Appendix C Tech Memo #2: MECP Procedure F-5-5 Analysis

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

F-5-5 Analysis Tech Memo

Prepared by GEI Consultants Canada (Formerly GM BluePlan Engineering)

Project No. 722063

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Version Updates

The following is a record of the changes/updates that have occurred on this document:

Version	Changes / Updates	Author	Reviewer	Date
1	1st Draft	Jonathan Brickman	James Jorgensen	July 18th, 2024
	Reviewed by City	-	City of London	September 6th, 2024
2	2nd Draft	Jonathan Brickman	James Jorgensen	December 3rd, 2024
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3	3rd Draft	Jonathan Brickman	James Jorgensen	January 28th, 2025
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6	Updated Final Version	Jonathan Brickman	James Jorgensen	June 10th, 2025

1. Introduction

Procedure F-5-5 is a supporting document for the Ministry of Environment, Conservation, and Parks (MECP) Guideline F-5 "Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters". The goals of this Procedure are to:

a) eliminate the occurrence of dry weather overflows;
b) minimize the potential for impacts on human health and aquatic life resulting from combined sewer overflows (CSOs); and
c) achieve as a minimum, compliance with body contact recreational water quality objectives (Provincial Water Quality Objectives (PWQO) for Escherichia coli (E. coli)) at beaches impacted by CSOs for at least 95% of the four-month period (June 1 to September 30) for an average year.

To comply with the procedure the City's wastewater system should, during a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. Additional controls are required for bathing beaches or receiving waters subject to specific local circumstances that may require enhanced controls.

It is understood that a primary directive for the City of London (City) is to manage the extraneous flows in the wastewater system and the associated overflows to the environment when the system is overwhelmed. To ensure the long-term efficiency of the wastewater system and to limit the volume and frequency of occurrence of untreated discharges, the City will need to adhere to Ontario's treatment requirements through a Pollution Prevention Control Plan (PPCP) Update Study.

An existing F-5-5 analysis will estimate the capture and treatment rate of wet weather flows during the seven month period between April to November for an average year. According to MECP, an average year of rainfall refers to "a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area". This volumetric control criterion is applied to the flows collected by the system immediately above each overflow location.

MECP clearly states in its guidance for PPCP development that characterization of the combined sewer system (CSS) is required, and that "Monitoring, modelling and other appropriate means shall be used to characterize the CSS and the response of the CSS to precipitation events." Because of the large number of overflow locations within the City's wastewater collection system, it is not feasible from a cost perspective to monitor each overflow site in real time; instead, the City relies on using an updated and accurate all-pipe hydraulic model of its wastewater system to characterize its CSS and report on whether F-5-5 targets are being achieved.

Ultimately, a list of priority overflow locations within the City were identified based on most negative impact and greatest potential to improve the system's overall performance. As part of the PPCP Update Study, alternative strategies will be developed in a separate technical memorandum that will evaluate how these priority overflows can be eliminated or mitigated.

1.1 Aims and Objectives

The aim of this technical memorandum is to assess the performance of sewer overflows (sanitary and combined) in comparison to the F-5-5 criterion to assess if the City's existing wastewater system is compliant with Guideline F-5.

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

- Update and re-run the InfoWorks ICM hydraulic model using the newly selected 2018 typical year rainfall series (Typical Year Selection Technical Memorandum is an appendix to the PPCP report);
- Review overflow statistics reported from the City's real-time SCADA (supervisory control and data acquisition) system for wastewater treatment plant bypasses and pumping station overflows;
- Estimate the % capture rate of wet weather flows in the collection system at all overflow locations; and
- Identify priority overflow locations based on their estimated discharge volume, percent capture of wet weather flow volume, and receiving watercourse status (impaired vs. unimpaired) between April to November in the 2018 typical rainfall year.

2. Treatment Requirements

The MECP Guideline F-5 *"Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters"* provides guidance to municipalities on the expected level of treatment for separate sanitary, partially separated and combined sewer systems. The relevant Procedures, as supporting documents to the Guidelines, are further described below.

2.1 Procedure F-5-5

"Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems"

Procedure F-5-5 is normally applied to partially separated and combined sewer systems and allows for additional Combined Sewer Overflow (CSO) controls where there is a demonstrated impact on human health and aquatic life. It is important to note that the Procedure F-5-5 requires 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, starting within 15 days of April 1. Additional requirements are depicted in **Figure 2-1.**

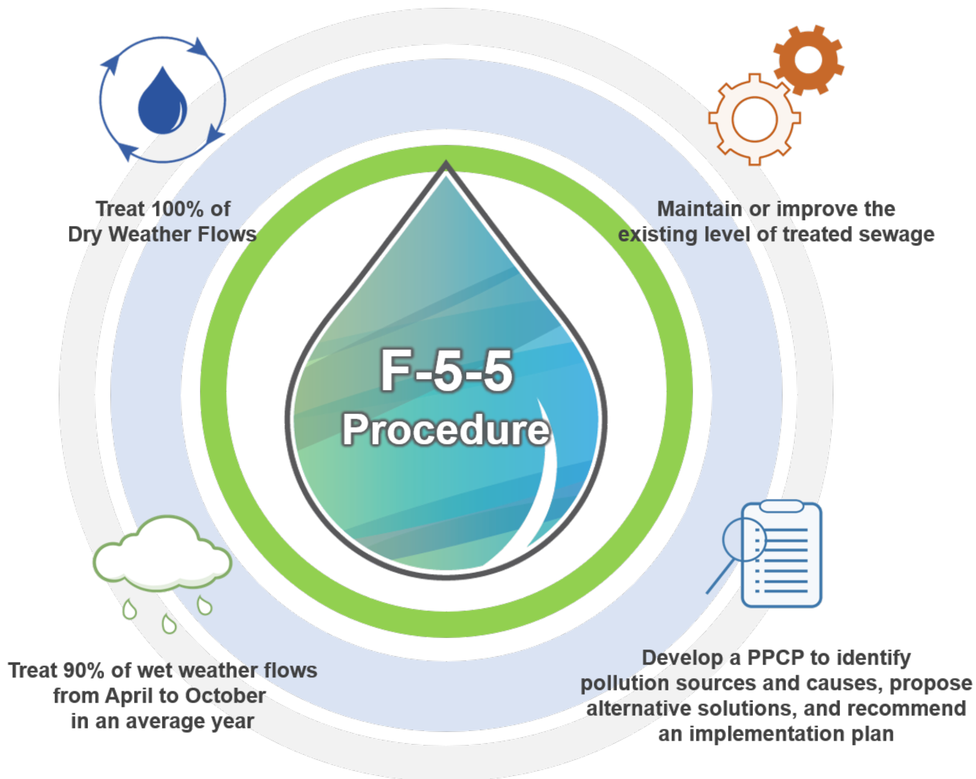

Figure 2-1: Procedure F-5-5 Requirements

The site-specific nature and impacts of CSOs are recognized in this Procedure, and there is flexibility for selecting controls for local situations.

3. Hydraulic Model Updates

This component of the project included a review of recently completed sewer related projects and a review of system performance (overflow frequency and total volume). Where indicated by the City, GEI incorporated recently constructed sewer infrastructure information into the model, specifically in the Greenway sewershed model where important sewer separation and replacement work has recently been completed. Updates were also made to the model's subcatchments in select locations upstream of recently completed sewer separation work to better represent post-separation system connectivity and runoff conditions.

The InfoWorks ICM hydraulic model was reviewed to verify whether it provided an adequate representation of the City's wastewater system and confirm its suitability for the PPCP as an accurate analysis tool. Through GEI's review of the updated hydraulic model results, some discrepancies were discovered in the existing conditions model which created the need for a modified approach to the F-5-5 analysis (discussed further in **Section 4.3**).

3.1 Capital Projects

Several recently completed capital projects were updated in the Greenway and Vauxhall models. These projects included combined sewer separation projects, construction of new sewers, and replacement of existing sewers. These projects were sourced from the City's latest geographic information system (GIS) data and model updates were made as necessary, with input provided by the City to confirm topological accuracy.

3.2 Typical Year Rainfall

Selecting an average or "typical" rainfall year which is representative of long-term precipitation patterns sets up a transparent and repeatable framework for analysis of overflows. The previous PPCP used 2010 as the typical year; for this PPCP update a typical year assessment was completed.

Based on long-term precipitation trends over the last ten (10) years, the Oxford Wastewater Treatment Plant (WWTP) rain gauge was chosen for the typical year rainfall assessment due to its overall data completeness. Based on the results of the assessment, 2018 was selected to be the typical year as it closely matched the average number of rainfall events, the average total rainfall depth, and the average peak rainfall intensities, per year using data between April to November for all years over the 22-year period (2001 to 2022). Additional information regarding the selection methodology can be found in the *"Typical Year Rainfall Analysis Review and Update"* Technical Memorandum.

It is noted that changes to the modelled overflow statistics compared to the previous PPCP are expected with the adoption of a new typical year rainfall.

4. Overflow Assessment

A combination of SCADA data and hydraulic model outputs were assessed to estimate the total number of overflows during the typical year of rainfall and the total annual volume of overflow discharges for each facility.

As part of this assessment, an estimated percent capture rate was calculated which indicates the proportion of total wet weather flow which was retained within the wastewater collection system for the typical year of rainfall. A minimum 90% capture rate is required for each facility to be considered compliant with F-5-5 requirements.

To address the impact of overflows, each overflow location was reviewed to characterize its specific frequency, volume, and contribution of pollutants. The overflows were prioritized based on most negative impact and greatest potential to improve the system's overall performance.

4.1 Location of Overflows

A total of 128 sanitary/combined overflows were identified across the City's wastewater collection system. Note that since the 2018 Phase 3 PPCP, 3 overflows were newly identified, and 14 overflows were entirely removed through sewer system improvements. These overflows are grouped by their general locations within the five sewersheds: Adelaide WWTP, Greenway WWTP, Oxford WWTP, Pottersburg WWTP, and Vauxhall WWTP. The locations of these overflow facilities are shown in **Figure 4-1**:

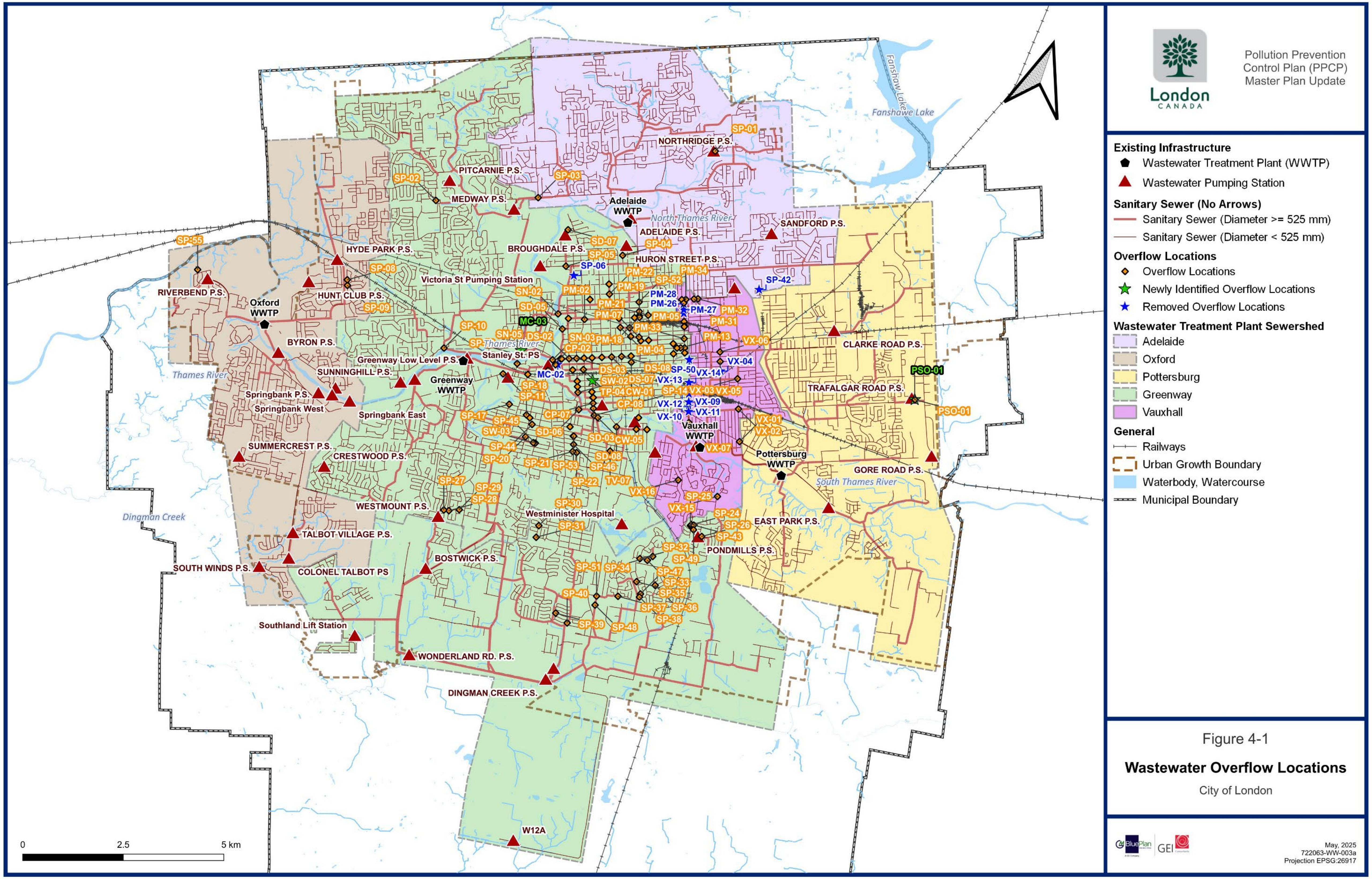

Figure 4-1: Wastewater overflow locations

Overflows within the City's sewer system are each classified as one of three types: Wastewater Treatment Plant Overflow/Bypass (reported using SCADA data), Sanitary Pumping Station Overflow (reported using SCADA data), or Collection System Overflow (reported using hydraulic model). These three overflow types are summarized in **Table 4-1**:

Table 4-1: F-5-5 Overflow Reporting Sources

Overflow Type	Reporting Source	Number of Facilities
Wastewater Treatment Plant Overflow/Bypass	SCADA	5
Sanitary Pumping Station Overflow	SCADA	35
Collection System Overflow	Hydraulic Model	128
	Total:	**168**

4.2 Characterization of Overflows (WWTP and PS Bypasses)

The City tracks overflows at its Wastewater Treatment Plant (WWTP) and Pumping Station (PS) facilities using recorded SCADA data. The City completed an internal analysis of each of its WWTP and PS facilities which demonstrated bypasses from April 1 to October 31, 2018. For each of these facilities, the number of bypasses, total annual bypass volume, system percent capture (excluding and including plant bypass) was calculated in addition to identifying the receiving stream and receiving stream rating. The results of this analysis are presented for WWTP and PS facilities in **Table 4-2** and **Table 4-3**, respectively.

It is noted that the F-5-5 percent capture rate for Dingman PS is unavailable due to low-quality inflow monitoring data. However, despite the unavailability of this calculation, Dingman PS will be considered a high-priority overflow site due to the significant number of BioMAP impaired sampling results in Dingman Creek, as well as the total recorded volume of overflow.

Table 4-2: Overflow reporting for WWTP facilities (2018 typical year)

WWTP	No. of Bypasses During the Typical Year	Raw Bypass Volume (m^3) During Typical Year (A)	Raw and Secondary Bypass Volume (m^3) During Typical Year	F-5-5 Percent Capture of Raw Bypass	F-5-5 Percent Capture of Raw and Secondary Bypass	Receiving Stream	Thames River Reach	Receiving Stream Rating
Greenway WWTP	2	322	2,801	100%	98.10%	Thames R. Main	Reach 7	Unimpaired/ Transitional
Pottersburg WWTP	2	18,419	18,419	90.70%	90.70%	South Thames R.	Reach 1	Unimpaired
Vauxhall WWTP	2	226	1,548	99.90%	99.10%	South Thames R.	Reach 3	Unimpaired
Adelaide WWTP	1	0	21,667	100%	89.10%	North Thames R.	Reach 4	Unimpaired
Oxford WWTP	0	0	0	100%	100%	Thames R. Main	Reach 9	Transitional

Table 4-3: Overflow reporting for PS facilities (2018 typical year)

PS	Sewershed	No. of Overflows During the Typical Year	Overflow Volume (m^3) During Typical Year	F-5-5 Percent Capture	Ultimate Receiving Stream	Thames River Reach	Receiving Stream Rating
Berkshire	Greenway	2	24	99.99%	Thames R. Main	Reach 7	Unimpaired/ Transitional
Medway	Greenway	2	478	99.96%	Midway Creek	N/A [a]	Unimpaired
Dingman	Greenway	1	37635	N/A[b]	Dingman Creek	N/A [a]	Impaired

[a] *The initial receiving stream is not part of the Thames River.*
[b] *Missing total flow information.*

A detailed overview of how the City assessed long-term rainfall trends and determined a revised typical year of rainfall for the purposes of F-5-5 analysis can be found in the *Typical Year Rainfall Analysis Review and Update* technical memorandum.

Based on actual recorded SCADA data, Pottersburg WWTP, Adelaide WWTP, and Dingman PS demonstrated a greater overflow volume during the smaller April 15th, 2018 event than for the larger April 7th, 2010 rainfall event. The April 10th, 2010 rainfall event showed a peak 5-minute intensity of 33 mm/hr, a total rainfall depth of 52 mm, and total rainfall duration of 3 days and 16 hours (Argyle Arena rain gauge). The April 15th, 2018 rainfall event showed a peak 5-minute intensity of 72 mm/hr, a total rainfall depth of 50 mm, and total rainfall duration of 1 day and 21 hours (Dundas Library rain gauge).

While larger rainfall events do generally result in greater runoff and higher peak wastewater flow rates in the sewer system, there are several complex factors that influence this relationship and in particular how rainfall magnitude correlates with overflow magnitude. In addition to rainfall, temperature can significantly affect runoff through the rate of snowmelt in the late winter and spring months. While the F-5-5 reporting period is limited to the April-October period to account for this, the effects of climate change have resulted in irregular long-term temperature conditions which have in some cases delayed/prolonged snow melt cycles and affected rates of evaporation and soil drying time; both of which can have an impact on antecedent catchment conditions and runoff during rainfall, particularly during rainfall events which have multiple intensity peaks where the catchment does not have sufficient time to return to dry weather conditions between peaks.

A high level review of historic weather data from Environment Canada showed that the 7-day antecedent weather conditions leading up to the April 7th, 2010 event had minimal antecedent rainfall (1mm total), whereas the April 15th, 2018 event was preceded by significant 7-day antecedent rainfall (20mm). It is suspected that the higher antecedent rainfall conditions preceding the April 15th, 2018 rainfall event resulted in more saturated soil, increased runoff, and higher resulting peak wet weather flows in the sewer system which caused a greater overall overflow volume at Pottersburg WWTP, Adelaide WWTP, and Dingman PS.

4.3 Characterization of Overflows (System Overflows)

While bypasses from the City's Wastewater Treatment Plants and Pumping Stations are reported and assessed using real-world observed SCADA data for the typical year, the City reports and assesses the frequency and volume of its collection system overflows using an all-pipe hydraulic wastewater model built using InfoWorks ICM software. The City's model was provided and used to assess system performance.

4.3.1 Greenway Sewershed Overflow Reporting Approach

Area-specific updates were made to the Greenway sewershed model network, based on information provided by the City. Updates included the modelling of new sanitary sewers, replacement of existing sanitary sewers, and combined sewer separation projects in the downtown area. After these updates were made the model was not recalibrated and therefore estimates of runoff flow reduction were applied. The combined sewer separation projects were represented in the hydraulic model using an assumed wet weather flow reduction rate of 50% in the downtown area, to represent a reasonable but conservative reduction in wet weather flow due to the recently completed downtown sewer separation work. This was achieved by reducing the contributing area of all subcatchments tributary to the separated sewer network by 50%.

Through a review of the typical year (2018) rainfall simulation results from the Greenway sewershed model, it was discovered that subcatchment attributes in several areas of the modelled sewershed were not set up entirely accurately, which resulted in unusual results for modelled flow rates, overflow volumes, and overflow frequencies at numerous overflow facilities in the Greenway model network. These model issues are likely a result of the complicated process to re-combine the previously separate hydraulic models representing the various assignment-specific model networks developed through previous wastewater studies.

To complete the F-5-5 analysis for the Greenway sewershed, the following methodology was applied:

1. Review the F-5-5 overflow statistics from the previous PPCP (2010 typical year) for system overflow locations within the Greenway sewershed;
2. Carry forward the previous F-5-5 overflow statistics (2010 typical year) as representative of overflow statistics for the 2018 typical year;
3. For downtown overflow facilities affected by upstream combined sewer separation work, compare the hydraulic model results for overflows pre- and post-separation using a significant rainfall event which would stress the City's sewer system (a 1-in-10-year design storm was used) to calculate the percent increase or reduction in overflow volume for this single rainfall event; and,
4. Apply the calculated percent change in overflow volume for the single design storm event to the annual overflow volume from the previous PPCP (using 2010 as the typical year).

An example of this methodology being applied for a hypothetical overflow facility is shown below:

- Downtown overflow facility SN-03, which underwent upstream combined sewer separation work, had a total annual overflow volume of 319 m^3 in the previous PPCP (2010 typical year rainfall).
- For a 1-in-10-year design storm, the hydraulic model showed a pre-separation overflow volume of 2,077 m^3 and a post-separation overflow volume of 1,957 m^3, for a 5.8% volumetric reduction.
- By applying this same 5.8% reduction factor to the typical year rainfall simulation results, the new total annual overflow volume for SN-03 would be estimated to be 300 m^3.

System overflow results for the remaining four sewersheds (Pottersburg, Vauxhall, Adelaide, and Oxford) were completed using the hydraulic model results for the 2018 typical year of rainfall as the model was deemed accurate in these locations.

4.3.2 Newly Identified or Relocated System Overflows

Some new system overflows (SSOs) have been identified or installed within the City's sewer system or relocated from an existing site. These newly identified or relocated overflow facilities are summarized in **Table 4-4**. It should be noted that because the previous 2018 PPCP model results have been carried forward for the Greenway sewershed, estimates of overflow frequency and volume at some of the newly identified SSOs listed in **Table 4-4** were not available as they were not represented in the previous model. Relocated SSOs (CW-06, SP-58) are reported in **Table 4-6** using the previous model results at their original nearby location, and the newly added SSO TP-04 is also reported using the current model results.

Table 4-4: Newly Identified or Relocated SSOs

System Overflow	Year	Newly Identified or Relocated	Reason for Identification or Relocation
TP-04	2019	Relocated	TP-04 was temporarily installed to replace the York Street overflow site CW-04.
SP-58	2018	Relocated	SP-58 was installed to replace the Cavendish Crescent overflow site SD-01.
CW-06	2019	Relocated	CW-06 was installed to replace the York Street overflow site CW-03.
SP-57	-	Identified in 2018 PPCP report	SP-57 has been active since 1987 and was installed to relieve a 1200mm high-level trunk sewer. SP-57 was identified in the previous PPCP commencement and has been assessed in subsequent modelling assignments.
PSO-01	1979	Newly Identified	Newly identified overflow pipe for the Trafalgar pumping station. The facility has been in service since 1980.
MC-03	-	Newly Identified	Newly identified overflow located east of the intersection at Wyatt Street and Cavendish Crescent.

4.3.3 Removed and Relocated System Overflows

Several of the City's system overflows (SSOs) have been removed or relocated elsewhere in the system since the previous PPCP. These removed or relocated overflow facilities are summarized in **Table 4-5**.

Table 4-5: Removed and Relocated SSOs

System Overflow	Year	Removed or Relocated	Reason for Removal or Relocation
CW-04	2018	Removed and Relocated	Removed as part of the York Street Sewer Separation Phase 1 project, completed in 2018. A new overflow, TP-04, was installed nearby for basement flooding protection.

System Overflow	Year	Removed or Relocated	Reason for Removal or Relocation
SD-01	2019	Removed and Relocated	Removed as part of the Cavendish Phase 1 project, completed in 2018. A new overflow, SP-58, was installed nearby for basement flooding protection.
CW-03	2019	Removed and Relocated	Removed as part of the York Street Sewer Separation Phase 2 project, completed in 2019. A new overflow, CW-06, was installed nearby for basement flooding protection.
VX-10	2019	Removed	Egerton Sewer system was redesigned; overflows deemed no longer necessary.
VX-11	2019	Removed	
VX-12	2019	Removed	
VX-13	2019	Removed	
VX-14	2019	Removed	
SP-42	2020	Removed	Flow monitor and model analyses showed overflow was inactive; overflow removed in 2020 during reconstruction of Roehampton Avenue.
MC-02	2020	Removed	MC-02 was an overflow from the storm sewer into the sanitary sewer system; removed in 2020 to minimize stormwater entering the sanitary sewer system.
SP-06	2018	Removed	Removed as part of infrastructure renewal project.
SP-50	2018	Removed	Egerton Sewer system was redesigned; overflows deemed no longer necessary.
VX-04	2016	Removed	Sanitary sewers on Ashland Ave were reconfigured in 2017, and overflow VX-04 was removed.
VX-09	2021	Removed	Egerton Sewer system was redesigned; overflows deemed no longer necessary.
PM-26	2023	Removed	Quebec Street was reconstructed in 2023 from Oxford Street East to the CP rail yard. Based on hydraulic analysis during design phase, only PM-25 (which was relocated) and PM-29 (which remained in-place) were recommended to remain active while PM-26, PM-27, and PM-28 were removed during construction.
PM-27	2023	Removed	
PM-28	2023	Removed	

Table 4-6 presents the results of the F-5-5 analysis completed for system overflows throughout the City's wastewater collection system, following the methodology detailed above for the Greenway sewershed. Only system overflows which showed at least one (1) overflow event for the 2018 typical year simulation have been included in this analysis.

It should be noted that the newly identified system overflows PSO-01 and SP-57 do not appear in **Table 4-6** as they did not exhibit any discharges for the 2018 typical year of rainfall in the hydraulic model. Relocated system overflows CW-06 and SP-58 are included in **Table 4-6** as they showed overflow discharges for the 2018 typical year of rainfall in the hydraulic model.

Table 4-6: Overflow reporting for system overflow facilities (2018 typical year)

Sewershed	Overflow Group	System Overflow	Location (Nearest Intersection)	Overflow Occurred in Previous PPCP	Overflow Volume (m^3), Typical Year (2018)	F-5-5 % Capture	BioMAP Receiving WQ Rating
Greenway	-	CP-09	Edward St. and Tecumseh Ave E.	Yes	322	99%	Impaired
Greenway	-	CW-05	Wellington Rd. and Grand Ave.	Yes	25	100%	Unimpaired
Greenway		CW-06 (replaced CW-03)	York St. and Richmond St.	No	384	100%	Unimpaired
Greenway	-	MC-01	Richmond St. and Horton St E.	Yes	2	100%	Unimpaired
Greenway	Pall Mall System	PM-01	Talbot St. and Mill St.	Yes	22	100%	Unimpaired
Greenway	Pall Mall System	PM-02	Richmond St. and Pall Mall St.	Yes	10,322	83%	Unimpaired
Greenway	Pall Mall System	PM-03	Maitland St. and Pall Mall St.	Yes	1,397	97%	Unimpaired
Greenway	Pall Mall System	PM-05	William St. and Central Ave.	Yes	2	100%	Unimpaired
Greenway	Pall Mall System	PM-06	William St. and Princess Ave.	Yes	126	100%	Unimpaired
Greenway	Pall Mall System	PM-09	Elizabeth St. and Lorne Ave.	Yes	7,752	78%	Unimpaired
Greenway	Pall Mall System	PM-11	Ontario St. and Dufferin Ave.	Yes	66	100%	Unimpaired
Greenway	Pall Mall System	PM-12	Ontario St. and Queens Ave.	Yes	4	100%	Unimpaired
Greenway	Pall Mall System	PM-15	Quebec St. and Dundas St.	Yes	259	97%	Unimpaired
Greenway	Pall Mall System	PM-19	Adelaide St N. and McMahen St.	Yes	58	98%	Unimpaired
Greenway	Pall Mall System	PM-20	Adelaide St N. and Piccadilly St.	Yes	11	99%	Unimpaired
Vauxhall	Pall Mall System	PM-25	Quebec St. and Salisbury St.	Yes	12	100%	Unimpaired
Greenway	-	SD-03	Wellington St. and South St.	Yes	160	86%	Unimpaired
Greenway	-	SD-05	Ridout St N. and Blackfriars St.	Yes	2,460	96%	Unimpaired
Greenway	-	SD-08	Trevithen St. and Weston St.	Yes	606	98%	Unimpaired
Greenway	-	SN-03	Thames St. and Dundas St.	Yes	300	100%	Unimpaired
Greenway	-	SN-05	Riverview Ave. and Evergreen Ave.	Yes	3,373	85%	Unimpaired
Greenway	-	SP-07	Ontario St. and Dundas St.	Yes	51	16%[2]	Unimpaired
Greenway	-	SP-12	Richmond St. and Simcoe St.	Yes	305	99%	Unimpaired
Greenway	-	SP-14	Adelaide St N. and South St.	Yes	78	99%	Unimpaired
Greenway	-	SP-19	Belgrave Ave. and Windsor Ave.	Yes	322	97%	Unimpaired
Greenway	-	SP-45	Carthcart St. and Devonshire Ave.	Yes	146	98%	Impaired
Greenway	-	SP-46	Belgrave Ave. and Emery St E.	Yes	261	99%	Unimpaired
Greenway	-	SP-53	Belgrave Ave. and Windsor Ave.	Yes	208	N/A[1]	Unimpaired
Greenway	-	SP-54	Belgrave Ave. and McKenzie Ave.	Yes	178	N/A[1]	Unimpaired
Greenway	-	SP-58 (replaced SD-01)	Cavendish Cres. toward river	Yes	6,174	95%	Unimpaired
Greenway	-	SW-01	Thames St. and King St.	Yes	38,842	87%	Unimpaired
Greenway	-	SW-02	Richmond St. and Grey St.	Yes	157	99%	Unimpaired
Greenway	-	SW-03	Cathcart St. and Devonshire Ave.	Yes	5	100%	Impaired
Greenway	-	TP-04 (temporarily replaced CW-04)	York St. and Clarence St.	No	672	100%	Unimpaired

[1] Overflows SP-53 and SP-54 did not have available F-5-5 capture rates through the previous PPCP study; these capture rates remain unavailable for the current PPCP Study as the F-5-5 analysis for the Greenway is based on the previously hydraulic model.
[2] Overflow SP-07 showed a very low percent capture rate through the previous PPCP study.

4.3.4 Pall Mall Overflow System Grouping

The Pall Mall sewer overflow system is a unique feature of the City of London's wastewater collection system that involves a series of unique system overflow sites in the downtown London area. These overflow sites all discharge to a common relief sewer, which ultimately discharges to the Thames River. While these system overflows will discharge independently of each other depending on the hydraulic conditions of the sanitary sewer network and the degree of surcharging at various locations within the network, these overflow sites essentially behave as one large system overflow facility as they all provide hydraulic relief to the same portion of sanitary sewer network. For example, raising the overflow level at one location would reduce overflows there but would increase overflows at another location, without changing the overall total overflow volume. Therefore, it is not accurate to assess to overflows, and subsequent solution alternatives, on an individual site basis. For this reason, the City identified an opportunity to group the Pall Mall overflow sites together for reporting purposes. The locations of the Pall Mall overflow sites are shown in **Figure 4-2**.

Using the hydraulic model results, the total overflow volume from the Pall Mall system was compared to the total wet weather flow volume for the 7-month period beginning April 1st and ending October 31st for the typical year of rainfall (2018).

The overflow volumes reported in **Table 4-6** were again used here to calculate the total overflow volume from the entire Pall Mall system. The City's existing conditions hydraulic model was used to estimate the total dry weather-only and wet weather-only flow volume for the April to October 2018 period. The difference between the total dry and wet weather flow volume represents the total volume of rainfall-derived inflow and infiltration (RDII); the total overflow volume from the Pall Mall system divided by the total RDII volume allowed for the estimation of total % capture. The results of this analysis are shown in **Table 4-7**:

Table 4-7: Pall Mall System Overflow Grouping Analysis (April to October 2018)

System	Total Dry Weather Flow (m^3)	Total Rainfall-Derived Inflow & Infiltration (m^3)	Total Wastewater Flow (not including overflows, m^3)	Total Wastewater Flow (including overflows, m^3)	Total Overflow Volume (m^3) from Pall Mall System	% Capture
Pall Mall	3,855,513	132,160	3,987,673	4,007,703	20,030	85%

Overall, the Pall Mall sanitary overflow system was estimated to capture 85% of the volume resulting from wet weather flows. Of the individual overflow facilities within this system, only the two largest overflow sites (PM-02 and PM-09) showed capture rates less than 90% which did not satisfy Procedure F-5-5 requirements (83% capture and 78% capture, respectively). As the overall system does not achieve the 90% capture requirement per Procedure F-5-5, the Pall Mall sanitary overflow system will be treated as a high priority overflow requiring further mitigative measures to reduce annual overflow volumes.

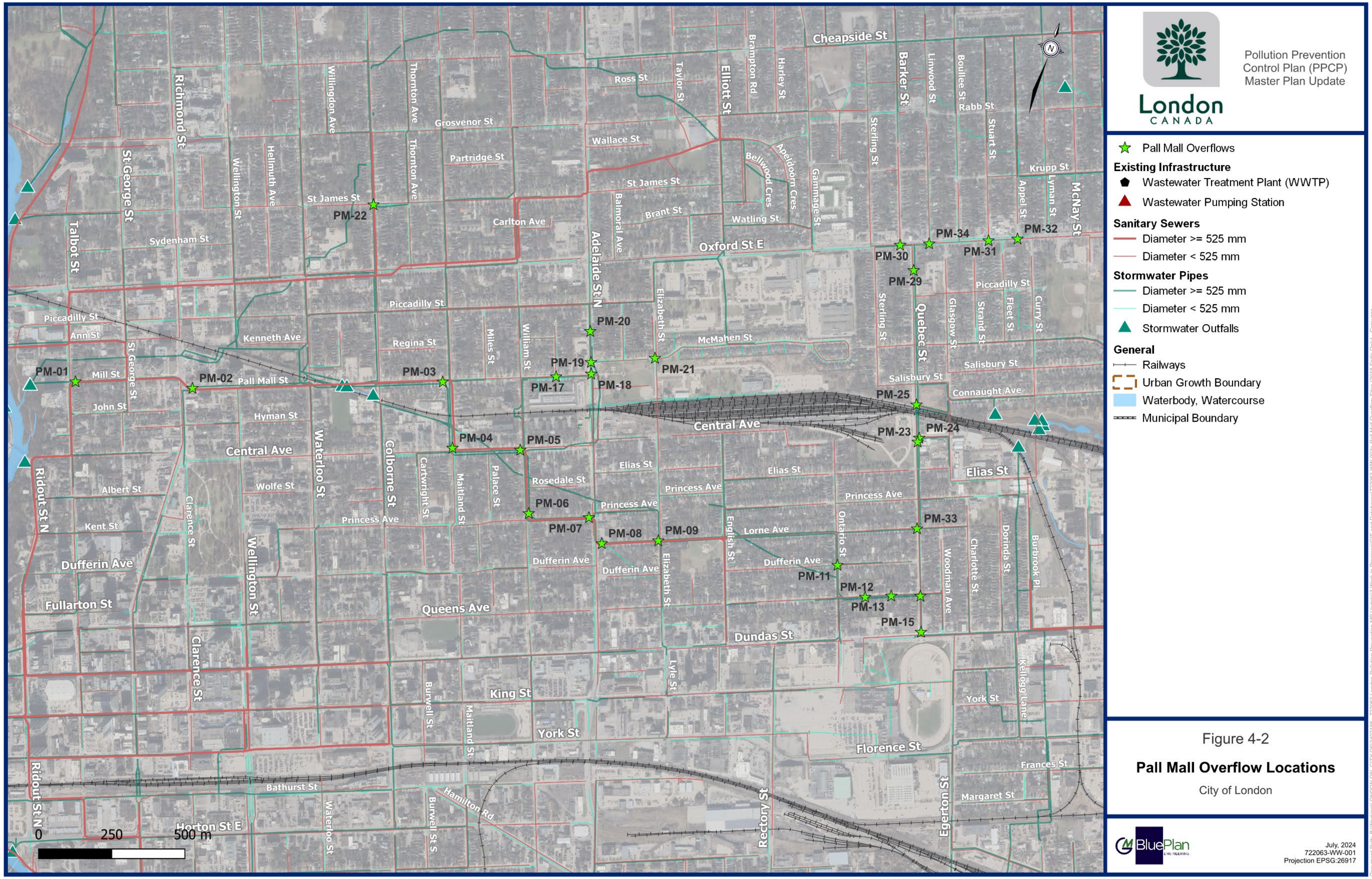

Figure 4-2: Pall Mall system overflow sites

4.4 High-Priority Overflows

For the purposes of this PPCP Update Study, a high priority overflow is defined as an overflow facility which does not satisfy the 90% volume capture criterion for the 2018 typical year of rainfall (as per Procedure F-5-5), and/or an overflow facility with impaired or transitional receiving water quality. Receiving water quality is classified using the BioMAP protocol, based on benthic monitoring. BioMAP studies were completed in 2012 by Upper Thames River Conservation Authority (UTRCA) to determine water quality in the Thames River reaches, Stoney Creek reaches, and Dingman Creek reaches.

The methodology to identify high priority SSO facilities involves a pre-defined set of criteria, consistent with the previous 2018 PPCP:

1. The receiving water BioMAP quality is classified as either impaired or transitional.
2. Discharges for the 2018 typical year of rainfall did not meet the MECP F-5-5 volumetric capture criterion.
3. The facility discharges a significant total overflow volume (1,000 m^3 or greater) for the 2018 typical year of rainfall.

If any of these three criteria were met for a given overflow facility, then that SSO was identified as a high priority site.

Certain SSOs which did not meet the high prioritization criteria were still included as high priority SSOs based on recent or ongoing changes to the collection system. Oxford WWTP demonstrated no overflows during 2018 and meets F-5-5 requirements; however, Oxford WWTP discharges to a transitional receiving water and did have multiple bypasses over the past 5-year period and so has been included as a high priority overflow site. Additionally, SSO TP-04, which replaced the removed SSO CW-04, is not classified as a high priority overflow based on the three above criteria; however, because TP-04 is technically a temporary overflow and is located within an area still undergoing sewer improvements, it has been included in the high priority SSO list.

The high priority WWTP, pumping station, and collection system overflows are presented in **Table 4-8** and are shown in **Figure 4-3**.

Table 4-8: High priority overflow facilities

Sewershed	Overflow Facility	Overflow Volume During 2018 Typical Year (m^3)	F-5-5 % Capture	Receiving Water Quality (Impaired vs. Unimpaired)
Greenway	PM-02[1]	10,322	83%[2]	Unimpaired
Greenway	PM-09[1]	7,752	78%[2]	Unimpaired
Greenway	SD-03	160	86%	Unimpaired
Greenway	SN-05	3,373	85%	Unimpaired
Greenway	SW-01	38,842	87%	Unimpaired
Greenway	SP-45	146	98%	Impaired
Greenway	SD-05	2,531	96%	Unimpaired
Greenway	PM-03	1,397	97%	Unimpaired
Greenway	SP-58 (replaced SD-01)	6,174	95%	Unimpaired
Greenway	CP-09	325	97%	Impaired
Greenway	SW-03	5	100%	Impaired
Greenway	TP-04 (temporarily replaced CW-04)	672	100%	Unimpaired
Greenway	Berkshire PS	24	100%	Unimpaired-Transitional
Greenway	Medway PS	478	100%	Unimpaired
Greenway	Dingman PS	37,635	N/A[4]	Impaired
Adelaide	Adelaide WWTP	21,667[3]	89%[3]	Unimpaired
Pottersburg	Pottersburg WWTP	18,419[3]	91%[3]	Unimpaired
Oxford	Oxford WWTP	0[3]	100%[3]	Transitional
Vauxhall	Vauxhall WWTP	1,548[3]	99%[3]	Unimpaired
Greenway	Greenway WWTP	2,801[3]	98%[3]	Unimpaired-Transitional

[1] PM-02 and PM-09 are part of the Pall Mall collection system overflow group, and any strategy to manage overflows at these two sites will also extend to the remainder of overflows within the Pall Mall system.

[2] Dingman PS was missing total flow information for 2018; due to the magnitude of overflow during the typical year, this facility has been included as a high priority overflow.

[3] WWTP overflow volume and F-5-5 capture rate include both the raw and secondary plant bypass.

[4] F-5-5 % capture estimates not available for Dingman PS; included as high priority overflow site due to high annual discharge volume and receiving watercourse quality.

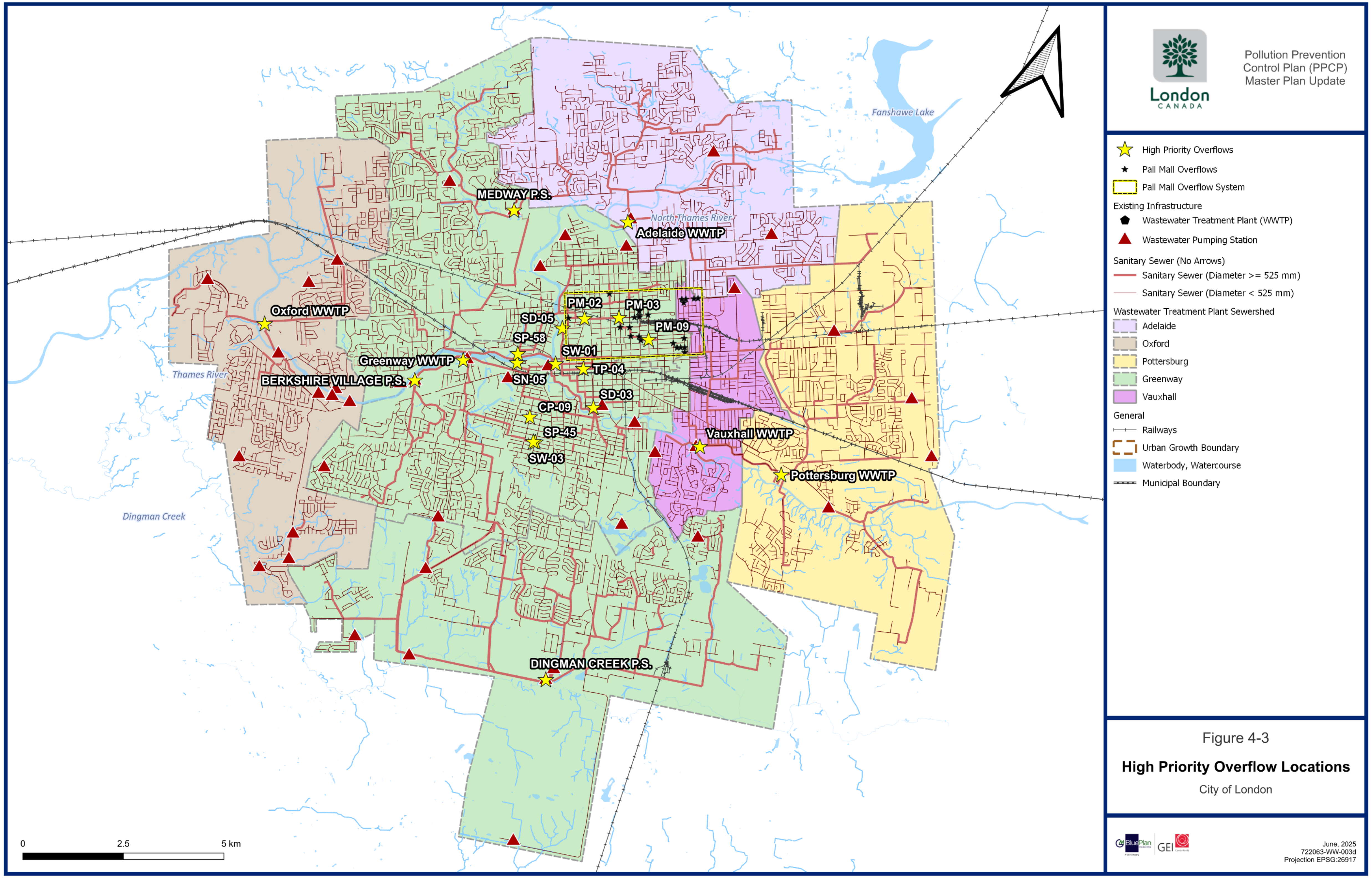

Figure 4-3: High priority overflow locations

5. Conclusion & Recommendations

The F-5-5 analysis is an important component of the City of London PPCP which enables the City to identify its existing overflow sites which exhibit overflows during the typical year of rainfall (2018) and target high priority overflow sites which do not currently satisfy the 90% wet weather volume capture requirement of Procedure F-5-5. High priority overflow sites have been identified using a combination of criteria including F-5-5 volumetric capture target, receiving water quality BioMAP status, and total annual overflow volume.

The PPCP study recommendations, including the final Implementation Plan, will be further discussed in a separate Technical Memorandum. The identified mitigation strategies will aim to reduce the volume and frequency of untreated wastewater discharges to satisfy the requirements of Procedure F-5-5, without negatively impacting existing system performance (i.e. sanitary sewer service and basement flooding protection).

In addition to mitigation strategies focusing on capital infrastructure improvements (sewer upsizing, provision of storage, further combined sewer separation, etc.), the City have identified an opportunity to investigate a “point-of-sale” foundation drain disconnection program, with the aim of implementing a requirement for private properties to disconnect their foundation drains (if they have a connection) at the time that the property is sold. This would be a long-term strategy which, if feasible, would facilitate the total disconnection of all currently connected properties and ultimately reduce wet weather flows and overflows in the City’s wastewater collection system.