Appendix I

TM8 - Capacity Assessment of Fountain Street Trunk Sewer

The Regional Municipality of Waterloo

Wastewater Treatment Master Plan Update

Technical Memorandum No. 8: Capacity Assessment of Fountain Street Trunk Sewer

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Preparation and Review Log

Version	Date	Prepared by (Deliverable Lead)	QC Reviewer	Project Manager Sign-off
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1. Introduction

1.1 Background

The Regional Municipality of Waterloo (the Region) is an upper tier municipal government, providing municipal services to seven area municipalities with a total population of approximately 550,000 people. The Region owns thirteen (13) wastewater treatment plants (WWTPs), one (1) wastewater residuals processing facility, six (6) wastewater pumping stations (with a seventh station under construction), and two wastewater collection systems (Ayr in the Township of North Dumfries and Wellesley in the Township of Wellesley), treating an approximate average of 66 million cubic meters of wastewater annually. The Region's Preston WWTP treats wastewater from an area that serviced a population of approximately 20,700 people in 2015 (Source: TM1A-WWTP Population and Flow Projections, CIMA+). An industrial/commercial area, located north of the main Preston area, is connected to the sewer network. This industrial area is located around Fountain Street (see Figure 1 below). The remaining contributing area is primarily residential.

The Fountain Street Trunk Sewer conveys flows from the East Side Lands (ESLs) development to south of Highway 401 and ultimately to the Preston WWTP. The interim strategy during the early development phase for the wastewater servicing of the ESLs includes sending flows to the Preston WWTP via the Fountain Street Trunk Sewer. In order to determine the capacity of the sewer system upstream of the Preston WWTP, flow monitoring of this trunk sewer was completed. Based on available data from the City of Cambridge, and the availability of hydraulic models for the service area, CIMA+ has assessed the existing sewer capacity and analyzed the impact of the additional flows from the ESLs development.

It can be noted that the long-term servicing strategy will be to convey flows from the ESLs to the Kitchener WWTP. When the existing infrastructure is nearing capacity, a new gravity trunk will be constructed from the southern end of ESLs (near Freeport Creek) to the Kitchener WWTP, and flows will be diverted to restore available capacity in the Fountain St trunk and at the Preston WWTP.

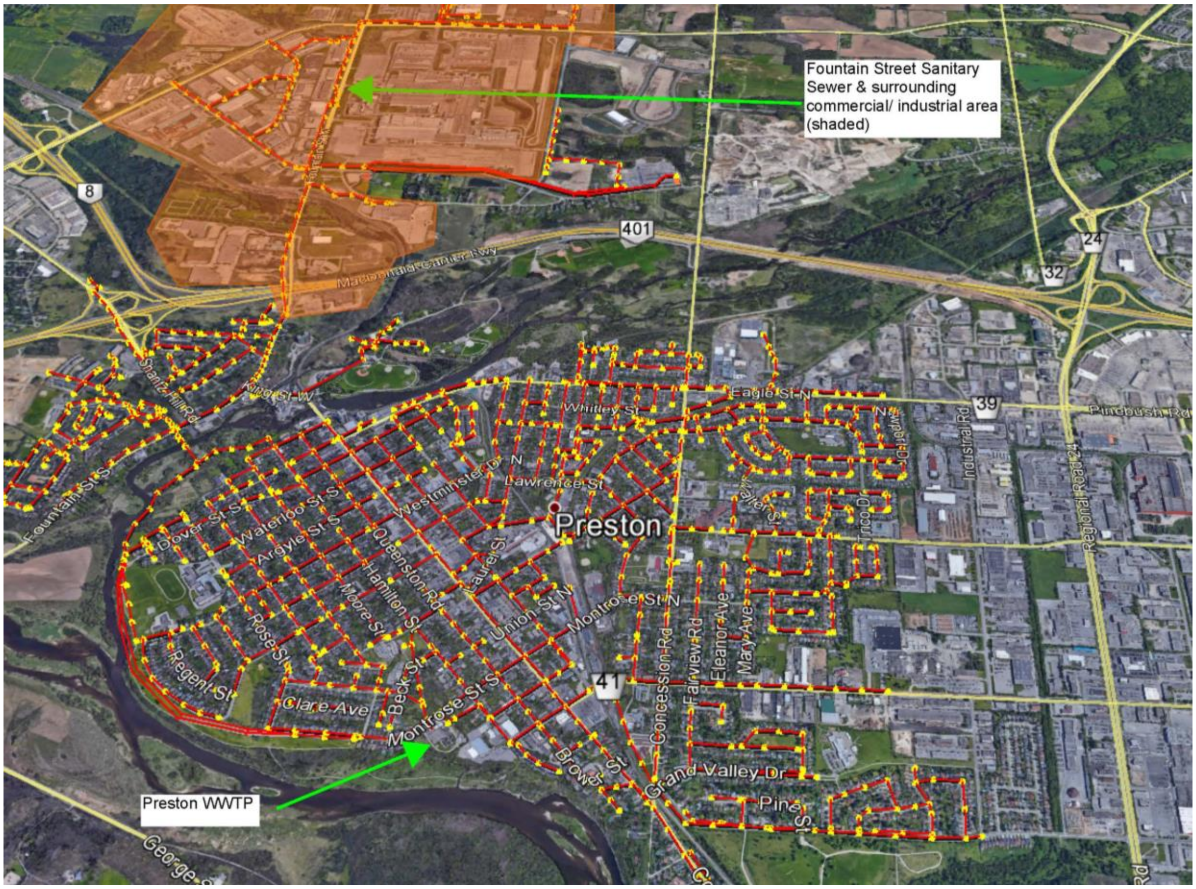

Figure 1 Preston Sanitary Sewer Network

1.2 Objectives

The main objective of this task was to complete a review of the Fountain Street Trunk Sewer capacity upstream of the Preston WWTP. This review has determined the available capacity for interim servicing of the ESLs development areas at the Preston WWTP. Furthermore, this review identified the flows and corresponding development stage where a critical point for capacity in the sewer network will be reached.

2. Hydraulic Model Review

2.1 City of Cambridge Sanitary Hydraulic Model

CIMA+ received two hydraulic model scenarios in PCSWMM software format for the purposes of this study: a 2012 scenario that represents the existing conditions, and a future 2033 scenario. The models cover the sanitary sewer network of the Preston area that drains to the Preston WWTP. The remaining City network is not part of this hydraulic model. The Preston sewer model consists of:

- 1275 nodes (maintenance holes);
- 95,450 meter of sewers which include 16,055 meters of trunk sewer (450 mm pipe diameter or larger) and 6,367 meters of force mains; and
- Nine (9) sewage pumping stations.

The average sanitary dry weather flow to Preston WWTP is 81 L/s for the existing (2012) scenario and 190 L/s for the future critical growth scenario with a design horizon of 2041-2042.

The hydraulic model was developed by AECOM in 2013 for the City of Cambridge Sanitary Master Plan. The model development and calibration report (Sanitary Servicing Master Plan Hydraulic Model & Calibration Documentation, AECOM 2013) described how the hydraulic wastewater model was built and calibrated. This model was created to assess sewer capacities and future growth scenarios as part of the 2012 Master Plan. A short-term flow survey was conducted in 2012 and Figure 3 shows the four (4) flow monitor locations and one (1) rain gauge location that was used in the AECOM report to calibrate the hydraulic model. Flow monitor location P123 is the only flow monitor that is located along Fountain Street trunk sewer south of Highway 401. The calibration of this flow monitor revealed that the model slightly under predicts the total flow compared to observed data and that the flow monitor did not show a response to rainfall. The report mentions data quality issues and therefore cautions the calibration use for detailed design use in the future. Due to the above calibration considerations, a sensitivity analysis was completed in Section 6 of this report.

The hydraulic model was built based on residential design criteria of 350 L/cap/d and infiltration & inflow figures around 0.15 L/s/ha.

The existing hydraulic model was used by CIMA+ to run the existing base scenario simulations. While assessing the AECOM future scenario model named “CambridgeSSMP_Preston_Growth”, it was noted that the future growth scenario was based on population numbers that have now been superseded since the last issue of the City’s Master Plan. Modelled population and flow projections based on the Province’s Places to Grow Growth Plan are significantly higher than current projections and therefore it was decided to use the existing base scenario model and update the population numbers in line with current Regional WWTMP projections. For instance, the AECOM 2033 total population projection for Preston was 83,301, while CIMA’s TM-1 Population and Flow Projections predicts a population of 25,692 for 2036 plus 7,413 population for the East Side Land Development. Part of the discrepancy is the diversion of some flows from the Preston WWTP service area to the Galt WWTP. However, the projections within the AECOM growth scenario largely over predict flows in terms of baseline flows (contributing developed area) and residential flows and therefore far exceed the current treatment plant capacity for Preston WWTP.

2.2 Flow Monitoring Data

Flow survey results that were carried out at various times between November 2010 and July 2015 were made available for the purpose of this study. Flow surveys were conducted at nine different locations in the sewer network, of which seven were located along the Fountain St trunk. In order to verify that the existing hydraulic model was calibrated in line with the available flow survey information, CIMA+ carried out spot checks for the relevant locations along the trunk sewer. The most downstream flow survey result available is at flow monitor location LS10 (825 mm diameter sewer), located upstream of Dover Street Sewage Pumping Station (SPS). The location of the flow survey point LS10 is shown in Figure 2.

Figure 2 Location of the Most Downstream Flow Monitor (LS10)

Rainfall monitoring data from Grand River Conservation Authority (GRCA) and their nearest rain gauge location, Cambridge Shade, was used to analyze dry weather periods within the flow monitoring period. The Cambridge Shade climate station has rainfall data available in hourly measured intervals and is approximately 8 km away from the flow survey site (refer to Figure 3 for location). It can be noted that the distance of the rain gauge from the study area is approximately the same distance that the AECOM report used for model calibration in the City of Cambridge Sanitary Master Plan.

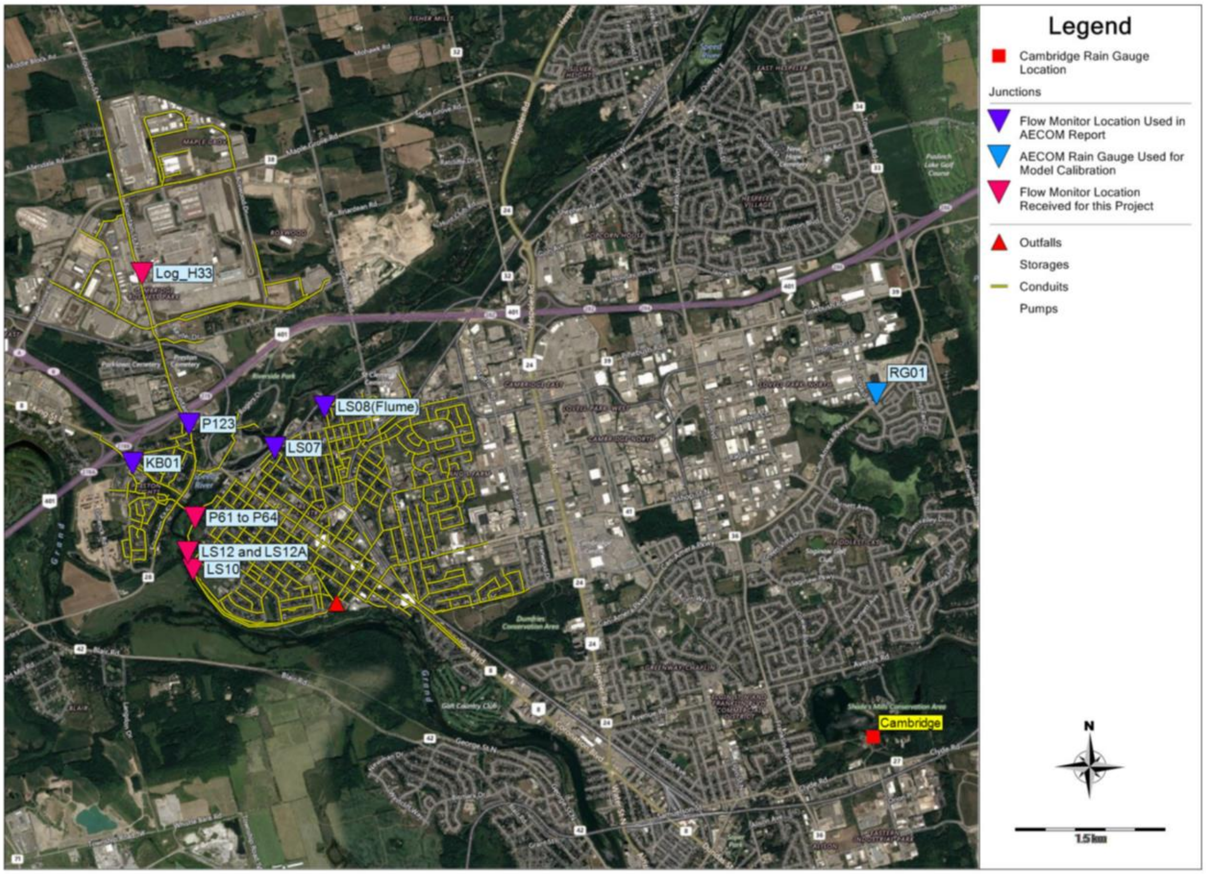

Figure 3 Rain Gauge Locations and Flow Monitor Locations

Flow survey information from FM LS10 was collected between April 1st, 2013 and September 30th, 2013. A comparison of the flow monitoring data versus the modeling results is provided in Table 1. The comparison includes results for the overall monitoring period, as well as a dry weather period (March 1-5, 2013) that was identified based on rainfall data. Additional details regarding the flow monitored versus modeled results are included in Appendix A.

Table 1 Comparison of Flow Monitoring and Modeling Results

Parameter	Flow Monitoring Results	Model Results	Difference (Model to Field)
Flow Survey Monitoring Period (April 1 – Sept 30, 2013)			
Minimum Flow	9 L/s	20 L/s	+11 L/s (+122%)
Maximum Flow	166 L/s	80 L/s	-86 L/s (-52%)
Average Flow	55 L/s	42 L/s	-13 L/s (-24%)
Dry Weather Flow Period (March 1-5, 2013)			
Minimum Flow	10 L/s	20 L/s	10 L/s (+100%)
Maximum Flow	106 L/s	80 L/s	-26 L/s (-25%)
Average Flow	56 L/s	42 L/s	-14 L/s (-25%)

In general, the hydraulic model predicts flows that follow similar trends as the measured flow data. The measured flows have higher peak flows and lower low flows than predicted from the hydraulic model. The maximum simulated peak flows during the dry weather flow period are approximately 25% lower than the measured flow (80 L/s vs 106 L/s). The average of the simulated flow (42 L/s) is also approximately 25% lower than the average dry weather flow measured (56 L/s) for the selected dry weather period.

Table 1 indicates the major difference in flows are related to the dry weather flow and is influencing both average and peak flow predictions. Despite the differences, CIMA+ would not recommend that the hydraulic model be re-calibrated. Flows in this trunk sewer section are receiving a major portion (roughly 50%) of its dry weather flow from large industrial users with varying water consumption that can fluctuate up to 100% from month to month (see Section 2.3 – Water Meter Records for Large Users, below).

In light of the potential difference between modeled and actual flows, a sensitivity analysis was completed to assess the impacts relative to the interim servicing of the ESLs. This analysis is included in Section 6 of this report.

2.3 Water Meter Records for Larger Users

As part of the model review, CIMA+ was provided water meter records for the largest water user within the Fountain Street Trunk catchment area. The discharged flow makes up approximately 50% of the average dry weather flow of the trunk sewer flows from Fountain Street to flow monitor LS010 and therefore have a significant impact on the shape of the diurnal wastewater hydrograph that will ultimately show a deviation from typical residential profiles. Residential wastewater consumption would contribute similar flows and generate a similar flow profile as observed when the model was created and calibrated in 2012/2013; however, there is potential for a much larger flow change from industrial users if and when their production capacities change.

Long-term water meter records were available for the largest industrial user from 2011 until April 2017 in monthly billing periods. The trend shows a steady increase of average water consumption over the last years from approximately 59,000 m^3 per month in 2011/12 to approximately 66,000 m^3 per month in 2016/17. The last available month of billing records covered a period from March 10th, 2017 to April 07th, 2017, a period of 28 days. During this time, a total water consumption of 91,020 m^3 was recorded. Statistically this is a peak consumption, which was only reached four (4) times in the past four (4) years. This was used to represent a worst-case sustained water consumption that is approximately 38% above the annual average. The calculated average water consumption and equal discharge over this period was 37.2 L/s and was updated in the hydraulic model. This update changed the industrial flow into Fountain Street Trunk sewer by adding 15.8 L/s to the 21.4 L/s that were represented in the existing model, based on 2012 below monthly average water consumption (55,365 m^3). This results in average model dry weather flow that more closely matches the measured average flow in the Fountain Street Trunk Sewer. Figure 4 shows the long-term water consumption trend, based on the varying monthly data sets.

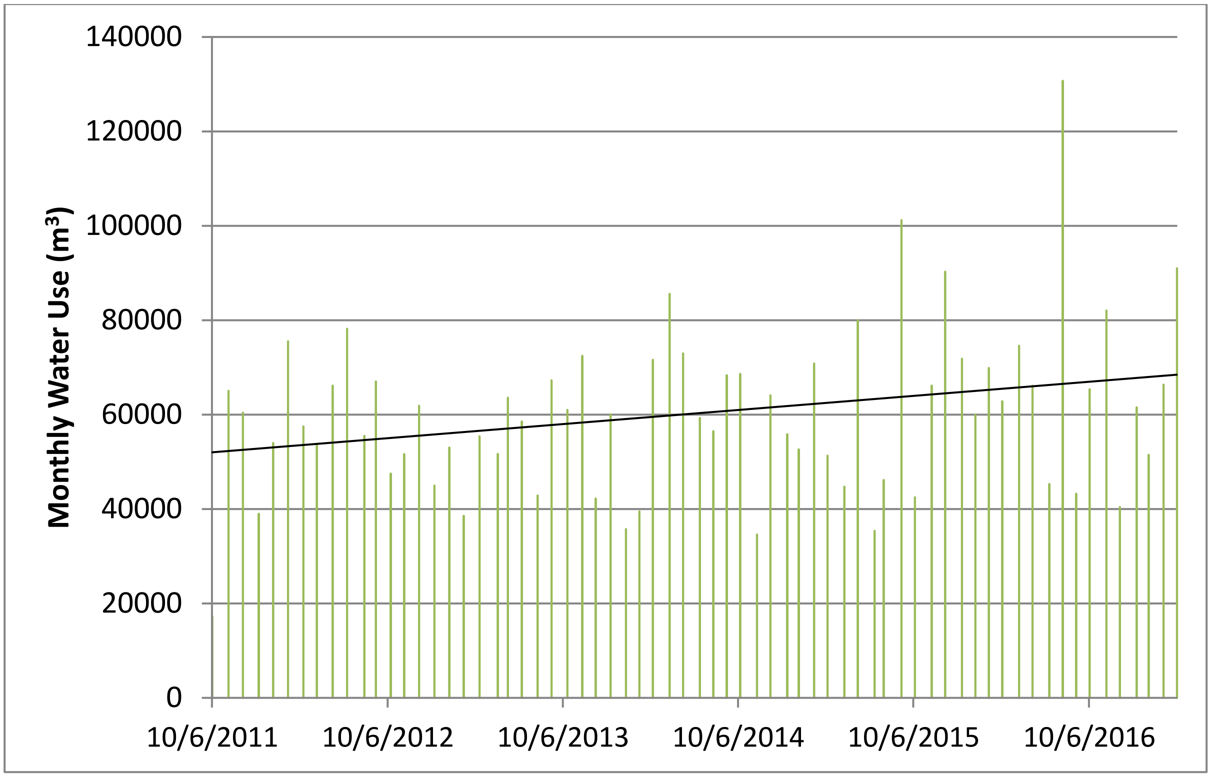

Figure 4 Water Meter Records for Large User in Fountain Street

2.4 Model Updates for Purposes of this Study

2.4.1 Model Updates for Existing Scenario

The existing hydraulic model was not altered with the exception for Dover Street sewage pumping station, where the pump capacity was set to unlimited, so that the station itself would not represent a bottleneck in the hydraulic system. Upgrades to this pumping station are currently in planning. The remainder of the hydraulic model was used as calibrated in 2012.

2.4.2 Model Updates for Future Growth Scenario

In order to create a critical development stage model and a full build out future development scenario, the following updates to the existing hydraulic model were made:

- An adjustment of the sewershed area was made to add the ESLs development (the total development area is 2,590 ha at full build out stage past year 2051 as per CIMA TM-1 Population and Flow Projections, Jan. 2017 - however only a small part of this area contributes to inflow and infiltration (I/I) baseline flows);

- Update the total pump firm capacity for Boxwood SPS to 473.4 L/s (Design flow stated in the Speedsville Sanitary Pumping Station Report) and add details to the model to run this SPS with two pumps (151.5 L/s @ 74.2 m head and 329.5 L/s @ 61.8 m head with two forcemains of 300 mm and 450 mm diameter, respectively);
- Change the pump firm capacity at Dover Street SPS to unlimited, so that no restrictions would result from this pumping station based on an on-going Class Environmental Assessment being conducted to assess the required capacity upgrades to eliminate any bottlenecks in the system caused by this SPS;
- Import the design storms for 1 in 5-year and 1 in 25-year from the AECOM Hydraulic Modelling Report;
- Update plant flows for a large industrial user within the Fountain Street Trunk catchment (average constant flow) from water meter usage records as per Section 2.3;
- Base the population growth on wastewater flows of 350 L/population equivalent/day, as agreed in a meeting with the Region and City of Cambridge on June 21st, 2017 where it was concluded to use the same wastewater generation rate as was used in the City of Cambridge Sanitary Master Plan;
- Growth sewershed area to contribute 0.15 L/s/ha Infiltration and Inflow (also based on City of Cambridge Sanitary Master Plan).
- I/I contributing sewershed area for ESL growth was determined based on the current observed average per capita flow within the Preston catchment of approximately 440 L/cap/d (Source CIMA TM-1A-Population and Flow Projections), equating to an I/I contribution of 90 L/cap/d when the 350 L/cap/d residential contribution is subtracted. This equates to 0.0069 ha/cap for I/I contribution when based on 0.15 L/s/ha design figure.

3. Capacity Review Criteria

Conditions that would represent a capacity constraint were defined through coordination with the Region and the City. It was agreed that a sewer would be considered surcharged if the depth of flow in the sewer was 85% of the total sewer diameter (referred to as a d/D ratio of 0.85). This surcharge ratio was previously used for design checks in the AECOM modelling report and is close to the theoretical maximum pipe full flow capacity of a sewer (approximately 0.9 d/D).

Similar to the previous AECOM Master Plan, dry weather flow events, 1 in 5-year storms and 1 in 25-year storms were run to test the network against the above defined surcharge ratio and potential flooding.

The design storms used for the test simulations were the same as those used for the AECOM Master Plan and represent Atmospheric Environment Service (AES) design storms with the peak/duration factor of 0.5 or 50% of the rainfall duration and maximum rainfall intensities of 100.3 mm/hr and 134.5 mm/hr, respectively, for the 5-year and 25-year storms. Hydrographs for the design rainfall events are provided in Appendix B. It is noted that the design storms are in addition to the I/I allowance to represent the overall extraneous flows for the catchment.

The Preston WWTP capacities were compared against the simulated flows. Average simulated dry weather flows from the hydraulic model were compared against average day treatment plant capacity and peak flows generated from a 1 in 25-year design storm were compared against the peak WWTP capacity. Table 2 shows a summary of the design criteria that were checked.

Table 2 Design Conditions

Design Criteria	Sewer Network Surcharge d/D = 0.85	Average Preston WWTP Capacity	Peak WWTP Capacity
Model Simulation Condition to be met	All Simulations	Dry Weather Flow Runs	1 in 25 Year Design Storm Peak Flows

4. Modelling Existing Conditions

Existing conditions were reviewed in the model for three scenarios: dry weather flow, a 1 in 5-year design storm, and 1 in 25-year design storm. The 1 in 5-year and 1 in 25-year design storm scenarios were run to simulate additional infiltration and inflow conditions into the sanitary sewer network.

Modelling showed there were no surcharging conditions (d/D of greater than 0.85) for the 1 in 5-year storm or the 1 in 25-year storm in the Fountain Street trunk. The simulated hydraulic modelling output plans and profiles for the trunk sewer are provided in Appendix C.

Table 3 shows the flows generated by the existing model scenario. “Baseline” flow represents the inflow/infiltration component in the model and “Average” flow represents the wastewater contributions from both population and industry. Simulated flows do not exceed the rated WWTP capacities. Whilst the model under predicted average dry weather flows at the most downstream flow monitor location (LS010), model flows to the Preston WWTP are high (120 L/s) when compared to current average plant flows of approximately 98 L/s. This suggests that the model is over-predicting the contributing average dry weather flows between the Dover Street SPS and the Preston WWTP.

Table 3 Existing Model Scenario Flows (2012 AECOM)

Model Runs	Simulated Model Flows	Available Preston WWTP Capacity
Average DWF to Preston WWTP	Baseline: 30.3 L/s Avg. Flow: 90 L/s Total Flow: 120 L/s	194 L/s or 16,800 m^3/d
Peak 1 in 25-year flow to Preston WWTP	Max. Flow: 340 L/s	498 L/s or 43,000 m^3/d

5. Modelling Future Development Scenarios

5.1 East Side Lands Build-out Conditions

The existing scenario model was updated to represent the future growth scenario and was initially run using a worst-case 1 in 25-year design storm under fully developed ESLs development conditions. As expected, this scenario resulted in the majority of trunk sewer sections upstream of the river siphon beneath the Grand River to be under heavy surcharge conditions, and surface flooding upstream of the river siphon. Since the full build-out development population is currently projected to be reached past year 2051, determining the critical population number from the ESLs development and when it would trigger hydraulic sewer restrictions or sewage treatment plant restrictions was reviewed.

5.2 East Side Lands Interim Servicing

The ESLs interim servicing was reviewed to determine the critical population that would trigger hydraulic sewer restrictions or restrictions at the Preston WWTP.

The Region currently forecasts the population of the ESLs development to grow as per Table 4.

Table 4 ESLs Development Population Projections (WWTMP TM1A)

ESLs	2016	2021	2026	2031	2036	2041	2046	2051	Beyond 2051
Population	628	2,661	4,584	5,753	7,413	9,239	12,182	14,297	45,733

It was determined through the hydraulic model that the sewer network has sufficient capacity to carry flows equivalent to the average and peak treatment capacity of Preston WWTP while operating below the sewer design surcharge condition of 0.85 d/D. Therefore, the critical design development with respect to the peak flow in the collection system would not be reached until flows exceed the design average day rated capacity of the Preston WWTP of 16,800 m^3/d (194.4 L/s).

When considering the interim servicing through the Preston WWTP, the maximum allowable population growth in the ESLs development (in addition to the general projected population growth for Preston) that would not exceed the treatment plant capacity was determined as follows:

- Population: 9,710 people

- Average flow: 49.5 L/s (39.3 average wastewater flows, 10.2 L/s baseflow)
- Critical Development Year: 2041-2042

Beyond this flow trigger, the Preston WWTP can no longer accommodate additional flows for treatment without an expansion to the average day rated capacity. It can be noted that if development of ESLs progresses faster than projected, the long-term servicing solution of conveying flows to the Kitchener WWTP would be implemented earlier. Flows to the WWTPs are reviewed annually as part of the Region's Water and Wastewater Monitoring Reports, and the Wastewater Treatment Master Plans are typically updated every 5 to 10 years to confirm recommendations and proposed timing.

Table 5 below shows modelled peak flows and population numbers for this critical development stage.

Table 5 Future Development Model Scenario Flows

Model Scenario	Peak 1 in 25-year flow to Preston WWTP	Average DWF to Preston WWTP (1)	Preston WWTP capacity
Critical Development (2041 - 2042)	Max. Flow: 381 L/s	Baseline: 35 L/s Avg. Flow: 152 L/s Total Flow: 187 L/s	Avg: 194 L/s or 16,800 m^3/d
			Max: 498 L/s or 43,000 m^3/d

Notes:
1. Total sewer flows = Baseline flows + Average WW flows.

Potential sewer network capacity bottlenecks were identified for the following locations along the Fountain St trunk sewer, as illustrated Figure 5:

- Fountain St N, north of Highway 401 (model node SM12349, pipe SP11345) – Sewer capacity of 531 L/s;
- Fountain St. S, south of King St W. (model node SM12162, pipe SP11060) – Sewer capacity of 894 L/s; and
- Upstream of the river siphon, south of the intersection of Shantz Hill Rd. and Fountain St S. (model node SM12323, pipe SP11249) – Sewer capacity estimated between 600 L/s and 890 L/s (governed by downstream siphon)

All of the flow capacities for the potential bottleneck locations are well in excess of the flow associated with the Preston WWTP average and peak rated capacities.

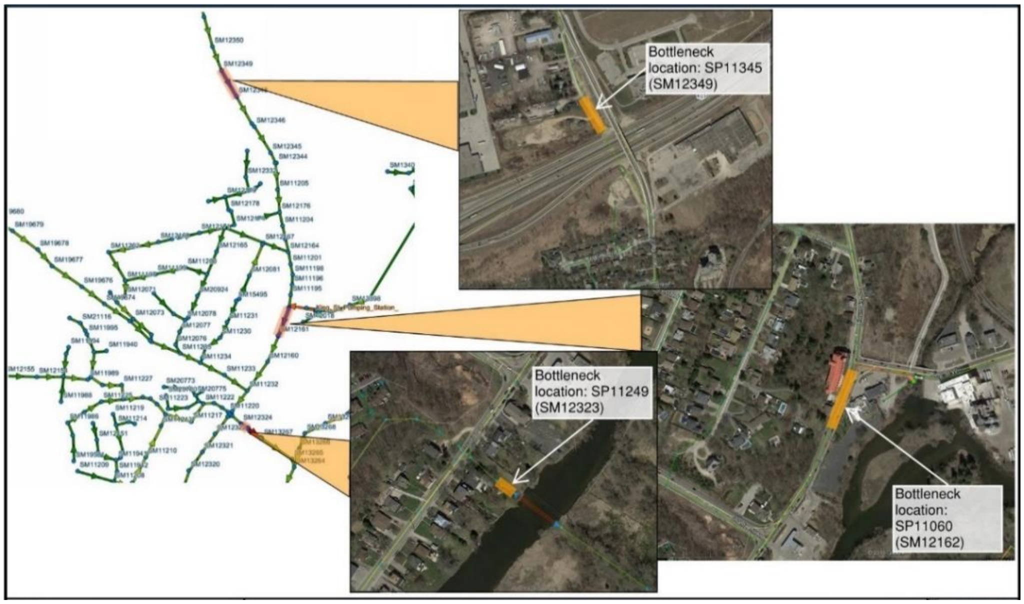

Figure 5 Location of Potential Sewer Bottlenecks on Fountain Street

6. Flow Sensitivity Analysis

As noted in Section 2.2, the comparison of flow monitoring data with simulated flows upstream of Dover Street SPS (at FM LS010) showed discrepancies between the two data sets with simulated peak flows and average flows approximately 25% below the measured peak dry weather flows. It was noted that a large percentage (50%) of wastewater flows are made up of industrial users flows that can vary from month to month. Based on a review of water use records, the existing industrial wastewater flows in the baseline 2012 model were increased by 15.8 L/s for the modelling included in this report. Overall, with this change the model over-predicted the average day flow to the Preston WWTP when compared to the model outputs. This suggests the model can be considered somewhat conservative in terms of average day flow predictions to the treatment plant.

The increase in baseline flow from the industrial users closed the model prediction gaps for average flows, but simulated peak dry weather flows still remained approximately 10% lower than measured (i.e., baseline simulation of 80 L/s plus 15.8 L/s = 95.8 L/s compared to 106 L/s measured). For the sensitivity analysis, this difference was applied to peak wet weather flows for the entire collection system. Table 6 summarizes the results of the sensitivity analysis.

Table 6 Peak Flow Model Sensitivity

Model Scenario (Year)	Model Prediction	Adjusted Flow (1)	Preston WWTP Capacity	Collection System Capacity (2)
Critical Development (2041 - 2042)	381 L/s	419 L/s	498 L/s	531 L/s

Notes:
1. Model Prediction increased by 10%.
2. Capacity bottleneck at Fountain Street Node SM12349

Overall, the sensitivity analysis shows model predictions to remain within the peak flow capacity of both the Preston WWTP and the collection system. Furthermore, the peak flow model predictions can be as much as 30% low before affecting the peak flow capacity of the Preston WWTP and overall diversion timelines.

In summary, the sensitivity analysis shows no change to overall project timing, which is governed by the average day rated flow capacity of the Preston WWTP.

7. Conclusions

The provided growth scenario models from the 2012 AECOM study were based on significantly higher growth projections consistent with Places to Grow. The model was updated to reflect growth rates consistent with the Moderate Growth Scenario developed in consultation with the Region of Waterloo for the Wastewater Treatment Master Plan Update.

A review of the model calibration and available flow monitoring data along the Fountain Street trunk indicated a significant deviation between measured and simulated flow. However, a significant portion of the flow in the Fountain Street trunk sewer is related to existing industrial users. On further review, it was identified from water use records that industrial water use in the area is much higher than the baseline used in the 2012 AECOM model. Applying these adjusted industrial flows resulted in average flows very close to measured average flows in the Fountain Street Trunk Sewer.

The impact of diverting ESLs to the Preston WWTP was assessed based on both the wastewater treatment plant capacity and the collection system capacity. Key findings of the assessment included:

- The average day flow to the Preston WWTP governs servicing capacity for ESLs. Overall, Preston WWTP has sufficient average day rated capacity (16,860 m^3/d) to manage projected population growth together with the ESLs growth until approximately 2041.
- The peak flow capacity of the Preston WWTP (498 L/s or 43,000 m^3/d) exceeds the projected peak flow in 2041 of 381 L/s
- The capacity limiting node in the tributary collection system is Fountain Street Node SM12349 at a capacity of 531 L/s. Again, this exceeds the peak flow capacity of the Preston WWTP.

A sensitivity analysis to model predicted peak flows showed no impact to overall timelines, with the average day flow rated capacity at the Preston WWTP remaining the critical parameter.

Overall, the Preston WWTP and the existing collection system can handle the projected flows (average and peak) associated with planned growth and ESLs development until approximately 2041. Accordingly, a diversion to the Kitchener

WWTP must be constructed and commissioned ahead of this timeline to ensure the Preston WWTP continues to operate within the approved rated capacity. After the long-term servicing solution of conveying flows to the Kitchener WWTP has been constructed, the available capacity in the Fountain St trunk and at the Preston WWTP will be restored. It can be noted that if development of ESLs progresses faster than projected, the long-term servicing solution of conveying flows to the Kitchener WWTP would be implemented earlier. Flows to the WWTPs are reviewed annually as part of the Region's Water and Wastewater Monitoring Reports, and the Wastewater Treatment Master Plans are typically updated every 5 to 10 years to confirm recommendations and proposed timing.

In addition to monitoring average day flows to the Preston WWTP, CIMA would recommend monitoring sewer flows at a downstream trunk sewer location periodically, approximately every five (5) years, in similar locations as the previous installed FM LS010 to help further calibrate the model and accommodate:

- Uncertainty of population projections and actual growth
- Future fluctuation in water use of large industrial users on Fountain Street, which can impact sewer flows and infrastructure timing greatly

Should this model be used for detailed design tasks in the future, re-calibration is recommended first with a new set of flow data and a rain gauge location that is ideally within 2.5 km of the sewer network and can record rainfall in 5-minute timesteps.

Appendix A

Flow Comparison Between Hydraulic Model Predictions and Flow Survey Results

Appendix B

Rainfall Hydrographs – 1 in 5-year and 1 in 25-year Design Storms

Appendix C

Hydraulic Modelling Profiles from Fountain Street to Preston WWTP – Existing Scenario for 1 in 5-year and 1 in 25-year Design Storms

Appendix D

Hydraulic Modelling Profiles from Fountain Street to Preston WWTP – Future Growth Scenario 1 in 25-year design storm for critical development population (9710 population and 68ha I/I contributing catchment area)

Appendix E

Hydraulic Modelling Profiles from Fountain Street to Preston WWTP – Future Growth Scenario 1 in 25-year design storm for full built out development