CITY OF BALTIMORE

Bernard "Jack" C. Young

Mayor

BALTIMORE CITY
DPW
DEPARTMENT OF PUBLIC WORKS
RUDOLPH S. CHOW, P. E.
DIRECTOR

DEPARTMENT OF PUBLIC WORKS

Rudolph S. Chow, P. E.

Director

Collection System Operations and Maintenance Annual Report

July 2018 to June 2019

Sanitary Sewer Overflow Consent Decree
Civil Action No. JFM-02-1524

January 2020

Prepared by:
Office of Asset Management

Contents

Executive Summary

On October 6, 2017, the City of Baltimore (City) entered into a Modified Consent Decree (MCD with the United States Environmental Protection Agency (EPA), the State of Maryland Department of the Environment (MDE) and the Department of Justice (DOJ). The objective of Paragraph 13 of the CD is to "implement a maintenance program for the Collection System, including its gravity sewer lines, force mains, Pumping Stations and other appurtenances (*e.g.*, manholes, pressure sewers, inverted siphons, meter vaults), to provide for the proper operation and maintenance of equipment while minimizing failures, malfunctions, and line blockages due to the lack of adequate preventative care." This report details the progress of the Collection System Operations and Maintenance (O&M) activities undertaken by the City. This is the thirteenth annual update report since implementation of the O&M plan in 2006. This report provides a fiscal year (FY) comparative analysis of O&M operations carried out by the City of Baltimore with an emphasis on activities during FY 2019.

The requirements for the Annual Report are specified in Paragraph 13 of the Consent Decree, which reads as follows:

"After implementation of the maintenance program required under Paragraph 13, Baltimore shall submit an annual report to EPA and MDE providing:

i. A list of complaints related to the Collection System;

ii. A list of completed work orders for the calendar year;

iii. A list of outstanding work orders;

iv. Current preventive maintenance schedules;

v. A list of tests performed of new sewer installations and rehabilitations;

vi. An evaluation of the efficacy of the grease control program;

vii. An evaluation of the efficacy of the root control program; and

viii. An updated list of known locations where Baltimore does not have ready physical and/or legal access to the Collection System."

During FY-2019 (July 01, 2018 to June 30, 2019), the number of sewer-related complaints decreased by 7.69%, which can be attributed to ongoing PM programs and the fact FY2019 was a dryer year. The table below compares the sewer related complaints over the past 5 fiscal years:

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Sewer Complaints	10,041	9,041	8,883	9,311	7,595

During this period, there were 7,595 sewer-related complaints reported in the Cityworks work order management system. In response to these complaints, 10,561 work orders were generated. In some cases, the generation of multiple work orders of different types was required to resolve a single complaint. In addition to the sewer-related complaints reported by customers, there were 2,695 work orders generated for preventive maintenance activities (*e.g.* sewer cleaning, FOG abatement). Therefore, the total number of sewer work orders generated during the reporting period was 13,256.

Activities within the City to reduce mainline chokes, and repeat sanitary sewer overflows (SSOs) are tracked in the tables below. Table ES-1 shows an increase in mainline choke work orders, while Table ES-2 shows repeat SSOs. SSO root cause analysis uses information from the preceding 24-month period to determine if it is a repeat event. Over the past several years, the City has enhanced data and data-tracking software (*e.g.* custom applications, improved GIS data) and user training for the tracking of work orders and associated volumes of repeat SSOs.

Table ES-1: Mainline Choke Work Orders Comparison

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Mainline Chokes	690	604	537	585	558

Table ES-2: Repeat SSOs Comparison

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Repeat Dry-weather SSOs (24-month period)	193	154	107	50	36
Volume of Repeat Dry-weather SSOs	87,832	248,935	54,374	1,923,759	455,536

Key accomplishments during the reporting period include the following:

- Under the Preventive Maintenance Cleaning Program, 312,839 linear feet of 6-in diameter to 27-in diameter sewer were cleaned. In addition, 58,878 linear feet of pipe were treated with chemical to abate grease.
- The City conducted over 364,559 feet of CCTV inspections.
- Approximately 442,103 linear feet of sewer pipe have been rehabilitated, replaced, or installed during this reporting period through various projects and programs.
- The Root Control Program chemically treated approximately 408,324 linear feet of pipe.

  The City inspected Food Service Establishments (FSEs) as part of the Fats, Oils and Grease (FOG) Program to minimize the amount of FOG discharged to the sanitary sewer system. During the reporting period 3,900 FSE inspections were completed for Program compliance, as well as educating FSE managers and staff about appropriate grease-handling practices.

SECTION 1 – Introduction

This Annual Report, the thirteenth since the implementation of the Operations and Maintenance (O&M) plan, provides an update on the progress of remedial measures required by the Consent Decree and an analysis of the impact of O&M activities conducted from July 1, 2018 to June 30, 2019 (FY 2019).

The requirements for the Annual Report are specified in Paragraph 13 of the Consent Decree, which reads as follows:

"After implementation of the maintenance program required under Paragraph 13, Baltimore shall submit an annual report to EPA and MDE providing:

i. A list of complaints related to the Collection System;

ii. A list of completed work orders for the calendar year;

iii. A list of outstanding work orders;

iv. Current preventive maintenance schedules (task description, location, frequency), description of changes made to the schedules during the calendar year.

v. A list of tests performed of new sewer installations and rehabilitations (location, date, description of new installation and/or rehabilitation);

vi. An evaluation of the efficacy of the grease control program (summary of grease-related blockages identified, corrective action taken, preventive action taken, monthly rate of grease-related blockages and (if available) comparison of current and previous year performance, list of referrals to pretreatment staff, identification of remaining persistent and chronic blockage areas);

vii. An evaluation of the efficacy of the root control program (summary of root-related blockages identified, corrective action taken, preventive action taken, monthly rate of root-related blockages and (if available) comparison of current and previous year performance, identification of remaining persistent and chronic blockage areas); and

viii. An updated list of known locations where Baltimore does not have ready physical and/or legal access to the Collection System and the strategies Baltimore is employing to improve and secure such access to the Collection System."

Elements of the O&M Program Include:

- Sewer inspections (CCTV)
- Sewer cleaning
- Sewer repairs, replacement, and rehabilitation
- Root control
- Grease abatement by chemical treatment
- Fats, Oils and Grease (FOG) Program (*e.g.* Food Service Establishment inspections)
- Limited Access Areas

During FY 2019, the City of Baltimore continued to grow and strengthen the Office of Asset Management (OAM), which strives to prioritize the renewal of aging infrastructure, justify infrastructure investments, provide transparency of the true cost of operating a utility system, and effectively manage limited resources. The OAM utilizes a strategic approach to the process of planning, maintaining, and operating physical assets to optimize the service life of these assets at the most appropriate cost and an acceptable level of risk, all while delivering an acceptable level of service. Currently, the OAM focuses on developing and implementing asset management programs for the collection system.

To evaluate the effectiveness of new and existing preventive maintenance programs, the OAM tracks Key Performance Indicators (KPIs). Tracking KPIs drives internal progress and provides transparent reporting to internal and external stakeholders. In the long term, tracking key metrics will allow the Department of Public Works (DPW) to better communicate the level of service provided to stakeholders and help foster greater understanding of the relationships between capital investment, rates, financial planning, and risk.

SECTION 2 – Complaints

2.1 Customer Complaints

The City of Baltimore's Control One Emergency Dispatch operation is a central call system which is available via phone (311) 24 hours a day, seven days a week for Baltimore City residents to report sewer-related complaints. This service is also available online 24 hours a day, seven days a week, as well as by mobile application. Each complaint in the 311 system is given a Customer Service Request (CSR) number so it can be tracked from the moment it enters the system until it is abated.

When a sewer related complaint is entered into the 311 system, it is forwarded by an automated transaction to the Computerized Maintenance Management System (CMMS) (Cityworks). Once a DPW Utility Investigator has investigated the complaint and a determination of corrective requirements is made, a work order is generated and the appropriate type of crew is assigned to perform the work. After completion of the work, the status of that work order is updated in Cityworks. There can be instances when multiple complaints in the 311 system are made by citizens for the same problem. In such cases, all complaints are forwarded to Cityworks, but work orders are generated only for unique problems that need to be resolved.

There were 7,595 sewer related complaints logged into Cityworks during the reporting period. From these complaints, 9,590 (reactive) work orders were generated; there are more work orders than sewer complaints because multiple work order types can be required to address a single complaint. Table 2-1 shows sewer complaints during the past six fiscal years.

Table 2-1: Sewer Complaints Comparison

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Sewer Complaints	10,041	9,041	8,883	9,311	7,595

A significant decrease in sewer complaints in FY2019 compared to prior FYs can be attributed to a significant increase in proactive work orders as shown in Table 2-3: Types of Work Orders. Proactive work included increases in comprehensive and target inspection and cleaning of sewers. A list of all sewer complaints is attached in Appendix 2-1 of this report.

2.2 Completed Work Orders

A work order is considered closed when the problem has been resolved and all related activities have been updated and closed in Cityworks. A list of work orders closed in FY2019 is provided in Appendix 2-2 of this report. A map of the density of these closed work orders is shown in Figure 2-1. This map provides an illustration of problem areas as indicated by the concentration of reactive work performed during the reporting period.

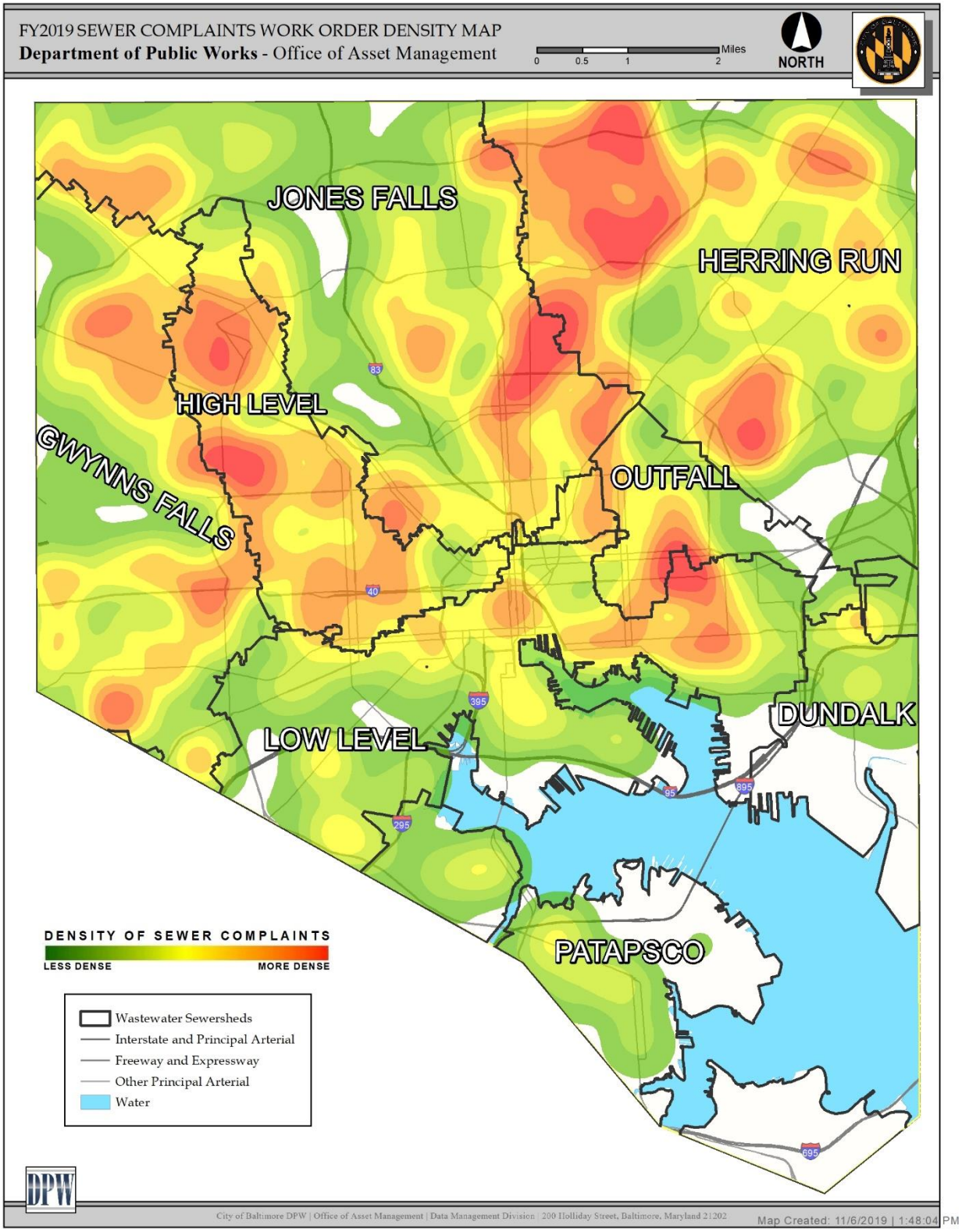


Figure 2-1: Work Order Density Map

The number of sewer related work orders completed during the past six fiscal years is illustrated in the table below.

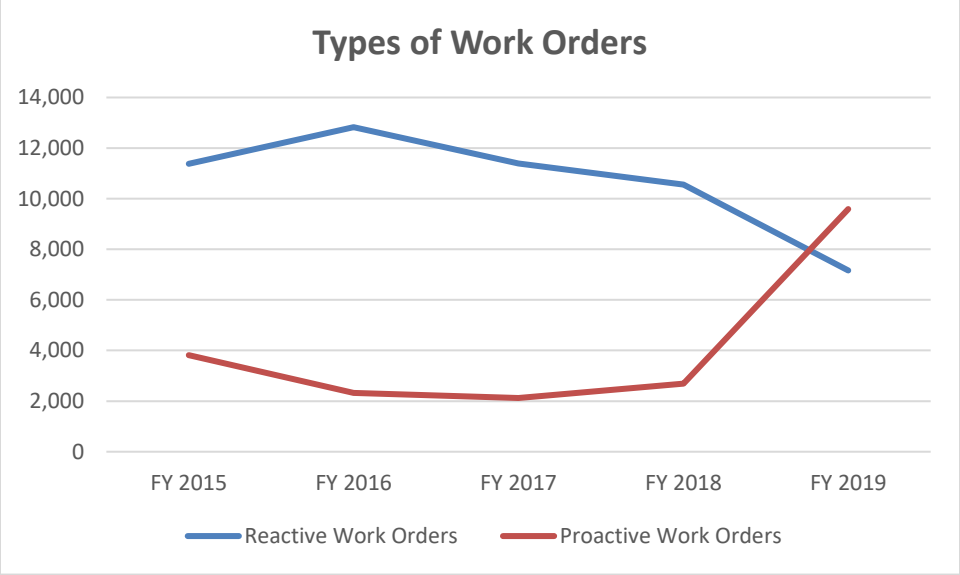
Table 2-2: Work Orders Completed by Fiscal Year

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Completed Work Orders	15,198	15,153	13,516	13,257	16,753

A breakdown of completed work orders by type is provided in Table 2-3. As previously indicated, the majority of work orders (7,595) were generated from sewer complaints logged into the 311 system; an additional 9,590 work orders were generated for preventive maintenance (*i.e.* not driven by a customer complaint) activities during the reporting period.

Table 2-3: Types of Work Orders

Type	FY 2017		FY 2018		FY 2019	
	Quantity	%	Quantity	%	Quantity	%
Reactive Work Orders	11,394	84.30%	10,561	78.60%	7,595	42.70%
Proactive Work Orders	2,122	15.70%	2,695	21.40%	9,590	57.30%
Total	13,516	100.00%	13,256	100.00%	16,753	100.00%



The above graph depicts a significant decrease in sewer complaints in FY2019 compared to prior FYs, which can be attributed to a significant increase in proactive work orders.

2.3 Outstanding Work Orders

A reactive work order is outstanding when any work necessary to address the complaint is not completed. All reactive workorders issued during the reporting period have been completed. Proactive maintenance work orders continue to be issued on cyclical schedules.

SECTION 3 – System-Wide Gravity Sewer Cleaning and Inspection Program

3.1 Preventive Maintenance

The City currently implements several preventive maintenance programs as part of the overall O&M strategy. These on-going programs include:

- Sewer Cleaning/Inspection
- Trunk Sewer Inspections
- Grease Abatement and Inspection of Food Service Establishments (See Section 5)
- Root Control (See Section 6)

The FOG and Root Control programs are described in detail in Sections 5 and 6, respectively.

3.2 Comprehensive and Target Cleaning/Inspection Program

The City has developed programs to inspect all sewers greater than 8 inches in diameter and clean, as necessary, every 7 years. Additionally, the City has developed targeted cleaning programs to identify sewers 8 inches and smaller that have experienced high incidents of sewer blockages per lineal foot. The targeted areas were identified and prioritized based on a risk analysis of the lines that serve the target areas. Targeted areas are scheduled to be cleaned on either a 2, 3, or 4 year cleaning cycle.

Table 3-1 indicates the linear feet of sewers that were proactively cleaned and Inspected during the past three years fiscal years, and Figure 3-1 shows the distribution of these lines.

Table 3-1: Collection System Cleaning and Inspection Production (Linear Feet)*

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total	124,360	110,549	145,049	268,497	312,839

*** Total includes comprehensive, targeted and routine cleaning production, signing the MCD for FY 2019 represents the first year the City of Baltimore will track this production for comparison in future years.**

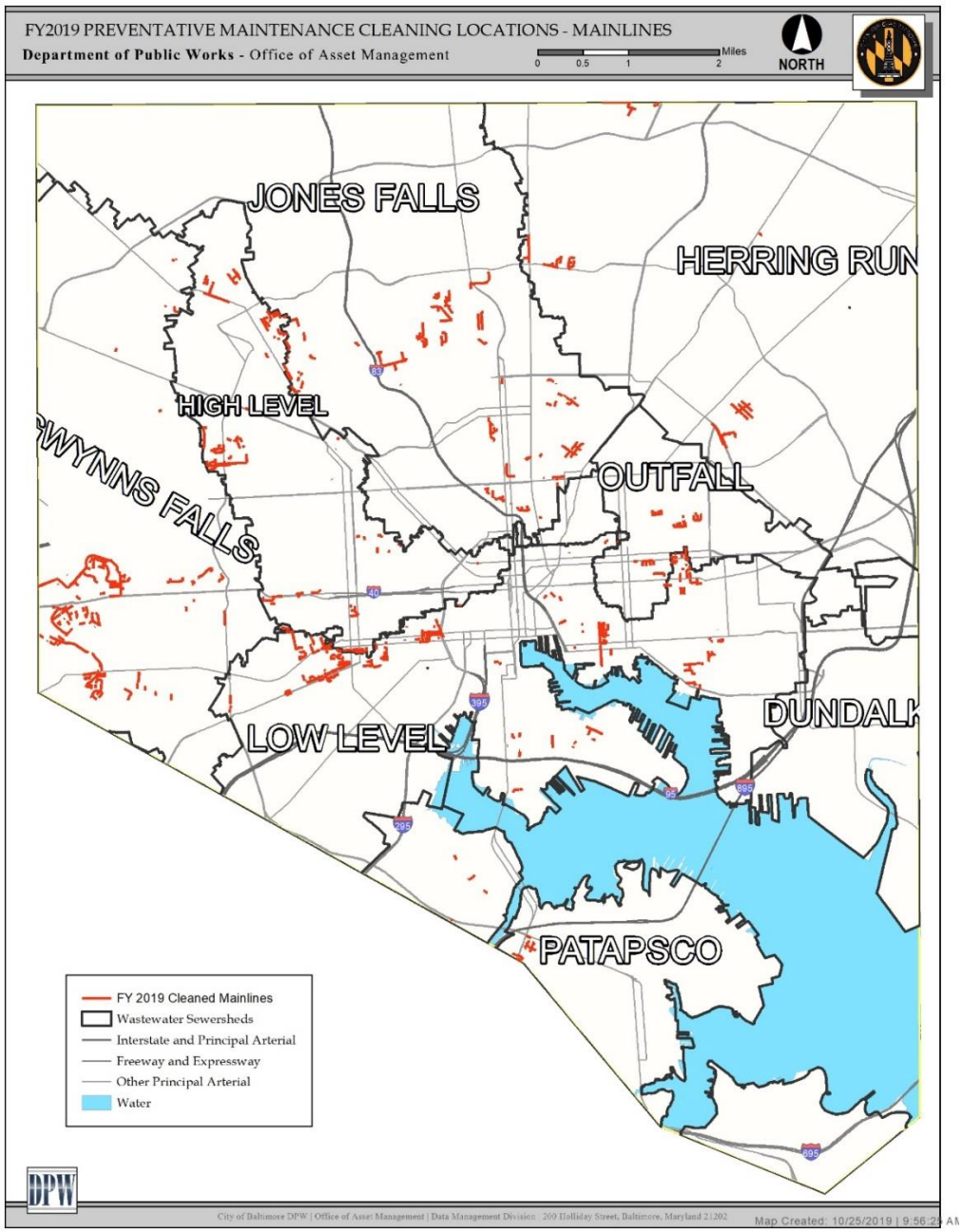


Figure 3-1: FY19 Collection System Cleaning and Inspection Locations

In addition to the scheduled comprehensive and targeted cleaning routine cleaning continues to be performed at locations with known maintenance issues that cannot be easily resolved or are slated for future projects. Routine cleaning is performed on either a 3, 6, or 12 month cleaning cycle depending on the severity of the issues needed to provide acceptable service. Routine cleaning supplements comprehensive and targeted cleaning efforts. Regular evaluations of these locations are made to determine the adequacy of the cleaning intervals and modifications to the schedule are made when appropriate.

A list of all routine cleaning locations is included in Appendix 5-1. Table 3-2 shows the number of cleaning locations by type and frequency for FY2019.

Table 3-2: Routine Cleaning Locations FY 2019

	Number of Locations by Frequency (Months)				
Type	**3 mo.**	**6 mo.**	**12 mo.**	**Total**	**Percentage**
Mainline Cleaning	195	298	25	518	60%
House Connection Cleaning	108	116	112	336	40%
Total	303	414	137	854	100%

SECTION 4 – New Sewer Installation and Rehabilitation

4.1 New Sewer Installation and Rehabilitation

The City is continuously evaluating the sanitary sewer collection system to develop and implement measures for elimination of unpermitted discharges from the system. These assessments identify capacity deficiencies, infiltration/inflow, and maintenance problems, in order to repair or replace portions of the collection system. A listing of sanitary sewer projects conducted during FY 2019 with tonnage cleaned and linear footage rehabilitated and replaced is provided in Table 4-1 below.

Table 4-1: Sewer Construction Projects, FY2019

SC No.	Location	Pipe Cleaning (LF/Tons)		New Pipe (LF)	Pipe Rehabilitation (LF)
SC903	Patapsco	8,180	LF	0.00	
SC910	Herring Run	0.00	LF	0.00	4,890
SC914	Low Level	34,821	LF	0.00	82,218
SC919	Outfall	23,657	LF	0.00	110,867
SC920	Gwynns Falls	6,600	LF	0.00	108,562
SC921	Gwynns Falls	3,290	LF	0.00	737
SC934	OutFall	27,186	LF	0.00	0.00
SC940	High Level	0.00	LF	7,829	0.00
SC941	Jones Falls	0.00	LF	0.00	0.00
SC953	High Level	36,104	LF	0.00	81,505
SC955	Gwynns Falls	0.00	LF	0.00	0.00
SC956	Herring Run	0.00	LF	0.00	0.00
SC962	Low Level	8,180	LF	0.00	2,433
SC963	HL, LL, GF	19,952	LF	0.00	19,217
SC964	JF HL	0.00	LF	0.00	8,160
SC965	North East Baltimore	0.00	LF	0.00	0.00
SC967	Jones Falls	18,435	LF	0.00	22,029
SC977	Gwynns Falls	20,822	LF	0.00	1,485
		Pipe Cleaning (LF/Tons)		**New Pipe (LF)**	**Pipe Rehabilitation (LF)**
Grand Total		**207,227**	**LF**	**7,829**	**442,103**
		0	**TONS**		

Notes:

1. Completed quantities in this table are based on the approved monthly construction invoices for each FY.
2. Pipe rehabilitation quantities only include CIPP/ Pipe Replacement and Pipe Bursting (point repair is not included).
3. Pipe Cleaning completed quantities include cleaning incidental to CIPP lining

Once construction is complete, newly installed and rehabilitated pipes are tested according to the project specifications and approved by the City. Generally, new sewers are tested from manhole to manhole or from manhole to terminus of the pipeline if there is no manhole at the upstream end. Testing is usually done by low-pressure air and/or infiltration/exfiltration tests as specified by the City. CCTV inspections are typically required for Cured-In Place Pipe (CIPP) lining rehabilitation to ensure that the construction is sound, there are no defects in the liner, and to provide a record of the post-lining condition of the sewer line after rehabilitation has been completed. Projects that involve cleaning only have post construction CCTV testing performed to verify that cleaning was performed as specified. Upon competition of new construction, testing was performed in accordance with the specifications listed below.

4.2 FIELD TESTS

A. Low Pressure Air Test

1. Test gravity sewers including house connections with low air pressure after completion of backfill. Field testing will commence when not more than one thousand feet (1000') sewer has been completed and includes immediate remedial required repair, replacement or modification to the installation procedures if the test section fails the test.

B. Hydraulic Test

1. Sewers over twenty-seven inches diameter and manholes are tested by the hydraulic method if approved air test procedure is not available.

C. Post-Construction Closed Circuit Television (CCTV)

1. Upon completion of the pipe installation, the Contractor performs a CCTV inspection using NASSCO Pipeline Assessment Certification Program (PACP) standards.

SECTION 5 – FOG Program

5.1 Fats, Oils and Grease (FOG) Program

Baltimore has implemented a comprehensive FOG Program that addresses FOG at the source and in the collection system. The FOG Program has two components: 1) Grease Abatement, and 2) Food Service Establishment (FSE) Inspections (described in Sections 5.3 and 5.4, respectively). Initially, Baltimore implemented a Grease Abatement program in 2008 addressing those portions of the collection system with FOG accumulation. In FY2012, the City began developing the FSE Inspection Program, and commenced inspections in FY2014. In FY2014, the FSE inspections were incorporated into Baltimore City's Industrial Pretreatment Program under the authority of Article 25 of the Baltimore City Code. The FOG management aspect of the Pretreatment Program includes promoting kitchen best management practices (BMPs) to residential and commercial customers and minimizing the discharge of FOG-bearing wastestreams to the sewer system. The program requires FSEs that discharge or have the potential to discharge process wastewater to the sanitary sewer to have a properly installed and sufficiently maintained grease control device (GCD).

5.2 Evaluation of Maintenance (Reactive) Work Orders

The City's work order management system, Cityworks, provides the ability to note the cause of problems for mainline chokes or blockages. An analysis of the Cityworks data can identify the presence of FOG as a contributor of a blockage. Table 5-1 provides a history of the work orders closed during the reporting period with grease problems identified. The DPW Pollution Control Section staff is notified of grease related blockages so that inspections of FSEs upstream of the impacted sanitary sewer can be performed.

Table 5-1: FOG Related Work Orders

FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
726	608	670	679	954

The FOG related work orders are periodically evaluated to help determine future targeting efforts for proactive treatment. GIS is utilized to overlay CCTV observations with work order history and field data to prioritize treatment schedules. The utilization of GIS has been successful in identifying grease problem areas within the collection system. In the evaluation of the FOG related work order there was an increase of 8% from the previous fiscal year. For fiscal year 2019 there was a 9% decrease in total linear footage treated from the previous fiscal year.

Figure 5-1 shows the grease treatment locations in the sewer system overlaid with the density of FSE locations.

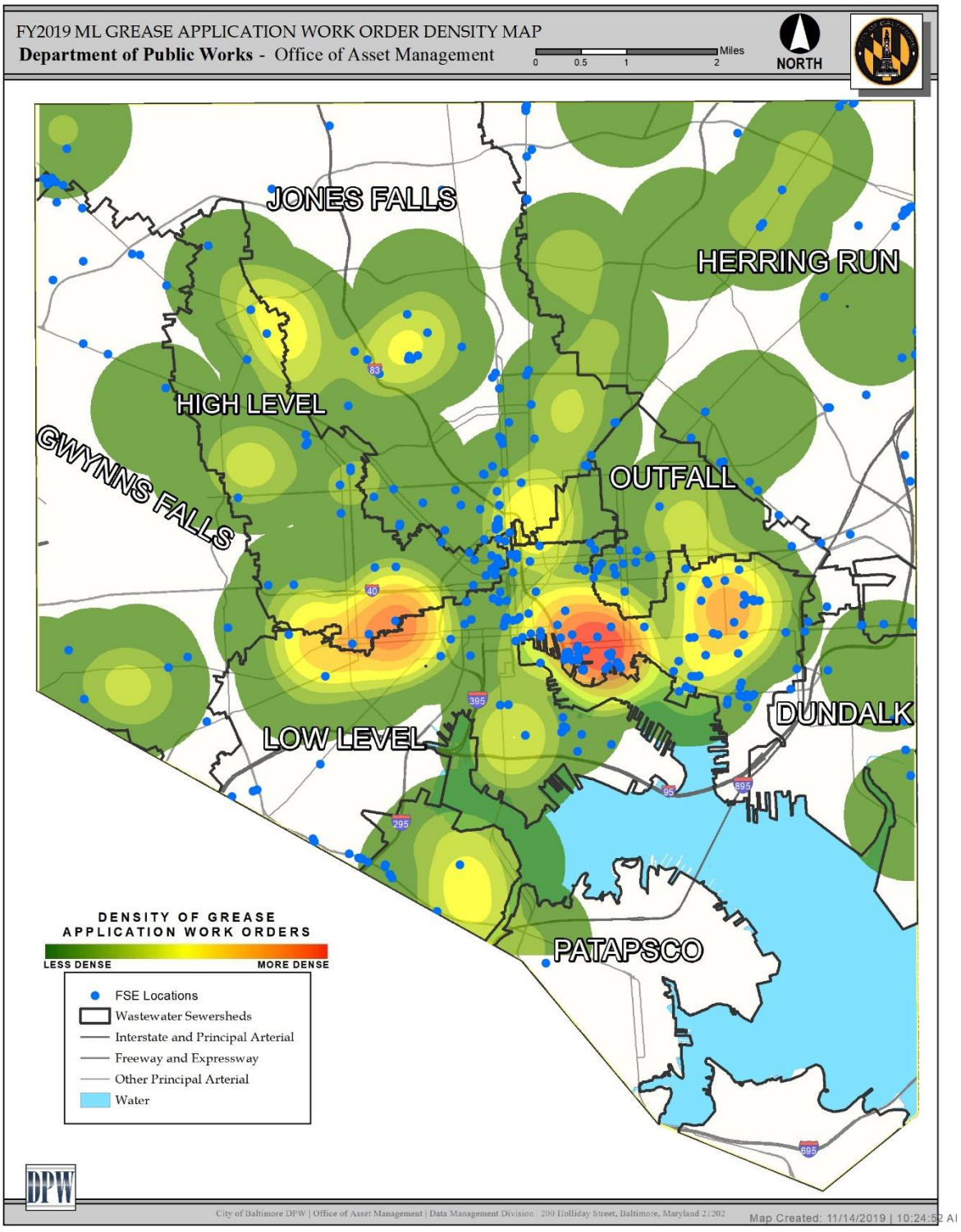


Figure 5-1: Grease Treatment Concertation and FSE Locations

5.3 Grease Abatement Chemical Application

Efforts undertaken for the grease abatement during the reporting period include:

- Reviewed work orders and CCTV with notation of grease observations.
- Applied grease-abatement chemicals to sewers located in grease problem areas.
- Maintained information in Cityworks for tracking the grease problem locations and grease abatement chemical applications.

Procedures for adding sewer segments to or removing sewer segments from the grease abatement inventory list are listed within the Standard Operating Procedure, AMD-PAS-0001 (Fog Abatement Inventory Management). The preliminary chemical application frequency that was assigned to each sewer continues to be refined as field crews return to the sites to perform subsequent grease abatement chemical applications, and field photos and CCTV are analyzed by Utility Engineers. The overall treatment was comparable to that accomplished in the previous reporting period, as shown below in Table 5-2.

Table 5-2: Grease Control Chemical Application

Total Length of Pipe (LF)	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
	70,132	73,938	70,156	63,902	58,878

5.4 FOG Prevention and Outreach – FSE Inspections

All FSEs that discharge or have the potential to discharge FOG to the sanitary sewer must comply with the following requirements:

1. Have a valid Wastewater Discharge Permit. DPW's Pollution Control Section issues these permits to non-residential users of the sanitary sewer system;
2. Have a properly sized, installed and functioning GCD. To be effective, each GCD is to be sized and installed in accordance with the Baltimore City Plumbing Code;
3. Clean and maintain the GCD frequently enough to comply with the 25% Rule (FOG Program Manual (2013) 3.3.1.) This frequency will depend on the number of fixtures discharging to it, the seating capacity of the establishment and the capacity of the device. The 25% Rule is an industry-accepted guideline for establishing cleaning frequency and minimizing the amount of FOG discharged to the sewer. The accumulation of solids settled at the bottom of the GCD and the grease floating on the top should not exceed 25% of the hydraulic depth at any time, as measured from the static water level to the interior tank bottom.
4. Keep a GCD maintenance log up-to-date and on-site. The log must document GCD maintenance and disposal activities. Waste hauler manifests and maintenance records must be retained for three years; and
5. Properly collect and dispose of FOG. It should be disposed as solid waste or stored in a covered,

leak-proof receptacle until it can be taken off-site by a licensed hauler.

FOG Inspectors use a mobile application (i.e. the FOG Inspection Application) to aid the inspection process and to maintain the database. FSE inspections are performed by DPW, Environmental Services Division, Pollution Control Section. The focus of the initial round of inspections was on educating customers about the FOG Program and appropriate grease handling practices. This stakeholder outreach continued during FY15 while performing inspections of GCDs within FSEs. During this fifth year of FSE inspections (FY2019) 3,900 inspections were performed. During those inspections, 3,832 GCDs were inspected. Non-compliant FSEs were issued Notices of Violation (NOVs) for lacking a GCD, insufficient maintenance and record-keeping for an existing GCD, certain Plumbing Code nonconformities, inadequate maintenance of waste grease storage areas, inaccessible GCD, and refused admittance. A total of 1,288 enforcement actions were initiated during this reporting period; one was rescinded. During the reporting period, 345 of the inspections were follow-up inspections after an NOV had been issued. As a result of the program, 15 facilities subsequently installed a GCD in FY2019. A breakdown of the total of FSE inspection violation types for the reporting period is shown in Table 5-3. A list of inspections conducted and enforcement actions take in contained in Appendix 5-1.

Table 5-3: Inspection Violation Types FY2019

Violation Type	Total
Unauthorized discharge (Fail 25% Rule, Improperly operating GCD, certain appurtenances not connected to GCD)	**619**
No Grease Control Device	**26**
Inadequate/No Maintenance Log	**469**
Plumbing Code	**31**
Refuses Admittance	**37**
Inaccessible GCD	**7**
Inadequate Maintenance of GCD, overflow, waste/recycle grease area	**100**
NOV Rescinded	**-1**
Total	**1288**

These data are stored in DPW's FSE database ("FOG APP"). This database is an inventory of FSEs that discharge or have the potential to discharge FOG-bearing wastewater to the sanitary sewer. The FSE database is used to track FSE general information, addresses, GCD details, inspection results and enforcement actions. The inventory is updated based on the results of the field investigations and

inspections that are performed. The FSE locations are maintained in the GIS and linked to the lateral through which the grease control device discharges. The FSEs can be viewed as a map layer, allowing network traces to be performed and identifying potential sources of FOG at specific locations.

These data are housed in the FSE database, comprised of current and historical data from Baltimore City Health Department and DPW. This database is an inventory of FSEs that discharge or have the potential to discharge FOG-bearing wastewater to the sanitary sewer. The FSE database is used to track FSE general information, addresses, GCD details, inspection results and enforcement actions. The inventory is updated based on the results of the field investigations and inspections that are performed. The FSE locations are maintained in the GIS and linked to the lateral through which the grease control device discharges. The FSEs can be viewed as a map layer, allowing network traces to be performed and identifying potential sources of FOG at specific locations.

During investigations of SSO, the FSE database and grease abatement data may provide potential sources of grease, and may facilitate coordination with the Pollution Control Section. These investigations may result in an enforcement action that may require either a GCD installation or increased frequency of GCD maintenance. Escalated enforcement actions including the assessment of penalties commenced with full program implementation during FY2016.

5.5 FOG Program Performance

In 2006, the City began evaluating grease-related work orders. Figure 5-4 shows complaint and preventive work orders which were due to grease-related problems, grease-related work orders as a percent of total work orders created by fiscal year.

Grease related work orders for mainlines and laterals have increased since FY 2018. The increase could be attributed to the reduction of grease control chemical applications. The cleaning program that was carried out in key problem areas within the collection system that may cause grease accumulation, such

as roots and sags.

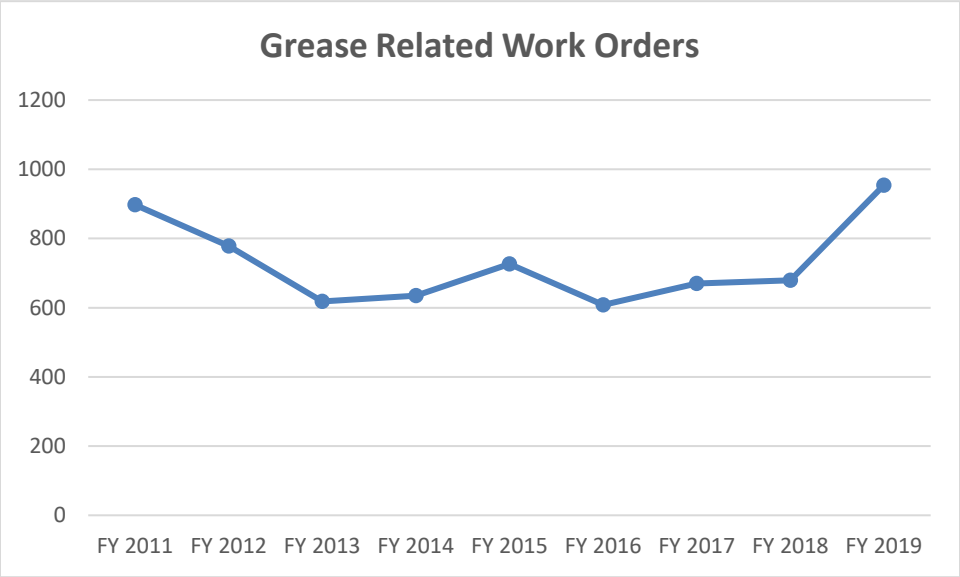


Figure 5-4: Grease-Related Work Orders by Fiscal Year

SECTION 6 – Root Control Program

6.1 Root Control Program

DPW continued to execute the Root Control Program during the reporting period. The progress is detailed below and includes:

- Continued evaluation of complaint records and maintenance work orders related to roots, and identification of areas with severe root problems.
- Identification of significant root growth through sewer inspection CCTV.
- Continued application of root control chemical to mainlines and laterals with significant root intrusion.

6.2 Evaluation of Maintenance (Reactive) Work Orders

Table 6-1 provides the history of work orders which identified the presence of roots as a contributing factor to the blockage.

Table 6-1: Root Related Work Orders

FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
2,078	3,147	3,215	3,336	2,918

The occurrences of lateral and sewer blockages caused by roots are used to identify laterals and sewer segments that should be added to the Root Control Program or referred for repair.

The number of root related work orders decreased from the previous fiscal year by 8.7%. This can be attributable to the continued uses of root control chemical at selected, targeted locations.

6.3 Root Control Chemical Application

The City has conducted root chemical treatments since FY 2008. Table 6-2 below reports the linear feet of sewer main treated with root control chemical during this period. The data shows that the length of sewer main treated with root control chemical peaked in FY 2013; this was driven by a large number of cyclical warranty treatments.

Table 6-2: Root Control Chemical Application Treatment

Fiscal Year	LF Treated
FY 2015	430,273
FY 2016	308,409
FY 2017	347,475
FY 2018	360,436
FY 2019	408,324

The City began evaluating historical data in FY2016 to determine the long-term chemical treatment cycle for sewer mainlines. The program will continue treatments until it can be demonstrated that areas do not require further treatment. Laterals are also included in the evaluations, but they are not warranted by the vendor due to the variability in conditions within the lateral. On-going evaluation of pre- and post-treatment CCTV videos for a limited number of mains is used to establish the most appropriate long-term treatment cycle for mains that require continuous treatment. Table 6-3 indicates the length of sewers by linear feet (LF) receiving one or multiple treatments to date, last treated in FY 2019.

The Root Control Program for FY 2019 has been maintained based on detailed review of root related work orders, CCTV that shows presence of live roots, and SSO locations. The program includes expansion to newly identified problem areas as well as re-treatments described above.

Based on the results of the root control chemical application performed this year and confirmation of the success of the program in reducing work orders, the City will continue to schedule repeat treatment where it is deemed necessary.

6.4 Root Control Program Performance

Of the 77.3 miles of sewer segments that have had one or more root treatments and are active in the Root Control Program. In addition to monitoring work orders, in FY2014, the City began to perform random, spot inspection of sewer mainlines that are included in the Root Control Program to help further evaluate the efficacy of the chemical application. The results of these inspections assist the City in establishing the appropriate treatment frequency for specific lines as the program continues to mature. There has been an overall decrease in the root related work orders during this reporting period.

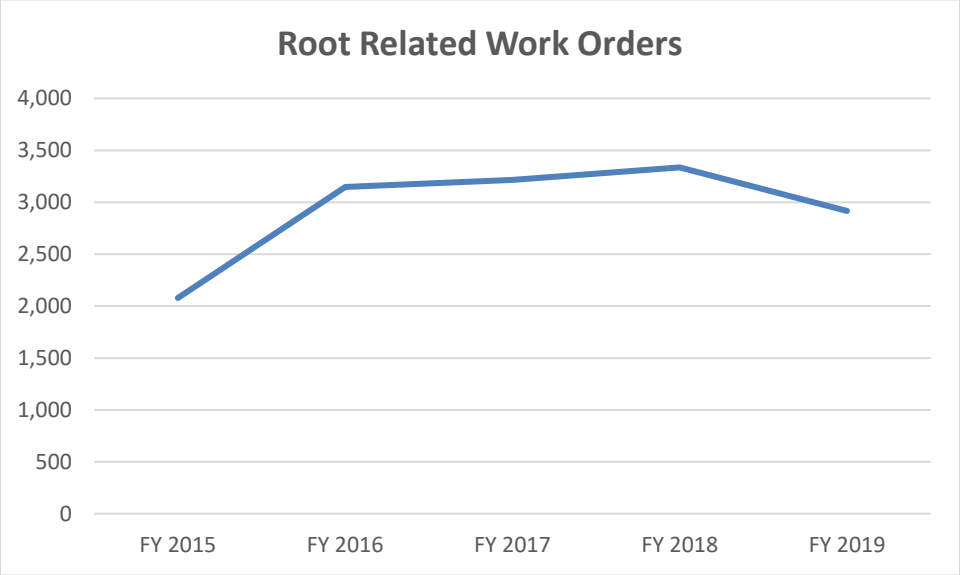


Figure 6-3: Root Related Work Order Comparison

SECTION 7 – Limited Access Areas

Limited access areas were previously identified during evaluations for each sewershed and were submitted as attachments in previous O&M annual reports. The list of limited access areas is dynamic, and varies over time as additional limited access sewers are discovered through on-going preventive maintenance programs and construction projects. Appendix 7-1 contains a comprehensive list of all manholes with limited access. Manholes in the list have been or will be addressed through construction projects. The City will amend and maintain the comprehensive list of limited access manholes.

Over the past eight years Baltimore has been addressing accessibility to these areas through construction contracts. These contracts include identifying the means and methods to gain access to the manholes. In most instances access is provided through temporary access roads and existing public trails.

SECTION 8 – Collection System Lateral Prioritization Program

The modified Consent Decree requires the City to address new or reoccurring Building Backups - also known as Water in Cellar (WIC). Baltimore City tracks the number of WIC's based on the address of structures and the frequency of backups. The program has three components: (1) identification, (2) inspection and condition assessment, and (3) prioritized repair/replacement and/or maintenance. During the period from July 1, 2018 to June 30, 2019 the city identified and inspected 1,624 locations. The table below reflects the total number of laterals that were identified as needing additional actions in order to prevent or reduce the number of building backups.

REPAIR TYPE	COMPLETE	IN PROGRESS	SCHEDULED	TOTAL
OAM HOUSE LATERAL LINING	47	91	55	193
OAM HOUSE LATERAL REPAIR	25	4	120	149
Total	72	95	175	342

The following graph demonstrates the efficacy of the Lateral Prioritization Program. The purple line shows the 12 month rolling average, which is trending favorably.

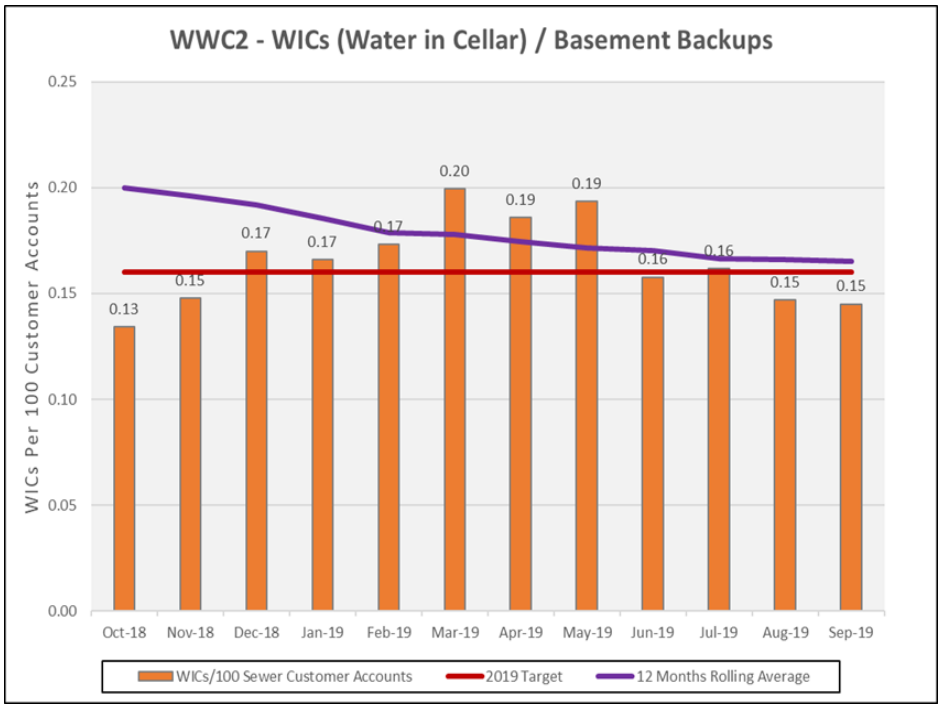


Figure 8-1: Water in Cellar Graph