# Inflow and Infiltration Program Review

For

# Brookfield WPCA, Brookfield, CT

By

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## I Executive Summary:

Reviewing programs as big as infiltration and inflow (I/I) studies for wastewater systems is no easy task. Much like asset management, infiltration and inflow programs represent a large umbrella of topics covering technical, managerial, and financial standards and practices. RCAP Solutions operates to serve small communities in these three areas under federally funded grants. This review is provided through our EPA funding at no cost to Brookfield Water Pollution Control Authority (WPCA). In this way we can provide unbiased third-party assistance to the communities we serve. Outlined here reflects the review of Brookfield WPCA's analysis and evaluation of its sewer system. Measuring the program against industry standards discussed throughout this review, Brookfield shows significant efforts to monitor and reduce excessive I/I throughout the system. In addition, regional partnership reflects value and sustainability. Brookfield WPCA's regional collaboration with Danbury, CT marks a great example and opportunity for other areas that can benefit. Overall, with the criteria used, Brookfield WPCA meets the requirements of both Inflow and Infiltration Analysis and the Sewer System Evaluation Survey. Furthermore, the utility shows ongoing efforts to improve and continue these programs.

## II Purpose:

The purpose of this review is to provide a third-party assessment of the Inflow and Infiltration (I/I) program for Brookfield WPCA in Brookfield, CT. Brookfield WPCA sends its collected wastewater to Danbury, CT where final treatment and discharge occurs. Danbury Water Pollution Control (WPC) provides wastewater services to Danbury, Bethel, Ridgefield, Newtown, and Brookfield. Through an interlocal agreement the city of Danbury limits the accepted discharge from Brookfield to 500,000 gallons per day (gpd). This amount has

decreased to 380,000 gpd through Danbury's efforts to reduce capacity while the utility is working towards upgrades. As of 2022 the average discharge from Brookfield is about 332,000 gpd. Danbury WPC is requesting an increase on their discharge permit by 200,000 gpd to accommodate future capacity needs for the area including Brookfield.

Environmental impact and aging private septic systems have initiated study areas in Brookfield to determine feasibility for sewer system expansion. Through CT Department of Energy and Environmental Protection (DEEP) grants, Brookfield has assessed two areas that would benefit from sewer services; these projects are, Candlewood Lake Area and Dean Road Area. In addition to these two areas the need for regionalization opportunities for several small sewer districts are in consideration. For these districts aging infrastructure and financial capacity are limited by the small revenue base and cost amounts for repairs and upgrades. Reliance on the capacity of the Brookfield WPCA with their agreement with Danbury is crucial for the area's environmental protection and economic stability.

Applications for sewer connections as well as projects mentioned above have been limited in hopes that Danbury will increase capacity and allowable discharge from Brookfield. This review provides details of the ongoing efforts of Brookfield WPCA to retain the maximum allowable capacity for sewer services by eliminating and limiting excessive inflow and infiltration. Through this assessment, the goal is to provide CT DEEP, and partners, a sufficient comparative review of Brookfield's I/I program so that determination for Danbury's discharge permit, as well as future expansion and services, can be made. In addition, RCAP will communicate with CT DEEP to ensure the requirements for this review are met.

## III Methodology:

Making sure what is collected, transported, treated, and discharged has minimal I/I, incorporates a large scope approach from asset management to environmental protection. A wastewater utility's knowledge of where and when infiltration, or inflow, occurs takes investigation, planning, data collecting and testing. Currently in Connecticut there are no officially adopted regulations for Inflow and Infiltration programs, though programs are strongly supported by CT DEEP. Firms and groups working in CT and around wastewater utilities with I/I programs have used the Massachusetts Department of Environmental Protection (Mass DEP) regulations to facilitate, guide and provide quality assurance. For this review the Mass DEP "314 CMR 12.04 Operations & Maintenance Standards for Wastewater Treatment Plants" will be used as well as Mass DEP supporting resources and documentation. This review is not intended to be an official compliance review but an assessment of the ongoing I/I program as it is measured against Mass DEP regulations. This review will be split into two sections, I/I Analysis Review, and the Sewer System Evaluation Survey Review. Within these two sections any sewer system rehabilitation or post construction monitoring will be included.

## IV Introduction:

Brookfield WPCA operates a wastewater collection utility with 1,870 connections comprising of 1,200 residential and 670 commercial customers. Brookfield WPCA sends its collected wastewater to the City of Danbury. The collected wastewater is then sent to Danbury WPC where final treatment and discharge occurs. Danbury is requesting an increase on their discharge permit by 200,000 GPD to accommodate the surrounding needs as the region's primary treatment plant including Brookfield WPCA and services to other surrounding towns and utilities.

Infiltration is when groundwater enters the sewer system through defects and openings in the system. Inflow is when water from rain events or surface water enters the sewer system through connections such as roof leaders, manhole covers and drain lines from a dewatering pumping system. The following analysis will use Mass DEP regulations to review the phases and tasks typically used in an I/I program framework.

## V Infiltration and Inflow Analysis:

The first elements in a comprehensive I/I program covers the collected data for the assets of the wastewater system as well as various monitoring schemes. An inventory of all the components incorporated in the wastewater system are gathered as well as details about the assets. In addition to the inventory of assets, other grouped data sets are captured to help address the analysis such as, sub-areas, pump stations, environmental zones, and elevation/flow diagrams. This is an important part of the Asset Management program that overlaps with an I/I program. In addition to the asset inventory, characteristics of each asset are recorded. Knowing the age and material of specific collection piping, or what the maintenance program for mechanical assets, supports the overall design capacity and sustainability. In addition to the Asset Management portion, various monitoring schemes are gathered to help identify user flows, groundwater trends and historical rainfall levels, providing the needed data to support an Infiltration and Inflow analysis.

<u>Mass DEP lists the following areas and phases for a comprehensive I/I Analysis</u>:

1. Inventory of Sewer System
2. Sewer Flow Monitoring
3. Groundwater Monitoring
4. Rainfall Monitoring
5. Flow Data Analysis
6. Single Season Two Phase Gauging
7. TV Inspection
8. I/I Report
9. Comprehensive Subsystem Approach

In the last ten plus years asset management has made great advancements with increased accuracy and greater data capturing with Geographic Imaging System (GIS) technologies. Brookfield WPCA has an active and fully maintained GIS mapping of the system. Documentation provided by Brookfield WPCA for this review shows that contracted engineering services through Langan Engineering and CDM Smith provided GIS mapping and analysis of the wastewater system.

Langan Engineering provided an I/I study in a report dated March 22, 2016, with a memorandum dated March 21, 2017. In this report Langan Engineering reviewed flow data from pump stations, gravity meters and pump run times taken between January 2015 to December 2016. Compiled data from dry weather flows were compared to rain event flows to determine I/I potentials. The study provided insight to the collected flow data and recommended further analysis and potential benefits from installing metering in certain locations. In addition, pump station flow data were assessed to determine if increased flow events impacted after a rain event occurred. This part of the I/I program meets the Mass DEP requirements for system inventory and flow monitoring and analysis.

Through the Clean Water Fund Planning Study grant from CT DEEP, Brookfield was awarded funds to contract with a firm for further analysis and assessment of the wastewater system. The funding was used during a period which began in 2019 and continued through 2022. With these funds, Brookfield contracted with CDM Smith to develop a Facilities Plan. This plan took the previous Langan Engineering report and data and expanded to include: a more robust asset management and outlook, assessments to the current pump stations and piping, rainfall and groundwater monitoring and flood zones, future planning, capital improvement planning and addressing potential environmental concerns.

A Facilities Plan from CDM Smith dated August 2020 provides comprehensive detail to the following areas marked in their report:

1. Existing Conditions
2. Needs Assessment
3. Collection System Assessment
4. Pumping Stations Evaluation
5. Staffing analysis
6. Capital Planning

Throughout CDM Smith's Facilities Plan there are elements that provide a detailed system wide assessment of the inventory, monitoring, analysis, and inspections. In Section 3: Collection System Assessment is where the bulk of an inflow and infiltration study is found. Referring to the Mass DEP list mentioned above, the CDM Smith I/I study meets the criteria needed for an I/I analysis. With respect to the inventory of the sewer system, all but two manholes were found unmapped and subsequently added to the inventory. These were found during closed circuit television (CCTV) inspections. The inventory of the system is displayed through GIS mapping, images included in the Facilities Plan. The inventory is explored further in Section 4: Wastewater Pumping Station Evaluation, which assesses each of the 14 pump stations. Each station is identified and assessed on the areas of the assets

onsite, station capacity, electrical requirements, access to back-up power and, controls and communications.

Measuring the impact of inflow and infiltrate, flow monitoring data was collected and assessed for sewer, groundwater, and rainfall. It is important to note that CDM Smith used EPA and Mass DEP standards and guidance for benchmarks and approach to excessive I/I in their analysis. January 2015-December 2016 data from the previous Langan Engineering was incorporated to compare with newer data from fall of 2017 to spring 2018 in the CDM Smith facilities plan to analyze annual and seasonal trends. Included in the analysis, Aquarion Water provided water consumption data for their customers served by Brookfield WPCA for base flow estimation. Subsections of the data were also broken down to further investigate and analyze areas with varying characteristics, utility service, customer types, metering, and pump station delineation.

CCTV inspections occurred in targeted portions and areas to assess operational, structural, and material variations; and notable characteristics such as joints, pipe size changes and access points. Segments were broken down to address the level rating for defects and important findings like excessive grease build-up or sections that were vulnerable to sediment accumulation. Mapping and images from inspections were provided in detail with pipe ID's and section categories. Further recommendations were made by CDM Smith to address any found defects or flow restrictions. From the analysis and evaluation most of the areas had no recommendations or need regular monitoring as the recourse, with only a few sites that were identified for cleaning and one point of repair being noted as "intruding object through pipe wall."

To the degree that the Mass DEP guidelines were followed herein, Brookfield WPCA meets the criteria for a comprehensive Inflow and Infiltration Analysis.

## VI Sewer System Evaluation Survey:

Following an I/I analysis, Mass DEP requires a Sewer System Evaluation Survey (SSES). Though not required in Connecticut this review will utilize the Mass DEP guidance to assess Brookfield's efforts to meet the intent of an SSES. This part of the I/I program is a follow-up to the initial analysis to review and address previously identified results and recommendations. This is where further inspection and monitoring can help determine more specifically causes of excessive I/I. Data collected during the SSES can also help determine if improvements instituted made an impact where excessive I/I was found.

Mass DEP lists the following areas and phases for a comprehensive Sewer System Evaluation Survey:

1. Ground Water Monitoring
2. Rainfall Monitoring
3. Flow Data Analysis
4. Television Inspection
5. Extensive Manhole Inspection
6. Smoke Testing
7. Rainfall Simulation
8. Property Inspections
9. Flow Data Analysis
10. SSES Report

CDM Smith's Facilities Plan addresses and furthers an I/I evaluation by using the previous Langan Engineering study for ground water, rainfall, and flow monitoring. Brookfield also used newer data collected from pump station flow data and existing four inline gravity meters. In addition, the wastewater system was divided up into sewershed and gravity sewer areas where base flows were calculated using industry standard techniques. Aquarion Water Company provided drinking water usage data for the customers on the Brookfield WPCA system. Using the existing and newer data CDM Smith utilized the Lyne-Hollick filter to attribute ground water, rainfall, and user flows. It is important to note that this method can have different values depending on approach. CDM Smith addresses this by using parameters best fitted for this analysis. Once again, the use of Mass DEP guidance is utilized to measure against standards and benchmarks.

Smoke Testing was completed April 2015 in the north section of Brookfield to help identify why this area was contributing stormwater flow. In a subsequent WPCA meeting of April 22, 2015, it was reported, "Smoke testing of sewer lines was done from Four Corners area north to the New Milford line. No major defects were discovered." There were only minor issues that were immediately corrected. One business had a parking lot drain connected to the system, others had cracked clean out covers and another had a disconnected sink drain that allowed smoke in the building. There were no gutter systems draining into the sewer system as feared. No further smoke testing was done after this work produced a null result.

The use of additional flow meters at specific locations is still an option to improve flow data and analysis. Where there was concern of excessive I/I, CCTV inspections occurred to facilitate I/I investigation, flow monitoring as well as extensive inspections to manholes and piping constructs. CCTV inspections remain to offer substantial evidence of the integrity of the sewer system and can continue to be utilized where regular monitoring and development is needed.

Infiltration from manhole covers is a common source of infiltration due to the location and conditions these vulnerable points undertake. Road paving, traffic/vibration and, freezing and thaw cycles can impact the seal and result in infiltration. Thorough manhole inspections resulted in work on specific locations where infiltration was found. Manhole cover pans were installed at these locations and follow-up analysis to find I/I improvements. In a follow-up report "Data Analysis of 14 Brookfield Sewage Systems with Rainfall" dated

July 25, 2022, flow results showed significant improvement to flows and subsequent I/I levels. The report also states "more opportunities for improvement" showing intent for continued use of this practice and monitoring. Rainfall monitoring also provided enough data over time to create trends to assist in capacity analysis for each station. With the available data weighted averages were calculated to incorporate rain events and the impact window for sewer flows. These two-day averages were then compared against rainfall in inches and trending applied to provide adequate simulation of rain impact on sewer flows for each pump station. This report identified specific areas to investigate more closely. It was found that manhole covers along some roads were collecting rainwater through the lid openings. The remedial action was to install manhole pans to prevent stormwater from entering the sewer system.

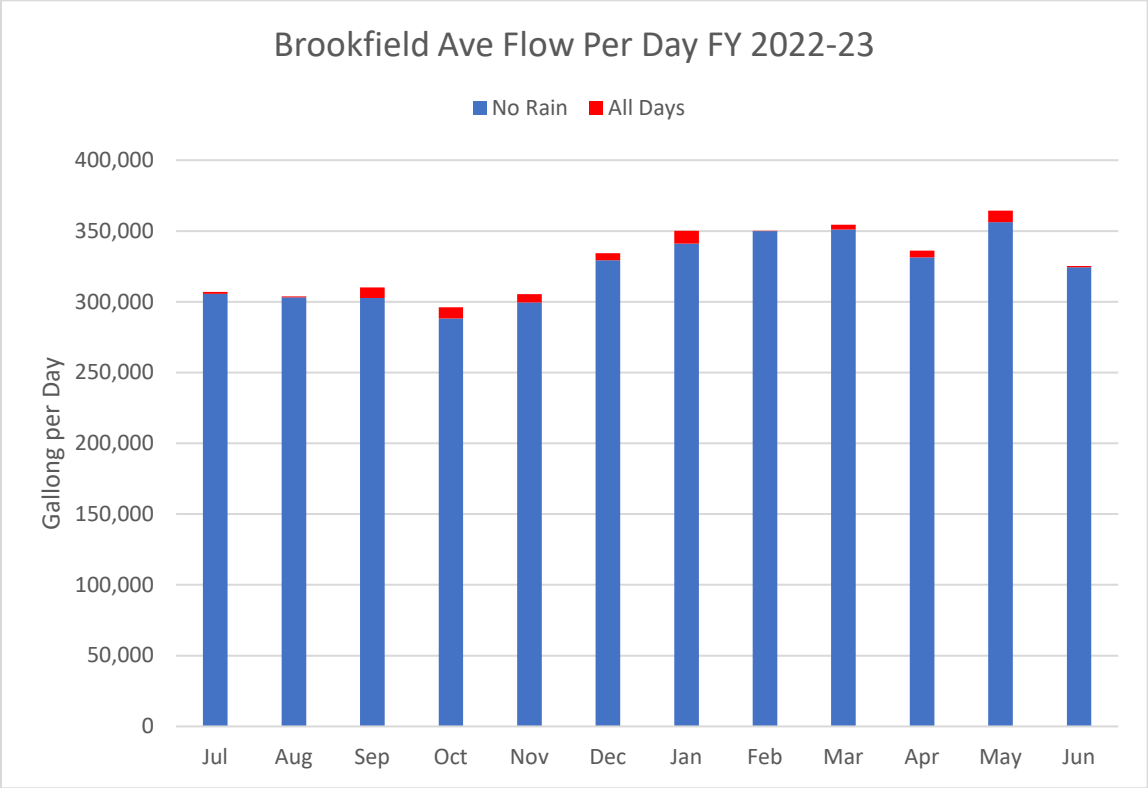
Another aspect of the property inspection, within CDM Smith's Facilities Plan, the electrical inspection findings in "Section 4: Wastewater Pumping Station Evaluation" were reviewed by Langan Engineering. This area of approach is not specifically mentioned in Mass DEP guidance but is an important aspect of the inventory, controls, and monitoring of a wastewater system. This can be viewed in Appendix B of the Facilities Plan. Langan Engineering covers each location's electrical assessment in detail and utilizes National Electrical Code (NEC), National Electrical Manufactures Association (NEMA), and National Fire Protection Association (NFPA 820) standards in the review.

To the degree that the Mass DEP guidelines were followed herein, Brookfield WPCA meets the criteria for a comprehensive Sewer System Evaluation Survey and has shown ongoing efforts to continue this important program.

## VII Recent Results:

The graph below (Graph 1-1) serves as a visual representation of a one-year study. Brookfield WPCA continually uses data from their collection system to provide analysis for flows during rain events. With the subsequent action to install manhole pans in the specific areas identified in previous assessments, I/I data was collected from July 1, 2022, through June 30, 2023. This study examined the flow on days with no rain. That flow was compared to total system discharge on all days. The analysis showed that incremental flow due to rain fall is only 1.4% greater than the baseline flow with no rain. Total rainfall for this period was measured at 30 inches for the year.

Graph 1-1




Data collected from Brookfield Data Collection System

## VIII Conclusion:

To see the benefits of a wastewater system's I/I program, continual monitoring and routine work becomes a necessary function of the utility. This can only be done by using the depth of effort displayed by Brookfield WPCA, outlined here in this review. A broad outlook is firstly attained by working through an inventory of the system. Aging infrastructure is a constant hurdle as standards and regulations continue to change and improve. Structures and development are designed and built to the degree needed at the time. Upgrades and improvements take time and increasingly large amounts of financial and staffing capacity. Increased environmental protection also influences not just the degree of treatment of wastewater but also the need for sewer services to areas that can benefit. Failing private septic systems are becoming more common as these systems are aging without the degree of asset management utilities practice. Wastewater capacity also reflects the economic development and stability of an area. Measuring capacity and future needs are blurred without knowing the impact of inflow and infiltration. Brookfield WPCA shows successful implementation through their reports, analysis, evaluation, and constant work efforts. These continual actions provide and illustrate the value of capacity in relationship to reducing I/I throughout the system. In addition, Brookfield WPCA shows exemplary determination, not in just one aspect of the analysis and evaluation; but in the

host of areas that I/I programs entail. There may be potential for improvement to measuring flow in the areas recognized in previous analysis, but to the degree of cost effectiveness and calculation consideration, Brookfield displays a magnitude of effort in acquiring the most accurate and reliable data. Finally making sure that each analysis and evaluation is reviewed and checked against other standards and perspectives shows a great deal of care for subsequent work and effort a program for I/I onsets. As a small wastewater utility, Brookfield runs at a level only large utilities provide. To the degree that the Mass DEP guidelines were followed herein, Brookfield WPCA meets the criteria for comprehensive I/I Analysis and a Sewer System Evaluation Survey. In addition to meeting standards for analysis and evaluation, Brookfield WPCA also demonstrates the success of these programs in the fractional margin of inflow and infiltration in their data.

# Notable References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