

Environmental Services

Department

**2022 Wastewater Collection
Performance Report**

April 2023



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EXECUTIVE SUMMARY

The City of Markham (the City) Wastewater Collection System (Collection System) is a separate sanitary system that serves the City's residents, businesses and institutional users. The City's Collection System discharges to the Regional Municipality of York (York Region) trunk wastewater collection system for further conveyance and treatment.

This 2022 Wastewater Performance Report (the Report) of the Collection System is prepared in anticipation of requirements by the Ministry of the Environment, Conservation and Parks (Ministry), under the new Consolidated Linear Infrastructure (CLI) approval program.

This is the first time the City is reporting the performance of its Collection System. An inherent challenge in this process is the lack of baseline information or comparative indicators to assess performance. This Report attempts to identify and create such baseline to assist the City to continue monitoring and recording the system performance in subsequent years.

The Environmental Services staff performs a number of operations and maintenance activities, asset management programs, as well as infrastructure renewal to ensure the Collection System performs as expected in compliance with provincial regulatory requirements and in conformance with industry's best management practices.

In 2022, the City had a total of two (2) sewage spills as a result of blockages, and had no system overflows due to wet weather events. The City received 143 public complaints associated with the Collection System, eight (8) of which were located on the public side, which resulted in two (2) sewer backups. From the total of 143 complaints, 135 were related to lateral sewer back-ups (originated from private property). The City addressed and resolved all these issues. In 2022, the City continued its monitoring and assessment of inflow/infiltration (I/I) in coordination with York Region.

In 2022, the City continued with implementation of specific elements of a Wastewater Management System (WWMS), consistent with corresponding elements of the Drinking Water Quality Management System (DWQMS). Such elements include, system monitoring, record keeping, financial management, emergency management, essential suppliers, personnel coverage, risk assessment, organizational roles, sampling and monitoring, infrastructure renewal, and continual improvement. Finally, for all planning, design, and construction aspects, the City has a number of support programs. These support programs, along with the efficient operation of the Collection System, work together to reduce and mitigate significant operational risks such as flooding, sewer system overflows and spills to the environment.

1 INTRODUCTION

This Report was completed to document compliance with the *Environmental Protection Act* (EPA) and the *Ontario Water Resources Act* (OWRA). It is also well positioned to fulfill the future requirements by the Ministry under the new CLI Environmental Compliance Approval (ECA) program.

This is the first time the City is reporting performance of its Wastewater Collection System (Collection System). The performance is being assessed considering the system inspections, monitoring, repair and maintenance programs, and other support programs. This Report is organized to address the following aspects of the City's Collection System:

1. A description of the organization, overview of the Collection System and management programs
2. An overview of the Collection System performance
3. A description of the maintenance activities carried out in 2022

1.1 Environmental Services Department Organization

The City's Collection System is managed by the Environmental Services Department (ES). The ES Department is structured with several Divisions with specific responsibilities. These groups work collaboratively and in close coordination to ensure compliance and delivery of sanitary collection services. Table 1 describes the primary responsibilities for these groups.

Table 1. Environmental Services – Division's Responsibilities

ES Divisions	Areas of Responsibility
Business Administration (BA)	Maintain compliancy in corporate financial procedures, legislative requirements for health and safety training, operators' training and licencing. Oversee wastewater management system, After Action Review (AAR), water meter maintenance program.
Infrastructure (INF) – IMS and Capital Planning	Planning of all Infrastructure Capital Works by analyzing and prioritizing them in line with international Asset Management best practices, develop & update short-term and long-term Infrastructure replacement needs/plan, update 25-year lifecycle reserve study, Management of Information Systems (IMS).
Infrastructure – Capital Delivery	Responsible for implementation of Infrastructure replacement, rehabilitation and preventive maintenance projects.
Infrastructure - Stormwater	Implementation of storm capital projects, Inflow and infiltration (I/I), flow monitoring. Strategic focus on the direction and management of City-wide storm sewer network, including flood control remediation, erosion control and stormwater management ponds maintenance.
Waterworks - Operations & Maintenance (O&M)	Sewer system operations, SCADA, pump stations instrumentation and preventative maintenance, customer service, CCTV and sewer flushing (in-house) program, hot spots program, preventative and corrective maintenance and emergency response.

Waterworks - Systems Engineering (SE)	New development and capital project review, Collection System design standards, I/I, sewer system modelling, water quality monitoring and effluent compliance, legal agreements, Sewer-use bylaw, temporary discharge permits, spill records, damage sewer investigation for cost recovery & repair, fat-oil-grease (FOG) program
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Other City departments provide critical services to assist ES Department in ensuring compliance and adequate performance. Other Departments involve:

- Operations – For fleet management, inventory controls
- Contact Centre and Security – For after hours customer support
- Finance – For procurement and corporate financial management
- Sustainability & Asset Management (S&AM) – For corporate asset management, and building facility maintenance
- Engineering – For new development and system expansions

1.2 Description of the Collection System

The Collection Systems is comprised of works for the collection and transmission of sewage, consisting of a separate sewage system and pumping stations. The City's Collection System consists of (Table 2):

- 929 km of sewers
- 5.5 km of forcemains
- 5 sanitary sewage pumping stations (SPS)
- 14,646 maintenance holes (MHs)
- 3 siphons

Table 2. Sanitary Sewage Collection System by Length

System Type	Pipe Diameter (mm)	Length (km)	Total Length (km)
Gravity Sewers	0 – 250	760.7	929
	300 – 500	119.0	
	525 – 1,050	46.7	
	≥ 1,200	2.6	
Forcemains	0 – 250	3.6	5.5
	300 - 500	1.9	
	≥ 525	N/A	
Total Length			934.5

*Data as of December 2022.

The City Collection System discharges to The Regional Municipality of York (York Region) Trunk Sewage System, which then is conveyed for treatment to The Regional Municipality of Durham (Durham Region).

A map of the Collection System is found in **Appendix A**. The City and York Region have a Partnership Agreement. Under this agreement, wastewater from the City's Collection System is conveyed to York Region through specific interconnections. There are a total of 106 interconnections, which vary year over year. In 2022, the City's water system supplied 30.45 million of m³ of drinking water to all customers. While there is no accurate number measured for sewage collection industry standard indicates that about 90% (or 27.41 million m³) is the volume of wastewater collection. Sewage is subsequently conveyed for treatment to Durham Region's Duffin Creek Water Pollution Control Plant, located in the City of Pickering before its final discharge into Lake Ontario.

1.3 Asset Management Program

The Asset Management Program relies on a number of activities that support compliance with requirements under the O. Reg. 588/17 for Asset Management Planning for Municipal Infrastructure (Table 3). These programs are carried out routinely and also with a holistic approach with a focus on criticality and condition-based assessments. The successful implementation of these programs assists the reduction of risks associated with infrastructure, reliability of provision of services, and compliance with regulatory requirements.

Table 3. Asset Management Program

Name	Responsible	Description	Frequency
Financial management	BA	<ul style="list-style-type: none"> Annual budget allocations Financial management 	<ul style="list-style-type: none"> Annual Monthly
Infrastructure Life Cycle	INF-IMS/CP	Infrastructure capital planning and update of life cycle	Annual
Sanitary sewer mains relining/ replacement	INF – Capital Delivery	<ul style="list-style-type: none"> Relining/ replacement of sewer mains and service connections, where required 	As needed
Sanitary Sewer Rehabilitation	INF-Storm	<ul style="list-style-type: none"> Based on CCTV results annually 	Annual
Infrastructure renewal & New development	SE	<ul style="list-style-type: none"> Engineering design standards Assets from New Development & RIGS 	As needed
Sanitary Pump station condition assessments	O&M/SE	<ul style="list-style-type: none"> For SPS For forcemains 	10 year cycle
Sanitary Pump station – component replacements	O&M	<ul style="list-style-type: none"> Component replacements Compliance with updated regulations 	As needed
SCADA Improvements	O&M	<ul style="list-style-type: none"> SCADA hardware and software SPS communications equipment 	Continual
Collection System modelling & monitoring	SE / INF-Storm	<ul style="list-style-type: none"> Collection System hydraulic modelling Flow monitors and I/I studies 	Continual
MH Inspection	O&M	<ul style="list-style-type: none"> Hot Spots & Easement MH inspection Routine area-based MH inspection 	<ul style="list-style-type: none"> Monthly 10-year

Sanitary pump station Maintenance	O&M	<ul style="list-style-type: none"> Preventative maintenance Reactive maintenance & emergency 	Various
Sewer CCTV inspections	INF / O&M	<ul style="list-style-type: none"> 10-year cycle Hot Spots and Emergency 	<ul style="list-style-type: none"> 10 year cycle Various
After Action Review (AAR)	BA	<ul style="list-style-type: none"> Continual improvement 	As needed

1.4 Wastewater Management System

Since 2018, the City initiated the development and implementation of a Wastewater Management System (WWMS) for the operation of the City's Collection System. The WWMS is in progress and currently includes specific elements consistent with the DWQMS:

- **Record keeping** – This is managed through the City's Computerized Maintenance Management System (CMMS) (i.e. EAM). This corresponds to Element 5 of the DWQMS.
- **Emergency management** – This includes ES Emergency Response Plan. This plan provides guidance on how ES Department staff will organize resources and respond to a water emergency events, which is used as a framework for wastewater emergencies. This corresponds to Element 18 of the DWQMS.
- **Financial management** – This is managed through the City's annual budget process, and Water rate Fees model, which is updated every year. This corresponds to Element 2, 14 and 15 of the DWQMS.
- **Risk Assessment** – This annual review of wastewater hazardous events and risks is conducted annually by the ES Department. This corresponds to Elements 7 and 8 of the DWQMS.
- **Organizational structure, roles and responsibilities** – This is accomplished with the ES Department organizational structure. Roles and responsibilities are documented and supported by the City's Human Resources Department. This corresponds to Elements 9 and 10 of the DWQMS.
- **Personnel coverage** – This is accomplished through the ES Business Continuity Plan, and a Standby Protocol that ensures coverage to respond to emergencies on the Collection System 24-7 for 365 days per year. This corresponds to Element 11 of the DWQMS.
- **Essential suppliers and services** – This corresponds to Element 13 of the DWQMS.
- **Infrastructure maintenance, rehabilitation and renewal** – This is achieved through ES' planning, design, capital improvement & operational programs. This corresponds to DWQMS Element 15.
- **Sampling, testing and monitoring** – This is accomplished through: the sewers flushing program; the sewer condition assessment through the CCTV program; the MH inspection program; and the flow monitoring programs. This corresponds to Elements 16 and 17 of the DWQMS.
- **Continual improvement** – This is carried out by the AAR process and the Inflow and Infiltration (I/I) Strategy, meant to identify deficiencies and opportunities for improvement derived from specific emergency or other procedural events. This corresponds to DWQMS Elements 21.

2 PERFORMANCE OVERVIEW

The City has existing operation, maintenance, and asset management programs for the Collection System. Based on these programs the following indicators have been selected to provide an overview of the Collection System performance:

- Compliance with the ECA and OWRA requirements.
- Spills, overflows and emergency response.
- System monitoring for sewer upset conditions, which involve customer service requests, flow monitoring, I/I, and hydraulic modeling.

These indicators will be used to establish a baseline to assess the system performance in subsequent years. In addition, the following aspects have been grouped to describe the operation, maintenance, and asset management activities to ensure good performance of the Collection System:

- Sewer collection system maintenance programs
- SPS maintenance programs

2.1 Compliance with ECA and OWRA Requirements

In 2022, the City complied with all ECA requirements. Relevant ECA requirements include:

- Overflow and spill event reports to the Ministry's Spills Action Centre (SAC)
- SPS overflow reports and corrective actions taken

The following OWRA requirements are in the process of being complied with:

- Three of the five SPS do not have an ECA. An application for a CLI ECA has been filed with the Ministry.
- Three of the five sewage forcemains connected to the SPS do not have an ECA. The CLI ECA application is also intended to bring this matter into compliance.

2.2 Overflows & Spills

The City has procedures in place so all overflow and spill events are reported to the provincial Spills Action Centre (SAC) in writing. The reporting of a private side overflow/spill to SAC is the responsibility of the property owner. However, the City takes a precautionary approach to reporting overflows/spills to SAC when such delineation is not clearly identified. If the City responds to an overflow/spill and the location of the blockage is unknown (i.e. private or public side), the City will notify SAC of the event.

In 2022, there were two (2) sewage spills (Table 4). One spill occurred on August 25, on John Street and Leslie Street. After investigation it was determined that the spill was contained with the sewer pipe and no actual spill occurred. The second was on August 30 due to a sewer main blockage affecting the Rona store at 8651 McCowan Road. This minor spill was controlled and cleaned up.

Table 4. 2022 Reported Spills

Date	Location	Root Cause
August 25	John Street and Leslie Street	Sewer main blockage due to debris left by store owner (under claim process)
August 30	8651 McCowan Rd.	After investigation it was confirmed the spill was contained within the sewer pipe - no actual spill.

2.3 Emergency Response

2.3.1 Emergency Management Plan

The ES Emergency Management Plan (EMP) provides Environmental Services staff guidance on how to organize resources and respond to a water and/or wastewater emergency event. The EMP is consistent with the mandatory DWQMS (Element 18, Emergency Management), and it is aligned with the City's Emergency Plan and is compliant with Ontario Regulation 380/04, *Emergency Management and Civil Protection Act*.

The following ES divisions/sections are involved: Waterworks (Operations and Maintenance, System Engineering), Infrastructure, Business Administration and Waste & Environmental Management.

In 2022, there were no emergencies declared for the Collection System. The City is currently in the process of updating its EMP with new classifications and definitions for emergency events as they relate to the Collection System. The current EMP relies on the DWQMS approach.

2.3.2 After Action Review (AAR)

When a significant operational challenge occurs (e.g. overflows, emergencies), the City investigates the situation to identify corrective and/or preventative actions for continual improvement purposes. To facilitate these investigations, the ES team applies an AAR process. This AAR process is comprised of the following parts:

- **Part 1: What was supposed to happen and what actually happen** – This is a **Fact Finding** process to understand the events leading up to the incident and the response to the incident are identified and corrective and preventative actions are prescribed.
- **Part 2: Strengths of the Process (What worked and why)** – This is to identify the good practices that worth continue applying.
- **Part 3: What did not work** – This is to identify non-conformities, deviation from procedures, weak processes or practices.
- **Part 4: What should be done differently next time** – This is to address or prevent Findings from re-occurring where applicable.
- **Part 5: Recommendations** – This is to identify specific actions and make them SMART. To address Findings and Improvements from the previous sections where applicable.

AAR are included as part of the Continuous Improvement quarterly review among ES Managers to ensure follow up and measure of effectiveness. In 2022, there was no AAR related to the Collection System.

2.4 System Monitoring

2.4.1 SCADA System

The Supervisory Control and Data Acquisition (SCADA) system controls the five (5) sanitary SPS. A Master Terminal Unit (MTU) is the central SCADA system, which is connected with each SPS via Remote Terminal Units (RTUs). Waterworks staff can have access to the SCADA functions through the Operator Interface terminal (OIT). The OIT interconnects all stations allowing to display information from the other SPS. There is also a centralized Historian system to allow for logging data and alarm and events, which are stored in the Historian for querying the data for the reporting purposes.

Since 2020 Waterworks has been undertaking a systematic approach to review and re-design its SCADA system to further suit their needs as their infrastructure expands and departments continue to grow. In 2022, ES completed two studies and commenced the upgrade of SCADA:

1. SCADA Assessment and Strategy Report (2022)
2. SCADA Cyber Security Audit (2022)
3. SCADA System Upgrade (Ongoing)

The primary objectives of these SCADA consulting assignments is to provide the City with the clear understanding of the compositions and current state of its SCADA system, a list of operational deficiencies and potential improvements, and ultimately making the short and long term improvements of the system. It is anticipated that many of these studies recommendations will be implemented in 2023 to 2025.

2.4.2 SCADA Alarms

The SCADA system monitors: SPS wet well levels; the operation of the “duty” and “stand-by” pumps; power supply; emergency generators; float levels; and intrusion alarms. Environmental Services staff have direct remote access to the monitoring displays and historic data. Unfortunately, the current SCADA system does not have the capacity to segregate “false” and “true” alarms (i.e. nuisance alarms, false and real alarms). A project for 2023 is to upgrade the SCADA alarm reporting system to include the capability to segregate and further classify alarm reports for several type of alarms. For 2022, a manual review of alarms provided an approximate classification of alarms as described in Table 6.

Table 5. 2022 SCADA SPS Alarms

Alarm Type	Calvert	Carlton	Milliken	Kennedy	Rougecrest	TOTAL	%
False Alarms	5,620	2,717	1,715	4,864	1,979	16,931	90
True Alarms	672	341	220	423	173	1,829	10
Total	6,292	3,058	1,935	5,287	2,152	18,760	100

Note: False Alarms includes unavoidable alarms for testing, cleaning, and calibrating, as well as duplicative alarms (nuisance alarms)

2.4.3 Customer Complaints

Complaints received from the public are tracked using the City's EAM database. Once a complaint is received, a service request is created and, when appropriate, Waterworks staff is dispatched to investigate and remediate the situation if possible. All work completed is tracked through work orders (WO). The most common complaints that the City receives related to the Collection System are:

- a) mainline sewer backups
- b) lateral blockages
- c) sanitary odours
- d) MH issues (e.g. displaced or broken MH covers)
- e) capital projects

In 2022, there were a total of 167 complaints received related to the Collection System. These are summarized in Table 6. All complaints were recorded, investigated and persistent issues addressed through flushing, repairs of infrastructure, treatment, and CCTV inspections.

Table 6. 2022 Complaints Received by Type

Type of Complaint	Complaint Description	No. of Complaints
Mainline Sewer Backup	Sewer backups due to obstructions in mainline sewers, 2 of which resulted in actual backups. Obstruction typically involve FOG accumulation, illegal dumping, and heavy rainfall.	8
Lateral Blockages	Sewer backups due to obstructions in sewer laterals	135 (private side)
Sanitary Odour	Sanitary odours experienced indoors and outside	11
Maintenance Hole	Maintenance hole issues such as dislodged or broken covers	12
Cross connections	Issues of sanitary and stormwater cross connections	1
Total		167

2.4.4 Flow Monitoring and Hydraulic Model

In 2015, York Region established a region-wide long-term sanitary flow monitoring program. This program consist of installing flow meters on the local municipalities' Collection Systems. The number of flow meters installed in Markham varies slightly every year based on York Region's needs of flow data. In 2022, there were 73 flow meters installed on the Markham local Collection System. The majority of York Region's flow meters were installed at connection points to the Regional trunk sewer with relatively larger catchment areas. Flow data collected by York Region's meters are accessible by the City and used for system capacity analysis, system hydraulic model calibration and I/I studies. York Region's program has an alarm set up when the water level reaches certain threshold, and then the City is notified.

Every year, City of Markham conducts a short-term sanitary flow monitoring program. Under this program, flow data is collected on smaller sewer catchment areas for the purpose of capital project design refinement, local system capacity analysis, and I/I reduction studies. In 2022, 7 flow meters were installed.

By the end of each flow monitoring period, a report summarizes findings and recommends next year flow monitoring locations. The City's short term monitoring program does not have an alarm set up.

The City also receives notifications from York Region from flow monitors placed on the City's sewer system and York Region's Sanitary Trunk System. These reports are not in real time, so inspections are scheduled days after alarms are received.

Infrastructure - Stormwater is in charge of managing, updating and calibrating the Collection System Hydraulic model. In 2016, Environmental Services staff completed the last calibration of the model. Environmental Services staff continues updating with new development, system changes and capital upgrades. The calibrated hydraulic model is used for system capacity analysis, capital upgrade planning and design, new development review and operational support.

2.4.5 Sanitary Effluent Compliance Program

The Sanitary Effluent Compliance Program is in joint with York Region. The Program focuses on industrial and commercial properties, which may have pH, oil & grease, solids, etc. issues in their sanitary effluent. Activities conducted in 2022 are included in Table 7.

Table 7. 2022 Effluent Compliance Program

Type of Effluent Compliance	Description	Quantity
Grease interceptor	Requires to establish regular pump-out or replace the broken grease interceptor.	3 food businesses
Solid issues	Requires the contractor to cleanup solid buildups in the Collection System	1 construction site
Sanitary effluent violation	York Region issuing various stage of violation notices to the business located within the City	5 businesses

2.4.6 Inflow and Infiltration Program

The ES Department Inflow and Infiltration (I/I) Program consist of applying a holistic approach to identify and resolve I/I issues. In 2022, the following remedial actions were identified and implemented (Table 8):

Table 8. 2022 I/I Remedial Actions

Program / Action Taken	Description	Quantity
Downspout Disconnection	Properties disconnected	0 downspouts
I/I Reduction Strategy	Carlton SPS catchment area	4 MHs identified
Private Plumbing Protection Rebate Program	Sanitary laterals repaired on the private side	21 lateral repairs
MH Repairs – O&M	Issues such as dislodged or broken covers	14 MHs

2.5 Reporting

The City relies on a CMMS for documenting and reporting all activities performed on the Collection System. In 2022, the City implemented successfully a transition from the old CMMS system (Hansen) to the new EAM system. Through EAM all maintenance and response activities are recorded via Work Orders (WO) and Customer Service Requests (CSRs).

In addition, the SCADA system is also used to create reports on SPS, report on SPS alarms and report on performance. Record keeping protocols are consistent with the DWQMS for Drinking Water and are maintained for 15 years.

3 SEWER COLLECTION MAINTENANCE PROGRAMS

Maintenance of the Collection System involves performing inspections to MH, condition assessment of the sewers via CCTV, cleaning the sewers, and making repairs. Table 9 shows a summary of maintenance activities completed in 2022.

Table 9. 2022 Linear Maintenance

Description	Average Quantity
CCTV inspection on Sewers – 10-Yr Program	94 km
CCTV inspection on Sewers – In-house Program (e.g. ACRs, Hot Spots, RIGS Program, emergencies)	12 km
Flushed Sewer Length (10-Yr CCTV)	94 km
Flushed Sewer Length – in-house program (O&M)	10.3 km
Flushed Sewer – Hot Spots	8.5 km
Sewer main Spot Repairs	42
Laterals Repairs	38
Laterals reaming and cleaning	43
MHs Inspections – O&M Reports	1,570
MHs Major repairs	22
MHs Minor repairs	11

3.1 CCTV Program

The City's CCTV Program is comprised of two separate but complementary programs. The large proportion of sewers inspection is completed under the 10-Year Program, which is outsourced on annual basis. This is complemented by the in-house CCTV inspections performed by Waterworks staff.

3.1.1 10-Year CCTV Program

Infrastructure – Stormwater manages a long term CCTV 10-Year program for the Collection System. The process follows NASSCO coding for deficiencies. Under this program all sewer pipes are inspected in a 10-year cycle conducted in tandem with the flushing sewer cleaning of sewers. First, sewers are flushed and then CCTV is able to inspect relatively clean pipes.

The focus of this inspection is to assess the structural integrity of sewers, but also to ensure the sewers are maintained and have the opportunity to detect major MHs deficiencies. When a structural issue is identified in a sewer main, sewer lateral or MH, it is triaged between the CCTV contractor, Infrastructure and O&M and repairs are scheduled according to risk and priority.

In 2022, a total of 94 km of sewer were completed for this CCTV and flushing. The 2022 area is located in the **Cluster 5a**, north from Highway 7, south from 16th Ave., and between Markham Road and Reesor Rd. All City areas for the 10-Year Program are illustrated on **Appendix B**.

3.1.2 In-house CCTV Program

This program is performed by the City's own CCTV Truck and Waterworks – O&M staff. Similarly as with the 10-Year Program it also involves completing tandem sewer flushing before inserting the CCTV camera. The objectives of this program to meet three separate distinctive purposes:

- CCTV for sewers Hot Spots maintenance
- CSRs and RIGS (new development) support
- Emergency sewer CCTV

In 2022, a total of 12 km of CCTV were completed, including 8.5 km for sewer Hot Spots maintenance, and the remaining as a result of responding to emergency inspections, and support to resolve CSRs, new development inspections (e.g. sewer locates for infill development) and emergency inspections.

3.2 10-Year Flushing Program

One potential cause of a sanitary sewer overflow or odour issues is a sewer backup. A sewer backup occurs when the sewer becomes fully or partially blocked by an obstruction. To mitigate issues at locations that regularly become obstructed, the City has a Hot Spot maintenance schedule. Hot spots are cleaned using high pressure flushing on a set schedule to prevent blockages. Mainline sewer pipes that are part of the regular preventative maintenance flushing program are flushed once every five years.

City's Flushing Program is comprised of three separate but complementary programs:

- **10-Year for Sewer Flushing program.** This program is part of the same 10-Year CCTV Program, and it is managed by Infrastructure – Stormwater under a long-term contract with a service provider. This program covers all City's sewers.
- **In-house Flushing Program.** This program utilizes the City's flushing truck. Specific sewershed areas as selected based on risk and operation's experience.
- **Hot Spot Program.** This is also an in-house activity covering approximately 8 km of sewers, which some are cleaned on a monthly and some on quarterly basis.

3.2.1 10-Year Sewer Flushing Program

ES Infrastructure manages a long term CCTV/Flushing contract for the Collection System. Under this program all sewer pipes are flushed/cleaned in a 10-year cycle conducted in tandem with the CCTV inspections. First, sewers are flushed and then CCTV is able to inspect relatively clean pipes.

In 2022, a total of 94 km of sewers were flushed. The area covered corresponds to the same CCTV area located in the **Cluster 5a**, north from Highway 7, south from 16th Ave., and between Markham Road and Reesor Rd. (**Appendix B**).

3.2.2 In-house Flushing Program

The In-house Flushing Programs includes sanitary sewer flushing from two distinctive purposes: Hot Spots maintenance and CSRs/Emergencies (Table 10). Historically, small sewersheds are selected based on

criticality and risk. Typically, the areas flushed correspond to areas where there have been sewer backups in the past. This approach tends to select similar sewersheds every number of years leaving some sewers not flushed for extended periods of time.

In 2023, a **pilot** project using the RATS acoustic technology will be applied to one sewersheds based on the same CCTV areas (**Appendix B**). This **pilot** will be tested to assess likelihood of sewer segments that may require immediate attention, regular flushing and no flushing. This Pilot program is intend to be implemented in 2023. This program will result in covering approximately 100 km of sewers per year – the equivalent of 10% of the sewers in the City. This figure is anticipated to be reduced to 50% according to the acoustic assessment (based on similar cases with other municipalities).

Table 10. In-house Flushing Program

Description	2022	2023 Goals
10-Year Cycle (for implementation in 2023)	N/A	100 km per year
Hot spot flushing	8.5 km	8.5 km per year
Emergency sewer flushing	6.5 km	As-needed basis
TOTAL	15.0 km	

Emergency flushing is the cleaning of sewers typically required to assist on CSRs and other emergencies. Moreover, the City receives notifications from York Region on flow monitors placed on the City's sewers and Regional Sanitary Trunk System, which reach 100% full pipe (i.e. before sewer may start to back up on the system).

In 2022, the City received zero actionable alarms for 100% full pipes (from York Region flow monitors). These numbers do not include false alarms. For every 100% pipe level alarm, Waterworks staff is dispatched to investigate.

3.3 Maintenance Hole Inspections

Waterworks operators inspect the current 14,646 MH on a holistic approach based on CSRs, Hot Spots maintenance, Easements MHs, and focusing on deficiencies as identified by Environmental Services staff or contractors. There are 88 MHs on the Hot Spot maintenance program, which are inspected every month. There are also about 500 MH located on Easements, which are inspected on annual basis.

In 2022, a total of 1,570 MHs were inspected, which correspond to the Easement MHs (500) and MHs associated with Hot Spots maintenance (88 per month). As a result of these inspections, a total of 33 repairs were completed.

In 2022, a new MH Inspection Program was prepared, covering all MHs in a 10-Year Cycle commencing implementation in 2023-2024. This program will be based on geographic areas consistent with that of **Appendix B**.

4 SEWAGE PUMPING STATIONS MAINTENANCE PROGRAMS

The Collection System includes five (5) SPS with various capacities. The station capacity and construction year are listed in Table 11. The City has a preventative maintenance program, a reactive maintenance, and a condition assessment program for these facilities, which are described in the sections below.

Table 11. List of Sanitary Pumping Stations

	Station	Address	Rated Capacity (L/s)	Construction Year	ECA
1	Calvert SPS	201 Macrill Rd. Buttonville	172	1995	N/A
2	Carlton SPS	218 Carlton Rd. Unionville	83	1976	Yes
3	Milliken SPS	Milliken Park 4289 14 th Ave. Milliken	55	2008	N/A
4	Kennedy SPS	7522 Kennedy Rd. Milliken	31	1987	N/A
5	Rougecrest SPS	26 Rougecrest Dr. Markham	6	1965	Yes

4.1 Preventative Maintenance

Maintenance of the SPS involves performing weekly station checks, as well as other inspections on a monthly, semi-annual and annual basis (**Appendix C**).

- For SPS maintenance activities completed in 2022, with frequency & targets, see Table 15
- For SPS maintenance on instrumentation completed in 2022, with frequency and targets see Table 16.

In general, maintenance activities for SPS can be classified as:

1. **Preventative Maintenance** – conducted on a routine basis to maintain the equipment in good working order and lessen the likelihood of failure. General maintenance main activities include: and receiving gram-positive and gram-negative bacteria to break up grease build up grease (weekly).
2. **Corrective Maintenance** – conducted to correct deficiencies discovered during routine inspections or preventative maintenance activities and return equipment back to working order
3. **Emergency** – conducted in response to pump failures and SCADA high priority alarms, such as power outages, i.e. connecting the mobile emergency generator to the stations.

Based on a calculated estimate by Waterworks staff, in 2022, a total of 1,366 hrs were spent on SPS maintenance activities. The breakdown is noted on Figure 1, which can be divided by 832 hours on preventative maintenance for the SPS; 312 hours on corrective maintenance (e.g. meeting with contractors, purchasing supplies); and 220 hours on emergency maintenance (i.e. 10 power outages at Rougecrest and Kennedy SPS, and Milliken SPS pump failure). The largest amount of time (61%) was

spent performing preventative maintenance. The next most significant activity was corrective maintenance (23%), and the last was for emergency maintenance (16%) (Figure 1. Percentage of Time Spent on SPS Maintenance Activities). A description of these activities is included in (**Appendix C**).

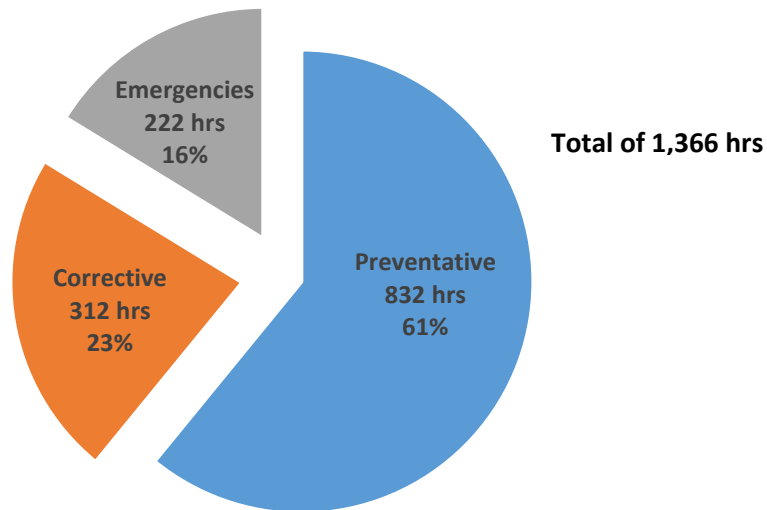


Figure 1. Percentage of Time Spent on SPS Maintenance Activities

4.2 SPS Condition Assessments

In addition, Waterworks performs SPS condition assessment and performance testing on a 10-year cycle for all five SPS. In 2022, two SPS were selected to have a condition assessment process:

- Calvert SPS – Completed in 2022
- Milliken SPS – Completed in 2022

The stations planned for condition assessment in 2023 include:

- Carlton SPS
- Kennedy SPS

The SPS condition assessment scope of work involve performing a review of the existing conditions of the SPS, design drawings, maintenance reports, as-builts, design reports, O&M manuals, pump capacities, etc. The major components of this scope include:

- Review existing documentation
- Conduct site visit and visual condition assessment of process elements as predictor of reliability, degree of surface corrosion and wear (i.e., process piping, valves, and process instrumentation) and general architectural elements.
- Interviews with Operations personnel and collection of known issues

- Pump drawdown testing. The intent of drawing down testing is to measure the current pump capacity under existing conditions.

It is anticipated that a list of specific maintenance needs and equipment replacement and further assessments will be the outcome for the condition assessment. The information collected from these two studies will be used for the Life Cycle capital planning for subsequent years based on criticality and risks.

4.3 Equipment Calibration

Flow meters, level sensors and pressure sensors are used to monitor the Collection System. To ensure proper functioning of the monitoring equipment, the equipment is calibrated as per manufacturer's operating manuals. The number of flow meters, level sensors and pressure sensors used in the Collection System, along with their location and manufacturer's manual recommendation for calibration requirements is provided in Table 12.

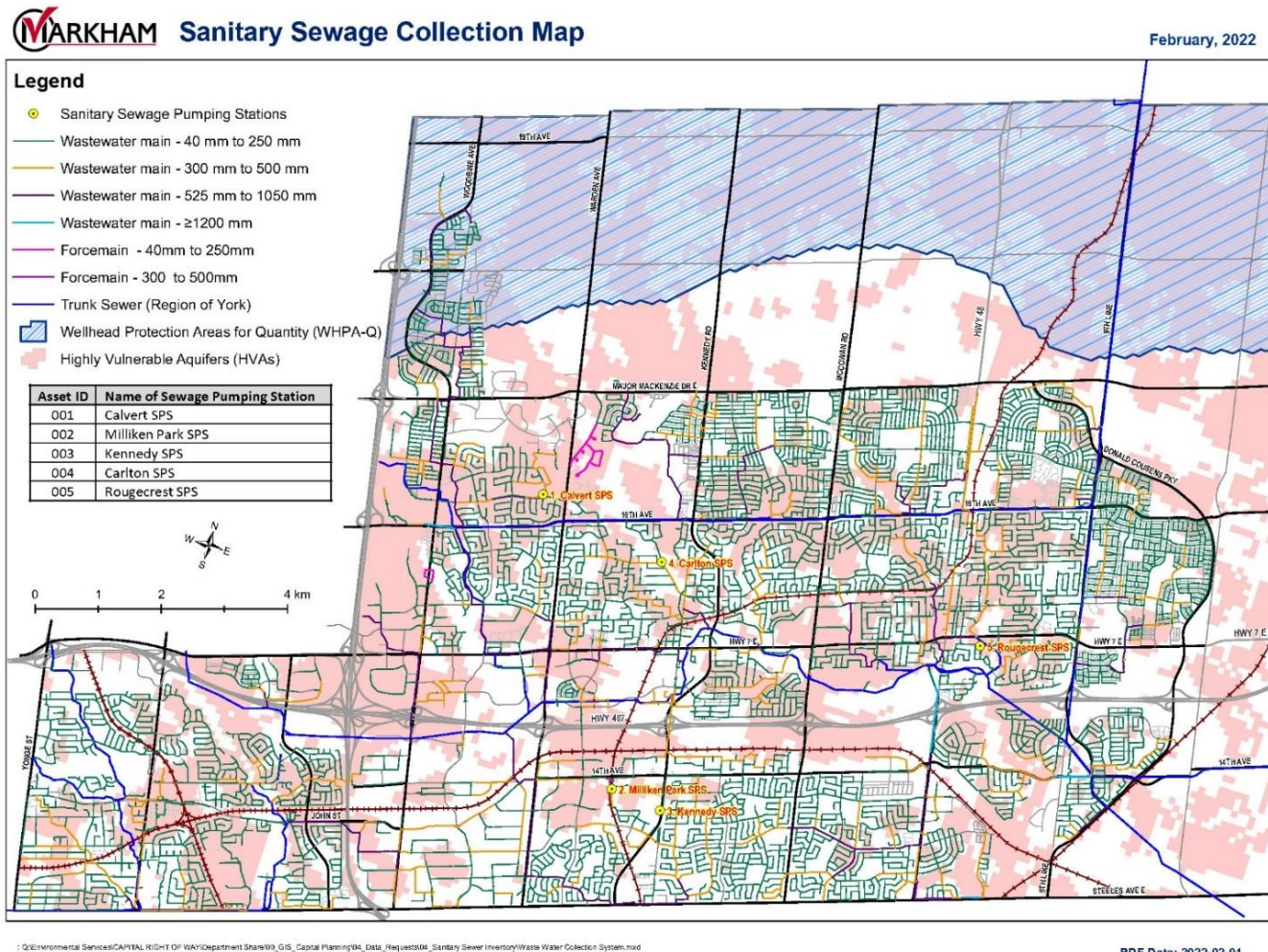
Table 12. Equipment Calibration/Verification

Type of Equipment	Count	Equipment Location	Manufacturer's Manual
Flow Meters and Displays	6	Calvert SPS (2); Carlton SPS (1), Milliken SPS (2), and Kennedy SPS (1)	Mag meters do not require annual calibration, only when malfunctioning
Wet Well Level Transducers	7	Calvert SPS (2); Carlton SPS (1), Milliken SPS (1), Kennedy SPS (1), Rougecrest SPS (1)	Only when malfunctioning
Pressure Transmitters	5	Calvert SPS (2); Carlton SPS (1), Kennedy SPS (1), Rougecrest SPS (1)	Only when malfunctioning

Waterworks staff make regular verifications when suspecting potential equipment malfunction. This verification is based on weekly inspections of level and verification of alarm reports. Moreover, a more formal verification is completed when SPS condition assessments are performed for each pumping station. In 2022, condition assessments were completed for Calvert and Milliken SPS. In 2023, condition assessments are scheduled for Carlton SPS and Kennedy SPS.

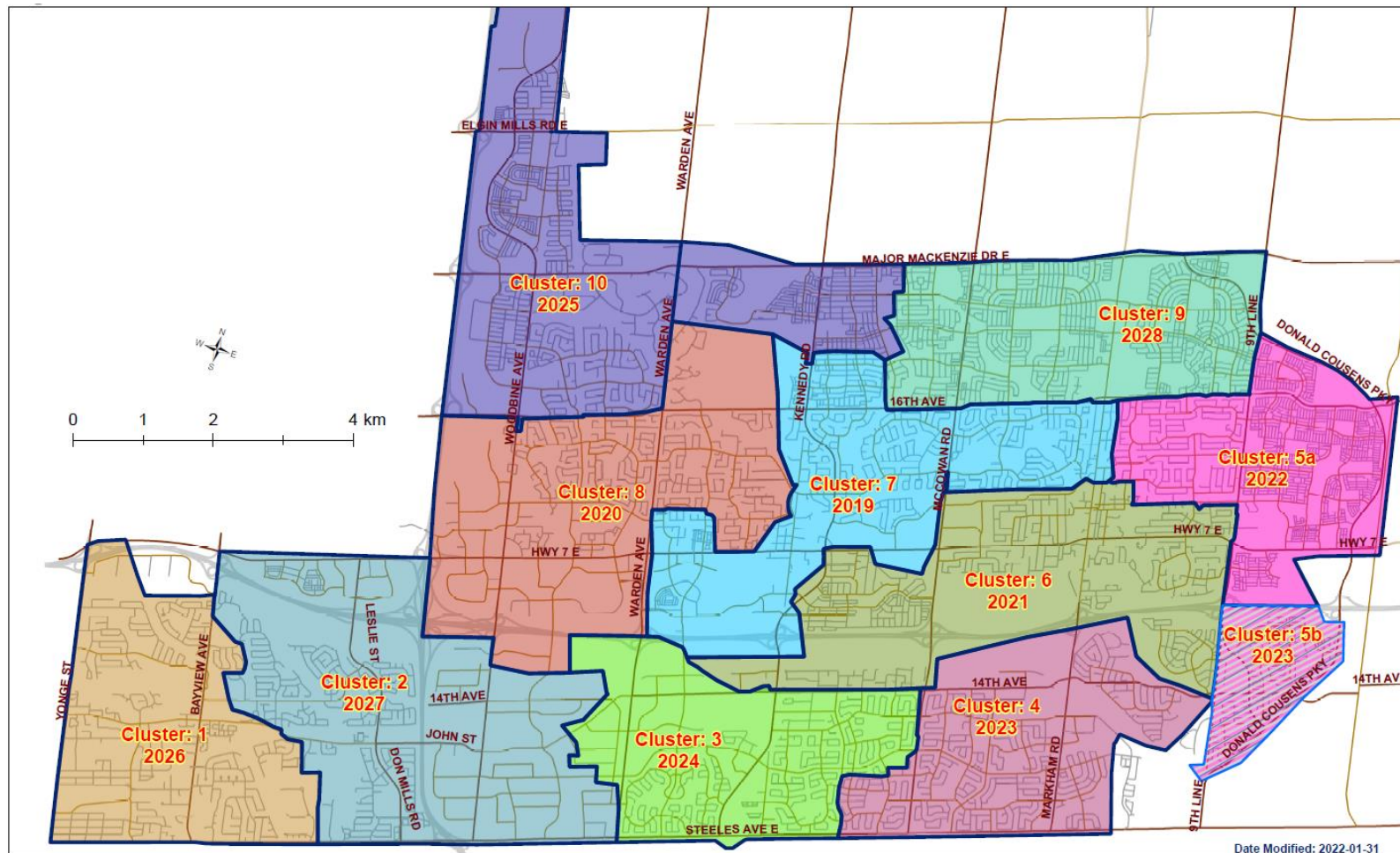
APPENDIX A – COLLECTION SYSTEM MAP

Figure 2. City of Markham Sanitary Collection System



APPENDIX B – CCTV 10-YEAR CYCLE AREAS

Figure 3. Collection System CCTV 10-Year Cycle Areas



APPENDIX C – PREVENTATIVE MAINTENANCE ACTIVITIES, FREQUENCY AND TARGETS

Table 13. Linear System Preventative Maintenance, Frequency and Targets

Activity	Description	Frequency	Target
Regular MH Inspection	10-Year Program	10-yr	1,431
Easement MH Inspection	All Easements MH as inspected once per year	Annually	500
Hot Spots MH Inspection	Involves an average of 88 MH per month	Monthly	1,056
I/I MH Inspection	Inspections during Wet Weather conditions	As needed	Variable
Syphon MH Inspection	The inspection is carried out during flushing	Quarterly	3
Sewer Flushing – INF	10-yr program	Annually	10-yr Cycle
Sewer Flushing – O&M	Hot Spots and emergency sewer flushing		8.5 km

Table 14. CCTV Inspection Targets

Maintenance Activity	Frequency	Target
Scheduled CCTV - Outsourced	Annually	10-yr Cycle
Ad Hoc CCTV Inspections	As Needed	N/A
CCTV Lateral Inspections	As Needed	N/A
I/I Inspections	As Needed	During rainfall events

Table 15. SPS Preventative Maintenance Frequency and Targets

Activity	Description	Frequency	Target
SPS Station Checks	<ul style="list-style-type: none"> Record the pump hours Record pump running amperage Install Bio Bags (Activated powder for wet well degreasing) Flow meter reading Diesel generator hours Test all Alarms Hi and Lo for Level Sensor and Floats Test All Alarms associated with a Power Failure by doing a diesel test 	Weekly	

SPS Can Maintenance	<ul style="list-style-type: none"> • Check for debris or rags and clean out as needed • Visually inspect all interior and exterior components of the building to ensure the condition and appearance remains optimal. 	Weekly	5
Building Maintenance and Cleaning	Building inside to be kept clean and tidy	Weekly	5
Standby Generator Test	<ul style="list-style-type: none"> • Completed to ensure generator operability in case of power failure by simulating a station Power Failure. • Deficiencies are documented on work order for follow up. 	Weekly	3
Standby Generator Load Test	A load test is different from the monthly test as tests the generator under full load of the facility for a longer period of time to ensure the generator can perform properly during a loss of power event.	Semi-annual	3
Wet well cleaning	<ul style="list-style-type: none"> • Wet Well is pumped down and pressure washed to remove debris, grease and build-up 	Quarterly	5
Facility Valve Inspection	<ul style="list-style-type: none"> • Valve exercising – Calvert SPS • Other stations (as needed) 	Semi-Annually	5
Electrical Safety Authority (ESA) Inspections	<ul style="list-style-type: none"> • The ESA performs mandated testing and submits a report. • Deficiencies are tracked and addressed by the electrical contractor 	Annually	5
SPS Overflow Inspections	<ul style="list-style-type: none"> • The visual inspection for any deficiencies are reported and corrective action is taken to mitigate overflows risks (Rougecrest and Carlton) 	As needed	2
Variable Frequency Drive (VFD) Maintenance	<ul style="list-style-type: none"> • Testing and calibration performed by a certified contractor • They are run to a full 60 hz every time so the speed is not variable as such. • We do not pace these pumps at Rougecrest so an analog calibration for speed potentiometer is not needed 	As needed (repair or inspection)	5

Facility QA/QC Inspections	<ul style="list-style-type: none"> A walkthrough of all sewage pumping stations. Supports the Weekly Inspection program to ensure that the facilities are being well kept and clean. Findings are reported back in a station deficiency form and they are tracked and addressed 	As needed	5
Thermographic Inspections	Electrical inspections	Every two years	5
Pump Vibration Analysis	Not performed currently	N/A	

Note: Emergency situations will require a phone call to the Supervisor for immediate attention

Table 16. SPS Instrumentation Preventative Maintenance Frequency

Activity	Description	Frequency
Flow Meter Calibration	A calibration certificate is submitted to us for our records	As per operating manuals
Float alarm test	Performed by SCADA	Weekly
UPS replacement	Run to fail	Run to Fail
Level transmitter calibration	Remapping. Checking for level sensor drifting	As needed
PLC/ICP Inspections	As part of the weekly station checks	Weekly
SCADA Alarm Verification	As part of the weekly station checks	Weekly
Mechanical Float Inspection	<ul style="list-style-type: none"> Floats tested using the SCADA system by pumping up and down the wet well to tip the floats and ensure they are accurately alarming. A Maintenance Activity Worksheet is completed 	Weekly