

City of Niagara Falls

**Master Servicing Plan and Wet Weather
Management Strategy
Volume 4: Wastewater Master Servicing
Plan and Wet Weather Management
Strategy**

Niagara Falls, Ontario

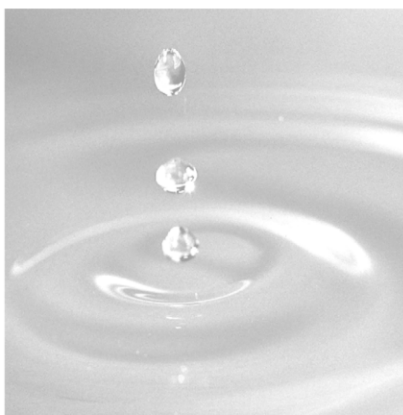
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Table of Contents

Acronyms and Abbreviations	iv
1. Introduction	5
1.1. Background and Study Area	5
1.2. Master Servicing Plan Objectives	5
1.3. Master Servicing Plan Report Outline	6
2. Wastewater System Policy and Criteria.....	8
2.1. Wastewater Servicing Principles and Policies	8
2.2. Regional Wastewater Level of Service Design Criteria	8
2.3. System Hydraulic Performance Criteria	8
2.4. Costing Framework	9
3. Existing Wastewater Collection System	11
3.1. Existing Wastewater Infrastructure	11
3.1.1. Niagara Falls Wastewater Treatment Plant	11
3.1.2. Sewage Pumping Stations	11
3.1.3. Regional Collection System	14
3.1.4. City-owned Gravity Collection System	14
3.1.5. Sanitary and Combined Sewer Overflows	15
4. Hydraulic Wastewater Model	16
5. Assessment of Existing Wastewater Infrastructure	18
5.1.1. Existing System Performance	18
5.1.2. Overflows	23
5.1.3. Opportunities and Constraints	25
6. Assessment of Future Wastewater Infrastructure	29
6.1. Growth Projections	29
6.2. Future System Flows	29
6.3. Future System Performance	32
7. Wastewater Servicing and Wet Weather Management Strategy	35
7.1. Regional Strategy	35
7.2. System-wide I&I Reduction	37
7.2.1. Sources of I&I	37
7.2.2. Challenges and Opportunities	38
7.2.3. Strategic Approach	39
7.3. Sewer Separation Strategy	39
7.4. Linear Upgrades	40
7.5. Assessment of Future Wastewater Infrastructure	40

7.5.1.	Project Areas and Alternatives	41
7.5.1.1.	Needs Additional Studies	43
7.5.2.	Prioritization Strategy	48
8.	Preferred Wastewater Servicing and Wet Weather Management Strategy	
	49	
8.1.	Capital Program	49
9.	Implementation and Lifecycle	56
9.1.	Capital Program Implementation Plan	56
9.2.	Monitoring and Adaptive Management	57
9.3.	Operation and Maintenance Practices	57
9.3.1.	Development Review Process	59
9.3.2.	Sewer Model Updates	59
9.3.3.	Master Plan Studies	59

List of Tables

Table 2-1.	Summary of Wastewater Design Criteria	9
Table 2-2.	Development Charges Shares by Category	10
Table 3-1	Sewage Pumping Station Characteristics	13
Table 3-2.	City-Owned Sewers	14
Table 3-3.	Sanitary Storage Facilities	15
Table 3-4.	F-5-5 Overflow Reporting Table	15
Table 5-1.	Existing Wastewater System Performance	18
Table 5-2.	Model Results for Region Owned SPS	22
Table 5-3.	Niagara Falls WWTP F-5-5 Wet Weather Flow Outfalls under Average Precipitation Year (2022)	24
Table 5-4.	Niagara Falls WWTP F-5-5 Wet Weather Flow Capture Rate under Average Precipitation Year (2022)	25
Table 6-1.	Population Projections	29
Table 6-2	Wastewater Flow Projections by SPS Catchment	31
Table 7-1.	Niagara Region Wastewater Capital Program for the Niagara Falls WWTP	35
Table 7-2.	Niagara Region Wastewater Capital Program for the South Niagara Falls WWTP	36
Table 7-3.	Sources of Inflow and Infiltration	38
Table 7-4.	Oakwood Drive SPS	41
Table 7-5.	Niagara Falls Convention Centre	42
Table 7-6.	Chippawa	42
Table 7-6.	Lundy's Lane SPS Catchment	44
Table 7-7.	Meadowvale SPS	45
Table 7-8.	Oldfield Road	46
Table 7-9.	Stanley Avenue north of NF WWTP	47
Table 8-1.	Wastewater Capital Program Summary – Linear Upgrades	50
Table 8-2.	Wastewater Capital Program Summary – I&I Reduction	50

Table 8-3. Wastewater Capital Program Prioritization Summary	51
Table 8-4. Wastewater Capital Program Prioritization Summary – Sewer Separation Strategy	52

List of Figures

Figure 3-1. Existing Wastewater Infrastructure	12
Figure 5-4 Existing Wastewater System Opportunities and Constraints	28
Figure 6-1. Growth Areas	30
Figure 6-2. 2051 Wastewater System Performance under Region Design Flow	33
Figure 6-3. Wastewater System Performance under 10-Year Design Flow	34
Figure 8-1. Wastewater Capital Program Prioritization	53
Figure 8-2. Wastewater Capital Program Performance	54
Figure 8-3. Sewer Separation Strategy Prioritization	55

Appendices

Appendix A	Wastewater Model Methodology
Appendix B	Buildout Performance Maps
Appendix C	Sewer Separation Strategy
Appendix D	Wastewater Capital Program Summary

Acronyms and Abbreviations

2021 Region MSPU	2021 Niagara Region Master Servicing Plan Update
CCTV	Closed-Circuit Television
CLI-ECA	Consolidated Linear Infrastructure – Environmental Compliance Approval
CSO	Combined Sewer Overflow
DWF	Dry Weather Flow
GIS	Geographic Information Systems
HGL	Hydraulic Grade Line
HRT	High-Rate Treatment Facility
I&I	Inflow and Infiltration
LOS	Level of Service
MLD	Million Litres per Day
MSP-WWMS	Master Servicing Plan – Wet Weather Management Strategy
NOTL	Niagara-on-the-Lake
O&M	Operation and Maintenance
SCADA	Supervisory Control and Data Acquisition
SSO	Sanitary Sewer Overflow
WWF	Wet Weather Flow
SNF	South Niagara Falls
SPS	Sewage Pumping Station
WWTP	Wastewater Treatment Plant

1. Introduction

1.1. Background and Study Area

The City of Niagara Falls (herein referred to as the “City”) has completed the 2025 Master Servicing Plan and Wet Weather Management Strategy (MSP-WWMS). The 2025 MSP-WWMS aims to address existing system level of service for the water distribution, wastewater collection, and stormwater collection systems as well as develop a plan to support growth to 2051 and beyond.

The City encompasses a total area of 212 km² bounded by the Niagara River to the east, the Town of Niagara-on-the-Lake to the north, the Town of Fort Erie to the south, and the city of Thorold to the west. The City’s urban service area encompasses approximately 82.3 km² or 39%, with the rest of the area defined as rural. The City is unique in that it experiences an annual influx of approximately 12 million tourists in the spring and summer seasons visiting the natural attraction of Niagara Falls, which puts significant seasonal load on the City’s core infrastructure. Further, the City’s aging infrastructure must continue to support a rapidly growing population as directed by the Provincial Planning Statement (2024) (superseding the *Places to Grow Growth Plan for the Greater Golden Horseshoe*), the City’s Official Plan, and the Niagara Region’s Official Plan.

The City is one of twelve municipally serviced lower-tier municipalities within the Niagara Region (“Region”) where the water, wastewater, and stormwater systems operate under a two-tier municipal service delivery model. The Region is responsible for raw water supply, water and wastewater treatment, storage facilities, major water booster pumping stations, major sewage pumping stations, transmission mains, force mains, and trunk storm and wastewater conveyance. The City is responsible for the local water distribution network, and local wastewater and stormwater collection systems’ infrastructure.

The 2025 MSP-WWMS builds on the previous work undertaken as part of the 1998 Water Master Servicing Study, 2017 Pollution Prevention Control Plan, 2017 Master Drainage Plan Update, and 2021 Region Master Servicing Plan Update as well as previous long-term infrastructure planning studies.

1.2. Master Servicing Plan Objectives

Niagara Falls, like many municipalities, needs to balance addressing existing system level of service and state of good repair as part of a holistic and measurable management approach to infrastructure systems. The City has unique needs to balance existing servicing needs with level of service, development pressures, regulatory requirements and protection of the environment. The MSP-WWMS aims to develop a long-term management plan with short- and long-term system upgrade needs and supporting maintenance and management activities. In the development of the MSP-WWMS, each upgrade (or program) trigger, financial implications, and functional objective is identified, thereby allowing the City to manage and adjust the plan moving forward based on changing growth trends and/or management priorities.

The objective of the MSP-WWMS is to develop a long-term servicing strategy for the drinking water, wastewater, and stormwater systems for the urban areas, current and future. More specifically, the key objectives are outlined as follows:

- Address the growth projections for the City as directed by the Provincial Planning Statement (2024)

- Develop a detailed system inventory, gap assessment, and capacity assessment to clearly identify the existing condition, State of Good Repair, risk and capacity of the City's existing water, wastewater, and stormwater infrastructure to meet level of service objectives and regulatory requirements.
- Review of existing and anticipated regulatory frameworks, existing system performance, and the City's existing financial constraints/tolerability to develop:
 - Appropriate system level of service criteria (in line with O.Reg 588/17)
 - Servicing policies and principles
 - Performance priorities
- Update the City's existing water, wastewater, and stormwater system models to enable the assessment of the existing and projected capacity and performance of the existing systems whilst addressing existing state of good repair and level of service deficits.
- Build off existing studies and recommendations while revisiting and updating past recommendations with the context of revised growth projection, updated performance criteria, and the latest infrastructure priorities.
- Review of system opportunities and constraints to identify potential servicing alternatives to address existing and long-term needs.
- Develop a comprehensive capital program, along with implementation triggers, to support the existing system needs and long-term growth.
- Develop a Wet Weather Flow Management Plan that outlines the City's strategy to monitor and address wet weather flows in the wastewater system including:
 - Prioritization of reduction programs including sewer separation, maintenance and rehabilitation recommendations, and public and private programs.
- Facilitate the necessary stakeholder input to satisfy the Municipal Class Environmental Assessment Master Plan requirements, and to ensure stakeholder buy-in.
- Complete suitable documentation, outlining the methodology, results, and recommendations of the Master Servicing Plan.

All project deliverables are aligned with the City's concurrent Official Plan Review, Transportation Master Plan, Asset Management Plan for Core Assets, and Development Charges Bylaw Update. Additionally, the City's MSP-WWMS is developed under the context of the Niagara Region's Official Plan and 2021 Master Servicing Plan Update to ensure that all plans are based on the same foundational elements.

1.3. Master Servicing Plan Report Outline

The MSP-WWMS report, including all supporting volumes, is the document placed on public record for the prescribed review period. Volume 4 – Wastewater Master Servicing Plan and Wet Weather Management Strategy is one of five volumes that make up the complete Master Servicing Plan Wet Weather Management Strategy Class EA Study Report and should be read in conjunction with other volumes.

Volume 4 consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, and selection of the preferred wastewater servicing strategy. This volume details baseline and growth wastewater system performance including detailed information regarding the capital program and additional implementation and ongoing maintenance solutions. This volume also details the sewer separation program and inflow and infiltration (I&I) reduction strategies as incorporated into the wet weather management strategy.

2. Wastewater System Policy and Criteria

Level of Service (LOS) objectives are critical elements in the evaluation of existing and future system performance and development of detailed servicing strategies, implementation of a system-wide capital program, and operations and maintenance practices. In addition to LOS objectives, policies were also laid out to provide guidelines and direction to the master planning process, in addition to ensuring that wastewater criteria are adequately representative to support the decision making for sizing and timing of future infrastructure.

This section summarizes the key Policy and LOS objectives as they relate to the wastewater system. A detailed summary of the MSP Policies and LOS objectives review and recommendations is provided in **Appendix A of Volume 2 – Planning and Consultation**.

2.1. Wastewater Servicing Principles and Policies

Based on the MSP-WWMS vision statement and the identified policy statements, the following customer service statement for the City's wastewater system was developed to guide the selection of Level of Service objectives and design criteria:

"To provide an efficient, sustainable, and reliable wastewater system that minimizes environmental impacts and is capable of accommodating growth"

The detailed wastewater servicing policies are summarized in **Appendix A of Volume 2 – Planning and Consultation**.

2.2. Regional Wastewater Level of Service Design Criteria

Given the inter-dependency between the Region and City infrastructure performance, the City's technical level of service was developed with consideration for the Region's criteria in order to harmonize servicing strategies and to avoid competing priorities and/or servicing philosophies. For the MSP-WWMS, only system performance criteria were reviewed as they impact the City's local sewer system. Detailed historic data analysis for per capita flow generation, rainfall-derived inflow and infiltration (RDII) design flow, and peaking factor as well as the summarized water system LOS design criteria used in the Region's 2021 MSPU are provided in **Appendix A of Volume 2**.

2.3. System Hydraulic Performance Criteria

Following the detailed review of all hydraulic performance data, including flows, capacity, velocities, and overflows, the wastewater system technical level of service criteria used in the Niagara Falls MSP-WWMS is summarized in **Table 2-1**. The majority of these criteria are inline with the Region's design criteria, with differences in the peak wet weather design storm and the freeboard criteria used for assessing system performance.

Table 2-1. Summary of Wastewater Design Criteria

Criteria			Performance Target
Wastewater Flows	Per Capital Rate	Residential	255 L/c/d
		Employment	310 L/c/d
	Peaking Factor		Harmon’s Peaking Factor
	I&I Allowance	Existing Areas	0.4 L/s/ha
		Greenfield	0.286 L/s/ha
System Performance	Peak Wet Weather Design Flows		10-Year Design Storm
	Existing Infrastructure		- d/D < 1 - HGL ≤ 2.1 m freeboard elevation
	New/Upgraded Infrastructure		- Full capacity velocity between 0.6-3.0 m/s - Minimum sewer size of 200 mm diameter (with the exception of top end/low flow sewers which can be sized to 150 mm to maintain minimum velocity targets) - HGL ≤ 2.1 m freeboard elevation at centreline of road
Overflows			Ministry of Environment, Conservation and Parks (MECP) F-5-5 Regulations: - No overflows during dry weather; - During a seven (7) month period commencing within 15 days of April of an average year, provide 90% volumetric control of wet weather in addition to all of the dry weather flow. Additionally, Section 11 of the F-5-5 Regulation mandates that: “When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem.”

2.4. Costing Framework

A capital costing framework is provided for all projects proposed as part of this MSP-WWMS. For the majority of the wastewater system projects, a base construction cost was first obtained using either a unit rate construction cost, based on pipe diameter, or unique project analysis. The base construction cost considered several complexity factors specific to each project such as creek crossings, railway and highway crossings, tunneling requirements, and area condition (rural, urban, suburban). Additional construction, design, administration, project contingency, provisional allowance, and non-recoverable HST costs were included as fixed percentages to produce a final project cost. For a further detailed breakdown, please refer to **Section 7 of Volume 2**.

Further to costed project, considerations for development charges splits were considered to support the City's current Development Charges. These categories are outlined in **Table 2-2**.

Table 2-2. Development Charges Shares by Category

Category	Low/Limited Growth Local flow increase <50% and no change in Fire Flow requirement	Moderate Growth Local flow increase >50% or change in Fire Flow requirement	Substantial Growth Local flow increase >100% with/without change in Fire Flow requirement
Addresses Existing Needs	10% - Existing deficiencies with limited growth. Provides capacity for secondary units and infill development	N/A	
Addresses Existing Needs and Supports Growth Needs	N/A	50% - Needed to support growth but also services existing users	75% - Predominately needed to support growth but also serves existing users
Triggered by Growth	75% - Needed to support growth but also serves existing users	N/A	
Supports New Growth Areas	N/A		100% - Servicing greenfield growth area (10% OB)
Supports Growth Needs and Operational Resiliency	50% - Support operational improvement. Provides additional system capacity for future growth (40% OB)	75% - Support operational improvement. Provides additional system capacity for future growth (50% OB)	
Supports Growth Needs and Operational Resiliency; Directly Services Growth Areas	N/A	75% - Support operational improvement. Provides additional system capacity for future growth (75% OB)	

Note: OB – Out of Bylaw supports post period growth

3. Existing Wastewater Collection System

3.1. Existing Wastewater Infrastructure

The Niagara Falls wastewater system is part of a two-tier wastewater system within Niagara Region and currently services both the City of Niagara Falls, and a portion of the Town of Niagara-on-the-Lake (NOTL) in the Village of St. David's (**Figure 3-1**). Wastewater collected throughout the system is conveyed to the Niagara Falls Wastewater Treatment Plant, located at 3450 Stanley Avenue, where it is treated before being discharged to the Ontario Power Generation (OPG) Canal. The Region owns and operates all sewage pumping stations used for conveyance to the Niagara Falls WWTP, and a majority of the forcemains and trunk sewers.

The City's collection system operates under a Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) No. 068-W601 issued March 8, 2025. The majority of the sewers are separated from the stormwater collection system, with approximately 15% of the system still serviced by combined sewers (**Figure 3-1**). The combined sewers flow downstream to separated portions of the system. Approximately 12% of the system is separated sanitary sewers carrying combined flows. The separated system also consists of sewers that are nominally or partially separated, meaning that it primarily carries sanitary flows only but roof leaders and foundation drains may still be connected. Under wet weather flow conditions, I&I in the wastewater system contributes to the risk of sewer surcharging, basement flooding, and surface flooding. The risks of flooding are mitigated by combined and sanitary overflows, in-line and offline storage facilities, and a high-rate treatment facility at Central SPS. The negative impacts of overflows of untreated and partially treated wastewater are managed by strategies proposed in the MPS-WWMS.

3.1.1. *Niagara Falls Wastewater Treatment Plant*

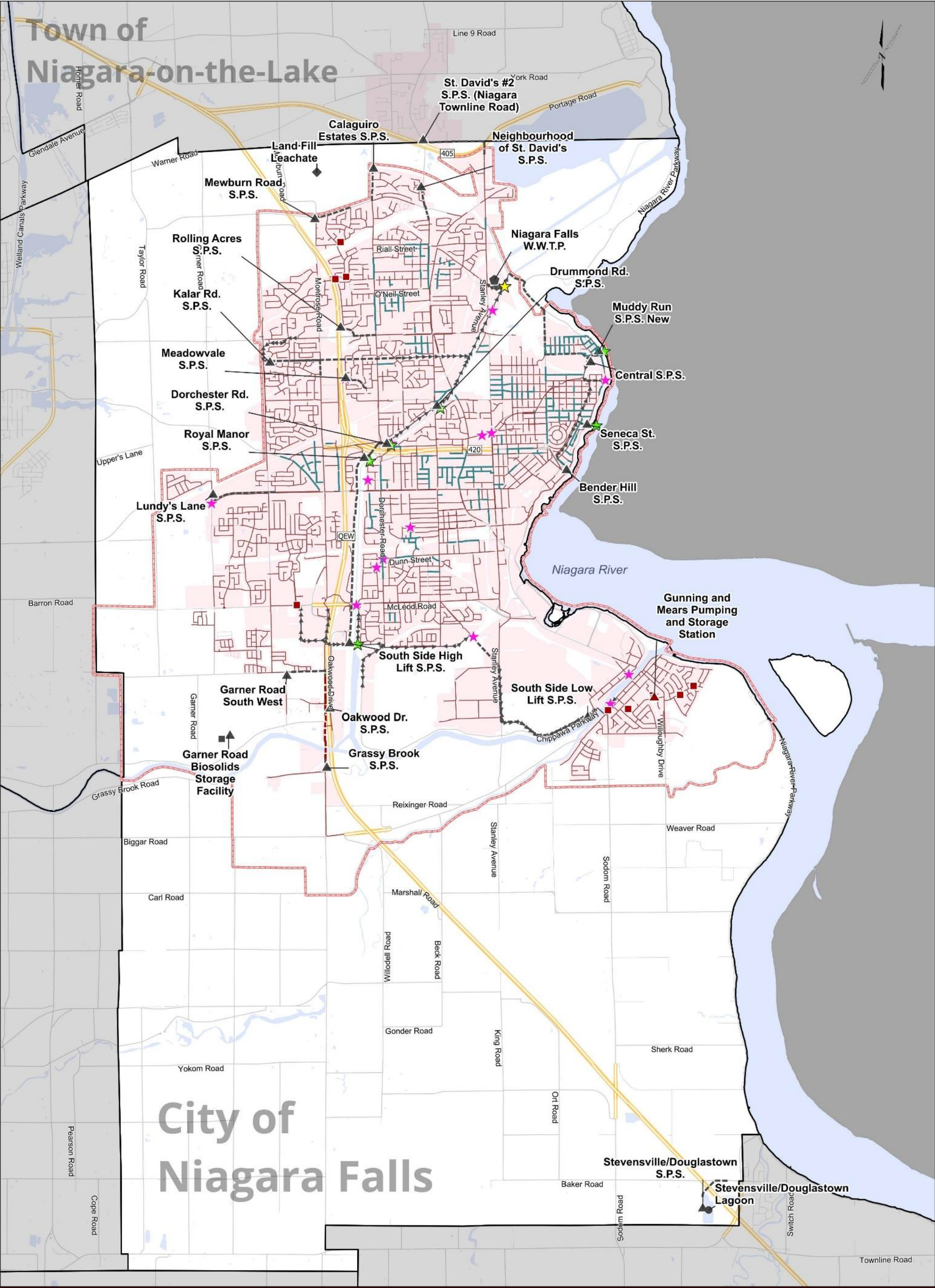
The Niagara Falls Wastewater Treatment Plant (WWTP) is owned and operated by the Region. The WWTP operates under the MECP Environmental Compliance Approval (ECA) Certificate #A-500-5110411564 issued August 22, 2021.

The WWTP provides a tertiary level of treatment which includes screening, grit removal, Rotating Biological Contactors and Settling process, flocculation, phosphorus removal, and disinfection. The WWTP's ECA rated capacity for average daily flow is 68.3 million litres per day (MLD) and can fully treat up to 136.4 MLD for peak flow events. For greater flows, the WWTP can provide primary treatment of up to 205 MLD.

3.1.2. *Sewage Pumping Stations*

The Region owns and operates 16 SPS within the City of Niagara Falls. **Table 3-1** lists each sewage pumping station's (SPS) listed ECA firm capacity as well as the station's existing operational firm capacity (the current operating capacity of the pump station based on performance testing and/or supervisory control and data acquisition (SCADA) trending). The operational firm capacity was used for the system assessment. In cases where the operational firm capacity was larger than the ECA firm capacity (e.g., Drummond SPS), the registered ECA capacity was used.

Central SPS also includes a high-rate treatment facility (HRT) which provides primary treatment to excess wet weather flows exceeding the station capacity prior to discharging to the environment. It is owned by the City and operated by the Niagara Region on the City's behalf.



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Sewer Overflows

- WWTP By-Pass
- Regional SPS Overflow
- City-owned Overflow

Forcemain

- Regional
- Municipal (Niagara Falls)

Gravity Main

- Regional
- Municipal (Niagara Falls)
- Other Municipal (NOTL)
- Sewer Separation Program

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse
- Wastewater Catchment

Reference(s)

- 1. Projection EPSG:26917
- 2. Base Data: City of Niagara Falls, 2023

12 km

Figure 3-1
Existing Wastewater Infrastructure

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)

Last Updated: November 2025
Document ID: 2402014-001

Table 3-1 Sewage Pumping Station Characteristics

Station Name	Location	Catchment Details		Pump Station Details			Forcemain Details		
		Area Exclusive of Upstream Catchments (ha)	Area Inclusive of Upstream Catchments (ha)	Number of Pumps	ECA Firm Capacity (L/s)	Operational Firm Capacity (L/s)	Single or Twinned Forcemain	Forcemain Diameter (mm)	Length (m)
↳Calaguiro SPS	Calaguiro Subdivision, Niagara Falls	22.7	22.7	2	7.0	5.5	Single	100	601
↳Central SPS	4300 Buttrey Street, Niagara Falls	675.2	977.9	5	1000.0	800.0	Single	900	2,776
— ↳Bender Hill SPS	Bender Street, Niagara Falls	197.6	197.6	4	330.0	237.0	Single	600	439
— ↳Muddy Run SPS	4222 May Avenue, Niagara Falls	63.0	63.0	2	100.0	77.0	Single	250	252
— ↳Seneca Street SPS	Seneca Street, Niagara Falls	42.1	42.1	2	67.7	63.0	Single	200	188
↳Dorchester Road SPS	Dorchester Road, Niagara Falls	360.3	577.1	3	235.0	185.0	Single	350	48
— ↳Lundy's Lane SPS	8971 Lundy’s Lane, Niagara Falls	97.1	97.1	3	98.4	56.3	Single	250	1,349
— ↳Meadowvale SPS	4491 Sussex Drive, Niagara Falls	35.9	35.9	2	38.9	34.0	Single	200	460
— ↳Rolling Acres SPS	Rolling Acres Drive, Niagara Falls	51.1	51.1	2	60.0	52.3	Single	300	728
— ↳Royal Manor SPS	7006 Windsor Crescent, Niagara Falls	32.7	32.7	2	10.5	8.8	Single	100	5
↳Drummond Road SPS	Drummond Road, Niagara Falls	85.3	85.3	2	46.0	56.7	Twin	150	12
↳Kalar Road SPS	4254 Kalar Road, Niagara Falls	500.1	500.1	4	510.0	463.0	Single	600	2,448
↳Mewburn SPS	Mewburn Road, Niagara Falls	8.9	8.9	2	23.3	17.1	Single	192	685
↳Neighbourhood SPS	St. Paul Avenue, Niagara Falls	19.7	19.7	2	40.0	29.0	Single	200	626
↳St. Davids #2 SPS	383 Four Mile Creek Road, Niagara Falls	34.8	235.8	2	43.6	42.9	Single	250	1,425
— ↳St. Davids #1 SPS	383 Four Mile Creek Road, Niagara Falls	201.0	201.0	2	40.9	28.8	Single	200	2,032
↳South Side High Lift SPS	7606 Oakwood Drive, Niagara Falls	1175.1	2077.7	5	760.0	609.0	Single	667	3,983
↳South Side Low Lift SPS	4414 Chippawa Parkway	719.5	719.5	4	576.0	392.1	Single	534	3,517
↳Garner SPS	Garner Southwest, Niagara Falls	98.0	98.0	2	190.0	99.7	Single	350	756
↳Oakwood SPS	8555 Oakwood Drive, Niagara Falls	32.0	32.0	2	16.7	13.0	Single	150	506
↳Grassy Brook SPS	9240 Montrose Road, Niagara Falls	53.0	53.0	2	20.9	17.8	Single	147	1,838

- Notes:
- 1. Kalar Road SPS has an additional 350 mm diameter forcemain (as emergency standby), approximately 1,269 m long, along the existing hydro right-of-way, and south along Montrose Road, discharging to a 600 mm diameter sanitary sewer. The 600 mm diameter forcemain presented in the table is operated as a single forcemain.
 - 2. Central SPS has a high-rate treatment (HRT) facility operated by the Region on behalf of the City with an additional ECA capacity of 4000 L/s.

3.1.3. Regional Collection System

The Regional trunk sewers (defined as >170 L/s of peak dry weather flow) collect and convey flow from the City's local collection system and Regional pump stations to the WWTP. There is a planned reconfiguration of the City's system to redirect half of the City's flows to a new South Niagara Falls (SNF) WWTP to provide the system additional treatment capacity.

The South Niagara Falls Wastewater Treatment Solutions Schedule 'C' Class EA study was completed in 2022. The strategy is comprised of a new SNF WWTP on Reixinger Road with deep tunneled trunk sewers to redirect the existing South Side High Lift SPS flows to the new WWTP, and shallow trunk sewers to collect flows from Thorold South. The SNF WWTP is currently in the detailed design stage and is anticipated to be completed construction in 2029.

Considering the South Niagara Falls Wastewater Treatment Solutions strategy, the current MSP-WWMS assessment assumes the following:

- The existing Niagara Falls system is assessed with current conditions and configuration of the system.
- The future system is assessed with the South Niagara Falls strategy implemented. The future scenarios of 2051 and post-2051 assume the commissioning of the South Niagara Falls WWTP by 2029. The system reconfiguration will involve:
 - Decommissioning of the South Side High Lift SPS and flows will be conveyed via the new deep trunk sewers west across the QEW to Montrose Road and then to the new SNF WWTP on Reixinger Road
 - Redirection of flows from the Peel Street SPS to the SNF WWTP system. This reroutes flows from Peel Street SPS to a new Black Horse SPS, where all Thorold South flows are pumped via a new forcemain to a shallow gravity trunk which conveys flows by gravity to the new SNF WWTP.

3.1.4. City-owned Gravity Collection System

The City owns and operates approximately 438 km of the gravity sewers that consist of fully separated sanitary sewers, sanitary carrying combined sewers, and combined sewers, as summarized in **Table 3-2**.

Table 3-2. City-Owned Sewers

Type of Sewers	Length (m)	Percent by Length
Fully Separated Sanitary Only	317,807	72.5%
Sanitary Carrying Combined	52,836	12.1%
Combined	63,752	14.6%
Others ⁽¹⁾	3,677	0.8%

Notes:

1. Includes inline storage, syphon, relief, wastewater effluent, sanitary overflow, virtual, and unknowns.

The City also owns and operates 10 inline and offline wastewater storage facilities, as shown in **Figure 3-1** and listed in **Table 3-3**.

Table 3-3. Sanitary Storage Facilities

Asset ID	Address/Location	Capacity (m ³)
SGM_07047	Cattell Drive	2070.78
SGM_05563	River View Public School	104.49
SGM_05469	Greenwood Street and Main Street	78.38
SGM_06473	Gunning and Mears Tanks	1011.07
SGM_00004	Harriman Crescent and Casey Street	125.72
SGM_00488	Harte Circle	469.43
SGM_05473	Gunning Drive and Mears Crescent	103.61
SGM_06609	Olden Avenue and Lalemant Road	66.34
SGM_05825	Parliament Avenue and Gunning Drive	327.08
SGM_04500	McLeod Relief Sewer	501.11

3.1.5. Sanitary and Combined Sewer Overflows

The City maintains 13 CSOs and 2 SSOs across the system to manage the risk of basement and surface flooding. As part of this study, the City-owned overflows were monitored for overflows from May to December 2023. There are 8 additional overflows at Regional SPSs (**Figure 3-1**).

Table 3-4. System Sanitary and Combined Sewer Overflows

Manhole ID	2023 FM ID	Location	Ownership	SSO/CSO	Discharge	Outlet
SMH_05342	FM145	Park Street	City of Niagara Falls	CSO	Direct to outlet	Niagara River
SMH_05546	FM135	Bellevue Street	City of Niagara Falls	CSO	Direct to outlet	O.P.G Canal
SMH_06144	FM138	McLeod Road	City of Niagara Falls	CSO	Direct to outlet	O.P.G Canal
SMH_04934	FM140	Greenwood / Bridgewater	City of Niagara Falls	SSO	Direct to outlet	Welland River
SMH_06498	FM142	General Abrasive / Stanley Avenue	City of Niagara Falls	CSO	Direct to outlet	O.P.G Canal
SMH_06890	FM139 ⁽¹⁾	Pell's Creek Sewer at John Daly Way	City of Niagara Falls	CSO	To Storm Relief	Welland River
SMH_02300	FM137	Valley Way at Houck Park	City of Niagara Falls	CSO	To Storm Relief	O.P.G Tunnel
SMH_03741	FM141 ⁽¹⁾	High Street / Brookfield Avenue	City of Niagara Falls	CSO	To Storm Relief	O.P.G Canal
SMH_04247	FM143	Dunn / Dorchester	City of Niagara Falls	CSO	To Storm Relief	O.P.G Canal
SGM_04518/ SMH_03282	FM147/ FM148 ⁽²⁾	Franklin North (Franklin Avenue / Ash Street)	City of Niagara Falls	CSO	To Storm Relief	O.P.G Canal
SMH_02296	FM136	Valley Way at Stanley Av	City of Niagara Falls	CSO	To Storm Relief	O.P.G Tunnel
SMH_05178	FM151	Front Street	City of Niagara Falls	SSO	Direct to outlet	Welland River
DMG_01058	FM144	Margaret Street / Warden Avenue	City of Niagara Falls	CSO	To Storm Relief	O.P.G Canal
SMH_06639	FM150	Lundy's Lane / Garner Road	City of Niagara Falls	CSO	To Storm Relief	Beaverdams Creek
DMH_03155	FM152	Portage Road / Morrison Street	City of Niagara Falls	CSO	To Storm Relief	O.P.G Canal

City of Niagara Falls
Master Servicing Plan and Wet Weather Management Strategy
Volume 4: Wastewater Master Servicing Plan and Wet Weather Management Strategy
Niagara Falls, Ontario
August 11, 2026

Manhole ID	2023 FM ID	Location	Ownership	SSO/CSO	Discharge	Outlet
N/A	N/A	Royal Manor SPS	Niagara Region	SPS Overflow		O.P.G Canal
N/A	N/A	Dorchester Rd SPS	Niagara Region	SPS Overflow		O.P.G Canal
N/A	N/A	S.S. High Lift SPS	Niagara Region	SPS Overflow		Welland River
N/A	N/A	Meadowvale SPS	Niagara Region	SPS Overflow		Shriner's Creek
N/A	N/A	Drummond SPS	Niagara Region	SPS Overflow		O.P.G Canal
N/A	N/A	Seneca St SPS	Niagara Region	SPS Overflow		Niagara River
N/A	N/A	Muddy Run SPS	Niagara Region	SPS Overflow		Niagara River
N/A	N/A	Bender Hill SPS	Niagara Region	SPS Overflow		Niagara River

Notes:

1. Unable to monitor due to site/configuration restrictions.
2. Historically counted as 2 separate CSOs as listed in CLI-ECA. Field survey show that there is 1 connection from sanitary to the storm via a storm chamber.

4. Hydraulic Wastewater Model

The City of Niagara (City) has an existing wastewater hydraulic model which was developed as part of the 2017 Pollution Prevention Control Plan (PPCP). The model was developed as an “all-pipes” model using InfoSWMM. The model includes all gravity sewers, overflows, Regional sewage pumping stations (SPS), and trunk sewers, including SPS catchments located in the Town of Niagara-on-the-Lake (NOTL) that discharge flows to the Niagara Falls WWTP system. Since the initial model development, the model has undergone periodic updates. The most recent update was completed as part of the Region’s 2021 Master Servicing Plan Update (2021 MSPU) which included some localized flow updates and calibration. As part of the City’s ongoing MSP-WWMS, the following updates were made:

- Updated starting point and spatial allocation of sanitary baseflow using updated water billing data
- Updated dry weather diurnal pattern and baseflow using updated and historical flow monitoring data from 12 monitor locations
- Updated wet weather calibration using updated and historical flow monitoring data from 16 monitor locations
- Updated network and geometry using GIS and survey data

For further details, please refer to the **Wastewater Model Methodology Technical Memo Appendix A**.

5. Assessment of Existing Wastewater Infrastructure

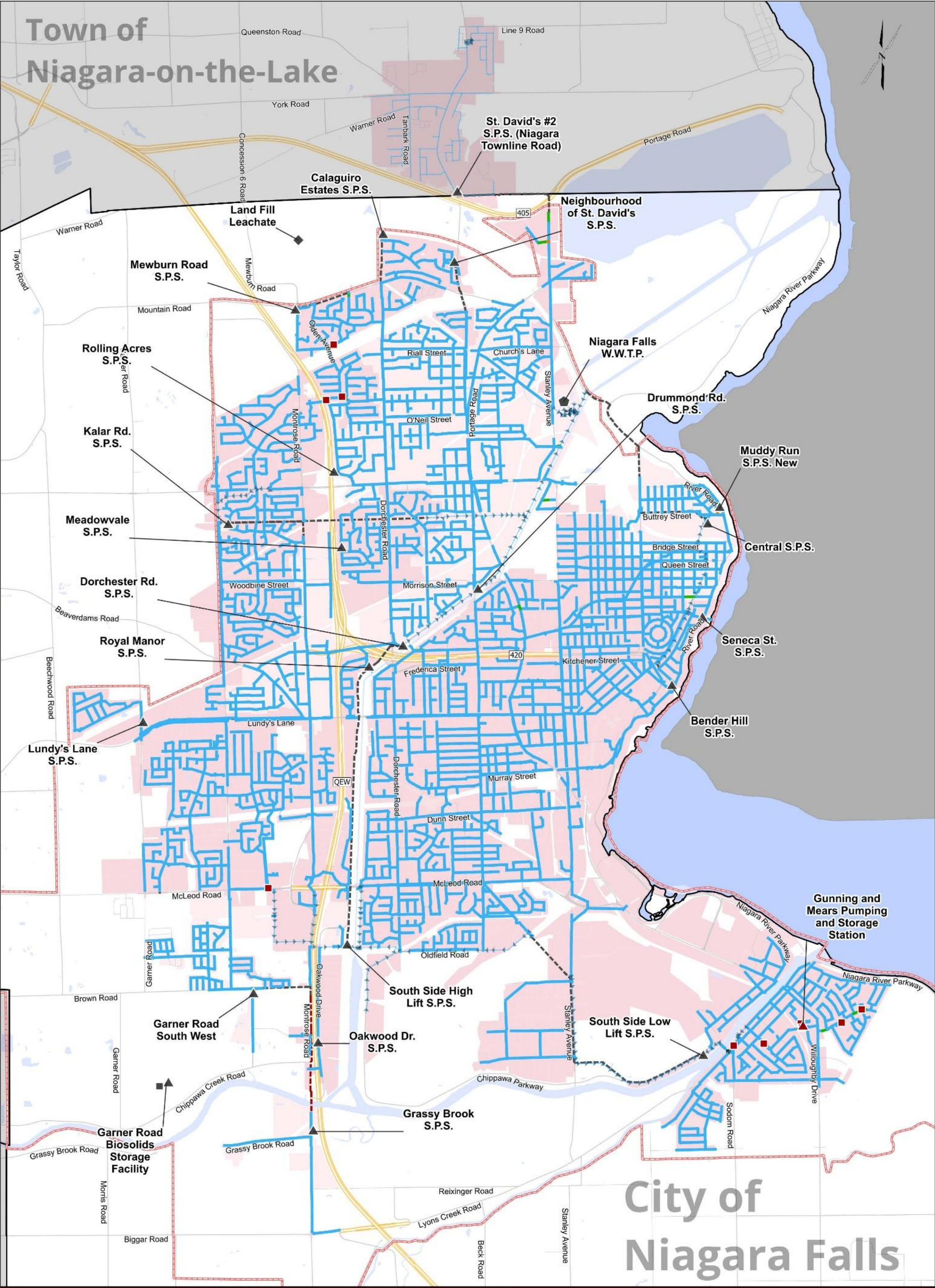
A critical step in the master planning process is the assessment of existing infrastructure performance to establish baseline conditions for the City's wastewater system. These existing conditions become the basis of future recommendations ensuring that the detailed analysis is completed for the entirety of the City's wastewater system. Once the existing system conditions are established, the potential impacts of growth demands are assessed to develop and recommend servicing strategies.

5.1. Existing System Performance

The existing system hydraulic performance was evaluated by using the City's PCSWMM model. Existing system capacity and hydraulic grade line (HGL) under dry weather flow, the Region's design flow conditions, and the peak 10-year design storm flow are presented in **Figure 5-1**, **Figure 5-2**, and **Figure 5-3**, respectively. Generally, the system has sufficient capacity for peak dry weather flow and the HGL in 72.9% of the system remains below the 2.1m basement flood protection freeboard elevation under the peak 10-year design storm, as summarized in **Table 5-1**. These LOS performance indicators were used as a basis for the City's preferred wet weather management strategy and capital program by flagging areas in the existing system which may require upgrades.

Table 5-1. Existing Wastewater System Performance

Design Storm	d/D <1	d/D >1 and HGL <2.1m freeboard elevation	d/D >1 and HGL >2.1m freeboard elevation
DWF	100.0%	0%	0%
Region Wet Weather Design Flow	97.1%	1.5%	1.4%
10-Year	72.9%	17.9%	9.2%



Regional Sanitary Facility

● Wastewater Treatment Plant (WWTP)

▲ Sanitary Pumping Station (SPS)

■ Biosolids Storage

● Lagoon

◆ Leachate Pumping Station

Municipal Sanitary Facility

▲ Sanitary Pumping Station

■ Sanitary Storage Tanks

Forcemain

--- Regional

--- Municipal (Niagara Falls)

Regional Sewer Performance

Surplus Capacity (d/D<= 0.5)

Surplus Capacity (d/D<1)

Surcharging

Surcharging with Basement Flooding Risk

Municipal Sewer Performance

Surplus Capacity (d/D<= 0.5)

Surplus Capacity (d/D<1)

Surcharging

Surcharging with Basement Flooding Risk

General Feature

Urban Area Boundary

Municipal Boundary

Waterbody, Watercourse

Wastewater Catchment

High I&I Catchments

Reference(s)

1. Projection EPSG:26917

2. Base Data: City of Niagara Falls, 2023

1

2 km

Figure 5-1

Existing System Performance Under Dry Weather Flow

Project Name:

Master Servicing Plan and Wet Weather Management Strategy

Client Name:

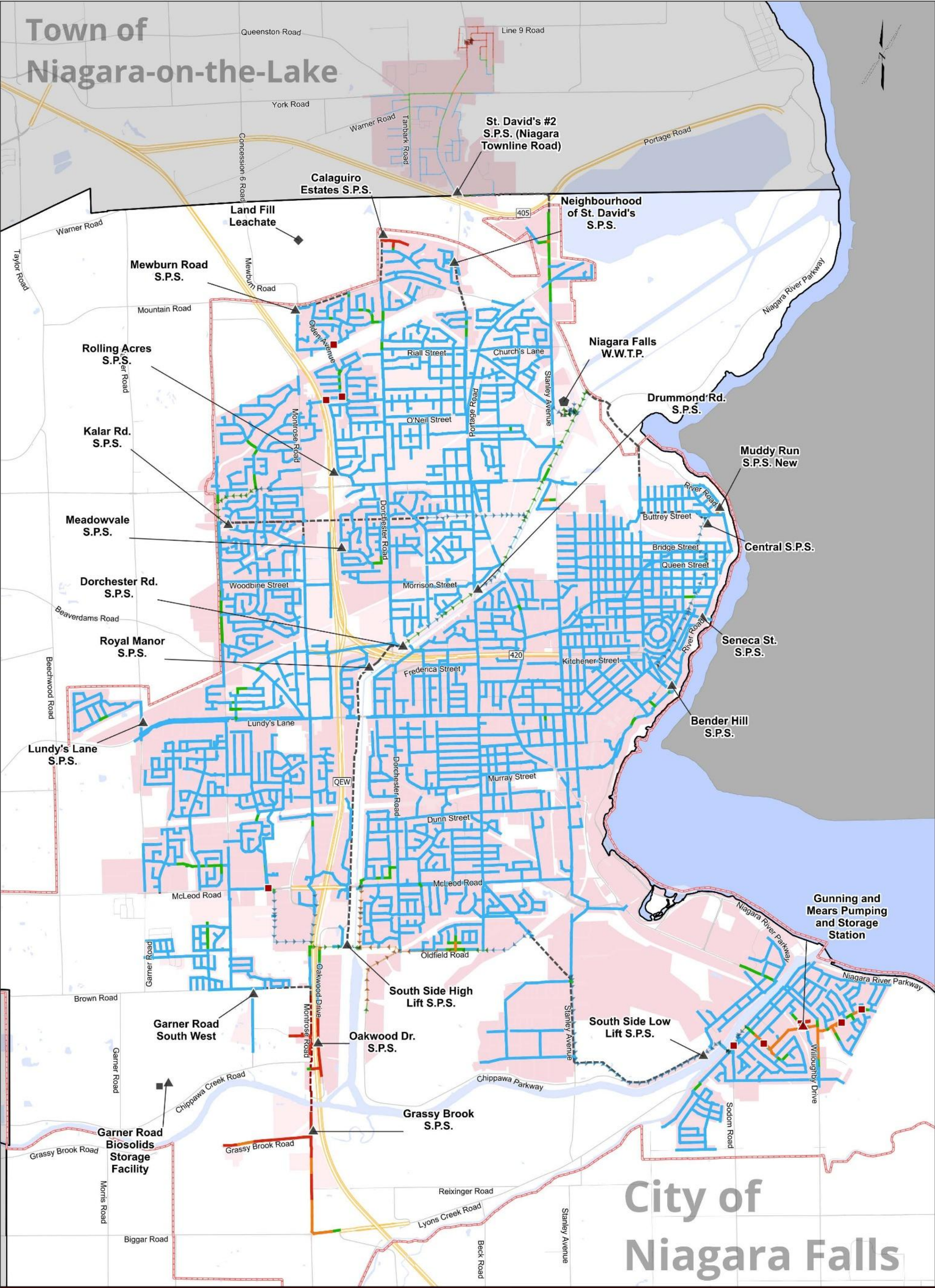
City of Niagara Falls (Ontario, Canada)

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CONSULTANTS

Last Updated: August 2025

Document ID: 2402014-001



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

Regional Sewer Performance

- Surplus Capacity (d/D<= 0.5)
- Surplus Capacity (d/D<1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D<= 0.5)
- Surplus Capacity (d/D<1)
- Surcharging
- Surcharging with Basement Flooding Risk

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse
- Wastewater Catchment
- High I&I Catchments

Reference(s)

- Projection EPSG:26917
- Base Data: City of Niagara Falls, 2023

1

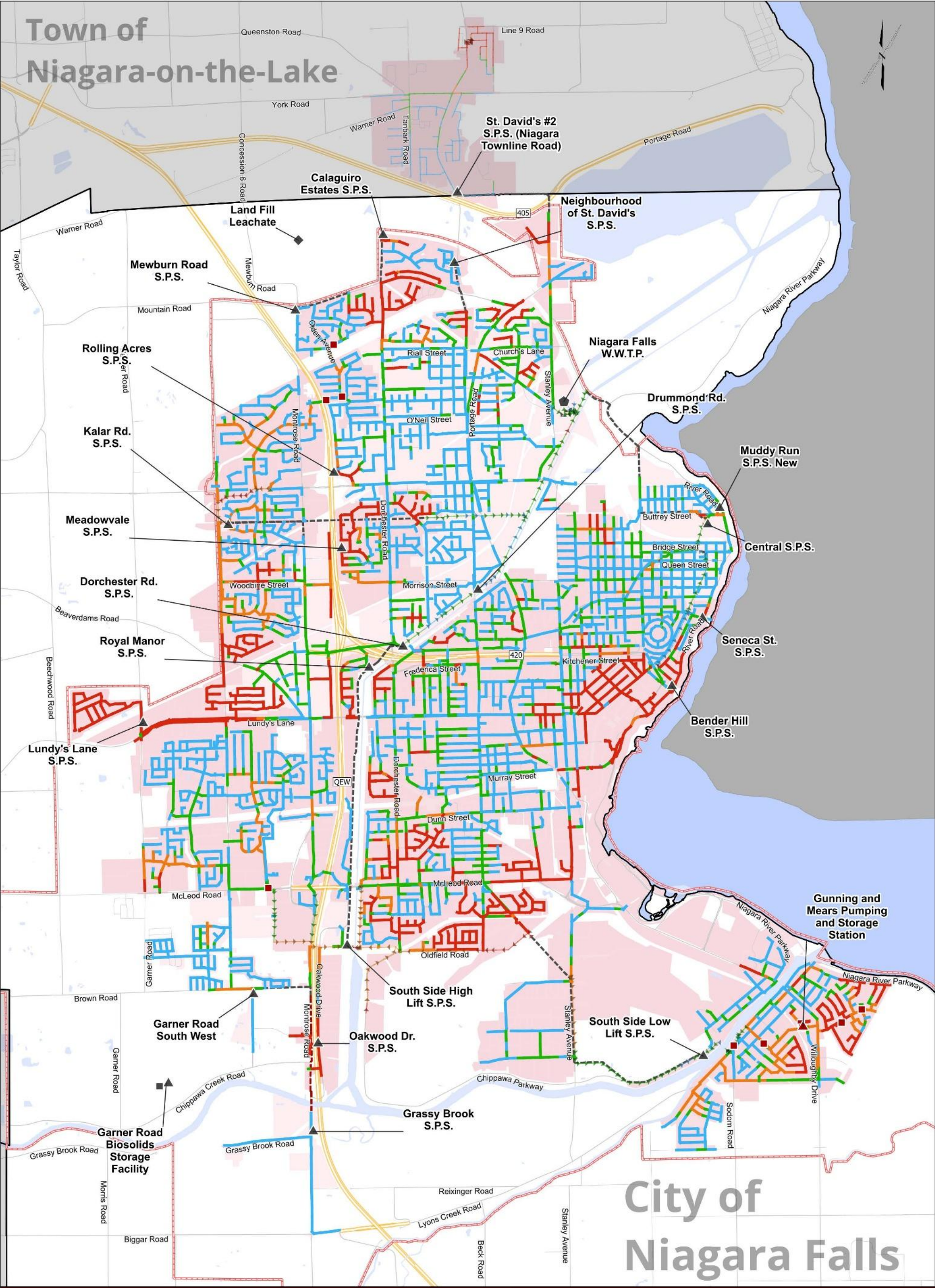
2 km

Figure 5-2
Existing System Performance Under Region Wet Weather Design Flow

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)





Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

Regional Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse
- Wastewater Catchment
- High I&I Catchments

Reference(s)

- Projection EPSG:26917
- Base Data: City of Niagara Falls, 2023

1 2 km

Figure 5-3
Existing System Performance Under 10-Year Design Storm

Project Name:
Master Servicing Plan and Wet Weather
Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)



Wastewater flows to the Region owned SPSs were modelled (as detailed in **Appendix A Model Methodology Technical Memo**) and summarized in **Table 5-2**. Deficiencies based on the Regional infrastructure level of service (**Appendix A of Volume 2**) are highlighted, particularly where flows exceed the operational firm capacity and where the RDII exceeds the Region and City's allowance of 0.4 L/s/ha for existing catchments.

Most catchments exceed the RDII allowance under the 5-year design storm flow, indicating high I&I rates throughout the system. All SPSs within the City boundaries have capacity to convey the Region's design peak wet weather flow, however, the 5-year and 10-year peak wet weather flow generally exceeds the SPS capacity.

Table 5-2. Existing Flow to Region-Owned SPS

SPS	Operation al Firm Capacity	Peak Dry Weather Flow	Design Allowance Peak Wet Weather (0.4 L/s/ha)	5-Year Storm Peak Wet Weather Flow		10-Year Storm Peak Wet Weather Flow
	L/s	L/s	L/s	L/s	L/s/ha (WWF component only)	L/s
L→Calaguire SPS	5.5	2.8	11.9 ⁽¹⁾	9.8	0.3	10.6
L→Central SPS	800.0	289.8	680.9	4371.2	6.0 ⁽¹⁾	4795.7
L→Bender Hill SPS	237.0	113.5	192.7	1004.6	4.5	1054.1
L→Muddy Run SPS	77.0	9.6	34.8	118.1	1.7	115.3 ⁽²⁾
L→Seneca Street SPS	63.0	5.5	22.2	131.4	3.0	121.1 ⁽²⁾
L→Dorchester Road SPS	185.0	80.2	301.4	442.9	1.1	480.7
L→Lundy's Lane SPS	56.3	10.5	48.2	180.4	1.8	183.9
L→Meadowvale SPS	34.0	7.4	21.8	108.2	2.8	118.7
L→Rolling Acres SPS	52.3	7.8	27.7	76.5	1.4	84.2
L→Royal Manor SPS	8.8	3.1	16.2	296.1	9.0	323.1
L→Drummond Road SPS	56.7	6.7	41.7	113.3	1.2	125.0
L→Kalar Road SPS	463.0	72.7	272.8	575.4	1.0	564.2 ⁽²⁾
L→Mewburn SPS	17.1	0.8	4.4	9.4	1.0	10.9
L→Neighbourhood SPS	29.0	2.6	9.8	7.5	0.3	8.4
L→St. Davids #2 SPS (NOTL)	42.0	33.9	133.8	51.9	0.4	55.2
L→South Side High Lift SPS	609.0	215.6	1,047.6	1154.1	0.8	973.2 ⁽²⁾
L→South Side Low Lift SPS	392.1	33.2	319.7	675.2	0.9	728.2
L→Garner SPS	99.7	9.6	48.8	116.6	1.1	110.9 ⁽²⁾
L→Oakwood SPS	13.0	1.9	16.0	32.0	0.9	38.5
L→Grassy Brook SPS	17.8	2.2	23.4	28.1	0.5	33.7

Notes:

1. Red Text denotes flows that exceed the operational firm capacity and where the RDII exceeds the 0.4 L/s/ha.
2. Model noise.

5.2. Overflows

5.2.1. MECP F-5-5 Compliance

The Niagara Falls system overflows were evaluated under the objectives of **MECP F-5-5: Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems**¹ for the 2 City-owned SSOs, 13 CSOs and 8 Region-owned overflows at the Region SPSs.

The Technical Criteria from MECP Procedure F-5-5 that are required for the Study are as follows:

- No overflows during dry weather;
- Maximize the use of the collection system for the storage of wet weather flows when capacity is available; and
- During a seven (7) month period commencing within 15 days of April of an average year, provide 90% volumetric control of wet weather in addition to all of the dry weather flow.

The City does not have historical modelling at the overflows directly. As such, the overflow volumes at the City-owned overflows were estimated based on the City's hydraulic model. The model generates flow volumes which can be used to determine the percentage of treated wet weather flow.

- Total System Flow Volume is the model estimated flow that is conveyed to the WWTP during the Typical Year (2022) F-5-5 Period.
- Total Wet Weather Volume is the wet weather only component of the system flow.
- CSO Untreated Volume is the volume of flow discharged from overflow structures with no treatment.

The overflows at the Region SPSs, Central SPS HRT, and the Niagara Falls WWTP By-pass were reported by the Region. **Table 5-3** presents the modelled and reported overflows under the City's Average Precipitation Year of 2022 determined in the **Wastewater Model Methodology Technical Memo (Appendix A)**. It is estimated that the system captures 95.7% of the system wet weather flows over the F-5-5 period of the Average Precipitation Year of 2022 and achieves all F-5-5 objectives as summarized in **Table 5-5** and **Table 5-5**.

Additionally, Section 11 of the F-5-5 Regulation mandates that:

"When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem until the necessary upgrading, as outlined by a Pollution Prevention and Control Plan is carried out in keeping with the requirements of this Procedure. Some development is allowed as upgrading proceeds, conditional upon its progress. The staged upgrading should at a minimum provide for the transmission and treatment of all flows from the additional development. This provision applies to significant development i.e. not to simple, one lot infill cases."

To align with the Procedure and Region approach, the MSP-WWMS assesses solutions such that growth does not increase system wet weather flows, City-wide. Development approvals will not be limited in advance of the I&I reduction, but it is encouraged that the City remove I&I at a similar rate of development.

¹ MECP F-5-5 Website: <https://www.ontario.ca/page/f-5-5-determination-treatment-requirements-municipal-and-private-combined>

Table 5-3. Niagara Falls WWTP F-5-5 Wet Weather Flow Outfalls under Average Precipitation Year (2022)

City Asset ID	Location	Ownership	SSO/CSO	Modelled/Reported	Overflow Volume (m ³)	Number of Overflow Days
SMH_05342	Park Street	City of Niagara Falls	CSO	Modelled	-	-
SMH_05547	Bellevue Street	City of Niagara Falls	CSO	Modelled	-	-
SMH_06144	McLeod Road	City of Niagara Falls	CSO	Modelled	5,578	206
SMH_04934	Greenwood / Bridgewater	City of Niagara Falls	SSO	Modelled	196	8
SMH_06498	General Abrasive / Stanley Avenue	City of Niagara Falls	CSO	Modelled	-	-
SMH_06890	Pell's Creek Sewer at John Daly Way	City of Niagara Falls	CSO	Modelled	-	-
SMH_02300	Valley Way at Houck Park	City of Niagara Falls	CSO	Modelled	50	3
SMH_03741 ⁽¹⁾	High Street / Brookfield Avenue	City of Niagara Falls	CSO	Modelled	-	-
SMH_04247	Dunn / Dorchester	City of Niagara Falls	CSO	Modelled	466	6
SGM_04518 ^(1,3)	Franklin North (Franklin Avenue / Ash Street)	City of Niagara Falls	CSO	Modelled	119	4
SMH_02296 ⁽²⁾	Valley Way at Stanley Av	City of Niagara Falls	CSO	Reported	-	-
SMH_05178 ⁽²⁾	Front Street	City of Niagara Falls	SSO	Reported	-	-
DMG_01058	Margaret Street / Warden Avenue	City of Niagara Falls	CSO	Reported	-	-
SMH_06639	Lundy's Lane / Garner Road	City of Niagara Falls	CSO	Modelled	469	7
DMH_03155	Portage Road / Morrison Street	City of Niagara Falls	CSO	Reported	-	-
N/A	Royal Manor SPS	Niagara Region	SPS Overflow	Reported	1,586	1
N/A	Dorchester Rd SPS	Niagara Region	SPS Overflow	Reported	8,732	9
N/A	S.S. High Lift SPS	Niagara Region	SPS Overflow	Reported	20,060	4
N/A	Meadowvale SPS	Niagara Region	SPS Overflow	Reported	-	-
N/A	Drummond SPS	Niagara Region	SPS Overflow	Reported	1,081	6
N/A	Seneca St SPS	Niagara Region	SPS Overflow	Reported	1,772	7
N/A	Muddy Run SPS	Niagara Region	SPS Overflow	Reported	509	6
N/A	Bender Hill SPS	Niagara Region	SPS Overflow	Reported	7,834	2
System Total CSO Untreated Volume					48,452	269

Notes:

1. CSOs which were not included as part of the CLI-ECA completed in March 2025 but were included in the hydraulic model.
2. CSOs which were included as part of the CLI-ECA completed in March 2025 but were not included in the hydraulic model
3. Historically counted as two CSOs as listed in CLI-ECA. Confirmed with field survey and City that it is a single CSO at Franklin and Ash Street.

Table 5-4. Niagara Falls WWTP F-5-5 Wet Weather Flow Capture Rate under Average Precipitation Year (2022)

Total System	Typical Year F-5-5 Period (2022)
Total System Flow Volume (m ³)	11,669,524
Total WWF Volume (m ³)	2,267,557
CSO Untreated Volume	48,452
System % Capture	97.9%

5.2.2. 2023 CSO Monitoring

The City's CSOs have not been historically monitored directly. As part of the current study, 17 of the City's major overflows were monitored between May and December 2023. Field surveys were also completed to confirm overflow configuration for modelling. The number of overflow events were counted based on peaks in flow following a rainfall event. Findings are summarized in **Table 5-5**.

Table 5-5. 2023 CSO Flow Monitoring

CSO Monitors	FM ID	# of Overflow Events
Bellevue Street	FM135	24
Valley Way at Stanley Av	FM136	21
Valley Way at Houck Park	FM137	6
McLeod Road	FM138	4
Pell's Creek Sewer at John Daly Way	FM139	-(1)
Greenwood / Bridgewater	FM140	0
High Street / Brookfield Avenue	FM141	-(1)
General Abrasive / Stanley Avenue	FM142	10
Dunn / Dorchester	FM143	28 ⁽⁴⁾
Margaret Street / Warden Avenue	FM144	0
Park Street	FM145	0
George Street	FM146	-(2)
Franklin North (Franklin Avenue / Ash Street)	FM147/ FM148	22 ⁽³⁾
Fraser Street	FM149	-(2)
Lundy's Lane / Garner Road	FM150	4
Front Street	FM151	6
Portage Road / Morrison Street	FM152	0

Notes:

1. Not monitored due to site/configuration restrictions.
2. Confirmed with City and/or field survey that CSO does not exist.
3. Historically listed as 2 separate CSOs as listed in CLI-ECA. Field survey show that there is 1 connection from sanitary to the storm via a storm chamber.
4. Noisy monitor data.

Compared to the average year (2022), 2023 was similar in terms of number of rainfall events, total rain volume, total duration, average event precipitation volume, and median peak 1-hr intensity, as shown in the **Wastewater Model Methodology Technical Memo (Appendix A)**. The flow monitoring program shows that the following overflow locations have a higher likelihood of overflows than the model suggests:

- Bellevue Street
- Valley Way / Stanley Avenue
- Dunn / Dorchester
- Franklin North

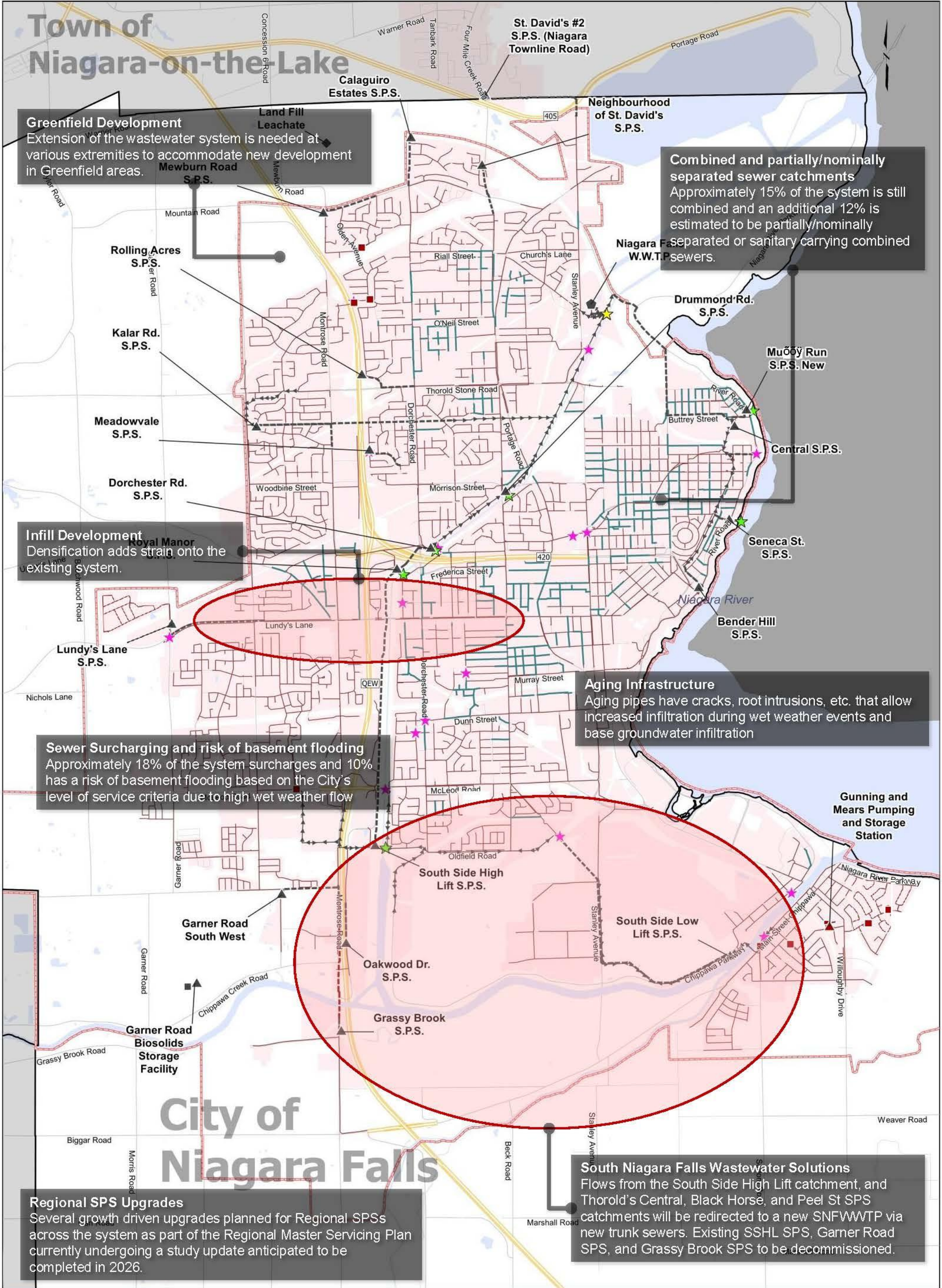
On the other hand, flow monitoring at McLeod Road shows that there are less overflows than what the model suggests to expect. The apparent inconsistencies may be due to uneven rainfall distribution across the system, as the model assumes uniform rainfall across the system based on the rain gauge at Niagara Falls WWTP used for the Average Year analysis.

5.3. Opportunities and Constraints

Existing wastewater system opportunities and constraints were identified through hydraulic analysis results from the City's wastewater model, a review of infrastructure data, and understanding of growth and the Region's MPSU capital projects. Overall, the wastewater system is able to collect and convey flows under dry and wet weather flow conditions while achieving the MECP F-5-5 objectives. However, with a portion of the system remaining as combined or nominally/partially separated, it is currently unable to meet the goals of total containment and treatment of sewage flows per the MECP Procedure F-5-1 required of fully separated systems. The following issues, opportunities, and constraints have been identified for the City's existing wastewater system, as further shown in **Figure 5-4**.

- **Sewer Surcharging and risk of basement flooding**
 - Approximately 17.9% of the system surcharges under the 10-year design storm and 9.2% of the system surcharges above the 2.1m basement protection freeboard elevation based on the City's level of service criteria due to high wet weather flow
- **Combined and partially/nominally separated sewer catchments**
 - Approximately 14.6% of the system is still combined and an additional 12.1% is estimated to be partially/nominally separated or sanitary carrying combined sewers, acting as a source of stormwater and I&I into the system leading to increased risk of overflows and flooding to basement and surface
- **Aging Infrastructure**
 - Aging pipes have cracks, root intrusions, etc. that allow increased infiltration during wet weather events and base groundwater infiltration
- **Regional Upgrades**
 - St. David's #2 SPS Upgrade from NOTL discharging to the City-owned Stanley Avenue Trunk Sewer from 42 L/s to 202 L/s
 - Bender Hill SPS full station replacement to re-establish the capacity from 237 L/s to 330 L/s ECA Capacity
 - Re-establish Central SPS capacity from 800 L/s to 1000 L/s ECA capacity
 - Re-establish Lundy's Lane SPS from 56 L/s to 98 L/s ECA capacity
 - Increase Royal Manor SPS capacity from 9 L/s to 16 L/s
 - Increase Dorchester Road SPS capacity from 185 L/s to 345 L/s
- **South Niagara Falls Wastewater Solutions**
 - Redirection of flows from the South Side High Lift catchment, and Thorold's Central, Black Horse, and Peel St SPS catchments to a new SNFWWTP via new trunk sewers

- Decommission SSLH SPS, Garner Road SPS, and Grassy Brook SPS
- **Infill Development**
 - Densification adds strain onto the existing system
- **Greenfield Expansion**
 - Extension of the wastewater system is needed at various extremities to accommodate new development in Greenfield areas.



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Sewer Overflows

- WWTP By-Pass
- Regional SPS Overflow
- City-owned Overflow

Forcemain

- Regional
- Municipal (Niagara Falls)

Gravity Main

- Regional
- Municipal (Niagara Falls)
- Other Municipal (NOTL)
- Yes

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse
- Wastewater Catchment

Reference(s)

1. Projection EPSG:26917
2. Base Data: City of Niagara Falls, 2023

1 2 km

Figure 5-4
Existing Wastewater System Opportunities and Constraints

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)

GEI

Last Updated: September 2025
Document ID: 2402014-001

6. Assessment of Future Wastewater Infrastructure

Following the evaluation of existing system performance, future growth to 2051 and buildout was assessed to understand growth impacts on the local distribution system. In combination with existing system performance, these results were used to develop the servicing strategy.

6.1. Growth Projections

To confirm appropriate projections, the growth forecast was developed through the review of planning data and workshops with City Staff as presented in **Section 4.2 of Volume 2** of this MSP-WWMS. Through discussions with the City, it was determined that two growth scenarios would be used to estimate future system demands and growth-related water infrastructure needs, consisting of:

- **Interim growth scenario – Growth to 2051:** Consisting of buildout of all existing draft plan areas.
- **City buildout scenario – Growth to Ultimate Buildout:** Consisting of full buildout of the City's Urban Boundary.

Table 6-1 summarizes the 2051 and buildout population projections with growth areas shown in Figure 6-1. Additional details regarding growth can be found in **Volume 2**.

Table 6-1. Population Projections

Growth Horizon	Residential	Employment	Total
Existing	96,720	37,857	134,577
2051	178,110	71,911	250,020
Buildout	287,172	117,544	404,716

6.2. Future System Flows

Projected population growth within the City increases wastewater flow across residential, employment, and tourist sectors. Future system flows were calculated with the planning data as outlined in **Table 6-1** and the design criteria as outlined in **Table 2-1**. The growth allocation applied growth to the identified growth parcels as delineated by the City or along intensification and tourist corridors with projections by traffic zone delineated in the Region's 2021 MSPU. **Table 6-2** summarizes the existing dry weather flow and calculated projected wastewater flow by SPS catchment area inclusive of all upstream catchments.

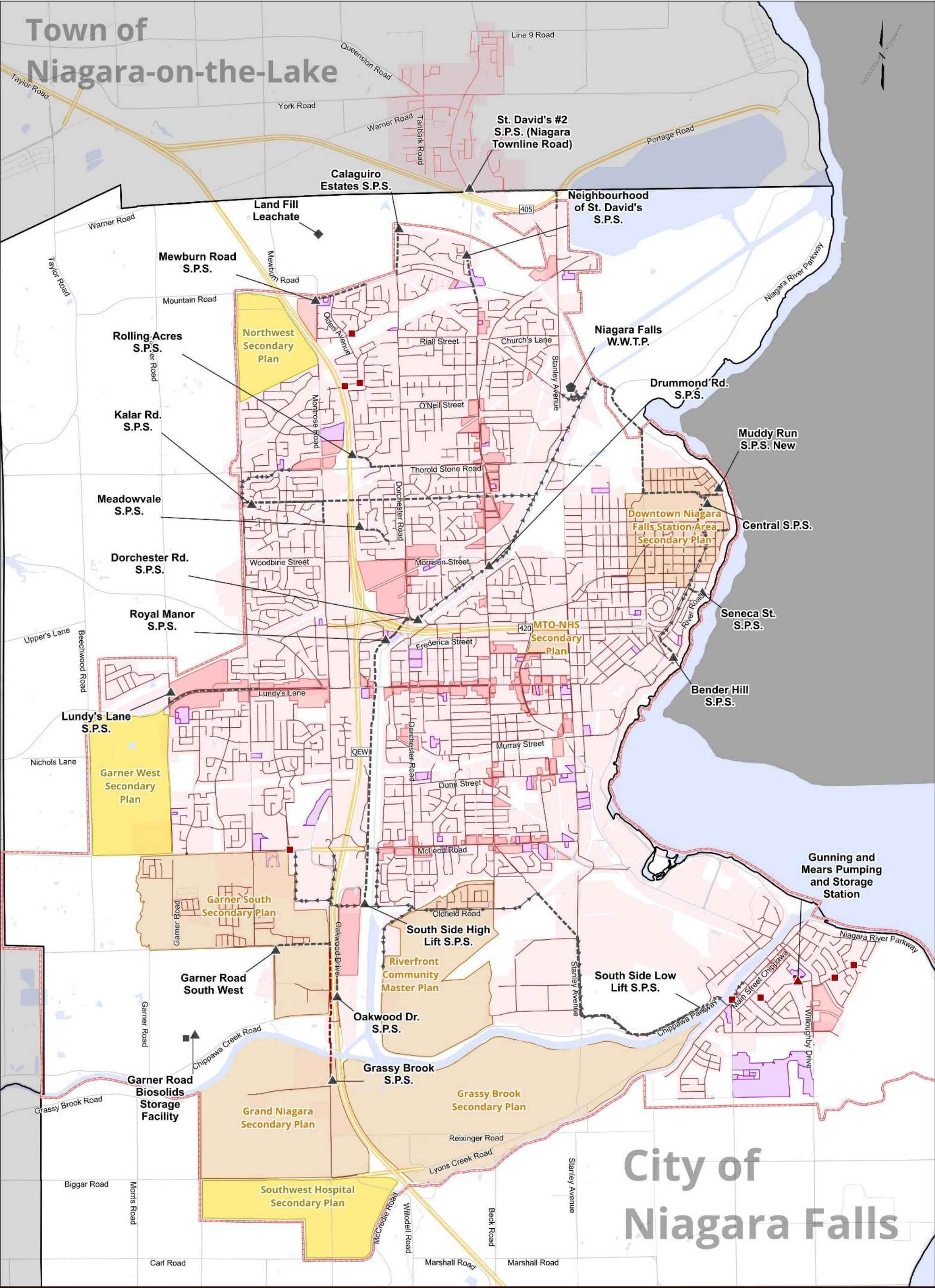


Figure 6-1
Growth Area

Project Name:
Master Servicing Plan and Wet Weather
Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)



Table 6-2 Wastewater Flow Projections by SPS Catchment

SPS Catchment (Inclusive)	Operational Firm Capacity	Existing RDII Design Flow (0.4 L/s/ha)	Existing Peak Dry Weather Flow	Existing Total Design Wet Weather Flow	Current to 2051				Current to Buildout			
					Additional Peak Sanitary Flow	Additional Greenfield RDII Design Flow (0.286 L/s/ha)	Growth Design Wet Weather Flow	Total Design Wet Weather Flow	Additional Peak Sanitary Flow	Additional Greenfield RDII Design Flow (0.286 L/s/ha)	Growth Design Wet Weather Flow	Total Design Wet Weather Flow
					L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s
Niagara Falls WWTP	N/A	265.2	654.4	2718.7	569.2	0.0	569.2	2,240.3	1,263.8	0.0	1,263.8	2,934.9
↳Calaguiro SPS	5.5	9.1	2.8	11.9 ⁽³⁾	0.0	0.0	0.0	11.9	0.7	0.0	0.7	12.6
↳Central SPS	800.0	270.1	289.8	680.9	206.1	5.1	211.2	892.1	362.3	10.2	372.5	1053.4
↳Bender Hill SPS	237.0	79.2	113.5	192.7	45.2	0.0	45.2	237.9	59.7	0.0	59.7	252.4
↳Muddy Run SPS	77.0	25.2	9.6	34.8	28.4	0.0	28.4	63.2	44.1	0.0	44.1	78.9
↳Seneca Street SPS	63.0	16.7	5.5	22.2	10.8	0.0	10.8	33.0	13.8	0.0	13.8	36.0
↳Dorchester Road SPS	185.0	136.0	80.2	301.4	98.4	0.0	98.4	399.7	316.3	0.0	316.3	617.7
↳Lundy’s Lane SPS	56.3	46.2	10.5	48.2	63.0	0.0	63.0	111.2	74.6	0.0	74.6	122.8
↳Meadowvale SPS	34.0	14.4	7.4	21.8	0.0	0.0	0.0	21.8	7.4	0.0	7.4	29.1
↳Rolling Acres SPS	52.3	20.4	7.8	27.7	0.0	0.0	0.0	27.7	5.5	0.0	5.5	33.3
↳Royal Manor SPS	8.8	13.1	3.1	16.2	6.0	0.0	6.0	22.2	9.8	0.0	9.8	26.0
↳Drummond Road SPS	56.7	34.9	6.7	41.7	12.1	0.0	12.1	53.8	66.9	0.0	66.9	108.5
↳Kalar Road SPS	463.0	200.0	72.7	272.8	87.3	21.6	108.9	381.6	178.8	48.5	227.3	500.1
↳Mewburn SPS	17.1	3.6	0.8	4.4	19.6	0.0	19.6	24.0	7.6	0.0	7.6	12.0
↳Neighbourhood SPS	29.0	8.7	2.6	9.8	0.0	0.0	0.0	9.8	4.3	0.0	4.3	14.1
↳St. Davids #2 SPS (NOTL)	42.0	16.5	33.9	133.8	20.5	0.0	20.5	154.3	52.1	0.0	52.1	185.9
South Niagara Falls WWTP ⁽¹⁾	N/A	N/A	N/A	N/A	472.4	170.0	766.5	766.5	826.4	340.3	1,218.9	1,218.9
↳South Side High Lift SPS ⁽²⁾	609.0	470.9	215.6	1,047.6	367.7	18.5	491.7	1,539.4	731.2	53.0	1,077.5	2,125.1
↳South Side Low Lift SPS	392.1	286.5	33.2	319.7	56.0	11.9	67.9	387.6	124.4	27.0	151.4	471.1
↳Garner SPS ⁽²⁾	99.7	39.2	9.6	48.8	30.2	20.0	50.2	99.0	42.9	103.2	146.1	194.9
↳Oakwood SPS	13.0	14.1	1.9	16.0	4.4	3.5	7.9	23.9	28.0	7.0	35.0	51.1
↳Grassy Brook SPS ⁽²⁾	17.8	21.2	2.2	23.4	200.0	70.2	270.1	293.6	293.5	156.1	449.6	473.0

Notes:

1. Thorold South flows not included, values reflect growth flow projections within the City of Niagara Falls only.
2. Future planned decommissioning as part of the SNF WWTP Solutions. Flows conveyed by gravity to SNF WWTP.
3. Red Text denotes flows that exceed the existing operational firm capacity.

6.3. Future System Performance

Local improvements are required to address both existing and future system capacity needs. The first step in the detailed analysis of the MSP-WWMS involved assessing the capacity and conditions of the existing infrastructure. Once the existing system conditions were established, the impacts of future growth on the wastewater system were analyzed to develop and evaluate potential servicing alternatives and address potential deficiencies and opportunities to improve system resiliency. The future system performance was evaluated with the following assumptions:

- The SNF WWTP Wastewater Solutions will be complete
- Region SPS were sized based on the Region's design wet weather flow for the 2051 and Buildout Growth scenarios using the City's respective planning projections

The LOS targets used in the evaluation of the 2051 system performance with the Region design wet weather flows are shown in **Figure 6-2**, and likewise with the City's 10-year design storm peak flows in **Figure 6-3**. Performance figures for the buildout scenario are provided in **Appendix B**.

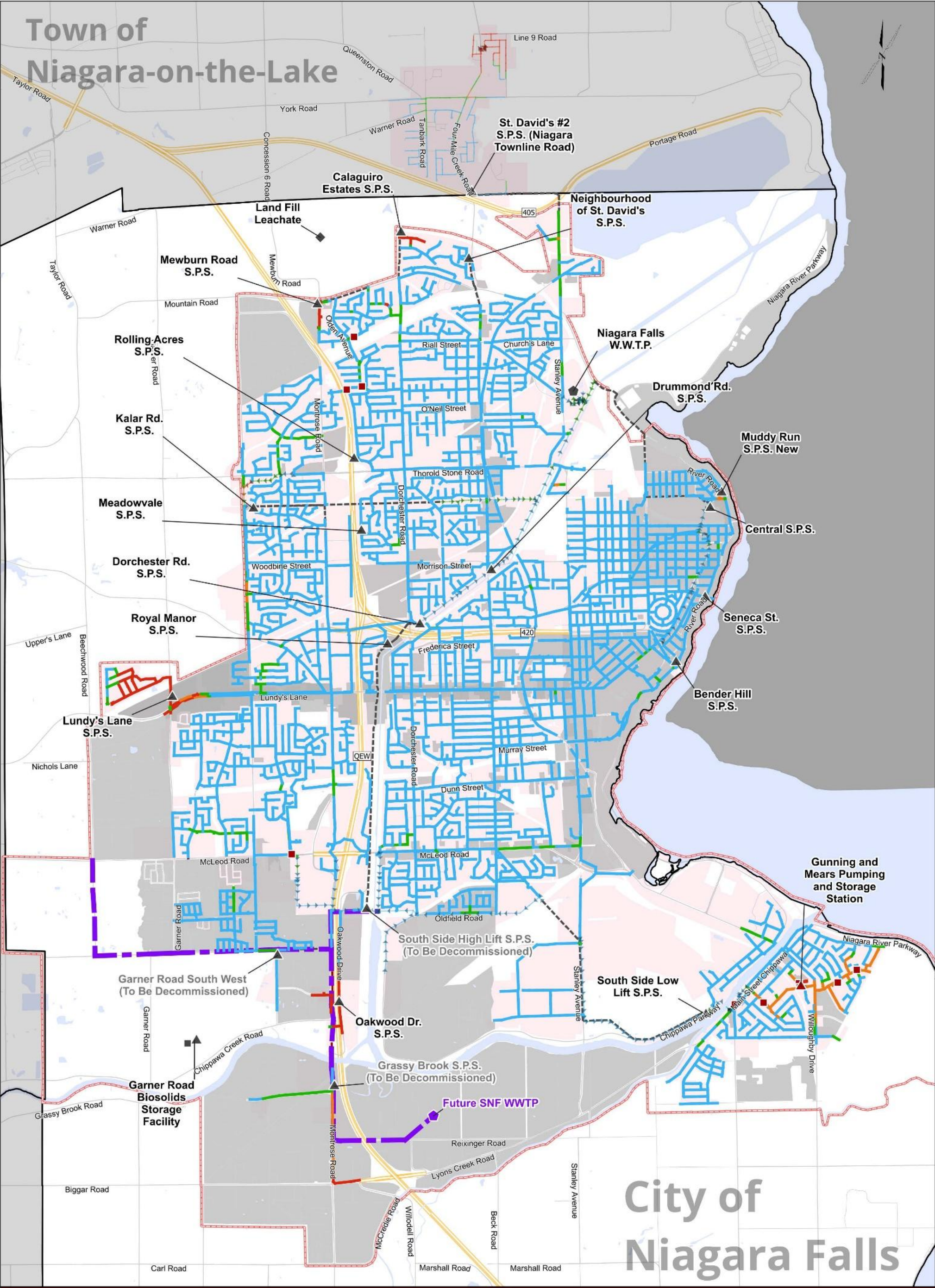
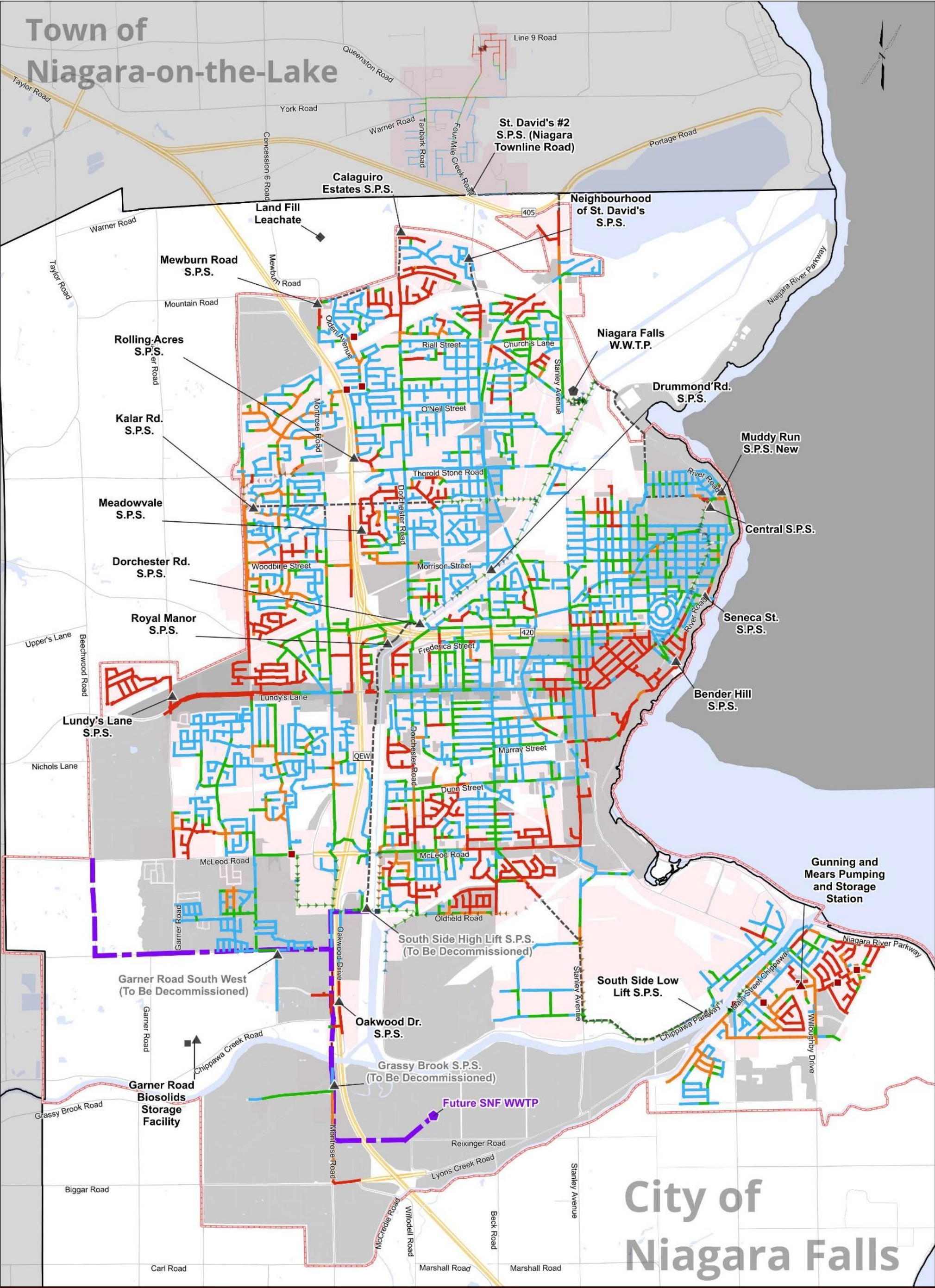


Figure 6-2
2051 Growth System Performance Under Region Wet Weather Design Flow

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)





Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (S.P.S.)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Force Main

- Regional
- Municipal (Niagara Falls)

Wastewater Catchment

- Growth Plans

Regional Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

Future Infrastructure

- Future SNF WWTP
- Future Trunk Sewers

Reference(s)

- Projection EPSG:26917
- Base Data: City of Niagara Falls, 2023

1 2 km

Figure 6-3
2051 Growth System Performance Under 10-Year Design Storm

Project Name:
Master Servicing Plan and Wet Weather
Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)



7. Wastewater Servicing and Wet Weather Management Strategy

The wastewater servicing and wet weather management strategy was developed under the context of identifying servicing solutions to address both system-wide and local opportunities and constraints. These alternatives focus on accommodating growth within the existing wastewater system to form an overall wet wastewater servicing and wet weather management strategy for the City.

As part of the MSP-WWMS, wastewater servicing strategies were reviewed to ensure:

- Best use of existing infrastructure to avoid new infrastructure where possible;
- Minimum cost of new infrastructure;
- Consideration for operations and maintenance costs to ensure financial sustainability;
- Long term reliability and security of the wastewater system;
- Avoidance and minimization of impacts and disruptions to the environment and cultural heritage resources where possible; and,
- Planning for future infrastructure in existing road right-of-ways where possible.

The strategy provides for a proactive and targeted approach to addressing wet weather impacts. Some wet weather management strategies will need to be a joint initiative between the City and the Region. The following sections summarize the wastewater servicing and wet weather management alternatives considered when developing the overall preferred strategy.

7.1. Regional Strategy

As part of the Region's 2021 MSPU, capital projects were identified as outlined in **Table 7-1**. These capital projects were included in the Region's most recent wastewater model update and carried forward into this model update and future system analysis. The City's growth projections were generally higher than the growth used in the 2021 Region MSPU. As such, the proposed SPS upgrade capacities were updated based on the City's growth projection flow needs following the Region's SPS assessment framework.

Table 7-1. Niagara Region Wastewater Capital Program for the Niagara Falls WWTP

Master Plan ID	Name	Description	Year
WW-FM-009	Dorchester Forcemain Upgrade	Replace Existing 350 mm Dorchester SPS Forcemain with new single 500 mm forcemain in Niagara Falls.	2027-2031
WW-FM-010	St. David's #1 Forcemain Upgrade	Replace existing 200 mm St. Davids #1 Forcemain with new single 400 mm in Niagara-on-the-Lake.	2027-2031
WW-FM-024	St. David's #2 Forcemain Upgrade	Replace existing 250 mm St David's #2 SPS forcemain with new single 400 mm in Niagara Falls.	2027-2031
WW-SPS-026	Dorchester SPS Pump Replacement	Increase station capacity from 185 L/s to 345 L/s by replacing the existing three pumps.	2027-2031

Master Plan ID	Name	Description	Year
		Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades.	
WW-SPS-031	St. David's #2 SPS Upgrade	Increase station capacity from 42 L/s to 202 L/s with a full station reconstruction.	2027-2031
WW-SPS-032	St. David's #1 SPS Upgrade	Increase station capacity from 29 L/s to 174 L/s. with a full station reconstruction.	2027-2031
WW-SPS-050	Bender Hill SPS Pump Replacement	Full station replacement at new location from 237 L/s to re-establish 330 L/s ECA capacity.	2022-2026
WW-SPS-051	Central SPS Pump Replacement	Increase station capacity from 800 L/s to re-establish 1000 L/s ECA capacity by replacing the existing five pumps.	2037-2041
WW-SPS-052	Lundy's Lane SPS Pump Replacement	Increase station capacity from 56 L/s to re-establish 98 L/s ECA capacity by replacing the existing three pumps.	2037-2041
WW-SPS-053	Royal Manor SPS Pump Replacement	Increase station capacity from 9 L/s to 16 L/s by replacing existing two pumps	2022-2026
WW-II-017	Region-Wide Wet Weather Reduction	Wet weather reduction program in all systems to be executed from 2022-2051	2022-2051
WW-ST-001	Region-Wide Flow Monitoring and Data Collection	Funding to support flow monitoring and data collection initiatives	2022-2051
WW-TP-005	Region-Wide WWTP Process Upgrades	Process upgrades to re-establish ECA capacity	2022-2051
WW-TP-006	Region-Wide WWTP Process Upgrades	Upgrades for odour control across the Region at forcemains, pump stations, and other locations.	2022-2051

Table 7-2. Niagara Region Wastewater Capital Program for the South Niagara Falls WWTP

Master Plan ID	Name	Description	Year
WW-D-003	Decommissioning of South Side High Lift SPS	Decommissioning of SSSL SPS, to be replaced by gravity trunk sewer to SNF WWTP	2037-2041
WW-D-004	Decommissioning of Garner SPS	Decommissioning of Garner SPS to be replaced by gravity connection to SNF WWTP	2032-2036
WW-D-006	Decommissioning of Grassy Brook SPS	Decommissioning of Grassy Brook SPS to be replaced by gravity connection to SNF WWTP	2032-2036
WW-FM-005	New Peel Street SPS Forcemain	New 400 mm Peel Street SPS Forcemain in Thorold from station to Black Horse SPS	2027-2031

Master Plan ID	Name	Description	Year
WW-FM-006	New Black Horse Forcemain to Niagara Falls	New Black Horse Forcemain to New South Niagara Falls Trunk on Barron Road to the Montrose Trunk Sewer	2027-2031
WW-SPS-028	Black Horse SPS Upgrade	New SPS location with increased capacity from 67 L/s to 180 L/s.	2027-2031
WW-SPS-058	Peel Street SPS Upgrade	Station upgrades which may be required to accommodate new forcemain	2027-2031
WW-SS-006	New Montrose Trunk Sewer	New tunneled trunk sewer on Montrose conveying flows from South Side High Lift SPS to the new South Niagara Falls WWTP	2027-2031
WW-SS-007	New Brown Road Trunk Sewer	Shallow gravity trunk from South Thorold to Garner SPS-South Niagara Falls trunk connection	2027-2031
WW-SS-008	Chippawa Trunk Sewer Phase 1	New tunneled 1200 mm trunk sewer from west of Lyon's Creek to South Niagara Falls WWTP	2032-2036
WW-SS-014	South Niagara Falls SSO Trunk	New sewer to eliminate overflows upstream of South Side High Lift SPS	2022-2026
WW-SS-015	Chippawa Trunk Sewer Phase 2	New tunneled 1200 mm trunk sewer from South Side Low Lift to west of Lyon's Creek	2037-2041
WW-TP-002	South Niagara Falls Wastewater Treatment Plant - Phase 1	New South Niagara Falls WWTP Phase 1 with 30 MLD capacity	2022-2026
WW-TP-003	South Niagara Falls Wastewater Treatment Plant Phase 2	New South Niagara Falls WWTP Upgrade from 30 MLD to 60 MLD	2037-2041
WW-TP-004	South Niagara Falls Wastewater Treatment Plant Outfall	New South Niagara Falls WWTP Outfall Structure	2022-2026

7.2. System-wide I&I Reduction

7.2.1. Sources of I&I

The analysis of flow monitoring data showed that the existing wastewater system experiences significant wet weather flow as summarized in **Table 5-2**, with RDII exceeding the Region allowance of 0.4 L/s/ha. Unwanted I&I can enter the system from a variety of sources, and each source exhibits a distinct wet weather flow response as fast, medium, or slow response to rainfall. Different field investigation strategies are used to determine and confirm the source and cause of I&I, as summarized in **Table 7-3**.

Table 7-3. Sources of Inflow and Infiltration

Source			Wet weather flow response	Field Investigation
Public	Infiltration	Defective sewer mains	Slow	CCTV
		Defective laterals	Slow	CCTV
		Defective manholes	Slow	CCTV/Scan
	Inflow	Catch basin connections	Fast	Smoke/dye testing + CCTV
		Submerged manhole lids	Fast	Topography review and/or site surveys
		Direct stormwater/sanitary connections (upstream combined sewers)	Fast	Smoke/dye testing + CCTV
		Indirect stormwater/sanitary connections	Medium/Fast	Smoke/dye testing + CCTV
Private	Infiltration	Defective laterals	Slow	CCTV
	Inflow	Downspout connections	Fast	Smoke testing + site surveys
		Weeping tile connections	Medium	Smoke testing + house surveys + CCTV
Other		Defective lateral inspection tees	Slow	Site surveys
		Backflow from water bodies (rivers, streams)	N/A	Flow data + video

7.2.2. Challenges and Opportunities

While some level of infiltration is inevitable, particularly in aging systems with compromised conditions, excessive I&I leads to peak flows that reduces the available capacity of the wastewater system leading to:

- Increased storage, pumping, and treatment needs
- Increased risk of sewer surcharging, basement flooding, CSOs, and surface flooding
- Reduced sewer capacity to accommodate future growth and more costly infrastructure upgrades

Reducing I&I presents several challenges. The process requires significant capital investment and time, and benefits may not always be immediately clear. As I&I sources are underground and sometimes on private property, it also requires strong co-operation with property owners and sustained support. Despite these challenges, I&I reduction remains a critical and cost-effective strategy for sustainable wet weather management, extending the lifetime of existing and new infrastructure. Such benefits include reduction of storage, pumping, and treatment volumes and associated costs; maximizes the use of existing infrastructure; defers or avoids costly sewer upgrades; reduces CSOs and associated water quality impacts; supports compliance with MECP F-5-5 requirements; and enhances system performance and resiliency under increase in intensity and frequency of rainfall due to climate change. Further, the Region assessment framework for SPS design capacity is based on a 0.4 L/s/ha RDII allowance for existing catchments. To encourage joint effort between the Region and local area municipalities to manage wet weather flows, flows exceeding this criteria will not be accommodated in Region infrastructure upgrades. The local system must accommodate wet weather volume with storage capacity or reduce I&I.

7.2.3. Strategic Approach

To best ensure success, I&I reduction should be completed through a tactical program approach which targets high priority areas and avoids redundant investigations. The basis of the I&I removal best practices is that all data collected is valuable and used to deduce sources of I&I. A tactical I&I workflow is as follows:

1. Short-term flow monitoring program and flow analysis
2. Field investigation
3. Removal of I&I source, for example:
 - a. Removal of cross-connections from storm sewers and catch basins
 - b. Sewer lining or replacement
 - c. Maintenance hole lining
 - d. Downspout and weeping tile/foundation drain disconnection from private properties
 - e. Sewer separation
4. Post-remediation monitoring to inform future decision-making

Public engagement is also critical for addressing private-side sources of I&I. The City's ongoing Weeping Tile Removal Assistance Program (WRAP) provides incentive for homeowners to disconnect existing weeping tile connections or downspouts to sanitary, install sump pumps, as well as backwater valves, by providing financial rebates to pay for the works. Historically, the rate of program adoption has been moderate with 95 applications in 2024. However, it is not well understood how many weeping tiles or downspouts are still connected to the sanitary system in the City and where they are. The City can review property age to understand where weeping tile systems are connected. In addition, the City should consider undertaking House Hold Drainage Surveys which review a significant sample size of properties (at least 100) for catchment areas. This data will give the City some additional information about the typical connectivity in defined catchment areas. These areas can be overlaid with the priority I&I reduction catchments delineated as part of the MSP-WWMS to target the program and prioritize funding applications.

The system-wide I&I reduction program is a key component of the MSP-WWMS for the Niagara Falls wastewater system. Successful implementation of I&I program will require collaboration with the Region and neighbouring municipalities, as well as leveraging funding opportunities such as the Region's CSO Control Costing Sharing Program.

7.3. Sewer Separation Strategy

The City's wastewater system is predominantly separated, however approximately 10% remains as combined sewers which collect and convey both storm and sanitary flow in the same pipe. Combined sewers are part of the legacy sewer infrastructure that contributes to I&I and associated critical issues including reducing available capacity in the downstream system, sewer surcharging, basement flooding, and overflow events during wet weather conditions. Furthermore, the combined flows are carried downstream to newer, separated sewers and Region sewers and SPSs, further increasing the risk of the negative impacts of sewer capacity issues. Sewer separation is a critical step towards mitigating these risks. However, there are various challenges to implementation, including:

- High capital costs and lack of funding
- Identifying all storm and sanitary connections within the network

- Logistical challenges due to disruptions to traffic, businesses, and residents during construction
- Environmental constraints when identifying outlets for new stormwater catchments
- Long implementation timelines

As part of the MSP-WWMS, a strategic, risk-based approach was developed in the form of a sewer separation strategy. Details of the analysis are provided in **Appendix C**. The strategy provides a long-term plan for bringing the City beyond the MECP Procedure F-5-5 requirements for combined system overflows and closer to the Procedure F-5-1 treatment requirements and elimination of SSOs and CSOs. The replacement of the combined system with separated sewers also enhances the system resiliency under climate change and future growth needs. The Strategy provides a roadmap to these goals by identifying the highest risk catchments and providing a guide to prioritizing investment that is flexible for aligning with other City initiatives, plans, and timing of funding availability.

The City is currently advancing detailed design for two sewer separation projects, including the Corwin and Valley Way sewer separation projects. These projects will provide valuable lessons to inform future phases of the Sewer Separation Strategy.

7.4. Linear Upgrades

Areas where there are existing deficiencies may benefit from sewer upgrades should I&I reduction be infeasible. Growth impacts have the potential to further increase the risk of pipe surcharging and basement flooding in the existing system and can be partially funded through development charges. To service growth areas, both greenfield and infill/intensification areas, sewer upgrades or construction of new sewers are necessary. These sewers include new extensions to service new greenfield growth areas, and sewer upgrades in existing areas to provide capacity for existing and growth flows. These projects are typically funded through development charges.

7.5. Assessment of Future Wastewater Infrastructure

The following servicing concepts were evaluated:

- Do nothing
- New sewers/upgrades including pipe upsizing and flow redirection
- Wet weather management including I&I reduction and sewer separation
- Hybrid solution

The process for developing, evaluating, and selecting the preferred wastewater servicing strategy followed these key steps:

1. Review of baseline performance across the system
2. Review of the future performance of the system under 2051 flow projections
3. Identify project areas based on deficiencies according to the City level of service criteria, opportunities, and constraints under existing and 2051 flow projections
4. Develop high-level servicing concepts to meet the City's Level of Service Design Criteria under Buildout flows
 - a. Identify new extension sewers required for greenfield growth servicing
 - b. Identify location of deficiency (i.e., insufficient local sewer capacity or downstream Regional infrastructure backflow)

- c. Identify if deficiency is present under the Region's design wet weather flow or due to high I&I exceeding the design flow
- d. Identify if the area receives combined flows and can benefit from sewer separation. Sewer separation areas will be flow monitored.
- e. Identify sewer upsizing need, storage need, or flow redirection to resolve deficiency
- f. Identify how much I&I reduction is required to resolve deficiency
- g. Estimate potential of I&I removal and minimize infrastructure upgrade need
5. Review each concept with evaluation criteria with respect to social, legal, technical, and financial factors. Develop advantages and disadvantages for each
6. Provide additional detail for the preferred concept ensuring alignment, siting, capacity, timing, and other technical factors
7. Develop a conceptual cost estimate for each project

Generally, most identified projects where there are deficiencies in the existing system benefited from a hybrid solution and are included in the final preferred capital program.

7.5.1. Project Areas and Alternatives

Project areas where there were more nuanced alternatives or flagged for additional study are summarized in the tables below. The final preferred alternative is decided upon based on discussions with City staff.

Table 7-4. Oakwood Drive SPS

	Alternative A: I&I Reduction	Alternative B: Coordinate with Region to increase SPS capacity
Project identification	- Flagged as part of 2021 Region MSP as having existing and growth-related wet weather capacity deficits under 5-year design flow, upgrades recommended - Deficits confirmed under current study, RDII exceeds Region allowance(>0.4 L/s/ha) - High priority, existing deficiencies, supports greenfield growth	
Overview	50% target I&I reduction	Increase SPS capacity to 5-year design storm peak flow (45 L/s) instead of Region design wet weather flow
Advantages	Potentially low overall cost – avoids SPS upgrade	- Guaranteed resolution of surcharging under projected flows - Still consistent with Region's assessment framework
Disadvantages	- All I&I removal costs will be incurred by City - City sewers already have sufficient capacity to convey flows, just not enough network storage to hold backflow from SPS - I&I removal does not guarantee resolution - Potential high costs should source of I&I be difficult to find	- Higher capital cost - Possibility that I&I may increase with aging infrastructure
Preferred Solution	Alternative B	

Table 7-5. Niagara Falls Convention Centre

	Alternative A: Linear Upgrades on Stanley and McLeod Road	Alternative B: Flow diversion - new sewer through Conrail Drain	Alternative C: Flow diversion – new sewer on Thundering Waters Blvd
Project identification	- Risk of basement flooding on McLeod Road and flooding to surface on Stanley Avenue due to sewer deficiencies under existing and future flows - High growth area: Intensification corridor on McLeod Road and Niagara Falls Convention Centre plan on Stanley Avenue		
Overview	- Twin sewer on Stanley Avenue - Upsize sewers on McLeod Road - I&I Reduction	- Twin sewer on Stanley Ave - Divert flows on McLeod from Stanley Ave to flow west to new sewer through Conrail Drain - Divert flows on McLeod from Ailanthus to flow east to new sewer through Conrail Drain - Upsize existing sewers on McLeod from Ailanthus to Stanley Ave - I&I Reduction	- Twin sewer on Stanley Ave - New sewer on Thundering Waters Blvd diverting flows from Stanley Ave directly south to Region trunk - Divert flows on McLeod from Ailanthus to Stanley Ave to flow east to new sewer on Thundering Waters Blvd - I&I Reduction
Advantages	Provides capacity for growth	Provides capacity for growth	Minimal environmental concerns
Disadvantages	High traffic on McLeod Road, construction challenges	Potential environmental concerns and design challenges to accommodate 15m environmental buffer	Surcharging still occurs along McLeod
Recommended Alternative	Alternative B		

Table 7-6. Chippawa

	Alternative A: I&I Reduction	Alternative B: Local Linear Upgrades	Alternative C: Deep Sewer
Project identification	- Risk of basement flooding along upstream neighbourhoods and downstream collector sewers within the catchment under existing and future flows based on updated flow monitoring data - Greenfield and intensification growth within catchment - Has a history of wet weather flow issues causing frequent basement flooding managed by several inline and offline storage facilities and I&I reduction efforts		
Overview	I&I reduction	Upsize sewers strategically and redirect flows within catchment for more efficient flow paths downstream to SSLL SPS	Redirect flows to future Rexinger Road trunk sewer to SNF WWTP
Advantages	Potential to identify and remove source of I&I	Resolves deficiencies in downstream collector sewers within the catchment	Provides wet weather flow a shorter, direct path to a trunk sewer
Disadvantages	I&I efforts have been completed with	Does not resolve some upstream deficiencies	Need to wait for commissioning of SNF

	Alternative A: I&I Reduction	Alternative B: Local Linear Upgrades	Alternative C: Deep Sewer
	rehabilitation projects on public side, however, wet weather issues persist Historical challenges with private and residential-side cooperation to access private-side I&I sources		WWTP and Reixinger Road trunk Does not resolve some upstream deficiencies
Recommended Alternative	Alternative B (with local flow monitoring to confirm flows)		

7.5.1.1. Needs Additional Studies

The following study areas were identified as having deficiencies under the existing and 2051 10-year design storm flows, shown in the figures in the tables below. These areas require further study before feasible alternatives can be identified and discussed.

- Table 7-7. Lundy's Lane SPS Catchment
- Table 7-8. Meadowvale SPS
- Table 7-9. Oldfield Road
- Table 7-10. Stanley Avenue north of NF WWTP

Table 7-7. Lundy's Lane SPS Catchment

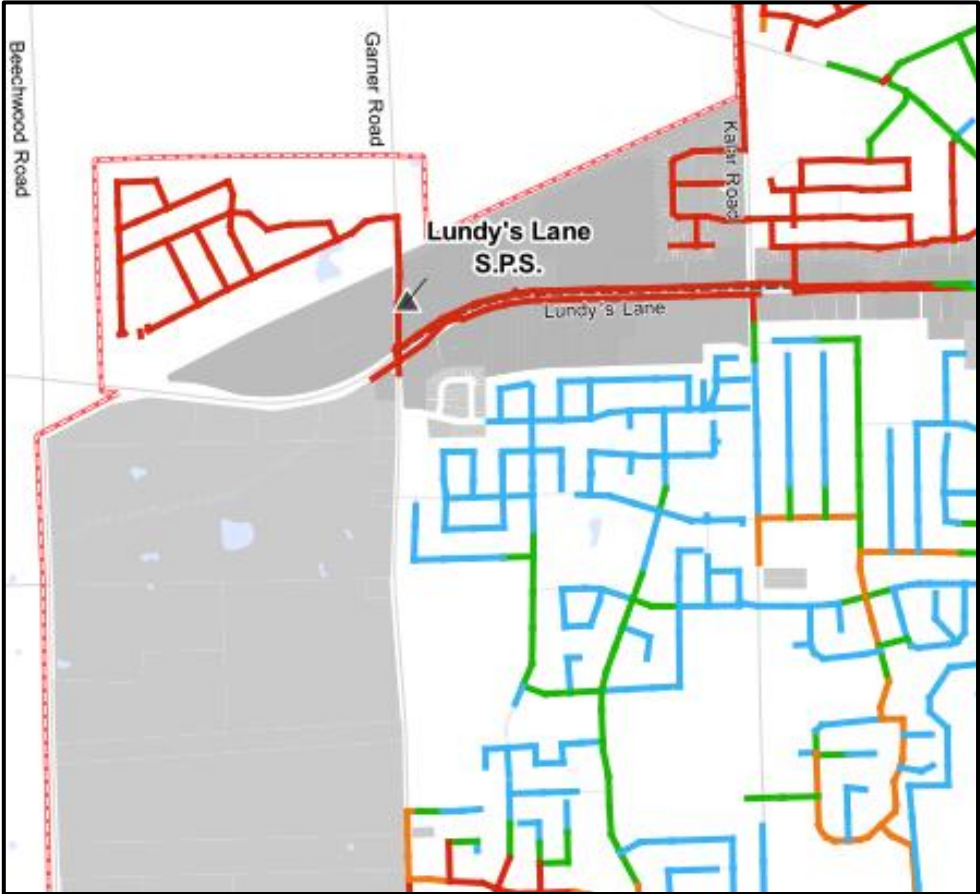
	Lundy's Lane
Project identification	 • Lundy's Lane SPS catchment deficient under existing and 2051 flows • Future deficiencies identified in the 2021 Region MSPU, flagged for upgrades • City-owned sewers where Lundy's Lane SPS discharges are also deficient under growth flows • I&I may not be sufficient to free up capacity to accommodate growth • Discharges to City-owned sewers that are residential before discharging to Region Trunk, construction challenges
Recommended Next Steps	• Flow monitoring upstream of SPS to confirm flows • Coordinate with Region on a joint study to develop alternatives to reroute flows south

Table 7-8. Meadowvale SPS

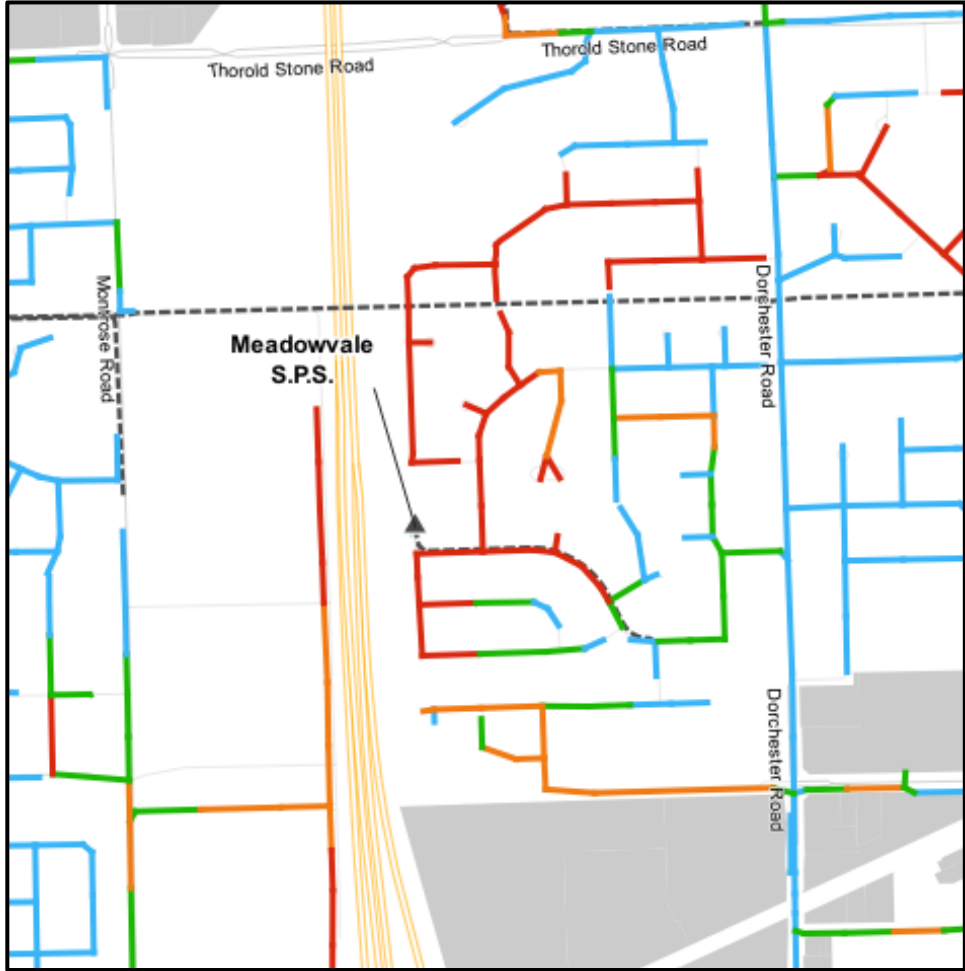
	Meadowvale SPS
Overview	 - Flagged as part of 2021 Region MSP as having existing wet weather capacity deficits under 5-year design flow, potential system or facility upgrades may be required - Confirmed deficiencies under current study with existing flows - Medium priority, existing deficiencies, no planned growth in catchment
Recommended Next Steps	- Flow monitoring upstream of SPS to confirm flows - Coordinate with Region on SPS upgrade to 5-year design flow

Table 7-9. Oldfield Road

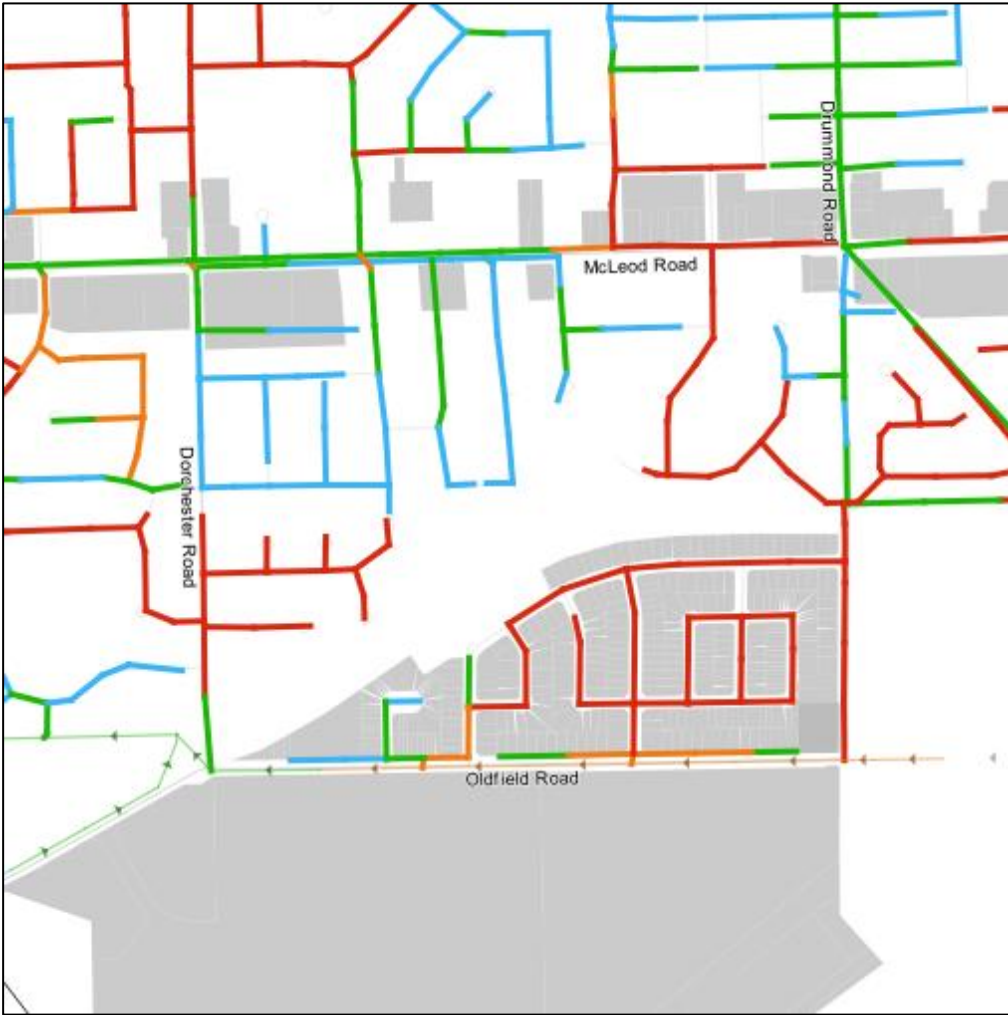
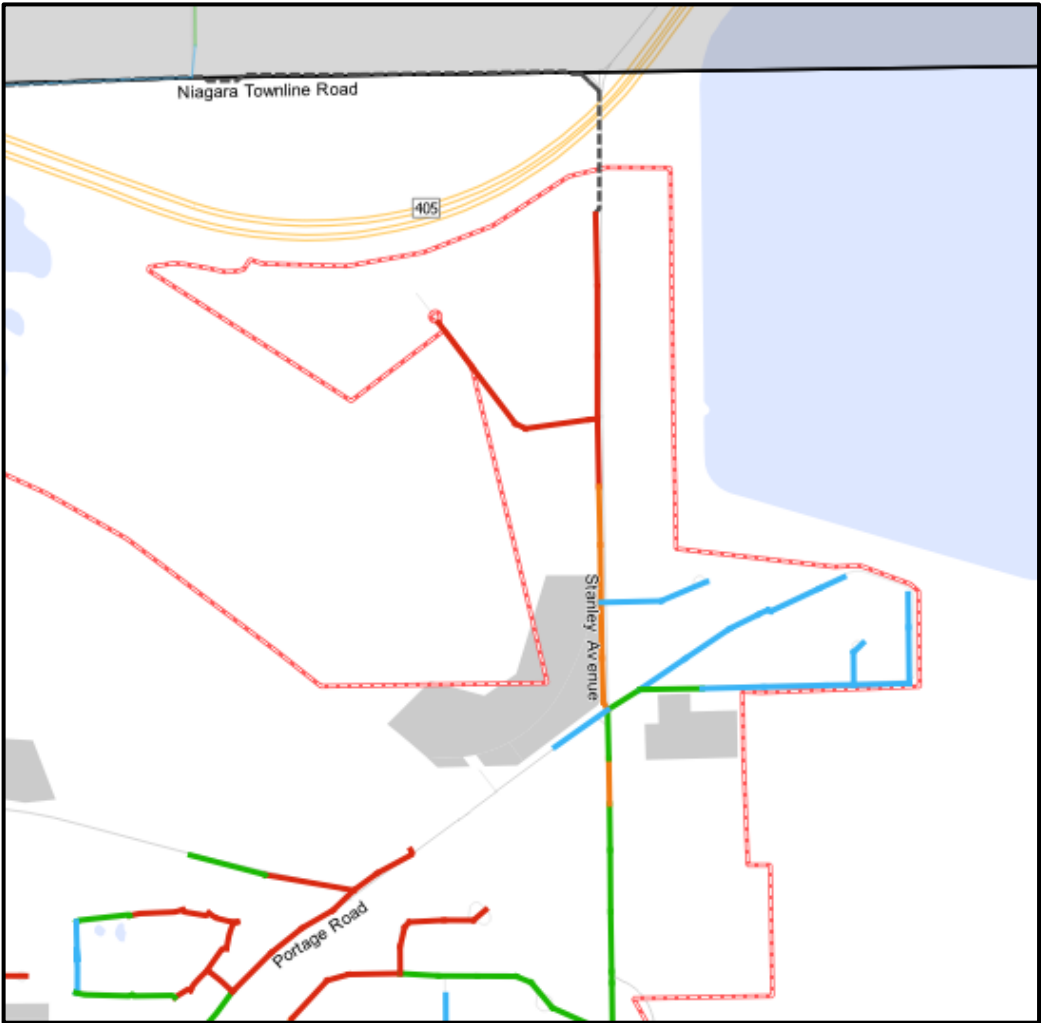
	Oldfield Road
Overview	 Existing and future deficiencies in local pipes due to backflow from Thundering Waters Region Trunk on Oldfield Road according to updated local flow monitoring
Recommended Next Steps	- Thundering Waters Region Trunk on Oldfield Road currently undergoing rehabilitation potentially reducing I&I - More localized flow monitoring to confirm flows after rehabilitation work - Confirm location and design of weir to update the City's hydraulic model

Table 7-10. Stanley Avenue north of NF WWTP

	Stanley Avenue
Overview	 The map shows Stanley Avenue running vertically. To the north is Niagara Townline Road. To the east is a large blue area representing water. To the south is Portage Road. A red dashed line outlines a sewer collection area. A red solid line indicates a sewer line running north-south along Stanley Avenue. A blue line indicates a sewer line running east-west, crossing Stanley Avenue. A green line indicates a sewer line running south-southwest, crossing Stanley Avenue. A yellow line indicates a sewer line running north-northeast, crossing Stanley Avenue. A small '405' shield is visible on the yellow line. A small '405' shield is also visible on the red dashed line. A small '405' shield is also visible on the red solid line. A small '405' shield is also visible on the blue line. A small '405' shield is also visible on the green line. A small '405' shield is also visible on the yellow line. - Sewer is owned and operated by the City, however it services flows from the neighbouring Town of Niagara-on-the-Lake - Existing and future deficiencies are resolved with a sewer upgrade project and I&I reduction
Recommended Next Steps	Proposed upgrades and funding should be coordinated with the Region and Town of Niagara-on-the-Lake

7.5.2. *Prioritization Strategy*

Areas are prioritized based on growth needs and existing deficiencies. This system aims to ensure that the wastewater system provides sufficient capacity for planned growth without increasing the risk of basement flooding for the existing system. This prioritization strategy is outlined as follows:

1. Existing and short-term growth needs
 - a. Addresses existing needs
 - b. Supports growth needs
 - c. Has DC timeline assigned
2. Existing and medium-term growth needs
 - a. Addresses existing needs
 - b. Supports growth needs
 - c. Does not have DC timeline assigned
3. Existing Risk: High
 - a. Addresses existing needs: Freeboard $\leq 1.8\text{m}$
4. Existing Risk: Exceeds level of service
 - a. Addresses existing needs – freeboard $> 1.8\text{m}$, $\leq 2.1\text{m}$
5. Supports/triggered by growth
 - a. Remaining projects

In general, this prioritization can be overlayed with works proposed within each right-of-way to further optimize overall replacements and system improvements.

8. Preferred Wastewater Servicing and Wet Weather Management Strategy

This section outlines the preferred capital program, by addressing existing and future hydraulic deficiencies, supporting forecasted growth flows, and improving overall system performance using the criteria detailed in **Section 2.3**. The final capital program consists of pipe upgrades, I&I reduction, and the sewer separation strategy. These improvements are designed to meet the LOS objectives through to 2051 and buildout. Most recommended pipe upgrade projects and works associated with the I&I reduction program are located within existing road rights-of-way or within greenfield growth areas, which are subsequently Schedule A or A+ Environmental Assessment type projects. Projects recommended under the Sewer Separation Strategy may require additional Environmental Assessment Studies.

8.1. Capital Program

The Wastewater Capital Program was developed through a detailed process of infrastructure sizing with consideration for I&I reduction potential, and cost estimation to support long-term servicing needs. The Wastewater Capital Program is presented in three parts:

1. Linear upgrades
2. I&I Reduction
3. Sewer Separation Strategy

The full program has been provided to the City as an Excel file detailed by asset, road, and type. **Figure 8-1** illustrates the location of capital program for infrastructure upgrades, I&I reduction catchments, and sewer separation catchments. **Figure 8-2** shows the capital program system performance with 2051 growth under the 10-year design storm. System performance under the buildout growth is provided in **Appendix D**. As there is high uncertainty in the amount of flow reduction from sewer separation areas, the existing sewer performance was maintained in the model. However, it is anticipated that sewer separation will improve the performance of the combined sewers as well as downstream infrastructure. Areas recommended for further study in **Section 7.5.1** are also modelled maintaining existing performance, although it is expected that future study will improve the sewer performance. **Figure 8-3** summarizes the sewer separation strategy by prioritization. A summary of the program, by road, is provided in **Appendix D**.

The recommended projects were identified by 2051 capacity needs and sized to meet full buildout requirements, ensuring that infrastructure can accommodate the future demand within its expected lifetime. Cost estimates were derived using unit rates that accounted for factors such as location, construction complexity, materials handling, and whether the work involves new infrastructure or rehabilitation, as detailed in the **Costing Methodology Memo (Volume 2 Appendix C)**. This costing made consideration for development charges and OB servicing needs as outlined in **Section 2.4**. The Wastewater Capital Program timeline was based on the City's development charges program and the majority of projects are near-term upgrades due to growth needs. Unless driven by growth needs, timelines for projects and programs are flexible and can be adjusted to meet funding and staffing capacity availability. The City should continue with I&I reduction and sewer separation efforts and improve the City's overall LOS.

The linear upgrades and I&I reduction components of the Wastewater Capital Program is summarized with timeline, the total length, and costs in **Table 8-1** and **Table 8-2**.

Table 8-1. Wastewater Capital Program Summary – Linear Upgrades

Project Timeline	Length (m)	Total Cost	DC Cost	OB Cost	City Cost
0 - 2 years	6,619	\$27,396,000	\$21,843,200	\$1,946,500	\$3,606,300
3 - 5 years	5,727	\$35,790,000	\$30,105,000	\$2,713,200	\$2,971,800
5 - 10 years	6,393	\$26,368,000	\$21,165,500	\$1,377,800	\$3,824,700
>10 years	4,787	\$19,678,000	\$11,525,600	-	\$8,152,400
TOTAL	23,526	\$109,232,000	\$84,639,300	\$6,037,500	\$18,555,200

Table 8-2. Wastewater Capital Program Summary – I&I Reduction

Project Timeline	Length (m)	Total Flow Monitoring Cost (Phase 1)	Total Sewer Investigation Cost (Phase 2)	Total Rehab Cost (Phase 3)	Total Cost + Provisional, Contingency, Studies, and Tax	Region Cost (Assuming 25% Share)	DC Cost	City Cost
0 - 10 Years	140,230	\$390,000	\$1,087,724	\$30,509,493	\$48,352,000	\$12,088,000	\$27,198,000	\$9,066,000
10+ Years	199,274	\$450,000	\$556,632	\$15,072,599	\$24,311,000	\$6,077,750	\$12,065,438	\$6,167,813
TOTAL	339,504	\$840,000	\$1,644,356	\$45,582,092	\$72,663,000	\$18,165,750	\$39,263,438	\$15,233,813

The Wastewater Capital Program has been categorized by the type of upgrade to maintain consistency with the City's development charges. The categories start with addressing growth needs in deficient areas of the system, followed by addressing growth needs, and finally addressing areas where there are existing deficiencies. Further detailed prioritization was completed for each project which ultimately split into the categories summarized in **Section 7.5.2. Table 8-3** presents the summary of the Wastewater Capital Program prioritization categories for the linear and I&I reduction projects with the total length and costs.

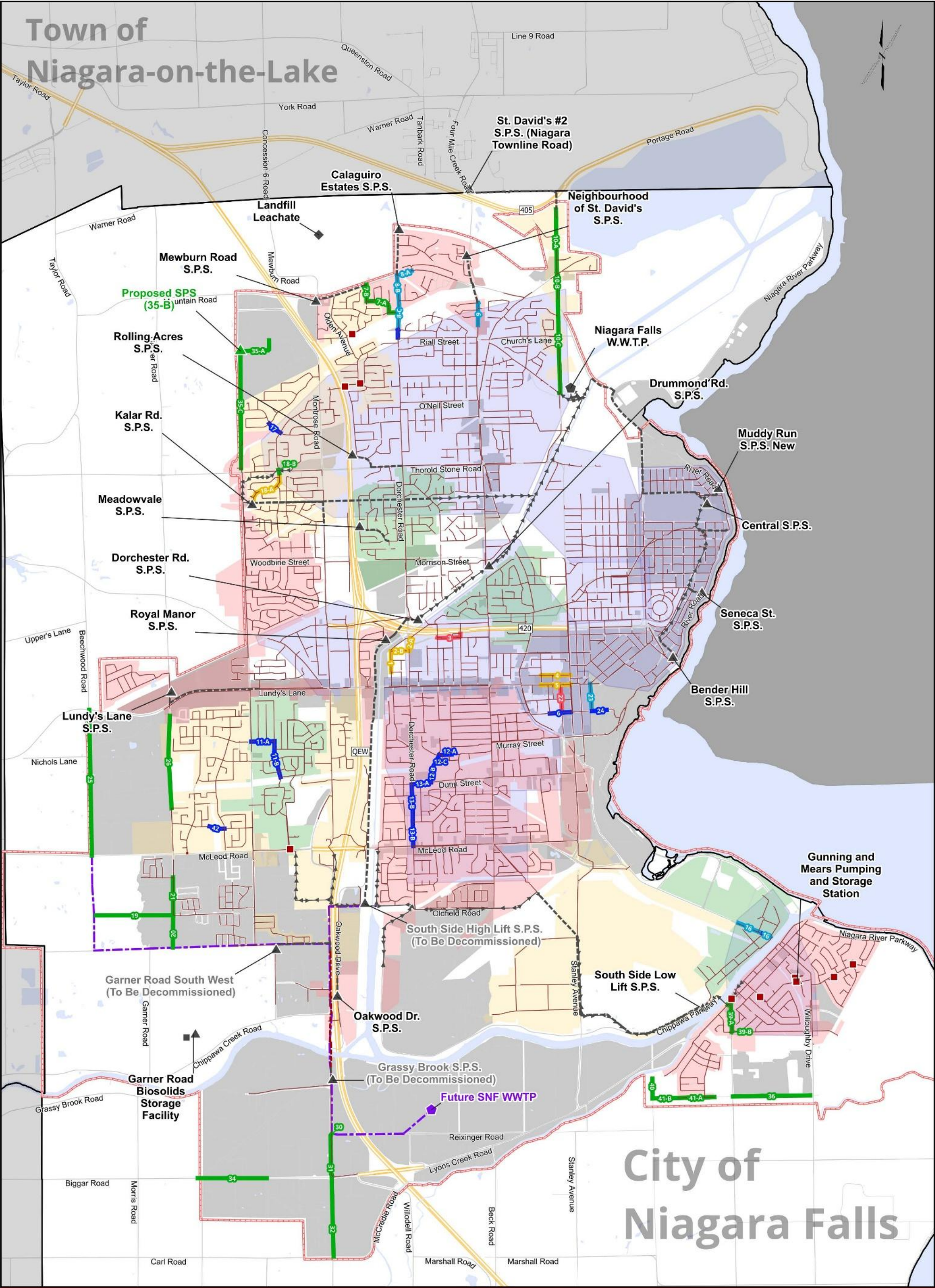
Table 8-3. Wastewater Capital Program Prioritization Summary

Prioritization Category	DC Share	Length (m)	Total Cost	DC Cost	OB Cost	City Cost
Addresses Existing Needs	10%	5,319	\$16,739,000	\$7,035,900	-	\$9,703,100
Addresses Existing Needs and Supports Growth Needs	50%	2,021	\$5,764,000	\$3,356,800	-	\$2,407,200
Addresses Existing Needs and Supports Growth Needs	75%	751	\$1,878,000	\$1,408,500	-	\$469,500
Triggered by Growth	90%	4,637	\$17,566,000	\$13,441,200	-	\$4,124,800
Supports New Growth Area (10% OB Share)	100%	10,798	\$67,285,000	\$59,396,900	\$6,037,500	\$1,850,600
TOTAL		23,526	\$109,232,000	\$84,639,300	\$6,037,500	\$18,555,200

Finally, the Sewer Separation Strategy prioritization is summarized in **Table 8-4**.

Table 8-4. Wastewater Capital Program Prioritization Summary – Sewer Separation Strategy

Catchment #	Catchment Name	% Sewers At Risk of Flooding	% Sewer Surcharging	Peak Growth Flow	Cost to Install New Sewer	Average Ranking Score	Overall Ranking Score	Priority	Cost
4	Falls Ave	1	1	3	3	0.45	1	High	\$9,400,000
7	Frederica St	3	2	4	4	0.8	2	High	\$14,839,000
8	Belmont Ave	2	4	7	6	1.075	3	High	\$20,608,000
6	Main St	6	6	2	9	1.2	4	Medium	\$45,121,000
3	Bridge St.	7	5	1	7	1.275	5	High	\$59,288,000
9	South Niagara Falls	5	3	8	2	1.3	6	Medium	\$16,956,000
2	Stanley Ave	4	8	6	5	1.375	7	Medium	\$16,956,000
1	Thorold Stone Rd	8	7	5	8	1.725	8	Low	\$53,699,000
5	Portage Rd	9	9	9	1	2.05	9	Low	\$3,810,000
TOTAL									\$227,633,000



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station
- Future SNF WWTP

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

Gravity Main

- Regional
- Municipal (Niagara Falls)
- Other Municipal (NOTL)
- Future Trunk Sewers

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

CP - I&I Reduction Catchments

- High
- Medium
- Low
- Sewer Separation Areas

CP - Linear Projects

- Existing and Short-Term Growth Needs
- Existing and Medium-Term Growth Needs
- Existing Risk: High
- Existing Risk: Exceeds Level of Service
- Supports/Triggered By Growth
- Proposed SPS

Reference(s)

- Projection EPSG:26917
- Base Data: City of Niagara Falls, 2023

1 2 km

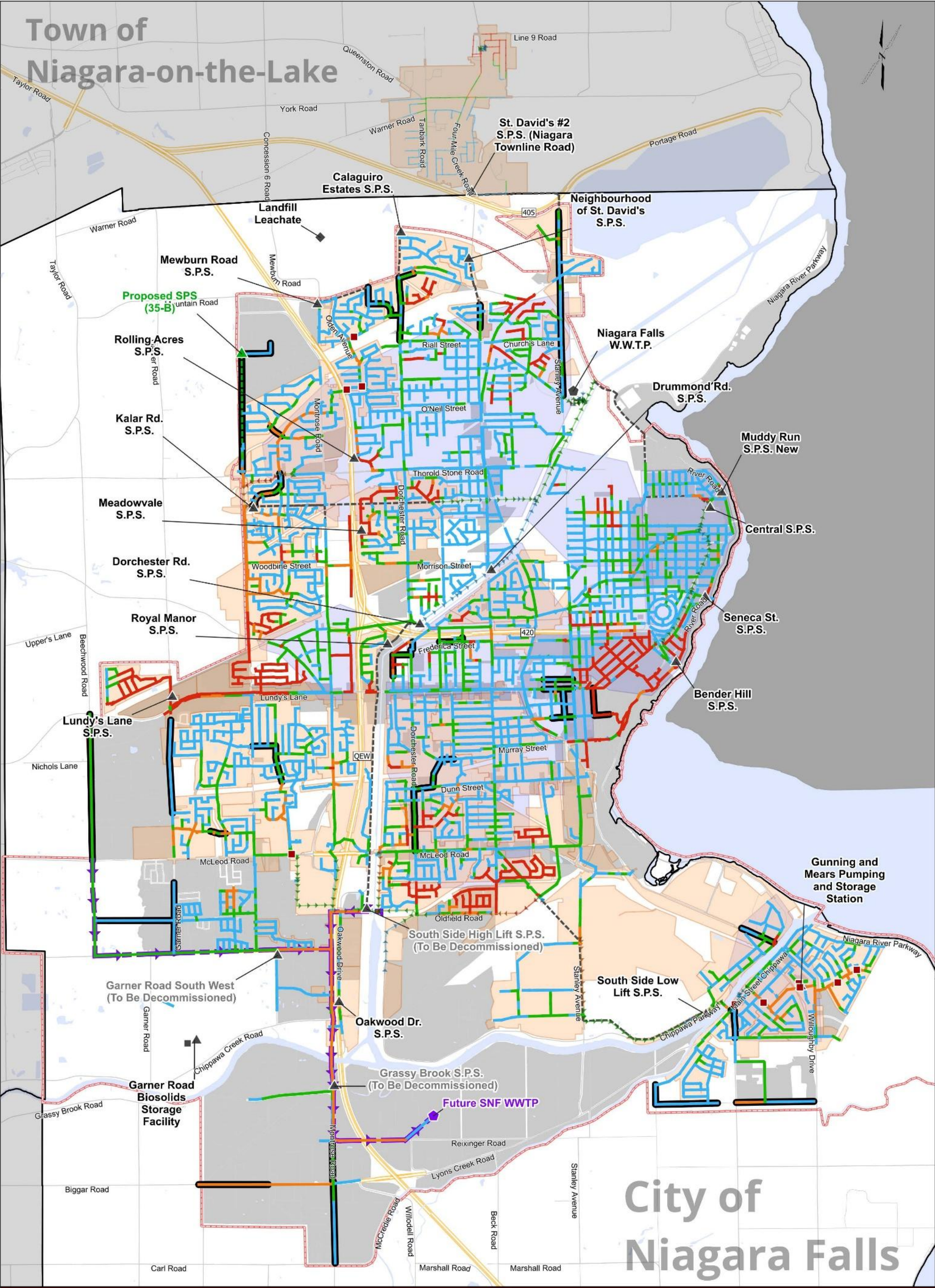
Figure 8-1
Wastewater Capital Program Infrastructure Upgrades and I&I Reduction Program

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)

GEI

Last Updated: March 2026
Document ID: 2402014-001



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

Regional Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

Forcemain

- Regional
- Municipal (Niagara Falls)

Wastewater Capital Program

- Linear Projects
- I&I Reduction Catchments
- Sewer Separation Strategy Area
- Proposed SPS
- Proposed Forcemain

Future Infrastructure

- Future SNF WWTP
- Future Regional Trunk Sewers
- Growth Plans

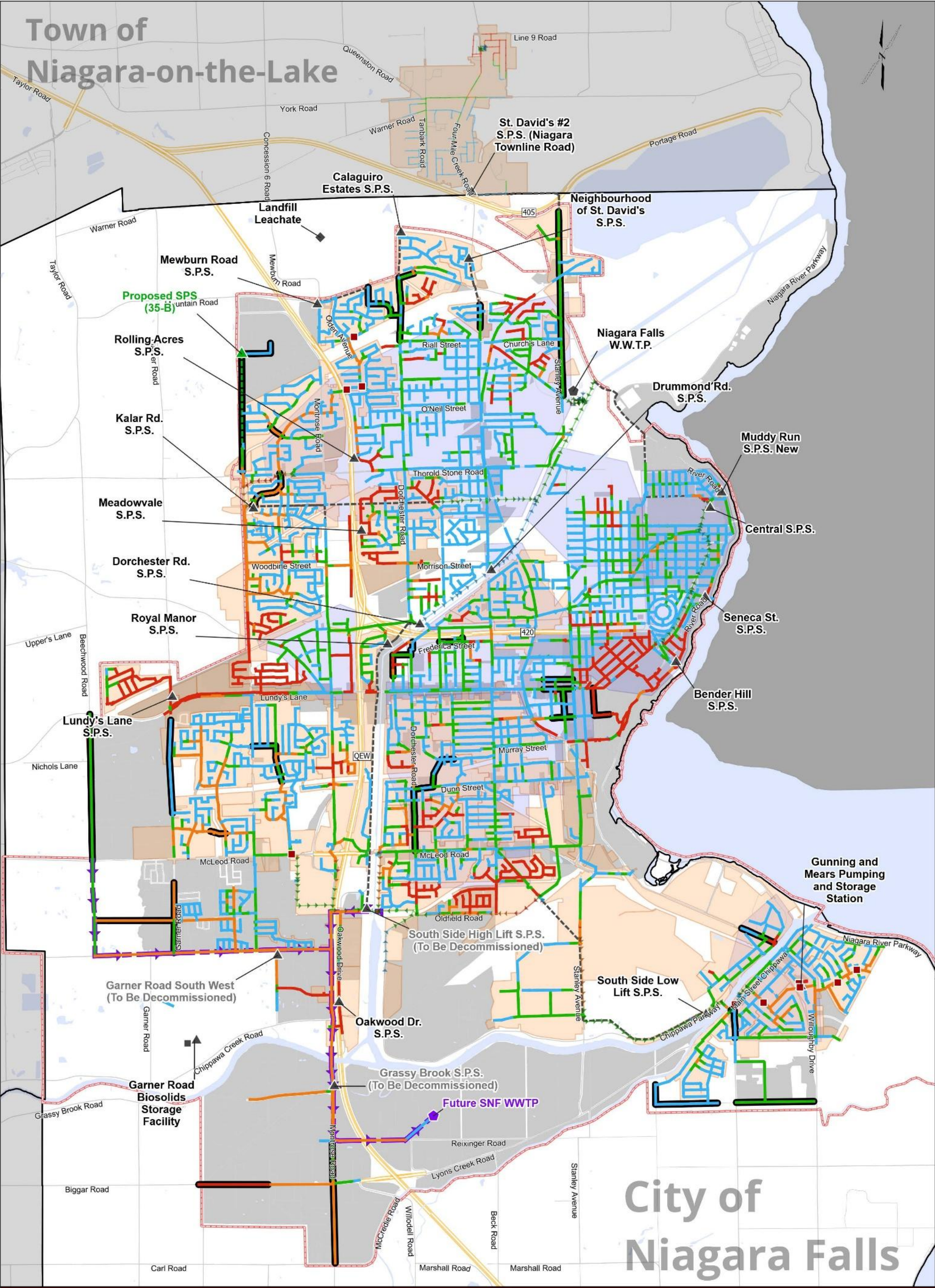
Figure 8-2
Capital Program with 2051 Growth System Performance Under 10-Year Design Storm

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)

GEI

Last Updated: March 2026
Document ID: 2402014-001



Regional Sanitary Facility - Wastewater Treatment Plant (WWTP) - Sanitary Pumping Station (SPS) - Biosolids Storage - Lagoon - Leachate Pumping Station	Regional Sewer Performance - Surplus Capacity ($d/D \leq 0.5$) - Surplus Capacity ($d/D < 1$) - Surcharging - Surcharging with Basement Flooding Risk	Wastewater Capital Program - Linear Projects - I&I Reduction Catchments - Sewer Separation Strategy Area - Proposed SPS - Proposed Forcemain	Figure 8-3 Capital Program with Buildout Growth System Performance Under 10-Year Design Storm
Municipal Sanitary Facility - Sanitary Pumping Station - Sanitary Storage Tanks	Municipal Sewer Performance - Surplus Capacity ($d/D \leq 0.5$) - Surplus Capacity ($d/D < 1$) - Surcharging - Surcharging with Basement Flooding Risk	Future Infrastructure - Future SNF WWTP - Future Regional Trunk Sewers - Growth Plans	
General Feature - Urban Area Boundary - Municipal Boundary - Waterbody, Watercourse	Forcemain - Regional - Municipal (Niagara Falls)	Project Name: Master Servicing Plan and Wet Weather Management Strategy Client Name: City of Niagara Falls (Ontario, Canada) GEI Last Updated: March 2026 Document ID: 2402014-001	

9. Implementation and Lifecycle

The City's preferred wastewater servicing strategy to support long-term growth and maintain reliable and efficient service delivery to 2051 can be achieved through a detailed implementation plan. This plan translates the recommended wastewater servicing strategy into an actionable, phased capital program with associated timelines and implementation considerations. It also provides a framework for ongoing monitoring and refinement to ensure that infrastructure delivery responds to growth priorities, system conditions, and regulatory requirements.

9.1. Capital Program Implementation Plan

The wastewater infrastructure phasing and implementation strategy has been developed to align the delivery of capital projects with projected growth, wet weather management, system performance requirements, and overall program coordination with road, water, and stormwater management infrastructure projects. This strategy is dependent on cooperation with the Region and is integrated with their facility upgrades. Project timelines and design capacities will be influenced by any future adjustments to planning projections or other major changes.

The timing for each project is provided at the following planning horizons:

- 0-2 years
- 3-5 years
- 5-10 years
- 10+ years

Servicing needs were assessed to determine when infrastructure is required based on potential capacity constraints and risk factors such as overflows and basement flooding. Key factors considered in developing the phasing plan include:

- **Servicing Dependencies:** Downstream impacts such as constraints or other servicing strategies that must be in place before a project can begin.
- **Construction Coordination:** Coordination with other City infrastructure programs such as water and stormwater.
- **Project Bundling:** Opportunities to group projects geographically or functionally to improve efficiency and minimize disruption.
- **Lead Time Requirements:** Recognition of regulatory approvals, property acquisition, Environmental Assessment processes, and other factors influencing project readiness.

This program provides a high-level baseline estimate for the City's capital budget. These costs will be further developed and refined during implementation as detailed information becomes available. During project implementation, primarily during detailed design, the following requirements should be considered:

- Refinement of infrastructure locations and alignments.
- Review and confirmation of property requirements.

- Identification of preferred construction methodologies, including review and mitigation of potential construction-related impacts (e.g., traffic, noise and vibration, dust, dewatering requirements, service disruptions, etc.).
- Assessment of installation methods (e.g., trenchless vs. open cut) for infrastructure near or crossing watercourses and valley lands.
- Completion of additional site-specific supporting investigations as required (e.g., source water protection, geotechnical, hydrogeological, topographic surveys, flood plain analysis, etc.).
- Fulfillment of all provincial, municipal and conservation authority permits and approval requirements.
- Additional engagement with First Nations and Indigenous communities where treaty rights may be impacted by projects.

9.2. Monitoring and Adaptive Management

The MSP WWMS provides a long-range framework for infrastructure delivery that reflects the current understanding of existing and future servicing needs. Servicing priorities will evolve over time as new information becomes available, thus it is essential that assumptions supporting the plan are periodically reviewed. A monitoring approach towards key technical, regulatory, and planning considerations will ensure the successful delivery of the recommended projects that is aligned with evolving conditions and priorities. This monitoring approach which may refine the plan should consider the following:

- Technical thresholds, such as facility and system capacity through flow monitoring data and refined calibration of the sewer model. Certain facilities and areas may require more frequent monitoring based on their sensitivity to system capacity constraints or growth pressures.
- Updated growth forecasts or changes in development timing.
- Completion of detailed design, which may alter scope and/or timing of projects.
- Permitting and approvals timelines, particularly for projects with longer lead times. Monitoring will consider the status and duration of permitting processes required under applicable legislation, such as approvals from the MECP, Conservation Authorities (e.g., under Ontario Regulation 41/24), and other regulatory bodies.
- Delays or acceleration of upstream/downstream or dependent projects.
- Status of funding sources, including development charges, capital reserves, and other funding programs, to assess financial readiness for project implementation.
- Changes to regulatory requirements. The City will monitor updates to federal, provincial and local policies, legislation, and technical guidelines that may influence the planning, design, or delivery of wastewater infrastructure. Where applicable, the City will adapt implementation strategies to maintain compliance and minimize delays associated with new or evolving regulatory requirements.

9.3. Operation and Maintenance Practices

Effective operation and maintenance (O&M) practices are essential to ensuring the long-term reliability, safety, and performance of the municipal wastewater system. These strategies focus on preserving

existing infrastructure, maintaining regulatory compliance, and minimizing service disruptions and risks to public health, safety, and the environment. The City's Wastewater Operations and Maintenance Manual describes the various practices and procedures to support these goals.

In addition to the core O&M practices, there are several studies that may be eligible for potential development charges contribution due to their role in supporting growth and system expansion. These initiatives are instrumental to capacity management, long-term planning, and the integration of new development into the existing wastewater system.

9.3.1. Combined Sewage Overflow Monitoring and Reporting

The City's currently active 13 CSOs and 2 SSOs have not historically been monitored directly. Currently the City reports on known collection system overflow or spill incidents. However, without modelling or monitoring, the City does not have complete information on environmental incidents. To meet the event-based reporting requirements of the City's CLI-ECA and track CSO performance over time, the City is interested in implementing real-time, permanent monitoring program of overflows to capture the date, time, and volume of by-pass events.

The Average Year CSO modelling and the overflow monitoring completed as part of the current study has shown that not all CSO/SSO locations overflow under various rainfall events. Sites showing modelled or monitored overflow volume or frequency would be prioritized for monitoring. Over time, the number of monitors would gradually decrease as system improvements allow CSO/SSO sites to be decommissioned.

Based on the modelling and monitoring as part of the current study, the following is a preliminary list of 8 CSO/SSO locations to prioritize permanent monitoring for:

- Bellevue Street
- McLeod Road
- Greenwood / Bridgewater
- Valley Way at Houck Park
- Dunn / Dorchester
- Franklin North
- Valley Way at Stanley Avenue
- Lundy's Lane / Garner Road

9.3.2. Household Drainage Survey

To support a targeted rollout and adoption of the City's Weeping Tile Removal Assistance Program (WRAP), the City should estimate how many properties have connected weeping tiles and/or downspouts to the sanitary system. The City can review property age to understand where weeping tile systems are connected. Generally, properties built between 1958 and 1978 had weeping tile connections. In addition, the Household Drainage Surveys approach reviews a significant sample size of properties (at least 100) for catchment areas. This data will give the City some additional information about the typical connectivity in defined catchment areas, such as the proportion of a surveyed catchment that has downspout disconnections, weeping tile connections, and unknown connections. The I&I reduction catchments delineated as part of the current MSP-WWMS can be leveraged for targeting program implementation and prioritizing applications.

9.3.3. *Development Review Process*

The development review process ensures that servicing capacity and infrastructure requirements are evaluated during the planning and approval of new developments. This process helps align growth with available system capacity and identifies where upgrades may be needed.

The City currently undertakes confirmation of system capacity needs through modelling analysis as they relate to developments on an as needed basis. This process should be continued and further refined as required.

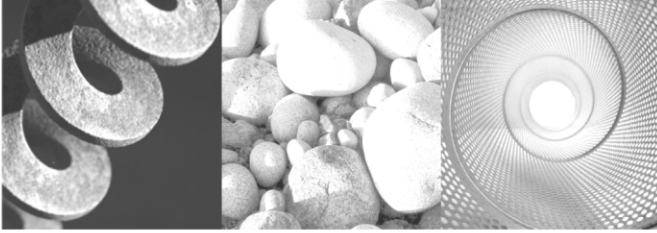
9.3.4. *Sewer Model Updates*

Regular maintenance and updates to the City's hydraulic sewer model is essential to reflect changes in the system due to growth and infrastructure upgrades. Updated flow monitoring data can provide refined calibration for portions of the system. Minor updates should be undertaken every couple of years with major updates and calibration at least every five years.

9.3.5. *Master Plan Studies*

The MSP WWMS provides a strategic framework for long-term infrastructure investment and policy development. This study should be updated every five years, as recommended by the government of Ontario.

Appendix A Wastewater Model Methodology



Master Servicing Plan Update and Wet Weather Management Strategy

Model Methodology – Wastewater

City of Niagara Falls

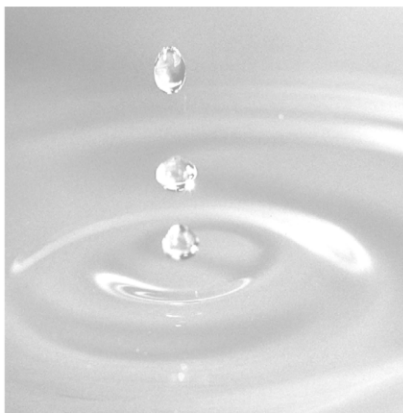
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March 11, 2026
Project No. 2402014



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Table of Contents

1.	Existing Wastewater System Model	3
1.1.	Model Update Objectives	3
1.2.	Model Update Scope	5
1.2.1.	Network Update	5
1.2.2.	Facility and Control Update	5
1.2.3.	System Flow Update	6
1.2.4.	Model Calibration & Validation	6
2.	Data Sources	7
2.1.	Sewer Network	7
2.2.	Overflows	7
2.3.	2.3 Regional Pump Stations	7
2.4.	Sewershed Delineation	7
2.5.	Flow Data	7
2.5.1.	Water Billing Data	7
2.5.2.	Flow Monitoring Data	7
3.	Hydraulic Model Build	10
3.1.	Sewer Network	10
3.1.1.	Extension to Niagara-On-The-Lake	11
3.2.	Pump Station Update/Development	11
3.3.	Wastewater Treatment Plant	11
3.4.	Sewershed	11
3.5.	Wastewater Flow Methodology	12
3.5.1.	Dry Weather Flow	12
3.5.1.1.	Dry Weather Flow Components	12
3.5.1.2.	Diurnal Profile	12
3.5.1.3.	Dry Weather Flow Methodology	13
3.5.2.	Wet Weather Flow	13
3.5.2.1.	Wet Weather Methodology	13
3.6.	Region Master Servicing Plan Update Capital Projects	14
4.	Model Calibration Criteria	16
4.1.	Dry Weather Flow Calibration Criteria	16
4.2.	Calibration Rainfall Event Selection	17
4.3.	Wet Weather Flow Calibration Criteria	18
5.	Wastewater Growth Demand Allocation	19
6.	Model Calibration Results	21

6.1.	Dry Weather Flow Calibration Results	21
6.2.	Calibration Rainfall Event Summary	22
6.3.	Wet Weather Flow (WWF) Calibration Results	22
6.3.1.	WWF Calibration Results Analysis	27
6.3.1.1.	Calibrated Catchments	27
6.3.1.2.	Incorrect or Missing Data from 2022 Region Flow Monitors	28
6.3.2.	Analysis of FM123-Stanley	31
6.3.3.	Conclusions	31

List of Tables

Table 2-1.	Sanitary Flow Monitoring Site Information – Region of Niagara	8
Table 2-2.	Sanitary Flow Monitoring Site Information – City of Niagara Falls	9
Table 2-3.	Combined Sewer Overflow Monitoring Site Information – City of Niagara Falls	9
Table 3-1.	Wastewater Model and GIS Data Comparison	10
Table 3-2.	Niagara Region Wastewater Capital Program in Niagara Falls	14
Table 6-1.	Dry Weather Flow Calibration Results	23
Table 6-2.	Calibration Rainfall Event Summary	24
Table 6-3.	Wet Weather Flow Calibration Results	25

List of Figures

Figure 3-1.	Sample Wet Weather Flow Components	12
Figure 4-1.	Dry Weather Flow Calibration Example	17
Figure 4-2.	Example of Flow Monitor with Pump Station Upstream	17
Figure 4-3.	Wet Weather Flow Calibration Example	18
Figure 5-1.	Process for Allocating System Flows	20
Figure 6-1.	Modelled Flows Influenced by Upstream Pumping Station(s)	21
Figure 6-2.	Calibrated DWF Prioritizing Peak Flow and Water Billing Data	22
Figure 6-3.	FM131-Kalar during the July 20, 2023 Storm Event	27
Figure 6-4.	FM181-Kalar-SPS-S during the July 20, 2023 Storm Event	27
Figure 6-5.	FM062-Grassy-Brook-SPS during the June 22, 2022 Storm Event	28
Figure 6-6.	FM071-Muddy-Run-SPS during the November 11, 2022 Storm Event	28
Figure 6-7.	FM004-Dorchesters-Rd during the 11 November 2022 Storm Event	29
Figure 6-8.	FM016-McLeod during the July 28, 2022 Storm Event	30
Figure 6-9.	FM004-Dorchester-Rd during the July 28, 2022 Storm Event	30
Figure 6-10.	FM123-Stanley during the 5 October 2023 Storm Even	31

Appendices

Appendix A	Flow Monitor Schematic
Appendix B	Map of Flow Monitor Locations
Appendix C	Summary of Model Updates

Joy Liu/JB

B:\Working\NIAGARA FALLS ON, CITY OF\2402014 - 622071 NF MSP and Wet Weather Mgmt Strategy\5 Work in Progress\Reports_Manuals_Contracts\Model Methodology Memos\NF Methodology Memo - Wastewater - DRAFT.docx

1. Existing Wastewater System Model

The City of Niagara (City) has an existing wastewater hydraulic model which was developed as part of the 2017 Pollution Prevention Control Plan (PPCP). The model was developed as an “all-pipes” model using InfoSWMM consisting of approximately 6,600 sewer elements. The model includes all gravity sewers, Regional sewage pumping stations (SPS), and trunk sewers, including SPS catchments located in the Town of Niagara-on-the-Lake (NOTL) that discharge flows to the Niagara Falls Wastewater Treatment Plant (WWTP) system. The InfoSWMM model was calibrated to approximately 20 flow-monitors for dry and wet weather flows. Since the initial model development, the model has undergone periodical updates, and most recently under the 2021 Master Servicing Plan Update (MSPU); which included some localized flow updates and calibration. As part of the City’s ongoing Master Servicing Plan and Wet Weather Management Strategy (MSP-WWMS), an update to the existing wastewater model was completed.

1.1. Model Update Objectives

The City’s project Terms of Reference (ToR) identified the following as the minimum criteria for consideration in the development/upgrade of the City’s hydraulic models:

- Maintain compatibility with the Region’s water and wastewater models, such that the information can be easily integrated and shared.
- Incorporate all Region owned pipes and facilities.
- Incorporate any system changes since the last updates to the models including network improvements (through replacement and rehabilitation) and additions.
- Incorporate any refinements to the model data utilizing updated network information provided by the City as a result of recent infrastructure investigation and condition assessments.
- Certain planned and committed future projects and system enhancements are known and should be incorporated into a future conditions model for evaluation in the various growth projection scenarios. While the specific timing of these projects is not fixed, the subsequent scenario analyses will provide some guidance on prioritization based on modelled impacts. These include:
 - Committed City and Region capital projects.
 - Recommended tanks and storage facilities removal and / or optimization (where appropriate).
 - South Niagara Falls Wastewater Solutions recommendations (new 30 MLD Wastewater Treatment Plant, Montrose Trunk Sewer, South Thorold, decommissioning of SPS) per Niagara Region’s ongoing capital project.
 - Proposed Chippawa Trunk Sewer from the new WWTP along Lyons Creek to drain the Chippawa catchment as recommended in the most recent Region MSPU.

Further, the project ToR anticipated scope of work for all model updates includes the following key tasks:

- Utilize existing hydraulic models as a basis for the model updates to leverage effort previously undertaken to establish topology, include facilities and provide validation.
- Incorporate new system elements as provided by the City.
- Synchronize updated network attribute data as provided by the City.
- Confirm facility data including pump attributes and storage capacity.
- Confirm a wastewater flow loading procedure for the model and update all manhole flows.
- Confirm a stormwater flow loading procedure for the model and update all manhole/ catch basin flows.
- Confirm a water demand loading procedure for the model and update all node/junction demands.
- Utilize City contour data sets to attempt to determine overland flow/drainage patterns.
- Utilize orthophotography of the City to establish sub-catchment parameters such as impervious area.
- Assumptions for the hydraulic parameters are to be presented, reviewed and documented.
- Orthophotography should also be utilized to provide information on drainage features including ponds.
- Establish baseline stormwater model runs.
- Calibration of all 3 models using flow data gathered historically and throughout the study.
- Validate the results of the new existing condition models with the current model and with available system flow monitoring results.
- Confirm operational parameters for the water, wastewater, and stormwater systems and update any control settings in the model.
- Identify a future workplan to be completed as part of a separate project to enhance and calibrate the stormwater model, including an implementation plan and design for storm sewer flow monitoring, including location, software, hardware and schedule. Some recent, localized monitoring will be made available from the City following award.

1.2. Model Update Scope

Based on the City's stated modelling objectives and taking into consideration the existing state of the City's model, the scope of the wastewater model update consist of the following:

- All City and Regio facilities (pumps) and downstream sewer network (including all City and Regional owned sewer mains) up to the wastewater treatment plant headworks.
- All City and/or Region owned sewer mains (including gravity and forcemains).
- All City and/or Region overflows in the collection system.
- External connections and contributions from the Town of Niagara-On-The-Lake and the City of Thorold.

The model update focuses on the following key areas:

- Wastewater network update and geometry validation.
- New/upgrade facilities validation including:
 - Facility geometry,
 - Pump Curves, and
 - Facility controls.
- System flow allocation and calibration.
- Development of wet weather flow scenarios

1.2.1. Network Update

The update to the wastewater system networks to reflect the current system condition includes verifying, flagging, and updating any discrepancy between the GIS and model network. Primary areas of focus includes the following:

- Addition of new sewers
- Identification of and removal of abandoned sewers
- Flagging of any discrepancies within the existing network for confirmation with the City
- Confirmation and updating of sewershed areas

1.2.2. Facility and Control Update

All regional facilities were recently updated as part of the Region's Master Plan. As such, the facility update re-confirms the station's capacity with the Region and for any stations that have undergone recent upgrades/rehab. The update includes an update of the following for the effected pumping and storage facilities:

- Confirms pump station capacities
- Confirms storage configurations

1.2.3. System Flow Update

The update to the wastewater system allocation uses water billing records for the spatial distribution of sanitary flows, and the Region's SCADA records and flow monitoring records to confirm total flows (including groundwater infiltration) wet weather flows, and daily diurnal patterns.

1.2.4. Model Calibration & Validation

The calibration and validation of the model for the primary flow conditions:

- Dry weather flow calibration
- Dynamic wet weather flow calibration using the RTK method

2. Data Sources

The following section outlines the data sources that were used to update the model.

2.1. Sewer Network

The City's sanitary GIS data, which includes sanitary pipes, sanitary manholes and sanitary laterals, were used as the basis of the network update and were the primary sources of sewer geometry including diameters and inverts for new sewers and to validate the model's existing parameters.

2.2. Overflows

The City's wastewater network has approximately 20 in-system City owned overflows . A review of the City's sanitary GIS and manhole surveys conducted in partnership with GEI were utilized to establish the system geometry at the system overflows.

2.3. Regional Pump Stations

The Region provided facility plan drawings and pump capacity for all Region pump stations within the City's system. This data was used as the primary source for the Region pump station geometry and configuration.

2.4. Sewershed Delineation

The parcel fabric was provided which includes land use and property size for properties. The parcel fabric was utilized to support the delineation of new individual sewer catchments.

2.5. Flow Data

2.5.1. Water Billing Data

Water billing from the City from 2018-2022 , was allocated by parcel and was used as the basis for the spatial allocation of sanitary baseflow.

2.5.2. Flow Monitoring Data

Flow monitoring data was used for model validation and calibration so that it accurately represents existing system conditions. A flow monitor schematic can be found in **Appendix A**.

A combination of historic City and Region flow monitors as well as the 2023 flow monitoring program conducted in partnership with GEI as part of the current Master Plan was used for the calibration. The historic and current sets of data spanned over two different time periods with no overlap which was taken into consideration during model calibration.

The historic flow monitoring program comprised of 15 Region-owned wastewater flow monitors in the City of Niagara Falls is shown in **Table 2-1**. Of the flow monitors, only 12 Region monitors had sufficient data for model calibration. Maps showing the flow monitoring locations in Niagara Falls are provided in **Appendix B**.

Table 2-1. Sanitary Flow Monitoring Site Information – Region of Niagara

Region Flow Monitor ID	Region Flow Monitor Name	Region/Model Conduit ID	City Conduit ID	Total Tributary Area (ha)	Included In Calibration
FM004	Dorchester-Road	19000303	SGM_04584	5	Y
FM054	Dorchester-Road	19001607	SGM_02100	374	N ⁽¹⁾
FM056	Drummond-Road-SPS	19002631	N/A	70	Y
FM062	Grassy-Brook-SPS	19002743	SGM_06201	16	Y
FM016	McLeod	19000306	SGM_05002	248	Y
FM070	Mewburn-SPS	19002788	SGM_01624	7	Y
FM071	Muddy-Run-SPS	19002746	N/A	51	Y
FM021	Oakwood	19000133	SGM_05099	324	Y
FM074	Oakwood-Drive-SPS	169024570	SGM_06667	16	Y
FM026	Park-Street	19000587	SGM_03255	118	N ⁽¹⁾
FM081	Royal-Manor-SPS	19002789	N/A	20	N ⁽²⁾
FM083	Seneca-Street-SPS	19002488	N/A	37	Y
FM034	Southside-Lowlift	19001448	SGM_05476	221	Y
FM035	Stamford-Interceptor/Green	19002753	SGM_00942	585	Y
FM037	Thorold-Stone-Road	19000686	SGM_01451	1946	Y

Notes:

1. Data is inconsistent with upstream flow monitors
2. No data was provided

The 2023 City flow monitoring program comprised of a total of 16 sanitary flow monitors and 17 overflow level monitors that were installed from May to December 2023. Of the total flow monitors, two sanitary flow monitors could not be identified within the hydraulic model and were excluded from calibration. The overflow monitors were used to help validate/confirm system overflows during major storm events. The information on each proposed sanitary flow and overflow monitoring site is summarized in **Table 2-2** and **Table 2-3** respectively. Maps showing the sanitary flow monitoring locations in Niagara Falls are provided in **Appendix B**.

Table 2-2. Sanitary Flow Monitoring Site Information – City of Niagara Falls

City Sanitary Flow Monitor ID	City Conduit ID	City Manhole ID	Region/Model Conduit ID	Total Tributary Area (ha)	Included in Calibration (Y/N)
FM009_CII4_Bridgewater	SGM_05737	SMH_04937	19000465	130	Y
FM035_NF2_2018_LOWES	SGM_05086	SMH_04808	169012739	97	Y
FM098_Clancys Parkinglot	SGM_03067	SMH_02297	169014776	218	Y
FM122_Portage & Mayfair	SGM_00558	SMH_01388	169015933	237	Y
FM123_Stanley	SGM_00949	SMH_01417	169015902	40	Y
FM124_Stanley & Hydro Canal	SGM_00922	SMH_06498	169015563	88	Y
FM125_Central SPS	SGM_06141	SMH_06134	19001496	289	Y
FM126_Palmer & Simcoe	SGM_02795	SMH_00567	19000134	77	Y
FM127_Twidale	SGM_03314	SMH_00731	N/A	N/A	N
FM128_Dorchester SPS N	SGM_02339	SMH_05586	169014279	185	Y
FM129_Dorchester SPS W	SGM_02269	SMH_05586	169014020	182	Y
FM130_Kalar SPS Outflow	SGM_01606	SMH_02692	N/A	N/A	N
FM131_Kalar	SGM_01784	SMH_02752	19000166	204	Y
FM180_Kalar SPS W	SGM_01887	SMH_02753	169017280	120	Y
FM181_Kalar SPS S	SGM_01913	SMH_02695	169016914	28	Y
FM182_Kalar SPS E	SGM_01836	SMH_02584	169016681	39	Y

Table 2-3. Combined Sewer Overflow Monitoring Site Information – City of Niagara Falls

City Sanitary Flow Monitor ID	Type	City Conduit ID	City Manhole ID
FM135_Garner & Lundys	CSO	SGM_07060	SMH_06639
FM136_Sussex	CSO	SGM_06444	SMH_06139
FM137_Royal Manor SPS	CSO	SGM_06876	SMH_03027
FM138_Dorchester SPS	CSO	SGM_06108	SMH_05640
FM140_Greenwood & Bridgewater	CSO	N/A	N/A
FM141_Brookfield & High	CSO	N/A	N/A
FM142_Muddy SPS	CSO	SGM_05925	SMH_05855
FM143_Park & Niagara	CSO	SGM_05923	SMH_05342
FM144_Seneca	CSO	SGM_06225	SMH_05968
FM145_John	CSO	SGM_07141	SMH_06890
FM146_Margaret & Warden	CSO	SGM_07399	DMH_01058
FM147_Bellevue	CSO	SGM_02544	SMH_05546
FM148_Franklin	CSO	SGM_07401	DMH_01450
FM149_McLeod W	CSO	SGM_06458	SMH_06163
FM150_McLeod E	CSO	SGM_04999	SMH_06162
FM151_Stanley	CSO	N/A	N/A
FM152_Portage & Morrison	CSO	N/A	N/A

3. Hydraulic Model Build

3.1. Sewer Network

The Wastewater network update and validation utilized the GIS sewer diameters and inverts. Following the addition of any new sewers and update of inverts and geometry, the wastewater network was processed based on the following assumptions:

- All gravity sewers flow downhill.
- There are no steps (incoming inverts that are lower than outgoing inverts) in the system, except at overflows, where the step is retained.
- Where pipe inverts are missing, the inverts will be:
 - Taken from the attached node chamber floor level, or
 - Interpolated between two known invert levels.
- If no invert information is available:
 - Sewer depth will be estimated using minimum coverage depth at the upstream manhole
- Maintaining minimum sewer depth and slope requirements based on available topography
- Maintain the above approach until inverts can be appropriately tie-into known inverts at downstream/upstream locations
- Negative gradients and steps will be corrected (including GIS) except at overflows, where the negative gradient will be retained.

Table 3-1 summarizes the updates applied to the model within the City of Niagara Falls boundary. Details of all updates are found in **Appendix C**.

A list of pipe inverts where data was missing and estimated may be included for further review or inspection if deemed necessary by the City.

Table 3-1. Wastewater Model and GIS Data Comparison

Wastewater Asset Type	Comparison Details	Existing Model	Updated GIS
Wastewater Junctions	Total number of Junctions	6403	6573
	New Junctions	2 (0.03%)	
	Deleted Junctions	1 (0.02%)	
	% Inverts Updated	0.30%	
	% Rim Updated	0.24%	
Wastewater Conduits	Total number of Conduits	6685	6866
	New Conduits	8 (0.12%)	
	Deleted Conduits	2 (0.03%)	
	% diameters Updated	0.03%	
	% Upstream inverts Updated	0.58%	
	% Downstream inverts Updated	0.70%	

3.1.1. Extension to Niagara-On-The-Lake

GEI previously completed the model calibration for the Town of NOTL as part of the 2022 PPCP project. There is a catchment within the town of NOTL that is connected to the Niagara Falls sanitary system which discharges flow to the Niagara Falls WWTP. The calibrated NOTL model has been added to the City of Niagara Falls hydraulic model for a more comprehensive analysis.

3.2. Pump Station Update/Development

The Sewage Pump Stations were updated as part of the Region 2021 MSPU and was based on available data including facility site plan drawings and ECA's and included the following:

- Reviewing available data to identify the general facility parameters including:
- Facility configuration,
- Number of pumps,
- Pump rated capacity and curves, and
- Overflow configuration.

3.3. Wastewater Treatment Plant

The Wastewater Treatment Plant, as included in the Region's existing model, was carried forward into the all-pipes model.

3.4. Sewershed

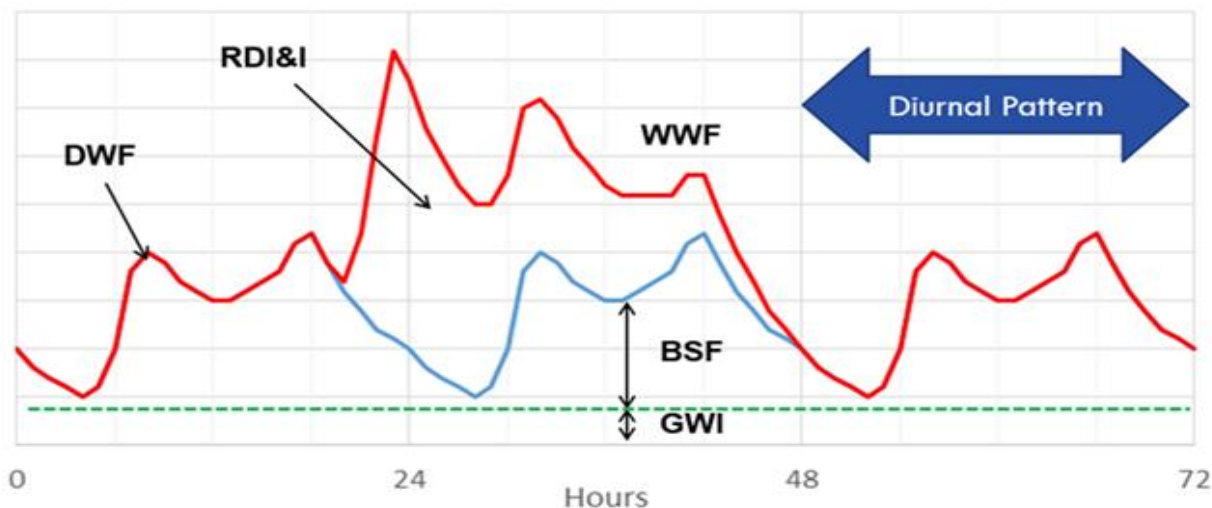
The sewershed catchments were delineated on a pipe-by-pipe basis. The sewersheds included full parcels and roadway geometries. For larger parcels, approximately 100 m of fronting area were accounted for in the sewershed. Overlapping pipe buffers were trimmed using mid-area projection lines.

All of the parcels with associated water billing records were allocated to the closest sanitary lateral. Flow monitor catchment areas were delineated through the combination of all upstream pipe catchments and one flow monitor catchment was delineated for each flow monitor. Sanitary catchments will be assigned to the pipe's upstream node.

3.5. Wastewater Flow Methodology

The following section outlines the general methodology that was utilized to characterize the system flows. In general, parcel-based sanitary flows were defined by utilizing the assigned parcel water billing demand and adjusted within each defined catchment area to match the observed base dry weather flow. The flow monitoring results were then utilized to establish general system flow characterization which was used to support the calibration of the system model. The resulting calibrated model was utilized to quantify system flow and performance. **Figure 3-1** illustrates the different components of wet weather flow.

Figure 3-1. Sample Wet Weather Flow Components



3.5.1. Dry Weather Flow

3.5.1.1. Dry Weather Flow Components

Dry weather flow (DWF) is defined as the flow in the sewer system during periods where the system is experiencing no influence from rainfall. The DWF is composed of base sanitary flow (BSF) and base groundwater infiltration (BGWI) which has entered the sewer through system defects.

3.5.1.2. Diurnal Profile

Sanitary flow in a wastewater system generally displays a diurnal pattern that varies throughout the day depending on the type of land use from which it originates. Residential patterns typically peak in the morning, then again towards the evening, coinciding with conventional workday hours. The pattern usually changes on weekends, often with delayed and lower peaks relative to weekdays. Commercial and industrial customers have more diverse patterns that are usually higher during business hours with lower or minimal flows at night, depending on the nature of the business.

3.5.1.3. Dry Weather Flow Methodology

Water billing records were allocated to existing parcels, based on available address information and were utilized to estimate base sanitary flow contributions within the local system and used in combination with flow monitoring results to estimate system groundwater infiltration rates.

- Dry days are defined as days where the system has not experienced rainfall and the system flows after a rainfall have returned to normal. Dry days from the flow monitoring data will be used to determine dry weather averages to support the development of dry weather flow diurnal patterns.
- Base sanitary flows were adjusted to match between 80% to 100% of measured billing based on observed minimum nighttime flow.
- Groundwater infiltration was estimated from the nighttime minimum flows and the flow monitor average dry weather results, estimated by subtracting upstream catchment billing records from average dry weather flow (ADWF):
 - BSF should be within the target range of 80-100% based on nighttime minimum flows.
 - Groundwater adjustments were based on meeting calibration of the balance of system monitors upstream and downstream.
- Diurnal patterns were based on an average curve developed from flow monitoring data. Diurnal patterns were adjusted to fit observed peak dry weather flows once BSF and GWI were allocated to the catchment.
- Graphical methods were used to validate calibration against the average dry weather flow of 5 days and a single day.

3.5.2. Wet Weather Flow

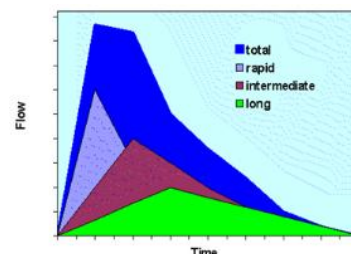
Wet weather flow is composed of base sanitary flow, base groundwater infiltration, and rainfall-derived inflow and infiltration (RDII). The RDII is dependent upon the characteristics of each catchment and the sewer system components within it, as well as the type and severity of the storm.

3.5.2.1. Wet Weather Methodology

The wet weather was modeled using the RTK Unit Hydrograph (RTK) approach.

The RTK method involves the fitting of three triangular unit hydrographs (slow, medium, and fast response) onto a measured RDII hydrograph from flow meter data, where:

- R is the fraction of rainfall volume entering the sewer system (volume under the hydrograph).
- T is the time from the start of rainfall to the unit hydrograph's peak, in hours.
- K is the ratio between the recession time and the time to unit hydrograph peak (T).



The RTK method is useful in the context of this project in that it allows for the identification of extraneous flow contributors based on their response times.

The model was calibrated to the flow monitors, and adjustments made on an individual catchment basis. Wet weather days include days where rain fell in the system and recovery days for the system to return to normal dry weather flows.

The RTK method was used to assign inflow and infiltration responses in the model using volume (R), time to hydrograph peak (T) and the lag to return to typical dry weather flows (K). RTK parameters will be adjusted to achieve a “best fit” at any given location, which considers:

- Meeting calibration of the balance of system monitors upstream and downstream .
- Best fit across multiple storm events.

3.6. Region Master Servicing Plan Update Capital Projects

As part of the Region’s 2021 MSP, capital projects were identified outlined in **Table 3-2**. These capital projects were included in the Region’s most recent wastewater model update and carried forward into this model update.

Table 3-2. Niagara Region Wastewater Capital Program in Niagara Falls

Master Plan ID	Name	Description	Year
WW-SPS-026	Dorchester SPS Pump Replacement	Increase station capacity from 185 L/s to 345 L/s by replacing the existing three pumps. Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades.	2027-2031
WW-SPS-031	St. David’s #2 SPS Upgrade	Increase station capacity from 42 L/s to 202 L/s with a full station Reconstruction.	2027-2031
WW-SPS-032	St. David’s #1 SPS Upgrade	Increase station capacity from 29 L/s to 174 L/s. with a full station reconstruction.	2027-2031
WW-SPS-050	Bender Hill SPS Pump Replacement	Full station replacement at new location from 237 L/s to re-establish 330 L/s ECA capacity.	2022-2026
WW-SPS-051	Central SPS Pump Replacement	Increase station capacity from 800 L/s to re-establish 1000 L/s ECA capacity by replacing the existing five pumps.	2037-2041
WW-SPS-052	Lundy's Lane SPS Pump Replacement	Increase station capacity from 56 L/s to re-establish 98 L/s ECA capacity by replacing the existing three pumps.	2037-2041
WW-SPS-053	Royal Manor SPS Pump Replacement	Increase station capacity from 9 L/s to 16 L/s by replacing existing two pumps	2022-2026
WW-D-003	Decommissioning of South Side High Lift SPS	Decommissioning of SSHL SPS, to be replaced by gravity trunk sewer to SNF WWTP	2037-2041
WW-D-004	Decommissioning of Garner SPS	Decommissioning of Garner SPS to be replaced by gravity connection to SNF WWTP	2032-2036
WW-D-006	Decommissioning of Grassy Brook SPS	Decommissioning of Grassy Brook SPS to be replaced by gravity connection to SNF WWTP	2032-2036

Master Plan ID	Name	Description	Year
WW-FM-005	New Peel Street SPS Forcemain	New 400 mm Peel Street SPS Forcemain in Thorold from station to Black Horse SPS	2027-2031
WW-FM-006	New Black Horse Forcemain to Niagara Falls	New Black Horse Forcemain to New South Niagara Falls Trunk on Barron Road to the Montrose Trunk Sewer	2027-2031
WW-SPS-028	Black Horse SPS Upgrade	New SPS location with increased capacity from 67 L/s to 180 L/s.	2027-2031
WW-SPS-058	Peel Street SPS Upgrade	Station upgrades which may be required to accommodate new forcemain	2027-2031
WW-SS-006	New Montrose Trunk Sewer	New tunneled trunk sewer on Montrose conveying flows from South Side High Lift SPS to the new South Niagara Falls WWTP	2027-2031
WW-SS-007	New Brown Road Trunk Sewer	Shallow gravity trunk from South Thorold to Garner SPS-South Niagara Falls trunk connection	2027-2031
WW-SS-008	Chippawa Trunk Sewer Phase 1	New tunneled 1200 mm trunk sewer from west of Lyon's Creek to South Niagara Falls WWTP	2032-2036
WW-SS-014	South Niagara Falls SSO Trunk	New sewer to eliminate overflows upstream of South Side High Lift SPS	2022-2026
WW-SS-015	Chippawa Trunk Sewer Phase 2	New tunneled 1200 mm trunk sewer from South Side Low Lift to west of Lyon's Creek	2037-2041
WW-TP-002	South Niagara Falls Wastewater Treatment Plant - Phase 1	New South Niagara Falls WWTP Phase 1 with 30 MLD capacity	2022-2026
WW-TP-003	South Niagara Falls Wastewater Treatment Plant Phase 2	New South Niagara Falls WWTP Upgrade from 30 MLD to 60 MLD	2037-2041
WW-TP-004	South Niagara Falls Wastewater Treatment Plant Outfall	New South Niagara Falls WWTP Outfall Structure	2022-2026

4. Model Calibration Criteria

The model calibration involves adjusting various parameters within the model so that the flow it generates more closely resembles the observed flow at each monitor. This process is done separately for both dry and wet weather flow.

4.1. Dry Weather Flow Calibration Criteria

For each selected flow monitor site, the DWF diurnal hydrograph patterns were compared to the modelled results based on the following criteria:

- Shape of the modelled hydrograph should be similar in shape and magnitude to the observed hydrograph.
- Timing of peaks and troughs should be within one hour.
- Peak and minimum modelled DWF should be within the average upper and lower limits of the observed flows.
- Total modelled volume of flow should be within the maximum and minimum total observed flow volume.
- Average dry weather flows for a “typical day” will attempt to match peak flows and total volumes within a range of ± 5 -10% accuracy compared to flow monitoring and SPS data.
- Catchments with upstream pump stations will likely not match the peak flows but will target the same volumetric criteria, the frequency of upstream pump station operation, and the range in flows (peak and minimum).

Figure 4-1 and **Figure 4-2** illustrates an example of dry weather flow calibration, where grey represents the observed dry weather flow at the flow monitor and purple represents the model flows.

Figure 4-1. Dry Weather Flow Calibration Example

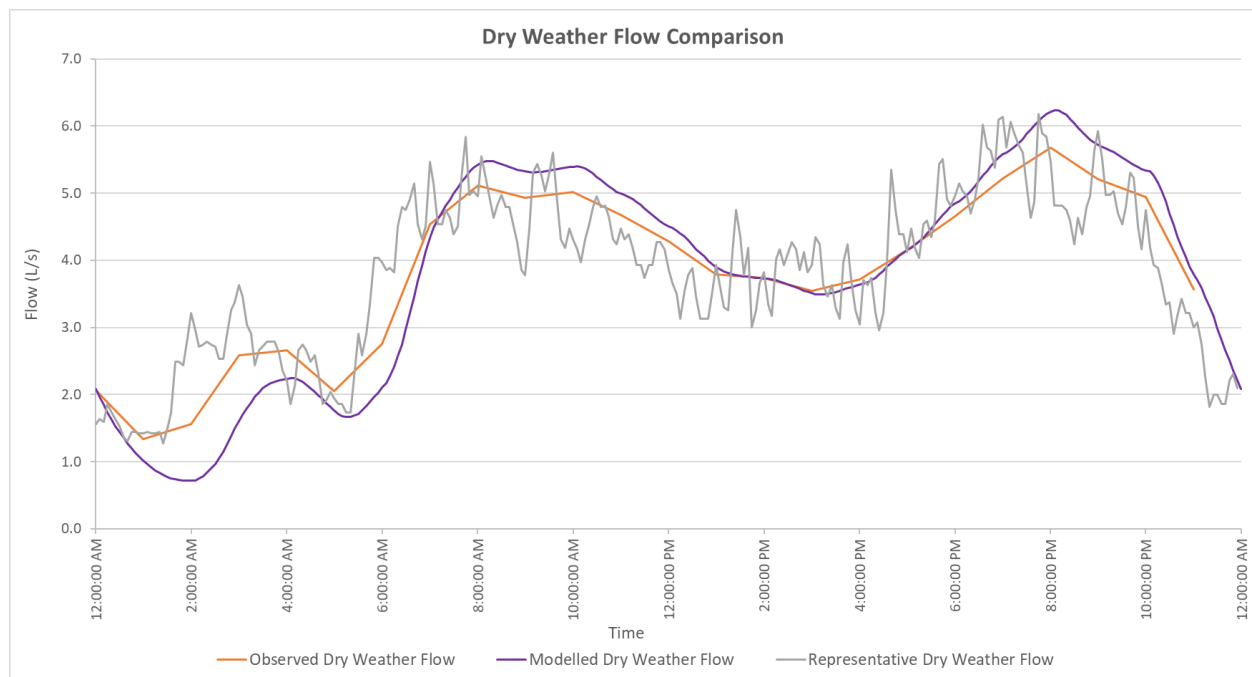
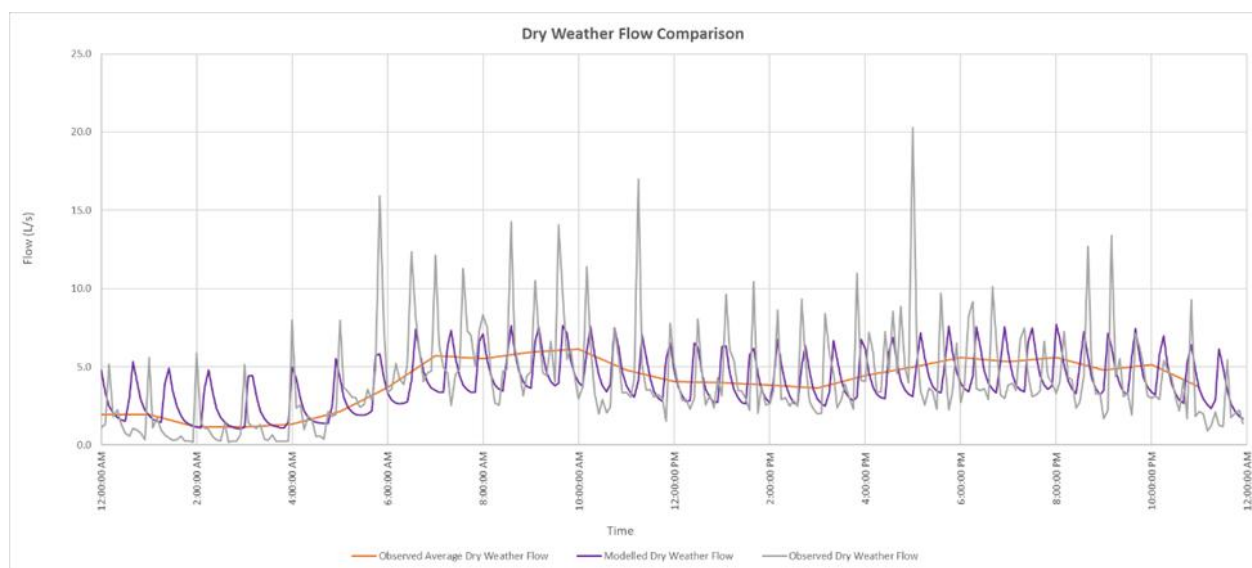


Figure 4-2. Example of Flow Monitor with Pump Station Upstream



4.2. Calibration Rainfall Event Selection

For wet weather flow analysis, it is necessary to identify rainfall events with enough intensity and volume that typically generate a rainfall-derived flow response in the wastewater collection system. Critical events are usually defined as those with a total depth of at least 15mm and a peak intensity of 5mm/hr.

4.3. Wet Weather Flow Calibration Criteria

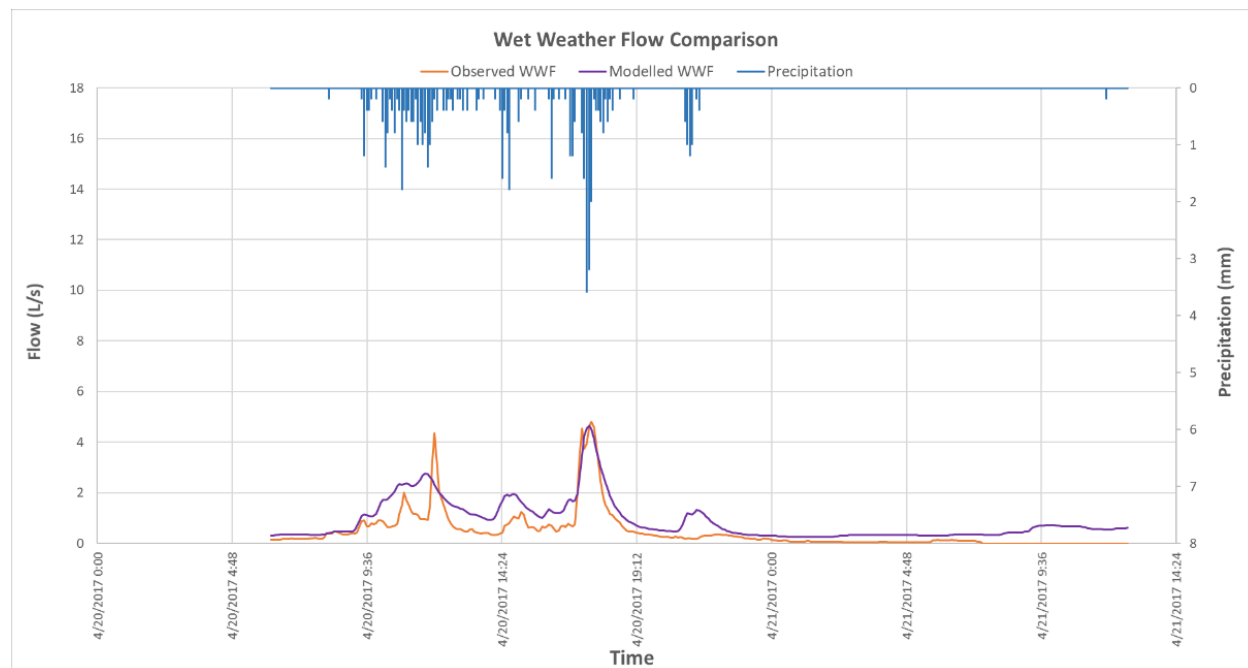
System wet weather response was compared to a variety of identified “Critical” rainfall events. Rainfall events with varying characteristics on depth, intensity and duration will be simulated and compared to ensure the model can reasonably characterize a range of storms.

For each flow monitor site, observed flow data was compared to modelled results for all three calibration events using the following criteria from the CIWEM Urban Drainage Group Code of Practice (2017):

- Timing of peaks and troughs for flow, depth, and velocity should be within ± 0.5 hour (between modelled and observed hydrographs) with respect to the duration of the event and timing of rainfall.
- Peak flow rates at each significant peak should be between the range +25% to -15%.
- Total volume of flow should be within the range +20% to -10%.

Figure 4-3 illustrates an example of wet weather flow calibration.

Figure 4-3. Wet Weather Flow Calibration Example



5. Wastewater Growth Demand Allocation

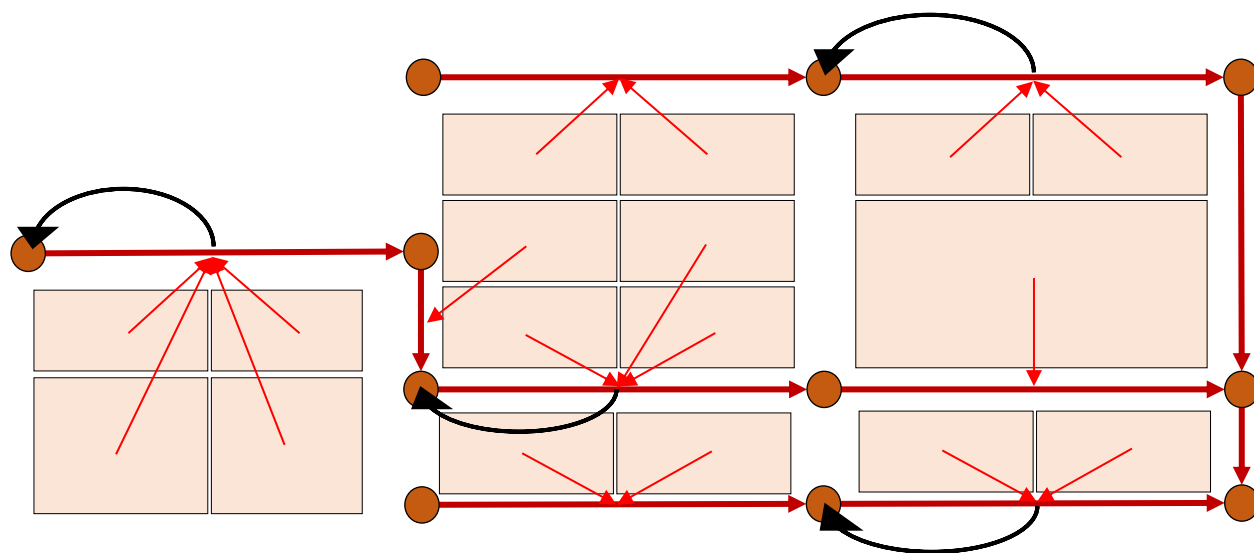
It is anticipated that the growth population and employment projections will be provided as Growth blocks (more discreet than TAZs) and TAZs.

Tributary population employment numbers to each sewershed and treatment facility will be calculated using the following process:

- A baseline growth blocks shapefile will be provided by the City. The growth areas should include the following:
 - All existing available vacant land supply
 - Known growth nodes and corridors
 - Buildout population
- TAZs will be overlaid with the growth area shapefile
 - Where growth in the TAZ exceeds the growth blocks, the remaining growth will likely be distributed across the zone as infill/intensification allowance
- For TAZs with no corresponding growth area shapes, all growth will be assumed to be proportionally applied to existing area within the urban boundary
- For TAZs partially in the urban boundary, all growth will be assumed to occur within the urban boundary with no growth outside the urban boundary
- For TAZs entirely outside the urban boundary, growth will only be applied to existing service areas proportionally based on area weighted basis or total service area within the TAZ
- The growth shapes will be overlaid with the existing sewershed areas to assign growth to individual sewersheds
- For unassigned growth shapes, a manual review of existing service network, topographic, and existing natural and physical features will be reviewed, and growth will be assigned to individual sewersheds based on likely service connection
- The following growth-related wet weather flow assumptions will be applied:
 - Intensification growth (growth located within the existing sewer service catchment) will not contribute additional wet weather flows to the system
 - Greenfield growth (growth located outside the existing sewer service catchment) will contribute additional wet weather flows to the system, in line with the MSP design criteria which will be determined in consultation with the Region)
- For allocation to the InfoSWMM model, the growth area shapes will then be allocated to the closest existing node within the growth shapes' previously assigned sewershed.

Figure 5-1 provides an example of the process used to allocate system flows.

Figure 5-1. Process for Allocating System Flows

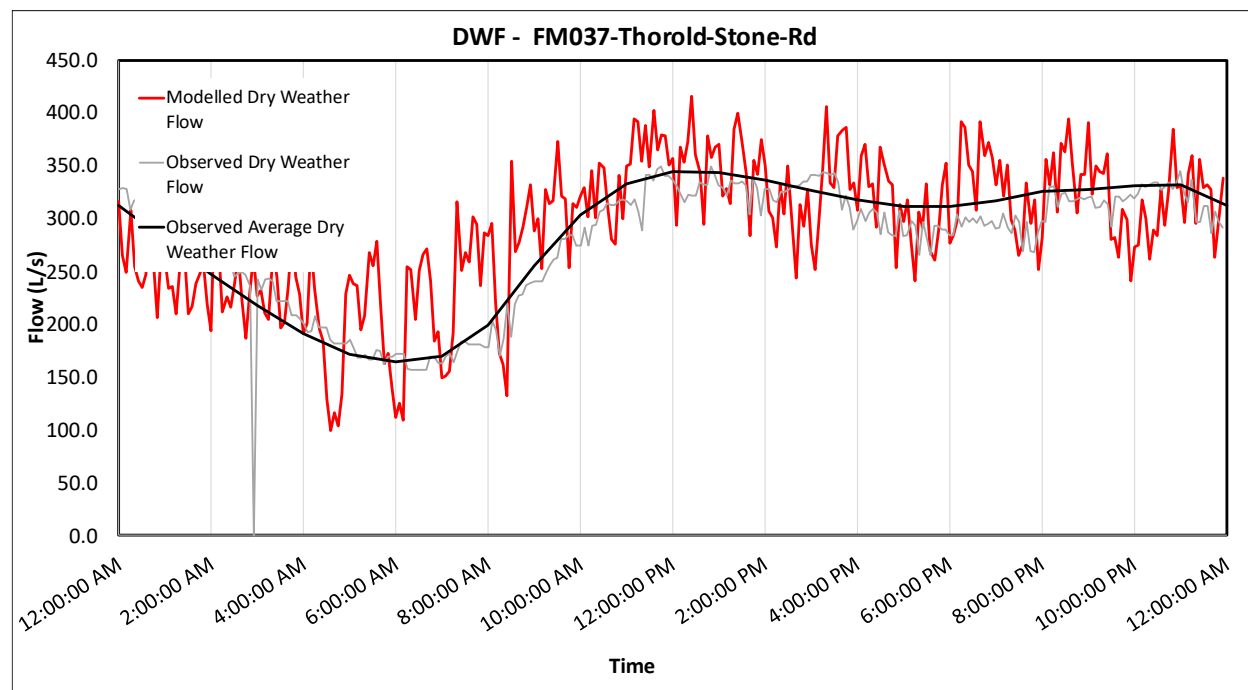


6. Model Calibration Results

6.1. Dry Weather Flow Calibration Results

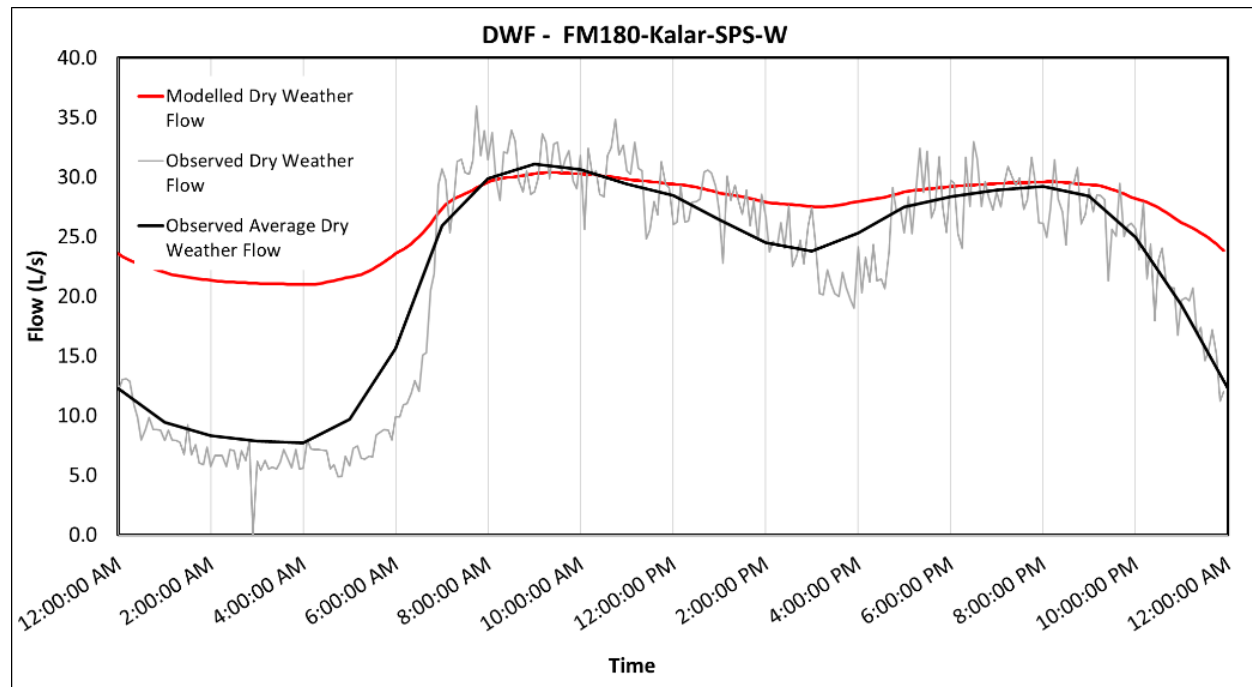
Most flow monitor catchments have been calibrated for DWF to meet the target calibration criteria with a few exceptions, as summarized in **Table 6-1**. In cases where the calibrated modelled peak dry weather flow exceeds the target criteria, fluctuations in modelled flows are explained by upstream pumping stations and are still considered an acceptable calibration, as shown in **Figure 6-1**.

Figure 6-1. Modelled Flows Influenced by Upstream Pumping Station(s)



In cases where the target calibration criteria could not be achieved for modelled volume or minimum flow, matching the peak dry weather flow and keeping the integrity of water billing data is prioritized as shown in **Figure 6-2**. Model error may also be influenced by flow contribution from calibrated catchments upstream where observed data may be inconsistent. By using a conservative, system-based approach to balancing inconsistencies across flow monitoring and water billing data, the model dry weather flow calibration is considered to be acceptable.

Figure 6-2. Calibrated DWF Prioritizing Peak Flow and Water Billing Data



6.2. Calibration Rainfall Event Summary

The rainfall events used to support the model calibration are summarized in **Table 6-2**. Multiple rain gauges were used and matched to flow monitors by proximity to capture heterogeneity in rainfall across the system.

6.3. Wet Weather Flow (WWF) Calibration Results

The WWF calibration generally yielded good results as the majority of catchments met the target calibration criteria for both peak flow and volume criteria for at least one rainfall event as summarized in **Table 6-3**. When the target criteria could not be met for all events, a comprehensive but conservative approach was taken to prioritize matching peak flows, consistency between upstream and downstream catchments, and balancing model error across several storm events.

Table 6-1. Dry Weather Flow Calibration Results

Catchment Name	Model Conduit ID	US/DS of Flow Monitor	Observed Average Max Flow (L/s)	Model Max Flow (L/s)	Max Flow % Difference	Observed Min Flow (L/s)	Model Min Flow (L/s)	Min Flow % Difference	Observed Average Volume (m³)	Modelled Volume (m³)	Volume % Difference
FM180-Kalar-SPS-W	169017280	US	31.1	30.4	-2%	7.7	21.0	172%	1918.9	2317.3	21%
FM131-Kalar	19000166	US	29.0	29.3	1%	10.0	11.4	15%	1863.3	1890.0	1%
FM182-Kalar-SPS-E	169016681	US	4.2	4.4	3%	0.7	0.9	34%	248.6	262.6	6%
FM181-Kalar-SPS-S	169016914	US	4.8	4.7	-3%	1.3	2.0	47%	300.6	313.4	4%
FM124-Stanley&HydroCanal	169015563	US	10.7	10.8	1%	2.5	1.6	-35%	608.8	605.7	-1%
FM035-Stamford-Green	19002753	DS	63.9	71.0	11%	28.6	31.9	12%	4292.7	4476.3	4%
FM123-Stanley	169015902	DS	16.0	20.3	27%	4.6	11.1	141%	967.6	1365.7	41%
FM122-Portage&Mayfair	169015933	DS	40.5	38.8	-4%	15.0	14.6	-3%	2476.0	2291.4	-7%
FM070-Mewburn-Road-SPS	19002788	US	0.8	0.8	4%	0.3	0.3	-9%	49.3	50.4	2%
FM037-Thorold-Stone-Rd	19000686	DS	344.7	448.9	30%	164.1	99.5	-39%	24370.2	25114.2	3%
FM056-Drummond-Rd-SPS	19002631	US	5.9	5.8	-1%	1.4	2.8	99%	351.5	385.3	10%
FM129-Dorchester-SPS-W	169014020	US	44.8	43.2	-4%	7.4	8.6	15%	2297.5	2304.3	0%
FM128-Dorchester-SPS-N	169014279	US	43.4	42.1	-3%	12.0	16.7	39%	2644.2	2586.3	-2%
FM016-McLeod	19000306	US	18.9	18.8	-1%	6.8	8.3	21%	1211.9	1256.6	4%
FM004-Dorchester-Rd	19000304	DS	99.8	107.2	7%	57.7	47.7	-17%	7202.5	7333.5	2%
FM034-SS-Lowlift	19000241	DS	28.7	33.2	16%	16.2	13.8	-15%	2039.8	2221.5	9%
FM009-CII4_Bridgewater	19000465	US	14.4	14.4	0%	4.5	7.0	56%	930.6	1008.5	8%
FM021-Oakwood	19000133	DS	78.2	93.6	20%	38.4	32.7	-15%	5608.0	5158.4	-8%
FM035-NF2_2018_LOWES	169012739	US	12.5	12.7	1%	3.7	4.6	24%	804.9	841.4	5%
FM062-Grassy-Brook-SPS	19002743	US	2.2	2.2	4%	2.0	1.9	-3%	179.7	181.0	1%
FM074-Oakwood-Dr-SPS	169024570	US	2.3	1.9	-17%	0.6	0.6	5%	105.7	98.8	-7%
FM125-Central-SPS	19001496	DS	212.6	211.0	-1%	70.3	88.5	26%	14402.4	12635.0	-12%
FM098-Clancys-Parkinglot	169014776	US	22.0	21.5	-3%	7.3	7.0	-4%	1331.7	1223.7	-8%
FM126-Palmer&Simcoe	19000134	DS	126.6	178.0	41%	41.6	51.5	24%	8117.1	7821.4	-4%
FM083-Seneca-St-SPS	19002488	US	5.3	5.3	0%	2.0	2.0	-1%	347.0	321.2	-7%
FM071-Muddy-Run-SPS	19002746	US	9.6	9.6	0%	3.7	3.6	-3%	589.1	573.6	-3%

Notes:
1. Green indicates that the value is within criteria and Yellow indicates that the value exceeds criteria

Table 6-2. Calibration Rainfall Event Summary

Rain Gauge	Event ID	Start of Rain	End of Rain	Rainfall Duration (dd:hh:mm)	Total Depth (mm)	Peak 1-hr (mm/hr)	Peak 5-min (mm/hr)
RG01 (City)	CE-20230715	7/15/2023 15:20	7/16/2023 6:15	00:14:55	29.5	12.7	48.8
	CE-20230720	7/20/2023 17:45	7/20/2023 19:50	00:02:05	13.2	8.9	21.3
	CE-20230815	8/15/2023 14:15	8/15/2023 23:05	00:08:50	12.4	5.6	18.3
	CE-20230906	9/6/2023 21:30	9/7/2023 5:40	00:08:10	21.1	9.4	61.0
	CE-20231005	10/5/2023 21:35	10/6/2023 8:55	00:11:20	18.8	7.9	33.5
RoN_RG11 (Region)	CE-20230715	7/15/2023 10:40	7/16/2023 2:05	00:15:25	16.5	5.5	24.0
	CE-20230720	7/20/2023 17:40	7/20/2023 19:40	00:02:00	16.8	11.3	30.0
	CE-20230906	9/6/2023 23:15	9/7/2023 5:30	00:06:15	15.3	6.3	33.0
	CE-20231005	10/5/2023 21:10	10/6/2023 19:15	00:22:05	23.0	5.5	36.0
	CE-20220622	6/22/2022 12:15	6/22/2022 13:45	00:01:30	8.0	6.8	21.0
	CE-20220717	7/17/2022 22:10	7/18/2022 11:55	00:13:45	51.5	13.3	27.0
	CE-20220720	7/20/2022 20:45	7/20/2022 22:20	00:01:35	17.3	16.8	66.0
	CE-20220728	7/28/2022 8:40	7/28/2022 19:10	00:10:30	52.8	21.0	147.0
	CE-20221111	11/11/2022 9:35	11/12/2022 1:25	00:15:50	42.0	13.3	27.0
RoN_RG15 (Region)	CE-20230715	7/15/2023 14:45	7/16/2023 2:10	00:11:25	32.3	12.3	48.0
	CE-20230720	7/20/2023 17:45	7/20/2023 19:55	00:02:10	6.5	4.3	9.0
	CE-20230815	8/15/2023 14:05	8/15/2023 22:10	00:08:05	21.3	12.0	30.0
	CE-20230906	9/6/2023 21:25	9/7/2023 5:50	00:08:25	30.8	19.8	51.0
	CE-20231005	10/5/2023 21:25	10/6/2023 9:10	00:11:45	26.0	10.3	45.0
	CE-20220622	6/22/2022 12:25	6/22/2022 13:55	00:01:30	47.0	43.8	90.0
	CE-20220717	7/17/2022 22:05	7/18/2022 12:10	00:14:05	41.3	12.5	30.0
	CE-20220720	7/20/2022 21:50	7/20/2022 22:00	00:00:10	10.3	10.3	87.0
	CE-20220728	7/28/2022 8:55	7/28/2022 19:10	00:10:15	4.5	2.3	21.0
RoN_RG16 (Region)	CE-20221111	11/11/2022 9:40	11/12/2022 3:30	00:17:50	36.0	8.3	18.0
	CE-20230715	7/15/2023 10:50	7/16/2023 2:55	00:16:05	29.0	11.8	81.0
	CE-20230720	7/20/2023 17:40	7/20/2023 20:50	00:03:10	25.0	18.8	51.0
	CE-20230815	8/15/2023 14:40	8/15/2023 23:45	00:09:05	15.5	11.5	27.0
	CE-20230906	9/6/2023 21:05	9/7/2023 5:30	00:08:25	13.0	3.3	18.0
	CE-20231005	10/5/2023 21:30	10/6/2023 19:20	00:21:50	19.8	7.5	33.0
	CE-20220622	6/22/2022 12:25	6/22/2022 12:35	00:00:10	0.8	0.8	6.0
	CE-20220717	7/17/2022 22:10	7/18/2022 12:00	00:13:50	51.0	12.5	24.0
	CE-20220720	7/20/2022 20:50	7/20/2022 22:05	00:01:15	16.8	16.5	75.0
	CE-20220728	7/28/2022 8:45	7/28/2022 19:15	00:10:30	47.8	19.5	90.0
	CE-20221111	11/11/2022 9:40	11/12/2022 1:30	00:15:50	43.3	14.0	27.0
RoN_RG24 (Region)	CE-20230715	7/15/2023 15:15	7/16/2023 3:35	00:12:20	25.5	9.5	54.0
	CE-20230720	7/20/2023 17:35	7/20/2023 19:50	00:02:15	16.5	11.0	36.0
	CE-20230815	8/15/2023 14:10	8/16/2023 2:10	00:12:00	16.3	6.8	21.0
	CE-20230906	9/6/2023 21:20	9/7/2023 5:25	00:08:05	21.3	8.8	45.0
	CE-20231005	10/5/2023 21:25	10/6/2023 19:10	00:21:45	19.5	5.8	24.0
	CE-20220622	6/22/2022 12:10	6/22/2022 14:10	00:02:00	62.3	52.8	105.0
	CE-20220717	7/17/2022 22:05	7/18/2022 12:00	00:13:55	51.0	14.8	24.0
	CE-20220720	7/20/2022 20:40	7/20/2022 22:05	00:01:25	5.5	5.0	36.0
	CE-20220728	7/28/2022 8:45	7/28/2022 19:05	00:10:20	11.3	7.5	36.0
	CE-20221111	11/11/2022 9:40	11/12/2022 2:00	00:16:20	42.3	13.8	27.0

Table 6-3. Wet Weather Flow Calibration Results

Flow Monitor Name	Flow Monitor ID	Rain Gauge	Model Conduit ID	Calibration Event #	Observed Peak Flow (L/s):	Model Peak Flow (L/s):	% Peak Flow Diff.	Observed Total Volume (m³):	Model Total Volume (m³):	% Volume Diff.
FM180-Kalar-SPS-W	FM180	RoN_RG11	169017280	CE-20230720	139.5	145.8	5%	5468.3	5916.7	8%
				CE-20230906	101.9	105.1	3%	5527.7	5828.9	5%
FM131-Kalar	FM131	RoN_RG11	19000166	CE-20230720	143.4	129.4	-10%	4542.2	4690.0	3%
				CE-20230906	72.4	77.6	7%	4833.8	4594.9	-5%
				CE-20231005	65.1	67.9	4%	4702.0	5024.7	7%
FM182-Kalar-SPS-E	FM182	RoN_RG11	169016681	CE-20230720	47.6	41.1	-14%	884.0	821.8	-7%
				CE-20230906	23.7	28.2	19%	684.7	795.2	16%
				CE-20231005	17.5	23.5	34%	721.3	932.0	29%
FM181-Kalar-SPS-S	FM181	RoN_RG11	169016914	CE-20230720	14.9	13.9	-7%	670.2	735.9	10%
				CE-20230906	9.9	10.5	6%	664.4	720.1	8%
				CE-20231005	10.5	10.7	2%	661.9	767.5	16%
FM124-Stanley&HydroCanal	FM124	RoN_RG16	169015563	CE-20230720	135.8	143.1	5%	1734.3	1799.3	4%
				CE-20230815	99.0	97.3	-2%	1388.2	1574.7	13%
				CE-20230906	40.5	27.6	-32%	1077.9	1516.5	41%
FM035-Stamford-Green	FM035	RoN_RG24	19002753	CE-20220717	1350.3	1227.8	-9%	28782.3	29860.3	4%
				CE-20220728	1717.9	1823.3	6%	25452.0	28677.9	13%
				CE-20221111	1171.9	1377.6	18%	30377.4	26931.2	-11%
FM123-Stanley	FM123	RoN_RG16	169015902	CE-20230715	92.1	54.2	-41%	2030.9	4866.5	140%
				CE-20230720	86.6	73.1	-16%	2393.9	4686.7	96%
				CE-20230906	33.5	35.1	5%	2448.4	4298.8	76%
				CE-20231005	49.6	40.8	-18%	2254.1	4519.1	100%
FM122-Portage&Mayfair	FM122	RoN_RG16	169015933	CE-20230715	184.6	475.2	157%	6547.8	7803.0	19%
				CE-20230815	307.0	371.5	21%	6471.0	6297.7	-3%
				CE-20230906	223.1	128.8	-42%	5804.1	6112.0	5%
				CE-20231005	256.8	255.0	-1%	6321.8	6888.6	9%
FM070-Mewburn-Road-SPS	FM070	RoN_RG11	19002788	CE-20220717	4.0	5.1	26%	219.9	273.8	25%
				CE-20220720	5.6	5.0	-11%	210.5	163.9	-22%
				CE-20220728	5.8	7.4	27%	263.1	300.0	14%
FM037-Thorold-Stone-Rd	FM037	RoN_RG16	19000686	CE-20220717	1433.4	1490.4	4%	100963.9	106536.8	6%
				CE-20220728	1395.0	1250.7	-10%	75489.7	81257.0	8%
				CE-20221111	1427.9	1481.0	4%	127717.7	102934.8	-19%
FM056-Drummond-Rd-SPS	FM056	RoN_RG16	19002631	CE-20220717	90.1	53.6	-41%	2530.7	1723.7	-32%
				CE-20220720	49.8	72.1	45%	886.5	1084.6	22%
				CE-20220728	79.9	83.2	4%	1384.0	1664.1	20%
FM129-Dorchester-SPS-W	FM129	RoN_RG11	169014020	CE-20230715	215.3	339.7	58%	6320.8	8042.2	27%
				CE-20230720	570.1	490.9	-14%	7326.9	8034.3	10%
				CE-20231005	261.9	350.0	34%	6660.3	9445.9	42%
FM128-Dorchester-SPS-N	FM128	RG01	169014279	CE-20230715	134.3	321.4	139%	5924.6	8290.6	40%
				CE-20230720	330.9	210.0	-37%	7968.7	6595.4	-17%
				CE-20230815	143.5	151.1	5%	7827.1	6488.3	-17%

Flow Monitor Name	Flow Monitor ID	Rain Gauge	Model Conduit ID	Calibration Event #	Observed Peak Flow (L/s):	Model Peak Flow (L/s):	% Peak Flow Diff.	Observed Total Volume (m³):	Model Total Volume (m³):	% Volume Diff.
FM016-McLeod	FM016	RoN_RG24	19000306	CE-20220717	363.5	231.1	-36%	8890.9	5157.5	-42%
				CE-20220728	372.2	322.5	-13%	4313.4	4923.0	14%
				CE-20221111	354.3	345.4	-3%	11645.4	5384.5	-54%
FM004-Dorchester-Rd	FM004	RoN_RG24	19000304	CE-20220717	1418.5	1561.0	10%	50058.5	53902.3	8%
				CE-20221111	1555.2	1448.7	-7%	77561.9	50537.8	-35%
FM034-SS-Lowlift	FM034	RoN_RG15	19000241	CE-20220622	657.7	797.6	21%	7298.4	15949.9	119%
				CE-20220717	612.5	355.6	-42%	12157.4	14890.5	22%
FM009-CII4_Bridgewater	FM009	RoN_RG15	19000465	CE-20230720	79.5	65.6	-18%	2699.9	2899.5	7%
				CE-20230815	140.5	93.0	-34%	5627.4	4715.9	-16%
				CE-20230906	182.7	114.4	-37%	8192.6	5405.8	-34%
				CE-20231005	129.5	91.1	-30%	4644.1	5432.9	17%
FM021-Oakwood	FM021	RoN_RG24	19000133	CE-20220717	212.3	412.7	94%	10701.8	23545.3	120%
				CE-20221111	409.9	412.5	1%	17025.7	22485.9	32%
FM035-NF2_2018_LOWES	FM035	RoN_RG24	169012739	CE-20230715	54.5	86.0	58%	2212.4	2388.0	8%
				CE-20230720	73.0	78.6	8%	1915.5	2140.9	12%
				CE-20231005	62.2	51.0	-18%	2004.7	2221.1	11%
FM062-Grassy-Brook-SPS	FM062	RoN_RG24	19002743	CE-20220622	9.7	42.1	332%	850.8	1453.1	71%
				CE-20220717	6.3	17.0	171%	524.6	992.3	89%
				CE-20221111	14.8	15.4	4%	1211.9	1097.3	-9%
FM074-Oakwood-Dr-SPS	FM074	RoN_RG24	169024570	CE-20220622	22.0	55.1	150%	1063.1	997.2	-6%
				CE-20220717	15.5	24.2	57%	559.0	995.3	78%
				CE-20221111	20.1	19.4	-4%	1496.3	870.0	-42%
FM125-Central-SPS	FM125	RG01	19001496	CE-20230720	2083.7	1484.8	-29%	37689.9	35974.3	-5%
				CE-20230815	1453.1	1008.0	-31%	39731.3	36549.5	-8%
				CE-20231005	2071.6	1540.6	-26%	36170.2	42256.6	17%
FM098-Clancys-Parkinglot	FM098	RG01	169014776	CE-20230715	234.5	756.3	222%	3810.5	5491.3	44%
				CE-20230720	191.7	281.9	47%	3287.6	3827.9	16%
				CE-20230906	83.9	455.9	443%	2902.2	4643.6	60%
				CE-20231005	546.8	390.6	-29%	3762.8	4401.4	17%
FM126-Palmer&Simcoe	FM126	RG01	19000134	CE-20230715	566.4	490.9	-13%	24066.5	24907.0	3%
				CE-20230720	434.9	377.1	-13%	19545.1	19729.4	1%
				CE-20230906	538.4	381.2	-29%	18458.8	23025.7	25%
FM083-Seneca-St-SPS	FM083	RoN_RG16	19002488	CE-20220717	48.1	74.6	55%	1830.1	2810.9	54%
				CE-20221111	73.7	78.8	7%	2709.0	2477.8	-9%
FM071-Muddy-Run-SPS	FM071	RoN_RG16	19002746	CE-20220717	69.2	69.0	0%	3206.3	3123.3	-3%
				CE-20220728	75.5	78.6	4%	2894.5	3117.0	8%
				CE-20221111	55.9	72.0	29%	3513.5	2928.5	-17%

Notes:
1. Green indicates that the value is within criteria and Yellow indicates that the value exceeds criteria

6.3.1. WWF Calibration Results Analysis

6.3.1.1. Calibrated Catchments

An example of a well-calibrated catchment can be seen for Kalar SPS as shown in **Figure 6-3** and **Figure 6-4**. In this catchment, there are four City flow monitors that were used to calibrate the model. All the flow monitors are seen to have met the calibration criteria in almost all the storm events except for FM182-Kalar-SPS-E during the October 5, 2023 event.

Figure 6-3. FM131-Kalar during the July 20, 2023 Storm Event

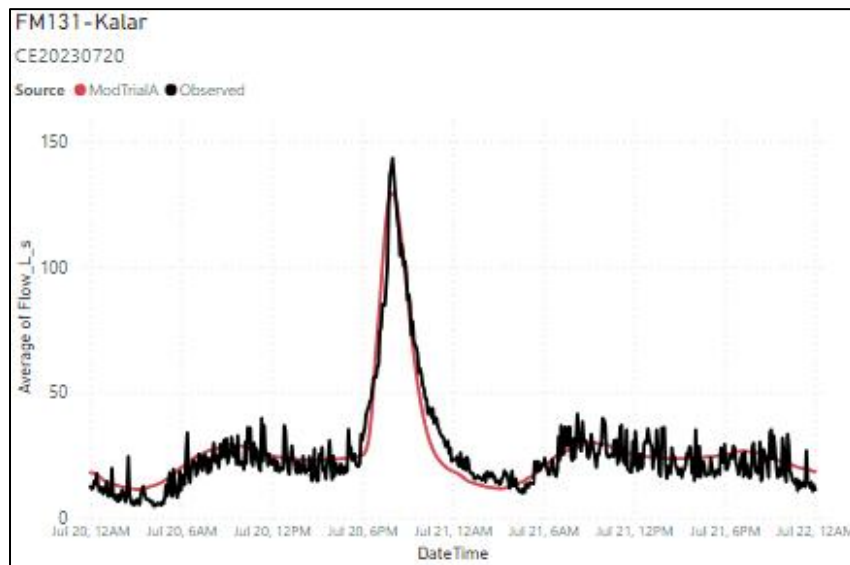


Figure 6-4. FM181-Kalar-SPS-S during the July 20, 2023 Storm Event



6.3.1.2. Incorrect or Missing Data from 2022 Region Flow Monitors

The model was not calibrated to events where observed flows may be inaccurate, as shown in **Figure 6-5** and **Figure 6-6**. Inaccurate observed data can be frequently seen in pumping station data where sensors fail during surcharging and backflow conditions during high wet weather flow events. In these cases, meeting the target criteria for other events at these flow monitors were prioritized.

Figure 6-5. FM062-Grassy-Brook-SPS during the June 22, 2022 Storm Event

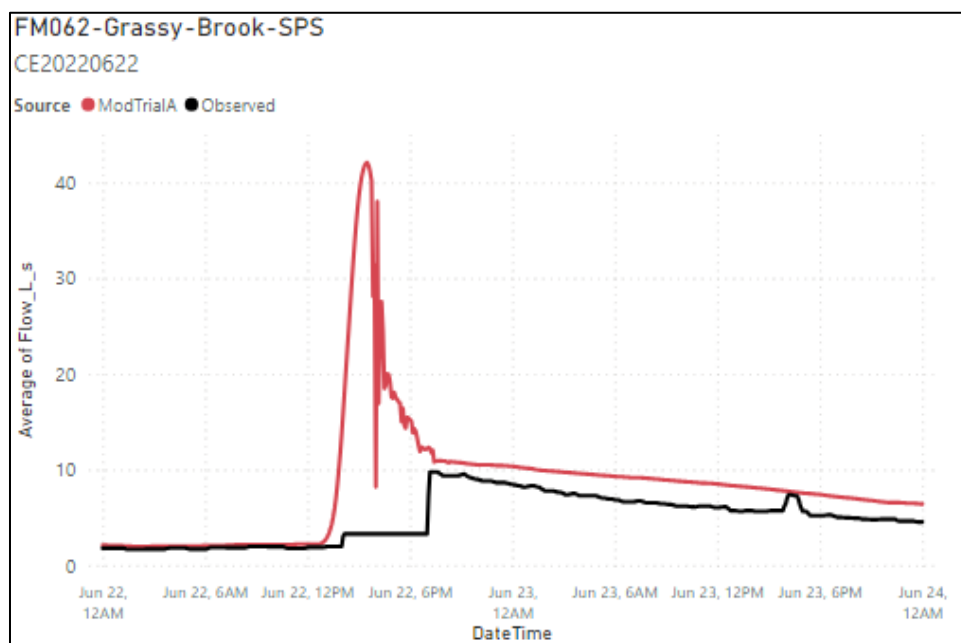
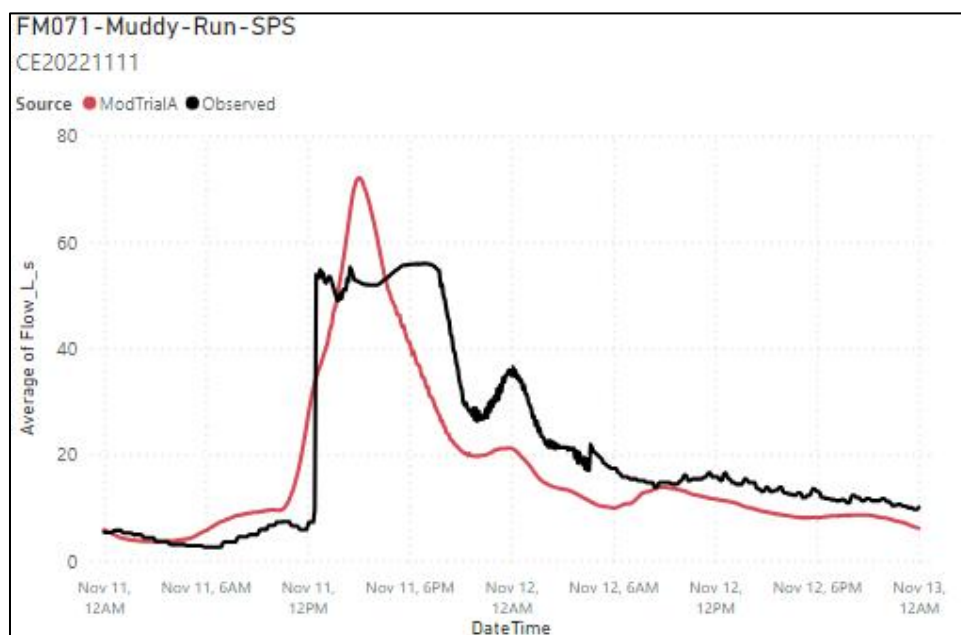
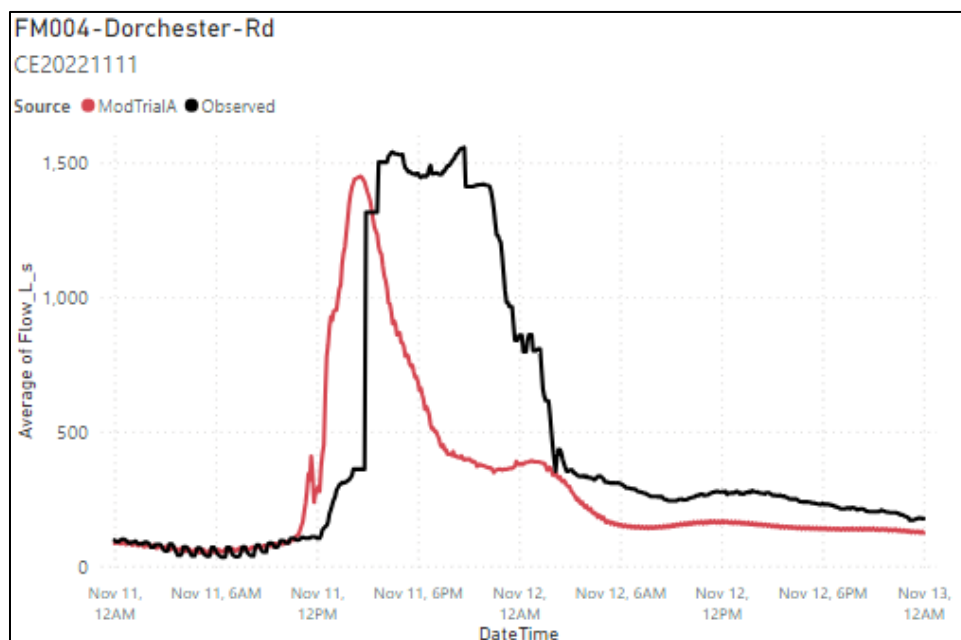


Figure 6-6. FM071-Muddy-Run-SPS during the November 11, 2022 Storm Event



Similarly, surcharging and backflow in sewers in the network during high wet weather events may also cause errors in the observed data. In such cases, the catchment was calibrated using a comprehensive but conservative approach to best balance errors across events and within the system. In the example of FM004-Dorchester-Rd, shown in **Figure 6-7**, the model could not match the high volume observed during the November 11, 2022 event without negatively influencing the calibration criteria in adjacent catchments such as FM016-McLeod. Matching the peak flow for the event was prioritized as a conservative approach, and other observed events with more reliable flow data across the system supported the calibration.

Figure 6-7. FM004-Dorchester-Rd during the 11 November 2022 Storm Event



An example of a critical storm event where the calibration criteria is adequately met can be seen in **Figure 6-8** and **Figure 6-9**.

Figure 6-8. FM016-McLeod during the July 28, 2022 Storm Event

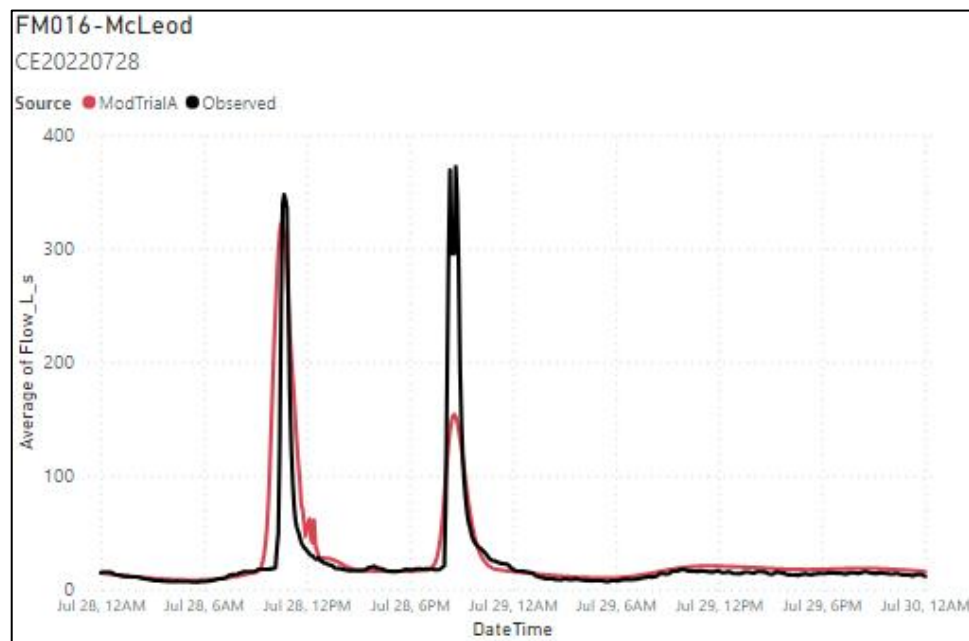
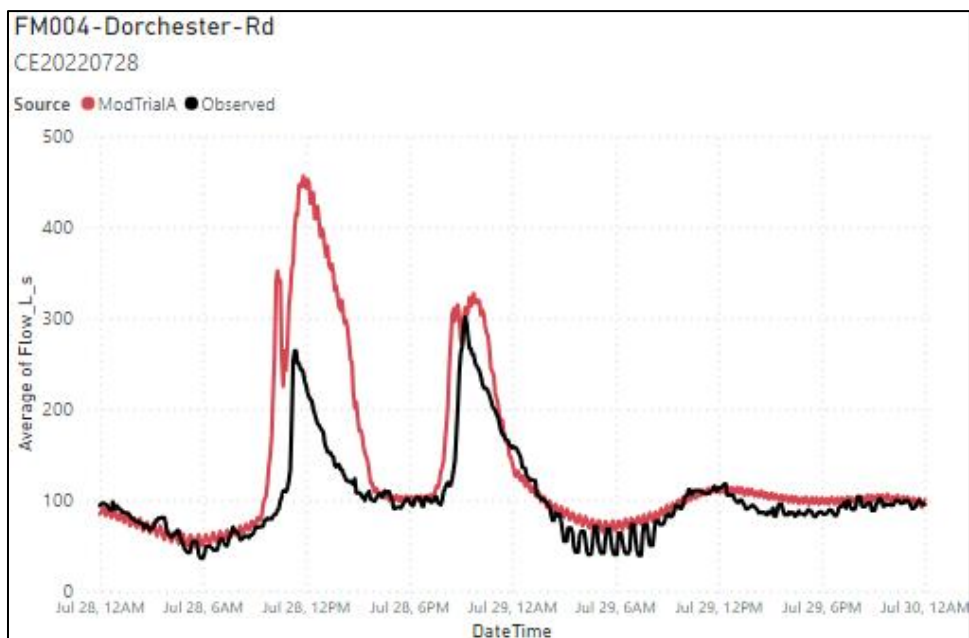


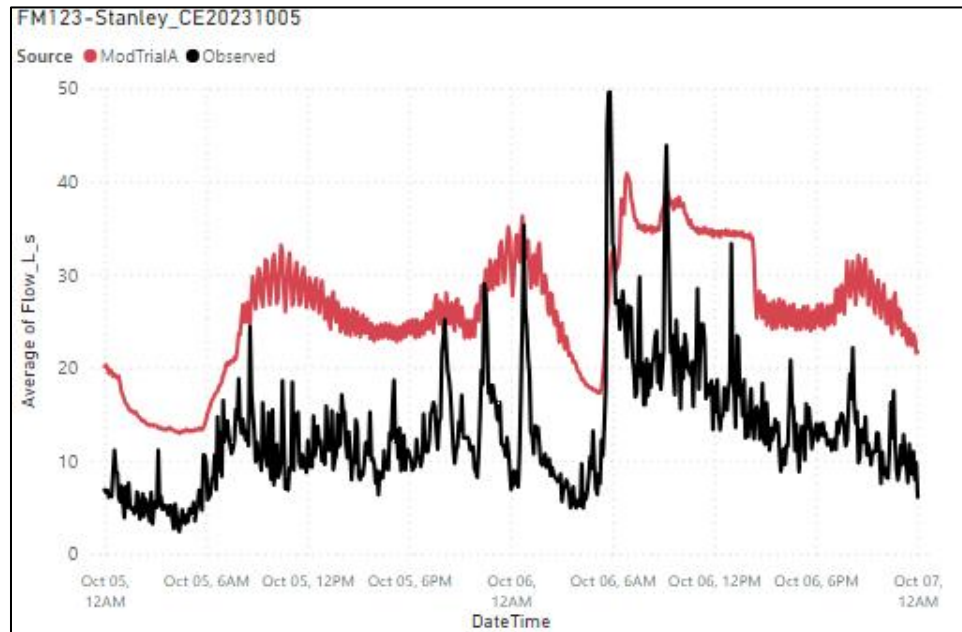
Figure 6-9. FM004-Dorchester-Rd during the July 28, 2022 Storm Event



6.3.2. Analysis of FM123-Stanley

FM123-Stanley is located downstream of NOTL, which has recently been updated as part of the 2022 NOTL PPCP. Errors in the modelled flows are influenced by flows from the upstream NOTL catchment, as shown in **Figure 6-10**. The flows from the NOTL model were not adjusted as part of the City's MSPU.

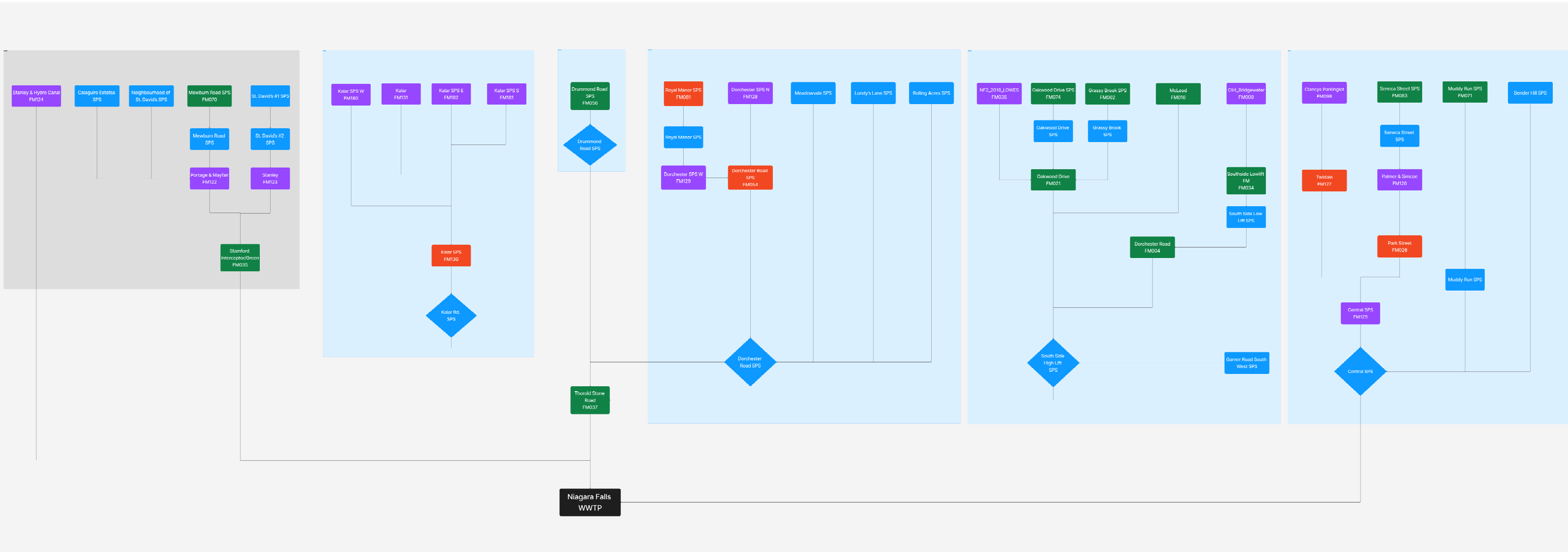
Figure 6-10. FM123-Stanley during the 5 October 2023 Storm Even



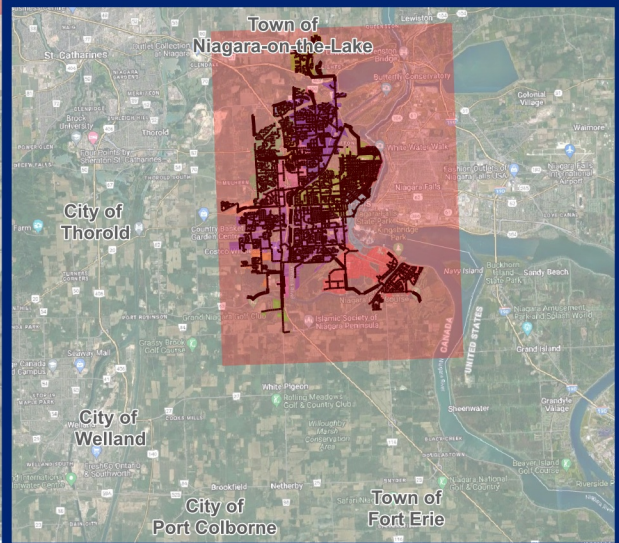
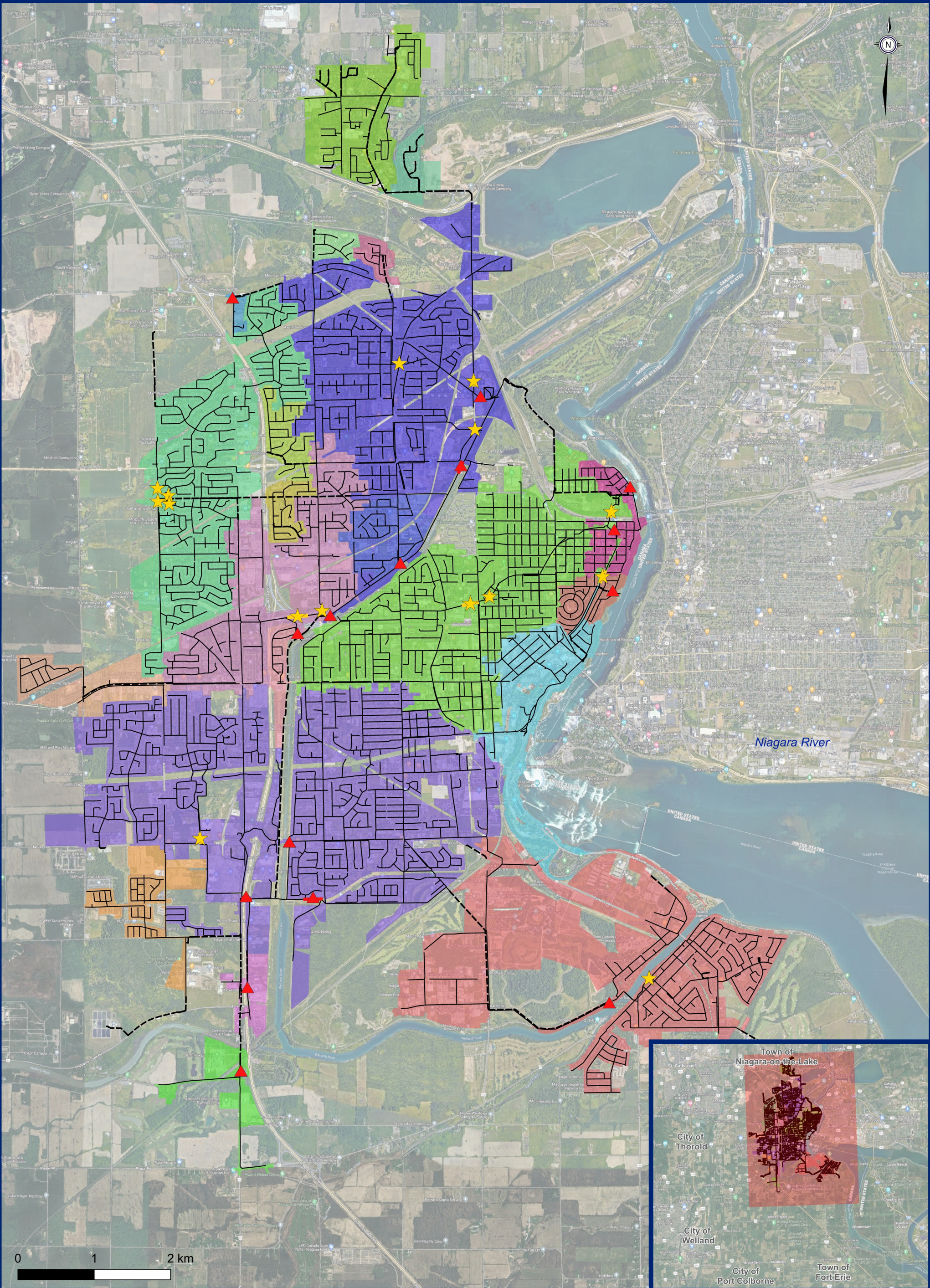
6.3.3. Conclusions

The Niagara Falls model calibration update was supported by 26 flow monitors across 10 storms covering a span of 2 years, with consideration for historical work. The flow monitoring catchments provide even coverage of the whole system and adequately meet the target calibration criteria.

Appendix A Flow Monitor Schematic



Appendix B Map of Flow Monitor Locations



Niagara Falls Master Servicing
Plan and Wet Weather
Management Strategy

Existing Infrastructure

- Sanitary Forcemain
- Sanitary Gravity Main

Wastewater Catchments

- Bender Hill SPS
- Calaguiro SPS
- Central SPS
- Dorchester Road SPS
- Drummond Road SPS
- Garnet SPS
- Grassy Brook SPS

- Kalar Road SPS
- Lundy's Lane SPS
- Meadowvale SPS
- Mewburn SPS
- Muddy Run SPS
- Neighbourhood SPS
- Niagara Falls WWTP
- Oakwood SPS
- Rolling Acres SPS
- Royal Manor SPS

- Seneca Street SPS
- South Side High Lift SPS
- South Side Low Lift SPS
- St. Davids #1 SPS
- St. Davids #2 SPS

Flow Monitors

- ★ City
- ▲ Region

**Wastewater Flow Monitoring
Program Map**



June, 2024
622071-WW-000
Projection EPSG:26917

Appendix C Summary of Model Updates

Junction ID	Reason for Update
164157158	Deleted because of orphaned node
GMBP_NODE_002	Added junction based on manhole survey
GMBP_NODE_001	Added junction based on manhole survey

Junction ID	Reason for Change in Invert or Rim Elevation
160010548	Updated rim and invert elev as provided in the dip sheet.
160010549	Updated rim and invert elev as provided in the dip sheet.
160005583	Updated rim and invert elev as provided in the dip sheet.
160010526	Updated invert elevation because of US conduit dip sheet changes.
160010523	Updated invert elevation because of US conduit dip sheet changes.
160008170	Updated invert elev only as provided in the dip sheet.
160008624	Updated rim and invert elev as provided in the dip sheet.
160006454	Updated rim and invert elev as provided in the dip sheet.
160007309	Updated rim and invert elev as provided in the dip sheet.
160007100	Updated invert elevation because of US conduit dip sheet changes.
160007308	Updated invert elevation because of US conduit dip sheet changes.
160010837	Updated rim and invert elev as provided in the dip sheet.
160007613	Updated invert elevation because of US conduit dip sheet changes.
160007615	Updated invert elevation because of US conduit dip sheet changes.
160007742	Updated rim and invert elev as provided in the dip sheet.
160007743	Updated rim and invert elev as provided in the dip sheet.
160023399	Updated rim and invert elev as provided in the dip sheet.
10000200	Updated rim and invert elev as provided in the dip sheet.
10000201	Updated rim and invert elev as provided in the dip sheet.
164000085	Updated invert elevation because of US conduit dip sheet changes.
160007609	Updated rim elev only as provided in the dip sheet.
160007611	Updated rim elev only as provided in the dip sheet.
10000023	Updated based on SPS drawings near hydro canal
10000024	Updated based on SPS drawings near hydro canal

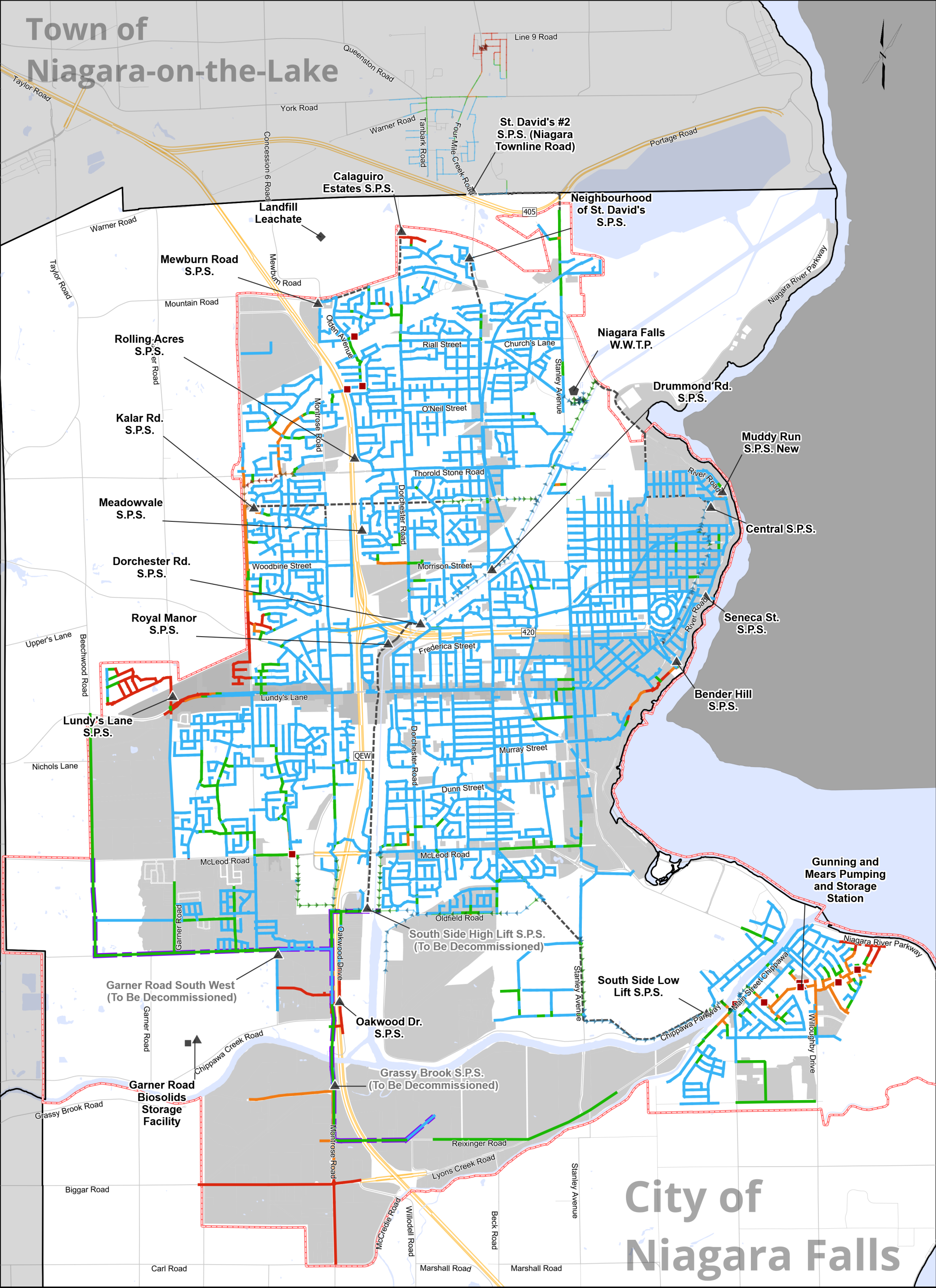
Conduit ID	Reason for Update
169013897	Converted from a conduit to a weir based on manhole survey
169013113	Pipe does not exist in updated model because of split pipe
169013113_1	Split pipe based on manhole survey
169013113_2	Split pipe based on manhole survey
DGM_04764	Added pipe based on manhole survey
GMBP_PIPE_001	Added pipe based on manhole survey
GMBP_PIPE_002	Added pipe based on manhole survey
GMBP_PIPE_003	Added pipe based on manhole survey
GMBP_PIPE_004	Added pipe based on manhole survey
Llimit_Tank	Added based on November 2023 model update

Conduit ID	Reason for Change in Diameters, Upstream or Downstream Invert Elevation
169017267	Incorrect diameter, flagged to the city sent on xxx
169011561	Chippawa model update from November 2023, changed to help drain the tank slower
169024419	Chippawa model update from November 2023
169011814	Chippawa model update from November 2023, Manhole survey changes made
169011901	Chippawa model update from November 2023
169011797	Chippawa model update from November 2023
169011599	Chippawa model update from November 2023
169019205	Reversed link and updated elevations
169012757	Manhole survey changes made
169016447	Manhole survey changes made
169011821	Chippawa model update from November 2023
169011812	Chippawa model update from November 2023, Manhole survey changes made
169012755	Manhole survey changes made
169011732	Chippawa model update from November 2023
169013184	Reversed link and updated elevations
169021659	Reversed link and updated elevations
169024683	Chippawa model update from November 2023
169017667	Manhole survey changes made
169024243	Chippawa model update from November 2023

169012951	Reversed link and updated elevations
169017289	Manhole survey changes made
169012756	Manhole survey changes made
169024693	Chippawa model update from November 2023
19000268	Manhole survey changes made
169014776	Manhole survey changes made
169011790	Chippawa model update from November 2023
169011845	reversed pipe based on inverts
169016395	Manhole survey changes made
169015925	Reversed link and updated elevations
169011826	Chippawa model update from November 2023
169016515	Manhole survey changes made
19000129	Manhole survey changes made
169024446	Manhole survey changes made
169011560	Chippawa model update from November 2023
169012952	Reversed link and updated elevations
169016394	Manhole survey changes made
169013170	Manhole survey changes made
169011813	Manhole survey changes made
169023640	Manhole survey changes made
169013487	Manhole survey changes made
169016514	Manhole survey changes made
169012758_2	Manhole survey changes made
169023641	Manhole survey changes made
169014777	Manhole survey changes made
169013171	Manhole survey changes made
169011738	Chippawa model update from November 2023
169017265	Manhole survey changes made
169013898	Manhole survey changes made
169024445	Manhole survey changes made
169011831	Chippawa model update from November 2023
169011922	Chippawa model update from November 2023
169011904	Chippawa model update from November 2023
169011842	Chippawa model update from November 2023
169011899	Chippawa model update from November 2023

169011563	Chippawa model update from November 2023
169012759	Manhole survey changes made
169011829	Manhole survey changes made
169011776	Manhole survey changes made
169019143	Chippawa model update from November 2023
169011827	Chippawa model update from November 2023
169016465	Manhole survey changes made
169016454	Manhole survey changes made
169011555	Manhole survey changes made
169011837	Chippawa model update from November 2023
169015560	Manhole survey changes made
169013904	Manhole survey changes made
169016516	Manhole survey changes made
169022088	Chippawa model update from November 2023
169011815	Chippawa model update from November 2023, Manhole survey changes made
169016523	Manhole survey changes made
169011554	Manhole survey changes made
169016448	Manhole survey changes made
169023736	Chippawa model update from November 2023

Appendix B Buildout Performance Maps



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

Wastewater Catchment

- Growth Plans

Regional Sewer Performance

- Surplus Capacity (d/D<= 0.5)
- Surplus Capacity (d/D<1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D<= 0.5)
- Surplus Capacity (d/D<1)
- Surcharging
- Surcharging with Basement Flooding Risk

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

Future Infrastructure

- Future SNF WWTP
- Future Trunk Sewers

Reference(s)

- 1. Projection EPSG:26917
- 2. Base Data: City of Niagara Falls, 2023

12 km

Appendix B-1
Buildout Growth System Performance Under Region Wet Weather Design Flow

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

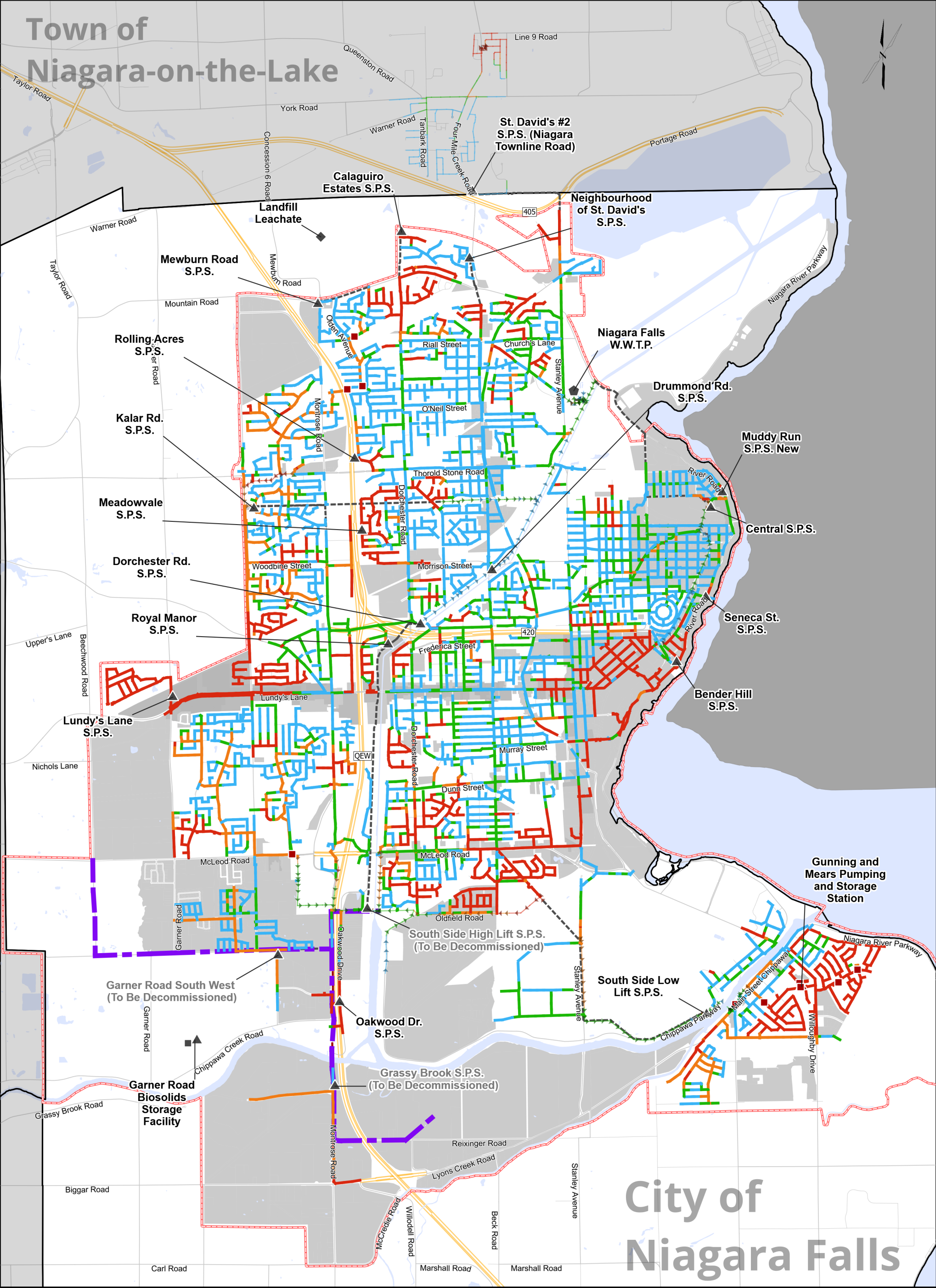
Client Name:
City of Niagara Falls
(Ontario, Canada)

GEI

Consultants
Canada

Last Updated: November 2025

Document ID: 2402014-001



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

Wastewater Catchment Growth Plans

Regional Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

Municipal Sewer Performance

- Surplus Capacity (d/D <= 0.5)
- Surplus Capacity (d/D < 1)
- Surcharging
- Surcharging with Basement Flooding Risk

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

Future Infrastructure

- Future SNF WWTP
- Future Trunk Sewers

Reference(s)

- Projection EPSG:26917
- Base Data: City of Niagara Falls, 2023

1 2 km

Appendix B-2

Buildout Growth System Performance Under 10-Year Design Storm

Project Name:

Master Servicing Plan and Wet Weather Management Strategy

Client Name:

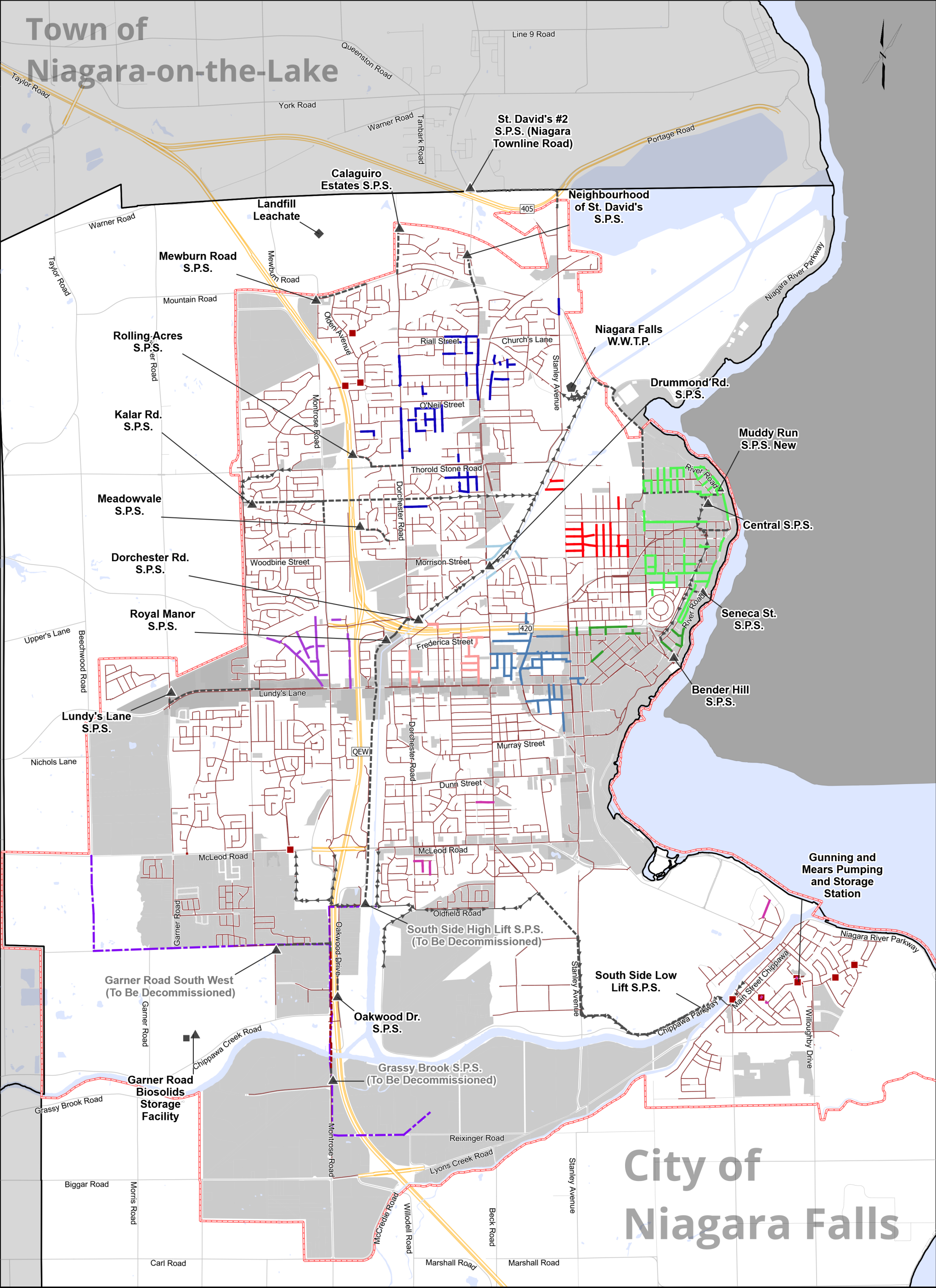
City of Niagara Falls (Ontario, Canada)

GEI

Consultants Canada

Last Updated: November 2025
Document ID: 2402014-001

Appendix C Sewer Separation Strategy



Regional Sanitary Facility

- Wastewater Treatment Plant (WWTP)
- Sanitary Pumping Station (SPS)
- Biosolids Storage
- Lagoon
- Leachate Pumping Station
- Future SNF WWTP

Municipal Sanitary Facility

- Sanitary Pumping Station
- Sanitary Storage Tanks

Forcemain

- Regional
- Municipal (Niagara Falls)

SSS Prioritization Ranking

- Rank #1: Falls Ave
- Rank #2: Frederica St
- Rank #3: Belmont Ave
- Rank #4: Main St
- Rank #5: Bridge St
- Rank #6: South Niagara Falls
- Rank #7: Stanley Ave
- Rank #8: Thorold Stone Rd
- Rank #9: Portage Rd

General Feature

- Urban Area Boundary
- Municipal Boundary
- Waterbody, Watercourse

Gravity Main

- Regional
- Municipal (Niagara Falls)
- Other Municipal (NOTL)
- Future Trunk Sewers

Reference(s)

- 1. Projection EPSG:26917
- 2. Base Data: City of Niagara Falls, 2023

12 km

Appendix C
Wastewater Capital Program Sewer Separation Strategy (SSS)
Prioritization Ranking

Project Name:
Master Servicing Plan and Wet Weather Management Strategy

Client Name:
City of Niagara Falls
(Ontario, Canada)

GEI

Consultants
Canada

Last Updated: June 2026

Document ID: 2402014-001

Appendix D Wastewater Capital Program Summary

City of Niagara Falls
Master Servicing Plan and Wet Weather Management Strategy
Volume 4: Wastewater Master Servicing Plan and Wet Weather Management Strategy
Niagara Falls, Ontario
August 11, 2026

Road Name	Project No.	Prioritization	Project Type	Project Timelines	Length (m)	Total Cost (\$)	DC Cost (\$)	OB Cost (\$)	City (Benefit to Existing) Cost (\$)
Brookfield Avenue	1	Existing and medium-term demand	Sewer Upgrade	5-10	271	\$748,000	\$374,000	-	\$374,000
Dorchester Road	2-A	Existing and medium-term demand	Sewer Upgrade	5-10	185	\$657,000	\$328,500	-	\$328,500
Garden Street	2-B	Existing and medium-term demand	New Sewer	5-10	236	\$653,000	\$326,500	-	\$326,500
Frederica Street	3	Existing and short-term demand	New Sewer	5-10	347	\$897,000	\$448,500	-	\$448,500
Spring Street	4	Existing and medium-term demand	Sewer Upgrade	0-2	370	\$890,000	\$667,500	-	\$222,500
Ferry Street	5	Existing and medium-term demand	Sewer Upgrade	0-2	381	\$988,000	\$741,000	-	\$247,000
Robinson Street	6	Existing Risk - LOS	Sewer Upgrade	3-5	269	\$649,000	\$64,900	-	\$584,100
Woodgate Street	7-A	Triggered By Growth	Sewer Upgrade	5-10	527	\$1,368,000	\$1,231,200	-	\$136,800
Woodfield Avenue	7-B	Triggered By Growth	Sewer Upgrade	5-10	216	\$522,000	\$469,800	-	\$52,200
Mountain Road	8-A	Existing Risk - High	Sewer Upgrade	10+	200	\$482,000	\$48,200	-	\$433,800
Dorchester Road	8-B	Existing Risk - High	Sewer Upgrade	5-10	333	\$864,000	\$777,600	-	\$86,400
Dorchester Road	8-C	Existing Risk - LOS	Sewer Upgrade	5-10	484	\$2,224,000	\$2,001,600	-	\$222,400
St Paul Avenue	9	Project Efficiency	Sewer Upgrade	5-10	300	\$727,000	\$72,700	-	\$654,300
Stanley Avenue	10-A	Project Efficiency	Sewer Upgrade	10+	841	\$4,481,000	\$4,032,900	-	\$448,100
Stanley Avenue	10-B	Triggered By Growth	Sewer Upgrade	10+	237	\$656,000	\$590,400	-	\$65,600
Stanley Avenue	10-C	Triggered By Growth	Sewer Upgrade	10+	1321	\$6,512,000	\$5,860,800	-	\$651,200
Rideau Street	11-A	Existing Risk - LOS	Sewer Upgrade	10+	300	\$723,000	\$72,300	-	\$650,700
Pitton Road	11-B	Existing Risk - LOS	Sewer Upgrade	10+	477	\$1,236,000	\$123,600	-	\$1,112,400
Corwin Crescent	12-A	Project Efficiency	Sewer Diversion	5-10	159	\$442,000	\$397,800	-	\$44,200
Carlton Avenue	12-B	Project Efficiency	Sewer Upgrade	5-10	256	\$907,000	\$816,300	-	\$90,700
Carlton Avenue	12-C	Project Efficiency	New Sewer	5-10	125	\$444,000	\$399,600	-	\$44,400
Dunn Street	13-A	Project Efficiency	Sewer Upgrade	10+	251	\$1,069,000	\$106,900	-	\$962,100
Dorchester Road	13-B	Project Efficiency	Sewer Upgrade	10+	775	\$3,561,000	\$356,100	-	\$3,204,900
Portage Road	16	Project Efficiency	Sewer Upgrade	3-5	458	\$1,099,000	\$109,900	-	\$989,100
Mount Carmel Boulevard	17	Existing Risk - LOS	Sewer Upgrade	10+	187	\$452,000	\$45,200	-	\$406,800
Brookdale Drive	18-A	Existing and medium-term demand	Sewer Diversion	5-10	634	\$2,014,000	\$1,084,300	-	\$929,700
Brookdale Drive	18-B	Triggered By Growth	New Sewer	5-10	44	\$123,000	\$36,900	-	\$86,100
Hydro Corridor	19	Supports New Growth Area	Internal	3-5	1000	\$1,998,000	\$399,600	\$199,800	\$1,398,600
Garner Road	20	Supports New Growth Area	New Sewer	0-2	430	\$904,000	\$361,600	\$90,400	\$452,000
Garner Road	21	Supports New Growth Area	New Sewer	0-2	490	\$1,030,000	\$927,000	\$103,000	-
Allendale Avenue	22	Project Efficiency	Sewer Upgrade	0-2	349	\$795,000	\$795,000	-	-
Clark Avenue	23	Existing Risk - LOS	Sewer Upgrade	0-2	355	\$918,000	\$918,000	-	-
Robinson Street	24	Existing Risk - LOS	New Sewer	0-2	191	\$436,000	\$436,000	-	-
Beechwood Road	25	Supports New Growth Area	Internal	3-5	1900	\$15,921,000	\$14,328,900	\$1,592,100	-
Garner Road	26	Supports New Growth Area	Internal	3-5	1200	\$9,213,000	\$8,291,700	\$921,300	-
Montrose Road	30	Supports New Growth Area	New Sewer	0-2	13	\$225,000	\$202,500	\$22,500	-
Montrose Road	31	Supports New Growth Area	Sewer Twinning	0-2	801	\$7,715,000	\$6,943,500	\$771,500	-
Montrose Road	32	Supports New Growth Area	New Sewer	0-2	790	\$7,451,000	\$6,705,900	\$745,100	-
Biggar Road	34	Supports New Growth Area	New Sewer	3-5	900	\$6,910,000	\$6,910,000	-	-
Northwest Secondary Plan	35-A	Supports New Growth Area	Internal	5-10	500	\$1,195,000	\$1,075,500	\$119,500	-
Northwest Secondary Plan	35-B	Supports New Growth Area	New Pump Station	5-10	75	\$8,716,000	\$7,844,400	\$871,600	-
Northwest Secondary Plan	35-C	Supports New Growth Area	New Forcemain	5-10	1700	\$3,867,000	\$3,480,300	\$386,700	-
Willick Road	36	Supports New Growth Area	New Sewer	0-2	1000	\$2,140,000	\$1,926,000	\$214,000	-
Sodom Road	39-A	Triggered By Growth	Sewer Upgrade	0-2	382	\$1,755,000	\$1,004,300	-	\$750,700
Sodom Road	39-B	Triggered By Growth	Sewer Upgrade	0-2	12	\$57,000	\$5,700	-	\$51,300
Ort Road	40	Project Efficiency	New Sewer	0-2	255	\$505,000	\$50,500	-	\$454,500
Willick Road	41-A	Project Efficiency	Sewer Upgrade	0-2	480	\$953,000	\$95,300	-	\$857,700
Willick Road	41-B	Project Efficiency	New Sewer	0-2	321	\$634,000	\$63,400	-	\$570,600
McGarry Drive	42	Existing Risk - LOS	Sewer Upgrade	10+	198	\$506,000	\$289,200	-	\$216,800