PS — SANITARY PUMPING STATION (NOT MODELLED)
- FORCEMAIN
- EXISTING SANITARY SEWER
- MODEL CONDUIT
- COMBINED SEWER OVERFLOW
- TANK OVERFLOW
- SANITARY SEWER OVERFLOW
- WATERBODY

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON CENTRAL SANITARY COLLECTION 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 diameter of the sewers in the wastewater system vary from 50 mm to 3200 mm as described in Table 7-1 and Figure 7-2. It should be noted that due to incomplete as-built information for several pipes, the construction year category “unspecified” is included in the age distribution for pipes. Additionally, the category “1900” was assigned to pipes that were known to have been built a long time ago but had no specific construction date.

Table 7-1 Kingston Central Wastewater Sewer Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	662
50	123
75	215
100	514
125	386
150	6,924
200	73,874
225	10,830
250	43,746
300	34,026
350	1,390
375	12,354
400	1,217
450	11,771
500	322
525	2,426
600	6,530
675	2,396

DIAMETER (mm)	LENGTH* (m)
750	2,885
825	2,659
900	7,730
1050	3,000
1200	5,792
1350	1,347
1500	320
2000	73
2400	120
3200	3
Total	**233,635**

**Data was obtained from Kingston GIS*

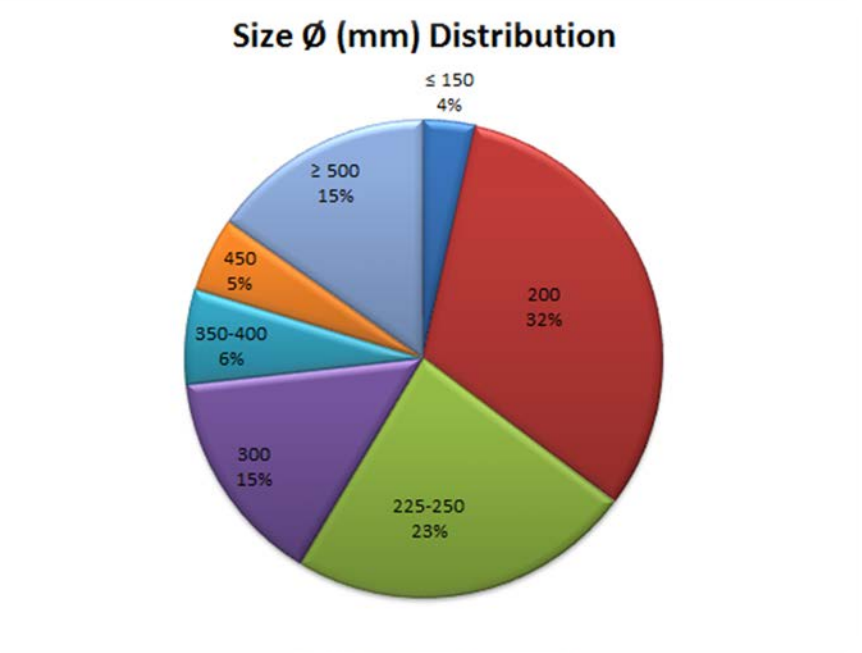

Figure 7-2 Kingston Central Wastewater Sewer Size

The Kingston Central collection system is made from asbestos cement (AC), cast iron (CI), cured in place pipe (CIPP), clay, concrete (CONC), stone and polyvinyl chloride (PVC). This is summarized in Table 7-2 and Figure 7-3. It should be noted that the material of several pipes is unspecified due to an incomplete asset inventory for material.

Table 7-2 Kingston Central Wastewater Sewer Material

MATERIAL	LENGTH* (m)
Unspecified	156,547
AC	22,765
CLAY	4,263
CONC	14,167
STONE	1,812
PVC	31,705
OTHER	2,376
Total	**233,635**

**Data was obtained from Kingston GIS*

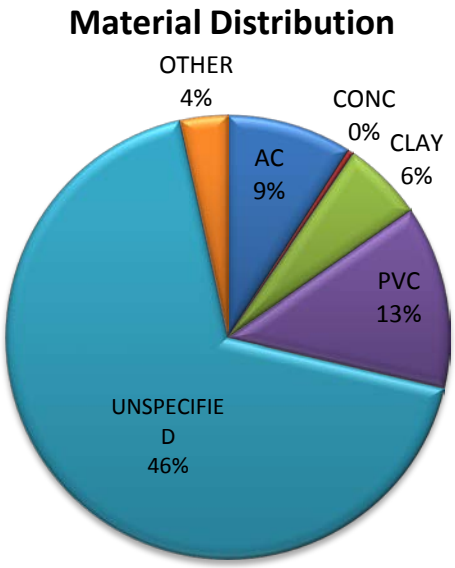

Figure 7-3 Kingston Central Wastewater Sewer Material

The Kingston Central wastewater collection system was built between the years 1941 and present. This is summarized in Table 7-3 and Figure 7-4.

Table 7-3 Kingston West Wastewater Collection System Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	13,608
1900	12,936
1901-1911	1,009
1911-1921	2,840
1921-1931	2,099
1931-1941	2,585
1941-1950	11,721
1951-1960	35,784
1961-1970	31,141
1971-1980	23,042
1981-1990	17,978
1991-2000	29,024
2001-2010	34,757
2011-present	15,112
Total	**233,635**

**Data was obtained from Kingston GIS*

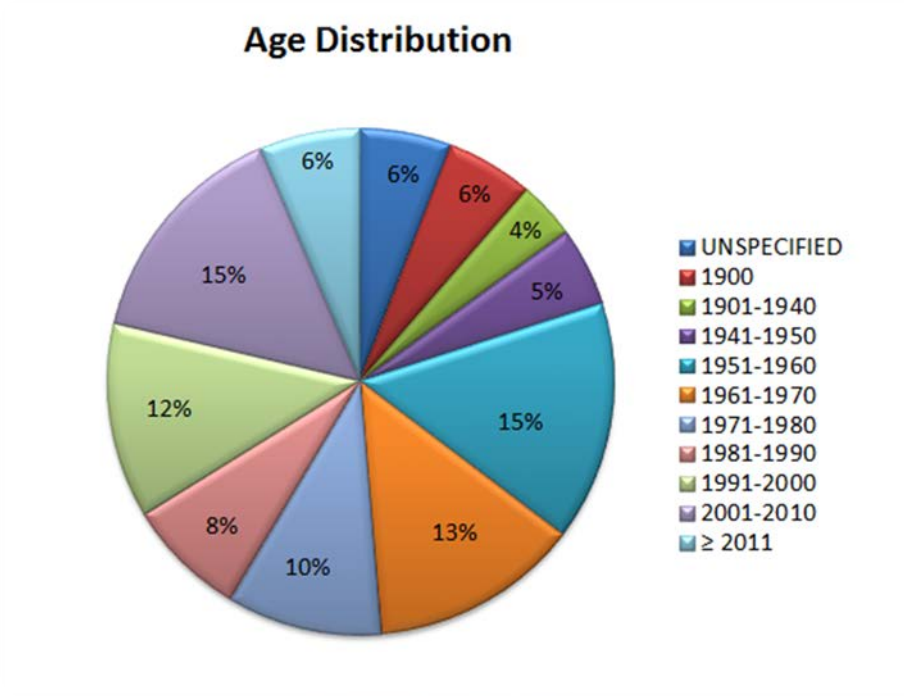

Figure 7-4 Kingston Central Wastewater Sewer Installation Year

7.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects for pump stations in Kingston Central.

- Portsmouth Sewershed Inflow and Infiltration Reduction Project (UK-14-17)
  - A study to reduce extraneous flows into the sanitary sewer system
- Pipe Upgrades (2021):
  - Yonge Street sewer upsize (Johnson Street to Portsmouth PS)
  - Alfred Street (Princess to Elm) sewer upsize from 375 mm to 450 mm
  - Elm Street (Alfred to Chatham) sewer upsize from 375 mm to 450 mm

7.2 PUMP STATIONS

The Kingston Central wastewater system has 12 pump stations. Please refer to Figure 4-6 for a flow chart outlining the pump station organization and Figure 7-1 for a map showing the Kingston Central wastewater collection system. Table 7-4 provides information regarding each of the pump stations in Kingston Central.

Table 7-4 Kingston Central Pump Stations

PUMP STATION	LOCATION	NO. OF PUMPS	RATED CAPACITY	DRAWDOWN TEST CAPACITY (2008)	AVERAGE FLOW (2013)
Greenview Dr. PS	38 Greenview Drive	2	47.3 L/s @ 9.1m	39 L/s 54 L/s	289 m^3/day
Notch Hill Rd. PS	60 Notch Hill Road	1	No data	No Data	No Data
Dalton Ave. PS	266 Dalton Avenue	4	(2) 386 L/s @43m (2) 364 L/s @43.5m	No Data	11844 m^3/day
King- Elevator Bay PS	1100 Elevator Bay	2	No Data	88 L/s 91 L/s	28 m^3/day
King- Lake Ontario Park PS	920 Lake Ontario Park	2	12.6 L/s @ 12.2m	No Data	No Data
Young St. PS	20 Younge Street	2	No Data	7 L/s 4 L/s	2 m^3/day
Hatter St. PS	91 Hatter Street	2	No Data	No Data	5 m^3/day
King- Portsmouth PS	621 King Street West	3	150 L/s @ 24m	166 L/s 158 L/s 165 L/s	6133 m^3/day
Morton St. PS	1 Morton Street	2	18 L/s @ 14.6m	No Data	34 m^3/day
Palace Rd. PS	270 Palace Road	2	51 L/s @ 8.4m	No Data	1803 m^3/day
King St. PS	62 King Street West	4	242 L/s @ 8.9m	No Data	22678 m^3/day
River St. PS	12 River Street	4	420 L/s @ 40m	No Data	55759 m^3/day

7.2.1 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects for pump stations in Kingston Central.

- Portsmouth Pumping Station Flow Direction
  - UK has initiated a class EA to evaluate the flow direction of the Portsmouth Pumping Station servicing the Portsmouth Area. The notice of completion was issued but a Part II bump-up request was submitted and the EA is currently under review by the MOECC.
  - Design is underway and is schedule to start construction in 2016/2017
- River Street Pumping Station Twin Forcemain Extension and James Street Trunk Watermain
  - The project is under construction to twin the forcemain from the existing twinned forcemain (under the river) to the connection at the existing Ravensview trunk sewer feeding the Ravensview WWTP

7.3 COMBINED SEWERS

The City of Kingston combined sewer collection system is situated in Kingston Central and comprises over 21 km of sewer pipe, as shown in Figure 7-5.

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Legend

- COMBINED SEWER
- WATERBODY

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON 2013 COMBINED SEWER 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: 0 175 350 700 Meters
1:27,500

Project No.:	Date:	Drawn By:	Checked By:	Code:	Figure No.:
151-02944-00	DECEMBER 2016	CM	MF	BR	7-5

7.3.1 SIZE, MATERIAL AND AGE

The diameter of the combined sewer system varies from 150 mm to 3200 mm as described in Table 7-5 and Figure 7-6 below.

Table 7-5 Kingston Combined Sewer Sizes

DIAMETER (mm)	LENGTH* (m)
150	171
200	525
250	3,607
300	121
350	7,519
375	18
450	2,197
525	866
600	849
675	624
750	473
900	372
1050	669
1200	377
1350	922
2400	79
3200	2.5
Total	**21,302**

**Data was obtained from Kingston GIS*

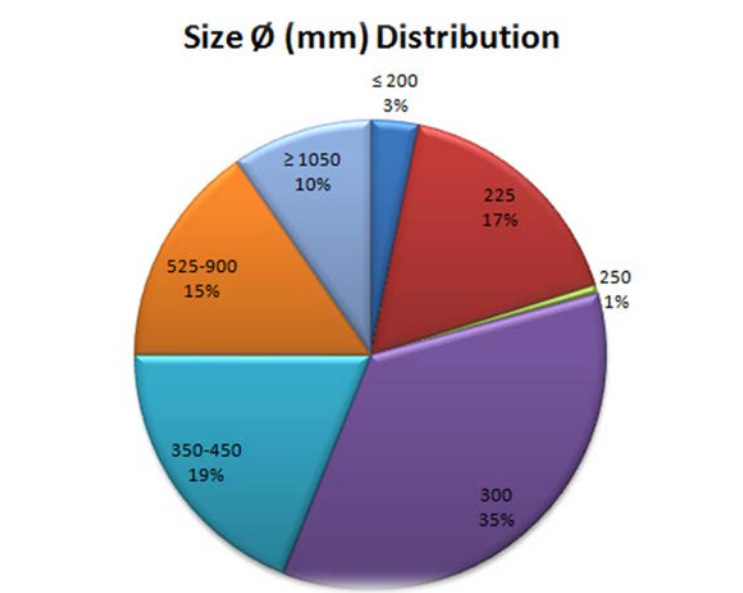

Figure 7-6 Kingston Combined Sewer Size

The Kingston combined sewer system is made from asbestos cement (AC), clay, stone, concrete (CONC) and polyvinyl chloride (PVC). This is summarized in Table 7-6 and Figure 7-7. It should be noted that the material of several pipes is unspecified due to an incomplete asset inventory for material.

Table 7-6 Kingston Combined Sewer Material

MATERIAL	LENGTH* (m)
Unspecified	16,183
AC	285
CLAY	978
STONE	1,486
CONC	1,583
PVC	787
Total	**21,302**

**Data was obtained from Kingston GIS*

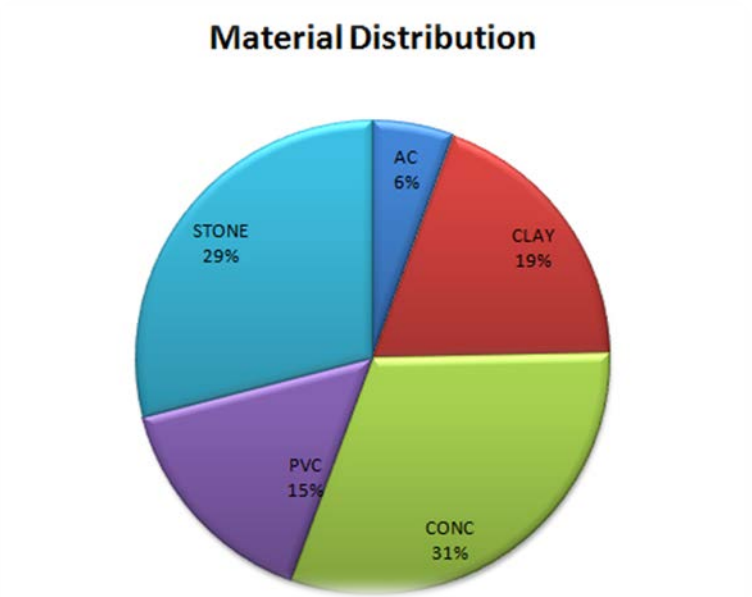

Figure 7-7 Kingston Combined Sewer Material

The Kingston combined sewer collection system was built between the years 1900 to present. This is summarized in Table 7-7 and Figure 7-8.

Table 7-7 Kingston Combined Sewer Collection System Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	1,035
1900	6,217
1901-1940	1,901
1941-1960	868
1961-1980	628
1981-2000	8,023
2001-present	2,631
Total	**21,302**

**Data was obtained from Kingston GIS*

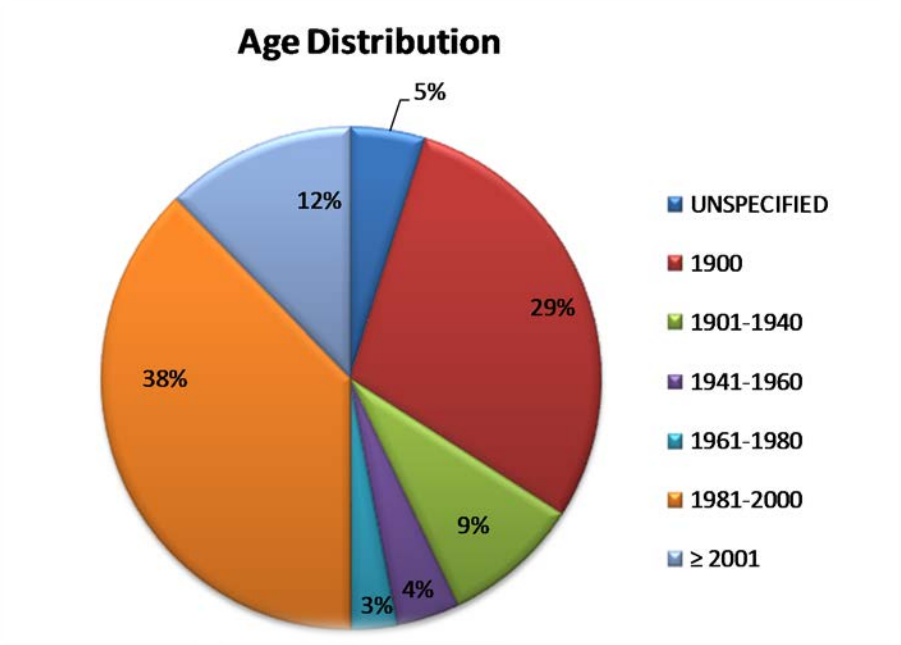

Figure 7-8 Kingston Combined Sewer Installation Year

7.4 PROPOSED SEPARATION

The recommendations of the Sewage Infrastructure Master Plan for the City of Kingston Urban Area (CH2MHILL, 2010) suggested focussing efforts on sewer separation with the goal of "virtual elimination of CSO".

Utilities Kingston produced a technical memorandum dated May 1, 2015 that documented recent progress and projected progress of combined sewer separation as displayed in Table 7-8 and Figure 7-9. The goal through 2018 is to have over 45% of the 2007 combined sewer area separated.

Table 7-8 Combined Sewer Separation 2008-2018 (Current and Projected)

YEAR	RATE OF SEWER SEPARATION (BY CITY BLOCK)	RATE OF SEWER SEPARATION (BY SURFACE AREA)
2008-2011	21.2%	18.4 %
2012	5.1 %	1.2 %
2013	4.0%	2.0%
2014	2.2%	2.9%
2015	2.2%	12.5%
2016	3.3%	0.6%
2017	5.1%	6.3%

YEAR	RATE OF SEWER SEPARATION (BY CITY BLOCK)	RATE OF SEWER SEPARATION (BY SURFACE AREA)
2018	2.5%	1.9%
Total	**45.5%**	**45.7%**

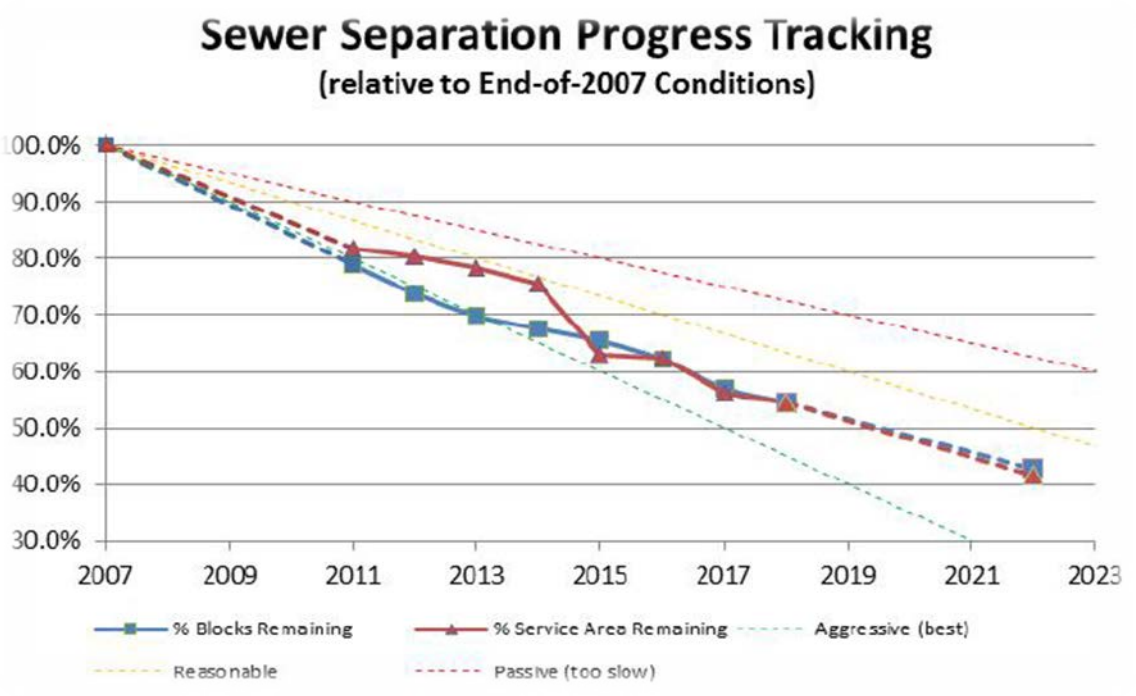

Figure 7-9 Combined Sewer Separation Progress

7.5 COMBINED SEWER OVERFLOWS

Utilities Kingston provided a Site Details document that was referenced to complete this section.

7.5.1 ACTIVE COMBINED SEWER OVERFLOWS

Figure 7-10 provides a map of the current active PCPs described below.

POLLUTION CONTROL PLAN (PCP) #8 PRINCESS STREET

PCP#8 is a CSO from a local collector located in a manhole on Princess Street between Frontenac Street and Alfred Street. Under low flow conditions, sanitary flow from the west and south (450 mm and 200 mm Ø respectively) enter the manhole and proceed east to the 375 mm Ø outlet sanitary sewer. It has a 450 mm Ø overflow to the adjacent 1050 mm Ø storm sewer (invert is 500mm higher than the low flow sanitary outlet) and a 450 mm Ø combined sewer outlet (invert is 900 mm higher than the low flow sanitary outlet. As of 2015, PCP#8 has been temporarily plugged.

POLLUTION CONTROL PLAN (PCP) #9 FRONTENAC STREET

PCP#9 is a CSO from a local collector located in a manhole on Frontenac Street between Princess Street and Mack Street. Under low flow conditions, sanitary flow from the north and south (225 and 200 mm ø respectively) enter the manhole and proceed east to the 200 mm ø outlet sanitary sewer. It has a 300 mm ø overflow to the adjacent 575 mm ø storm sewer (invert is 200 mm higher than the low flow sanitary outlet). As of 2015, PCP#9 has been temporarily plugged.

POLLUTION CONTROL PLAN (PCP) #14 BARRACK STREET

PCP#14 is a CSO from trunk located in a manhole in the right exit lane of the Wolfe Island Ferry Dock. There is a flap gate preventing lake water from entering. From the 1200 mm ø trunk sewer, there is a 900 mm ø outlet to the east that travels into the CSO manhole. Under low flow conditions, sanitary from the east flows west via the 900 mm ø combined sewer. During an overflow event, sanitary flow from the trunk sewer will back up and flow east to the manhole. The CSO manhole has a weir inside (500 mm higher than low flow outlet) which prevents overflow from entering the adjacent 900 mm ø storm sewer under low flow conditions.

POLLUTION CONTROL PLAN (PCP) #15 QUEEN STREET

PCP#15 is a CSO from a local collector located in a chamber at the base of Queen Street adjacent to Tim Hortons. Under low flow conditions, sanitary flow from the west and south (450 mm ø combined sewer and 225 mm ø sanitary sewer respectively) enters and turns 180° to flow into the 1200 mm ø trunk sewer to the west. Under high flow conditions, the flow will outlet via the 450 mm ø storm sewer to the east (240 mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #22 WILLIAM STREET

PCP#22 is a CSO in line tank outlet from a local collector located on William Street between King Street and Ontario Street. It is a 41 m long 1650x1340mm elliptical concrete pipe with a volume of 88 m^3. Combined sewer flow from the west (600 mm ø) enters the tank. The outlet chamber is equipped with a vortex device to limit outflows to 15 L/S. Under low flow conditions, sanitary flow is directed to a 300 mm ø outlet. Under high flow conditions, flow that cannot be contained in the tank will outlet via the 450 mm ø storm sewer to the east (storage overflow weir is 2220 mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #23 EARL STREET

PCP#23 is a CSO in line tank outlet from a local collector located on Earl Street between King Street and Ontario Street. It is a 46m long 2110 x 1340 mm elliptical concrete pipe with a volume of 106 m^3. Combined sewer flow from the west (600 mm ø) enters the tank. The outlet chamber is equipped with a vortex device to limit outflows to 15 L/s. The overflow is located in a manhole downstream of the tank outlet chamber. The downstream manhole has a weir with a 200 mm ø sanitary orifice which directs low flow to a 200 mm ø sanitary sewer outlet under low flow conditions. Under high flow conditions, flow that cannot be contained in the tank is directed to a 525 mm ø storm sewer to the east (storage overflow weir is 3000 mm higher than the low flow outlet and is equipped with a cone sieve at the storm outlet to limit floatables).

POLLUTION CONTROL PLAN (PCP) #24 GORE STREET

PCP#24 is a CSO in line tank outlet from a local collector located on Gore Street between King Street and Ontario Street. It is a 61 m long 1095 x 1730 mm elliptical concrete pipe with a volume of 95 m^3. 300 mm ø

sanitary and 300 mm Ø storm sewer flow from the west (600 mm Ø) enters the tank. The outlet chamber is equipped with a vortex device to limit outflows to 15 L/S. Under low flow conditions, flow from the sanitary sewer continues to the 200 mm Ø sanitary outlet. Under high flow conditions, storm/sanitary flow that cannot be contained in the tank will outlet via the 375 mm Ø storm sewer outlet (storage overflow weir is 1670mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #25 LOWER UNION STREET

PCP#25 is a CSO in line tank outlet from a local collector located on Lower Union Street between King Street and Ontario Street. It is a 46m long 1340 x 2110mm elliptical concrete pipe with a volume of 115 m^3. Combined sewer flow from the west and north (600 mm and 350 mm Ø respectively) enters the tank. The outlet chamber is equipped with a vortex device to limit outflows to 15 L/S. The overflow is located in a manhole downstream of the tank outlet chamber. Under low flow conditions, the downstream manhole directs flow to a 450 mm Ø sanitary sewer outlet to the east. Under high flow conditions, flow that cannot be contained in the tank is directed over a weir to a 450 mm Ø storm sewer to the east (storage overflow weir is 2550 mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #26 WEST STREET

PCP#26 is a CSO from a trunk sewer located in a manhole at the bend where West Street turns east becoming Ontario Street. Under low flow conditions, sanitary flow from the west and south (375mm Ø combined sewer and 900 mm Ø sanitary sewer respectively) continues north to the 1200 mm Ø sanitary trunk. Under high flow conditions, combined and sanitary flow will rise above the weir and overflow to the east 900 mm Ø storm sewer (storage overflow weir is 1400 mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #51 CLARENCE STREET

PCP#51 is a CSO in line tank outlet from a local collector located on Clarence Street between King Street and Wellington Street. It is a 78.5 m long box culvert (half 1800 x 2400mm and half 1800 x 3000 mm) with a volume of 380 m^3. Combined sewer flow from the west (450 mm Ø) enters the tank. The outlet chamber is equipped with a vortex device to limit outflows to 15 L/S. Under low flow conditions, the outlet chamber directs flow to a 250 mm Ø sanitary sewer outlet to the east. Under high flow conditions, flows that cannot be contained in the tank is directed over a weir to a 375 mm Ø storm sewer over a to the east (storage overflow weir is 2810mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #52 RAGLAN ROAD

PCP#52 is a CSO from a local collector located in a manhole on Raglan Road just west of the Rideau Street intersection. Under low flow conditions, combined wastewater flow from the west (900 mm Ø) enters the manhole and proceeds south east to the 375mm Ø outlet sanitary sewer. Under high flow conditions, flows are directed over a weir and into the 900 mm Ø overflow to the adjacent 900 mm Ø storm sewer (weir is 550 mm higher than the low flow sanitary outlet).

POLLUTION CONTROL PLAN (PCP) #53 UNION STREET

PCP#53 is a CSO from a local collector located in a manhole on Union Street at the Division Street intersection. Under low flow conditions, combined wastewater flow from the west (1350 mm Ø) enters the manhole and proceeds east to the 1350 mm Ø outlet combined sewer. Under high flow conditions, flows are directed over a weir and into the 900 mm Ø overflow to the adjacent 1050 mm Ø storm sewer.

POLLUTION CONTROL PLAN (PCP) #55 O'KILL STREET

PCP#55 is located in a chamber at the east end of the O'Kill CSO tank near the Murney Tower parking lot. Combined sewer from the O'Kill Pump Station enters the CSO tank via a 1200 mm ø sewer and is stored until it can be pumped back into the O'Kill Pump Station. During an overflow event, when the tank reaches capacity, combined wastewater is directed into an overflow trough and on to the overflow chamber to a 1350 mm ø storm sewer.

POLLUTION CONTROL PLAN (PCP) #56 COLLINGWOOD STREET

PCP#56 is located in a chamber at the south west corner of the Collingwood CSO Tank at Collingwood Street south of King Street. Combined sewer enters the CSO tank via a 1200 mm ø combined sewer pipe and is stored until it can be pumped back to the gravity system via a 250 mm ø sanitary forcemain. During an overflow event, when the tank reaches capacity, the combined wastewater is directed into an overflow chamber to a 1425 x 1925 mm storm sewer outlet pipe.

POLLUTION CONTROL PLAN (PCP) #65 BELLE PARK

PCP#65 is a SSO (Sanitary Sewer Overflow) from a local collector located in a manhole in Belle Park behind 525 Rideau Street. Low flow from the 1200 mm ø sanitary enter a 390 mm ø orifice and proceeds to the main mixing chamber. Flow from the two 900 mm ø sanitary trunk sewers enter the main mixing chamber. Overflows from the 1200 mm ø sanitary sewer enter directly to the upper level 1200 mm ø storm sewer. Low flow from the mixing chamber proceeds to the lower level 1200 mm ø sewer to River Street Pumping Station. Overflow from the mixing chamber is conveyed to the upper level 1200 mm ø storm sewer which outlets to the Lake.

POLLUTION CONTROL PLAN (PCP) #67 CHATHAM STREET

PCP#67 is a CSO located in a manhole on Chatham Street just north of the intersection with Elm Street. Under low flow conditions, wastewater flow from the west (450 mm Ø) enters the manhole and proceeds east to the 600 mm ø sanitary sewer. Under high flow conditions, flows are directed into a 900 x 900 mm overflow pipe to the adjacent 1350 mm ø storm sewer (440 mm higher than the low flow outlet).

POLLUTION CONTROL PLAN (PCP) #68 QUEBEC STREET

PCP#68 is a CSO located in a manhole on Quebec Street in the Barrie Street intersection. Under low flow conditions, wastewater flow from the south and west (300 mm and 375 mm Ø respectively) enters the manhole and proceeds north to the 450 mm ø sanitary sewer. Under high flow conditions, flows are directed over a weir into a 375 mm ø overflow pipe to the adjacent 1050 mm ø storm sewer (770 mm higher than the low flow outlet). As of 2015, PCP#68 has been temporarily plugged.

POLLUTION CONTROL PLAN (PCP) #70 CARLISLE STREET

PCP#70 is a CSO located in a manhole in the intersection of Carlisle Street and Chestnut Street. Under low flow conditions, wastewater flow from the south and west (300 mm and 225 mm Ø respectively) enters the manhole and proceeds east to the 375 mm ø sanitary sewer. Under high flow conditions, flows are directed to a 375 mm ø overflow pipe to the adjacent 1350 mm ø storm sewer (513 mm higher than the low flow outlet). As of 2015, PCP#70 has been temporarily plugged.

POLLUTION CONTROL PLAN (PCP) #71 ALFRED STREET

PCP#71 is a CSO located in a manhole on Alfred Street north of Princess Street and south of Elm Street. Under low flow conditions, wastewater flow from the south (375 mm Ø) enters the manhole and proceeds north to the 375 mm ø sanitary sewer. Under high flow conditions, flows are directed to a 250 mm ø overflow pipe to the adjacent 450 mm ø storm sewer (390 mm higher than the low flow outlet).

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Legend

- WWTP — WASTEWATER TREATMENT PLANT
- PS — SANITARY PUMPING STATION
- COMBINED SEWER OVERFLOW (CSO)
- SANITARY SEWER OVERFLOW (SSO)
- TANK OVERFLOW (TO)
- CSO (TEMPORARILY PLUGGED)

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

Scale:
0 125 250 500 Meters
1:17,500

Project:
Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title:
PCP OVERVIEW MAP

Project No.:	Date:		
151-02944-00	DECEMBER 2016		
Drawn By:	Checked By:	Code:	Figure No.:
CM	MF	BR	7-10

7.5.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of imminent Utilities Kingston capital improvement projects with proposed completion in 2015.

- Overflow Plugging:
  - Princess Street (PCP#08)
  - Frontenac Street (PCP#09)
  - North/Wellington (PCP#10)
  - Queen Street (PCP#15)
  - Brock Street (PCP#19, replace temporary plug with permanent plug)
  - Johnson Street (PCP#21)
  - Lower Albert Street PCP#31)
  - Chatham Street (PCP#67)
  - Alfred Street (PCP#71)
  - PCP#72
- West Street Bypass (PCP#26)
  - Weir adjustment to 75.5 m
- 900mm Overflow Pipe on PCP#53
  - New weir across pipe, elevation to be determined; approximately 88.0 m

8 KINGSTON EAST WASTEWATER SYSTEM

The City of Kingston East wastewater collection system comprises an area of approximately 1386 ha. It is generally bordered by Great Cataraqui River to the west, Macdonald-Cartier Freeway to the north, Ravensview WWTP access road to the east and Lake Ontario to the south. There are approximately 10,200 people living in Kingston East. Wastewater flow from Kingston East is conveyed to Ravensview WWTP. Figure 8-1 provides and overview of the wastewater system.

Legend

- WWTP — WASTEWATER TREATMENT PLANT
- PS — SANITARY PUMPING STATION
- PS — SANITARY PUMPING STATION (NOT MODELLED)
- FORCEMAIN
- EXISTING SANITARY SEWER
- MODEL CONDUIT
- COMBINED SEWER OVERFLOW
- TANK OVERFLOW
- SANITARY SEWER OVERFLOW
- WATERBODY

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KINGSTON, ONTARIO,
K7L 4X7

Project: Water and Wastewater Master Plan Updates

City of Kingston, Ontario

Title: KINGSTON EAST SANITARY COLLECTION 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: 0 150 300 600 Meters, 1:25,000

Project No.:	Date:	Drawn By:	Checked By:	Code:	Figure No.:
151-02944-00	DECEMBER 2016	CM	MF	BR	9-1

8.1 LINEAR INFRASTRUCTURE

8.1.1 SIZE, MATERIAL AND AGE

The diameter of the wastewater sewer system varies from 75 mm ø to 1350 mm ø as described in Table 8-1 and Figure 8-2. It should be noted that due to incomplete as-built information for several pipes, the construction year category “unspecified” is included in the age distribution for pipes. Additionally, the category “1900” was assigned to pipes that were old but had no specific construction date.

Table 8-1 Kingston East Wastewater Sewer Sizes

DIAMETER (mm)	LENGTH* (m)
Unspecified	159
75	171
100	608
150	3,402
200	32,768
250	8,471
300	6,757
350	1,048
375	1,875
400	1,100
450	3,379
525	29
900	3,461
1050	2,280
1200	2,921
1350	565
Total	**68,994**

**Data was obtained from Kingston GIS*

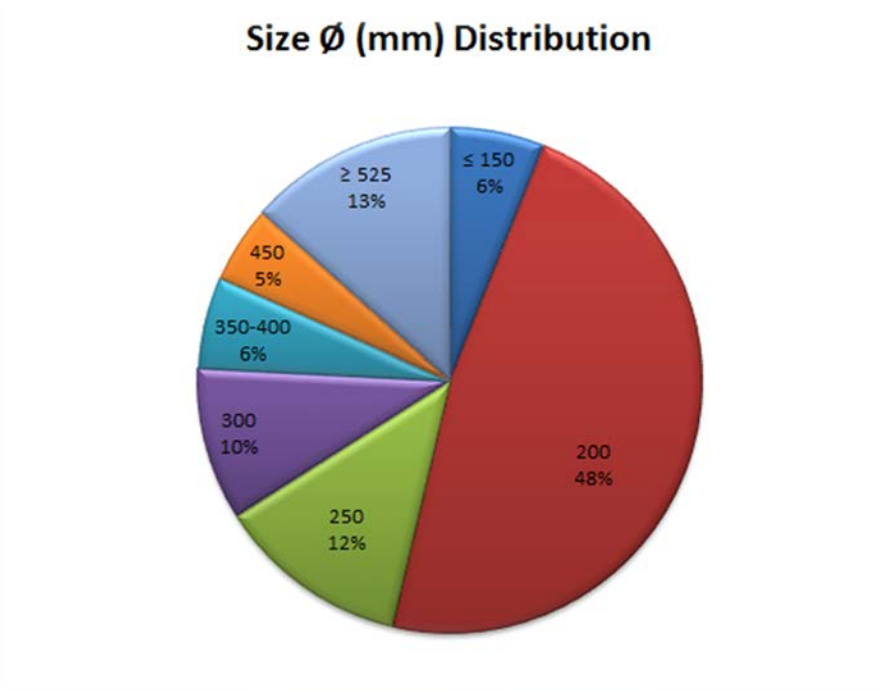

Figure 8-2 Kingston East Wastewater Sewer Size

The Kingston East wastewater collection system is made from asbestos cement (AC), cast iron (CI), clay, concrete (CONC) and polyvinyl chloride (PVC). This is summarized in Table 8-2 and Figure 8-3. It should be noted that the material of several pipes is unspecified due to an incomplete asset inventory for material.

Table 8-2 Kingston East Wastewater Sewer Material

MATERIAL	LENGTH* (m)
Unspecified	15,002
AC	3,120
CI	1,608
CLAY	1,501
CONC	13,394
PVC	34,369
Total	**68,994**

**Data was obtained from Kingston GIS*

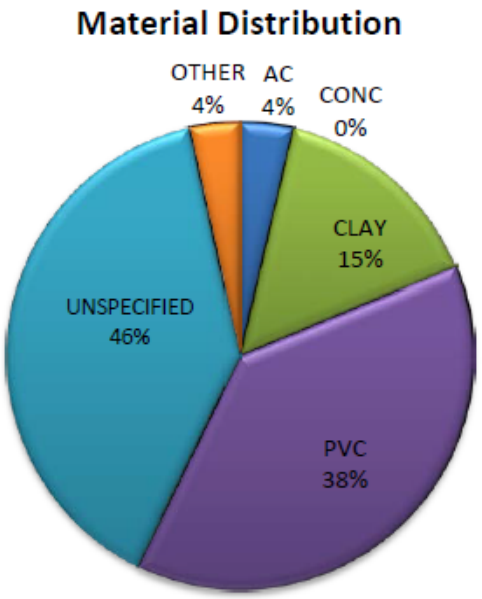

Figure 8-3 Kingston East Wastewater Sewer Material

The Kingston East wastewater collection system was built between the year 1940 and present. This is summarized in Table 8-3 andFigure 8-4.

Table 8-3 Kingston West Wastewater Collection System Installation Year

YEAR INSTALLED	LENGTH* (m)
Unspecified	6,200
1940-1950	5,931
1951-1960	10,561
1961-1970	1,651
1971-1980	8,742
1981-1990	7,773
1991-2000	10,752
2001-2010	13,772
2011-present	3,612
Total	**68,994**

**Data was obtained from Kingston GIS*

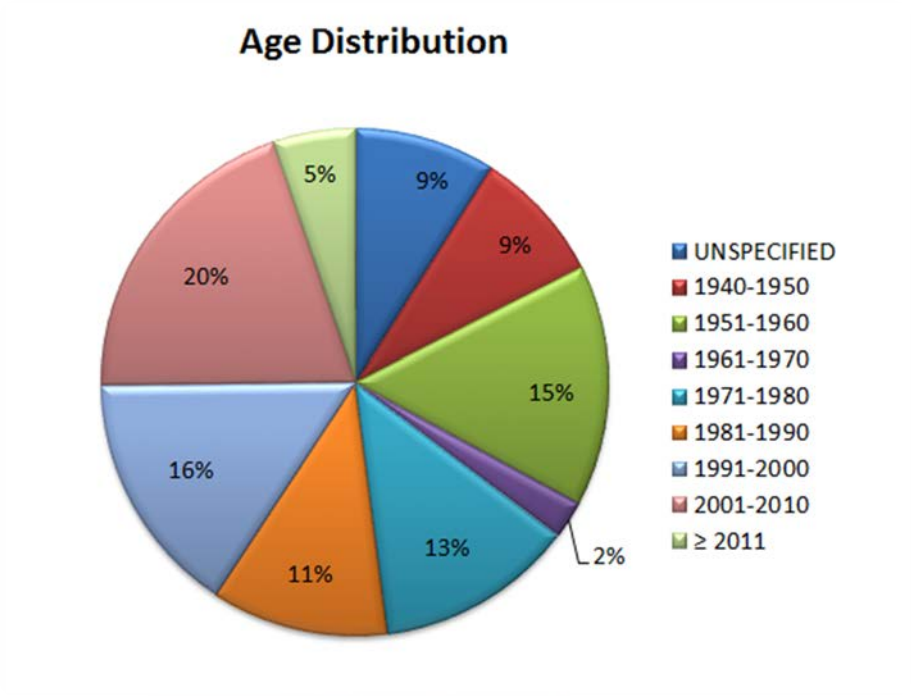

Figure 8-4 Kingston East Wastewater Sewer Year

8.1.2 PROPOSED CAPITAL IMPROVEMENT PROJECTS

Below is a list of current Utilities Kingston capital improvement projects in Kingston East.

- River Street Forcemain Twinning
  - UK has initiated a Municipal Class Environmental Assessment (Class EA) study for the River Street Pump Station Twin Forcemain Extension. The notice of completion was issued in January 2012. Project is almost complete.
- Ravensview Trunk Sewer Twinning
  - UK has initiated a Municipal Class Environmental Assessment (Class EA) study for the Ravensview Trunk Sewer Twinning. The notice of completion was issued in January 2012. Project is currently deferred.
- Highway 15 Trunk Sewer Upsize/Twinning
  - Section of Highway 15 trunk sewer upsize to 450 mm, to be completed along with Highway 15 widening
  - Section of Highway 15 trunk sewer upsize to 525 mm

8.2 PUMP STATIONS

The Kingston East Wastewater System has five pump stations. Please refer to Figure 4-6 for a flow chart outlining the pump station organization and Figure 8-1 for a map showing the Kingston East wastewater collection system. Table 8-4 provides information for each pump station.

Table 8-4 Kingston East Pump Stations

PUMP STATION	LOCATION	NO. OF PUMPS	RATED CAPACITY	DRAWDOWN TEST CAPACITY (2008)	AVERAGE FLOW (2013)
James St. PS	213 James Street	3	No Data	30 L/s 44 L/s 54 L/s	740 m^3/day
Schooner Dr. PS	22 Schooner Drive	2	18 L/s @ 14.5m	16 L/s 15 L/s	1275 m^3/day
Kenwoods Circle PS	84 Kenwoods Circle	2	38 L/s @ 28m	44 L/s 20 L/s	74 m^3/day
Barrett Ct. PS	723 Barrett Crescent	3	No Data	103 L/s 107 L/s 98 L/s	2320 m^3/day
HWY 15 PS	289 Main Street	2	No Data	54 L/s 55 L/s	514 m^3/day

8.2.1 PROPOSED CAPITAL IMPROVEMENT PROJECTS

→ Kingston East - Rideau Community Sanitary Sewer System Upgrades

- UK has initiated a Municipal Class Environmental Assessment (Class EA) to examine the required sanitary sewer upgrades in Kingston East- Rideau Community Sewer System (Riverview Pump Station)

8.3 COMBINED SEWER OVERFLOWS

There are no active combined sewer overflows in Kingston East.

8.4 RAVENSVIEW WASTEWATER TREATMENT PLANT

The Ravensview WWTP is located at 947 Highway #2 East in Kingston City (within the County of Frontenac). The treatment plant is operated under amended Environmental Compliance Approval (ECA) number 4097-6QDMTW.

The raw wastewater entering the Ravensview WWTP is primarily of domestic origin.

The Ravensview WWTP is secondary treatment plant which utilizes biological aerated filters (BAF) to achieve its effluent objectives. The plant has a rated capacity of 95,000 m^3/d and a peak capacity of 193,000 m^3/d.

8.4.1 UNIT PROCESS DESCRIPTION

Sewage enters the Ravensview WWTP via a 1350 mm diameter gravity sewer. Preliminary treatment consists of coarse mechanically cleaned bar screen and aerated grit tanks.

Primary treatment consists of seven rectangular settling tanks. Primary effluent is directed by gravity to the Intermediate Primary Effluent Pump Station. Settled sludge and scum are pumped to the sludge digestion system. Alum is dosed into the aerated grit tanks to assist with the removal of phosphorus and the settling of solids.

Secondary treatment consists of one 11-cell biological aerated filter. Each BAF cell has a filtration area of 147 m^2. Air is supplied by three positive displacement blowers. A 1,286 m^3 backwash system and two 1,370 m^3 spent backwash water storage tanks are part of the process.

Secondary effluent is disinfected year-round using sodium hypochlorite. The treated effluent from the facility is discharged to the St. Lawrence River.

Waste sludge generated at the site are processed through an anaerobic digestion system consisting of a four digester vessels, one with the ability to conduct temperature phased anaerobic digestion. Stabilized Biosolids are dewatered using a centrifuge and the Biosolids cake is spread on agricultural lands as a nutrient and soil conditioner. Temporary storage of Biosolids cake is provided at the site.

A process flow schematic of the liquid treatment train is presented in Figure 8-5.

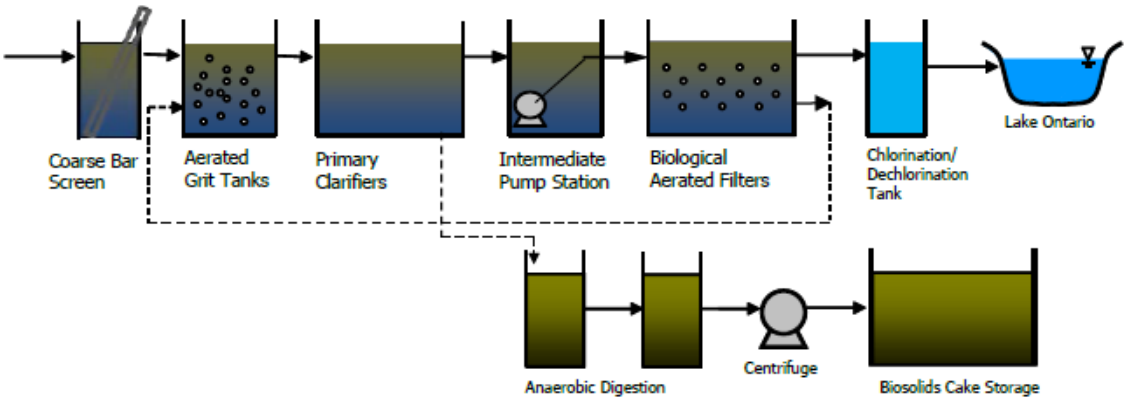

Figure 8-5 Ravensview WWTP Process

A description of the unit processes is provided in Table 8-5 below.

Table 8-5 Ravensview WWTP Unit Process Design Data

UNIT PROCESS	DESCRIPTION
Inlet Works	Three 12 mm mechanical bar screens Two aerated grit tank (18 m wide, 3.37 m long and 3.8 m deep)
Primary Treatment Facilities	Rectangular clarifiers consisting of: → Seven clarifiers, each measuring 31.7 m x 15.25 m x 3.7 m SWD → Two scum pumps, each rated at 13 L/s. → Seven progressive cavity raw sludge pumps, each rated at 11 L/s to transfer primary sludge to the sludge digestion process.
Intermediate Primary Effluent Pumping Station	A pumping station to transfer primary effluent from the primary clarifiers to the biological aerated filtration system consisting of: → Four submersible pumps, each with a capacity of 2.23 m^3/s.
Secondary Treatment Facilities	One Biological Aerated Filter consisting of: → 11 cells each having a filtration area of 147 m^2 and a media depth of 3.5 m. → Four high speed centrifugal blowers providing approximately 3,533 cubic metres per hour to the biological aerated filtration tanks.
Phosphorus Removal	Three chemical feed pumps adding alum at a rate of up to 180 L/hr, with two 35 m^3 liquid coagulant storage tanks.
Disinfection	One 900 m^3 chlorine contact chamber connected in series with one 960 m^3 baffled chlorine contact tank having the dimensions of 14.3 m x 17.8 m x 5.0 m (SWD). Three chemical feed pumps adding sodium hypochlorite at the rate up to 680 L/hr and chemical storage in three tanks, each with a capacity of 17,000 L. Two chemical metering pumps rated at 10 L/hr to provide disinfection prior to discharge to the St. Lawrence River. The dechlorination agent is stored in one 15 m^3 tank.
Outlet Works	One outfall, with a diameter of 1,050 mm.
Sludge Digestion Process	An anaerobic digestion system consisting of: → Two Primary Digesters with an effective volume of 2,465 m^3 → One Secondary Digester with an effective volume of 3,700 m^3 → One Temperature Phased Anaerobic Digester with a volume of 2,465 m^3 → Three sludge recirculation pumps rated at 30 L/s

UNIT PROCESS	DESCRIPTION
	→ Two sludge transfer pumps rated at 11 L/s → Two sludge recirculation pumps rated at 132 L/s → Two Dewatering Centrifuge rated at 9.1 L/s → Enclosed Biosolids Cake Storage Facility with a capacity of 6,000 m^3

8.4.2 EFFLUENT CRITERIA

The plant is required to meet average monthly concentration and annual average loading limits for $cBOD_5$, total suspended solids, and total phosphorus. The effluent compliance limit for E. coli is 200 organisms per 100 mL based on a monthly geometric mean density. The effluent objectives and limits are summarized in Table 8-6 as per ECA requirements.

Table 8-6 Ravensview WWTP Effluent Objectives and Compliance Criteria

PARAMETER	EFFLUENT OBJECTIVES	NON-COMPLIANCE LIMIT CONCENTRATION	NON-COMPLIANCE LIMIT TOTAL LOADING
$CBOD_5$	15 mg/L	25 mg/L	2,375 kg/d
TSS	15 mg/L	10 mg/L	2,375 kg/d
Total P	0. 8 mg/L	0.6 mg/L	95 kg/d
Total Chlorine		0.04 mg/L	N/A
Total Ammonia Nitrogen	Oct–May 12 mg/L Jun&Sep 7 mg/L Jul-Aug 5 mg/L	N/A	N/A
Acute Lethality		Non-Lethal	N/A
E. coli	100 organisms per 100 mL	200 organisms per 100 mL	N/A
pH	6.0-9.5	6.0-9.5	N/A

8.4.3 HISTORICAL FLOWS AND PERFORMANCE

Historical average and maximum day flows to the Ravensview WWTP from 2010 to 2014 are shown in Figure 8-6 along with the ECA effluent flow rate limits. Flow data was obtained from the 2010 to 2014 Wastewater Annual Reports. Historically, the plant has remained in compliance with the average day flow limit of 95,000 m^3/d.

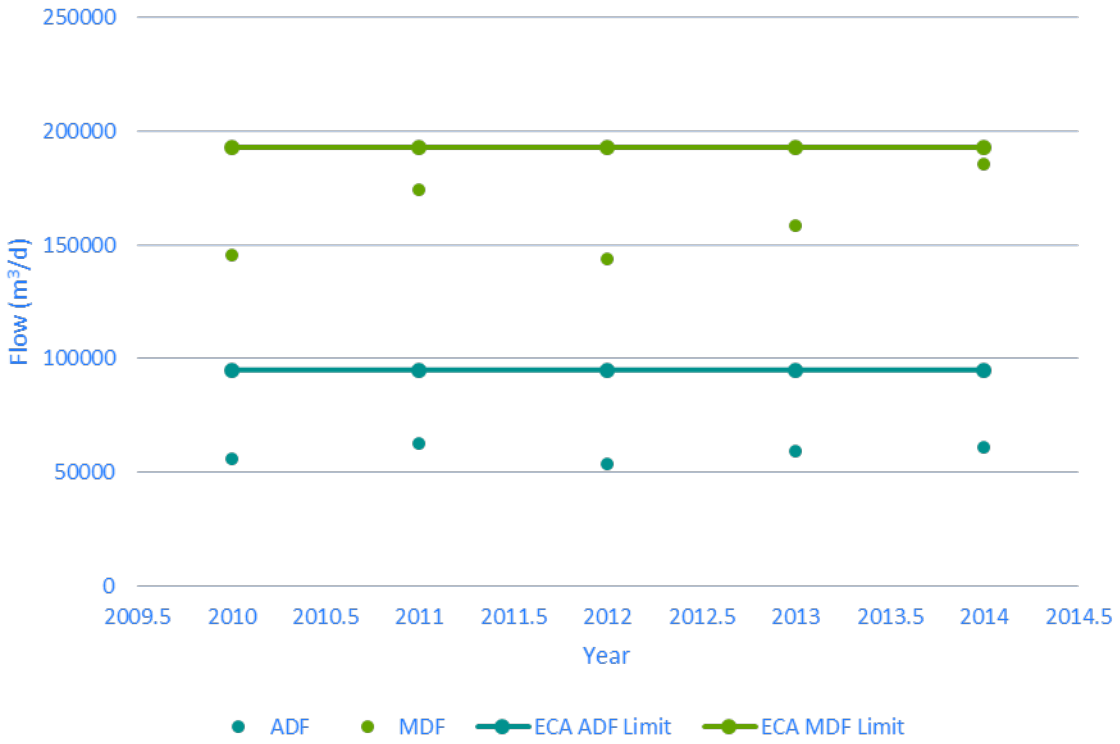

Figure 8-6 Ravensview WWTP Historical Flows

Historical effluent quality, obtained from the Wastewater Annual Reports, is summarized in Table 8-7. On average, limits were not exceeded for any of the effluent parameters from 2010 to 2014.

Table 8-7 Ravensview WWTP Effluent Quality

PARAMETER	2010	2011	2012	2013	2014	LIMIT
$CBOD_5$ (mg/L)	5.6	3.3	2.6	2	2.2	25
Suspended Solids (mg/L)	3.9	2.7	4.1	5.2	4.3	25
Total Phosphorus (mg/L)	0.46	0.39	0.45	0.49	0.42	1
Total Chlorine (mg/L)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Acute Lethality	pass	pass	pass	pass	pass	pass

8.4.4 PROPOSED CAPITAL IMPROVEMENT PROJECTS

There are currently no Utilities Kingston capital improvement projects for the Ravensview WWTP.

8.5 CANA WASTEWATER TREATMENT PLANT

The Cana WWTP is located at Cana Boulevard, Just north of Kingston Mills Road, in the City of Kingston. The treatment plant is operated under amended Environmental Compliance Approval (ECA) number 2-0288-70-731116.

The raw wastewater entering the Cana WWTP is primarily of domestic origin.

The Cana WWTP is a rectangular extended aeration package plant. The plant has a rated capacity of 94.6 m^3/d.

8.5.1 UNIT PROCESS DESCRIPTION

Sewage enters a wetwell as the head of the Cana WWTP from the gravity wastewater collection system. Pumps transfer the influent through a manually raked bar screen and into the secondary treatment system.

Secondary treatment consists of an aeration tank equipped with diffusers. Air is supplied by two centrifugal blowers. Secondary clarification of the mixed liquor occurs in a conical clarifier. All settled sludge from the clarifier is transferred back into the aeration tank for storage until it is removed from the system via a haulage service.

The treated effluent is disinfected with chlorine & De-chlorinated and is discharged to a ditch that drains into Colonel By Lake.

A process flow schematic of the liquid treatment train is presented in Figure 8-7.

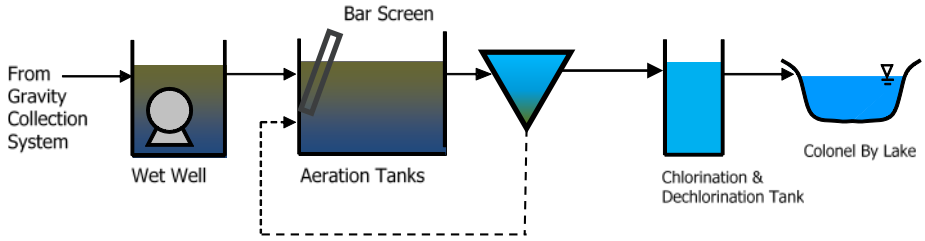

Figure 8-7 Cana WWTP Process

A description of the unit processes is provided in Table 8-8 below.

Table 8-8 Cana WWTP Unit Process Design Data

UNIT PROCESS	DESCRIPTION
Inlet Works	One Wet Well (approximately 2.52 m x 3.35 m x 1.2 m (distance of invert pipe over base) Two Influent Transfer Pumps One manually raked bar screen
Secondary Treatment Facilities	One rectangular treatment unit consisting of: → Aeration tank approximately 7.54 m x 3.35 m x 3.05 m SWD (assumes freeboard of 600 mm) with coarse bubble diffusers → Two centrifugal blowers One conical clarifier consisting of: → Square clarifier measuring approximately 3.35 m x 3.35 m. → one airlift pump to pump the return activated sludge from the clarifier to the aeration tank
Disinfection	One concrete chlorine contact chamber (approximately 0.6 m wide and 3.35 m long)
Outlet Works	200 mm diameter effluent sewer from the chlorine contact chamber to the outlet headwall discharging to the Colonel By Lake.

8.5.2 EFFLUENT CRITERIA

The plant's ECA does not require the plant to achieve a specific effluent limits.

8.5.3 HISTORICAL FLOWS AND PERFORMANCE

Historical average and maximum day flows to the Cana WWTP from 2010 to 2014 are shown in Figure 8-8 along with the ECA effluent flow rate limits. Flow data was obtained from the 2010 to 2014 Annual Summary Spreadsheets. Historically, the plant is at its average day flow limit of 94.6 m^3/d, and the Utility has undertaken an environmental assessment to recommend a solution for this site.

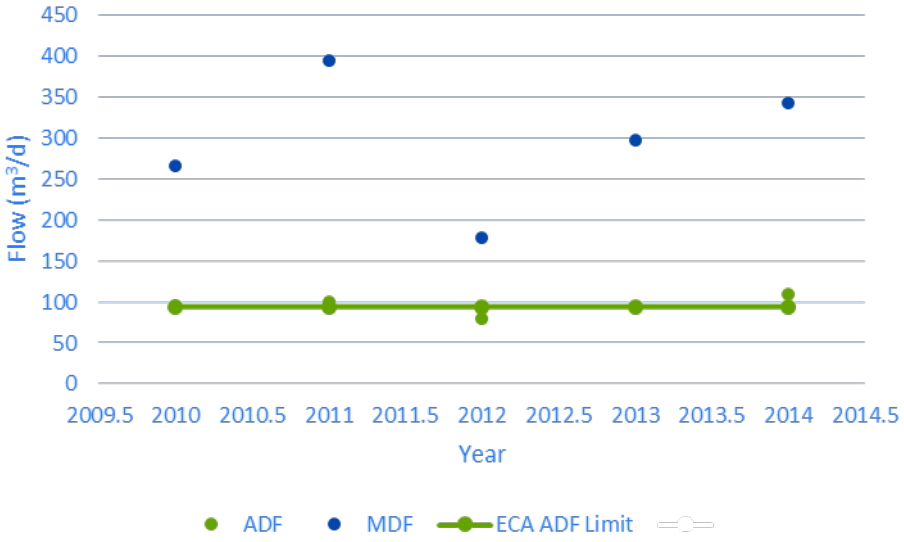

Figure 8-8 Cana WWTP Historical Flows

8.5.4 EXISTING DEFICIENCIES AND CAPACITY LIMITATIONS

The Cana WWTP is nearing the end of its useful service life and is in need of repairs and/or replacement. An EA has been completed recommending the replacement of the existing plant with an SBR type system.

8.5.5 PROPOSED CAPITAL IMPROVEMENT PROJECTS

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

- Cana WWTP Upgrades - General Contractors Pre-Qual (UK-14-13)
- Cana WWTP Upgrades - Mechanical Subcontractors (UK-14-14)
- Cana WWTP Upgrades - Electrical Sub-Contractors (UK-14-15)

9 GROWTH STUDIES

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. 12 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 Wastewater Masterplan.

9.3 COMMERCIAL INVENTORY AND MARKET ANALYSIS

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 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 COMMERCIAL STUDY UPDATE

The Regional Commercial Study Update was completed by Sorensen Gravely Lowes and Urban Metrics 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 recently completed Commercial Market Inventory Analysis (UrbanMetrics Inc., 2008).

9.6 CITY OF KINGSTON PLANNING INFORMATION

The City of Kingston Planning Department provided mapping and reports related to the current (up to the end of December 2014) Committed and Pending Urban Residential Subdivisions, Site Plans and Secondary Plans. These report detailed the City's currently approved (Committed) residential plans and plans that have been submitted to the City and are currently being reviewed (Pending). The reports detailed specific developments, the type of number of residential units (i.e. single family, semi-detached etc.) as well as the number of remaining development units (for Committed subdivision) based on issued building permits.

10 MODELING

10.1 MODEL SUMMARY

The wastewater model is a trunk sewer representation of the City's collection system and was originally developed using InfoSWMM Suite 10.0. WSP completed the last update of the model from the *Front Rd. Water Interconnection and Portsmouth PS Forcemain Environmental Assessment* and is using this version to make a new model update for it to be suitable for Master Plan simulations.

The model represents the sewer system which divides the City of Kingston into three (3) main collection areas (Kingston West, Kingston Central, Kingston East) that outlets to two (2) separate waste water treatment facilities. The west system, which generally includes the portion of the City within the urban boundary west of Little Cataraqui Creek, collects and conveys flows to Cataraqui Bay WWTP. The central and east systems, which generally include the area east of the Little Cataraqui Creek, discharge to Ravensview WWTP. The Kingston Central and Kingston East catchment areas are divided by the Cataraqui River where flows are conveyed from Kingston Central via the River Street Pumping Station forcemain to Kingston East.

- To represent the City's sewer system the model uses a combination of pipe elements (conduits), pipe nodes (junctions), storage nodes (pump stations, CSO tanks and wet wells) and weirs/orifices (PCP's, combined sewer overflow locations). The following is an approximate summary of unique InfoSWMM model elements:
- 290 Sub catchments
- 850 Conduits
- 800 Junctions
- 16 Storage Nodes (PS, CSO Tanks, Wet Wells)
- 18 Weirs/Orifices (PCP's, CSO's)

10.2 SUPPORTING MODELING DATA

In support of updating the model various amounts of data is required as model inputs which serve as the basis for accurate model representation of observable field conditions. This section describes the data received in support of the Master Plan model update.

10.2.1 RAINFALL DATA

Utilities Kingston has provided collected rainfall data from their River St. weather station for the years of 2013 and 2014, similar to the provided SCADA and flow data. This data is used in conjunction with researched Queen's University and Environment Canada rainfall data to verify the major rain events during these calendar years and to form the basis of rainfall input for extended period simulation into the trunk sewer model and wet-weather calibration.

In addition to the River St. rain data Utilities Kingston has also provided WSP with 2008 rain data and AES design storm data for 12-hr storm events. This information is used to validate the model to previous versions and for simulation of design storm events and peak CSO scenarios.

10.2.2 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 dry-weather loading for the trunk model and is also used for the development of diurnal patterns and model calibration.

10.2.3 AS-BUILTS, PUMP DETAILS, 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 provided for various Pumping Stations, CSOs and other PCP's. A summary of the facilities and their associated monitoring information can be found in Section 4 (Table 4-2). Information from CSO monitoring data was retrieved separately from Utilities Kingston's FlowWorks.com account. A summary of the CSOs' status, location, type and associated monitor can be found in Section 4 (Table 4-1). The hydraulic information compiled from this is summarized for facilities, including pumping stations as Hydraulic Summary Sheets. Table 10-1 below lists the in-line sewer monitors, their location and their status.

Table 10-1 In-Line Sewer Monitor Summary

MONITOR ID	MANHOLE #	STATUS
C7b	8554E-070	Currently Monitored
C1	2285-020	Currently Monitored
C10	N/A	Previously Monitored
C11	0828-010	Currently Monitored
C12	2140-010	Currently Monitored
C13	3213-010	Previously Monitored
C14	7954-160	Previously Monitored
C15	9227E-070	Currently Monitored
C16	5405-030	Currently Monitored
C17	3941E-050	Currently Monitored
C18	0048-030	Currently Monitored
C19	9231-030	Currently Monitored
C2	5402-010	Previously Monitored
C20	N/A	To be determined

MONITOR ID	MANHOLE #	STATUS
C21	8902-010	Currently Monitored
C22	3204-020	Currently Monitored
C23	3406-100	Currently Monitored
C24	3208-010	Planned Site, Pending
C25	3210-010	Planned Site, Pending
C26	0329E-050	Currently Monitored
C27	0329-030	Planned Site, Pending
C28	N/A	N/A
C29	N/A	N/A
C3	9227E-010	Currently Monitored
C30	N/A	N/A
C4	7104-010	Previously Monitored
C5	9903-110	Previously Monitored
C6	9729-010	Currently Monitored
C7	8554E-040	Previously Monitored
C8	0004-010	Currently Monitored
C9	N/A	N/A
E1	0630-020	Currently Monitored
E2	0633-100	Currently Monitored
E3	N/A	N/A
E4	N/A	N/A
Kingston12	0837E-020	Previously Monitored
Kingston13	0842-030	N/A
Kingston14	9228E-010	Previously Monitored

MONITOR ID	MANHOLE #	STATUS
Kingston15	0526-040	N/A
Kingston16	32149E-020	N/A
Kingston17	0630-020	N/A
W1	33240-020	Currently Monitored
W10	32149E-020	Currently Monitored
W11	31325E-110	Previously Monitored
W12	0842-230	Previously Monitored
W13	0526-040	Currently Monitored
W14	0842-060	Currently Monitored
W15	35511-040	Currently Monitored
W16	32321-020	Currently Monitored
W17	0769E-230	Currently Monitored
W18	N/A	N/A
W19	N/A	N/A
W2	33024-010	Previously Monitored
W20	N/A	N/A
W3	0346-210	Previously Monitored
W4	33738-010	Previously Monitored
W5	33472-010	Currently Monitored
W6	34023-020	Previously Monitored
W6b	34156-010	Previously Monitored
W7	0837E-020	Currently Monitored
W8	0345E-150	Currently Monitored
W9	9853-010	Currently Monitored

10.2.4 CATCHMENT AREAS AND COMBINED SEWER SEPARATION

In addition to the standard GIS data provided for infrastructure updates, Utilities Kingston has also provided sanitary catchment and sub catchment data for the entire sanitary service area as well as the projected combined sewer separation areas for Kingston Central. The combined sewer separation was divided into 2012, 2013, 2014, 2020, 2025 and 2035 yearly projections.

10.3 MODEL ADDITIONS

As summarized in Table 10-2, 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 10-2 Alternatives/Inclusions and Infrastructure Additions

MODEL ALTERNATIVES / INCLUSIONS	
Calibration to 2013/2014 flow and rainfall data	
2013/2014 diurnal patterns developed from flow data	
2013/2014 adjusted water consumption loading	
2014, 2015, 2021, 2026, 2036 Combined Sewer Area separation GIS Data	
Alternative for Dry-Weather and Wet-Weather flow for calibrated conditions	
INFRASTRUCTURE ADDTIONS / UPGRADES	
General	Model element additions identified in RFP and from 2015 GIS Data Update (Including secondary pumping stations, CSOs, SSOs, etc.)
Point Works	West St Bypass (PCP#26) weir adjustment to 75.5m (2015)
	Permanent plugging of: → Queen St CSO (PCP#15) (2015) → North/Wellington CSO (PCP#10) (2015) → Brock St (PCP#19, replace temp plug with permanent) (2015) → Johnson St CSO (PCP#21) (2015) → Lower Albert St CSO (PCP#31) (2015)
	New weir across 900mm overflow pipe on PCP#53 at Union/Division.
Linear Works	Yonge St sewer upsize (Johnson to Portsmouth PS)
	River St PS Forcemain Twinning
	New 'Riverview PS' forcemain, from new PS location near waterfront to Hwy15 trunk sewer roughly at 0636-010

Facilities	Portsmouth Pumping Station upgrades and Forcemain to Cataraqui Bay WWTP (2019)
	Greenview PS Upgrades (2016)
	Schooner Drive PS will be replaced with a new “Riverview PS” located in the quarry property (2018)
	Hatter Drive PS Decommissioning (2016)