

Appendix D Tech Memo #3 Disconnection Program Analysis



London
CANADA

City of London Pollution Prevention Control Plan (PPCP) Update Study

Disconnection Program Analysis Technical Memorandum

Prepared by GEI Consultants Canada (Formerly GM BluePlan Engineering)



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1. Introduction

The *Disconnection Program Analysis Tech Memo* has been prepared in support of the City of London (City) *Pollution Prevention Control Plan (PPCP) Update Study* as part of their ongoing efforts to improve the performance of the City's sanitary and combined sewer infrastructure.

Under the MECP F-5-5 Procedure, municipalities are required to demonstrate the capture and treatment of all dry weather flows in addition to 90% of the volume resulting from wet weather flows in a 7-month period from April to November, starting within 15 days of April 1. If there are overflow locations not meeting the 90% capture rate, the municipality shall recommend an implementation plan to focus the necessary system improvements in the areas which most require mitigation to achieve F-5-5 compliance.

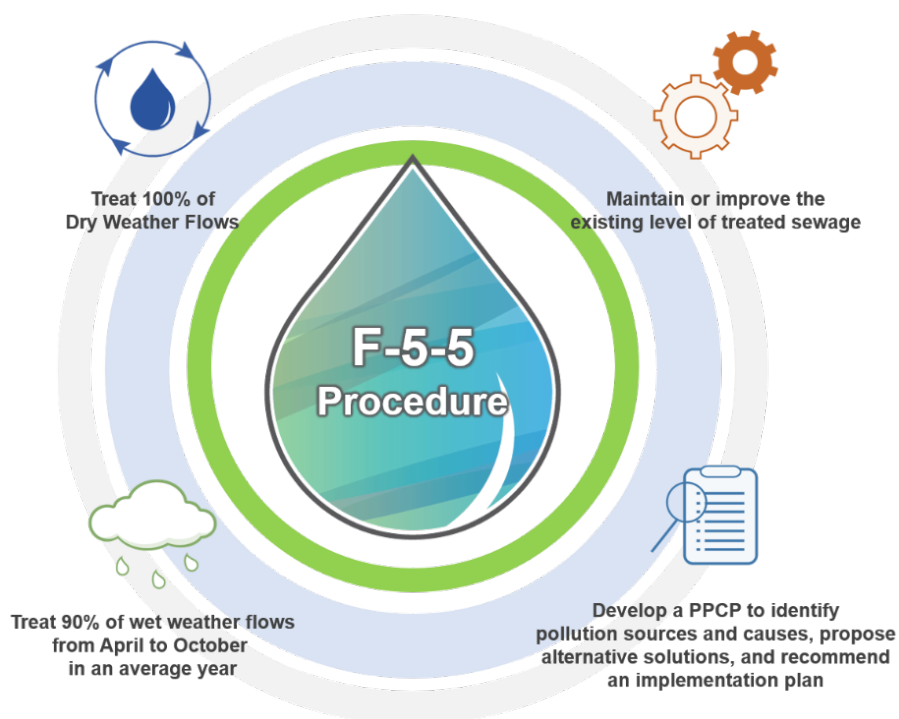


Figure 1-1. Procedure F-5-5 Requirements

From the *F-5-5 Analysis Tech Memo*, a list of high priority system overflow locations (based on their estimated discharge volume, percent capture of wet weather flow volume, and receiving watercourse status (impaired vs. unimpaired) for the 2018 typical rainfall year) within the City were identified. Rankings were based on most negative impact and greatest potential to improve the system's overall performance. An evaluation of how these high priority overflows can be eliminated or mitigated will inform the preferred alternative strategy.

In addition to mitigation strategies focusing on capital infrastructure improvements (sewer upsizing, provision of storage, further combined sewer separation, etc.), weeping tile disconnection programs at the source level may provide the most significant reduction in wet weather flow volume to the high-priority overflow locations. This tech memorandum will investigate a mandatory “point-of-sale” weeping tile disconnection program, via local applicable by-law, with the aim of implementing a requirement for qualifying single-family detached homes to disconnect their weeping tiles (if they have a connection) at the time that the property is sold.

1.1 Aims and Objectives

The aim of this technical memorandum is to assess the feasibility and efficacy of implementing a City-wide point-of-sale weeping tile disconnection program to reduce wet weather flow volume and help the City to conform to and beyond the 90% capture rate for all high priority overflow locations.

To achieve this aim, the following key objectives have been identified:

1. Review existing City programs and initiatives, including the *Basement Flooding Grant Program* (City By-Law A.-7562-160) and previous City weeping tile disconnection pilot programs, to understand the successes and challenges of the City’s voluntary and incentivized disconnection approaches;
2. Evaluation of alternative treatment methods, such as provision of storage, reconfiguration of overflow weirs, linear conveyance upsizing, pumping station capacity upgrades, and weeping tile disconnection to determine most suitable alternative to implement for the City;
3. Best practice review of relevant disconnection approaches (voluntary, mandatory for targeted areas and City-wide, and (dis)incentivized), including those that have been successfully implemented in other municipalities for comparison;
4. Perform a high-level feasibility analysis for the proposed point-of-sale disconnection program to determine the amount of peak wet weather flow reduction for a specific rainfall event across the City; and,
5. Provide additional considerations for the implementation of the proposed point-of-sale disconnection program, including how to manage public perspectives (behavioral willingness) and how to manage potential risk disclosure prior to a property sale.

1.2 History of Weeping Tile Connections

Prior to 1985, City building codes and local by-laws did not prohibit weeping tile discharge to sanitary sewers. As a result, common practice was to connect weeping tiles - underground perforated pipes around the basement foundation - to the sanitary sewer lateral via a direct (gravity) connection. The aim of the weeping tiles was to capture stormwater and direct it away from the foundation to reduce the risk of basement flooding. However, during heavy rainfall events and/or in areas of high groundwater, stormwater collected from the weeping tiles (in connected areas) may overload the sanitary sewer capacity and cause a backup of sewage into homes and businesses. As well, this can lead to the release of untreated sewage to the environment at emergency overflow outlets and pumping station bypass locations due to the system's inability to manage the excessive amount of volume.

As per Phase 3 of the 2018 PPCP, approximately 50,000 properties within the City may have existing weeping tiles that are still connected to the sanitary system, and the approximate inflow and infiltration (I&I) contributions from these connections is 80% for houses constructed between 1920 to 1985. For most new homes constructed between 1985 and 1995, weeping tiles were required to be connected to a sump pit and pump, designed to discharge to the surface rather than into the storm or sanitary sewer. After 1995, all new homes constructed required their weeping tiles to be connected to a sump pit and pump, designed to discharge to the storm sewer through storm laterals, which includes both the storm building sewer and the private drain connection (PDC).

Weeping tile disconnection programs can have a significant effect on I&I reduction to control the amount of stormwater entering the sanitary system at the source. Disconnection requires installation of a sump pump pit and pump which discharges water onto the lawn or other permeable surfaces or directly to the storm sewer. A backwater valve may be required if the property has experienced past basement flooding due to sanitary sewer backup. This is shown in **Figure 1-2**.

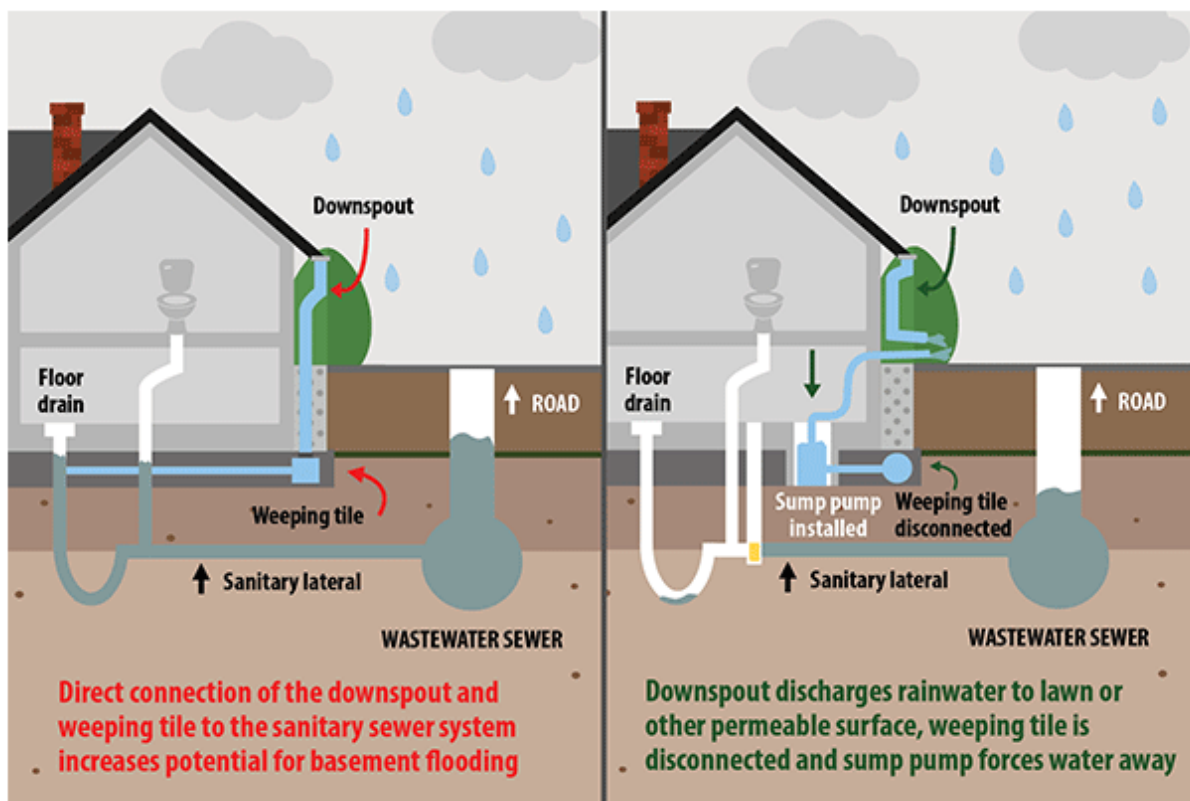


Figure 1-2. Weeping Tile Connection Vs. Disconnection¹

¹ <https://www.ratehub.ca/blog/weeping-tile-perimeter-drain/>

2. City Programs and Initiatives

Sanitary sewer overflows (SSO) and basement flooding have been a longstanding issue for the City. To address this issue, several City programs and initiatives have been implemented to encourage homeowners to disconnect their weeping tiles from the sanitary sewer system.

2.1 Effective Communication & Public Education

The City has applied numerous measures to increase basement flood awareness, including social media (e.g., Twitter and Facebook), newspaper ads, public meetings, brochures, surveys, mass information mailings for affected neighbourhoods, as well as public service announcements that run on a local television station.

On the City's website, there is a dedicated page with information regarding what to do if your basement is flooding, what causes basement flooding, and how to prevent basement flooding. The information is very useful to help homeowners understand at a high-level the impact of connected weeping tiles to the sanitary sewer system, as shown in **Figure 2-1** and described below.

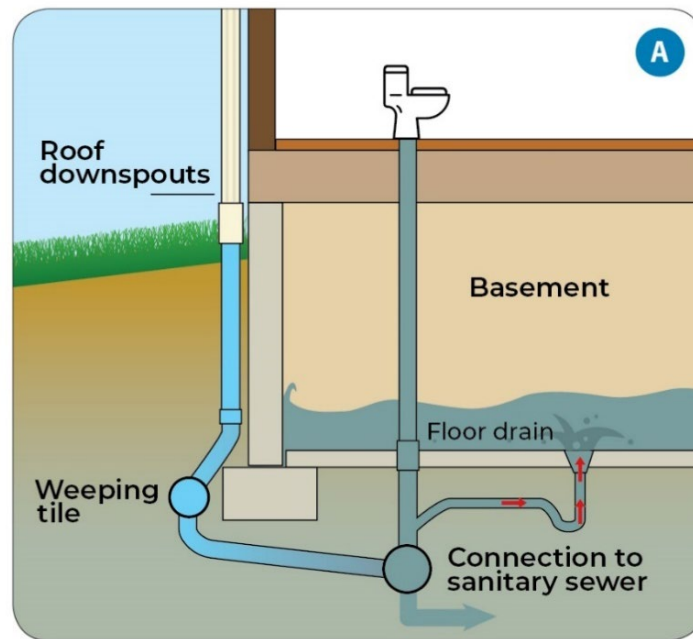


Figure 2-1. Weeping Tile Infographic as shown on City Website²

² <https://london.ca/living-london/water-environment/flooding>

*“Rainwater and groundwater should NOT enter the sanitary sewer system (**Figure 2-1**). Have a licensed plumber/drainage contractor disconnect your weeping tiles from the sanitary sewer system. Disconnect your downspouts to ensure by-law compliance. Have a licensed plumber/drainage contractor install a sump pit and pump and backwater valve. The sump pump will direct the weeping tile groundwater to the ground surface or to the storm sewer system. Be sure to properly maintain your backwater valve and sump pump for the best level of protection.”*

The City’s Council messaging is therefore very clear in their effort to limit the amount of stormwater that enters the sanitary sewers.

2.2 Basement Flooding Grant Program

The City also has a voluntary *Basement Flooding Grant Program* that was designed to provide financial assistance to qualifying residential properties that have experienced past basement flooding due to a City sewer main backup. Properties that are not eligible for this program are condominiums (other than vacant land condominiums), and non-residential properties including but not limited to institutional, industrial and commercial properties. The *Basement Flooding Grant Program By-Law A.-7562-160*³ was most recently amended on June 4, 2024, and is in alignment with the *Drainage By-Law WM-4*⁴ which outlines requirements for discharges into public sewage works. As per *Part 4.1*, “Prohibited Discharges - Sanitary Sewers”, no person shall permit storm water from their property to be discharged into a sanitary sewer. And as per *Part 5.7*, “Requirements for Foundation Drain Flows”, the foundation drain flows from a lot shall be discharged via a sump pump to the ground surface, or via a sump pump to a storm sewer.

The program provides a grant of up to 90% of the total cost, up to a maximum, for primary items such as disconnecting weeping tiles and redirecting flows to a new sump pit and pump, installing a sump pump battery backup, and installing a backwater valve. A sump pit and pump are used to remove the stormwater collected from around the basement foundation, which then gets pumped to the storm sewer or a permeable surface. During extreme wet weather events where sump pumps are critical, a battery back-up system will allow the pump to run for a limited amount of time when electricity is interrupted or unavailable. A sanitary backwater valve is a basement flooding

³ <https://london.ca/by-laws/basement-flooding-grant-program-law-7562-160>

⁴ <https://london.ca/by-laws/drainage-law-wm-4>

protection device that automatically closes if sewage starts to back up from the sanitary sewer. These measures can help reduce the amount of stormwater entering the sewer system and the risk of unwanted water entering basements during sanitary backups. Regular maintenance of the sump pump and cleaning of the backwater valve is required to ensure continuous operation and effectiveness. Additional financial assistance may be provided for the cost of relevant accessories including sewer ejectors and storm laterals, including PDCs.

As part of the application, cost estimates/quotes must be obtained from licensed plumbers or drainage contractors to assess the appropriate remedial measures. Once the City has reviewed and approved the application, a licensed plumber or drainage contractor must be hired to complete the proposed works and obtain the appropriate permits. It is important that a qualified and licenced plumber/ drainage contractor be utilized to ensure the retrofit is effective and to ensure compliance with the City's by-laws and the Ontario Building Code. A proper weeping tile configuration, including a disconnected downspout is shown in **Figure 2-2**.

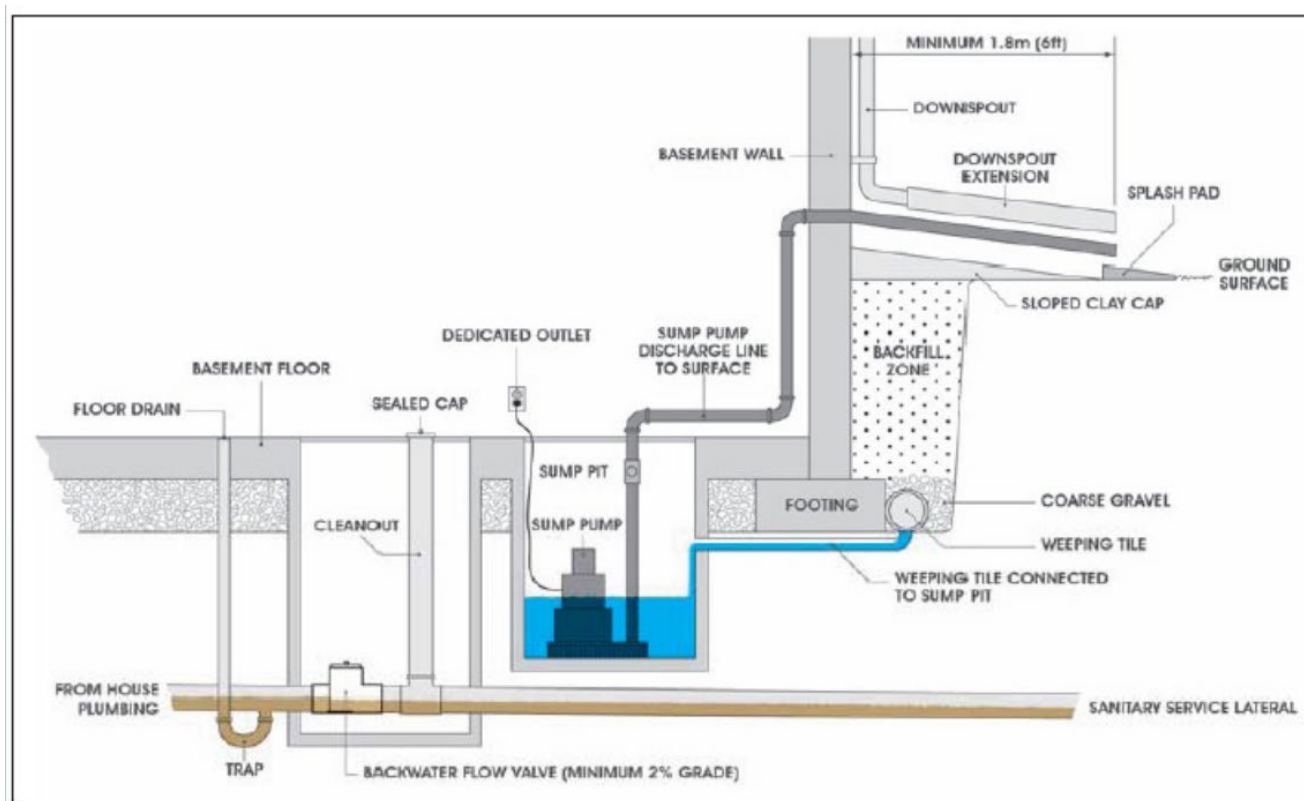


Figure 2-2. Proper Weeping Tile Configuration⁵ (ICLR)

2.3 Pilot Projects

Several factors typically contribute to a neighbourhood's vulnerability to basement flooding, including⁶:

- Weeping tile connection to the sanitary sewer;
- High groundwater table which can get saturated too quickly;
- Clay soil conditions resulting in poor rainwater absorption;
- Poor lot grading that does not effectively drain away from basement foundation;
- High percentage of impervious surface area due to the close proximity of homes and reduces the neighbourhood's drainage capacity; and,

⁵ <https://utilitieskingston.com/Wastewater/BasementFlooding/Protect>

⁶ https://www.iclr.org/wp-content/uploads/2018/08/cities_adapt_rainfall_london.pdf

- Downspout discharge location at or near a building's foundation wall.

Below are the weeping tile disconnection pilot projects initiated by the City to reduce wet weather flows in neighbourhoods vulnerable to basement flooding:

1. **Blanchard Crescent (2013).** The City selected this area due to its history of basement flooding within the Sherwood Forest subdivision. There was extensive communication with homeowners over multiple years before the project began. In the end, 32 of the 50 households voluntarily participated in the full pilot program, which is a participation rate of 64%. A map of the participating homes along Blanchard Crescent is shown on **Figure 2-3**. The City covered all costs associated with the retrofit and provided an additional \$1,000 incentive payment for future maintenance, with total project costs (including internal and external works) of \$477,000⁷.

⁷ https://www.iclr.org/wp-content/uploads/PDFS/Kyle_Chambers.pdf

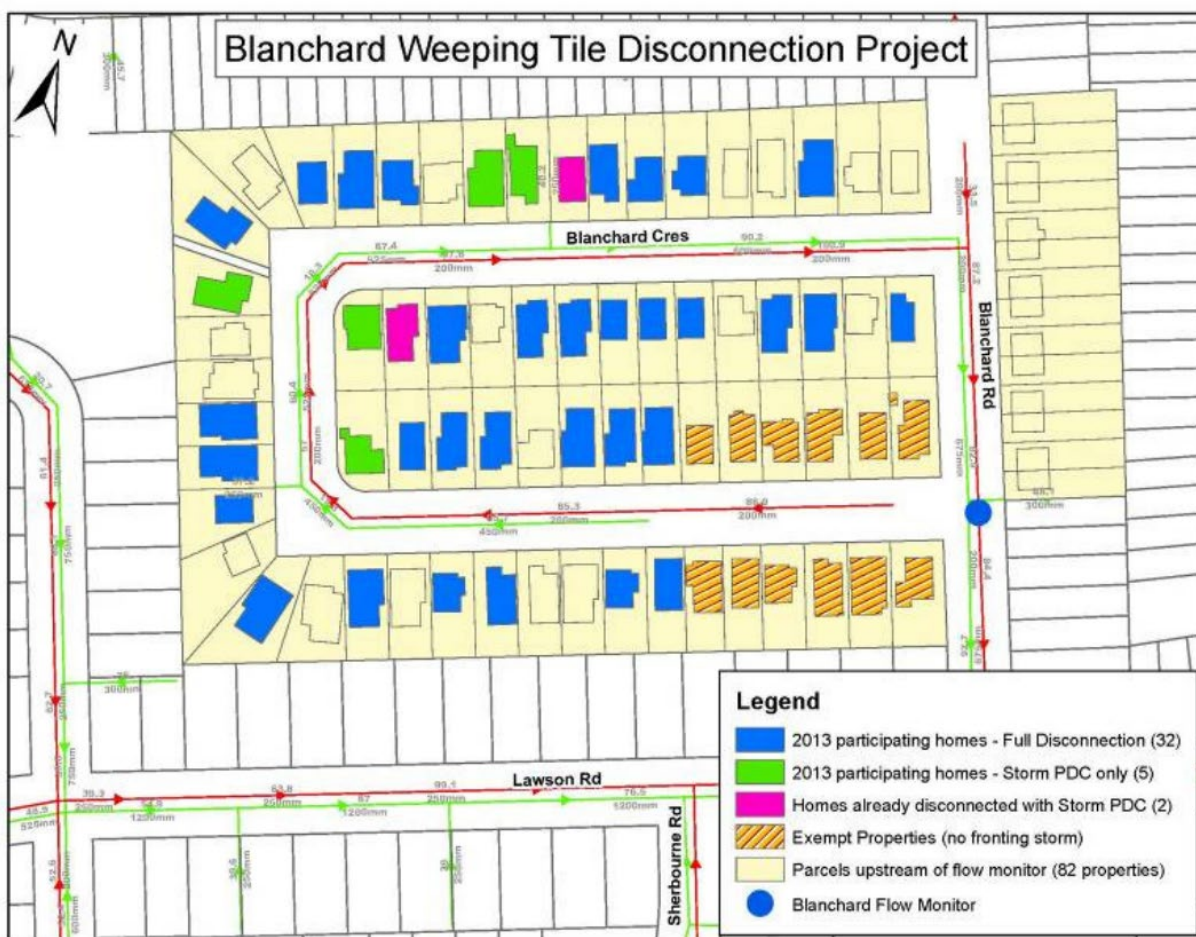


Figure 2-3. Blanchard Crescent Participating Homes⁸

2. **Renny Crescent (2021).** This pilot program was initially planned for 2020 as a City contract but was cancelled due to the COVID-19 pandemic. In 2021, It was decided to run an application-based program where homeowners fill out an application and obtain a quote from a list of prequalified plumbers. Only 9 of the 80 households participated, which is a participation rate of 11%. A map of the participating homes along Remy Crescent is shown on **Figure 2-4**. Restoration for each home was capped at \$5,000, while the \$1,000 incentive still applied. The homeowners also had to sign a liability release.

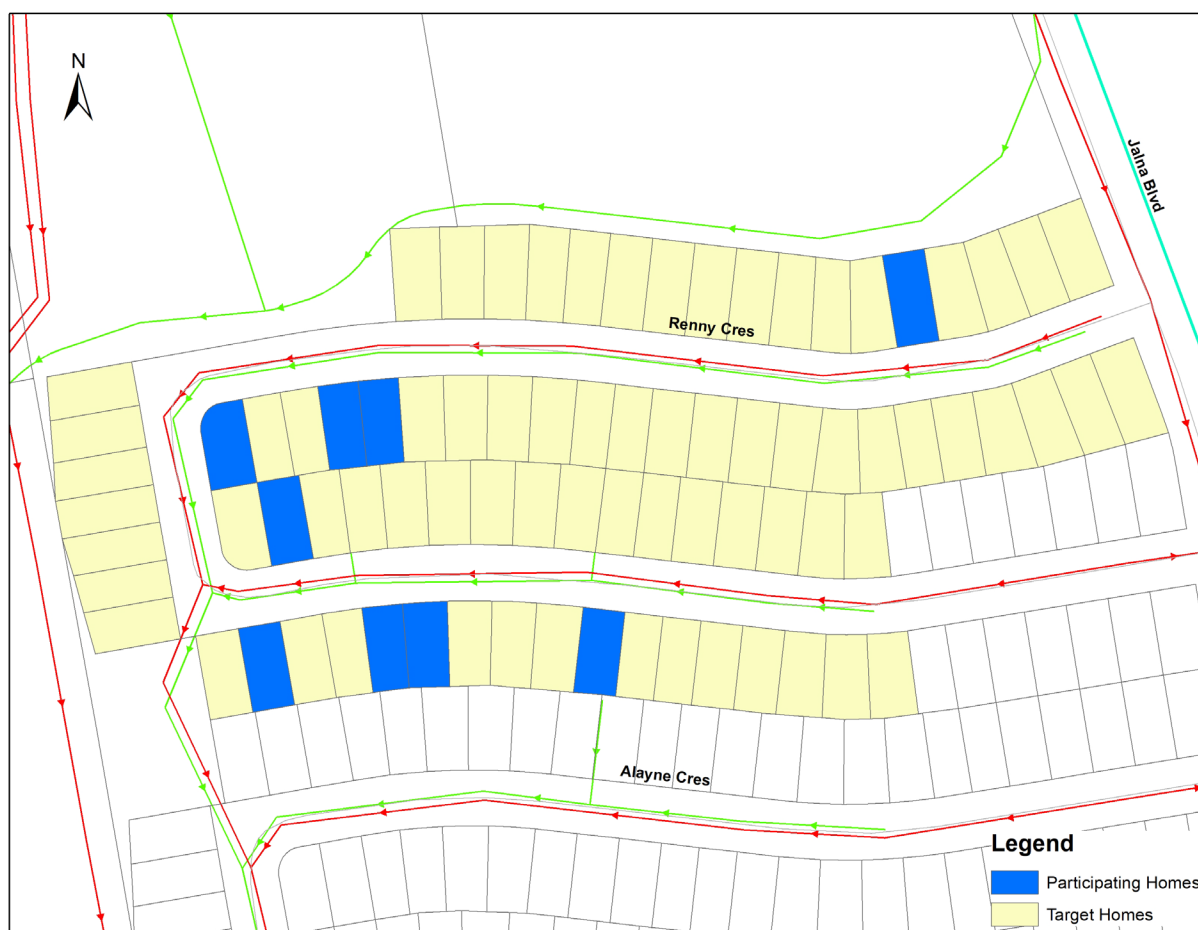


Figure 2-4. Remy Crescent Participating Homes

3. **Augusta Crescent (2022).** The City selected this area after the significant storm in September 2021 where many homes on this street flooded. A total of 29 of the 138 households participated, which is a participation rate of 21%. A map of the participating homes along Augusta Crescent is shown on **Figure 2-5**. Although this was an application-based program, there was the option for the City to pay the plumber directly. Similar to Remy Crescent, restoration was capped at \$5,000 with a \$1,000 incentive, and homeowners had to sign a liability release.



Figure 2-5. Augusta Crescent Participating Homes

The comprehensive and intensive approach completed indicate that the participation rate for the Sherwood Forest Pilot represents some of the highest that could be expected for other areas, through a voluntary and incentivized approach.

2.3.1 Successes and Challenges

The overall success of the pilot programs has been rather limited, largely due to a very low participation rate. However, City staff monitored the flow in the sanitary sewer downstream of Blanchard Crescent and observed a significant decrease in wet weather flow since the project was completed. This suggests that source control through weeping tile disconnection from the sanitary system remains an effective method for reducing I&I. This approach is also noted to be less expensive compared to infrastructure upsizing and storage solutions.

The City faces a lot of challenges in implementing a weeping tile disconnection program. Most homeowners are not aware of the program and encouraging their participation through voluntary

and incentivized approaches can be challenging. Some homeowners may not be aware of the benefits of disconnection or may have concerns about the process, including maintenance and costs. Working directly with homeowners on their private property and inside homes also introduces both liability and legal concerns, and requires extensive staff time and coordination.

During a recent extreme wet weather event on July 15-16, 2024, the City responded to over 500 basement flooding calls, as per the flooding calls data provided by the City. This event was not unique to the City of London; future and more frequent extreme storm events are expected. However through weeping tile disconnection, the City can effectively reduce stormwater in the sanitary sewer system, which in turn, aims to protect homeowners' basements, mitigate SSOs, and enhance the overall water quality in the City.

2.4 Efficacy Analysis Discussion

In Phase 3 of the 2018 PPCP, completed by CH2M Hill Canada Limited, three catchment areas were identified that would benefit from a targeted weeping tile disconnection program. These three areas were Group B (Cathcart/Devonshire), Group H (Medway PS), and Group I (Sunninghill PS). Since 2018, the City has found it challenging to achieve a high homeowner participation rate in these areas. This may be since many homeowners have not been personally impacted by wet weather basement flooding and were not willing to allow such invasive work to be conducted in their basements without greater incentives. However, **Figure 2-6** shows that there is a direct correlation between the amount of rain received during a rainfall event and the high flow in the sanitary sewer, which is due to I&I sources, including connected weeping tiles. Homeowners who may not have personally experienced basement flooding may still be major contributors of wet weather inflows and may cause flooding to the rest of the neighbourhood, as illustrated in **Figure 2-7**.

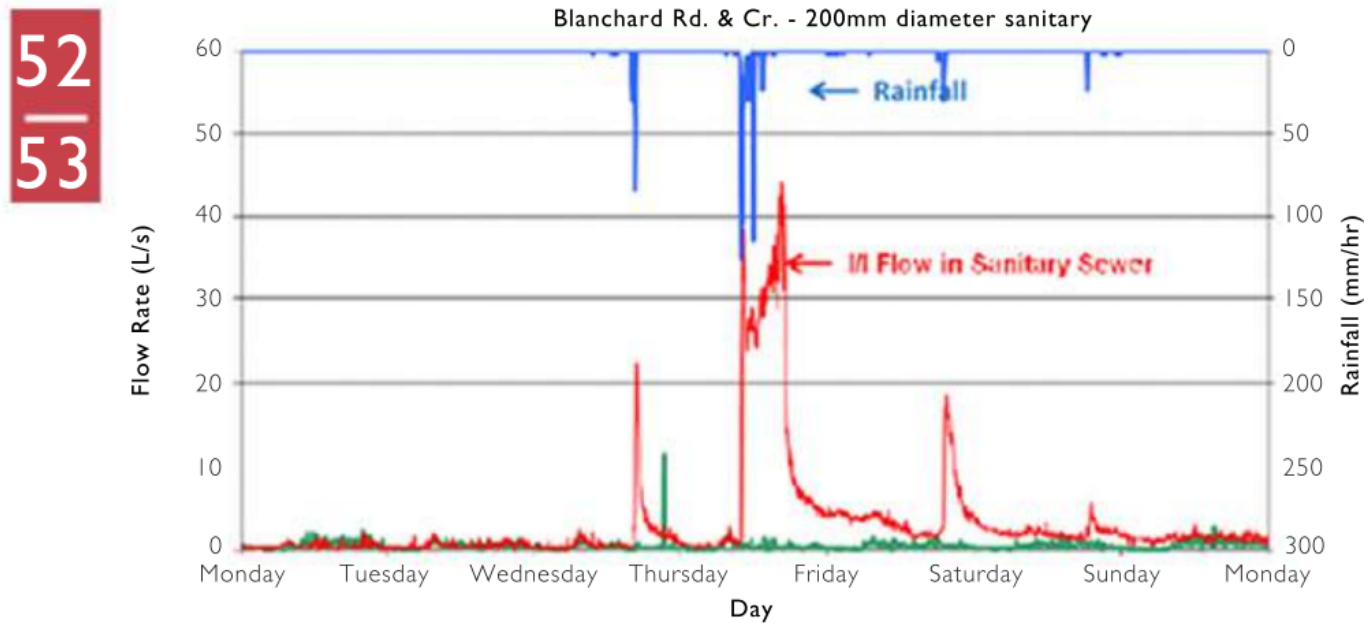


Figure 13: In this graph, the blue line represents the amount of rain received in mm/hour, the red line represents the flow inside the sanitary sewer in L/s and the green line represents a week's worth of flow in the sanitary sewer with no rainfall in L/s in the Blanchard Crescent Area. This graph highlights the fact that there is a direct correlation between the amount of rain received (approximately 80mm during the rainfall event) and high flow in the sanitary sewer, evidence of Inflow and Infiltration.
(Source: City of London)

Figure 2-6. Correlation between amount of rain received and high flow in sanitary sewer⁸

⁸ https://www.iclr.org/wp-content/uploads/2018/08/cities_adapt_rainfall_london.pdf

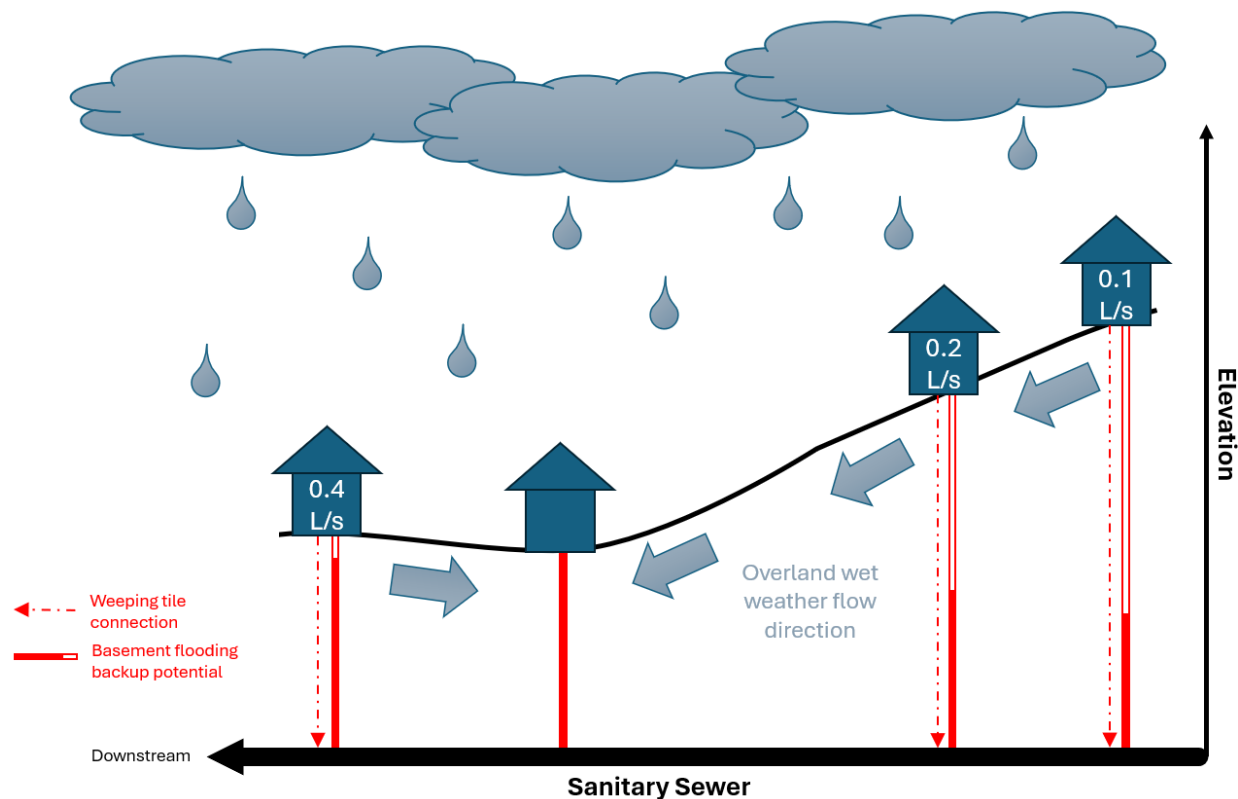


Figure 2-7. Illustration of basement flooding backup potential

The lack of homeowner participation and voluntary disconnection uptake can further be seen through the historic progression of the City's *Basement Flooding Grant Program*. Originally designed to provide a 100% subsidy to lessen the financial impact on homeowners, City staff found that contractors were taking advantage of the program through canvassing homeowners in areas not designated to receive funding. This caused undue strain on the program, and subsequently the subsidy was reduced to 50% of the cost of installation. However, the 50% subsidy was not widely adopted by homeowners and had to be increased to 75%. Again, the City found that homeowner participation was still low, and the subsidy was increased to 90% under the new *Basement Flooding Grant Program By-Law A.-7562-160*.⁹

Between 2013 to 2023, a total of 499 weeping tiles have been disconnected through the *Basement Flooding Grant Program*, corresponding to a wet weather peak flow reduction of approximately 49.9 to 499 L/s for the entire City during a particular storm. This assumes a flow rate range of 0.1 – 1.0 L/s per disconnection. The large rate range accounts for the variation in peak flow coming from

⁹ https://glsclcities.org/wp-content/uploads/2015/09/Involving_Homeowners_in_Urban_Flood_Risk_Reduction_-_City_of_London_Ontario_2011.pdf

weeping tiles during rainfall events, as shown in **Figure 2-7**, which can vary from property specific soil conditions to the size and power of the sump pump. It should be noted that the *Basement Flooding Grant Program* is a 'reactive' program for homes that have experienced past basement flooding as a result of sanitary sewer backup and focuses on homeowners installing a backwater valve. The I&I removal from these individual properties is an overall minimal amount and is simply a result of requiring the home to be isolated from the City sanitary sewer to reduce backup potential through weeping tiles disconnection. However, within specific subcatchments, the impact of disconnecting multiple homes is anticipated to be significant and is a worthwhile effort. It is likely that application of an enhanced weeping tile disconnection program may be effective for the long-term depending on the disconnection approach utilized.

Although the current grant program and past pilot programs have helped to reduce some risk in sewer overflows and basement flooding, the primary challenge remains in achieving adequate homeowner participation through both voluntary and incentivized approaches. While the *Basement Flooding Grant Program* aims to lessen the financial impact on homeowners, the efficacy of disconnecting weeping tiles rests solely on motivation by homeowners and not through City enforcement. The disconnection targets set as per Phase 3 of the 2018 PPCP Implementation Plan for the three identified catchment areas are therefore not anticipated to be met unless the City considers a different delivery or execution approach.

3. Best Practice Review

This section provides an evaluation of alternative treatment methods and industry literature review of I&I reduction best practices. In addition, different weeping tile disconnection approaches were assessed with critical commentary on its overall effectiveness. Local weeping tile disconnection programs, including those offered by some Ontario municipalities, that have been successfully implemented either through voluntary, mandatory, or (dis)incentivized approaches, were identified as examples.

3.1 Evaluation of Alternative Treatment Methods

Several alternative treatment methods and strategies may be available, at the City's discretion, given the existing infrastructure within the study area. Many of these alternatives have been implemented in the past, but may not meet expectations during future extreme rainfall events, and would therefore require enhancements to achieve the F-5-5 90% compliance capture.

1. Provision of storage

Storage tanks are designed, either above or below ground, to temporarily hold excess stormwater and sewage during peak rainfall periods and are then emptied slowly into the sewer system and treated once capacity is available, helping to prevent overflows. To store large volumes, storage tanks will need to be flexible in location as there is limited siting areas available. Generally, odour may also be an issue, if not properly maintained and emptied, when located near urban areas. Some of these operational concerns may be less of a factor for in-line (passive) storage which generally have less operational and maintenance needs (in comparison to off-line storage tanks).

Additional risks include storage limits due to the frequency and intensity of the rainfall event. For example, the twinned 2500 mm diameter storage pipes that were installed in White Oaks in 2004 experienced this limitation during the recent extreme rainfall on July 15th, 2024. The rainfall event volume exceeded the approximately 4,000 m³ of storage capacity and did not provide protection against a second peak the following day on July 16th. Although these storage pipes operated exactly as intended, they are more effective in smaller rainfall events. It was noted that the storage pipes took more than 12 hours to fully drain by gravity into the sewer system which was also overwhelmed.

Based on previous project experience at a Class 4 planning-level (prepared for the purposes of Wastewater Master Plans), the estimated cost for a storage tank is approximately \$10M for 5ML capacity, or \$2,000 per m³. This is a high level or "order of magnitude" estimate of capital construction costs only. It should be recognized that cost

estimates prepared on a per-volume basis (e.g., \$/ML of storage) are simplistic and do not account for site-specific considerations like land acquisition, geotechnical conditions, tree/vegetation removal, odour control, proximity to other infrastructure, etc. Additionally, these estimates do not consider ongoing operation and maintenance (O&M) costs which are highly variable, such as the need for labour associated with clean-outs for off-line (uses pump) storage.

2. Reconfiguration of overflow weir

Note that reconfiguration of overflow weirs may not be feasible in the majority of sewersheds since the rest of the sanitary system does not share the same interconnectivity as the Pall Mall/ Dundas area. This alternative is also not applicable to most overflows in the City, as many overflow locations are not controlled by weirs.

Overflow weirs are structures designed to manage excess flow in a combined sewer system by allowing spills during peak flows or extreme rainfall events. Although the weirs help to prevent system backups, this leads to untreated or partially treated sewage being released into the environment and ultimately reducing the ability to capture 90% of flows as per F-5-5.

Reconfiguring weirs involves altering their design (height or shape) or location for better flow control and diversion during extreme rainfall events. By adjusting the height of the weir to sit higher, more volume can be retained in the system before it spills over. Although this can be an inexpensive localized solution, if the overall system capacity is insufficient, downstream overflow locations may have increased spillage and upstream homes may have increased basement flooding risk. Additionally, it may also stress the system if the treatment capacity is not adequately scaled. Adjustable weirs may be an option to provide flexibility to manage different flow rates at peak conditions.

3. Linear conveyance upsizing

Linear conveyance upsizing refers to increasing the capacity of sewers by replacing them with a larger diameter to handle higher volumes. Municipalities proactively upsize sewers to address future demands due to urban growth and more intense rainfall patterns caused by climate change. However, upsizing is typically only designed to handle a maximum return period and costs increase significantly to accommodate larger design storms. Larger conveyance systems means that for a certain design storm event, the system can carry the combined flow of sewage and stormwater without reaching its overflow threshold during normal and peak flow conditions.

4. Pumping station capacity upgrades

Sanitary pumping stations transfer sewage from local collection systems to treatment plants and are used where gravity is insufficient at moving sewage due to elevation changes. Capacity upgrades at pumping stations require installing larger or additional pumps such that more sewage can be moved by forcemain. Upsizing of the forcemain may also be required to accommodate the increased volume and flow. As well, storage improvements such as wet wells or retention basins should be considered to temporarily hold excess flow during peak times. It is imperative that the facility have regular maintenance to ensure continuous and reliable operation during extreme rainfall events. This alternative would be very effective at reducing bypasses at the pumping stations but would be very costly as it involves many different upgrades. However, the pumping stations would only be moving more flow to downstream overflow locations and does not address the issue at the source.

5. Weeping tile disconnection

Weeping tiles that are connected to the sanitary sewer contribute additional stormwater inflows to the system, which can quickly become overwhelmed during extreme rainfall events. By disconnecting weeping tiles, the overall volume of stormwater entering the system is reduced, thus lowering the frequency and severity of overflows. Additional benefits include reducing basement flooding risks for the immediate neighbourhood area. Implementing a disconnection solution across a large area may be very logistically complex, requiring coordination with local regulations, and can take a long time before the expected impacts are achieved. If not properly redirected or alternative drainage solutions are not properly designed and maintained, the weeping tile disconnection will not be as effective for larger design storms. The disconnection process can also be disruptive to property owners, and they will need to be informed and engaged to ensure successful implementation.

3.1.1 Industry Literature Review

Many municipalities typically choose to upgrade their collection sewer system to provide additional capacity and limit the amount of SSOs being discharged into the environment. However, these system improvements are a very expensive process, and do not guarantee the elimination of basement flooding risk. Many industry papers discuss the need for cost-effective methodologies to sustainability improve the system's level of service with the removal of I&I. Although these papers mainly focus on infrastructure and planning approaches, actions at the homeowner or private property level can play a significant role.

Source control methods offer a long-term solution that will limit the volume and frequency of untreated sewage discharges and improve overall water quality, while maintaining an acceptable level of service. Although weeping tile disconnection does not directly reduce a home's risk of basement flooding, if numerous homeowners serviced by a particular sewershed participate, sewer backup risk can be greatly reduced for the overall neighbourhood. This type of source control can also improve the performance of downstream conveyance and end-of-pipe facilities and is an accepted and effective best practice as evidenced by the following literature references:

- Institute for Catastrophic Loss Reduction. *"Assessing local mandatory measures to reduce flood risk and inflow & infiltration in existing homes"* 2017 report.
- Institute for Catastrophic Loss Reduction. *"Protect your home from Basement Flooding"* 2011 report.
- Institute for Catastrophic Loss Reduction. *"Involving Homeowners in Urban Flood Risk Reduction – Case Study of Sherwood Forest in London, Ontario"* 2011 report.
- Sustainable Prosperity. *"New Solutions for Sustainable Stormwater Management in Canada"* 2016 report.
- Toronto and Region Conservation Authority – Credit Valley Conservation Authority. *"Low Impact Development Stormwater Management Planning and Design Guide"* 2010 report.
- The Government of Canada *"Protect your property with flood ready fixes"* website.

3.1.2 Note on Regulatory Compliance

It is important to also compare MECP's Guideline F-5-5 with other international regulatory frameworks to understand and anticipate if more stringent measures may be required in the future for minimizing the amount of the wet weather overflows to the environment. Examples of more stringent regulatory frameworks are found in the U.S., Germany, and the UK, where local specific requirements for reducing the frequency and volume of combined sewer overflow (CSO) and SSO discharges are strictly enforced. Similar to the F-5-5, these frameworks often involve comprehensive control plans, rigorous monitoring, and detailed reporting.

Weeping tile disconnection, as a form of source control method, will aim to reduce the City's frequency and volume of CSO and SSO discharges beyond the F-5-5 90% compliance; eventually achieving 100% capture rate at most, if not all, high priority overflow sites. In comparison, hard infrastructure measures, including upsizing sewers and constructing storage tanks, will only aim to achieve the minimum compliance target. In the future, if Ontario regulation is updated or changed to also become more stringent, the City will already be prepared with an effective weeping tile disconnection program to meet the new limits.

3.2 Disconnection Approaches

To increase participation rates and support the adoption of weeping tile disconnection by homeowners, many municipalities have considered the use of voluntary, mandatory via local applicable by-law, or (dis)incentivized approaches. However, common to all approaches, is the importance of increasing awareness of urban flood risk to all homeowners through better public education and campaigning to encourage risk reducing behaviour.

- **Voluntary:** Involves a partial or full subsidy on the disconnection of weeping tiles, installation of sump pits and pumps, and installation of backflow valves.
- **Mandatory via local applicable by-law:** Prohibits through local by-law the discharge of stormwater from the property into the municipal sanitary sewer and requires the use of sump pumps to discharge to the ground surface or to a storm sewer. Certification from a licensed plumber is required for compliance and the municipality has the authority to enforce the by-law through fines and legal action.
- **(Dis)incentivized:** Encourages the disconnection of weeping tiles by targeting the homeowner's wastewater bill, either appearing as a credit benefit or as a punitive utility charge.

3.2.1 Voluntary

The City understands the inherent public sensitivity with respect to invasive interior and exterior work as part of weeping tile disconnection within private property. Homeowners who participate in a voluntary disconnection program typically are assisted financially to encourage participation if they are reluctant due to affordability. Several municipalities across Ontario offer some form of voluntary weeping tile disconnection program, with either partial or full rebates/ subsidies: for disconnecting weeping tiles, for professional plumbing services, and for the installation of alternative yard drainage system. The below comparison table shows the types of rebates/ subsidies offered by other municipalities across Ontario for benchmarking. Note that financial assistance is only applicable to eligible homeowners as defined by the specific municipality.

Table 3-1. Comparison of Financial Rebates/ Subsidies offered by Ontario Municipalities

	Program Name	For Weeping Tile Disconnection	For Professional Plumbing Services	For Installation of Alternative Drainage Solutions
City of London¹⁰	Basement Flooding Grant Program	• 90% up to \$4,000 for disconnection and sump pump • 90% up to \$1,400 for battery back-up	• 90% up to \$1,800 for backwater valve • 90% up to \$6,000 for sewage ejector and holding tank	• 90% up to \$7,000 for storm private drain connection
City of Cornwall¹¹	Flood Risk Reduction Rebate Program	• 80% up to \$2,000 for disconnection	• 80% up to \$500 for backwater valve	• 80% up to \$500 for lot grading
City of Ottawa¹²	Residential Protective Plumbing Program	• 100% up to \$1,250 for sump pump and battery back up	• 100% up to \$100 for professional assessment • 100% up to \$700 for interior backwater valve	N/A
City of Kingston¹³	Preventative Plumbing Program	• 50% up to \$1,000 for disconnection • 75% up to \$1,400 for sump pump	• 75% up to \$1,200 for backwater valve	N/A
City of Hamilton¹⁴	Protective Plumbing Program	• 100% up to \$2,000 for sump pump and backwater valve		N/A
Region of Peel¹⁵	Sanitary Backwater Valve Rebate Program	N/A	• 100% up to \$1,500 for backwater valve	N/A

¹⁰ <https://london.ca/living-london/water-environment/flooding/basement-flooding-grant-program>

¹¹ <https://www.cornwall.ca/en/live-here/flood-risk-reduction.aspx>

¹² <https://ottawa.ca/en/living-ottawa/drinking-water-stormwater-and-wastewater/wastewater-and-sewers/basement-flooding/residential-protective-plumbing-program#section-818935e7-c5ca-4c99-a782-1be71e77f743>

¹³ <https://utilitieskingston.com/Wastewater/basementflooding/Protect/Preventative/PPFAQ>

¹⁴ <https://www.hamilton.ca/home-neighbourhood/house-home/basement-flooding/protective-plumbing-program#grant-program>

¹⁵ <https://peelregion.ca/water/pipes-downspouts/backwater-valve-rebate#:~:text=Peel%20Region%20offers%20a%20sanitary,basement%20flooding%20due%20to%20rainfall.>

	Program Name	For Weeping Tile Disconnection	For Professional Plumbing Services	For Installation of Alternative Drainage Solutions
Region of Durham¹⁶	Loan Program for Homes that have Experienced Sewer Backup Flooding	• Interest-free loan up to \$3,000 for sump pump and backwater valve		N/A
Region of Halton¹⁷	Enhanced Basement Flooding Prevention Subsidy Program	• 100% up to \$5,000 for disconnection, sump pump, and battery back-up	• 50% up to \$675 for internal backwater valve	• 50% up to \$2,000 for sanitary lateral repair
City of Niagara Falls¹⁸	Weeping Tile Removal Assistance Program	• 100% up to a \$4,000 for disconnection, sump pump, and battery back-up	• 100% up to \$1,200 for backwater valve	N/A
City of St. Catharines¹⁹	Flood Alleviation Program	• 100% up to \$3,500 for sump pump and backwater valve		N/A
City of Brantford²⁰	Basement Flooding Prevention Grant Program	• 80% up to \$4,000 for disconnection, sump pump and battery back-up	• 80% up to \$300 for professional assessment • 80% up to \$3,000 for internal backwater valve	• 80% up to \$2,000 for storm lateral repair
City of Thunder Bay²¹	Flood Prevention Measures	• 50% up to \$500 for disconnection • 50% up to \$1,500 for sump pump	• 50% up to \$1,750 for backwater valve	• 50% up to \$1,500 for private drain connection

¹⁶ <https://www.durham.ca/en/living-here/resources/Documents/My-Property/Sump-Pump-Loan-Notice.pdf>

¹⁷ <https://www.halton.ca/Repository/Basement-Flooding-Prevention-Subsidy-Application>

¹⁸ <https://niagarafalls.ca/living/environment/wrap.aspx>

¹⁹ [https://www.stcatharines.ca/en/water-utilities-and-services/basement-flooding.aspx#:~:text=Our%20Flood%20Alleviation%20Program%20\(FLAP,back%20Dup%20from%20sewer%20surcharging.](https://www.stcatharines.ca/en/water-utilities-and-services/basement-flooding.aspx#:~:text=Our%20Flood%20Alleviation%20Program%20(FLAP,back%20Dup%20from%20sewer%20surcharging.)

²⁰ <https://www.brantford.ca/en/living-here/flooding-relief-and-prevention-grant-programs.aspx#Storm-lateral-repairs>

²¹ <https://www.thunderbay.ca/en/city-services/discounts-and-rebates.aspx#Drainage-rebate>

There have been numerous studies related to the knowledge-based informational challenges associated with basement flood risks and impacts. A study on the mitigation of basement flooding due to sewer backup indicates that more than 95% of Canadian homes do not have backwater valves installed²². This low rate of installation demonstrates that many homeowners are unaware of the simple mitigation measures that can better help to protect homeowners from damages caused by extreme rainfall events. Voluntary approaches that involve a partial or full rebate/subsidy must therefore rely heavily on effective public education and communication.

As part of the existing *Basement Flooding Grant Program*, the City should continue to offer informational materials and workshops to educate homeowners about the benefits of disconnecting weeping tiles and how to properly manage stormwater. This helps homeowners understand the value of the program and guides them through the disconnection process. The City may also consider the potential to take advantage of the “window of opportunity” at strategic moments, including times when a major flood event has made local news or when residents are purchasing new homes, that may help increase basement flooding knowledge and act on the financial assistance available.

3.2.2 Mandatory – Targeted

Mandatory measures that include hard regulatory requirements and are strictly enforced to ensure compliance with disconnecting weeping tiles may present multiple challenges. These legal challenges generally revolve around a few key issues:

1. **Cost and Financial Burden:** The cost of disconnecting weeping tiles and making necessary modifications to their plumbing systems can be substantial. Homeowners may argue that such a mandatory program imposes an unfair financial burden, particularly for those with limited resources.
2. **Property Rights and Regulations:** Homeowners may argue that the mandatory disconnection infringes on their rights by requiring significant alterations to their private property. They may contend that the regulations are overly restrictive or that the City has not provided adequate compensation or support for the changes.
3. **Implementation and Communication:** Homeowners may argue that the City’s communication was inadequate and that they were not properly informed about the

²² [https://ascelibrary.org/doi/abs/10.1061/\(ASCE\)NH.1527-6996.0000298](https://ascelibrary.org/doi/abs/10.1061/(ASCE)NH.1527-6996.0000298)

implementation requirements, the timeline for compliance, or the potential consequences of non-compliance.

4. **Effectiveness and Necessity:** The effectiveness and necessity of the disconnection may be challenged by homeowners. They may argue that the program does not sufficiently address the issues it aims to solve or that other, less disruptive, solutions could be more effective.

The potential application of a 'hard mandatory' disconnection program would be most feasible for targeted neighbourhoods where the use of punitive measures can be more easily enforced. However, the City may need to take measures to protect itself from potential lawsuit claims from affected homeowners.

3.2.2.1 City of Ann Arbor (MI)²³

This municipality is an example of a mandatory weeping tile disconnection program where all improper stormwater inflow disconnection costs shall be at the homeowner's expense (*Chapter 28, Section 2:51.1*). Unless for qualified participants in targeted neighbourhoods, the City will reimburse the homeowner up to a maximum amount for corrective work to be done. For homes in the targeted neighbourhoods that chose not to complete the work within the stated timeframe, a charge was applied to the homeowner's wastewater bill reflecting the Wastewater Treatment Plant (WWTP) treatment costs and the conveyance system O&M costs required to accommodate the excess flow due to their connected weeping tiles.

The mandatory disconnection program was determined to be effective within the targeted neighbourhoods, but the municipality faced several lawsuits from its affected homeowners. The lawsuit claims the ordinance violated²⁴: (1) the Michigan state law setting forth the requirements for a government to take private property for public use; (2) the Michigan state constitutional prohibition against taking private property for public use without just compensation; (3) the corresponding U.S. constitutional prohibition against taking private property, which is a Fifth Amendment claim; and (4) the prohibition against violating the federally protected rights of others.

²³ https://library.municode.com/mi/ann_arbor/codes/code_of_ordinances?nodeId=TITIIUTSE_CH28SESEDI_2_51.1PRFODRDIPO

²⁴ <https://annarborchronicle.com/2014/02/28/lawsuit-filed-on-city-footing-drain-program/index.html#:~:text=The%20ordinance%20was%20enacted%20in,sewage%20backups%20in%20homeowners%27%20basements.>

3.2.3 Mandatory – City Wide

Although municipalities in Ontario have clear authority to take action to steward the sanitary sewer system and to impose related requirements, including the disconnection of weeping tiles from the sanitary sewer, no examples have been found implementing a certification of conformance by-law.

In the United States, variations of local conformance by-law can be found which offers the municipalities power for enforcement over homeowners to disconnect their weeping tiles at the title transfer “point-of-sale” of a qualifying residential home. This type of by-law involves a mandatory inspection process that identifies qualifying residential homes with connected weeping tiles and requires that the selling homeowners ensure disconnection by the time the title ownership is transferred to the buyer. Therefore, responsibility for compliance is placed on the seller of the property, while the certificate of compliance stays with the property after the sale. Generally, key steps in setting up a certificate of conformance point-of-sale by-law disconnection program may involve:

1. Identifying the “trigger(s)” for certification conformance;
2. Establishing property criteria requiring certification conformance and any exemption cases;
3. Setting an applicable compliance period and extension period before fines and other legal action may be required;
4. Setting an applicable validation period for which the certification is valid for;
5. Defining financial assistance eligibility, which may be separate from any existing voluntary disconnection programs;
6. Outlining the administrative processes and fees for obtaining the certificate;
7. Ensuring appropriate internal staff resources are available, and if required, a team of vetted, and certified plumbers;
8. Engaging external stakeholders to ensure real-estate industry readiness and seller/buyer awareness; and,
9. Proposing sewer by-law updates with Council acceptance.

This type of mandatory disconnection program is considered ‘soft mandatory’ and may be viewed more favourably by Council and homeowners since certification conformance is only required when triggered. This differs from a City wide inspection program because only properties being sold are inspected for weeping tile connection. Rather than conducting systematic house-to-house inspections to check for I&I related issues within a targeted neighbourhood, the City may consider the use of a point-of-sale as a possible trigger to take action.

The successful implementation will require homeowners to be aware and engaged about the new by-law requirements, which may be a challenge. Public education, stakeholder contact and effective and repeated communication should continue to be used. It should be noted that punitive measures involving fines and other legal action for non-compliance should be used as a last resort.

3.2.3.1 New York State Department of Environmental Conservation

To comply with New York State Department of Environmental Conservation (NYSDEC) directives limiting the amount I&I within sewers, many municipalities within the State of New York, including the Villages of Akron, Depew, Kenmore, Lancaster, and Orchard Park, along with the Towns of Cheektowaga, Grand Island, Amherst and Tonawanda, have instituted point-of-sale sewer I&I inspections. The names, implementation, and details of these programs may vary, but the common theme is they require an I&I inspection before a property can be sold. Generally, these programs are enforced by the individual municipality with the goal of avoiding paying penalties to the NYSDEC due to excessive I&I flows from downspouts, weeping tiles, and sump pumps into the sanitary sewer system.

Under the point-of-sale certification conformance, a property must be inspected (according to an inspection checklist²⁵) to ensure no illegal stormwater sources are connected to the sanitary sewer system. If the inspection fails, no person shall transfer title to another person nor accept from any other person the transfer of title of the property for which the structure is located. A notice of violation will be issued to the homeowner describing the prohibited discharges and recommendations to remedy the infractions. For the Village of Kenmore²⁶, if an inspection cannot be completed prior to closing, then a waiver can be purchased for a specified check amount (\$3,000 for residential properties with less than 5 units) and will be returned if a certificate of compliance is obtained within 60 days from when the waiver is issued. For the Town of Tonawanda²⁷, if repairs cannot be made before closing, then a waiver can be purchased for a specified check amount (\$1,500) and will be returned if the repairs are completed within the time specified in the guaranty. For the Town of Amherst²⁸, if repairs cannot be made before closing, an agreement can be made between the seller and the prospective buyer to purchase a waiver for a

²⁵ https://www3.erie.gov/dsm/sites/www3.erie.gov.dsm/files/2024-04/item5e_timeofsalehouseinsp.pdf

²⁶ <https://www.villageofkenmore.org/index.php/sewer-storm-water-info/78-whats-new/881-inflow-infiltration>

²⁷ <https://ecode360.com/10933183#10933183>

²⁸ <https://ecode360.com/32387867>

specified check amount (\$1,500), which allows the buyer to assume responsibility for the repairs, and will be returned if the repairs are completed within the time specified in the guaranty²⁹.

It is often anticipated that more than one inspection will be needed before the certificate can be issued, so it is recommended that the sellers schedule the inspections as soon as there is a Contract for Sale for the property. Properties identified as having possible problems with connections, may be asked to allow the municipality or a specified contractor to perform additional smoke and/or dye tests to verify the location of the leak/ illegal sources of stormwater.

3.2.3.2 Metropolitan Council Environmental Services³⁰

The Metropolitan Council Environmental Services (MCES), which provides regional wastewater collection and treatment for the metropolitan area, requires the City of Orono to reduce peak flows to the regional wastewater collection system. These inspections allow the City to ensure that private properties have no illegal connections to the sanitary sewer system, including roof drains, foundation drains, or sump pumps, which contribute to excess peak flow discharges. Additionally, this will help to reduce the cost to the City's utility customers as they won't have to pay MCES surcharges.

For properties that pass inspection, the City issues a Certificate of I&I Compliance to the homeowner, which is valid for 10 years. Properties that don't pass inspection are issued a correction notice delineating the problems. Repairs should be completed within 90 days of receipt of the correction notice. If repairs cannot be completed prior to the title transfer of a property, proof of an escrow equalling 110% of the estimated cost of repairs shall be provided to the City. If repairs are not completed, a monthly surcharge will be applied to the utility bill until the property is in compliance.

3.2.4 (Dis)Incentivized

Homeowners are often unaware or unconcerned about their financial role in the operation costs of WWTPs and the O&M costs of the sewer system to convey wastewater flows. However, when excess and unnecessary wastewater flow is discharged into the sewer system due to connected stormwater sources, homeowners should be responsible for the increased costs to accommodate these flows. Many municipalities offer incentives and/or disincentives to encourage homeowners to

²⁹ https://www.amherst.ny.us/content/departments.php?dept_id=dept_10&div_id=div_12&menu_id=menu_02

³⁰ <https://www.oronomn.gov/504/Inspections-Program>

disconnect their weeping tiles to reduce the overall treatment and conveyance costs. This can either appear as a credit benefit or as a punitive utility charge on their wastewater bills.

3.2.4.1 City of Stratford (ON)³¹

This municipality is an example of applying a surcharge to residential wastewater bills as a disincentive if the property has directly connected downspouts. The surcharge (*By-Law 128-2022*) is calculated by taking the net recoverable amounts (the product of total expenditures plus lifecycle costs less non-rate revenues and deducting the base charge amounts) and dividing them by the volumes. This results in a wastewater volume rate that is calculated to remain constant in 2020 and increase by 2% per year in subsequent years. The base rate for the first three cubic metres per month is typically higher, while usage over three cubic metres is subject to a lower amount.

The City may consider the use of rebate programs or charges to cover the additional treatment costs of wastewater flow from weeping tile connections in targeted neighbourhoods or City wide. However, coordination with the City's treatment operations team will be required to determine appropriate rebates or surcharge rates.

3.3 Evaluation of Disconnection Approaches

The effectiveness of disconnection approaches can vary and be difficult to compare. The evaluation provided in **Table 3-2** can help to guide the City in selecting the preferred approach based on the overall rating. Each approach was given a score between 0 (empty circle) to 4 (full circle) based on the expected impact to each criterion. Some criteria, such as Participation Rate, Efficacy, and System Improvement Potential, were necessary to be weighted higher than others to more clearly reflect the beneficial impact they would have on meeting the F-5-5 90% wet weather flow capture requirements.

Below is a brief description of each criterion:

- **Flexibility of Choice** – Ability of each approach to empower homeowners to decide whether to participate in the program based on their individual needs and constraints.
- **Participation Rate** – Ability of each approach to satisfy minimum homeowner participation requirements in order to be effective at meeting the City's objectives for overflow reduction potential and basement flooding risk.

³¹ <https://www.stratford.ca/en/live-here/waterandsewerrates.aspx>

- **Financial Implications** – Ability of each approach to be financially feasible and sustainable, taking into account both immediate and future costs, in order to allow the homeowner to disconnect without significant financial implications.
- **Customer Impact** – Ability of each approach to directly and indirectly affect impacted homeowners, taking into account the level of disruption caused as well as practical, financial, and emotional considerations.
- **Efficacy of Meeting City's Objectives** - Ability of each approach to effectively meet the City's objectives for overflow reduction potential and basement flooding risk within the same area/ sewershed, not specific to individual homes.
- **System Improvement Potential** – Ability of each approach to enhance and improve the level of service in the sanitary sewer system, both in the short-term and long-term, by addressing existing capacity constraints to accommodate extreme wet weather flows.
- **Implementation Flexibility** - Ability of each approach to be easily controlled by the City in terms of program logistics, including timing and spatial variability, to help determine the scalability and practicality from an operational perspective.
- **City Workload Management** – Ability of each approach to limit the administrative complexity, requiring efficient allocation of City resources, including staff, budget, and legal considerations, without adding strain on existing workloads.
- **Program Time Scale** - Ability of each approach to meet the City's objectives within a reasonable time scale, considering enforcement and compliance measures.

Table 3-2: Evaluation of Disconnection Approaches on Meeting the F-5-5 90% Wet Weather Flow Requirements

	WEIGHTING 1 = lowest weighting 2 = mid weighting 3 = highest weighting		Voluntary E.g. City of London (City-wide)		Mandatory E.g. Town of Tonawanda, NY		Incentivized E.g. City of London (Blanchard Cres.)		Disincentivized E.g. City of Ann Arbor, MI
Flexibility of Choice	1		4 Homeowners can decide not to participate with no legal or financial repercussions		1 By-law requirement, legal repercussions if not in compliance		4 Credit benefit/ additional funding incentive offered for homeowners who decide to participate		2 Punitive charge incentive applied for homeowners who decide not to participate
Participation Rate	3		1 Low participation expected without additional funding, relies on public education for homeowners to act		4 Highest participation expected as it is a requirement for all eligible homeowners across the City		2 Higher participation expected than voluntary due to additional funding, relies on public education for homeowners to act		3 Higher participation expected than voluntary and incentivized, relies on public education for homeowners to act
Financial Implications	2		4 Most financially feasible for homeowners as subsidies are available to cover capital costs, 90% up to a maximum		1 Some rebate/ subsidy opportunities may be available to support homeowners, but will be less than voluntary		4 Most financially feasible for homeowners as credit benefit/ additional funding is available to cover capital costs and future costs		1 Some rebate/ subsidy opportunities may be available to support homeowners, but will be less than voluntary
Customer Impact	2		4 Maintaining the existing <i>Basement Flooding Grant Program</i> will satisfy and benefit existing flood-impacted homeowners, while not disrupting others		0 Impacted homeowners affected due to potential property closing delays and may disproportionately disrupt certain demographics, leading to increased risk for legal challenges		2 Level of disruption and impact dependent on homeowners' choice to disconnect		1 Level of disruption and impact dependent on homeowners' choice to disconnect, may disproportionately affect certain demographics
Efficacy of Meeting City's Objectives	3		1 Variable decrease in basement flooding risk and minimal overflow reduction anticipated, dependent on homeowner participation in same area/ sewershed		4 Decreased risk of basement flooding for homeowners in same area with limited number of overflows anticipated across the City		1 Variable decrease in basement flooding risk and variable overflow reduction anticipated, however more homeowners expected to participate in same area/ sewershed compared to voluntary		2 Variable decrease in basement flooding risk and variable overflow reduction anticipated, however more homeowners expected to participate in same area/ sewershed compared to voluntary and incentivized
System Improvement Potential	3		1 Minimal system improvements anticipated, no meaningful beneficial change from existing at current participation rate		4 Large system improvements and resiliency anticipated, including long-term WWTF and PS cost savings		2 Some system improvements compared to existing due to higher participation rate		3 More system improvements compared to existing and incentivized due to higher participation rate
Implementation Flexibility	1		3 More flexibility in scheduling inspections for seasons where weather conditions are favourable		1 Less flexibility in scheduling inspections, based on timing of home sale		2 Building Division required to inspect work when homeowner calls		2 Building Division required to inspect work when homeowner calls
City Workload Management	1		4 No additional implementation necessary, no strain anticipated on existing workloads		1 High complexity expected requiring significant administration and City resources once by-law is approved and operational		3 Some complexity expected, requiring additional funding approval for incentives		3 Some complexity expected, requiring additional coordination with City wastewater operations team for wastewater billing when applying punitive charges
Program Time Scale	2		0 No enforcement available as it is homeowner initiated, program length may be indefinite without additional measures		4 Strict and streamlined enforcement for homeowner compliance across the City will help to minimize program length		2 No enforcement available as it is the homeowner's choice to disconnect, program length anticipated to be shorter than voluntary		3 Enforcement in the form of punitive charge for non-disconnection will help to minimize program length
Overall Rating			33 Least preferred disconnection approach		49 Most preferred disconnection approach		36 Second least preferred disconnection approach		41 Second most preferred disconnection approach
LEGEND: Negative Outcome/ Greatest Overall Impact Positive Outcome/ Lesser Overall Impact									



Based on the results of the evaluation, the most preferred disconnection approach was determined to be mandatory followed by disincentivized and incentivized, with the existing voluntary being the least preferred. Overall, implementing a City wide point-of-sale mandatory weeping tile disconnection program is preferred for the long term, allowing for enhanced enforcement and higher homeowner participation rates. Source control action at the homeowner level will ultimately play a significant role in the reduction of CSOs and SSOs to the Thames River and other receiving streams, as well as improve overall system resiliency.

4. Feasibility of Point-of-Sale Disconnection Program

This section will investigate the feasibility of a City wide weeping tile disconnection program, specifically with the implementation of a “point-of-sale” mandatory by-law. The aim of the program is to implement a requirement for private properties to disconnect their weeping tiles (if they have a connection to the municipal sanitary system) at the time that the property is sold. This would be a long-term strategy which, if feasible, would reduce wet weather flows in the City’s wastewater collection system.

4.1 Supporting MPAC Data

In Ontario, the Municipal Property Assessment Corporation (MPAC) plays a crucial role in the real estate landscape by providing detailed property assessments. This includes the compilation and analysis of property sale data. In July of 2024, MPAC graciously provided property sale data of all residential properties across the City of London to be used as a tool to help estimate the turnover rate of qualifying residential properties across the City.

The property sales data provided between 2014 to 2024 includes important information such as the roll number, residential property type codes and descriptions, age of primary structure, most recent sale date, and the number of times the property was sold. Considering only single-family detached residential homes (MPAC property type code 301 and 313 for off and on water, respectively), the total number of sales in the last decade across the City was 36,903, compared to total housing stock sales of 58,915. **Figure 4-1** shows the number of single-family detached home sales broken down annually, while **Figure 4-2** is broken down monthly by year. The monthly trend indicates that the summer months between June to August have the most amount of single-family detached home sales.

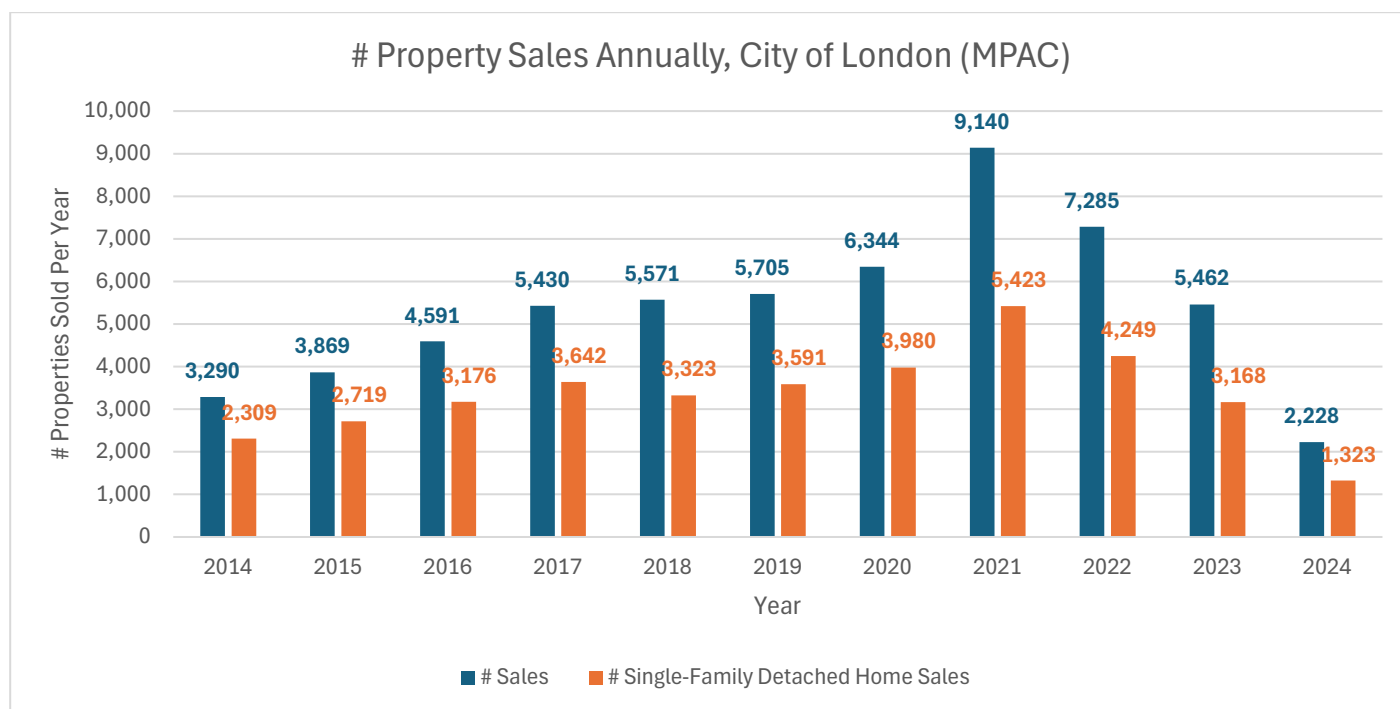


Figure 4-1: # Property Sales Annually, City of London (MPAC)

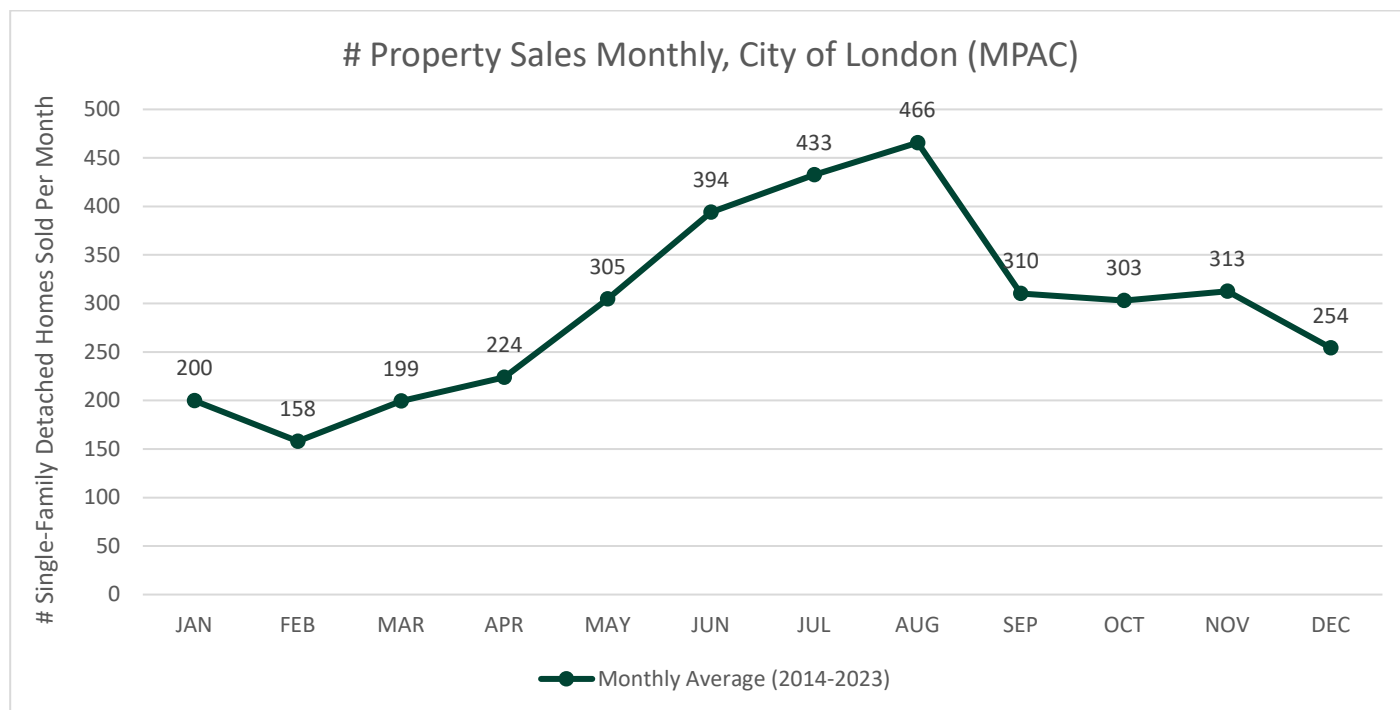


Figure 4-2: # Single-Family Detached Home Sales Monthly, City of London (MPAC)

Using the MPAC data for 2014-2023, the estimated turnover number (the average number of single-family detached homes expected to be sold per year) is 3,558. Broken down monthly, it ranges from 158 (in February) to 466 (in August). This represents approximately a rate of 4.5% per year of total single-family detached housing stock, which is calculated from 3,558 divided by the

total number of single-family detached homes of 79,850 based on the City's Building Parcel Age shapefile.

4.2 Supporting Peak Flow Reduction Assumptions

The below assumptions were considered to review the feasibility of the point-of-sale disconnection program at a high level to estimate the amount of peak wet weather flow volume reduction. These assumptions may be further refined or modified in a separate tech memorandum outlining the implementation plan and resource requirements for the program.

- Assume that all single-family detached houses (zoned within R1, R2, or R3) with a single address point will be inspected by the City prior to the closing date of the sale.
- Assume all single-family detached houses constructed before 1985 are all likely to have weeping tiles connected to the sanitary system. This represents approximately 51,836 houses or 65% (which is 51,836/79,850) of total single-family detached housing stock, based on the City's Building Parcel Age shapefile. Note that the Building Age shapefile may not include all age data related to single-family buildings
- Assume that a qualifying residential home are properties that have a single-family detached house constructed before 1985 and are inspected/ confirmed to have connected weeping tiles to the City's sanitary sewer system.
- Assume that 51,337 houses or 99% of total single-family detached houses are qualifying residential homes. This is calculated from the number of known weeping tile disconnections (499 houses as per the *Basement Flooding Grant Program*) subtracted from 51,836 houses with assumed connected weeping tiles.
- Assume that a rate of 0.1% per year of qualifying residential homes will voluntarily disconnect their weeping tiles through the *Basement Flooding Grant Program*. This is calculated from the average yearly voluntary disconnections which is 45 (as per the participant data provided from the *Basement Flooding Grant Program*) divided by 51,337 of qualifying residential homes.
- Assume that a rate of 4.4% per year of qualifying residential homes will be sold and will be required to participate in the mandatory point-of-sale disconnection program. This is calculated from the 0.1% per year of voluntary disconnection subtracted from the 4.5% per year single-family detached housing stock turnover rate (as per the MPAC data).
- Assume that each qualifying residential home that disconnects their weeping tile through the mandatory point-of-sale disconnection program will reduce the peak wet weather flow into

the sanitary sewer system at a rate between 0.1 - 1L/s per year. This range is discussed previously in **Section 2.4**.

From these assumptions, the City can expect approximately 351 L/s – 3,513 L/s peak flow reduction per year for the entire City during a particular storm, for mandatory disconnections. Note that these assumption numbers do not account for growth and additional housing stock. As well, the 4.5% is a simple rate, meaning only 3,558 unique qualifying residential homes will be sold per year, and will take approximately 15 years for all qualifying residential homes to be sold and disconnect their weeping tiles, either through voluntary or mandatory.

A discussion on how the mandatory point-of-sale disconnection program can reduce peak wet weather flows at specific high-priority locations can be found in **Appendix B**. In the early days of program implementation, it is recommended that the City conduct a pilot flow quantification program to more accurately determine the amount of flow removed during a large storm event.

4.2.1 Town of Tonawanda Sump Pump Program

As part of the feasibility analysis, the City of London met with the Town of Tonawanda to discuss their experience and lessons learned with implementing their Sump Pump Program for point-of-sale weeping tile disconnections. The meeting was held via Microsoft Teams on September 10, 2024, and a full summary of the meeting and minutes is provided in **Appendix A**.

Primarily, the Town's much smaller size and population (71,939 as of 2018) is the most significant caveat, relating to the scalability of such a program for the City of London. It was determined that all property types within the Town were required to participate, including condos and commercial properties, and it was reasonable for one Building Department staff to conduct 4-5 inspections, with dye testing, per day. This is aided by the very low turnover rate of homes sold, at 20-25% of whole housing stock since the program was implemented pre-1998, which is mostly comprised of the same starter homes. It is therefore feasible for homes to more easily get re-inspected after the 2-year Certificate validation period, if being re-sold. Remedial work can be completed by the homeowners themselves or any 3rd party licensed plumber, as long as the building code is met. No funding or subsidies are available for the remedial work as per the New York state law which prohibits public resources spent on private land.

4.3 Managing Public Perspectives

The City understands the inherent public sensitivity with respect to a mandatory weeping tile disconnection program. Education and outreach materials can be used to inform homeowners about the risks associated with having a weeping tile connected to the sanitary sewer system and the benefits of disconnecting it. This can be done through workshops, seminars, and public information campaigns to increase public awareness of the proposed by-law changes to address

I&I reduction and increase the overall resiliency of the City. The findings from the Sherwood Forest pilot indicates that a one-time mailing of information may not be sufficient for the communication of flood reduction information. More aggressive information distribution methods may be required to increase resident up-take of City information.

Negative public responses are often driven by misinformation or a perception of long-term disruption, inconvenience, or loss of existing beneficial use. Therefore, the communications strategy will need to focus on providing as much clear and factual information as possible. The below **Table 4-1** identifies some possible positive and negative responses to a proposed by-law change.

Table 4-1. Positive/ Negative Public Responses to By-Law Change

	Positive Public Response	Negative Public Response
Understanding and Awareness	If the by-law addresses a well-recognized issue or is well-communicated, people might appreciate it and view it as a step towards improvement.	If there's a lack of awareness or understanding, people might be confused or skeptical about the by-law's purpose and implications.
Impact on Daily Life	If the by-law improves quality of life, such as reducing basement flooding or enhancing public safety, it can be welcomed and supported.	If it imposes new restrictions or costs, such as increased repairs, equipment, or O&M, people might resist or protest.
Economic Considerations	If the by-law has economic benefits, such as reducing long-term costs, it might be viewed favorably.	If it increases costs for businesses or individuals, such as through administration fees or compliance expenses, it could face criticism.
Equity and Fairness	If the by-law is perceived as fair and equitable, addressing the needs of diverse groups, it is likely to gain support.	If it disproportionately affects certain groups or is seen as unjust, it could lead to backlash and demands for changes.
Enforcement and Compliance	If the by-law is easy to comply with and is enforced softly, it might be accepted and followed without much resistance.	If compliance is seen as overly burdensome or if enforcement is perceived as heavy-handed, it can lead to frustration and non-compliance.
Transparency and Involvement	If the by-law process was transparent and included public input, people are more likely to view it as legitimate and acceptable.	If the by-law was implemented without adequate public consultation, it might be viewed as a top-down imposition and face resistance.

Additionally, the City should consider that the public may already be comfortable with a familiar type of regulation, such as the vehicle safety standards certificate³². Similar to the proposed point-of-sale by-law, which requires a certificate of compliance to be obtained when transferring title ownership of a house, a safety standards certificate is required to legally transfer ownership of a used car in Ontario. The below table compares the similarities in the proposed point-of-sale certificate of compliance with the existing vehicle safety standards certificate that homeowners may already be familiar with.

Table 4-2: Vehicle Safety Standards Certificate Comparison

Program Aspect	Vehicle Safety Standards Certificate	Point-of-Sale Certificate of Compliance
Inspection requirements	The safety inspection must be conducted by a repair shop registered and licensed with the Ontario Ministry of Transportation	The I&I inspection must be conducted by a registered and licensed plumber in Ontario.
Aims and objectives	The certificate indicates that the vehicle meets minimum specific safety standards set by the province as part of the 2016 Passenger/Light-Duty Vehicle Inspection Standard ³³ . However, it is not a warranty or guarantee of the vehicle's condition. The aim is to reduce the risk of dangerous malfunctions on the road while driving, while contributing to a safer road environment.	The certificate indicates that the home meets minimum specific by-law requirements set by the City of London as part of the point-of-sale weeping tile disconnection program. However, it is not a warranty or guarantee of the home's condition. The aim is to reduce the wet weather flow in the sanitary system, while improving the neighbourhood resiliency.
Transfer of Ownership	A used vehicle can be legally bought and registered without a safety standards certificate but cannot put plates on a vehicle without one. Therefore, a safety standards certificate is required to drive the vehicle on the road. Exemptions may be applicable.	A qualifying home that is being sold, without a prior valid certificate, is subject to I&I inspection and must be found or repaired to compliance prior to closing. Therefore, a certificate of compliance is required transfer title ownership to the potential buyer. Exemptions may be applicable.

³² <https://www.ontario.ca/page/safety-standards-certificate>

³³ <https://www.ontario.ca/files/2022-03/mto-passenger-light-duty-vehicle-inspection-standard-en-2022-03-18.pdf>

Program Aspect	Vehicle Safety Standards Certificate	Point-of-Sale Certificate of Compliance
Validation period	The certificate is valid for 36 calendar days from the date of inspection assuming no repairs are required. This means that the vehicle must be sold and ownership transferred within this period of time.	The certificate may be valid for 10 years from the date of inspection assuming no repairs are required. The certificate also stays with the property after the sale, which means that the home can be sold multiple times within this period of time without having to be inspected again and requiring a new certificate.
Exemptions	A used vehicle can be sold “as is” in its current state without a certificate if an agreement is made between the seller and potential buyer for the buyer to assume responsibility of repairing the vehicle to standard. The seller therefore has no further obligation once the sale is complete, and ownership is transferred.	If the inspection fails, then the qualifying home cannot be sold and the title cannot be transferred. Repairs must be made to remedy the non-compliances prior to closing. If another inspection or repairs cannot be completed prior to closing, a waiver (or escrow) can be purchased for a specified check amount and will be returned if the certificate is obtained within 60 days from when the waiver is issued.
Impacts to sell value	A safety inspection and certificate can potentially increase the sell value of the vehicle and may be more appealing to potential buyers as it adds more trust that the vehicle is in good condition.	Without an I/I inspection and certificate of compliance, the sell value of a qualifying home can potentially decrease due to the lack of buyer confidence in the condition of the home, the possible increased repair costs for the buyers, and the increased probability of needing to extend the closing date or the purchasing of a waiver.

Public perspective can be shaped by how well the by-law is communicated, its perceived fairness, and its impact on individuals and the community as a whole. Engaging with the community early on and addressing concerns transparently can help in garnering positive public feedback.

4.4 Managing Disclosure of Potential Risk

In addition to the physical disconnection of weeping tiles, it is important on a transparency level to inform prospective buyers regarding the condition of the property's drainage systems and any potential basement flooding risk such that additional measures can be implemented. This transparency will help buyers make better informed decisions and encourages sellers to address any known issues before listing their properties.

Real estate sector professionals, such as real estate agents, lawyers, and insurance brokers, are ideally positioned to discuss the risks and mitigative measures with prospective buyers before the purchase of a home. At present, there is no requirement to disclose detailed information related to if a home has experienced previous basement flooding or if any mitigative measures have been installed. Truthful disclosure is necessary as it may not be visibly evident during home inspections that there has been a past flood event in the home, as some damages can be easily hidden by a coat of paint and by furniture, or is located in the structure of the home.³⁴

Mandatory disclosure by real estate professionals through the Multiple Listing Service (MLS), the Property Disclosure Statement (PDS), or through MPAC may directly influence the desirability of a home and may inform purchasing decisions once these factors are known. Considerations for the implementation of mandatory disclosure include:

- Consulting with the City's real estate board to raise awareness of the purpose, authority and processes of the program;
- Consulting with the Canadian Real Estate Association to have the MLS updated to identify the status of weeping tile disconnections and implementation of flood mitigative measures; and,
- Consulting with the Ontario Real Estate Association and the Canadian Bar Association regarding amendments to the PDS.

³⁴ <https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=12196&context=etd>

5. Recommendations

The impacts shown from disconnecting weeping tiles over the long term demonstrates that significant overflow volume reduction can be achieved, which meets and goes beyond the F-5-5 requirement. The real estate assessment of the number of qualifying residential homes expected to be sold per year, as detailed in **Section 4.1** and **Section 4.2**, also confirms that the by-law is feasible and can be applied City-wide.

The point-of-sale weeping tile disconnection program offers several notable cost-benefits once implemented. Primarily for the City, it targets I&I at the source and effectively removes excess water from the sewer system to reduce downstream capacity issues, eliminating the need for expensive short-term upsizing of local sewers and pumping station upgrades due to capacity constraints. However, upsizing may still be required to service future growth and development. Additionally for the impacted homeowners, the program can reduce the frequency of basement flooding, resulting in fewer insurance claims and lower costs for repairs. On a broader scale, this will improve both public health and environmental protection by minimizing pollution to the Thames River and other receiving streams. However, the main cost drawback may include the need for other stormwater management techniques or ground source infiltration technologies to ensure proper drainage and infiltration. In some areas, the additional wet weather flow could overwhelm the existing storm sewer system, necessitating upgrades or expansion of storm sewer capacity. These further infrastructure improvements may incur additional costs for the City.

It is recommended that the City move forward with the development of a point-of-sale mandatory weeping tile disconnection program as the main strategy to reduce the volume and frequency of wet weather overflows at high-priority locations. The priority area examples, as shown in **Appendix B**, were presented to the City project team and they have indicated interest in implementing the City-wide program.

This *Disconnection Program Analysis Technical Memorandum* will form the basis of further assessment in the *Implementation Plan Technical Memorandum*, which will outline resource requirements and phasing. Additionally, the Implementation Plan will determine the critical steps for Council buy-in and the legality of the by-law, which will need to be discussed internally with the City's legal team.



Appendix A

Town of Tonawanda Meeting Summary and Minutes

Meeting Minutes

Project: City of London PPCP Update Study	Project No.: 2402185-722063	
Meeting: Town of Tonawanda Meeting		
Date: Tuesday, September 10 th , 2024	Time: 12:00pm to 1:00pm	
Location: Microsoft Teams		
Attendees:		
<u>Town of Tonawanda</u> Michael Kessler (MK) Mike Metzger (MM) Noelle Sawicki (SW) Jeff Morris (JM)	<u>City of London</u> Yanzhen Ou (YO) Kyle Chambers (KC) Hagos Eman (HE)	<u>GEI Consultants Canada</u> James Jorgensen (JJ) Jonathan Brickman (JB) Ashley An (AA)

Meeting Minutes
- Sump pump program implemented pre-1998 - Purpose was to eliminate I/I, don't know if by forceful hand
- Inspections process: - Dye testing through building department (1 person) 4-5 per day (30min – 2 hours each) - Use mobile app with survey 123 through ArcGIS, notes all connections and downspouts - Complete report and provide to homeowner - If non-compliant, will need to obtain 3rd party licensed plumber to do remedial work (homeowner can also do the work), just has to meet the code. - Requires a separate electric service for the sump pump. - Installation of sump pump, discharge onto lawn/ green space - Follow-up inspection required - No title transfer until work is done and certificate of compliance of obtained - Certificate is valid for 2 years, and home needs to get re-inspected afterwards if being sold again - There is a fee of 70\$ to purchase certificate - Waiver can also be purchased and returned when remedial work and follow-up inspection is completed - Bank and lawyers to coordinate to hold money in escrow
- Turnover rate: 20-25% of housing stock have been disconnected since program has been implemented - Of the 25% rare to not find something that needs to be disconnected - Approximately 23,500 total residential homes in Town - Town has identified that starter homes have been sold multiple times, while larger homes have been sold at a slower rate - Sump pump program applies to all property types, including condos and commercial properties
- Town currently does a lot of slip lining projects (15-20 per week) - Slip lining ensures owners don't reestablish illegal connections to the sanitary sewer

• Town also does pre and post slip lining flow monitoring • Town has received a lot less complaints and backups since sump pump program implemented. Check valves are very important.
• Funding? ○ The cost of disconnections and installing sump pump are considered part of the cost of selling a home ○ There is a low income program available, but is separate from the sump pump program ○ The NY state law prohibits public resources spent on private land
• Town advice: ○ Spend time understanding how the floor drains are constructed and where sump pumps should be placed to avoid flooding (where the drainage is pitched to). May also need to remove the storm inputs. ○ Prioritize training for workers on site if doing dye testing ○ Ordinances will also need to be updated when codes change ○ Need consistency across departments if they are responsible for any aspect of the program. Work with the building department early on if coordinating with them to issue permits for remedial work ○ Realtors may be the largest pushback against the new program
• Other similar programs: ○ City of Tonawanda, City of Kenmore
Meeting Action Items
Town of Tonawanda to provide standard detail of remedial work
Town of Tonawanda to provide contact information for Eerie County which have recently completed a pilot project to replace the trap
Additional Notes
Further questions can be emailed to Town, and future meetings can be scheduled once further details have been established by the City.



Appendix B

Feasibility Analysis for High-Priority Example Areas

Several high-priority overflow locations that were identified from the *F-5-5 Analysis Tech Memo*, including SD-03 and PM-09 and their associated upstream subcatchments, were selected as examples to conduct priority area exercises. The objective of these exercises was to determine the feasibility of implementing a point-of-sale mandatory weeping tile disconnection program in a localized area and confirm whether the F-5-5 90% compliance capture rate can be achieved. The results, successes and constraints, of the priority area exercises can then be extrapolated to the entire City using GIS technologies and standard assumptions.

B.1 Priority Area 1: SD-03

System overflow SD-03 is part of the Greenway Sewershed, with an overflow volume during the 2018 typical year of 160 m³ and a F-5-5 capture rate of 86%. SD-03 is located on Wellington St. and overflows directly to the South Thames River. Based on the high-priority overflow list, SD-03 is ranked #2, based on percent capture, not including the Pall Mall Overflow System. The upstream subcatchment area is bounded by South Thames River to the south, the VIA railway to the north, Egerton St. to the east, and Connor St. to the west. There is also a small area of contributing parcels within the subcatchment located on South St. between Waterloo St. and Wellington St. A map showing the SD-03 overflow location and upstream subcatchment area can be found on **Figure 6-1**.

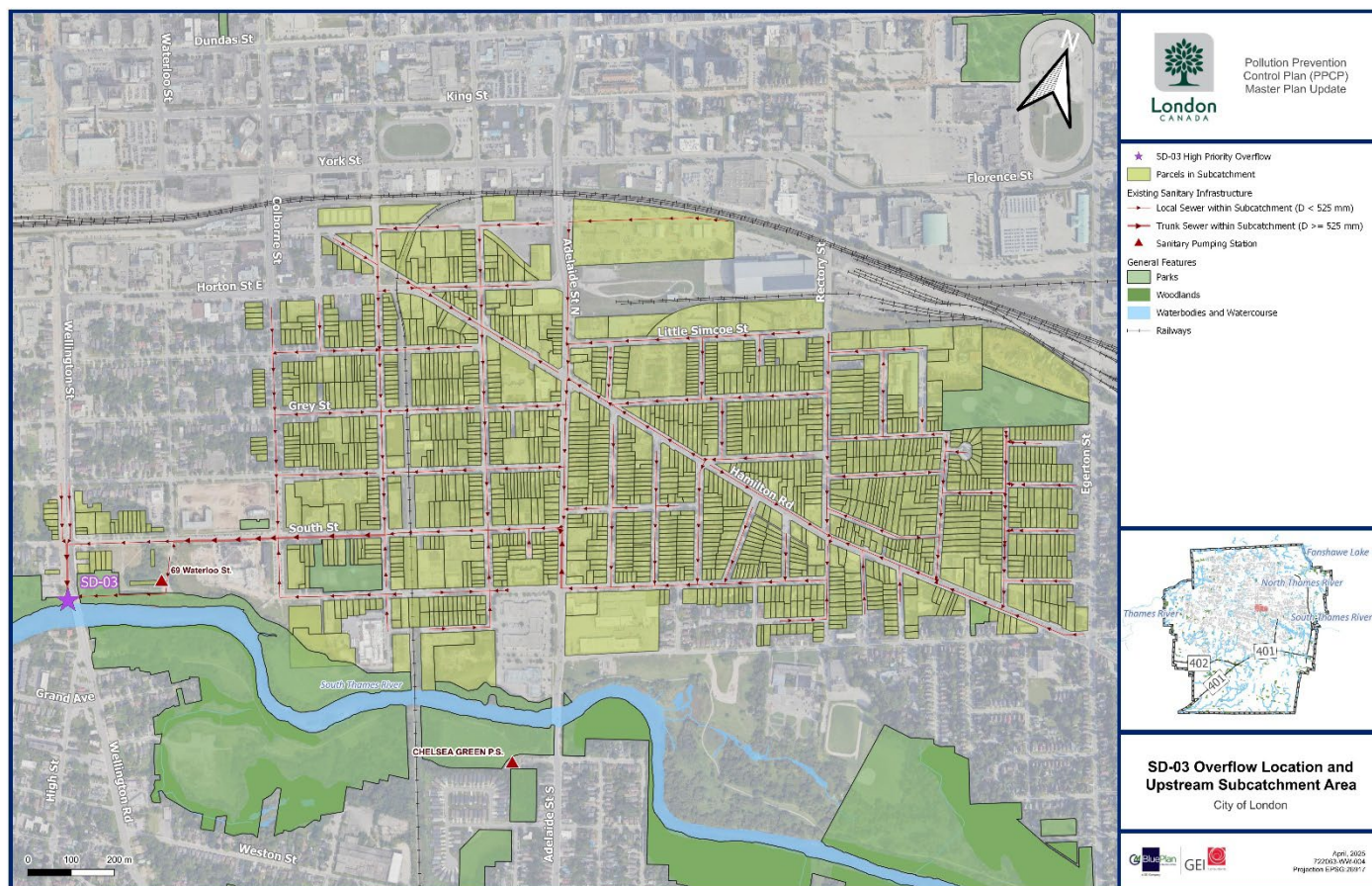


Figure 6-1. SD-03 Overflow Location and Upstream Subcatchment Area

The land use within the upstream subcatchment area of SD-03 is primarily residential, with a few larger industrial, commercial, and institutional (ICI) areas including those surrounding the BMO Centre London to the northwest and south, those surrounding the CNRA Park to the north and northwest, those located southeast of the intersection at Adelaide St. N. and Nelson St., and those located around the intersection at Adelaide St. N. and Hamilton Rd. The following points describe the existing wastewater infrastructure assets within the upstream subcatchment area of SD-03:

- The sanitary sewer system is fully separated from the storm sewer system;
- The local wastewater collection system is comprised of both small and large diameter sewers ranging from 200mm to 450mm;
- The trunk wastewater sewers are considered those greater than 525mm, with the largest in the subcatchment area being 675mm. The trunk sewers are found along a portion of South St. between Colborne St. and Waterloo St., as well as along Wellington St. between South St. towards the overflow location SD-03; and,

- There is one wastewater pumping station east of the overflow location SD-03 located at 69 Waterloo St.

Between 2013 and 2023, 2 residential homes (out of the total 499 throughout the City) within priority area 1 have voluntarily disconnected their weeping tiles and received financial assistance from the City's *Basement Flooding Grant Program*. **Figure 6-2** shows the location of these 2 residential homes, as well as all qualifying residential homes.

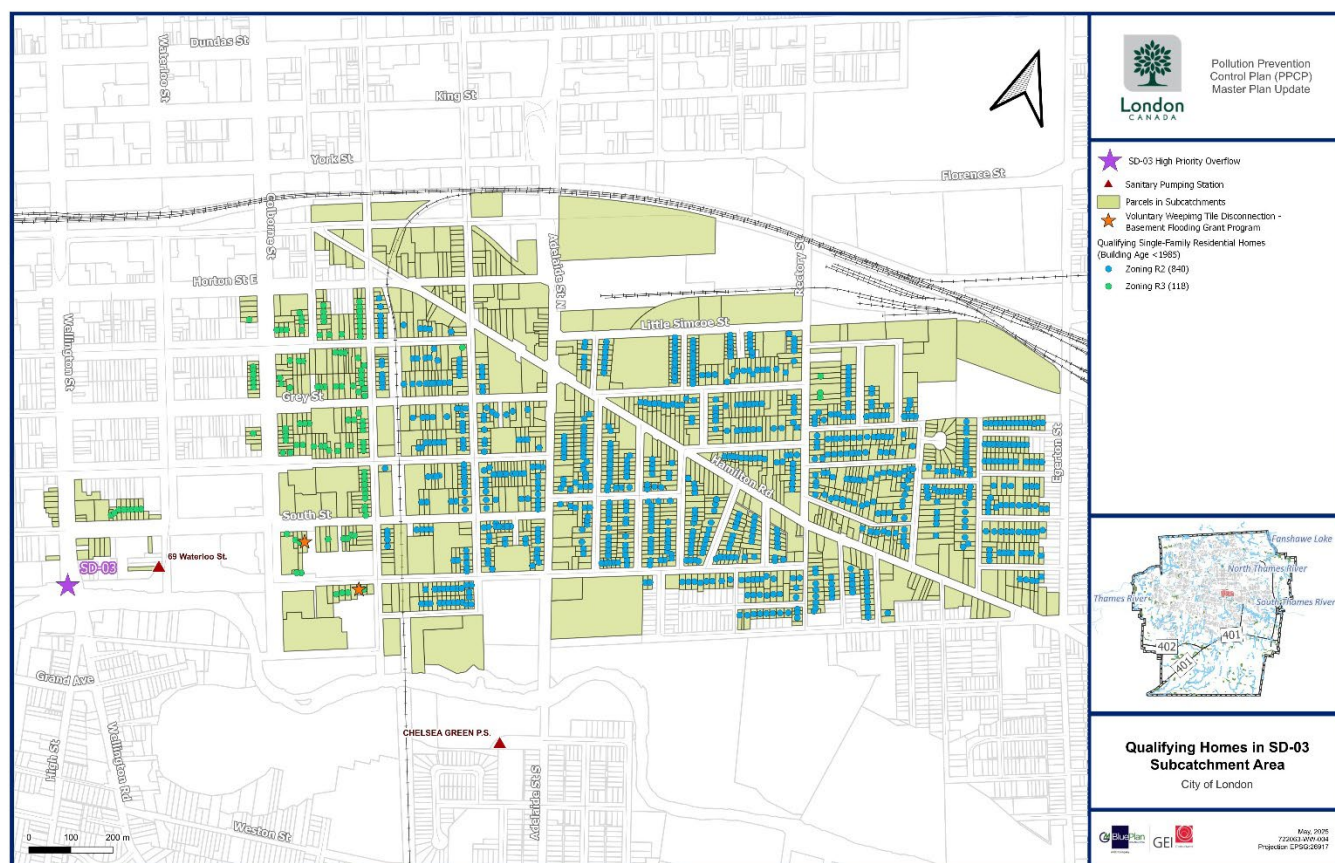


Figure 6-2. Qualifying Homes in SD-03 Subcatchment Area

Based on the available information and using the assumptions described in **Section 4.2**, a total of 958 qualifying residential homes are assumed within the SD-03 upstream catchment area. Further, the number of qualifying residential homes that are required to disconnect their weeping tiles is estimated to be 42 per year. One spill was modelled at the overflow location during the 2018 typical year for a duration of 28.4 minutes, and therefore the minimum and maximum anticipated wet weather reduction volume, as a result of the mandatory point-of-sale program within the priority area 1, is estimated to be 7.2 and 72 m³ per year, respectively. Additionally, it would take approximately 1 year at a minimum or approximately 7 years at a maximum to achieve the F-5-5

90% capture compliance at SD-03. The high-level priority area 1 calculations are shown in **Table 6-1**.

Table 6-1. Priority Area 1 Calculations

	Number of Residential Homes
Total number of parcels in subcatchment	1605
Total number of qualifying residential homes (R1-R3)	958
Connected weeping tiles	$(958 - 2) * 99\% = 947$
Disconnection through voluntary (per year)	$947 * 0.1\% = 1$
Disconnection through mandatory (per year)	$947 * 4.4\% = 42$
	Amount of WW Reduction
Minimum anticipated WW reduction flow rate (per year)	$42 * 0.1 \text{ L/s} = 4.2 \text{ L/s}$
Maximum anticipated WW reduction flow rate (per year)	$42 * 1 \text{ L/s} = 42 \text{ L/s}$
Minimum anticipated WW reduction volume (per year)	$4.2 \text{ L/s} * 28.4 \text{ min} = 7.2 \text{ m}^3$
Maximum anticipated WW reduction volume (per year)	$42 \text{ L/s} * 28.4 \text{ min} = 72 \text{ m}^3$
	F-5-5 90% Capture Compliance
SD-03 2018 typical year total overflow volume	160 m ³
Overflow volume 86% captured	$160 \text{ m}^3 * (86\% / 14\%) = 983 \text{ m}^3$
Overflow volume 10% allowance	$(160 \text{ m}^3 + 983 \text{ m}^3) * 10\% = 114 \text{ m}^3$
Overflow volume 4% compliance capture difference	$160 \text{ m}^3 - 114 \text{ m}^3 = 46 \text{ m}^3$
Minimum number of years to compliance	$46 \text{ m}^3 / 72 \text{ m}^3/\text{yr} = \sim 1 \text{ yrs}$
Maximum number of years to compliance	$46 \text{ m}^3 / 7.2 \text{ m}^3/\text{yr} = \sim 7 \text{ yrs}$

B.2 Priority Area 2: PM-09

Overall, the Pall Mall sanitary overflow system within the Greenway Sewershed was estimated to capture 85% of the volume resulting from wet weather flows. However, of the individual system overflows, PM-09 showed an overflow volume during the 2018 typical year of 7,752 m³ and a F-5-5 capture rate of 78%. PM-09 is located at the intersection of Elizabeth St. and Lorne Ave. and does not overflow directly to a waterbody. Based on the high-priority overflow list, PM-09 is ranked #2, not including the Pall Mall Overflow System. The upstream subcatchment area is generally bounded by the VIA railway to the south, Central Ave. to the north, Lyle St. / Elizabeth St. to the west, and Egerton St./ Dorinda St to the east. A map showing the PM-09 overflow location and upstream subcatchment area can be found on **Figure 6-3**.



Figure 6-3. PM-09 Overflow Location and Upstream Subcatchment Area

The land use within the upstream subcatchment area of PM-09 is primarily residential north of Dundas St. and east of Egerton St. There is a large ICI area associated with the Western Fair District, as well as close to the VIA railway. The following points describe the existing wastewater infrastructure assets within the upstream subcatchment area of PM-09:

- The sanitary sewer system is fully separated from the storm sewer system;
- The local wastewater collection system is comprised of both small and large diameter sewers ranging from 150mm to 450mm. There is also a small section of egg-shaped sewers (500mm x 750mm) along Lorne Ave, immediately before the PM-09 overflow; and,
- There are no wastewater pumping stations.

Between 2013 and 2023, zero residential homes (out of the total 499 throughout the City) within priority area 2 have voluntarily disconnected their weeping tiles. **Figure 6-4** shows all the qualifying residential homes.

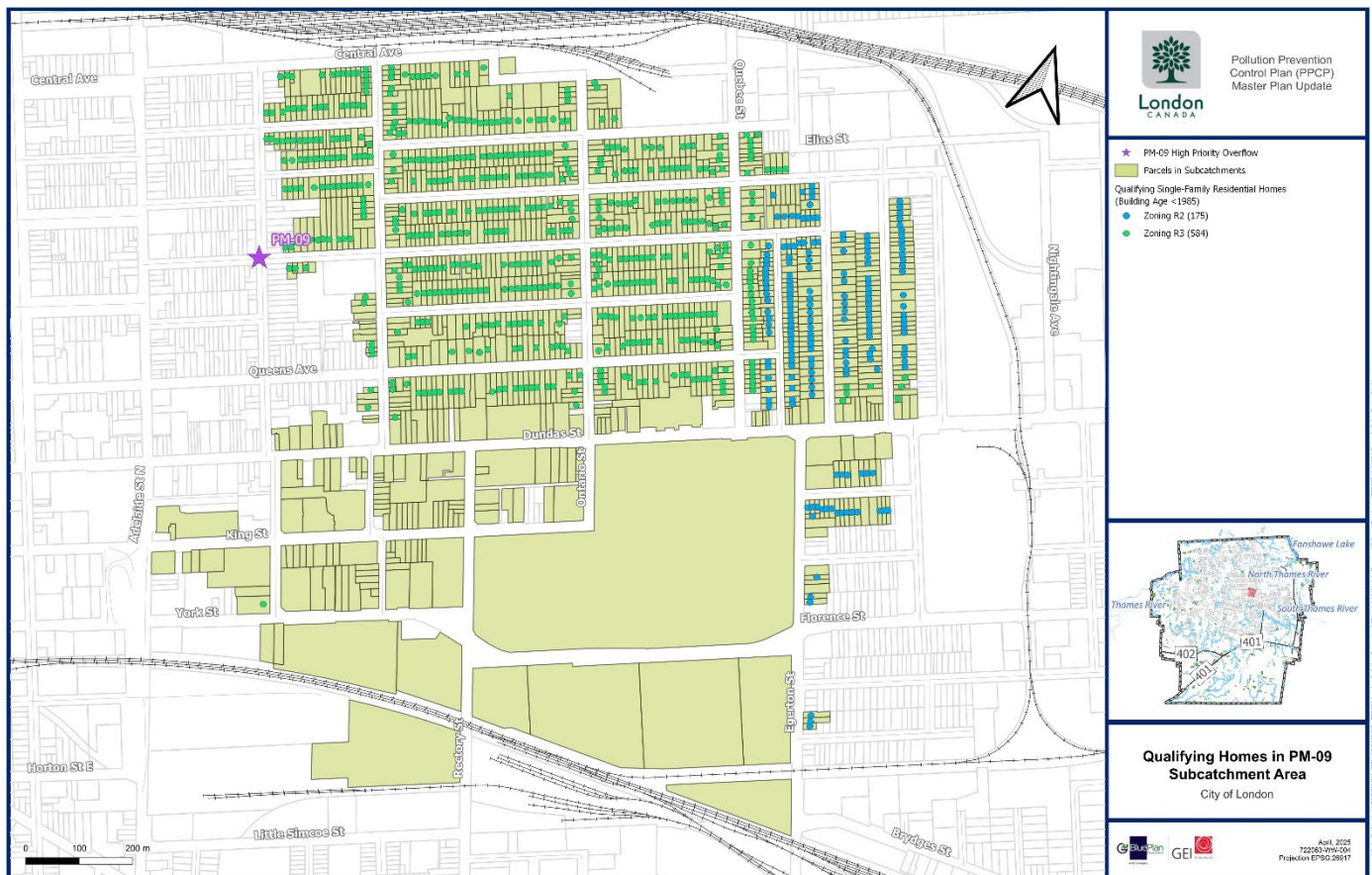


Figure 6-4. Qualifying Homes in PM-09 Subcatchment Area

Based on the available information and using the assumptions described in **Section 4.2**, a total of 759 qualifying residential homes are assumed within the PM-09 upstream catchment area. Further, the number of qualifying residential homes that are required to disconnect their weeping tiles is estimated to be 34 per year. It should be noted that the existing hydraulic model provided by the City is configured inaccurately at this overflow location, resulting in inconclusive spill data, including the number of spills and associated duration. A general spill duration of 1 hour is assumed at PM-09 during the 2018 typical year, and therefore the minimum and maximum anticipated wet weather reduction volume, as a result of the mandatory point-of-sale program within the priority area 2, is estimated to be 12 and 122 m³ per year, respectively. Additionally, it would take approximately 35 years at a minimum or approximately 346 years at a maximum to achieve the F-5-5 90% capture compliance at PM-09. The high-level priority area 2 calculations are shown in **Table 6-2**.

Table 6-2. Priority Area 2 Calculations

	Number of Residential Homes
Total number of parcels in subcatchment	1239
Total number of qualifying residential homes (R1-R3)	759
Connected weeping tiles	759 * 99% = 752
Disconnection through voluntary (per year)	752 * 0.1% = 1

	Number of Residential Homes
Disconnection through mandatory (per year)	$752 * 4.4\% = 34$
	Amount of WW Reduction
Minimum anticipated WW reduction flow rate (per year)	$34 * 0.1 \text{ L/s} = 3.4 \text{ L/s}$
Maximum anticipated WW reduction flow rate (per year)	$34 * 1 \text{ L/s} = 34 \text{ L/s}$
Minimum anticipated WW reduction volume (per year)	$3.4 \text{ L/s} * 60 \text{ min} = 12 \text{ m}^3$
Maximum anticipated WW reduction volume (per year)	$34 \text{ L/s} * 60 \text{ min} = 122 \text{ m}^3$
	F-5-5 90% Capture Compliance
PM-09 2018 typical year total overflow volume	$7,752 \text{ m}^3$
Overflow volume 78% captured	$7,752 \text{ m}^3 * (78\% / 22\%) = 27,484 \text{ m}^3$
Overflow volume 10% allowance	$(7,752 \text{ m}^3 + 27,484 \text{ m}^3) * 10\% = 3,524 \text{ m}^3$
Overflow volume 12% compliance capture difference	$7,752 \text{ m}^3 - 3,524 \text{ m}^3 = 4,228 \text{ m}^3$
Minimum number of years to compliance	$4,228 \text{ m}^3 / 122 \text{ m}^3/\text{yr} = \sim 35 \text{ yrs}$
Maximum number of years to compliance	$4,228 \text{ m}^3 / 12 \text{ m}^3/\text{yr} = \sim 353 \text{ yrs}$