REGION OF PEEL

WASTEWATER CAPACITY IMPROVEMENTS IN CENTRAL MISSISSAUGA

APPENDIX 2-E

Hydraulic Analysis Report

Regional Municipality of Peel

Wastewater Capacity Improvements in Central Mississauga

Hydraulic Analysis Report

Prepared by GM BluePlan for:

Region of Peel

Project No. 718018

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Region of Peel
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1 INTRODUCTION AND BACKGROUND

1.1 Study Background and Memo Introduction

The Region initiated the Wastewater Capacity Improvements for the Central Mississauga Class Environmental Assessment (EA) Study in March 2019 to identify, develop and implement a strategy to service growth and relieve capacity restraints in the Central Mississauga area. The study is being undertaken as a Schedule ‘C’ project in accordance with the requirements of the Municipal Class Environmental Assessment process, prepared by the Municipal Engineers Association (MEA) (October 2000, as amended in 2007, 2011 and 2015).

Hydraulic restrictions along sections of the Cooksville Creek Trunk Sewer, Canadian Pacific Railway (“CPR”) Trunk Sewer and Little Etobicoke Creek Trunk Sewers, as well as other limitations that challenge further upgrades to existing trunk sewers (particularly along the CPR), have triggered the need to consider alternative alignments for conveyance of flow to the G.E. Booth Wastewater Treatment Plant (WWTP). The Region is also undertaking replacement, rehabilitation and installation of additional sewers on Burnhamthorpe Road, Wilcox Road and Cawthra Road. This Class EA study will integrate these system improvements and review these projects with a broader approach to ensure alignment with long-term wastewater servicing objectives.

The primary purpose of this project is to complete a Class EA Study to enhance the conveyance capacity of key trunk sewers that will meet growth needs to 2041 and beyond within the Mississauga City Centre, the Hurontario Corridor and the Dundas Corridor as well as to:

- Provide operational flexibility for sewer maintenance, inspection and emergency operations
- Meet level of service across different areas
- Address wet weather issues

The project team has developed a preliminary preferred servicing solution that will achieve the goals listed above. This solution consists of the following infrastructure projects:

- New 1,500 mm sewer on Burnhamthorpe Rd from Central Pkwy to Cawthra Rd, connecting to the future 1,500 mm Cawthra Trunk Sewer
- New 1,500 mm Cawthra Trunk Sewer Extension from Dundas St to The Queensway
- New 1,500 mm – 1,800 mm Trunk Sewer on The Queensway from Hurontario to East Trunk Sewer within Etobicoke Creek. This sewer will intercept / connect to several existing sewers that cross The Queensway flowing from north to south. Interconnection points are discussed in subsequent sections of this memo and are proposed at several locations.

These projects connect to existing Peel wastewater trunk sewers throughout Central Mississauga. Depending on their location, these connection points will be planned to include various types of control structures that will regulate flow to the downstream sewers. The Region has indicated that the preferred method of control for these structures will be via Real Time Control (RTC) which will be linked to the Region's Supervisory Control and Data Acquisition (SCADA) system. Further description of the RTC is in subsequent sections of this memo.

This memo is intended to outline the background modelling methodology, results and need for infrastructure upgrades. In addition, this memo will provide guidance and control logic for operation of the control structures under varying conditions once all infrastructure is constructed. The preliminary preferred servicing strategy as well as the key flow control location is provided in **Figure 1-1**.

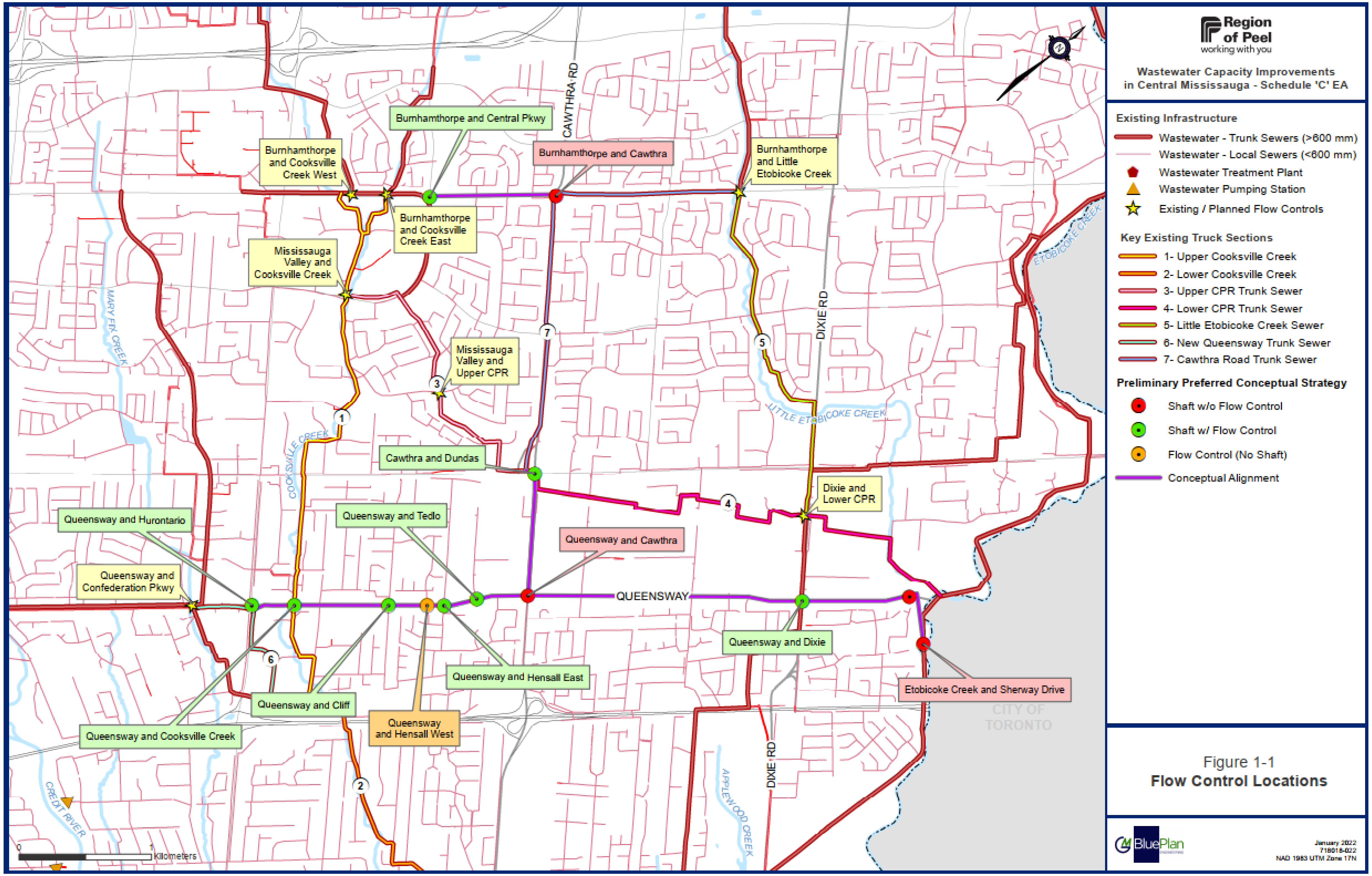


Figure 1-1: Preliminary Preferred Strategy and Flow Control Locations

2 PROJECT NEEDS

This section outlines the main purpose that is driving the need for upgrades and the servicing strategy

2.1 "Operational Flexibility"

The term "***Operational Flexibility***" is a broad term utilised to describe various levels of wastewater security, capacity and/or redundancy that enables the Region to actively control flow and maintain target levels of service under highly variable and increasing flow conditions. A key goal for the Region through this EA was to provide operational Flexibility in this area as opposed to simply added capacity (i.e., in the case of a capacity constraint, twinned pipes with ability to control flow between them is generally more favourable than a simple upsized sewer replacement or parallel twinning).

The preliminary preferred solution will allow the Region to isolate several sections of older sewers that are anticipated to experience capacity constraints in the future, thus maintaining level of service and enabling potential inspection and maintenance activities.

The two main benefits of operational flexibility are capacity and maintenance; these are outlined further at a high level in this section with more detailed modelling information in **Section 3**.

2.2 Capacity – Growth

The Central Mississauga wastewater system services areas within Mississauga that are experiencing rapid intensification growth. Several intensification locations are will experience growth that flow to these sewers include:

- Dundas St Corridor (Dundas Connects)
- Hurontario Corridor (Hurontario LRT)
- Mississauga City Centre (MCC)
- Hurontario / Eglinton
- Britannia Farm

Growth is the key driver for the capacity upgrades, with over 100,000 people and jobs added to the area, shown in **Table 2-1**.

Table 2-1: Growth Projections 2016-2041

Wastewater Catchment Area	Total Growth 2016-2041
CPR Trunk Sewer only	25,480
Cooksville Queensway Trunk Sewer only	61,730
Catchment encompassing both CPR Trunk Sewer and Cooksville Queensway Trunk Sewer	41,180
Total	**128,390**

In addition to the 2041 projections, a sensitivity check of increased intensification beyond 2041 was reviewed and modelled. This scenario is called 2041* and assigns additional growth to some areas.

Further, the Provincial 2051 forecasts were released in August 2020 and, although these projections are not finalized in detail at the local level, it is anticipated that additional intensification will be assigned to this area, adding more wastewater flow to the catchment.

Modelling results for the future scenarios are shown in **Section 3**.

2.3 Capacity – Wet Weather

The Region of Peel has seen a wide range of high intensity storms in recent years which have resulted in direct response within the wastewater conveyance systems. Although the Region has separated sewers and is proactively addressing Inflow and Infiltration (I/I) issues, there are still major impacts to the conveyance during wet weather events.

A secondary driver for project upgrades is the ability to handle large wet weather events while maintaining levels of service and minimizing the risk of flooding in the trunk and local sewers.

Design Storms reviewed within the Central Mississauga modelling are described in **Section 3**.

2.4 Maintenance, Inspection and Rehabilitation

The trunk infrastructure within Central Mississauga was predominantly constructed in the 1960s and 1970s. As growth flows increase over the next decades, there will be a greater need for maintenance and rehabilitation measures to ensure the sewers operate as designed and do not experience failures. The ability to divert flow to new trunk sewers on an extended basis with minimal bypass pumping required will facilitate inspection of the sewers and ability to maintain and rehabilitate large portions of these aging trunk sewers.

Although rehabilitation plans are not part of the scope of this EA, a control logic to divert flows and isolate sections of sewers to facilitate the works is described in **Section 4**.

3 HYDRAULIC ANALYSIS

3.1 Hydraulic Analysis Tools

The hydraulic analysis was undertaken using a combination of tools. One of these was the Region's dynamic wastewater hydraulic model and the other was a high-level wastewater schematic, which was built from modelling results. The schematic was used to quickly analyse all the potential scenarios and the preferred scenarios were reviewed in detail using the hydraulic model.

3.1.1 Wastewater Model

The wastewater hydraulic model is a dynamic hydraulic and hydrological model containing all the Region's sanitary sewer network. The model was originally calibrated in 2015 and has been maintained with regular updates to the network, catchments and hydrology.

As a separate assignment, the Central Mississauga catchment area was recalibrated in 2018 to 11 flow monitors. This recalibration added additional flow monitor coverage compared to the original calibration and ensured that the model was up to date for the purposes of the Central Mississauga EA.

In addition, all phases of the Cawthra Road capital project (from Burnhamthorpe Rd to Dundas St) upgrades were added to the model from the latest available design drawings as this capital project was already under construction.

The model for the purposes of this project was originally going to be an extract of the study area in order to create efficiencies in simulation run times, but through the process of developing the model, it was felt that the boundary conditions were not limited to the immediate catchment as surcharging in the East Trunk and the East to West diversion could have an impact on the strategy.

The model has highly developed scenario for existing conditions, 2041, 2041* analysis and Ultimate scenario. For the purposes of the project, the model was reviewed using the 2041* and Ultimate analysis scenarios and optimized for the 2041* analysis scenario.

3.1.2 Wastewater Schematic

The wastewater schematic was developed to be able to make quick decisions on scenarios without having to run simulations for close to 100 different combinations of gate settings. To develop the schematic, results from the model were exported to spreadsheets and linked to the Region's GIS asset IDs. Calculations were written within the spreadsheet were written to adjust the proportion of flow in the sewer network based on gate settings that could be set as a percentage of total flow. The adjustable gate settings would recalculate all flows downstream of the gate.

The user has the ability to select from the following scenarios: existing conditions, 2041 (1 in 5 and 1 in 25-year storm), 2041* (1 in 5 and 1 in 25-year storm), and ultimate (1 in 5 and 1 in 25-year storm). The schematic can be used to develop strategies for completing maintenance work and managing the system performance with future growth.

The schematic was also used to review iterations of flow controls, where 100% of flow is redirected to certain sewers for complete isolation.

A figure showing the developed schematic can be found in **Figure 3-1**.

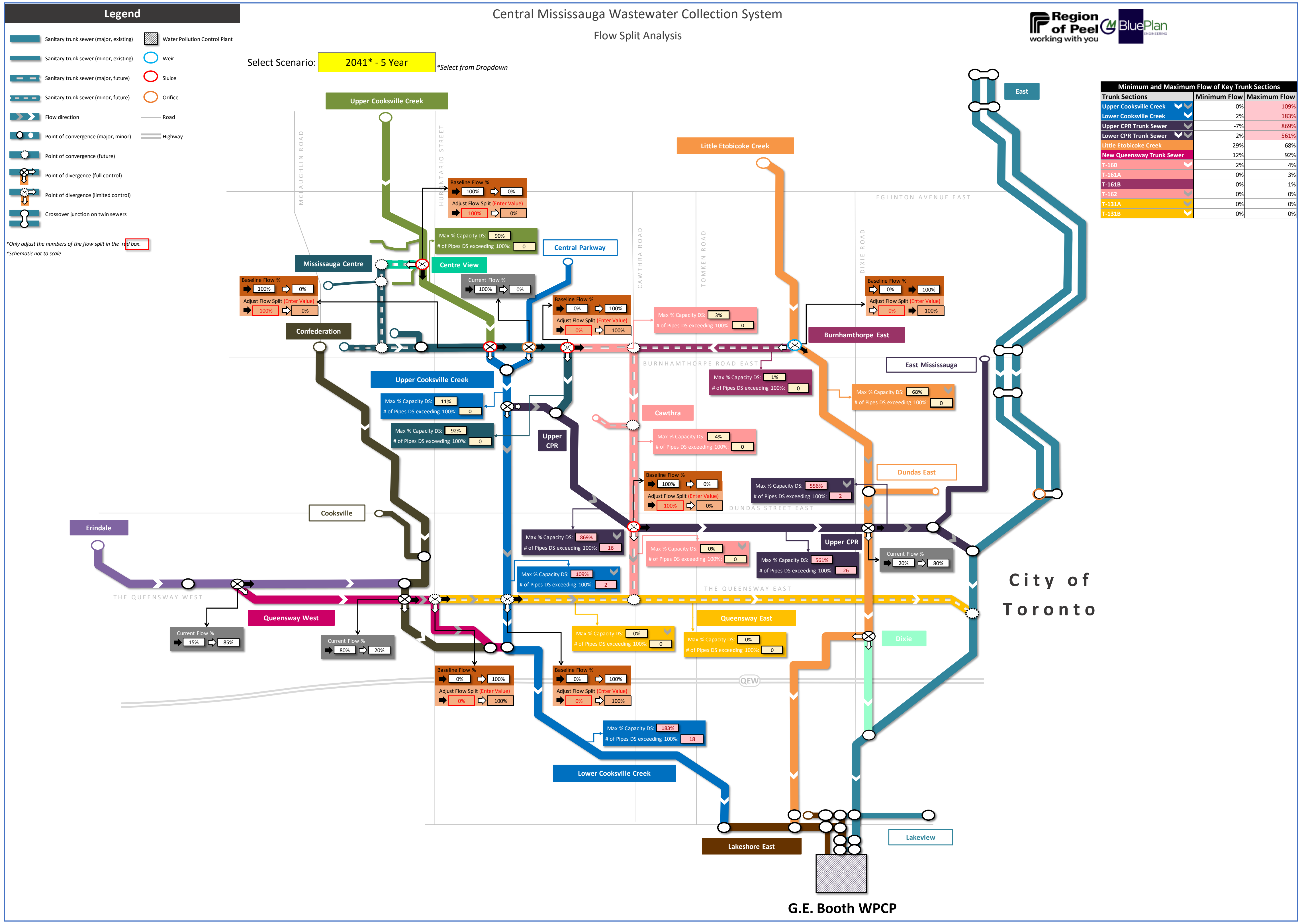


Figure 3-1: Central Mississauga Wastewater Schematic

3.2 Modelling Analysis and Results

3.2.1 Design Storm

The design storms used for the analysis were 5-year and 25-year return period, 12-hour SCSII design storms. Typically for trunk sewers, the Region uses the lower intensity, longer duration AES design storm to account for attenuation in the system. Although the Central Mississauga EA focuses on the trunk sewer, it was felt that the higher intensity, shorter duration SCSII storm would be more conservative due to the relatively small catchment area. **Figure 3-2** and **Figure 3-3** show the distribution of the design storms used in the analysis.

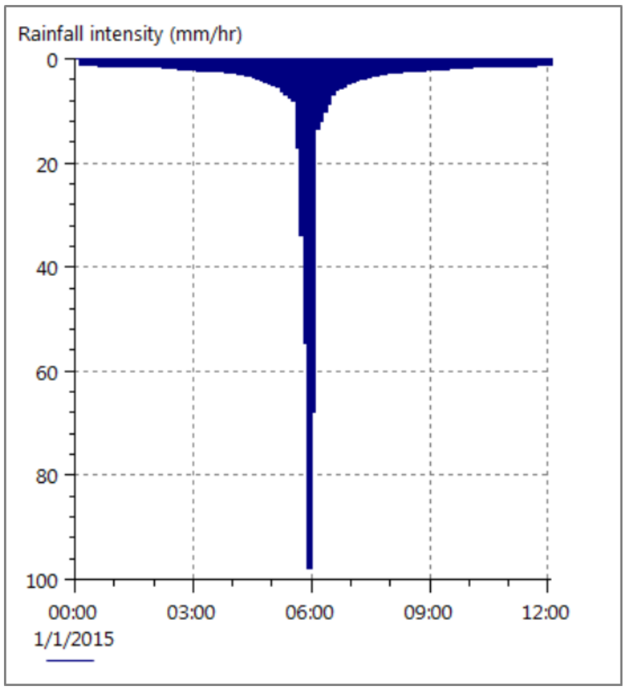


Figure 3-2: 1 in 5-year SCSII 12-hour Design Storm

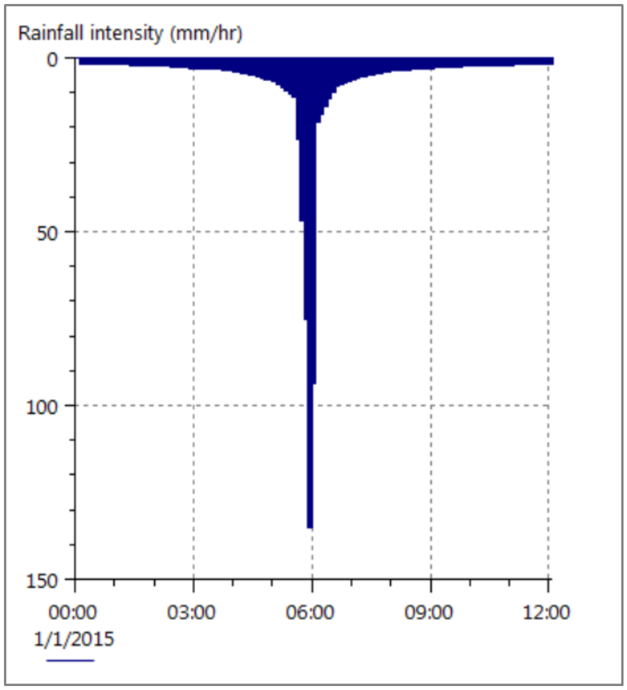


Figure 3-3: 1 in 25-year SCSII 12-hour Design Storm

3.2.2 Level of Service Criteria

The level of service criteria for the analysis was reviewed and agreed at the "Modelling and Level of Service Meeting" held on June 14, 2019. The Level of Service follows the Region's design Master Servicing Plan criteria and is shown in **Table 3-1**. In addition to this the system was optimized to remove surcharging under a 1 in 25-year design storm scenario.

Table 3-1: Level of Service Criteria

System	Diameter	Design Storm	Capacity Upgrade Trigger
Major Trunk	> 750 mm	5 year SCS Type II	d/D ≥ 0.85
		25 year SCS Type II	Water Depth ≤ 1.8 m below ground

3.2.3 Growth Scenarios

Without projects, capacity constraints were reviewed for the, 2041* scenario, and Ultimate scenario.

With projects, it was decided that strategies would be reviewed using the 2041* analysis scenario. This scenario was developed in conjunction with the Region to provide more detail, based on planning applications, to the 2041 model loading.

3.3 Analysis Results (Without Projects) and Project Needs

The results in **Table 3-2** below show the maximum flows and d/D analysis using the 2041* and Ultimate Scenarios. This was undertaken without proposed capital projects or control gates for both a 5 year and 25-year return period SCSII design storm. Further, in this section are thematic maps showing d/D analysis across the catchment area. **Figure 3-4** and **Figure 3-5** show the 2041* analysis scenario under 1 in 5 and 1 in 25 year return period design storms, and **Figure 3-6** and **Figure 3-7** show the Ultimate analysis scenario under a 1 in 5 and 1 in 25 year scenario.

As the results show, without projects or optimization, there is significant surcharging across the catchment. Five of the ten identified sewer reaches are surcharged by flow with two reaches being surcharged by depth caused by backwater conditions from the sewers that have insufficient capacity.

Table 3-2: Maximum Flows and d/D analysis for 2041*

	2041* 5 yr		2041* 25 yr	
Key Locations	**Max DS Flow (L/s)**	**Max Surcharge[1]**	**Max DS Flow (L/s)**	**Max Surcharge[1]**
Upper Cooksville Creek North	761	0.79	804	0.82
Mississauga Centre View	1775	2	1776	2
Upper CPR	1747	2	1739	2
Lower CPR	2035	2	2226	2
Little Etobicoke Creek	519	0.53	661	0.62
Confederation	623	0.64	776	0.73
Lower Cooksville Creek	3106	2	3563	2
Upper Cooksville Creek South	1159	0.91	1280	2
New Queensway	1909	0.72	2148	1
Cawthra	-126	1	-140	1

[1] *In the modelling software '1' designates surcharged by depth and '2' designates surcharged by flow*

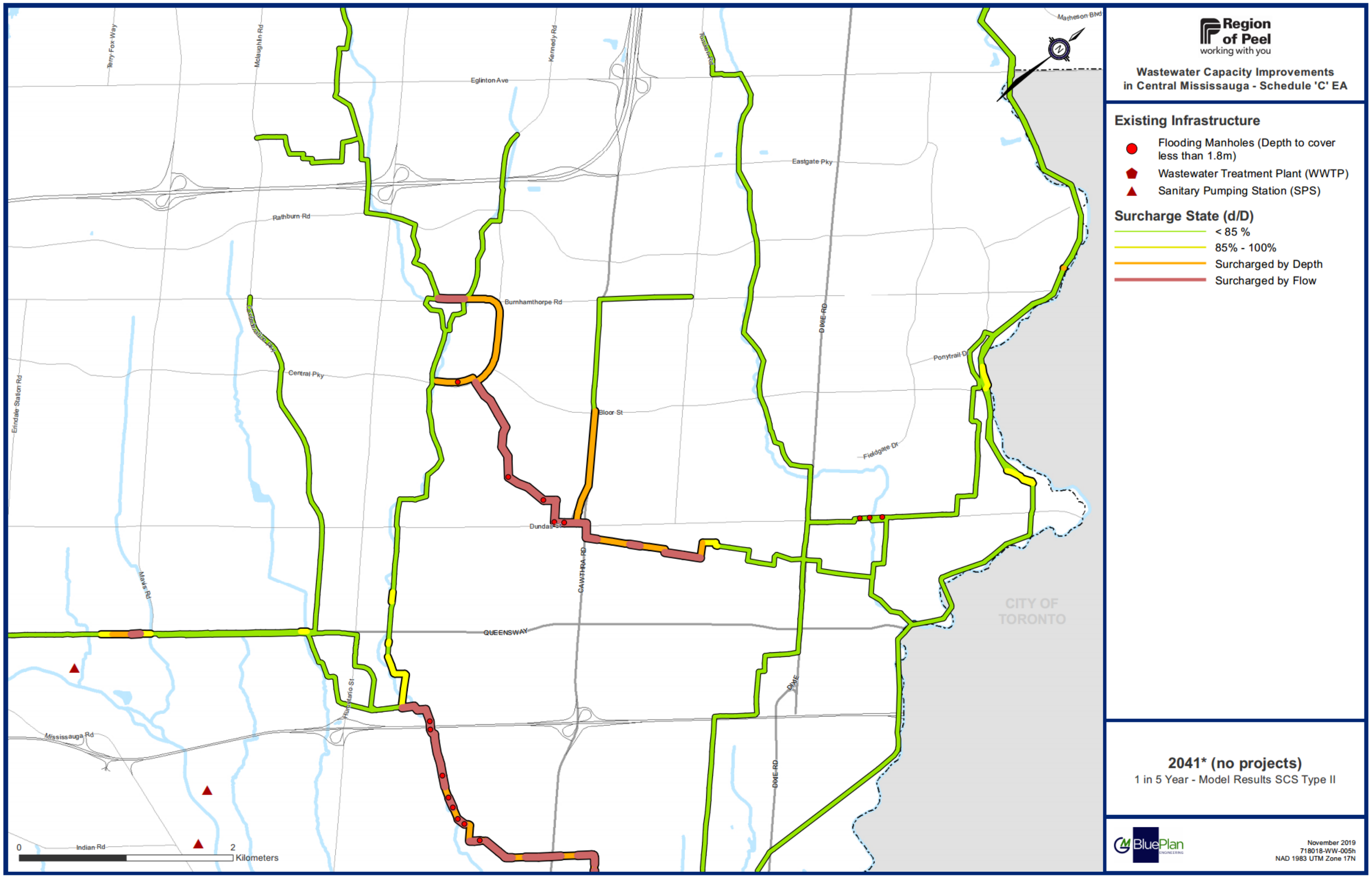


Figure 3-4: 2041* (no projects) 5yr SCSII Design Capacity Analysis

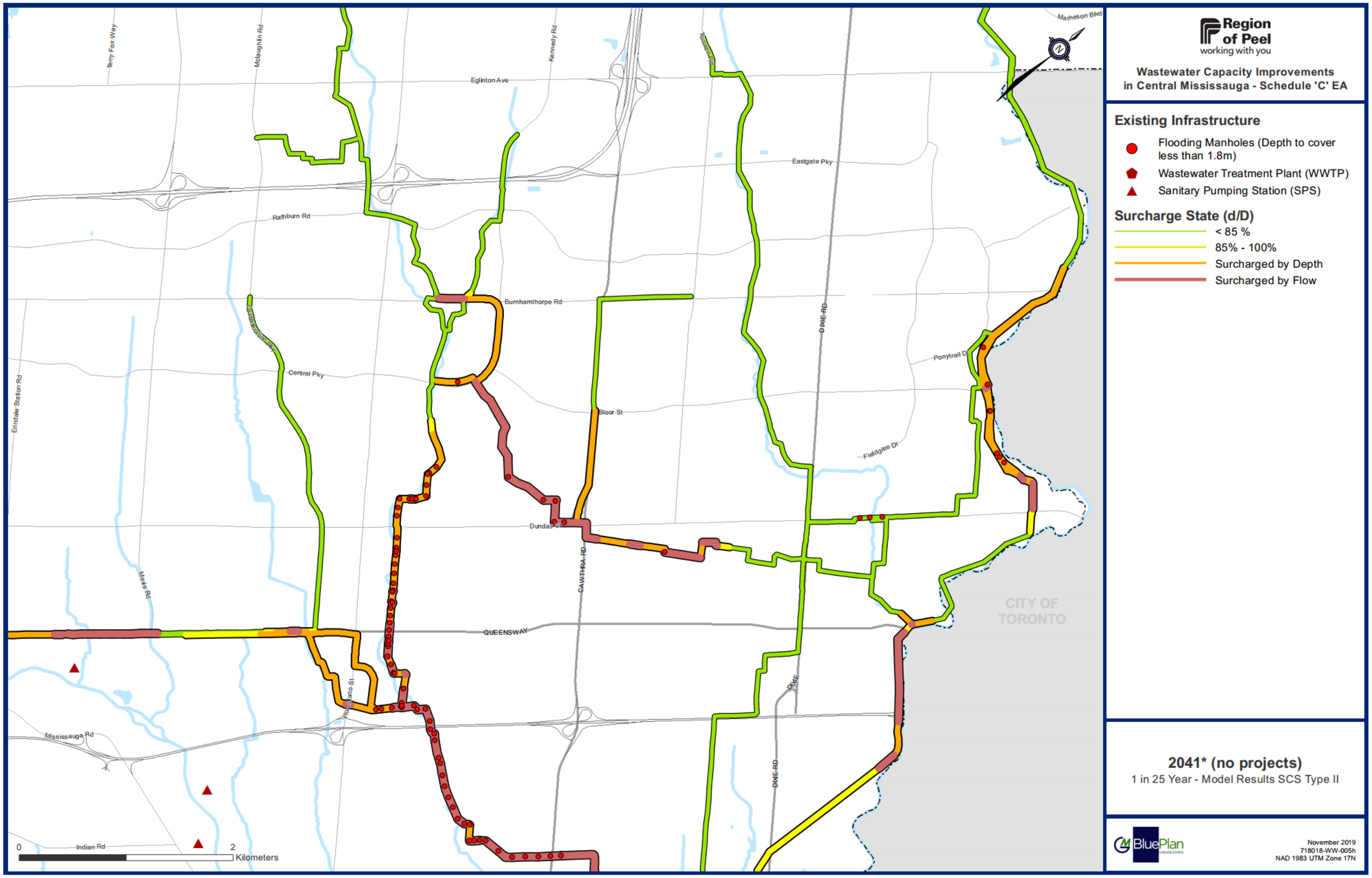


Figure 3-5: 2041* (no projects) 25yr SCSII Design Capacity Analysis

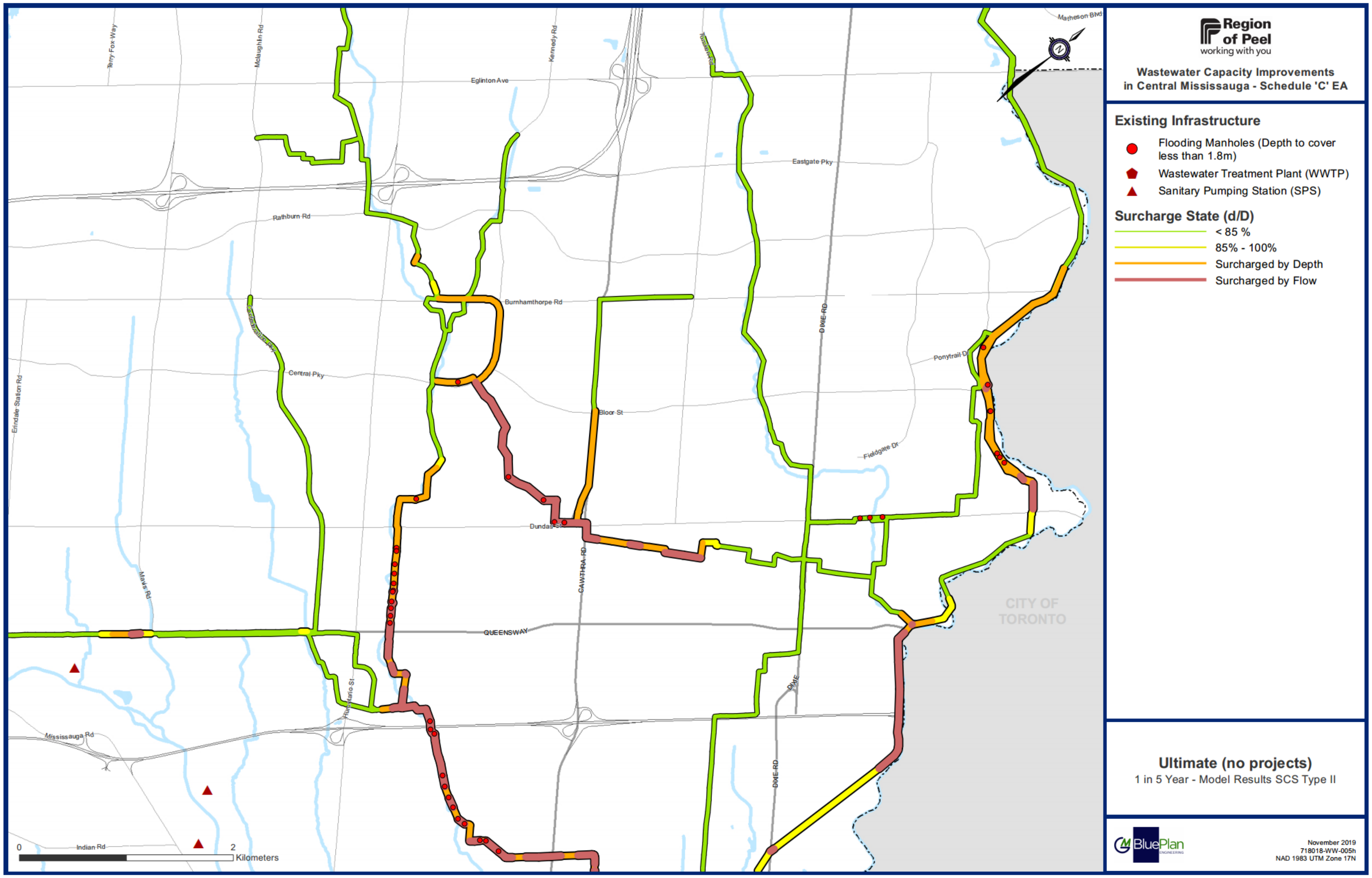


Figure 3-6: Ultimate* (no projects) 5yr SCSII Design Capacity Analysis

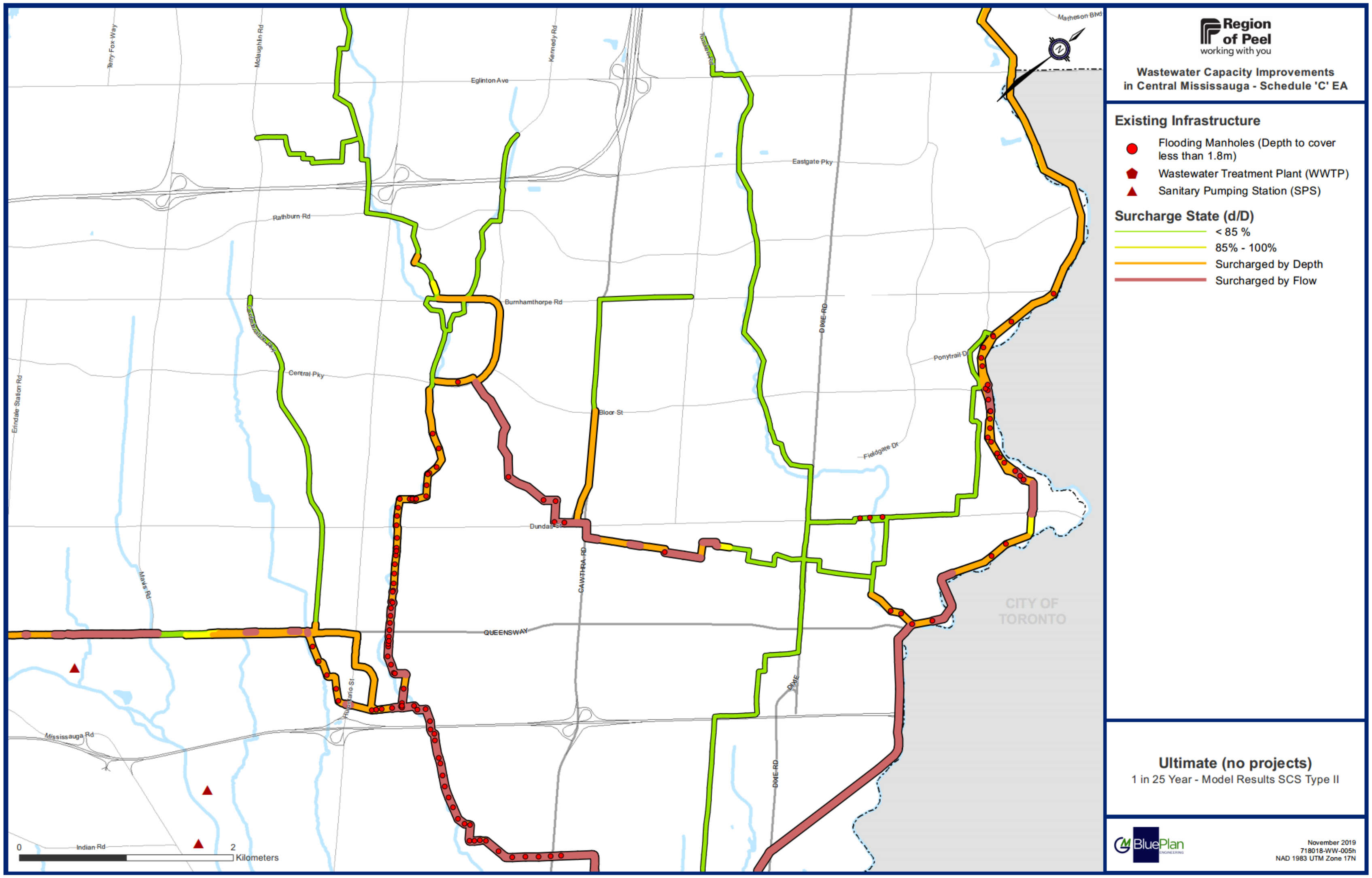


Figure 3-7: Ultimate* (no projects) 25yr SCSII Design Capacity Analysis

3.4 Analysis Results with Capital Projects

As part of understanding the flows in the catchment, over one hundred scenarios were run with different combinations of gate openings to understand what the potential maximum and minimum flow were for each proposed capital project that would be reviewed. By doing this, gates could be optimized to manage worst case scenarios under the design storms, and it would also provide details of maximum flow to size the capital projects based on the worst-case scenarios. **Table 3-4** shows what the maximum and minimum flows are for each reach of pipe for each design storm, whether these flows will cause surcharging, and what the optimum gate settings and pipe sizes are for the worst-case scenario.

The results in **Table 3-4** show that there are no basement flooding risks under the maximum flow scenarios for each project. Surcharging is shown for projects T-161 and T-131 when entering the current design specifications, so new pipe sizes have been identified in the table as well as optimized gate settings to prevent surcharging.

Figure 3-8 and **Figure 3-9** show the impact of optimizing the gates on managing capacity constraints during 1 in 5 year and 1 in 25 year.

As can be seen in **Figure 3-8**, the sewer system can be optimized to remove all capacity constraints during a 1 in 5-year design storm. However, **Figure 3-9** shows that there are some capacity constraints along the proposed Queensway Trunk sewer. In addition, there is some backing up from the East Trunk that is shown, but it is reasonable to assume that the east trunk flows can be managed by the east to west diversion.

Table 3-3 shows the optimized gate settings and the flow split at these gates.

Table 3-3: Optimized Gate Setting and Percentage Flow Split

						1 in 5yr SCSII		1 in 25yr SCSII	
Control Name	Node ID	Gate 1 ID	Gate 2 ID	Gate 1 Opening (m)	Gate 2 Opening (m)	Gate 1% Flow	Gate 2% Flow	Gate 1% Flow	Gate 2% Flow
Burnhamthorpe and Central Parkway	SMH-6547045	SMH-6547045.1	SMH-6547045.2	0.144	1.056	24%	76%	24%	76%
Burnhamthorpe and Cooksville Creek West	SMH-1793068	SMH-1793068.1	SMH-1793068.2	0.129	0.453	37%	63%	36%	64%
Centre View and Upper Cooksville	SMH-1793670	SMH-1793670.1	SMH-1793670.2	0.75	0.428	64%	36%	64%	36%
Cawthra and Dundas	CP_139	CP_139.2	CP_139.1	1.5	0	100%	0%	100%	0%
Burnhamthorpe and Little Etobicoke Creek	SMH-1789392	SMH-1789392.1	SMH-1789392.2	0.6	0.051	76%	24%	76%	24%
Queensway and Hurontario	SMH-6567075	SMH-6567075.3	SMH-6567075.4	0.387	0.387	38%	62%	41%	59%
Queensway and Cooksville	SMH-1786813	SMH-1786813.3	SMH-1786813.4	0.617	0.054	89%	11%	89%	11%
Dixie and Queesnway	SMH-1786421	SMH-1786421.2	SMH-1786421.3	0.165	0.165	84%	16%	83%	17%

NB: Burnhamthorpe and Cooksville Creek East has a single gate and no option to divert so is 100% open for the purposes of the optimized gate settings

Table 3-4: Maximum and Minimum Flow Options for Capital Projects

Project	Built Y/N	Proposed Size (mm)	Design Storms	Peak Flow (L/s)	Freeboard Y/N	Surcharging Y/N	Upsized Based on Modelled Results
T-161	N	1200	1 in 5 SCS	1303	Y	N	
			1 in 25 SCS	1400	Y	N	
		1200	1 in 5 SCS	1992	Y	Y	1350
			1 in 25 SCS	2116	Y	Y	1350
Little Etobicoke Creek Diversion	N	600	1 in 5 SCS	0	Y	N	
			1 in 25 SCS	0	Y	N	
		600	1 in 5 SCS	337	Y	Y	1200
			1 in 25 SCS	414	Y	Y	1200
T-162	N	1500	1 in 5 SCS	96	Y	N	
			1 in 25 SCS	137	Y	N	
		1500	1 in 5 SCS	2357	Y	N	
			1 in 25 SCS	2571	Y	N	
T-131	N	1800	1 in 5 SCS	1318	Y	N	
			1 in 25 SCS	1461	Y	N	
		1800	1 in 5 SCS	4086	Y	Y	1950
			1 in 25 SCS	4229	Y	Y	1950

(blue)	Minimum Flows
(green)	Maximum Flows

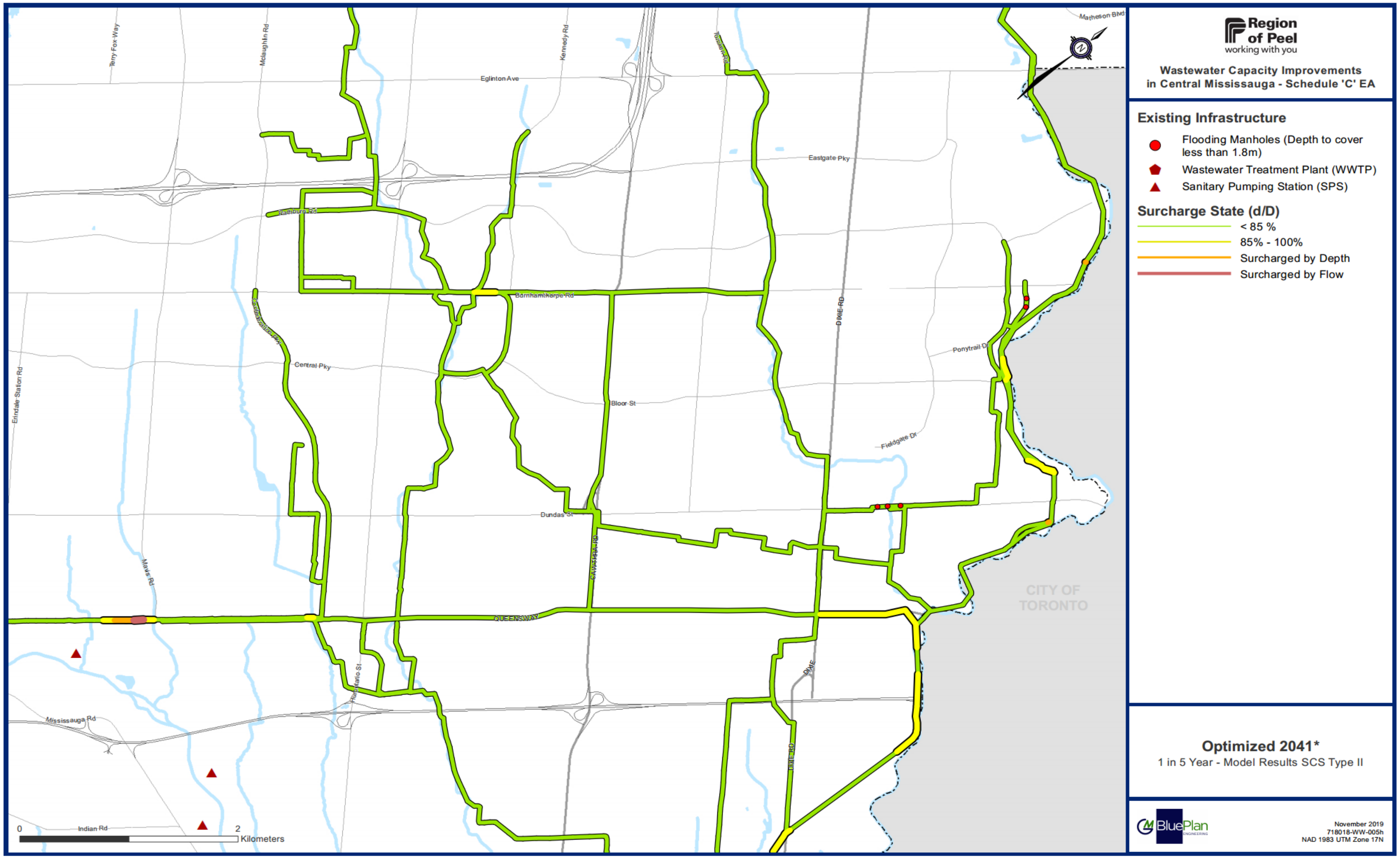


Figure 3-8: Optimized 2041* (with projects) 5yr SCSII Design Storm Capacity Analysis

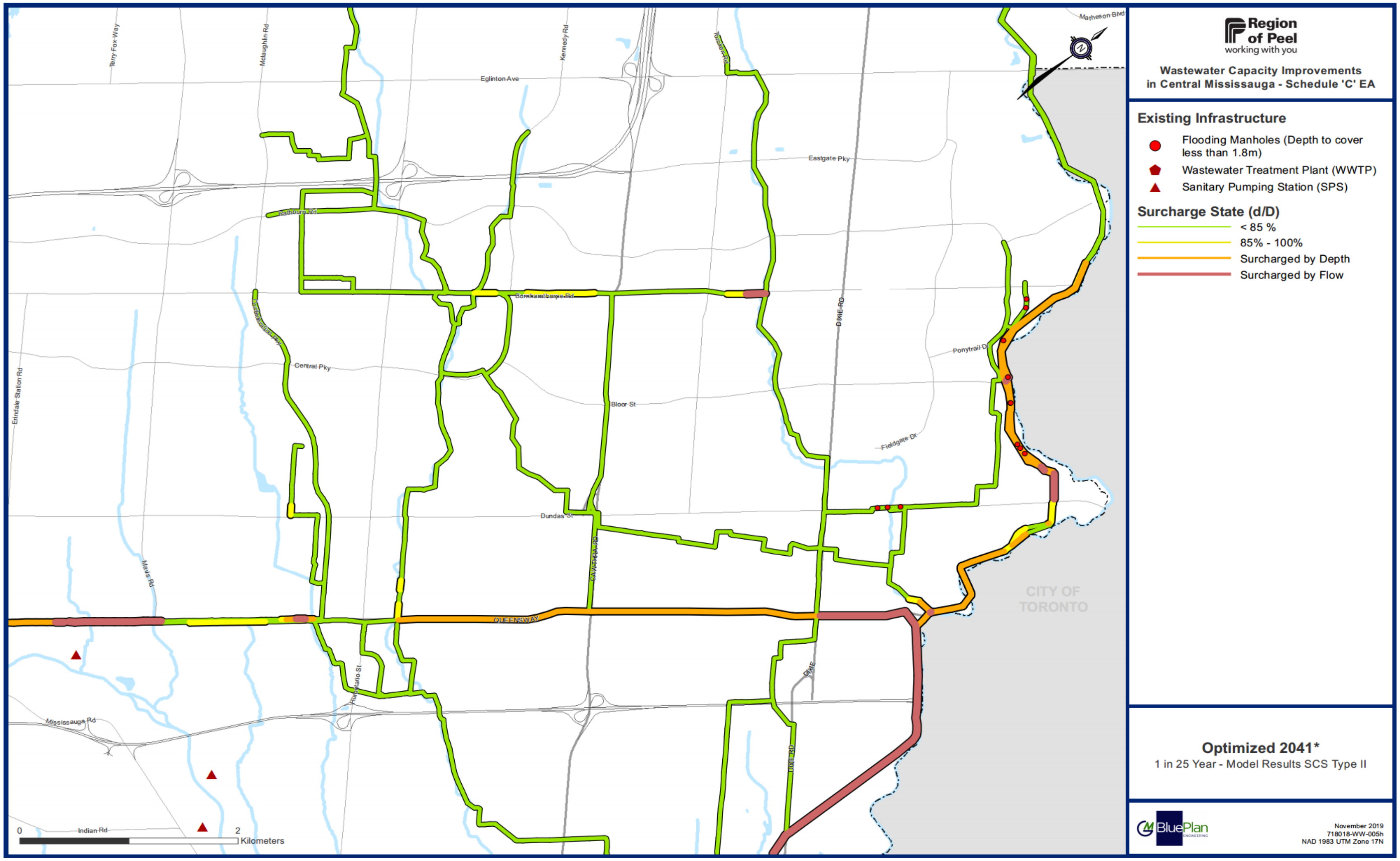


Figure 3-9: Optimized 2041* (with projects) 25yr SCSII Design Storm Capacity Analysis

3.4.1 Timing / Phasing

An outcome of the EA will be developing a preliminary phasing plan for the preferred solution. While the modelling scenarios for growth focused on the Future 2041* scenario, these projections represent the Region's and the City of Mississauga's best estimate for that time period and growth can occur at a faster or slower rate than predicted. Additionally, in order to determine the exact year that a pipe is triggered for capacity needs, multiple interim year modelling scenarios would be required. However, interim year SGUs for the (*) scenario have not been developed at the time of writing.

The main capacity constraints that were identified in the modelling runs, in particular for 2041* 5 yr SCS, are as follows:

- Lower Cooksville Creek from QEW south – Constraint is relieved by Queensway Trunk (T-131)
- Upper CPR between Central Pkwy and Cawthra – Constraint is relieved by Burnhamthorpe Trunk (T-161)
- Lower CPR between Cawthra and Stanfield – Constraint is relieved by Cawthra South Trunk (T-162) and Queensway Trunk (T-131)

The pipe sections from the above list that experience constraints sooner, or that are "triggered" first depend on several factors:

- Burnhamthorpe/ Cooksville Creek West. If this control diverts more flow east, to CPR, there is greater risk of capacity constraints in those sewer sections. If flow is left to continue south, constraints may be observed in Lower Cooksville Creek Trunk sooner. Preliminary assumptions and discussions with Peel staff have indicated that the plan is to continue to divert flow east to the 1,500 mm sewer on Burnhamthorpe Rd.
- The rate of growth within the MCC, Hurontario Corridor and Dundas Corridor could be faster or slower in certain areas, resulting in triggering a pipe constraint sooner, i.e., the "2041*" projected growth and flow could theoretically be reached in an earlier (or later year) depending on development pressure.
- The construction of the Cawthra Tunk Sewer between Burnhamthorpe and Dundas will bring some additional flow to the Lower CPR Trunk Sewer in the short term

In addition to capacity constraints, other factors should be considered when determining phasing of the preliminary preferred solution. Final timing will require consideration of the factors below along with collaboration with the Region.

- The Burnhamthorpe Trunk Sewer (T-161) can be considered to be a stand-alone piece of the overall solution (it is not necessarily dependent on the other projects). This project only requires that the Cawthra Sewer (between Burnhamthorpe Rd and Dundas St) be constructed. Once this occurs, the Burnhamthorpe Trunk Sewer can be implemented, which will effectively twin the Upper CPR. It should be noted that construction is only just being completed on the new MCC Watermain along Burnhamthorpe, in the same alignment as the

future sewer. Timing of future construction should consider social impacts and potential "construction fatigue" in the area.
- Cawthra South Trunk Sewer (T-162) cannot proceed without the Queensway Trunk Sewer (T-131); it will need to be part of a later phase or be built concurrently
- Maintenance and/or inspections are important for the Region to maintain Levels of Service and to keep the system in a good state of repair. If a section of sewer is to be prioritized for maintenance or inspection, an earlier trigger of a given project could provide that opportunity.
- Region operations staff can provide additional input into capacity constraints that occur in the field but may not be captured in the hydraulic modelling; this could result in the desire to expedite a solution.
- There are inherent risks of schedule delays for major projects. Design and construction of the Queensway Trunk Sewer could take several years and need to be in place well before 2041. Planning for an earlier in-service date could provide additional buffer for delays.
- The 2020 Water and Wastewater Master Plan "in service dates" are as follows: T-131: 2027, T-161: 2026, T-162: 2027. These are relatively aggressive timelines for completion of Design and Construction and will continue to be revisited moving forward.
- Potential development delays due to COVID-19 and subsequent budget impacts

3.5 Queensway Interconnection Points

In order to interconnect the other key sewers to the Queensway Trunk Sewer, and to construct the preferred solutions, key connection points and shaft locations were identified. These include:

- Queensway/Hurontario
- Queensway/Cooksville Creek
- Queensway/Cawthra
- Queensway/Dixie
- Queensway/Etobicoke Creek (2 locations, one at north side of Queensway, just west of bridge, one at the downstream connection point to the East Trunk Sewer)
- CPR / Cawthra
- Burnhamthorpe/Central Pkwy
- Burnhamthorpe/Cawthra

In addition to the Key Connection Points, other Minor Connection Points (generally from local sewers) were also reviewed to determine if there was value in connecting these local sewers to the Queensway Trunk. To help determine the connection benefits, local modeling in the sub-catchments south of Queensway, was completed. This was done in order to assess the potential benefits of intercepting the local sewers that cross Queensway from north to south. The review included catchments labelled based on their cross street as follows:

- Camilla Rd

- Cliff Rd
- Hensall (West) – sewer passes in between homes on Abruz Blvd, just west of Hensall St
- Hensall St (East)
- Tedlo St
- Cawthra Rd
- Haines Rd
- Stanfield Rd
- Dixie Rd

These subcatchments are shown in **Figure 3-10**.

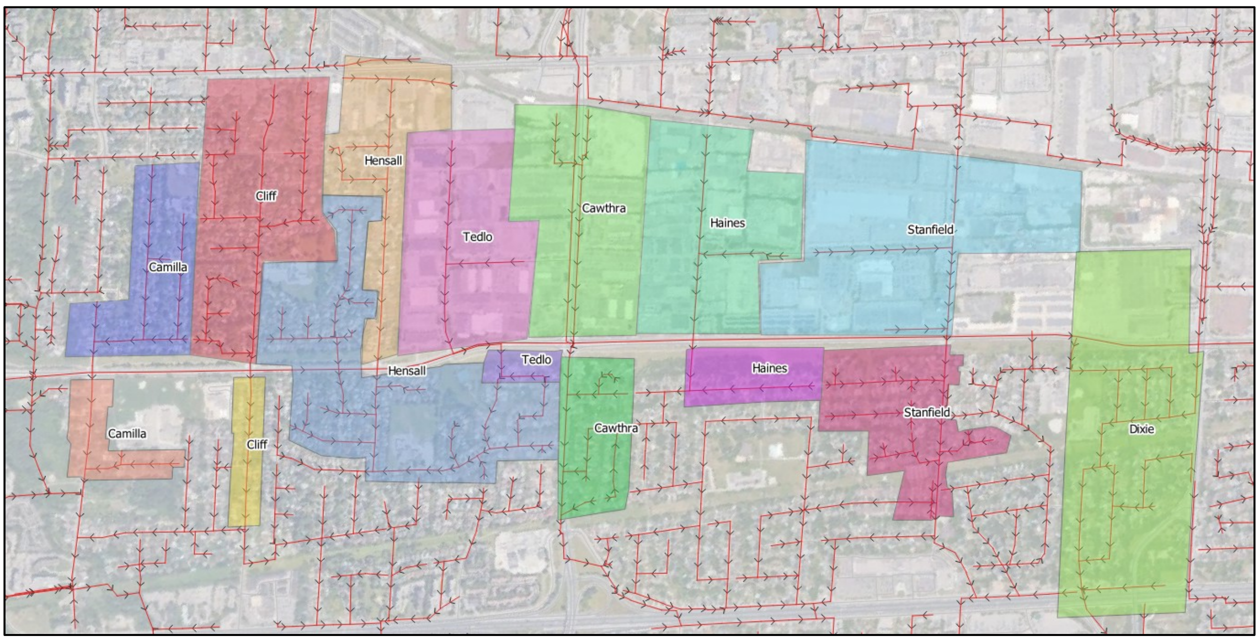


Figure 3-10 – Queensway Local Subcatchments

These interconnection locations were also investigated to determine the benefit for tunneling constructability; an interconnection location could be deemed to be favourable to optimize tunnel drive lengths or be at a location with open space and good access. Overall, this was an iterative process to determine the preferred interconnection locations that would provide a combination of:

- Flow diversion to Queensway to relieve capacity constraints
- Optimally spaced shaft/compound location
- Estimated shaft/compound cost

In general, an additional shaft wasn't recommended if there were no downstream local capacity constraints (diversion of flow not beneficial for capacity relief) and if it was not determined to be necessary to optimize tunnel drive lengths.

Modelling results demonstrated constraints, mainly in the Hensall West, Hensall East and Cliff catchments, shown in **Figure 3-11.** These constraints could be relieved with connections at these locations. These connections do not divert a significant amount of flow to the Queensway sewer; however, the combined constructability and capacity benefit have deemed those locations to be designed as connection points.

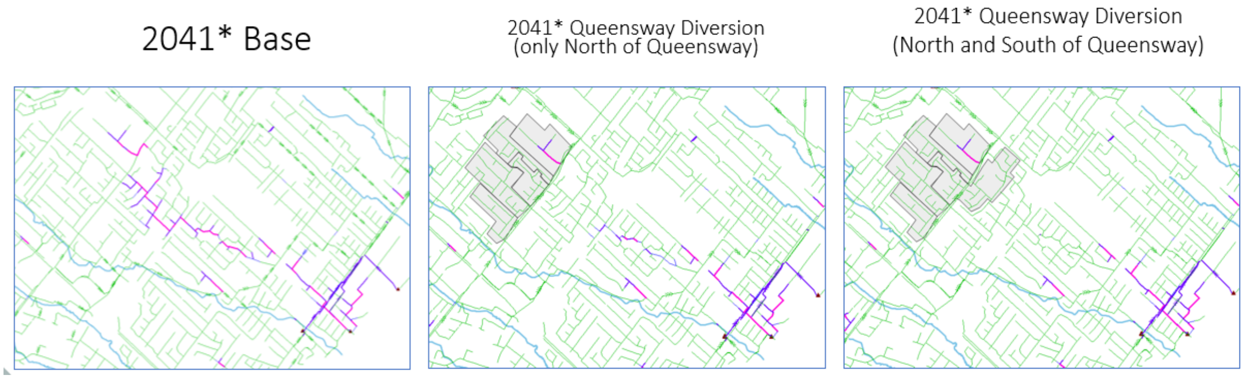


Figure 3-11 – Queensway Local Sewer Modelling Results

The table below shows a summary of flows at the connection points from the catchments to the north of the proposed Queensway Trunk Sewer. The flows shown are for the 2041 baseline model and the 2041 Optimized Model (see gate settings in **Table 3-3**) using a 1 in 25year SCSII design storm.

A high level review of the potential to drain local catchments from south to north to connect to the Queensway Trunk Sewer. Connecting the southern catchments could provide further flow relief from the downstream catchments, however, the majority of the local constraints were addressed with the northern local catchment interconnections only(**Figure 3-11**, centre image). Due to several potential constraints such as new sewer length, depth and local disruption, these south to north sewers were not recommended.

Table 3-5: Subcatchment Wet Weather Flow Projections

Site	Connection Type	2041 Peak WWF - 25 yr SCS (L/s(	2041* Peak WWF - 25 yr SCS (L/s)
Dixie Road	Minor Connection Point	447	467
Stanfield Road	Minor Connection Point	80	80
Haines Road	Minor Connection Point	61	61
Tedlo Street	Minor Connection Point	68	68
Hensall Street	Minor Connection Point	58	58
Cliff Road	Minor Connection Point	62	62
Camilla Road	Minor Connection Point	32	32

Site	Connection Type	2041 Peak WWF - 25 yr SCS (L/s(	2041* Peak WWF - 25 yr SCS (L/s)
Cooksville Creek	Key Connection Point	1046	1046
Hurontario Street	Key Connection Point	1746	1746

4 OPERATIONAL STRATEGY

4.1 General Operational Philosophy

As noted in previous sections, modelling and analysis of multiple scenarios has been completed to develop the preferred infrastructure strategy. Control settings under 2041* growth and 5 and 25 year SCSII design storms were developed in order to optimize flow to all existing and new trunk sewers and maintain levels of service and can be found in **Table 3-3**.

While these control settings are beneficial to determine sizing and to ensure the system will generally provide the overall planned capacity, the settings represent a modelled storm event. Control Logic in the form of Real Time Controls (RTC) will be required to be able to adapt to continually changing wet weather and flow conditions within the system as well as depending on the Region's current plans or operational strategy (inspection).

In general, the operational logic for gate settings that will be developed sets out to achieve the following goal:

Adjust gate settings to optimize flow within downstream sewers to ensure depth is < 85% full

This goal is applicable to the normal day to day dry weather operation of the system as well as during rain events.

In the case where sections of sewers are to be isolated for inspection or maintenance, a different control logic will apply, which is described in subsequent sections, along with RTC control logic.

4.2 External Control Factors

Once the preferred strategy is in place and sewers and controls are constructed, it will be possible to directly control the flow at several locations that outlet to any of the internal Trunk Sewers.

While the internal sewers are able to be controlled, via gates and control structure, it is also important to consider the *external* conditions to the area. There are two other key considerations that the Region must incorporate into the final control logic:

1. **East to West Diversion** – The East to West Diversion lies along the East trunk sewer upstream of the Central Mississauga outlet point at Queensway / Etobicoke Creek. The diversion is currently under construction and will serve to divert significant volumes of flow from the East Trunk System to the West Trunk System. Preliminary model runs have assumed baseline peak wet weather flow diversions to free up capacity in the East Trunk. However, it is anticipated that the Region will include several monitoring points on the East Trunk between Derry Rd and the G.E. Booth WWTP that will help inform the RTC and will direct the controls to send more or less flow to the Diversion, when required under a wet weather event.

2. **Booth/Clarkson PWWF Balancing** – The G.E. Booth and Clarkson WWTPs are currently undergoing a Class EA for expansions which will review the Average Day

Flow and Peak Flow capacity needs in the future. This EA and expansion plan will include a diversion strategy that will determine both the average flow that needs to be sent from East to West, as well as the peak flow capacities at both plants and how to balance peak flows at the plants.

Consideration to the peak flows capacity of the Plants as well as the capacity of the discharge point at the East Trunk Sewer will need to be considered in the long term Flow Control Strategy of the Central Mississauga System.

The Region is currently undertaking a detailed study to develop a Region-wide real-time control strategy and any real-time controls developed for the Central Mississauga catchment area must be coordinated and developed in conjunction with the Regional strategy.

4.3 Normal Operational Conditions and Wet Weather Events

Under normal future operating conditions (dry weather flow) it is anticipated that the existing sewers will have adequate capacity to convey the wastewater flow while maintaining level of service. The control logic will focus on balancing flow to maintain minimum velocities in some of the flatter sewer sections, such as the new Queensway Sewer between Hurontario St, Cooksville Creek and Cawthra Rd. In order to achieve this, selected gates will need to be completely closed under normal conditions to ensure self cleansing velocities are achieved.

During wet weather events, level sensors in downstream sections will monitor flow depth and adjust the gate settings to optimize the flow and balance capacities between downstream sewers. The control logic is further defined in **Section 4.5**. **Table 4-1** identifies the flow control locations and downstream considerations required.

4.4 Maintenance / Isolation Operational Strategy

Under the conditions where the Region requires isolation of a section of sewer for maintenance or inspection activities, this could be done on a manual basis. Any section to be isolated would require a closed gate at the upstream end (where available), with the consideration for any subsequent impacts which would be captured by the RTC logic. The main locations where pipe isolation could have other impacts are:

1. **Lower CPR** – Isolating the Lower CPR sewer would require sending all flow south along Cawthra Trunk to the new Queensway Trunk. Under this scenario, the controls at Queensway/Hurontario and Queensway/Cooksville Creek would need to balance the flow between Lower Cooksville and Queensway to ensure that there is still adequate capacity in the Queensway sewer.
2. **Lower Cooksville** – Similar to the Lower CPR isolation, this requires sending as much flow east along the Queensway Sewer as possible; controls at Dundas / Cawthra that control flow to the Lower CPR will need to balance these flows.
3. **Central Pkwy** – Isolating the Central Pkwy Sewer can be achieved by sending all flows east to Cawthra; the controls at Burnhamthorpe and Little Etobicoke

Creek will need to be set up to ensure no constraints are triggered in the Cawthra Sewer or Lower CPR.

4. **Little Etobicoke Creek** – Similar to the Central Pkwy isolation scenario, the controls at Burnhamthorpe and Central Pkwy will need to ensure Cawthra and downstream sewers are not constrained.

Table 4-1: Flow Control Descriptions

Flow Control Location	Immediate Downstream Sewers	General Control Description
Burnhamthorpe / Cooksville Creek West	- Upper Cooksville Creek Trunk - Burnhamthorpe Trunk	- Control structure will be installed in short term, intended to divert most to all flow to Burnhamthorpe Trunk, which relieves flow from Upper Cooksville Creek Trunk
Burnhamthorpe / Cooksville Creek East	- Upper Cooksville Creek Trunk - Burnhamthorpe Trunk	- Existing control structure designed to divert all flow to the new Burnhamthorpe Trunk sewer flowing east, which relieves flow from Upper Cooksville Creek Trunk
Burnhamthorpe / Central Pkwy	- Central Pkwy / Upper CPR - Burnhamthorpe Trunk Sewer (T-161)	- Balance flow between Burnhamthorpe / Cawthra Trunk and Upper CPR Trunk; which has flat sections, however no major capacity constraints observed in modelling
Burhamthorpe / Little Etobicoke Creek	- Little Etobicoke Creek Trunk - Burnhamthorpe Trunk	- Balance flow between Little Etobicoke Creek Trunk and Burnhamthorpe /Cawthra Trunk. - No capacity constraints observed in modelling of Little Etobicoke Creek Trunk; normal operation to maintain flow down Little Etobicoke Creek. Diversion of flow to Burnhamthorpe / Cawthra Trunk likely required under extreme conditions only
Cawthra / Dundas	- Lower CPR - Cawthra South (T-162)	- Divert flow from Lower CPR Trunk to New Cawthra Trunk / Queensway Trunk - Capacity constraints in Lower CPR Trunk sewer, diversion to the south will be required under future wet weather events, as Lower CPR Creek Trunk depth increases
Queensway / Hurontario	- New Queensway Trunk / Lower Cooksville Creek Trunk - New Queensway Trunk (T-131)	- Divert flow from Lower Cooksville Trunk to New Queensway Trunk. - Capacity constraints in Lower Cooksville Creek Trunk; diversion to the east will be required under future wet weather events, as Lower Cooksville Creek Trunk depth increases
Queensway / Cooksville Creek	- Cooksville Creek Trunk - New Queensway Trunk (T-131)	- Divert flow from Lower Cooksville Trunk to New Queensway Trunk. - Capacity constraints in Lower Cooksville Creek Trunk; diversion to the east will be required under future wet weather events, as Lower Cooksville Creek Trunk depth increases

Flow Control Location	Immediate Downstream Sewers	General Control Description
Queensway / Camilla	- Camilla Rd Sewer - New Queensway Trunk (T-131)	- Intercept flow heading south into local network; full diversion with no control should be considered - No capacity constraints within Camilla Dr Sewer; no major benefit to interconnection - Opportunity to bring local sewer west from Camilla to connect at the Cooksville Creek Shaft - At this time, no connection to Camila Dr sewer is proposed
Queensway / Cliff	- Cliff Rd Sewer - New Queensway Trunk (T-131)	- Intercept flow heading south into local network; full diversion with no control should be considered - Capacity constraints observed Cliff/Hensall/Tedlo catchment south of Queensway; shaft location at Cliff provides opportunity to connect all flow and divert to Queensway.
Queensway / Hensall West	- Hensall St Sewer (West) - New Queensway Trunk (T-131)	- Intercept flow heading south into local network; full diversion with no control should be considered - Capacity constraints observed Cliff/Hensall/Tedlo catchment south of Queensway - Opportunity to bring local sewer east from west of Hensall St to shaft location at Hensall St.
Queensway / Hensall East	- Hensall St Sewer (East) - New Queensway Trunk (T-131)	- Intercept flow heading south into local network; full diversion with no control should be considered - Capacity constraints observed Cliff/Hensall/Tedlo catchment south of Queensway
Queensway / Tedlo	- Tedlo St Sewer (Eest) - New Queensway Trunk (T-131)	- Intercept flow heading south into local network; full diversion with no control should be considered - Capacity constraints observed Cliff/Hensall/Tedlo catchment south of Queensway - Opportunity to bring local sewer west from Tedlo to connect at Hensall Shaft
Queensway / Dixie	- Dixie Rd Trunk Sewer - New Queensway Trunk (T-131)	- Dixie / Haig improvements completed and no capacity constraints in Dixie Rd Sewer; normal operation to maintain flow down Dixie. Diversion of flow to Queensway Trunk likely required under extreme conditions only
Key Control Location		

4.5 Real-time Control (RTC) Logic

A general control logic that is defined based on the minimum downstream capacity has been written into the model. This logic dictates that if the minimum downstream capacity of one reach is exceeded, then the gate upstream of that point will incrementally close by 0.01m until the depth no longer exceeds 85% d/D to ensure that capacities do not exceed 85% d/D if there is potential to divert capacity to another reach. If depth drops below 85% d/D then the gate will incrementally open by 0.01m. In addition, if both reaches are under capacity, then the gate shall open fully. For the logic to work using depth as the range, a separate regulator file needs to be loaded in the simulation to ensure the depth is measured from zero. **Table 4-2** shows details of the minimum pipe capacity on each trunk and which gate this relates to in the model. **Figure 3-2** shows an example of the control logic in InfoWorks ICM and **Table 4-3** shows the control logic written in tabular form. Appendix A contains the full RTC control logic exported from the model.

Table 4-2: Identification of Individual Trunk Minimum Capacities

Trunk Sewer	Control Node	Control Link	Control Type	Model Link ID	Limiting pipe full capacity (L/s)	Diameter (mm)	85% Depth (mm)
Upper Cooksville Creek	SMH-1793670	SMH-1793670.2	Variable Sluice	SMH-1793240.1	794	750	637.5
Mississauga Centre	SMH-1793670	SMH-1793670.1	Variable Sluice	SND-6520993.1	1621	1200	1020
Mississauga Centre	SMH-1793068	SMH-1793068.2	Variable Sluice	SMH-CO01.1	1621	1200	1020
Upper Cooksville Creek	SMH-1793068	SMH-1793068.1	Variable Sluice	SMH-1786806.1	665	900	765
Upper CPR	SMH-6547045	SMH-6547045.1	Variable Sluice	SMH-1790089.2	231	1200	1020
Cawthra (T-161)	SMH-6547045	SMH-6547045.2	Variable Sluice	CP_118.2	1403	1200	1020
Burnhamthorpe East/Cawthra	SMH-1789392	SMH-1789392.2	Variable Sluice	CP_127.3	294	600	510
Little Etobicoke Creek	SMH-1789392	SMH-1789392.1	Variable Sluice	SND-6514255.1	767	900	765
Upper CPR	CP_139	CP_139.1	Variable Sluice	SMH-1790293.1	376	900	765
Cawthra Road Trunk	CP_139	CP_139.2	Variable Sluice	CP_132.2	3161	1500	1275
New Queensway	SMH-6567075	SMH-6567075.4	Variable Sluice	SMH-6567081.1	1688	1350	1147.5
New Queensway	SMH-6567075	SMH-6567075.3	Variable Sluice	SMH-1783265.1	1464	1500	1275
T-131	SMH-6567075	SMH-6567075.4	Variable Sluice	SMH-1786813_2.2	2180	1800	1530
lower Cooksville Creek	SMH-1786813	SMH-1786813.4	Variable Sluice	SMH-6540350.1	503	900	765
T-131	SMH-1786813	SMH-1786813.3	Variable Sluice	CP_073.2	3750	1800	1530
Little Etobicoke Creek	SMH-1786409		Weir	SMH-1786427.1	672	900	765
Little Etobicoke Creek	SMH-1786421	SMH-1786421.3	Variable Sluice	SMH-1786420.1	1225	900	765

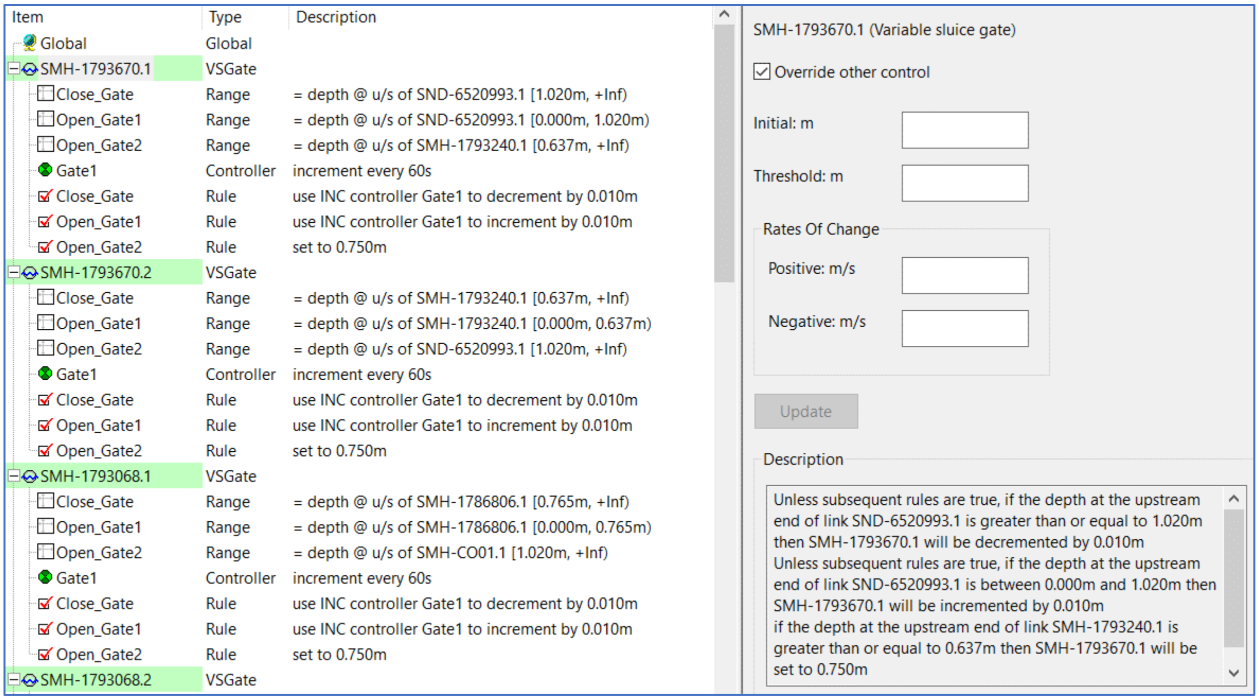


Figure 4-1: Example of RTC setup for Gate 1

Table 4-3: RTC Controls for a Pair of Gates

Gate 1	Set to optimized gate opening
Range 1	Close gate if depth exceeds 85% d/D at pipe with least capacity downstream of Gate 1
Range 2	Open gate if depth is below 85% d/D at pipe with least capacity downstream of Gate 1
Range 3	Open gate if depth exceeds 85% d/D at pipe with least capacity downstream of Gate 2
Controller	Incremental controller that adjusts Gate 1 every 60s depending on the range
Rule 1	If Range 1 is met, close Gate 1 in increments of 0.01m
Rule 2	If Range 2 is met, open Gate 1 in increments of 0.01m
Rule 3	If Range 3 is met, open Gate 1
Gate 2	Set to optimized gate opening
Range 1	Close gate if depth exceeds 85% d/D at pipe with least capacity downstream of Gate 2
Range 2	Open gate if depth is below 85% d/D at pipe with least capacity downstream of Gate 2
Range 3	Open gate if depth exceeds 85% d/D at pipe with least capacity downstream of Gate 2
Controller	Incremental controller that adjusts Gate 2 every 60s depending on the range

Rule 1	If Range 1 is met, close Gate 2 in increments of 0.01m
Rule 2	If Range 2 is met, open Gate 2 in increments of 0.01m
Rule 3	If Range 3 is met, open Gate 2

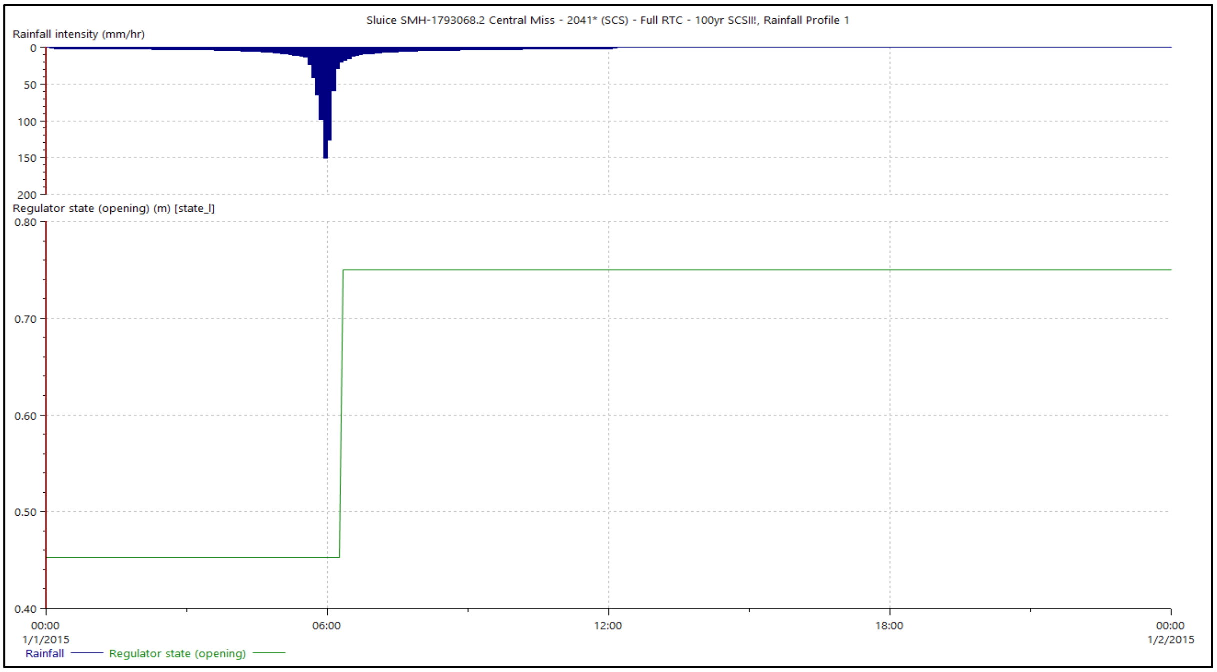
It should be noted that an RTC can have unlimited rules and ranges so, in addition to depth, the control could look at velocity or rainfall. The controls can also look at multiple locations in the system. For the purposes of this project, the control looks at the downstream capacity to manage surcharging, but it could also look at upstream flow as a way to distribute flows.

Although the optimization for the system has been undertaken for a 1 in 25-year return period design storm, in reality large storms will impact the system and the control needs to be able to adapt to those eventualities. In this case, if surcharge depth is exceeded at both downstream reaches, then both gates will open fully. To review this fully an asset management approach should be taken to assess the risk relating to surcharging in both reaches as surcharging in one reach may be preferable to surcharging in another reach based on sewer condition and sewer freeboard.

4.6 RTC Results and Performance

The section discusses the operation of the RTC procedure during a 1 in 5yr, 1 in 25yr storm, and 1 in 100yr design storms. It should be noted that the opening of the gates was set up as per the optimized static settings identified in **Table 3-3**. From reviewing the simulations, the optimization of the gates was sufficient for the real-time controls not to need to adjust the gates during a 1 in 5yr and 1 in 25yr storm, so in order to confirm that the gates were working as intended, a 1 in 100 year storm was run to observe results under extreme conditions. The results below detail how the gates operate under the 1 in 100yr design storm.

4.7 Burnhamthorpe and Cooksville Creek East Flow Control



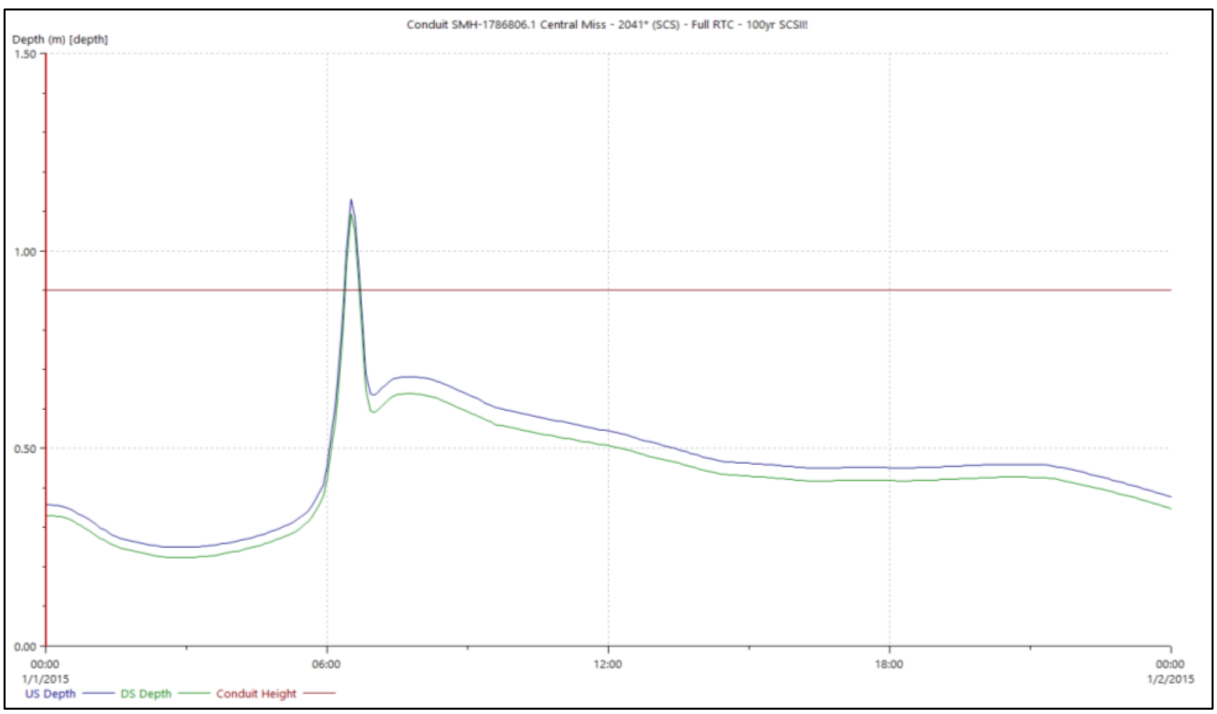
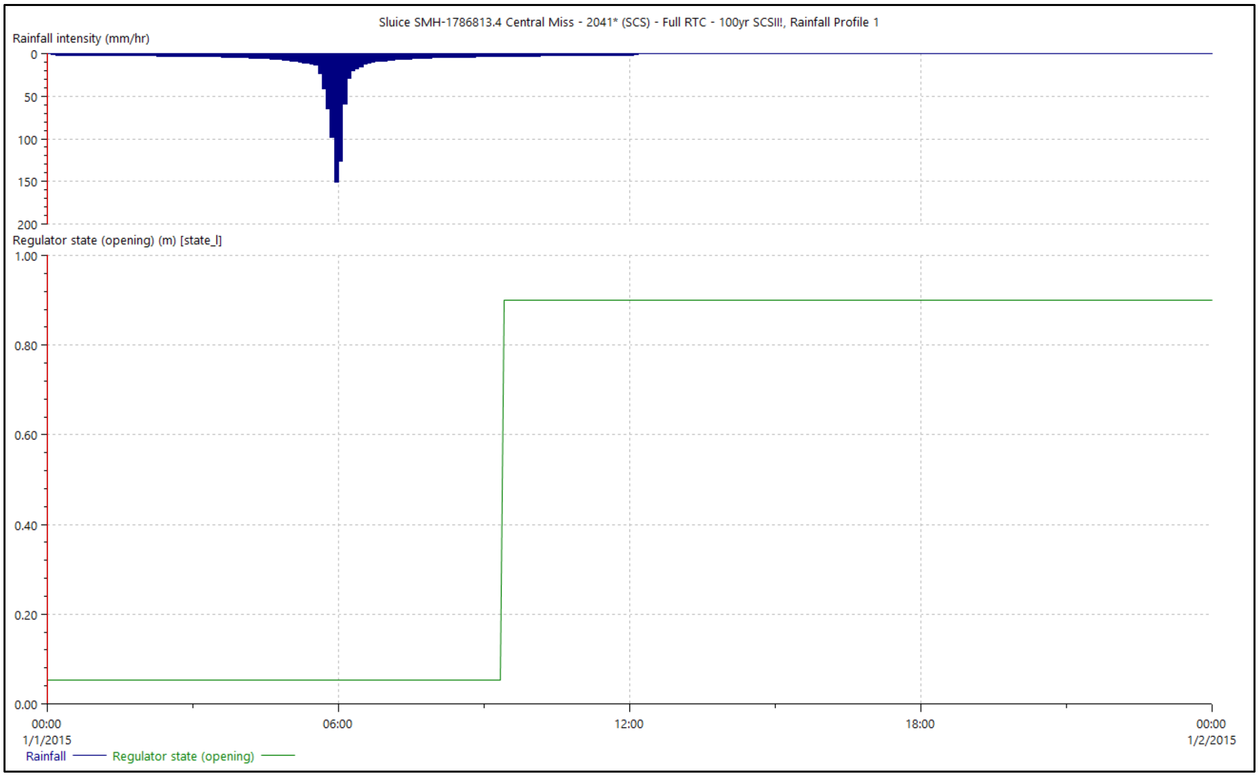


Figure 4-2: Gate SMH-1793068.2 Opening and Reducing Surcharging Downstream

As shown in **Figure 4-2**, surcharging occurs in Upper Cooksville Creek under a 1 in 100yr design storm. As a result, gate SMH-1793068.2 at Burnhamthorpe and Cooksville Creek opens to send more flow along Burnhamthorpe Rd to the Cawthra Rd Trunk Sewer and removes the surcharging, shown here at the minimum downstream constraint.

4.8 Queensway and Cooksville Creek Flow Control

The control gate at Queensway and Cooksville Creek operates to send flow south down the lower Cooksville Creek. Although flow is diverted, the issue with surcharging along the new Queensway trunk stems from restrictions outside of the study area in the downstream East Trunk. As stated earlier in the report, there is a Region-wide RTC study that is ongoing and will develop the strategy for the East to West Diversion to relieve surcharging in the East Trunk.



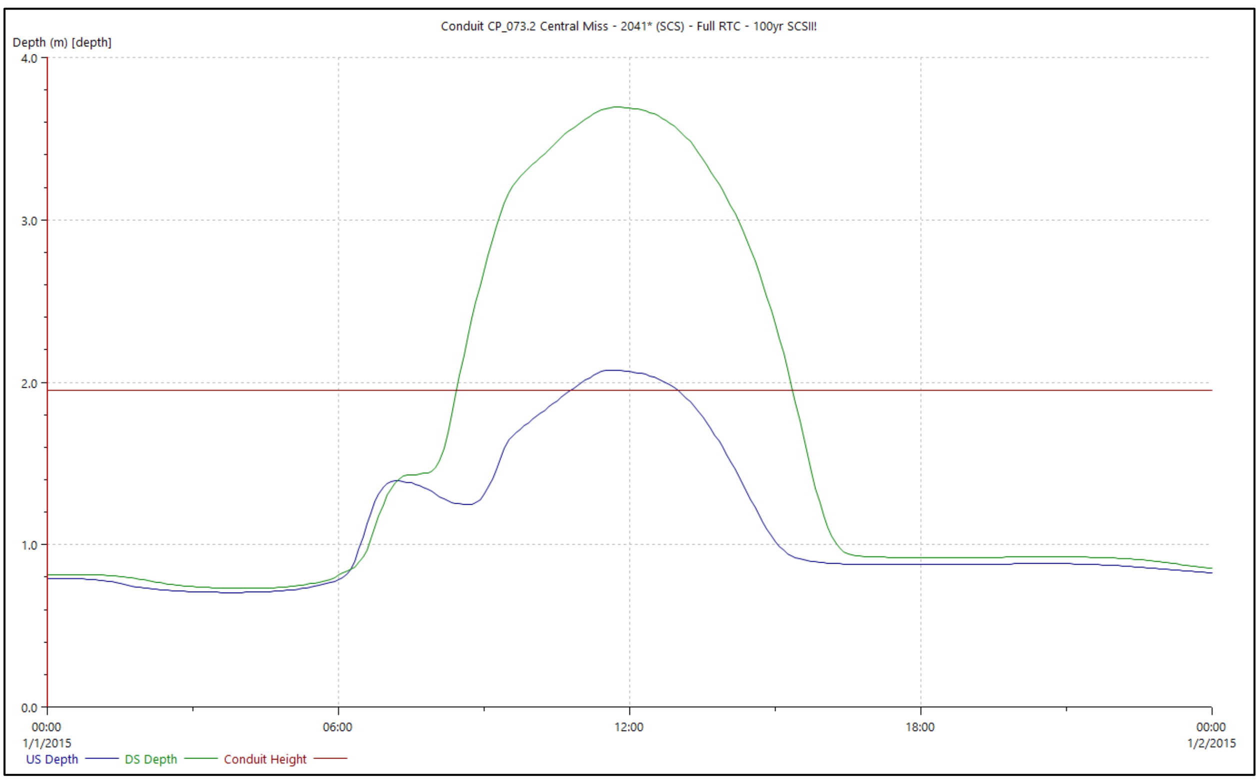


Figure 4-3: Gate SMH-1786813.4 Opening but East Trunk Restrictions Maintain Surcharging.

4.9 In-line Storage Analysis

The following section reviews the potential for in-line storage at the proposed control gates and also along the proposed Queensway Trunk

4.9.1 In-line Storage at Control Gates

A high-level analysis was undertaken at each control gate to understand the in-line storage capacity at each gate. Due to the complexity and adjustability of the upstream network, a number of assumptions were made for to undertake this analysis. These were:

- Assume both gates are closed
- Assume that 100% d/D is the maximum storage capacity

The following calculation was used to assess the volume of in-line storage:

$$V = \frac{L}{6}(A_1 + 4M + A_2)$$

where:
V = volume of storage, m^3 (ft^3)
L = length of section, m (ft)
A_1 = cross-sectional area of flow at base, m^2 (ft^2)
A_2 = cross-sectional area of flow at top, m^2 (ft^2)
M = cross-sectional area of flow at midsection, m^2 (ft^2)

Table 4-4 shows the storage volume up to the first point of surcharging for each viable gate within the study area. The control point at Burnhamthorpe and Cooksville Creek East only has a single gate so was not reviewed for this analysis.

Table 4-4: In-line Storage Volumes for Viable Control Gates

Control Name	Node ID	In-Line Storage (m3)
Burnhamthorpe and Central Parkway	SMH-6547045	209
Burnhamthorpe and Cooksville Creek West	SMH-1793068	4
Centre View and Upper Cooksville	SMH-1793670	9
Cawthra and Dundas	CP_139	708
Burnhamthorpe and Little Etobicoke Creek	SMH-1789392	89
Queensway and Hurontario	SMH-6567075	555
Queensway and Cooksville	SMH-1786813	51
Dixie and Queensway	SMH-1786421	56

4.9.2 In-line Storage in Queensway Trunk Sewer

The following analysis examines potential options to utilize all or part of the proposed Queensway Trunk Sewer for storage. **Figure 4-4** shows the layout of the proposed Queensway Trunk and **Figure 4-5** shows a long-section of the Queensway Trunk. The assessed length of the Queensway Trunk includes four individual pipe lengths for which the calculated storage volumes are shown in **Table 4-5**.

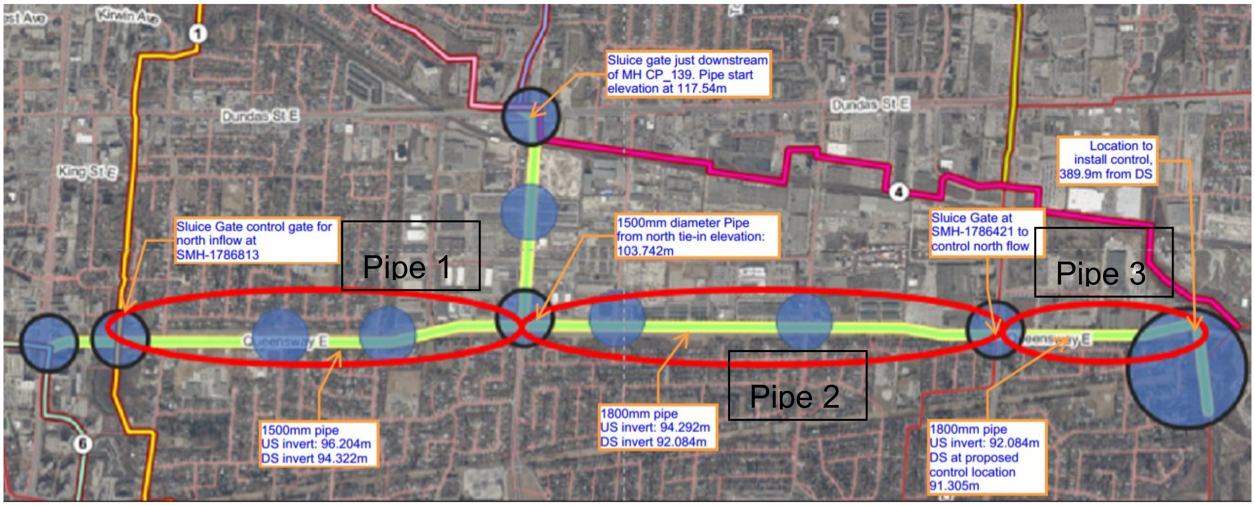


Figure 4-4: Layout of Queensway Trunk

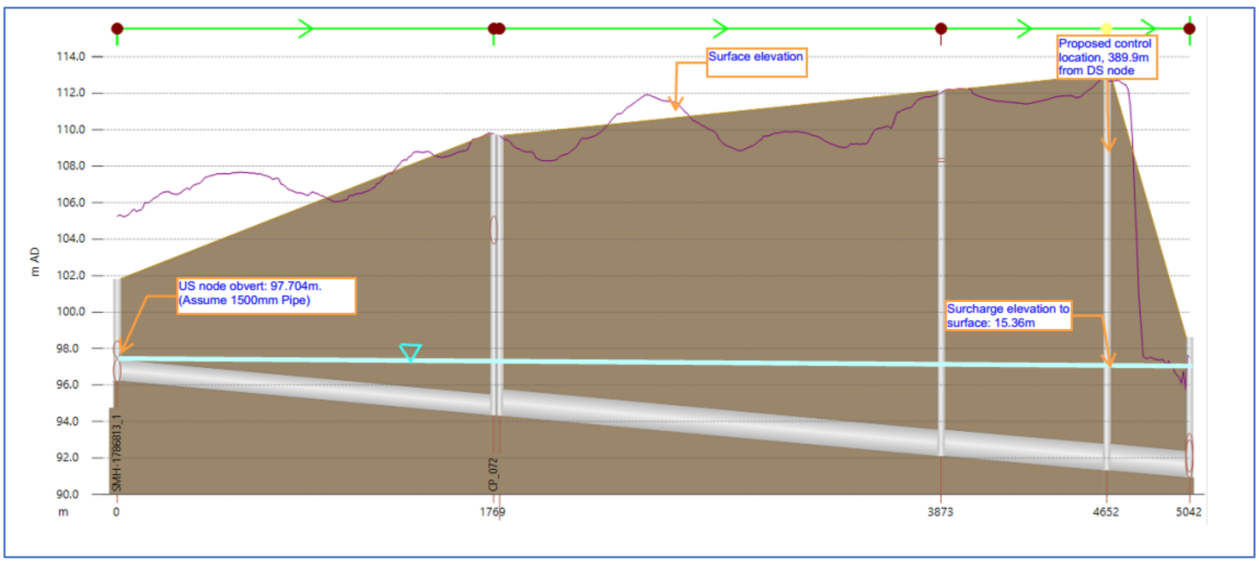


Figure 4-5: Long-section of Queensway Trunk

Table 4-5: Queensway Trunk Storage Capacity by Individual Pipe Length

Pipe ID	US Node ID	DS Node ID	US Inv	DS Inv	Length	Size (mm)	Storage Volume (m3)
Pipe 1	SMH-1786813_1	CP_072	96.204	94.322	1,769	1,500	3,126
Pipe 2	CP_073	SMH-1786421_1	94.292	92.084	2,075	1,800	5,281
Pipe 3	SMH-1786421_1	Proposed Control	92.084	91.305	779	1,800	1,982
Total					4,652		**10,389**

5 SUMMARY AND RECOMMENDATIONS

The purpose of the hydraulic analysis was to identify and confirm constraints within the Central Mississauga study area and develop a preliminary operational strategy. Below is a summary of the key analyses methodology, results, and recommendations:

I. Analyses Methodology

- The Region's wastewater model and GMBP's Central Mississauga schematic were used for the hydraulic analyses.
- Hydraulic analyses were completed for the study area under the following model runs:
  - 2041* 5-year SCSII
  - 2041* 25-year SCSII
  - Ultimate 5-year SCSII
  - Ultimate 25-year SCSII

II. Analyses Results & Recommendations

- Capacity constraints were identified within the Central Mississauga study area which further confirmed and validated the need for twinning of key trunk sewers:
  - Upper Cooksville Trunk Sewer
  - Lower Cooksville Trunk Sewer
  - Upper CPR Trunk Sewer
  - Lower CPR Trunk Sewer
- The above capacity constraints are relieved through the project's proposed trunk sewers:
  - 1500 mm Cawthra Trunk Sewer (Dundas Street to Queensway East)
  - 1500 mm Burnhamthorpe Sewer (Central Parkway to Cawthra Road)
  - 1500 – 1800 mm Queensway Sewer (Hurontario to Etobicoke Creek to Sherway Drive)
- The general operational philosophy developed for the preferred infrastructure strategy includes flow control settings to optimize flow to all existing and proposed trunk sewers and maintain levels of service during normal day to day dry weather, during rain events as well as during maintenance activities
  - The operational logic for gate settings will set out to adjust gate settings to optimize flow within downstream sewers to ensure depth is < 85% full
- Based on the completed model runs, existing and future capacity needs and constructability of new infrastructure, the following flow control locations were selected to help relief capacity constraints during normal and wet weather flow conditions and support maintenance and rehabilitation activities:
  - Burnhamthorpe Road and Central Parkway
  - Cawthra Road and Dundas Street
  - Queensway East and Hurontario Street
  - Queensway East and Cooksville Creek
  - Queensway East and Cliff Road

- Queensway East and Hensall Street (West)
- Queensway East and Hensall Street
- Queensway East and Tedlo Street
- Queensway East and Dixie Road

- There is a potential opportunity to utilize the Queensway East Trunk Sewer for in-line storage. In-line storage could provide the system with further flow attenuation to manage peaks within the trunk sewer network as well as at the G.E. Booth Wastewater Treatment Plan. The maximum storage capacity available within the new Queensway Trunk Sewer is estimated to be approximately 10,000 m^3. Storage opportunities, control logic and subsequent control structure design to facilitate storage may be revisited during Detailed Design.

Appendix A: Real Time Control Logic

RTC validation report for

Description:

Global

SMH-1793670.1 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1793670.2 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1793068.1 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1793068.2 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-6547045.1 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-6547045.2 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1789392.1 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

CP_139.1 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-6567075.4 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-6567075.3 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1786813.4 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1786813.3 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

SMH-1786421.3 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Gate1

Rules:

Close_Gate

Open_Gate1

SMH-1789392.2 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

CP_139.2 (Variable sluice gate)

Definitions:

Close_Gate

Open_Gate1

Open_Gate2

Gate1

Rules:

Close_Gate

Open_Gate1

Open_Gate2

Total number of errors: 0

SMH-1793670.1 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SND-6520993.1 is greater than or equal to 1.020m then SMH-1793670.1 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SND-6520993.1 is between 0.000m and 1.020m then SMH-1793670.1 will be incremented by 0.010m

if the depth at the upstream end of link SMH-1793240.1 is greater than or equal to 0.637m then SMH-1793670.1 will be set to 0.750m

SMH-1793670.2 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1793240.1 is greater than or equal to 0.637m then SMH-1793670.2 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1793240.1 is between 0.000m and 0.637m then SMH-1793670.2 will be incremented by 0.010m

if the depth at the upstream end of link SND-6520993.1 is greater than or equal to 1.020m then SMH-1793670.2 will be set to 0.750m

SMH-1793068.1 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1786806.1 is greater than or equal to 0.765m then SMH-1793068.1 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1786806.1 is between 0.000m and 0.765m then SMH-1793068.1 will be incremented by 0.010m

if the depth at the upstream end of link SMH-CO01.1 is greater than or equal to 1.020m then SMH-1793068.1 will be set to 0.750m

SMH-1793068.2 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-CO01.1 is greater than or equal to 1.020m then SMH-1793068.2 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-CO01.1 is between 0.000m and 1.020m then SMH-1793068.2 will be incremented by 0.010m

if the depth at the upstream end of link SMH-1786806.1 is greater than or equal to 0.765m then SMH-1793068.2 will be set to 0.750m

SMH-6547045.1 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1790089.2 is greater than or equal to 1.020m then SMH-6547045.1 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1790089.2 is between 0.000m and 1.020m then SMH-6547045.1 will be incremented by 0.010m

if the depth at the upstream end of link CP_118.2 is between 1.020m and 9999.000m then SMH-6547045.1 will be set to 1.200m

SMH-6547045.2 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link CP_118.2 is greater than or equal to 1.020m then SMH-6547045.2 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link CP_118.2 is between 0.000m and 1.020m then SMH-6547045.2 will be incremented by 0.010m

if the depth at the upstream end of link SMH-1790089.2 is greater than or equal to 1.020m then SMH-6547045.2 will be set to 1.200m

SMH-1789392.1 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link CP_127.3 is greater than or equal to 0.510m then SMH-1789392.1 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link CP_127.3 is between 0.000m and 0.510m then SMH-1789392.1 will be incremented by 0.010m

if the depth at the upstream end of link SND-6514255.1 is greater than or equal to 0.765m then SMH-1789392.1 will be set to 0.675m

CP_139.1 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1790293.1 is greater than or equal to 0.765m then CP_139.1 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1790293.1 is between 0.000m and 0.765m then CP_139.1 will be incremented by 0.010m

if the depth at the upstream end of link CP_132.2 is greater than or equal to 1.275m then CP_139.1 will be set to 0.900m

SMH-6567075.4 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-6567081.1 is greater than or equal to 1.147m then SMH-6567075.4 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-6567081.1 is between 0.000m and 1.147m then SMH-6567075.4 will be incremented by 0.010m

if the depth at the upstream end of link SMH-1783265.1 is greater than or equal to 1.275m then SMH-6567075.4 will be set to 1.350m

SMH-6567075.3 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1783265.1 is greater than or equal to 1.275m then SMH-6567075.3 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1783265.1 is between 0.000m and 1.275m then SMH-6567075.3 will be incremented by 0.010m

if the depth at the upstream end of link SMH-6567081.1 is greater than or equal to 1.147m then SMH-6567075.3 will be set to 1.950m

SMH-1786813.4 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-6540350.1 is greater than or equal to 0.765m then SMH-1786813.4 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SMH-6540350.1 is between 0.000m and 0.765m then SMH-1786813.4 will be incremented by 0.010m

if the depth at the upstream end of link CP_073.2 is greater than or equal to 1.530m then SMH-1786813.4 will be set to 0.900m

SMH-1786813.3 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link CP_073.2 is greater than or equal to 1.530m then SMH-1786813.3 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link CP_073.2 is between 0.000m and 1.530m then SMH-1786813.3 will be incremented by 0.010m

if the depth at the upstream end of link SMH-6540350.1 is greater than or equal to 0.765m then SMH-1786813.3 will be set to 0.900m

SMH-1786421.3 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SMH-1786420.1 is greater than or equal to 0.765m then SMH-1786421.3 will be decremented by 0.010m

if the depth at the upstream end of link SMH-1786420.1 is between 0.000m and 0.765m then SMH-1786421.3 will be incremented by 0.010m

SMH-1789392.2 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link SND-6514255.1 is greater than or equal to 0.765m then SMH-1789392.2 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link SND-6514255.1 is between 0.000m and 0.765m then SMH-1789392.2 will be incremented by 0.010m

if the depth at the upstream end of link CP_127.3 is greater than or equal to 0.510m then SMH-1789392.2 will be set to 0.900m

CP_139.2 (Variable sluice gate)

Unless subsequent rules are true, if the depth at the upstream end of link CP_132.2 is greater than or equal to 1.275m then CP_139.2 will be decremented by 0.010m

Unless subsequent rules are true, if the depth at the upstream end of link CP_132.2 is between 0.000m and 1.275m then CP_139.2 will be incremented by 0.010m

if the depth at the upstream end of link SMH-1790293.1 is greater than or equal to 0.765m then CP_139.2 will be set to 0.900m