Sewer Capacity Assessment Guidelines

TORONTO

For general comments or suggestions, please contact:

David Kellershohn
Manager, Strategic Policy and Planning
E-mail: David.Kellershohn@toronto.ca

Toronto Water
Water Infrastructure Management
55 John Street, 18th Floor
Toronto, ON M5V 3C6

All application-specific inquiries should be directed to the case review manager

City of Toronto – Sewer Capacity Assessment Guidelines

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Table of Contents

List of Tables

List of Tables

List of Figures

List of Figures

1.0 Introduction

Applicants for development or transit projects requesting sewer service connections for wastewater discharges to the City of Toronto's sewer systems are required to assess available sewer capacity in order to determine compliance with the *City of Toronto Act*.

1.1 Purpose

The purpose of the *Sewer Capacity Assessment Guidelines* is to provide a consistent approach for the assessment of capacity in the City's local sanitary and combined sewer systems that supports growth-related development and transit projects from a wastewater discharge perspective.

The guidelines are to supplement existing City requirements from the *Design Criteria for Sewers and Watermains* (2021) and *Terms of Reference – Servicing Report*.

1.2 Objectives

The guidelines aim to achieve the following objectives for the assessment of capacity in sanitary and combined sewers:

1 To establish guiding principles needed to define adequate sewer capacity based on the City's policy objectives and regulatory obligations.

2 To set capacity assessment criteria in order to satisfy the guiding principles.

3 To outline a capacity assessment process describing minimum expectations for analysis, data usage and assumptions, assessment evaluation and mitigation requirements.

1.3 Limitations

The guidelines are intended to achieve the City's policy objectives using best available information and practices for local sewer system capacity assessment.

The capacity assessment of pumping systems, trunk sewers and wastewater treatment plants are beyond the scope of this document.

The guidelines are not intended to provide prescribed methodology for hydraulic analysis and modelling, or substitute for professional engineering judgement or rationale.

Case-specific direction with respect to detailed engineering design, implementation and coordination of applicant-proposed mitigation measures are also beyond the scope of the guidelines.

2.0 Capacity Assessment

2.1 Guiding Principles

Adequate sewer capacity will be available in the City's sanitary and combined sewer systems when the following engineering guiding principles are satisfied:

1. Sewers function as intended for design flow conditions, by providing acceptable levels of service consistent with MECP *Design Guidelines for Sewage Works* (2008).

2. Sewers function under extreme Wet Weather Flow (WWF) conditions, by providing acceptable Hydraulic Grade Line (HGL) levels of service to support the objectives of the City's Basement Flooding Protection Program; and

3. Wet weather flow mitigation measures are prioritized to achieve the City's *Wet Weather Flow Master Plan* objectives for sewer systems:

    a) To provide Combined Sewer Overflow (CSO) control in combined sewers, consistent with MECP *Procedure F-5-5* (1997).

    b) To reduce Inflow & Infiltration (I&I) to sanitary and combined sewers; and

    c) To reduce basement flooding risk.

The sewer capacity assessment process and capacity criteria in subsequent sections of these guidelines are based on achieving the above engineering guiding principles.

2.1 Assessment Process

Figure 1 outlines the assessment process required to determine if adequate sewer capacity is available to accommodate wastewater discharges to the City's sanitary sewers.

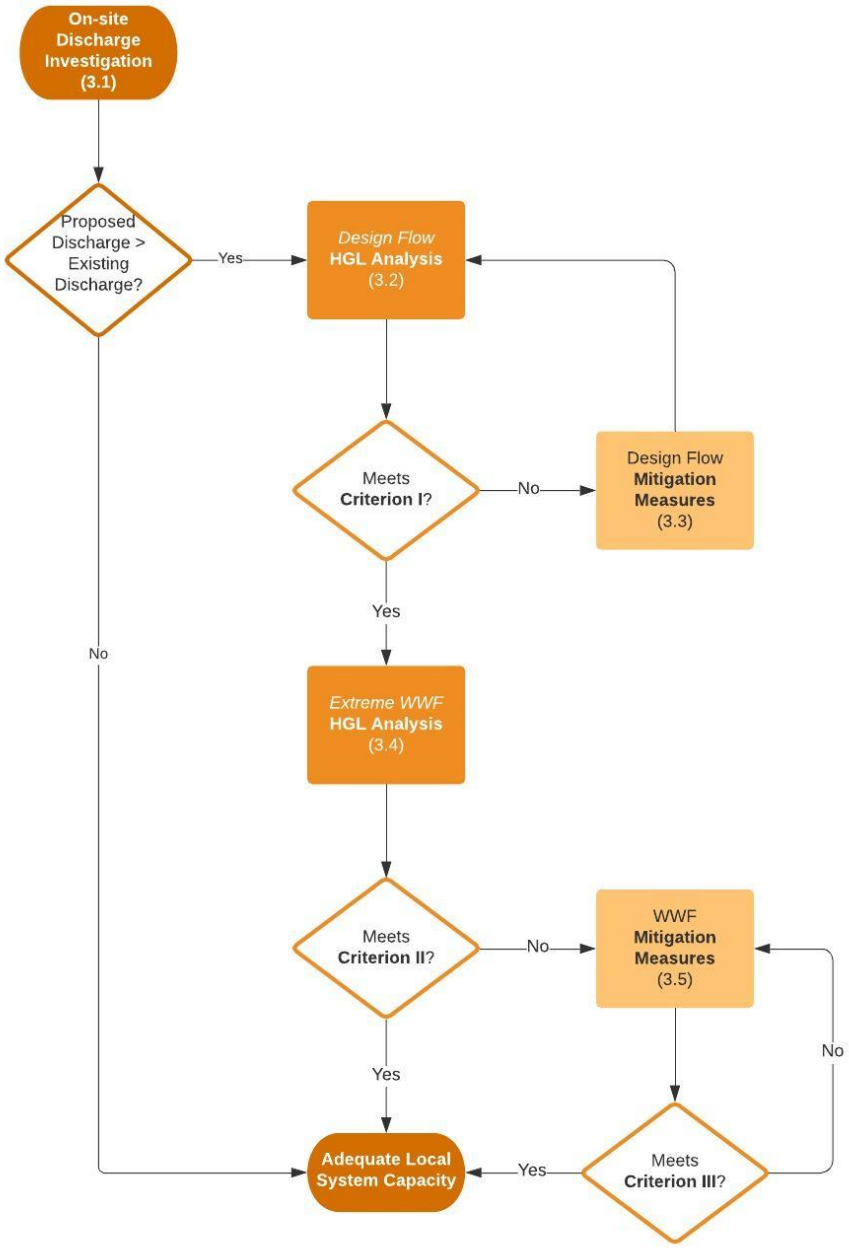

Figure 1: Capacity Assessment Process for Sanitary Sewers

Figure 2 outlines the assessment process required to determine if adequate sewer capacity is available to accommodate wastewater discharges to the City's combined sewers, including partially separated systems.

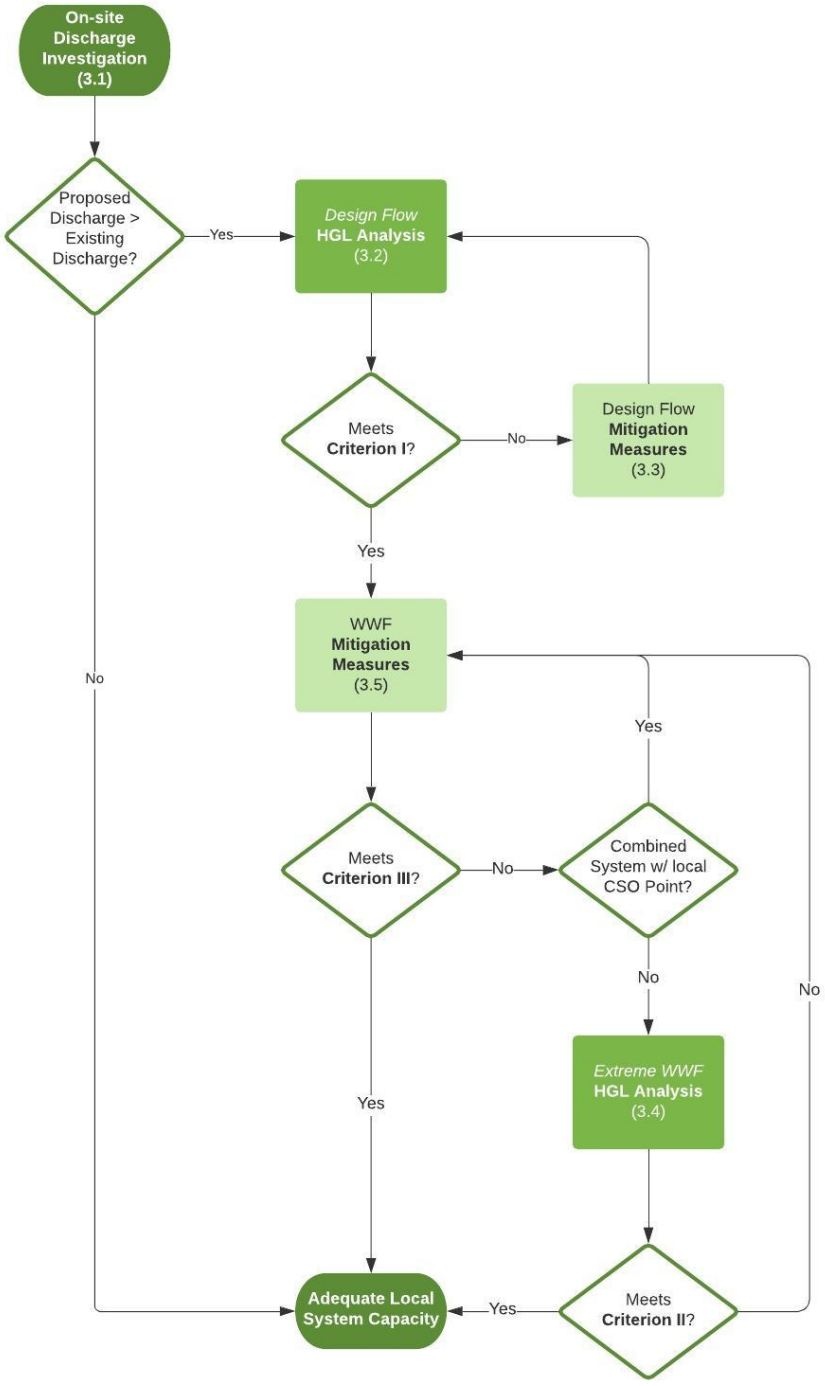

Figure 2: Capacity Assessment Process for Combined Sewers

2.2 Capacity Criteria

The capacity criteria in Table 1 shall be met to where new and additional discharges to the City's sanitary or combined sewer systems are proposed.

Table 1: Capacity Criteria for Sanitary and Combined Sewers

Criteria	Discharge to sewer system	
	Sanitary sewer	**Combined sewer**
Criterion 1 "*Design Function"*	Under proposed design flow[1] conditions, there will be no surcharge[2] in the sewer system.	Under proposed design flow conditions, plus contributing peak stormwater flows under the 2-yr design storm event, there shall be no surcharge in the sewer systems.
Criterion 2 *"Basement Flooding Protection"*	Under proposed extreme WWF[3] conditions, which includes I&I generated under the May 12, 2000 storm event[4], the HGL in the sewer will be at least 1.8 m below grade.	*[Not applicable if Criterion 3 is met]* Under proposed extreme WWF conditions, which includes I&I generated under the 100-yr design storm event, the HGL in the sewer will be at least 1.8 m below grade.
Criterion 3 *"WWF Mitigation"*	*[Not applicable if Criterion 2 is met]* Under proposed extreme WWF conditions, WWF mitigation measures[5] will ensure that the proposed HGL will be no higher than the existing HGL. The proposed peak flow rate will be no greater than existing peak flow rate at the connection to the trunk sewer or pumping station.	Under the 2-yr design storm event, off-site WWF and I&I mitigation measures[6] will offset two times the proposed increase from on-site discharges to the system. For systems containing CSO points for CSO control, ensure there will be no increase in peak overflow rate at the CSO point.

[1] Based on design sanitary sewage and design I&I allocation rate assumption.

[2] No surcharge deemed when HGL is below pipe obvert.

[3] Based on design sanitary sewage and estimated WWF I&I assumptions.

[4] Estimate equivalent 25-yr design storm, where no WWF I&I for May 12, 2000 event is available from BFPP studies.

[5] Includes WWF/I&I reduction, sewer upsizing and upgrades.

[6] Includes cross-connection/catchbasin disconnection, sewer separation and so on.

2.3 Criteria Exceptions

Where case-specific, localized capacity constraints are demonstrated to exist in sanitary sewer segments, exceptions to the Capacity Criteria in Table 1 may be considered.

1. Exception to Criterion 1 may apply under the following conditions:

    a) Sewers are flat, for example a syphon sewer; and

    b) No new sewer upsizing or upgrades can be feasibly designed and constructed.

2. Exception to Criterion 2 may apply to ensure the proposed HGL will be at least 0.3 m below grade (prevent causing surface spill or near spill condition) under the following conditions:

    a) Sewers have no service connections[7] to private properties; or sewers have service connections to private properties with no basements, or sump pumps; and

    b) Sewer segments are shallow due to existing grade restrictions, or are located within a valley, ravine or park.

3. Exception to Criterion 3 may apply to ensure the proposed HGL will be no higher than the existing HGL, under the following conditions:

    a) Existing HGL is less than 0.3 m below grade–causing surface spill or near spill condition; and

    b) Sewers have no service connections to private properties; or sewers have service connections to private properties with no basements or sump pumps; and

    c) Sewer segments are shallow due to existing grade restrictions, or are located within a valley, ravine or park.

[7] Verified by applicant via surveys, field testing and CCTV or both, as required.

3.0 Procedural Guidelines

The following sections describe procedural guidelines for the assessment process shown in Figure 1 and Figure 2.

3.1 Onsite Discharge Investigation

1. Investigate and determine all existing and proposed discharge components from the subject site at the point of discharge to the City's sewer system:

    a) For discharges to separate sanitary sewer systems, estimate design flow (see Table 2) to the sanitary sewer.

    b) For discharges to partially or fully combined sewer systems, estimate following discharges to the combined sewer system:

        i. Design Flow (see Table 2).

        ii. Peak stormwater flow discharged[8] under 2-yr design storm event, if applicable, where the discharge can be demonstrated[9] to occur from the subject site**.**

    c) Include estimates for foundation drainage, for example private water discharge, only where permission has been received to discharge foundation drainage.

2. Compare total existing (Qe) and proposed (Qp) on-site discharges of all flow components at the point of discharge to the City's sewer system:

    a) Where Qp <= Qe, adequate sewer capacity is available; no further analysis is required

    b) Where Qp > Qe, proceed to HGL Analysis Design – Flow section.

[8] Where no storm water management (SWM) quantity controls are provided, estimate uncontrolled peak stormwater flow; where SWM storage and outlet controls are provided, estimate controlled design peak outflow based on hydraulic routing.

[9] Verified by applicant via site surveys, field investigations, existing drainage patterns and so on.

3.2 HGL Analysis – Design Flow

1. Conduct HGL Analysis – Design Flow of the existing sewer system to determine HGL depth along sewer legs from the subject site to nearest trunk connection, pumping station or CSO point assuming the proposed development[10] scenario:

    a) For sanitary sewers, estimate and use Design Flows (see Table 2) from all contributing catchments.

    b) For combined sewers, estimate and use Design Flows (see Table 2), in addition to Peak Stormwater Flow discharged under 2-yr design storm event from all contributing drainage catchments.

    c) Include estimates for all additional contributions of foundation drainage, where permission has been received to discharge foundation drainage under design conditions.

    d) Use best available data for hydraulic analysis and/or modelling.

[10] Proposed development population to include all development pipeline estimates such as approved, active, and under review development applications, in addition to existing baseline population estimates.

Table 2: Design Flow Estimation Components and Assumptions

Flow component	Flows estimation assumptions
Sanitary sewage flows	• For residential/domestic land-use, assume 240 L/c/d for average wastewater flow generation to population assumptions for the proposed development[11] scenario; apply Harmon peaking factor for Peak Sanitary Sewage Flow. • For institutional/commercial/industrial (ICI) land-use, use best available data, as prioritized from a) Monitored water consumption data from last 3-yrs of data for existing ICI use; or b) Application-specific demand requirements for proposed ICI use; or c) Assumption of 250 L/c/d or 180,000 L/floor ha/day, where no other information is available.
Infilow & Infiltration (I&I)	Use design allocation of 0.26 l/s/ha.

[11] Proposed development population to include all development pipeline estimates such as approved, active, and under review development applications, in addition to existing baseline population estimates.

2. Determine whether Criterion 1 in Table 1 is met.

   a) Where Criterion 1 is met –

      i. For sanitary sewer systems, proceed to HGL Analysis – Extreme WWF section.

      ii. For combined sewer systems, proceed to WWF Mitigation Measures section.

   b) Where Criterion 1 is not met, proceed to Design Flow Mitigation Measures section.

3.3 Design Flow Mitigation Measures

1. Where Criterion 1 cannot be met, determine Design Flow Mitigation Measures, based on Table 3 and conduct HGL Analysis – Design Flow to ensure that the mitigation measures to be applied will achieve compliance with Criterion 1.

2. All mitigation measures are to be implemented by the applicant[12].

3. Where an upgrade to the City's sewers is proposed as a mitigation measure, the upgrade will accommodate sanitary sewage flows from proposed development population assumptions within the same sewershed, inclusive of all existing and development pipeline estimates, such as approved, active, and under review development applications.

4. Proposed upgrades will also assess, and recommend any additional upsizing needs to accommodate future land-use population assumptions based on EA study assumptions for Planning Horizon Projection, Secondary Plan/Community Planning Estimates, and Proposed Development scenario, whichever is greater.

[12] Where measures coincide with projects in City's capital plan, implementation coordination opportunities may be explored explored on a case-by-case basis, subject to capital project status and completion timelines.

Table 3: Design Flow Mitigation Measures

Sewer system	Design flow mitigation measure	Minimum design consideration
Sanitary sewers	• New sanitary sewers • Sanitary sewer upgrade or upsizing	• Assume residential wastewater generation of 450 L/c/d[13] applied to future land-use[14] population from all contributing catchments within sewershed. • Size new sewers for full capacity equating to 80% of pipe capacity. • See Design Criteria for Sewers and Watermains manual for additional guidance. • Mitigation measure will not be accepted to accommodate new and additional foundation drainage discharge.
Combined sewers	Sewer separation – new sanitary and/or storm sewers	• Assume residential wastewater generation of 450 L/c/d applied to future land-use population from all contributing catchments within sewershed. • For new storm sewers, assume 2-yr design storm for sizing and confirm adequate receiving storm sewer system capacity. • Size new sewers for full capacity equating to 80% of pipe capacity. • See Design Criteria for Sewers and Watermains manual for additional guidance.

[13] Conservatively accounts for safety factor in future growth assumptions to ensure sewer longevity.

[14] Future land-Use population to be based on EA study assumptions for Planning Horizon Projection, Secondary Plan/Community Planning Estimates, and Proposed Development scenario, whichever is greater.

3.4 HGL Analysis – Extreme WWF

1. For all sanitary sewer systems, and combined sewer systems with no CSO points where Criterion 3 cannot be met, conduct HGL Analysis (Extreme WWF), to determine HGL depth along sewer legs from the subject site to nearest trunk connection, pumping station, or CSO point for the proposed development[15] scenario:

    a) For sanitary sewers, use Sanitary Sewage Flows, in addition to the estimated I&I generated under May 12, 2000 storm event (see Table 4) from all contributing catchments.

    b) For combined sewers, use Sanitary Sewage Flows, in addition to estimated WWF including I&I generated under 100-yr storm event (see Table 4) from all contributing catchments.

    c) Include proposed estimates for additional contributions of foundation drainage, in cases where permission has been received to discharge foundation drainage under extreme WWF.

    d) Use best available data for hydraulic modelling.

[15] Proposed development population to include all development pipeline estimates such as approved, active, and under review development applications, in addition to existing baseline population estimates.

Table 4: Flow Estimation under WWF conditions

Flow component	Extreme WWF
Sanitary sewage flows	• For residential/domestic land-use, assume 240 L/c/d for average wastewater flow generation to population assumptions for the proposed development scenario; apply Harmon peaking factor for Peak Sanitary Sewage flows. • For ICI land-use, use best available data, as prioritized from – a) Monitored water consumption data from last 3-yrs of data for existing ICI use; or b) Application-specific demand requirements for proposed ICI use: or c) Assumption of 250 L/c/d or 180,000 L/floor ha/day, where no other information is available.
Inflow & Infiltration (I&I)	• Where completed BFPP EA study is available, use: o calibrated I&I rate generated under May 12, 2000 storm event for sanitary sewers; or o calibrated WWF including I&I generated under 100-yr design storm event for combined sewers. • Where no completed BFPP EA study is available, see Appendix A, *Flow Monitoring and I&I Estimation Protoco*l and use: o estimated I&I rate under 25-yr design storm event for sanitary sewers; or o estimated WWF including I&I under 100-yr design storm event for combined sewers.

2. Determine whether Criterion 2 in Table 1 is met.

   a) Where Criterion 2 is met, adequate sewer capacity is available

   b) Where Criterion 2 is not met, proceed to Criterion 3 WWF Mitigation Measures.

3.5 WWF Mitigation Measures

1. Determine and design WWF Mitigation Measures to meet Capacity Criteria, based on the hierarchy in Table 5.

2. All mitigation measures are to be implemented by the applicant[16].

3. Where an upgrade to the City's sewers is proposed as a mitigation measure, the upgrade will accommodate sanitary sewage flows from proposed development population assumptions within the same sewershed, inclusive of all existing and development pipeline estimates, such as approved, active, and under review development applications.

4. Proposed upgrades will also assess, and recommend any additional upsizing needs to accommodate future land-use population assumptions based on EA study assumptions for Planning Horizon Projection, Secondary Plan/Community Planning Estimates, and Proposed Development scenario, whichever is greater.

5. Determine whether Criterion 3 in Table 1 is met:

    a) Where Criterion 3 is met, adequate sewer capacity is available

    b) Where Criterion 3 is not met, the project cannot proceed until appropriate WWF Mitigation Measures are proposed for implementation.

[16] Where measures coincide with projects in City's capital plan, implementation coordination opportunities may be explored on a case-by-case basis, subject to capital project status and completion timelines.

Table 5: WWF Mitigation Measures

WWF mitigation measure	Minimum design considerations
Priority #1 – Permanent off-site WWF reduction measure within impacted sewershed: a) Cross-Connection Disconnection b) Catchbasin Disconnection c) Maintenance Hole Lid Replacement[17] d) Sewer Separation e) Foundation Drain Disconnection[18]	• For measures in a combined sewer area, demonstrate 2 times WWF offset can be feasibly achieved under 2-yr design storm event. • For measures in sanitary sewer system, demonstrate 2-times I&I offset can be feasibly achieved under extreme WWF conditions, see Table 4. • For measures diverting increased stormwater flows to storm sewers, confirm adequate receiving storm sewer conveyance capacity.
Priority #2 – BFPP Projects, for example sewer upsizing or upgrades in Capital Plan or recommended by completed BFPP studies or modifications thereof.	• Follow BFPP study assumptions for wastewater generation rate applied to future land-use[19] population for all contributing catchments within sewershed; • Conduct hydraulic modelling using extreme WWF I&I rate, see Table 4. • Mitigation measure will not be accepted to accommodate new and additional foundation drainage discharge.
Priority #3 – Applicant-proposed sewer improvement projects, for example upsizing and in-line storage.	• Follow BFPP study assumptions for wastewater generation rate applied to future land-use population for all contributing catchments within sewershed; • Conduct hydraulic modelling using extreme WWF I&I rate, see Table 4. • Mitigation measure will not be accepted to accommodate new and additional foundation drainage discharge.

[17] Subject to operational approval.

[18] Resulting from existing building/structure removal.

[19] Future Land-Use population to be based on EA study assumptions for Planning Horizon Projection, Secondary Plan/Community Planning Estimates, and Proposed Development scenario, whichever is greater.

Appendix A – Protocol for Flow Monitoring and I&I Estimation

The purpose of this protocol is to provide applicants and their consultants a minimum basis[20] for conducting flow monitoring and estimating extreme WWF Inflow & Infiltration (I&I) rates used in sewer capacity assessment for existing sewer systems.

This protocol may apply to development or transit project applications requiring WWF hydraulic analysis, when no completed BFPP EA studies[21] with hydraulic model calibrated WWF I&I rates are available for the impacted sewershed.

A.1 Minimum Flow Monitoring Requirements

1. Where insufficient data is available from City-conducted flow monitoring program within impacted sewershed to estimate extreme WWF I&I rates, applicants may conduct a sewershed-specific flow monitoring program.

2. Provide rationale and recommend for at least one rain gauge location and three flow monitoring locations[22] within sewer network, for example downstream of site, near connections from sub-sewersheds, near connection to trunk on a sewer network plan to capture I&I variations due to sewershed characteristics, that is to say catchment area, land-use, population density and so on:

    a) Conduct monitoring at 5-min intervals for a minimum 3-month period, between April 1st and October 31st to ensure highest likelihood of capture of rainfall and storm events.

    b) Extend[23] monitoring period until the capture of at least two rainfall events equal to or exceeding 20 mm of rainfall depth over a duration of 24 hours or less.

3. Submit Flow Monitoring Plan for review and approval by City prior to execution of plan, prepared by a professional engineer responsible for the preparation of the Servicing Report.

4. Secure all necessary City permits, remove equipment/instrumentation in a timely manner, and restore infrastructure to existing conditions or better.

5. Applicant to ensure monitoring and data collection is conducted by qualified person(s) with necessary training and certification in a reliable, accurate and repeatable manner through provisions for intrinsically-safe equipment/ instrumentation, adequate installation, calibration/validation, QA/QC and so on.

A.2 Extreme WWF I&I Estimation

1. Applicant to review and analyze all flow monitoring data (including City-owned data, where available) to determine maximum, minimum and average Dry Weather Flows[24] (DWF) and groundwater infiltration[25] (GWI) and provide supporting graphs, calculations and summary tables.

2. Analyze flow data to determine observed peak Wet Weather Flows[26] (WWF), peak instantaneous I&I and provide supporting graphs, calculations and summary tables.

3. For each rainfall event recorded within a 24 hr duration, plot observed total rainfall depth [in mm] against the observed peak instantaneous I&I flow [in L/s] on a scatter plot.

4. Conduct linear regression to estimate line of best fit trendline from observed scatter plot data and extrapolate to projected Extreme WWF I&I rate for:

    a) 25-yr[27] design storm rainfall depth of 85 mm over 24 hours for sanitary sewers (see Figure A.1)

    b) 100-yr design storm rainfall depth of 112 mm over 24 hours for combined sewers

5. Develop Extreme WWF I&I input hydrograph at monitoring location required for hydraulic modelling and calibration used in sewer capacity assessment by applying the projected Extreme WWF I&I rate as a multiplier to a:

    a) Normalized May 12, 2000 storm event hydrograph pattern for sanitary sewers (see Figure A.2).

b) Normalized 100-yr design storm event (6-hr Chicago distribution) hydrograph pattern for combined sewers.

6. Submit I&I Estimation Report prepared by a professional engineer based on QA/QC of collected flow and rainfall data. Comment on appropriateness of selected I&I rate using sensitivity analysis, where necessary.

[20] Subject to best available information and City's capital planning practices at the time.

[21] EA study status available on Basement Flooding Protection Program Map.

[22] Ensure monitoring plan will not impact or be impacted by planned capital projects.

[23] May require additional monitoring into following calendar year.

[24] All flow in a sewer except that caused directly by rainfall. Typically measured during a period of extended dry weather (7 to 14 days) and seasonally high groundwater.

[25] Measured during low off-peak/night-time flows (midnight to 6 am) per day for the DWF analysis period, minus significant industrial or commercial nighttime flows.

[26] Highest flow during and immediately after a rainfall/storm event. Includes sanitary sewage flows and I&I.

[27] Representative return period for May 12, 2000 storm.

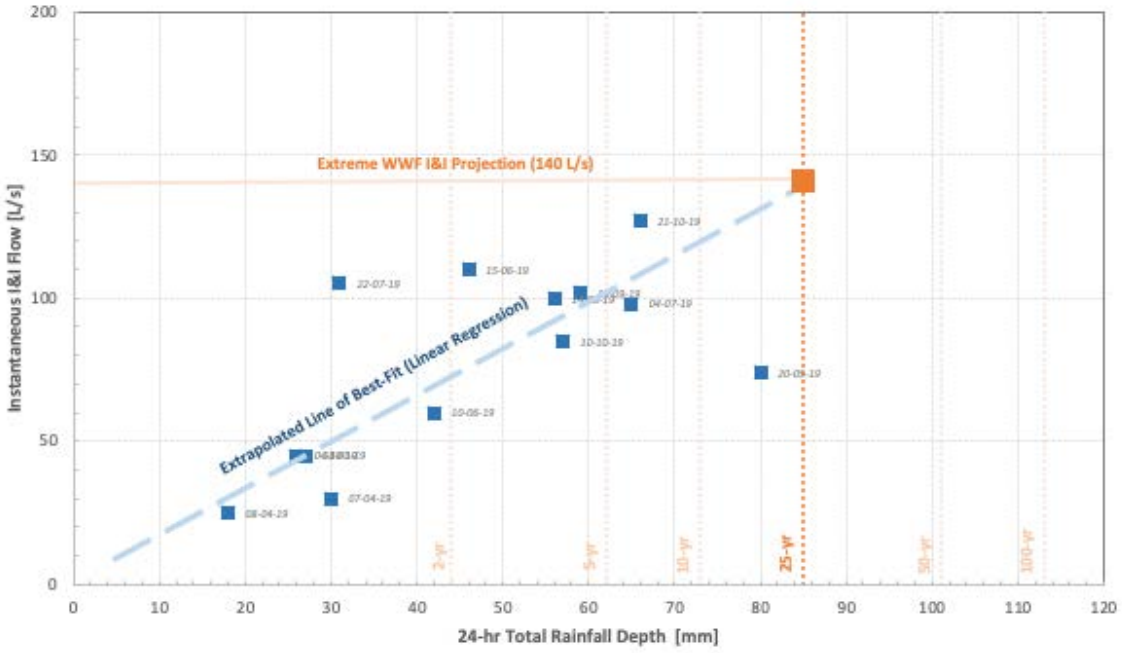

Figure A.1 – Projection of extreme WWF I&I from flow monitoring data

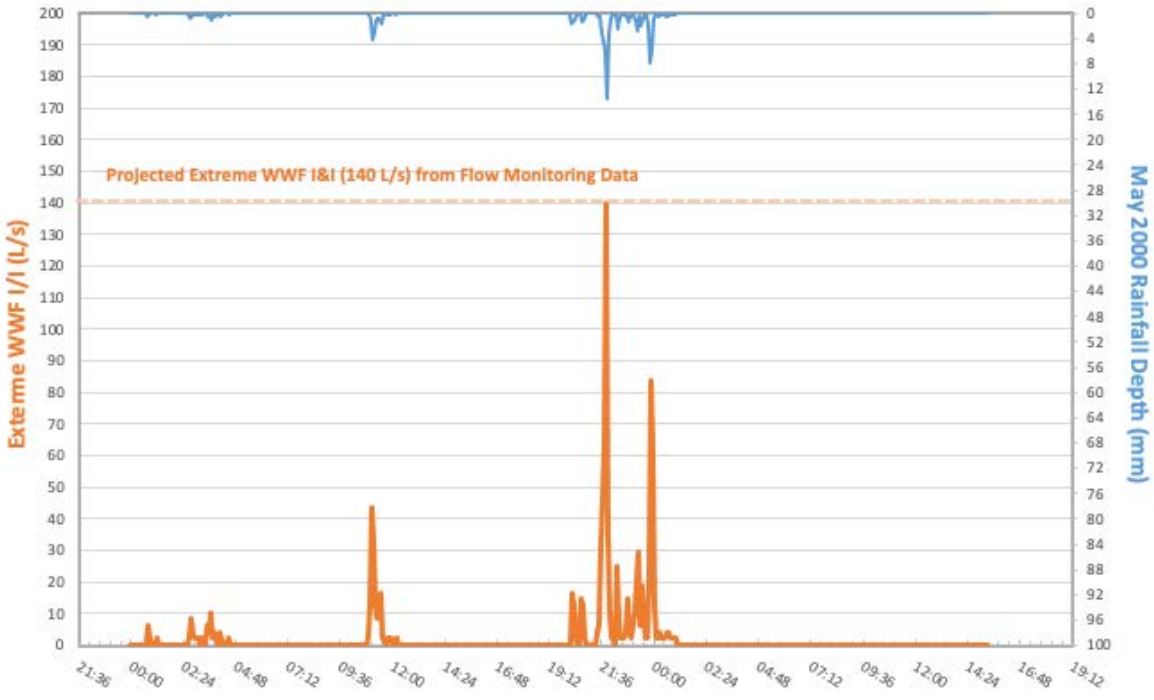

Figure A.2 – Estimation of extreme WWF I&I pattern based on May 12, 2000 storm event