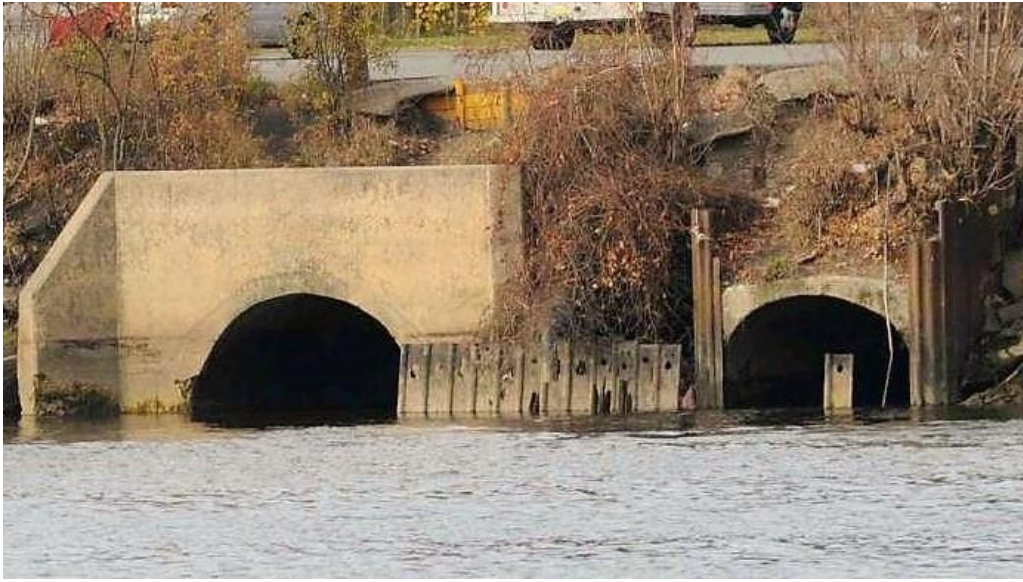




Hidden Capacity

A Report on How Proper Maintenance and Cleaning of Sewer Systems Can
Have Huge Benefits!

Issued by the Jersey Water Works Combined Sewer Overflow Committee

March 2019



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Issued by the Jersey Water Works Combined Sewer Overflow Committee

This report was prepared by the Jersey Water Works Combined Sewer Overflow committee and does not reflect the position of the New Jersey Department of Environmental Protection (NJDEP) or the United States Environmental Protection Agency (US EPA).

Executive Summary

The ability of sewage collection systems to deliver flows to sewage treatment plants efficiently is a fundamental purpose of all sewer collection systems. As sewer systems age, the risk of deterioration, blockages, and collapses increases. Cleaning and inspecting sewer lines are essential to the proper functioning of this important community asset; failure to do so can result in serious sewage flooding, overflows, backups, and collapses.

The purpose of this paper is to highlight the importance of sewer cleaning and inspection as critical elements of a proper and effective sewer system operation and maintenance program. Additional basic, cost-effective “gray” type controls, which have the potential to reduce combined sewer overflows (CSOs), sewer backups, and flooding significantly, are also presented. The cleaning and proper maintenance of sewer collection systems is relevant to both combined sewer systems (i.e., systems that convey sanitary/industrial flows as well as stormwater) and separate sanitary systems (systems that carry only sanitary/industrial flows). This paper also provides regulatory recommendations to help ensure that municipalities/utilities are implementing these basic, cost-effective control measures and are operating and maintaining their collection systems properly.

New Jersey communities with combined sewer systems are often located in financially disadvantaged, older urban communities with aging and deteriorating sewage infrastructure, some of which dates back to the 1800s. Due to the multitude of problems in many of these municipalities, the funding and implementation of basic, cost-effective CSO controls, including the proper cleaning, operation and maintenance (O&M) of sewage collection systems, has often been overlooked. Past regulatory efforts, including the issuance of CSO general permits and the issuance of administrative orders, have not been successful in all cases. While the recent issuance of individual CSO permits represents a big step forward in terms of CSO control in New Jersey, these permits should be assessed carefully and future enhancements considered.

Recommendations:

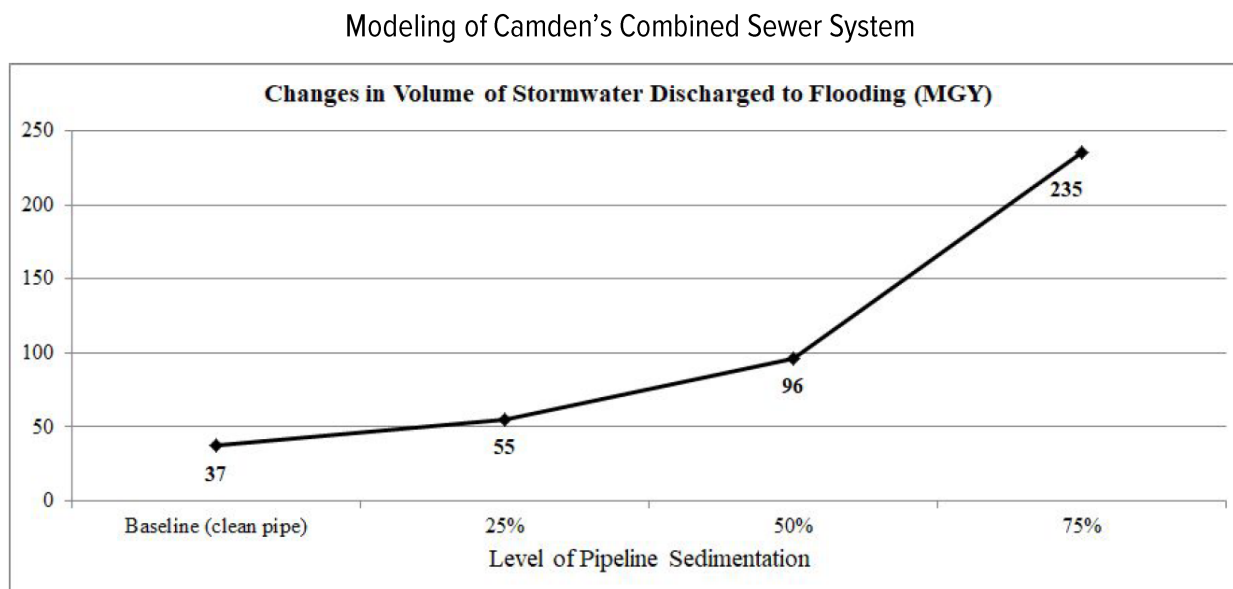
1. NJDEP should strongly encourage CSO permittees to:
 - Provide summaries of sewer system and CSO cleaning and inspection activities to help document the proper operation and maintenance of the sewer collection system.
 - Carefully consider the basic, cost-effective sewer system and CSO controls identified in this paper as part of a report documenting the evaluation and implementation of the nine minimum controls (NMCs).
 - Provide this information along with the required Development and Analysis of Alternatives Report due July 1, 2019.
2. NJDEP and US EPA should increase the frequency of comprehensive CSO inspections and document the Implementation of sewer system and CSO O&M activities.
3. NJDEP should update future New Jersey Pollutant Discharge Elimination System (NJPDDES) CSO permit requirements to:
 - List all sewer system and CSO infrastructure owned or operated by the permittee.
 - Require remote monitoring of key portions of the collection system, such as regulators.
 - Require an annual CSO status report, including a summary of O&M activities (including summaries of system cleaning and inspection) and the implementation status of the nine minimum and long-term CSO controls.
4. Increase the awareness of funding opportunities for sewer system and CSO infrastructure upgrade and maintenance.
5. Encourage the sharing of technical and managerial resources necessary for sewer system improvement projects to reduce the burden and costs on individual CSO municipalities.

Impact of Proper Maintenance of the Combined Sewer System in Camden

NJ AIMS developed a fact sheet in March of 2017 to highlight the impact of improper maintenance of the combined sewer system in Camden. Recent modeling of Camden's combined sewer system found that the buildup of sedimentation and other debris in the trunk and outfall sewer pipes resulted in increased community and street flooding. If proper cleaning of the sewer system were performed, the model predicts that 90 percent of the flooding from the combined sewer system could be eliminated!

Results of this study conclude:

- When sewer pipe obstruction levels are reduced from 75 percent to 25 percent, flooding drops by more than 90 percent.
- When pipe sediment increases from a 25 percent obstruction to a 75 percent obstruction, the annual volume of flooding increases from 18 million gallons to nearly 200 million gallons over the baseline.



Source: Jersey Water Works – NJ AIMS Fact Sheet, “Impact of Proper Maintenance of Combined Sewer Overflow System on Flooding in the City of Camden”, p3



A dirty sewer, with significant grease and oil build up, hinders wastewater flow.



A clean sewer, without grease or oil build up, allows appropriate flow downstream.

Source: NYC Department of Environmental Protection, State of the Sewers 2012, p.10

Inspections of CSO Operation and Maintenance programs in New Jersey

Despite the fact that permit requirements for sewer system operation and maintenance plans have existed for decades, and administrative orders having been issued by the NJDEP, some New Jersey communities have yet to implement even basic CSO controls.

According to the US EPA's [*2004 Report to Congress on the Impacts and Control of CSOs and SSOs*](#), effective Aug. 23, 1999, the City of Camden was required by a state administrative order to implement fully the CSO O&M program and develop and implement the CSO pollution prevention plan by Sept. 30, 1999. As evidenced by the Camden modeling study, this effort was not successful.

The US EPA inspections from 2012 identified several New Jersey CSO communities that had failed to develop and implement O&M programs as required by the New Jersey CSO General Permit. The following is a small excerpt from an inspection report; a more in-depth excerpt from the report can be found in Appendix B.

“The Town’s maintenance approach does not include regularly scheduled inspection and maintenance of the collection system. The Town performs sewer cleaning on a reactive basis, responding to customer complaints (i.e., basement backups or other types of unpermitted releases) and field crew observations rather than implementing a regularly scheduled preventive maintenance approach.”

“As a result of the lack of an inspection program, the Town is not able to properly assess the condition of its collection system and identify defects and areas of concern before they result in failures. Additionally, a CCTV inspection program that follows the Town’s sewer cleaning activities would allow the Town to evaluate the efficacy of its cleaning activities and modify its sewer cleaning procedures to minimize damage caused to the aging collection system by the cleaning equipment.”

“To evaluate the Town’s familiarity with the PVSC regulators which control discharge from its collection system, the EPA Inspection team requested to view the regulators during the inspection. The Town stated that it is not allowed to open the manholes which provide access to the regulator chambers. In order to further evaluate the Town’s ability to communicate and coordinate with PVSC, as would be required during a collection system problem such as a dry weather overflow from a CSO, the EPA Inspection Team

requested that the Town follow the steps it would normally take to gain access to the regulator chambers.

The Town contacted PVSC which responded to the request to meet the EPA Inspection Team in the field to provide access to the regulator chambers. The EPA Inspection Team asked the Town staff whether this process had been implemented before. Many of the field crews and management staff responded that it was the first time they had seen the regulators, and stated they were not familiar with the characteristics and design flows of PVSC's regulators. As such, the Town is not aware whether the regulator design flows allowed for maximum storage of wet weather flows within the collection system, as required by the Nine Minimum Controls for Combined Sewer Overflows. Additionally, the Town's inability to access the regulator chambers independently of PVSC severely limits the ability of the Town to identify and report dry weather overflows from its CSOs, as required in Section C.2. of the permit. In addition, many of the CSO outfalls are underwater during higher tidal periods, further limiting the Town's ability to know when a dry weather overflow is occurring. Given these constraints and the lack of any system by which overflows can be noted, the Town is incapable of fulfilling this obligation in its permit."

Since these inspections, CSO communities have made progress in developing CSO O&M plans but significant issues remain. Some CSO communities continue to maintain collection systems on a reactive basis, and cannot determine if a dry weather overflow has occurred, or if there is tidal infiltration into the collection system.

Current and Past Regulatory Requirements/Efforts

Regulatory requirements for the proper operation and maintenance of combined sewer systems have been in place since the 1990's.¹ However, as evidenced by the Camden modeling study as well as inspections of combined sewer systems, many combined sewer systems in New Jersey have failed to implement basic, cost-effective controls, including the proper cleaning and maintenance of sewer systems. This problem contributes to combined sewer overflows and flooding in New Jersey communities.

¹ US EPA, CSO Control Policy, April 11, 1994, NJDEP, CSO General Permit, March 1, 1995

In 1994 the US EPA issued its *CSO Control Policy*. In 2000, Section 402(q) of the Clean Water Act was amended to require that each permit, order or decree for a discharge from a combined sewer system needed to conform to the 1994 *CSO Control Policy*. The *CSO Control Policy* requires communities with CSOs to implement NMCs immediately to reduce CSO discharges, and to develop CSO Long Term Control Plans (LTCPs) as soon as practicable, but generally within two years of receiving a water discharge permit with this requirement.

The NMCs are minimum technology-based controls that can be used to address CSO problems. These cost-effective measures can be implemented without extensive engineering studies and should be implemented prior to implementation of long-term control measures. The deadline for implementation of the NMCs was Jan. 1, 1997. In addition, permittees are required to submit appropriate documentation demonstrating implementation of the NMCs, including any proposed schedules for completing minor construction activities. The NMCs are:

- Proper operation and regular maintenance programs of the sewer system and CSOs
- Maximum use of the collection system for storage
- Review and modification of pretreatment requirements to assure CSO impacts are minimized
- Maximization of flow to the publicly owned treatment works for treatment
- Elimination of CSOs during dry weather
- Control of solid and floatable materials in CSOs
- Pollution prevention
- Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts
- Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls

According to US EPA guidance, documentation of the implementation of the NMCs should include:

- The alternatives considered for each minimum control
- The actions selected and the reasons for their selection
- The selected actions already implemented
- A schedule showing additional steps to be taken
- The effectiveness of the minimum controls in reducing/eliminating water quality impacts

The guidance includes information for the proper operation and regular maintenance programs for the combined sewer system and states that “implementation of this minimum control will reduce the magnitude, frequency, and duration of CSOs by enabling existing facilities to perform as effectively as possible.” It also stresses the importance of maintaining records and the identification of a proper operation and maintenance program as a high management priority.

The guidance stresses the importance of a sewer system inspection program, and states that “the appropriate frequency of inspections will depend on the type of facilities, historical records of performance and failure, sensitivity of nearby surface waters to CSOs, adequacy of the maintenance program, and other factors.” The guidance recommends inspections of “regulator devices and interceptors, trunks, and combined sewers during dry weather for blockages, excessive deposition of solids, excessive infiltration/inflow, and structural deterioration that needs to be corrected.” The program should also document procedures for routine maintenance activities and should focus on preventative maintenance to avoid failures during critical times.

Recommended documentation to demonstrate the implementation of an adequate O&M program to reduce impacts of CSOs includes the following:

- An identification of combined sewer system (CSS) components requiring routine operation and maintenance
- An evaluation of operation and maintenance procedures to include regular inspections; sewer, catch basin, and regulator cleaning; equipment and sewer collection system repair, or replacement where necessary
- An operation and maintenance manual and/or procedures for the CSS and CSO structures
- Resources allocated (staff, equipment, training) for maintenance of the CSS and CSO structures
- A summary of inspections conducted and maintenance performed.

Implementation of a comprehensive O&M program, including sewer cleaning, can be a cost-effective way to meet other required NMCs, including maximum use of the collection system for storage, maximization of flow to the publicly owned treatment works for treatment, and elimination of CSOs during dry weather. The subcommittee recommends that all permittees evaluate carefully, and implement where appropriate, the following cost-effective control measures. Many of the recommended measures are derived from US EPA guidance for the nine minimum controls.

Basic, Cost-effective Sewer System and CSO Controls

1. Collection System Inspection.

Inspection programs are required to determine current sewer conditions and to aid in planning a maintenance strategy.² This control enables the identification of serious deficiencies that restrict the use of the system's available storage capacity or limit its ability to deliver combined flows efficiently to the treatment plant. The inspection program should be implemented on a proactive basis with regularly scheduled inspections, with the inspection frequency depending upon the type of infrastructure, historical records of performance and failure, sensitivity of nearby surface waters, adequacy of the maintenance program, and other factors. All critical elements of the sewer system and CSO infrastructure, including regulator devices, tide gates, interceptors, trunk and combined sewers should be inspected during dry weather for blockages, excessive deposition of solids, excessive infiltration/inflow, and structural deterioration that needs to be corrected. Regulators are particularly important in controlling CSOs, and US EPA recommends biweekly inspections, as well as inspections after wet weather events.

2. Sewer Line Cleaning and Removal of Obstructions to Flow.

Sediments, tree roots, fats, oils, and grease as well as other items can restrict flow and result in flooding and dry weather overflows (DWOs) at upstream locations and can restrict flow to the publicly owned treatment plant (POTW). The cleaning of interceptors, trunk sewer lines and siphons to remove and prevent accumulations of debris and sediment should be performed as part of a regular maintenance program. Restrictions can be removed through sewer flushing (utilizing water from a tank truck or hydrant), power rodding (using a truck or trailer mounted rodding machine with a variety of cutting tools), balling (using various sizes of spinning balls with high velocity water), jetting (using a truck or trailer-mounted high-velocity cleaner (hydro-jet) with an assortment of nozzles), power bucket machines (system whereby buckets are pulled on a cable to remove sediment from sewer lines), or other common maintenance methods. Where flow obstruction is caused by sediment accumulations in sections with low gradients, sewer flushing might be an effective control measure. When a section of the conveyance system routinely accumulates sediment deposits at a substantial rate, design and installation of a permanent flushing station or an in-line grit chamber might be the most cost-effective approach and should be considered as part of the LTCP. In addition to interceptors and trunk sewers, inlets, as well as piping between inlets and combined sewer mains, need to be inspected and cleaned.

² US EPA, Office of Water, Collection Systems O&M Fact Sheet, Sewer Cleaning and Inspection, EPA 832-F-99-031, September 1999, p1

3. Sewer Repair.

Groundwater can enter the sewer system by infiltration into sewer pipes and, when combined with peak sanitary sewage flow, can exceed the capacity of the regulator and result in a DWO. Where specific DWO problem locations can be linked to defects in localized sewer segments, repair may be appropriate as a minimum control measure. Infiltration also limits the capacity of the collection system and POTW to treat combined sewer flows. In areas with leaky pipes, the implementation of green infrastructure projects, which have the potential to increase groundwater levels, may increase infiltration into the sewer system. For widespread infiltration problems, a comprehensive infiltration/inflow control program would likely be a necessary component of the LTCP.

4. Tide Gate Maintenance and Repair.

Tide gates can fail to close properly because of obstruction by trash or timber, corrosion or warping, or deteriorated gaskets. Leaking tide gates can admit significant volumes of water into the conveyance system, thereby occupying system storage and conveyance capacity that would otherwise be available during wet weather periods. A tide gate inspection and maintenance program can use sensors placed inboard of the gate to detect tidal intrusions during dry weather periods and alert maintenance crews. The sensors can also be used to detect Dry Weather Overflows.

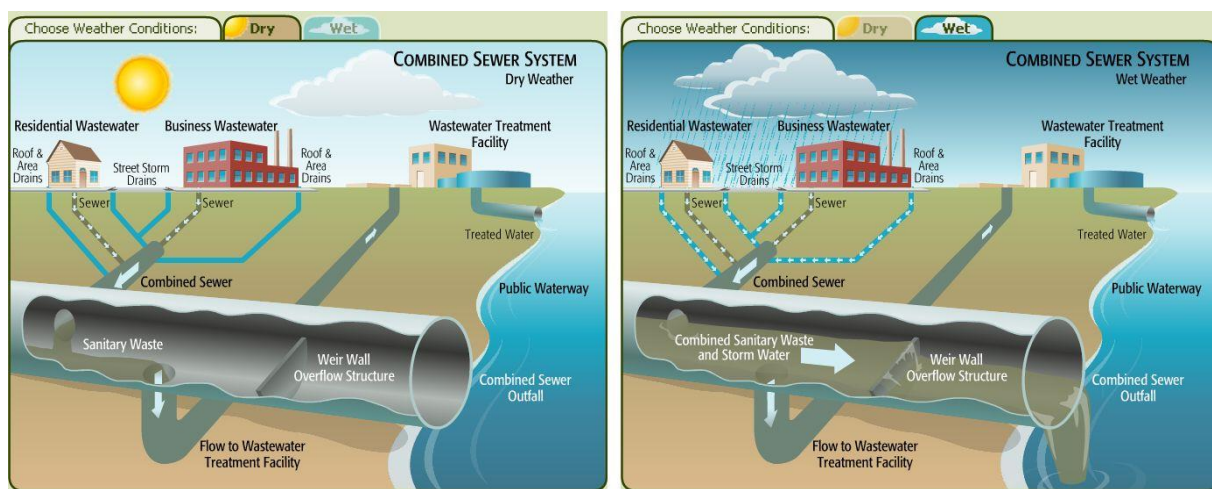
5. Maintenance/Repair/Rehabilitation of Regulators.

Frequently, regulators with hydraulically or mechanically actuated gates can become stuck in the bypassing position because of damage, deterioration, or inadequate maintenance. This may allow dry weather flows to enter the outfall. Simple repairs can correct some of these problems. Additionally, the orifice through which dry weather flows pass from the regulator to the interceptor can become blocked with trash and refuse and result in a DWO. Routine inspection and maintenance will eliminate such blockages. Debris and relatively large items can be removed manually. Jet washing can remove grease, sediment, and fiber buildup from relatively small orifices.

6. Adjustment of Regulator Settings.

Many regulating devices, with simple modifications, can be used to increase in-system storage of wet weather flows. In some cases, stop planks or brick/concrete weirs can be raised to increase in-system storage (see illustration below). In addition, interactive controls can be used to induce temporary in-line storage of wet weather flows (e.g., a regulator setting can be manipulated automatically in response to depth or flow in an interceptor). Regulator settings can also be adjusted to eliminate DWOs. Appropriate sewer system characterization and modeling should be performed to ensure regulator adjustments will not result in system backups.

Illustration of Weir Wall



Source: Henderson Water Utility: <https://www.hkywater.org/departments/wastewater/combined-sewer-system#cs-detail-links>

7. Upgrade/Adjustment of Pump Operations and Interceptor Lift Stations.

Increased pumping rates might be possible through repair, modification, or augmentation of lift stations. This would increase the available capacity in upstream portions of the system but would depend on sufficient hydraulic capacity of downstream portions, as well as processing capacity of the POTW, to accept the increased flow rates. The subcommittee also recommends that all lift/pump stations be alarmed and that permittees consider substituting more efficient variable-speed pumps for existing on/off-type pumps, although the additional costs may result in this measure being considered in the LTCP rather than as one of the NMCs. As part of the O&M program, emergency generators and backup pumps should be tested regularly.

8. Maintenance of CSO Outfalls and Controls.

Combined sewer outfalls must be inspected, maintained, cleared of sediment and debris, and repaired as necessary. Floatable control devices, such as netting and screens, must be cleaned regularly and retained materials properly disposed of. Failure to maintain the outfall and netting/screening facilities adequately can result in flooding, backups and DWOs.

NJDEP CSO Permit Program and Operations and Maintenance

The NJDEP's first general CSO permit became effective on March 1, 1995. That permit required a proper operations and maintenance program. The two general permit requirements for the O&M program are:

- On or before March 1, 1996, the permittee shall develop, maintain as current and implement a proper operation and maintenance program that will meet the requirements of the permit and will maintain a good working order and will operate as effectively as possible all treatment works, facilities, and systems of treatment and control for collections and treatment that are installed or used by the permittee for water pollution control and abatement to achieve compliance with the terms and conditions of the permit.
- The permittee shall develop O&M Plan and Manual(s), that support the implementation of the proper operation and maintenance program, and that demonstrates that the permittee has made or shall make the necessary financial, administrative, and institutional arrangements to meet the requirements of the permit. An O&M Plan and Manual(s) shall contain the following elements structured to address the type of facility regulated by the general permit authorization, including, but not limited to: an Annual

Budget Analysis; a Financial Management System; Staffing and Training an Emergency Operations Program, including a System Vulnerability Analysis and Emergency Operations Program: Administrative Functions; and Operation and Maintenance Manuals(s).

Subsequent general permits became effective on Feb. 29, 2000, and Aug. 1, 2004. Each of those general permits continued these requirements. When the first individual permits became effective on July 1, 2015, the O&M requirements changed significantly with expanded detail. These new requirements are in effect today, with some requirements related directly to sewer pipe cleaning. The requirements relevant to our discussion are:

- The O&M Program shall also include Standard Operating Procedures (SOPs) for the inspections, operations and scheduled preventative maintenance to ensure the system will function properly.
- SOPs should be created for system operations. The SOPs should include a frequency of inspections, regular maintenance, and timely repair and documentation of such information.
- Ensure that system storage and conveyance is maximized.
- Conduct visual inspections of sufficient scope and frequency to be assured that unpermitted discharges, obstructions, damage and dry weather overflows will be discovered.
- Prevent intrusion into the system by high tides and receiving water flooding.
- Provide a gravity sewer and catch basin inspection and cleaning schedule as necessary.
- Remove within one week of becoming aware any obstructions contributing to overflows due to debris, Fats, Oils Greases (FOG) and sediment build up.

Importance of Controlling Excessive Infiltration and Inflow

In addition to a proper O&M program, both the previous CSO general permit and the current Individual CSO permits recognize the importance of identifying and controlling sources of excessive inflow and infiltration (I/I). Infiltration is the seepage of groundwater into pipes or manholes through defects such as cracks, broken joints, etc. Inflow is the water that enters the sewer through direct connections such as

roof leaders, direct connections from storm drains or yard, area, and foundation drains, the holes in and around the rim of manhole covers, etc.³

The previous CSO general permit stated the following:

“Infiltration/Inflow Control - Excessive infiltration and inflow (I/I) can increase operations and maintenance costs and can consume hydraulic capacity, both in the collection system and at the treatment plant. In CSSs, surface drainage is by design the primary source of inflow. Other sources of inflow in CSSs that might be appropriate to control include tidal inflow through leaking or missing tide gates and surface runoff from open spaces. Infiltration is ground water that enters the collection system through defective pipe joints, cracked or broken pipes manholes, footing drains, and other similar sources. Elimination of excessive Infiltration and Inflow (I/I) in separate sanitary sewer systems tributary to a downstream combined sewer system can provide additional storage, conveyance and treatment capacity.”

The current Individual CSO Permits require that permittees, as part of the development and implementation of a sewer O&M program:

“Provide for ongoing I/I reduction strategies to meet the definition of non-excessive infiltration (in combined and separately sewered areas) and non-excessive inflow (in separately sewered areas) as defined in N.J.A.C. 7:14A-1.2 through the identification of excessive I/I sources and the prioritization and implementation of I/I reduction projects.”

The permit also requires, in the Evaluation of Alternatives section for the LTCP, that the permittee evaluate the technical feasibility of implementing various CSO controls, including:

“I/I reduction to meet the definition of non-excessive infiltration and non-excessive inflow as defined in N.J.A.C. 7:14A-1.2 in the entire collection system that conveys flows to the treatment works to free up storage capacity or conveyance in the sewer system and/or treatment capacity at the STP, and feasibility of implementing in the entire system or portions thereof.”

³ US EPA. (2005). Guide For Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems EPA Publication Number: EPA 305-B-05-002. p2-37

Excessive I/I can lead to overflows in sewer collection systems and exceed the capacity of the regional treatment plant. As noted in the permit requirement above, reducing excessive I/I from upstream separate systems can help reduce CSOs in downstream communities with combined sewer systems. As an example of regional I/I control, the Massachusetts Water Resources Authority has implemented a comprehensive voluntary program to control I/I, which contributes about 55 to 65 percent (approximately 185 to 275 million gallons per day, or mgd) of MWRA's annual wastewater flow. Annual average daily sanitary flow (including residential, commercial, industrial, and institutional flow) accounts for about 150 mgd with little variation from year to year. While infiltration increases the average daily flow significantly, it tends to increase and decrease gradually, while inflow can increase local dry weather flow by two to five times (or more).⁴ Completed local I/I reduction projects that have received MWRA financial assistance have been estimated to reduce flows by 90 million gallons per day⁵. Since existing systems will continue to deteriorate and system growth is likely, future additional reductions in I/I will be needed.

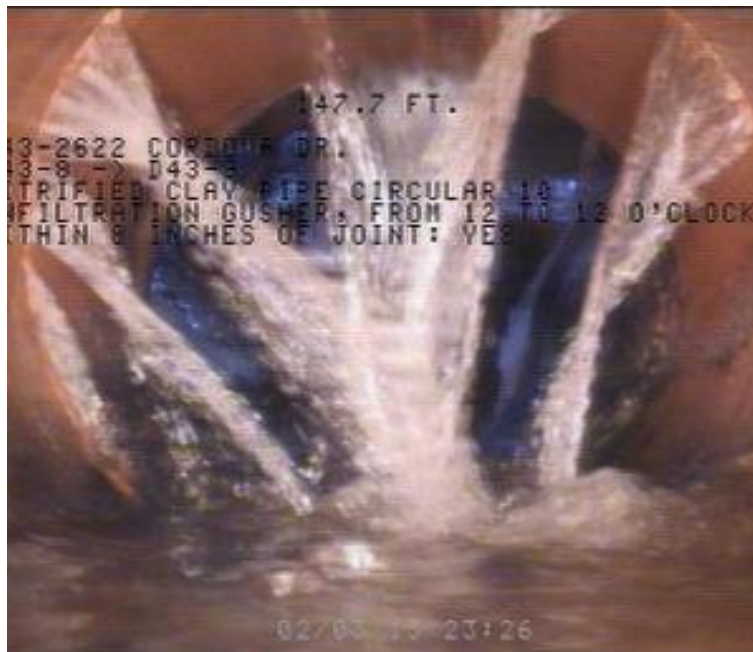
As noted above, a comprehensive effort to reduce excessive I/I can result in significant benefits by reducing sewage overflows and increasing capacity in both the collection system and the treatment plant. However, it appears that strategies to identify and reduce I/I are not being implemented and documented sufficiently in all New Jersey CSO communities. An examination of several recently developed CSS characterization studies revealed that while some communities discussed efforts to identify and correct excessive I/I, in others it was not discussed at all. Therefore, it is difficult to ascertain individual CSO communities' efforts to identify and correct excessive I/I as part of their O&M program.

Information on inflow reduction can be found in the Combined Sewer Overflow Technology Factsheet on Inflow Reduction at <https://www3.epa.gov/npdes/pubs/inflwred.pdf>. Information on conducting a Sanitary Sewer Evaluation Study can be found in Appendix A (Study Phase of an Inflow and Infiltration Reduction Program – Technical Details).

⁴ Massachusetts Water Resources Authority, Infiltration/Inflow Task Force Report, A Guidance Document for MWRA Member Sewer Communities and Regional Stakeholders, March 2001, 5

⁵ Mr. David W. Coppes, Chief Operating Officer, Massachusetts Water Resources Authority, Letter to Ms. Karen McGuire, US EPA Region 1 and Mr. Lealdon Langely, Massachusetts Dept. of Environmental Protection, Aug. 28, 2018, 4-6

Excessive Inflow and Infiltration



Source: City of Ft. Lauderdale: <https://www.fortlauderdale.gov/departments/public-works/engineering/water-sewer-design>

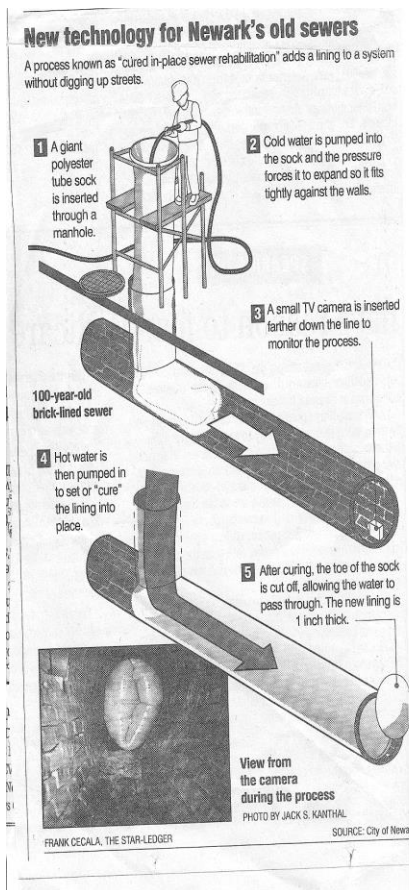
Contributes to Sanitary and Combined Sewer Overflows



Source: Raleigh, NC:
<https://www.raleighnc.gov/services/content/PubUtilAdmin/Articles/SanitarySewerOverflows.html>



Horseshoe-shaped brick sewer under Mulberry Street near Lafayette Street built ca. 1870.
(Photograph by Specialty Sewer Services, Inc.)



Infiltration in the Newark Sewer System; Reducing I/I in the Newark Sewer System

Benefits of Sewer Cleaning and Reporting of O&M Activities

Example Benefit of Sewer Cleaning

New York City Department of Environmental Protection (NYCDEP) has been aggressively pursuing maintenance and cleaning of its interceptors. In 2012, NYCDEP completed a two-year sewer cleaning project aimed at reducing discharges of untreated sewage and increasing pipe capacity. Using a floating sonar device, NYCDEP surveyed approximately 136 miles of interceptor sewers, with the intention of identifying those sewers in need of cleaning. Of the 136 miles of sewer surveyed, approximately 19 percent, or 26 miles, of sewers were cleaned. In addition to identifying the pipes in need of cleaning, by using the sonar device NYCDEP was also able to assess the structural condition of the sewer lines, and schedule repairs/replacement where required.

During the cleaning process, NYCDEP removed approximately 29 million pounds of sediment and debris, which they estimate was enough to fill nearly three Olympic-sized swimming pools. The NYCDEP estimates the cleaned sewers provide 1.9 million gallons per day of extra capacity during wet weather events. This additional wet weather capacity can be related directly to a significant decrease in CSO discharges. NYCDEP estimates CSO discharges have decreased nearly 100 million gallons annually as a result of sewer cleaning.

The interceptor sewers were cleaned using Vactor trucks with 30-foot hoses. These trucks vacuumed debris, while a water jet was used to break up clogs. Each Vactor truck was able to remove between 12 and 18 cubic yards of material before being emptied.

NYCDEP expects to continue using sonar survey and sewer cleaning on a two-year schedule.

Example Reporting of CSO O&M and BMPs required by Permits and Orders

The NYCDEP is required by its CSO permit to prepare an annual report on the implementation of CSO Best Management Practices, which are similar to the NMCs in the New Jersey CSO permits. The city is also required by its consent order with the New York State Department of Environmental Conservation to implement a CSO BMP program, including, among other things, an interceptor inspection and cleaning program, an evaluation of the hydraulic capacity of the collection system, and a tide gate inspection and repair program. The Philadelphia Water Department is also required by its permit to produce an annual CSO status report.

The following are excerpts from the 2017 NYCDEP CSO BMP report.

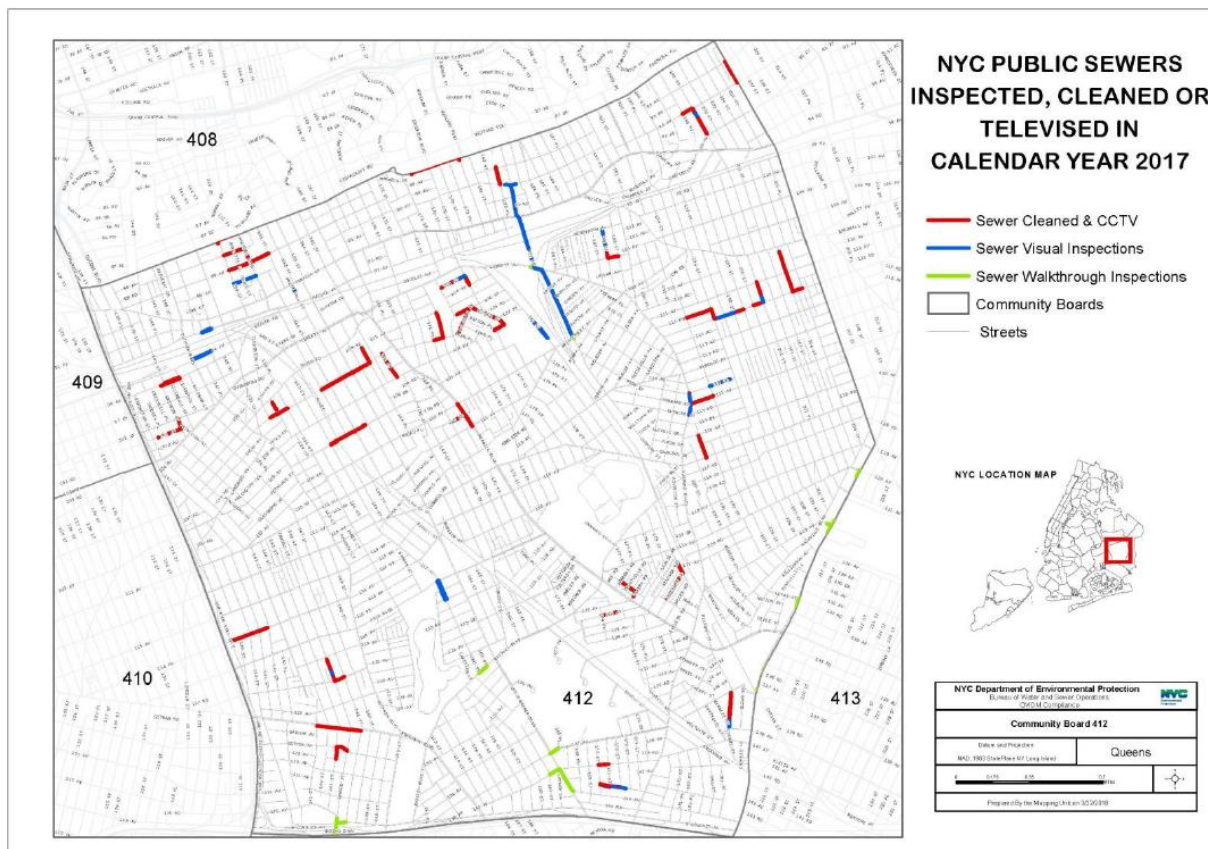
“Notable CSO BMP achievements during 2017 include:

- DEP’s Interceptor Improvement Program is ongoing for inspections, cleaning, and rehabilitation of large intercepting sewers. During 2017, 89,459 feet of intercepting sewers were inspected citywide and 6,969 cubic yards of sediment were removed. An additional 2,146 cubic yards of sediment were removed from non-interceptor assets such as treatment plants, pumping stations, regulators, and other sewer appurtenances.
- DEP staff continued to work to improve the operability of tide gates in CSO outfall chambers to reduce seawater infiltration into the combined sewer system, thus increasing available capacity for conveying storm flows.”

In addition, the report contains informative tables and maps:

Table 2-1: Summary of Sewers Inspected & Cleaned by DEP BWSO & DDC in CY 2017		
METHOD	INSPECTED (miles)	CLEANED (miles)
In-House (Reactive)	182.90	182.90
In-House (Proactive)	340.79	340.79
CMOM Unit*	90.18	64.66
Lining	15.91	15.91
Guniting	1.91	1.91
Inspections & Cleaning (DDC)	17.78	17.78
TOTALS:	649.47	623.95

Table 2-2: Summary of Sewers Inspected & Cleaned by DEP BWSO CMOM Unit in CY 2017			
METHOD	INSPECTED (miles)	CLEANED (miles)	COST (\$)
CMOM Sewer Investigations	25.73	0.21	N/A
City-Wide Contract Inspection & Cleaning	64.45	64.45	\$3,897,902
TOTALS:	90.18	64.66	\$3,897,902



DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER AND SEWER OPERATIONS
CMOM SECTION

Inspected Locations

N	LOG	Location	Ins	CB	Start	Comp	*Footage (LF)		
							Cleaned	Surveyed	Walked

2017

In-House Survey

Brooklyn

1	14-450	Bath Av (2125)	CO		1/12/2017	1/12/2017		518	
2	14-719	W 22 St (2519) bt Bay 52 St and Bay 53 St	AQ		2/11/2015	4/27/2017			
3	15-135	Hudson Av Outfall (Reg#R-21) ; RH-003	CO		2/16/2017	2/16/2017		483	
4	15-136	Gold St Outfall (Reg#R-20A) ; RH-005	CO		2/16/2017	2/16/2017		360	
5	15-140	Creamer St Outfall ; RH-031	CO		1/17/2015	2/16/2017			
6	15-226	Fulton St (1409)	AQ		5/6/2015	5/6/2015		354	
7	15-274	Ocean AV (1326)	AQ		3/7/2015	4/27/2017			
8	15-301	Patchen Av (13)	TC		5/4/2017	5/4/2017			
9	15-841	Noll St (100) K	AQ		5/2/2017	5/2/2017			
10	16-011	Sutter Av bt Montauk Av and Milford St	MS		5/11/2017	5/11/2017			205
11	16-662	W 24 St (3024)	CO		1/12/2017	1/12/2017		565	
12	16-666	7 Av (6501)	CO		1/12/2017	1/12/2017		435	
13	16-744	McDonald Av (1652) bt Ryder Av and Av O	MA		12/14/2016	2/5/2017			
14	16-747	SEK20067-Gowanus Canal Area Phase-2	RF		2/1/2017			2,828	
15	16-771	Coney Island Manhole Inspections	NG		12/15/2016				

Recommendations

1. The NJDEP should strongly encourage CSO permittees to:

- Provide summaries of sewer system and CSO cleaning and inspection activities to help document the proper operation and maintenance of the sewer collection system.
- Carefully consider the basic, cost-effective sewer system and CSO controls identified in this paper as part of a report documenting the evaluation and implementation of the nine minimum controls (NMCs).
- Provide this information along with the required Development and Analysis of Alternatives Report due July 1, 2019

Additional evaluation and documentation of the NMCs, including sewer system and CSO inspection, cleaning and maintenance programs for the sewer system and the CSOs is needed. This is to ensure that basic, cost-effective sewer system and CSO controls are evaluated and implemented before more expensive LTCP-based controls are considered. As identified in the *CSO Control Policy*, this evaluation should be based on site-specific information gained through characterization of the combined sewer system as well as modeling activities done in conjunction with the long-term CSO control plan.

We recommend that the NJDEP strongly encourage CSO permittees to include the documentation of the evaluation and implementation of the NMCs, including the basic, cost-effective controls identified in this paper, along with the Development and Evaluation of Alternatives Report due on July 1, 2019. In addition, the NMCs should be integrated into the LTCP selected CSO controls.⁶

As stated previously, documentation of the implementation of the NMCs should include:

- The alternatives considered for each minimum control
- The actions selected and the reasons for their selection
- The selected actions already implemented
- A schedule showing additional steps to be taken
- The effectiveness of the minimum controls in reducing/eliminating water quality impacts

For the first minimum control, both the NJPDES CSO permit as well as the *CSO Control Policy* require development of “proper operation and regular maintenance programs for the sewer system and the CSOs” and the development of O&M plans. Documentation for this control should include the sewer system and CSO O&M plans for each permittee, as well as information on inspections conducted and maintenance performed. To allow better assessment and evaluation of the implementation of the O&M program, we strongly recommend that this information, which is already required by the permit, be aggregated and included in a **summary O&M report** for the sewer system and CSOs. This report should include:

- Identification of the owner/operator of all key components of the sewer collection infrastructure, along with a summary description/condition assessment of the various parts of the sewer system infrastructure
- Information summarizing the implementation of the O&M program for the previous year, including inspection/cleaning approaches (reactive, proactive), inspection frequencies, and summaries of:
 - Inspections performed, and results
 - Cleanings and maintenance performed
 - Improvements made to sewer system infrastructure, and
 - Efforts made to identify and control excessive I/I

⁶ U.S. Environmental Protection Agency. (1995a). *Combined Sewer Overflows Guidance for Long-Term Control Plan*. EPA 832-B-95-002. 2-4

- In addition, NJDEP and others should carefully review the analysis of I/I reduction in the Development and Evaluation of Alternatives Report, an existing permit requirement, in order to ensure a comprehensive analysis is performed for both CSO communities and tributary, upstream separate sanitary systems that are hydraulically connected.

2. NJDEP and US EPA should increase the frequency of comprehensive CSO inspections and document the implementation of sewer system and CSO O&M activities.

We recommend that increased state and federal CSO inspections:

- **Document sewer system and CSO O&M activities.** If a report does not already exist, the inspector should develop a high-level report that summarizes the implementation of the sewer system and CSO O&M activities for the previous year. This report should include the summary information identified for the summary O&M report above (inspections performed, results, cleanings etc.). This brief, high-level report can be developed by reviewing information already required by CSO permittees, including O&M manuals and inspection and cleaning logs, as well as with interviews of people directly involved in O&M activities. The high-level documentation of **sewer system and CSO O&M activities** should be confirmed with the permittee and evaluated with other available information (e.g., number of backups, collapses, overflows, complaints, previous inspection reports and violations) to help assess system performance and determine if the system is being operated properly.
- **Include enhanced field inspections.** Utilize experienced CSO inspectors and increase the number of field inspections of sewer system and CSO infrastructure to confirm the implementation of proper O&M activities. Consider the use of pole cameras to help inspect, evaluate and document the condition of critical sewer/CSO infrastructure that is less accessible.
- **Confirm the evaluation and implementation of basic, cost-effective sewer system and CSO controls.** Inspectors should update as needed existing inspection questionnaires and checklists (e.g., Chapter 12 of US EPA's NPDES Compliance Inspection Manual <https://www.epa.gov/sites/production/files/2017-01/documents/npdesinspect.pdf> or Appendix C of EPA's Combined Sewer Overflows - Guidance For Permit Writers https://www.epa.gov/sites/production/files/2015-10/documents/csopermitwriters_full.pdf) to include specific questions concerning the evaluation and implementation of the basic, cost-effective sewer system and CSO controls identified in this paper. The basic, cost-effective sewer

and CSO controls are particularly relevant in helping to meet the NMC requirements in the permit, in particular:

- Proper operation and regular maintenance program requirements
 - Maximum use of the collection system for storage
 - Maximization of flow to the POTW for treatment
 - Prohibition of CSOs during dry weather, and
 - Control of solids/floatables in CSOs
- **Share inspection results and take prompt enforcement action.** Distribute CSO inspection reports, including documentation of **sewer system and CSO O&M activities**, to a wider group, including state and federal agencies (both permit and compliance/enforcement departments), municipal governments, supplemental CSO groups, etc. Take prompt enforcement action for permittees not operating and maintaining sewer systems and CSOs properly. Consider sewer bans as well as fines for permittees not implementing existing, or future, permit CSO O&M requirements.

3. NJDEP should update future NJPDES CSO permit requirements

Upon expiration or modification of the existing NJPDES CSO permits, the NJDEP should include the following requirements, which build upon existing permit requirements:

- List/identify in the permit all sewer system and CSO infrastructure that is owned or operated by the permittee. Listing in the permit of all critical sewer and CSO infrastructure (e.g., CSO outfalls and controls, regulators, tide gates, and pump stations) will help clarify ownership and operational responsibility for these assets.
- Require remote monitoring of key portions of the collection system (regulators, tide gates) to help identify DWOs, obtain more accurate assessments of CSOs, and identify leaking tide gates. Currently, many municipalities cannot determine if DWOs occur or if there is backwash/leakage of river or tidal water into the sewer collection system. Many CSO communities must rely upon infrequent inspections by wastewater treatment plant operators of critical system infrastructure, such as regulators and tide gates. Remote monitoring of these critical infrastructure components can be a more cost-effective and accurate way to help eliminate DWOs and ensure that the collection system is operating properly.

- Require development of an annual **CSO status report** for the sewer collection system and waste water treatment plant. This report builds upon existing permit requirements for proper operation and maintenance of the collection system and will help ensure that these activities are being implemented. It is recommended that the report include, at a minimum, the following:
 - Identification of the owner/operator of all key components of the sewer collection infrastructure, along with a summary description /condition assessment of the various parts of the sewer system infrastructure
 - Information summarizing the implementation of the O&M program for the previous year, including inspection/cleaning approaches (reactive, proactive) and frequencies. The report should include summaries of inspection results and maintenance activities performed for all key parts of the collection system, including pipes, regulators, outfalls, inlets, tide gates, and floatables controls/netting systems. This summary should be signed and certified by the licensed operator and require that each component be inspected and/or cleaned a minimum of every three years. The report should also identify improvements that have been made to the sewer system infrastructure and include efforts made to identify and control excessive I/I.
 - Information summarizing the implementation of the nine minimum and long-term CSO controls for the previous year

4. Increase the awareness of funding opportunities for sewer system and CSO infrastructure upgrade and maintenance.

- Inform and encourage CSO permittees and municipalities to take advantage of the special funding opportunities available (principal forgiveness and interest-free loans) to perform flow abatement projects, including sewer rehabilitation and projects to reduce I/I. Allow owners and operators of sanitary sewer systems that are upstream and hydraulically connected to combined sewer systems access to these funding opportunities. Additional information is available at https://www.nj.gov/dep/dwq/pdf/NJEIFP_Funding_Booklet20170517.pdf.

5. Encourage the sharing of technical and managerial/administrative resources related to sewer system projects to reduce the burden and costs on individual CSO municipalities.

- Identify opportunities for sharing of technical resources, such as those involved with inspecting (flow monitoring, CCTV inspections) and cleaning (e.g., flushing/jetting) of sewer systems among

municipalities, and between treatment plants and member municipalities, to allow for a more efficient use of technical resources.

- Evaluate and recommend ways to manage grants and projects jointly, to reduce the administrative burden on individual municipalities. We note that the six CSO municipalities near Albany, N.Y., (collectively known as the Albany Pool) created the nonprofit Albany CSO Pool Communities Corporation to lessen the burdens on local governments and provide a vehicle to administer construction, finance, operation, and maintenance of certain sewer systems and CSO projects jointly. Additionally, many larger sewer districts and authorities, such as the Massachusetts Water Resources Authority, manage millions of dollars in grants and interest-free loans to member sewer communities to perform local I/I reduction and sewer rehabilitation projects.

While our recommendations apply primarily to combined sewer systems, many of the approaches identified apply to separate collection systems as well, and we recommend that future efforts evaluate ways to improve the operation of these systems.

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Appendix A

Study Phase of an Inflow and Infiltration Reduction Program – Technical Details

The communities with separate sanitary sewer collection systems can conduct a sanitary sewer evaluation study (SSES). The purpose of an SSES is to identify issues within the sewer system that could cause problems leading to overflows and basement backups caused by a surcharged sanitary sewer system (overload due to stormwater runoff in system). During surcharge conditions, the sewer can back up into homes that are lower in elevation or it can overflow from sewer maintenance holes. The ultimate goal of the SSES is to find the sources of inflow and infiltration (I & I); this will lead to the improvement in sanitary sewer capacity and result in the reduction of some basement backups and overflows. Some technical actions that can be employed are listed below:

1. Smoke Testing

Smoke testing consists of introducing a harmless, non-toxic theatrical-type smoke into the sewer. Smoke will escape from defects in the sewer system and those locations are identified and marked by personnel conducting the study. Types of defects may include roof downspouts, uncapped cleanouts, driveway drains, stairwell drains or yard and area drains. It is imperative that proper and effective notification to the affected residents be made well prior to the conducting of these tests. This type of testing is more relevant in older systems (older than 40 years) but even in newer systems it may help pinpoint the location of sump pumps that are connected illegally to the sanitary sewer system.

2. Building Sewer Assessments

This phase is focused on the private side of the sewer system. In the past, the private side has not been given as much attention as the public, but in recent years it has been determined that the private side is a major contributor of I & I. The building sewer assessment takes between 10 and 15 minutes. Study personnel will visit each house. It is imperative that these personnel have proper credentials and are clearly identifiable by their clothing and vehicles (ID badges, labeled uniforms and be in a vehicle clearly marked with the appropriate logo).

If the home has a basement, crew members will look for a connection between a sump pump and the sewer. They will take pictures of the sewer pipe leaving the home, the sump pump, and any other direct connection to the sanitary sewer. They will ask the home occupant brief questions about any history of

water backing up, sewer-related problems or leaking basement walls. They will also take a measurement of the basement floor in relation to the finish floor elevation to compare the main and basement elevations to see how prone the basement is to backing up. The investigation is similar for a crawl space. If the home does not have a crawl space or basement the interior investigation is very quick. Often slab homes do not have sump pumps, which are the major contributor of I & I from the private side.

The crew will also investigate the outside of the house looking for downspouts or outside drains connected to the sewer. If defects are found affecting the sanitary sewer, they will need to be corrected. The town in questions will determine if the correction of these defects should be publicly funded as part of an I/I reduction program. The building sewer assessments are a key component to the overall investigation. They provide a better picture of troubled areas and help find defects that are inexpensive to remove and are large contributors of I & I.

3. Maintenance Hole and Mainline Sewer Investigations

In any sanitary sewer collection system, there are numerous opportunities for I & I to find its way into the sewer. The town should have an ongoing program for rehabilitating the public portion of the sewer system. In many cases, it has been determined that a large quantity of inflow and infiltration comes from defects on the private side. Extensive television inspection efforts are needed to document, and sometimes repair “on the spot” defects in the sewer mains. The targeting of these efforts are based on known trouble areas and areas with higher wet-weather flows.

4. Flow Monitoring

A fleet of portable area-velocity flow meters will be deployed at key points in the collection system, based on an analysis of the system to break the system up into smaller mini-tributary areas. This program should be ongoing for an appropriate amount of time that includes several (more than three) significant rainfall events that activate existing I & I sources and cause surcharging in the system, in order to obtain the true hydraulic relationships between varying amounts of rainfall and the wet-weather flow rates in the various parts of the system. This is also used to prioritize where to focus repair efforts.

5. Sewer Modeling

Sewer modeling takes all the information obtained from the SSES and the flow study and compiles and analyzes it so that town staff can plan the rehabilitation projects for upcoming years on a priority basis.

The success of the overall I/I reduction program is entirely dependent upon individual property owner participation. The higher the individual participation, the more accurate the picture of the sewer system becomes.

Appendix B – Excerpt from a US EPA Inspection Report of 2012

“The following sections provide a summary of the observations made during the inspection, and from a review of materials provided by the Town, which support the finding that the Town has failed to properly operate and maintain its collections system.

Collection System Cleaning

The Town’s maintenance approach does not include regularly scheduled inspection and maintenance of the collection system. The Town performs sewer cleaning on a reactive basis, responding to customer complaints (i.e., basement backups or other types of unpermitted releases) and field crew observations rather than implementing a regularly scheduled preventive maintenance approach.

The Town has a jetter truck which it uses to clear blockages in the collection system. The Town stated that their goal is to use the truck as little as possible to ensure its continued functionality, and that it is used mainly for clearing blockages after a backup or overflow has been identified. The result of this approach is that preventive sewer line cleaning is not performed. For example, the Town’s *Reports on Operations and Maintenance Activities* (See Appendix C) submitted to PVSC for the period from March 2011 to July 2012 included only five instances of the Town having performed reactive sewer line cleaning, for a total of 1,075 linear feet cleaned (~1.5 percent of collection system).

Additionally, the EPA Inspection Team observed that the field crews appeared to be inexperienced with operating the jetter and did not have an operational SOP for operating the jetter. the EPA Inspection Team observed the field crews operating the jetter at high pressures (greater than 3,500 psi), a practice that is not typically used in older sewer assets due to the potential damage to aging sewer pipes from high pressure jetting. Additionally, the jetter hose burst during the observation of the Town’s cleaning of the sewer line.

Collection System Inspection

The Town has not developed or implemented a sewer inspection program. The Town does not conduct any regularly scheduled inspections of the collection system using CCTV equipment or other means of visual inspections. The Town has the ability to contract CCTV services with PVSC and National Water Main Cleaning; however, this is only done on an as needed basis to support individual projects or emergency repairs.

As a result of the lack of an inspection program, the Town is not able to properly assess the condition of its collection system and identify defects and areas of concern before they result in failures. Additionally, a CCTV inspection program that follows the Town's sewer cleaning activities would allow the Town to evaluate the efficacy of its cleaning activities and modify its sewer cleaning procedures to minimize damage caused to the aging collection system by the cleaning equipment.

Data Collection and Recordkeeping

The Town currently does not have a system for collecting and maintaining observations and data on its collection system. While reactive maintenance is noted in a central log book, observations made by field crews during reactive maintenance activities are not recorded, and the Town relies solely on the institutional knowledge of its staff to direct maintenance and capital improvement activities.

When performing reactive maintenance activities, the field crews are not provided with any means of recording their observations detailing the nature and cause of a system problem. Crews also do not record any information on the actions required to resolve the problem. As a result, the Town does not maintain any data which could be used to analyze common issues or identify hot spots within the collection system. Instead, the Town uses the institutional knowledge of the field crews to direct maintenance activities and relies entirely on the field crews to report abnormalities.

Additionally, the Town does not have a capital improvement plan to ensure that its wastewater system assets are renewed appropriately. The Town relies on field crews to verbally report to the engineering department on any assets which require capital improvements. The engineering department, in turn, has to create a capital improvement project within the Public Works Department's annual operating budget.

Summary of Observations

Due to the Town's failure to provide adequate operator training, its failure to implement a regularly scheduled inspection and maintenance program, its failure to adequately collect and manage information on its collections system, its failure to develop an operations and maintenance plan as discussed in Finding 1, and its failure to develop an FIAA as discussed in Finding 2, the Town has failed to properly operate and maintain its collection system as required by 40 CFR Section 122.41(e), and Sections 7:10A-1.12 and 7:14A-6.12(c) of the N.J.A.C., and Section C.5.b of the Permit.

Additional Concerns

To evaluate the Town's familiarity with the PVSC regulators which control discharge from its collection system, the EPA Inspection team requested to view the regulators during the inspection. The Town stated that it is not allowed to open the manholes which provide access to the regulator chambers. In order to further evaluate the Town's ability to communicate and coordinate with PVSC, as would be required during a collection system problem such as a dry weather overflow from a CSO, the EPA Inspection Team requested that the Town follow the steps it would normally take to gain access to the regulator chambers.

The Town contacted PVSC which responded to the request to meet the EPA Inspection Team in the field to provide access to the regulator chambers. The EPA Inspection Team asked the Town staff whether this process had been implemented before. Many of the field crews and management staff responded that it was the first time they had seen the regulators, and stated they were not familiar with the characteristics and design flows of PVSC's regulators. As such, the Town is not aware whether the regulator design flows allowed for maximum storage of wet weather flows within the collection system, as required by the Nine Minimum Controls for Combined Sewer Overflows. Additionally, the Town's inability to access the regulator chambers independently of PVSC severely limits the ability of the Town to identify and report dry weather overflows from its CSOs, as required in Section C.2. of the permit. In addition, many of the CSO outfalls are underwater during higher tidal periods, further limiting the Town's ability to know when a dry weather overflow is occurring. Given these constraints and the lack of any system by which overflows can be noted, the Town is incapable of fulfilling this obligation in its permit. In addition, Section D.1.a.ii. of the permit states that the permittee must conduct an annual inspection of "all combined sewer overflow control facilities." The Town presently does not have access to the regulators which can only be opened by PVSC staff. The Town is therefore incapable of conducting the required annual inspection.

Recommended Reference Materials

The EPA Inspection Team discussed the aforementioned findings with the Town and emphasized the need for a preventive sewer maintenance and cleaning program. The EPA Inspection Team recommends that the Town develop and implement structured and written standard operating procedures (SOPs) for any sewer maintenance and cleaning performed by the Town.

The SOPs should include detailed step-by-step procedures for conducting the maintenance and cleaning activities including, but not limited to,

- Pipe maintenance activities such as preventive maintenance, cleaning, and blockage removal;
- Types of equipment to be used (i.e., “tiger tails,” nozzles, screens/rakes, etc.);
- Guidelines and/or reference tables for appropriate jetting pressures and flows based on the type of jetting activity, type of pipe, size of pipe, age of pipe, and known condition of pipe; and
- Formal documentation of pipe conditions, materials removed during cleaning, and other findings for review by managerial staff.

The operation of high pressure sewer equipment without formal training and without SOPs can create serious safety issues and may significantly damage the structural integrity of the sewer pipe. Reference materials to support the development of the SOPs are available from various sources (equipment manufacturers, equipment vendors, professional associations, etc.), including references such as the National Association of Sewer Service Companies’ *Jetter Code of Practice* (<http://nassco.org/publications/techman.html>) which provides guidelines for the proper operation of sewer jetter equipment.”