City of Winnipeg
CSO Annual Report Background

Environment Act Licence No. 3042
Clause 13

Document History and Status

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Acronyms and Abbreviations

AACE	American Association of Cost Engineers International
CEC	Clean Environment Commission
City	City of Winnipeg
CS	combined sewer
CSO	combined sewer overflow
DEP	district engineering plan
EA	Environment Act Licence
EMC	event mean concentrations
GI	green infrastructure
NEWPCC	North End Sewage Treatment Plant
NPRI	National Pollutant Release Inventory
O&M	operations and maintenance
PLUM	Planning and Land Use Model
PWWF	peak wet weather flow
P2	Pollution Prevention
RTC	real-time control
SOIS	Sewer Overflow Information System
SRS	storm relief sewer
TP	total phosphorus
TN	total nitrogen
WSER	Wastewater Systems Effluent Regulations

1. Purpose

The operation of the City of Winnipeg's (the City's) combined sewer system is governed by Environment Act (EA) Licence No. 3042. To comply with Clause 13 of EA No. 3042, the City is required to submit annual reports documenting Combined Sewer Overflow (CSO) Master Plan implementation progress and work planned for the subsequent year by March 31 of each year (referred to throughout this document as the "annual report").

The CSO Background Information document provides an overview of the key considerations and historic reported changes of the *CSO Master Plan*. The information within this document is specific to the background information regarding the CSO annual reports. For details about the changes and updates that have occurred for a particular year, refer to the corresponding year's annual report.

2. Combined Sewer Overflows

Combined sewer systems are sewers that are designed to collect both land drainage (rainwater and snowmelt) and wastewater (sewage from homes and businesses) in the same pipe. Most of the time, combined sewer systems transport all of the land drainage and wastewater to a sewage treatment plant, where it is treated and then discharged to the river. However, during periods of heavy rainfall or snowmelt, the additional volume in combined sewer systems can exceed the capacity of the sewer system. During these occasions, combined sewer systems are designed to overflow and discharge excess volumes directly to the river without reaching the sewage treatment plant. These overflows, called combined sewer overflows (CSOs), contain not only land drainage, but also wastewater and debris.

Historically, combined sewers discharged directly to rivers. In the 1930s, diversion weirs were put in place to divert flows to the North End Sewage Treatment Plant (NEWPCC). The outfalls were retained to offer a level of protection against large wet weather events that could overload the system and result in basement flooding.

Combined sewers carry all the wastewater flow to the sewage treatment plants during dry weather conditions. During periods of heavy rainfall or snowmelt, there is the potential for basement flooding due to high volumes of land drainage entering the sewer system. CSOs protect basements from flooding by relieving excess flow to the river.

About a third of the City's sewer system contains combined sewers. Typically, these were built before the 1960s and serve older areas of the city. Every time there is a CSO, there is a temporary discharge to the river of bacteria, floating debris, and organic material (nutrients). By reducing CSOs, we can do our part to help protect the health of our rivers and lakes.

3. Regulations

Combined sewers are regulated by federal and provincial requirements. On an annual basis, the City submits CSO discharge data to the National Pollutant Release Inventory (NPRI), Wastewater Systems Effluent Regulation (WSER) and the Province of Manitoba (the Province) to comply with both the federal and provincial regulations.

In 1999, the Federal Government required reporting on estimated sewage lost from the sewer network under the Canadian Environmental Protection Act, as part of the NPRI.

In 2012, the Federal Government under WSER mandated the City to keep CSO records from 2013 and provide annual CSO Reporting by February 15 of the subsequent year.

In 2013, the Province issued the first Combined Sewer Overflow Licence to the City of Winnipeg, EA Licence No. 3042. It contained 16 clauses requiring public education, CSO reporting, interim water quality sampling and analysis, public notification and the development of a *CSO Master Plan*. The City of Winnipeg's responses to date concerning each of regulatory requirements contained within EA Licence No. 3042 are listed below:

- The Public Education Plan was submitted to the Province in December 2013. This plan outlined a high-level schedule for public engagement activities to comply with Clause 9. The Province requested bi-annual report updates; this requirement was completed with the last report dated June 2019.
- The Combined Sewer Overflow Notification Plan was submitted to the Province in April 2014. This plan outlined the significant event, quarterly CSO reporting, and annual CSO reporting processes to comply with Clause 14.
- The Interim Water Quality Monitoring Plan was submitted to the Province in January 2014. This plan outlined the plans to comply with Clause 15 which concluded with the analysis of the samples collected documented in the submission of the December 2015 *CSO Preliminary Proposal* submission.
- The *CSO Public Notification System Plan* was submitted to the Province in December 2015. This plan outlined a new notification system to inform the public in the event of an overflow to comply with Clause 10.

- The *CSO Master Plan* was submitted to the Province on August 28, 2019 (see Section 4) and was subsequently approved by the Province on November 13, 2019. This triggered Clause 13 of EA No. 3042, which requires the City to submit an annual report documenting the CSO monitoring progress and results of the preceding year, along with a work plan for the subsequent year by March 31 of each year. Clause 13 specifically states:

The Licencee shall, upon approval of the Master Plan submitted pursuant to Clause 11 of this Licence, implement the plan such that progress towards meeting the required level of treatment is demonstrated annually by submission of an annual report, due March 31 of each year for the preceding calendar year. Annual submissions shall include the progress made on the plan pursuant to Clause 11 including monitoring results and the work plan for the subsequent calendar year.

The Provincial approval letter dated November 13, 2019 contained the following additional requirements:

a) The Licencee shall submit for approval an outline of the content of the annual report as required by Clause 13 of the Licence by December 31, 2019;

b) The Licencee shall, prior to submission of the annual report, submit a monitoring plan for approval;

c) The Licencee shall include in the annual report the monitoring report, the proposed planning for the year ahead, and the milestones achieved;

d) The Licencee shall, from the date of issue of this Letter, collect CSO water samples and model river quality data every 5 years to demonstrate improvements in the river water quality due to implementation of Control Option No. 1. The next river water quality report is due December 31, 2024;

e) The Licencee shall carry out an assessment of the impact of climate change to the performance of the CSO program and shall include the assessment report along with the CSO Master Plan for Control Option No. 2 which is due April 30, 2030; and

f) The Licencee shall, on or before April 30, 2025, submit for approval a report demonstrating that the percent capture performance measure, an alternative to Control Option No. 2 as proposed in the CSO Master Plan dated August 28, 2019,

will provide equivalent water quality protection to Control Option No. 2 (i.e., four overflows in a representative year).

The City met with the Province to discuss the proposed outline for the *CSO Master Plan* annual reports on December 16, 2019. A proposed outline was submitted on December prior to the December 31 deadline.

On July 8, 2021, the Province requested that the estimated increase and decrease in CSO volume as a result of small-scale developments and infrastructure developments on the overall combined sewer system be documented in the annual report. Refer to section 5.5 for further information.

The regulation changes in 2023 included the removal of the requirement to submit significant rainfall event notifications, as per a Provincial letter received January 13, 2023. As such, references to Significant Rainfall Event Notifications have been removed from the annual report.

On May 2, 2025, the Province issued a Letter of Clarification for condition f) of the Master Plan approval letter. The letter granted an extended deadline of April 30, 2026 for the submission of the *Percent Capture Assessment* Report for Control Option No. 2.

4. CSO Master Plan History

Prior to the Federal and Provincial regulations summarized in Section 3, the City made major investments in wastewater treatment upgrades and focused on the combined sewer approach to eliminate dry weather overflows and protect the river water quality within Winnipeg. Projects that the City has invested in to relieve CSOs and protect basement flooding prior to the Federal and Provincial licensing requirements include:

- In 1937, diversion weirs and interceptor sewer system were put in place to divert combined sewer flows to the North End Sewage Treatment Plant (NEWPCC).
- Since the 1960s, municipal regulations were in place to ensure that no new property developments were permitted to be serviced by combined sewers. All new developments must be serviced by a separated sewer system.
- The City also focused on completing infrastructure upgrades to eliminate CSOs to the river and reduce risks of basement flooding, such as sewer separation works, sustainable drainage systems, latent storage dewatering stations, and outfall chamber upgrades.

After the proclamation of the Environment Act on March 31, 1988, the Province of Manitoba requested the Clean Environment Commission (CEC) hold hearings on protecting Winnipeg's rivers and waterways. In 1992, the hearings concluded with recommendations to the City that a CSO study be commissioned. The CSO Management Strategy study was completed in 2002 and the final report was presented at the CEC public hearings completed in response to a raw sewage spill which occurred at NEWPCC in 2003. The 2002 CSO study documented the water quality impacts of combined sewers and formulated remedial measures for CSO control.

Following the 2003 CEC hearings, the CEC provided a report with advice and recommendations in August 2003. It was recommended in this report that the required funding to address CSOs in Winnipeg should be shared by the Federal and Provincial Governments in addition to the City. It was recommended the City be directed to complete the CSO work within the next 25 years, monitor CSOs and implement a public notification system. An excerpt from this 2003 CEC report is shown below:

The City of Winnipeg should be directed to shorten the timeframe to complete its combined sewer overflow plan from the proposed 50 years to a 20 to 25-year period.

The City of Winnipeg should be directed to take immediate action to reduce combined sewer overflows by instrumenting outfalls, adjusting weirs, accelerating combined sewer replacement, advancing the pilot retention project and undertaking other reasonable measures to reduce combined sewer overflows within two years.

Based on the CEC recommendations, the Province issued EA No. 3042 on September 4, 2013, mandating the development of the City's Combined Sewer Overflow Master Plan.

In response to the Clause 11 Licence requirements, the *CSO Master Plan Preliminary Proposal* was completed on December 18, 2015, recommending an 85% CSO volume capture long-term control target. This proposal included plans, costs, evaluation criteria, and recommendations for five different targets to address CSOs. These targets are known as Control Options, and each of the five Control Options studied are listed below:

- Control Option 1: 85 Percent Capture in a Representative Year
- Control Option 2: (district average of) Four Overflows in a Representative Year
- Control Option 3: Zero Overflows in a Representative Year
- Control Option 4: No More than (a total of) Four Overflows per Year
- Control Option 5: Complete Sewer Separation

The Province responded to the City on November 24, 2017 with approval of the *CSO Master Plan Preliminary Proposal*. The letter specifically directed the City to:

- *Submit a Master Plan including detailed engineering plans, proposed monitoring plans, and an implementation schedule for Control Option No. 1 as identified in your CSO Master Plan Preliminary Proposal on or before August 31, 2019 and for Control Option No. 2 as identified in your CSO Master Plan Preliminary Proposal on or before April 30, 2030, and*

- *Implement the CSO Master Plan for Control Option No. 1 by December 31, 2045, unless otherwise approved by the Director.*

On August 28, 2019, the City submitted the *CSO Master Plan*. The Master Plan included the District Engineering Plans (DEPs), proposed monitoring plans, and an

implementation schedule for Control Option No. 1 with potential migration to Control Option No. 2.

Upon receipt of the *CSO Master Plan* submission, the Province responded to the City with the following requests on November 13, 2019:

- Part 1: complete an outline of the content of the annual report as required by Clause 13 of the Licence by December 31, 2019,
- Part 2: complete a monitoring plan for approval prior to the submission of the annual report, which will include the monitoring report, the proposed planning for the year ahead, and the milestones achieved.
- Part 3: complete a water quality assessment once every 5 years to demonstrate improvements in the river water quality as a result of implementation of Control Option No. 1. The next report is due December 31, 2029.
- Part 4: complete an assessment of the impact of climate change to the performance of the CSO program and an assessment report with the *CSO Master Plan* for Control Option No. 2, which is to be submitted by April 30, 2030,
- Part 5: complete a report demonstrating that the percent capture performance measure complies with Control Option No. 2, by April 30, 2025, and
- Part 6: implement *CSO Master Plan* for Control Option No. 1 by December 31, 2045.

On May 2, 2025, the Province issued a Letter of Clarification for condition f) of the Master Plan approval letter. The letter granted an extended deadline of April 30, 2026 for the submission of the *Percent Capture Assessment* Report for Control Option No. 2.

The overview of the *CSO Master Plan* development timeline is illustrated in Figure 1. The *CSO Master Plan* began its implementation phase upon the receipt of the Provincial approval letter in November 2019.

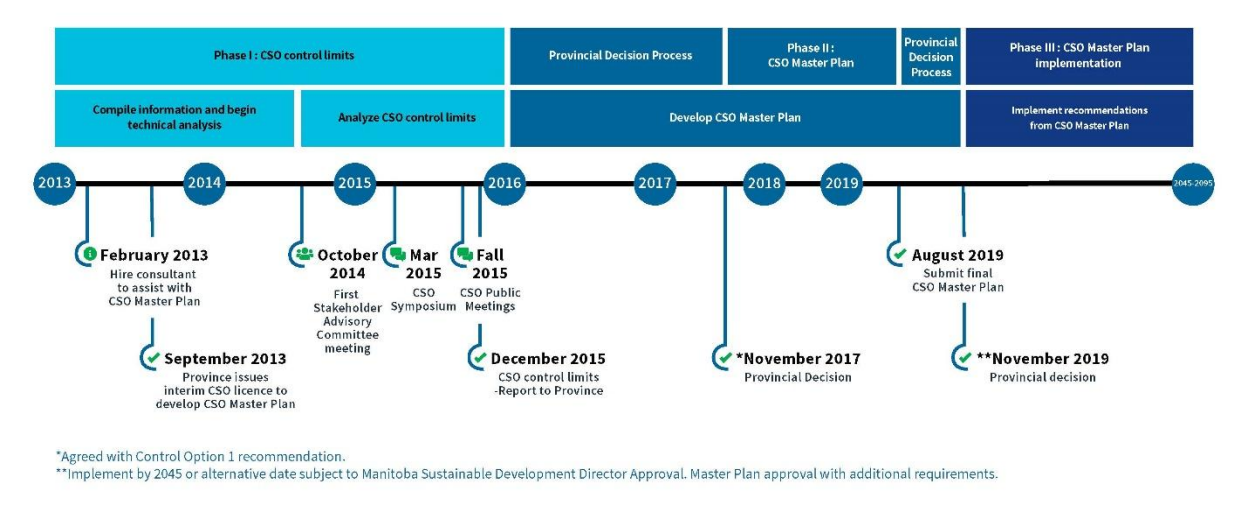

Figure 1 - CSO Master Plan Development Timeline

5. Master Plan Key Components

The following subsections identify the major considerations in the design of the *CSO Master Plan* to meet the requirements of EA No. 3042. These considerations will shape the reporting process for implementation of the *CSO Master Plan*.

5.1. Hydraulic Modelling

Monitoring instrumentation and analysis tools were crucial components to the development of the proposed solutions for the *CSO Master Plan*. At the beginning of the federally mandated CSO reporting period in 2002, no permanent CSO outfall instrumentation was in place. The estimation of percent sewage volume lost from CSOs was solely based on analytical assumptions up until 2012. With the recommendation from the CEC in 2003, the City invested in CSO event monitoring and volume calculation tools to improve the confidence intervals of CSO estimations. The CSO Monitoring Program commenced in 2009 and by 2013, CSO instruments were successfully installed at 25 locations. Using the available data from the 25 monitored locations, the model estimates of wastewater flows from CSOs were validated.

Due to the difficulties of installing and maintaining instruments in harsh conditions with no local power source, detailed modeling of the combined sewer networks was undertaken to estimate the performance of the remaining combined sewer

outfalls. An advanced hydraulic and hydrological model was built to represent the existing wastewater collections system. In 2014, the model was calibrated based on temporary instruments at five locations.

This model was further developed as more monitoring data became available. In 2015, the *CSO Master Plan* Regional Model was completed, which represented each of the CSO districts and outfalls. By 2015, CSO instruments were successfully installed at 14 additional combined sewer outfalls, bringing the total number of outfalls being monitored to 39. The model was then utilized to produce annual CSO results estimation with validation at the 39 permanent CSO instrumented locations.

In 2017, the City created a CSO overflow validation tool to identify and track differences between the model estimates and the observed instrumented overflows. This information was used to identify instrument maintenance, model maintenance, and areas for operational improvement.

In 2019, the City upgraded the hydraulic model from sewer systems to an integrated catchment modelling platform software to utilize the hydraulic software's latest and advanced features. Changes and impacts resulting from the software conversion process were documented.

In 2020 and 2021, CSO instruments were installed in three additional outfall locations each year. In 2022, one additional outfall location was monitored. The permanent CSO instrumented locations increased from 39 to 46 locations of the total 76 CSO outfalls.

5.2. Design Basis

The Preliminary Proposal recommended the Control Option No.1: 85 percent capture in a representative year. This option was the highest ranked of the control options considered in the study and was later approved by the Province in 2017.

5.3. Representative Year

The *CSO Master Plan* adopted the year 1992 as the representative year for annual rainfall intensities and river levels. Based on a detailed review of 53 years of historic rainfall records at the Winnipeg International Airport, it was determined

that the year 1992 would be a suitable rainfall year to be representative of typical conditions with respect to accumulated rainfall (i.e. mm per event), number of annual events, and total annual precipitation characteristics.

Similar evaluations of the historic river level records were completed and determined that the year 1992 could also be a suitable representative of typical river level conditions in Winnipeg. As such, the 1992 river level trends and rainfall intensities were used in sophisticated numerical modeling to estimate the volume and frequency of CSO events during the recreation season (May through September, inclusive). It was agreed with the Province as part of the *CSO Master Plan Preliminary Proposal* development that the year 1992 would form the representative year and would be utilized for planning and evaluation of current and future CSO performance.

5.4. Baseline Conditions

The *CSO Master Plan* was developed with the 2013 year as the baseline year. The Preliminary Proposal, existing hydraulic models, and other CSO related relevant reports were developed based on this baseline condition.

To ensure a common basis for control system sizing and regulatory compliance that is not affected by the annual variations in precipitation and river levels, the *CSO Master Plan* adapts the 2013 hydraulic model with the 1992 Representative Year precipitation and river levels as the baseline condition for planning and evaluation of control options.

5.5. Planning Projections

The Master Plan accounts for population growth in the design process. Clause 8 of EA No. 3042 requires no increase in frequency or volume of CSO in the existing system due to new and upgraded land development. Increases in wastewater from growth in population located within a combined sewer district is generally required to be offset with reductions in runoff area.

To demonstrate compliance with the licensing requirements, the City regulates the development process by requiring that the post development peak wet weather flows (PWWF) in the combined sewer districts are equal to or less than the pre-development PWWF. As the City continues to regulate the development

process and prohibit the use of combined sewers in new developments, it was anticipated that there would be no impact in the combined sewer systems from new development. The *CSO Master Plan* projections account for an unmitigated increase in sewage flow only in the separate sewer areas.

In 2020, the City started to use the *CSO Master Plan* to meet Clause 8 for small developments (e.g. single family and two-family) by removing additional flows in the combined sewer areas. Strategic CSO mitigation projects from the *CSO Master Plan* will be used to offset any additional flows that may come from small-scale developments. This approach aligns with the goals of *OurWinnipeg* and the *Complete Communities Direction Strategy* by enabling population growth in the intensification target area without costly on-site land drainage management.

The 1 m^3 average runoff value was based on a review of small-scale development approvals. Three development scenarios were reviewed: a single-family dwelling (SFD) developing into two duplexes; a SFD going to two SFDs; and a SFD going to two SFDs with secondary suites. For a 5-year design event, the increase in runoff volume for these design scenarios averages to 1 m^3, see Appendix A.

The annual report documents the estimated increase in volume of CSOs caused by small-scale developments and the estimated decrease in volume as a result of infrastructure development on the overall combined sewer system on an annual basis. This aligns with the requirements detailed in the Provincial letters from July 8, 2021, June 7, 2022 and August 1, 2023.

5.6. CSO Control Technologies

Clause 8 of EA No. 3042 requires the use of green technology and innovative practices in the design and operation of all new and upgraded storm and wastewater infrastructure. Both green and grey infrastructure are considered in the *CSO Master Plan* design. Green infrastructure (GI) refers to the use of natural hydrologic processes to reduce, store, or attenuate surface runoff from entering the combined or land drainage sewer systems. Many of the GI projects also improve the water quality of the surface runoff received. Grey infrastructure refers to the conventional infrastructure projects to address sewer system incapacity, such as pipes and storage tanks.

The control technology selection for each of the combined sewer districts was developed through a two-step approach and selection process. The first step of the review included an evaluation of the applicability of sewer control option for the district. This evaluation was based on a number of criteria, including compatibility with existing sewer infrastructure, proximity to the primary CSO outfall/interceptor sewers, and estimated hydraulic performance. The initial solution configurations were implemented within the model based on system hydraulics. Locations were verified with the City's GIS database with respect to constructability and feasibility.

The second step of the process included the refinement of the initial control option selection to achieve the 85 percent capture target in the most cost-effective manner. These refinements included:

- A review and further evaluation of sewer districts with screening operational challenges
- Incorporation of additional complete or partial sewer separation where cost-effective
- The addition of sewer system control and/or Combined Sewer-Storm Relief Sewer (CS-SRS) interconnection adjustments to accommodate additional latent storage
- Incorporation of additional off-line storage, where required, to provide the remaining volume capture required to meet Control Option No. 1

Further details to each of these refinements can be found in Section 3.5.4 of *CSO Master Plan* Part 2.

5.7. Water Quality

As per Clause 15 of EA No. 3042, the City developed an Interim Combined Sewer Overflow Monitoring Plan to aid in the development of the *CSO Master Plan*. The Interim Plan was a multi-year water quality monitoring program that was conducted to collect and update river and CSO water quality data for the development of the *CSO Master Plan*. The water quality monitoring data was collected in 2014 and 2015. The event mean concentrations (EMC) of the data

collected from the 2014 and 2015 water quality monitoring program are provided in

Table 1. The EMC of ammonia, nitrate, and total phosphorus (TP) were used to determine pollutant loads in the NRPI reports, while TP, total nitrogen (TN), and nutrient loading were used as the baseline for the water quality modeling and loading assessments for evaluation of control option alternatives for the *CSO Master Plan*. The assessment indicated that the CSO discharge quality varied by location and between events but was within expected ranges for combined sewer discharges. There was very little difference in performance among the control option alternatives.

Table 2 indicates the number of days the bacteria objective may be exceeded for each alternative. The detailed analysis and results of the *CSO Master Plan* water quality monitoring work are documented in the Preliminary Proposal.

Table 1 - Pollutants EMC from 2014/2015 Water Quality Monitoring Program

Substance Name	Unit	EMC
[1]Ammonia	mg/L N	5.72
[1]Nitrate-N	mg/L N	0.34
[1,2]Total Phosphorus	mg/L P	2.71
[2]Total Nitrogen	mg/L N	15.25

1 – Parameters used in the NPRI reports
2 –Parameters used in the CSO Master Plan nutrient loading assessments

Table 2 - Potential Plans Bacteria Metrics (CH2MHill et al., 2015)

Plan Alternative	Control Limit	Number of Exceedances (days/year)
-	Baseline	44
1	85% Capture in a representative year	44
2	Four Overflows in a representative year	41
3	Zero Overflows in a representative year	35
4	No More Than Four Overflows per year	39
5	Complete Sewer Separation	42

As per the *CSO Master Plan* approval letter, the City will be implementing Control Option No. 1 while further evaluating the bacteriological water quality improvement identified for Control Option No. 2. A water quality report will be submitted once every 5 years, starting on December 31, 2024.

The first of these reports, the *2024 River, Stream, and Combined Sewer Overflow Discharge Water Quality Monitoring Report* was submitted on December 13, 2024. Following comments from the Province, a revised report was submitted on August 9, 2025. Please refer to the full report for further information. The next Water Quality Monitoring Report is due December 31, 2029.

The implications of maintaining a percent capture program on water quality will be evaluated and will be provided in the 2030 Master Plan update submission.

5.8. Climate Change

Climate change considerations were accounted for in the planning and development of the *CSO Master Plan*. As documented in the *CSO Master Plan* Preliminary Proposal, historic precipitation information (1960 to 2012) was reviewed to understand precipitation trends and the impact climate change may have on the precipitation trends over time.

Precipitation trends indicate that climate change is linked to less frequent but larger rainfall events. Winnipeg is expected to experience an increase in the frequency of small rainfall events but a consistent trend for larger events. Since the smaller events can be captured in the CSO control system, it is expected that the trend would not be detrimental to the CSO program performance. However, there is a high degree of uncertainty in long-term trends if the frequency of large events increases.

GI has been identified as an opportunity to improve CSO performance levels and provide resiliency to the potential future impacts of climate change. The City will continue to undertake GI pilot projects to evaluate their benefits and long-term performance for future application. An allowance of 10 percent of the total *CSO Master Plan* capital cost estimates has been included for future GI implementation and to achieve regulatory compliance for Clause 8 of EA No. 3042.

Furthermore, prioritizing sewer separation work will provide the program with climate change resiliency. Any additional runoff generated from climate change impacts on precipitation trends will continue to be directed to the land drainage sewers for the districts which have been separated.

The City will continue to monitor and track weather patterns to assess any impact to the *CSO Master Plan* and the use of 1992 as the representative year to represent the long-term typical conditions in the City of Winnipeg.

5.9. Communications

Maintaining an open engagement with stakeholders is essential to the success of the *CSO Master Plan*. The City will continue to engage with public and the Provincial regulator on progress of the *CSO Master Plan* execution.

5.9.1. Public Engagement

The City established a public engagement program to inform, engage, and consult the public on the *CSO Master Plan* in the first stage of the Master Plan. The public engagement program included multiple public consultation events for the public to provide input. In addition to public consultation events, a Stakeholder Advisory Committee (SAC) was established to provide advice and direction on the study phase.

The general public was engaged through various public presentations and workshops, internet-based tools, including a blog open for public comments, an email Q&A option, a CSO educational video, and media interviews. The information gathered from the public engagement was evaluated and integrated into the Preliminary Proposal.

Upon submission of the Preliminary Proposal, the City continued to inform and educate the public on the development of the Master Plan using the internet-based tools. The City optimized the public webpage dedicated to the *CSO Master Plan* work by restructuring and updating it to allow more content and the most up-to-date information be made available to the public. The updated website also allows the public to access the information and navigate the website in a more effective and user-friendly manner. To view the website, visit https://legacy.winnipeg.ca/waterandwaste/sewage/csoMasterPlan.stm.

5.9.2. Public Education

The City website contains important information relating to the *CSO Master Plan*. The website serves as a public education tool to provide Winnipeg residents information on the Master Plan and its benefits. Animated videos and plain language descriptions illustrate and clearly describe the operation of our complex combined sewer systems. The City website also contains information about CSO relief projects and the annual CSO discharge results.

5.9.3. Public Notification System

The City introduced a public notification system called the Sewer Overflow Information System (SOIS) in 2004 to notify the public on the likelihood of overflows as a result of the recommendation from the 2003 Clean Environment Commission hearings. This system indicated the likelihood of overflows into the Red and Assiniboine Rivers based on readings of high-water sensors in the sewers at various overflow locations along with the City's rivers and other monitoring indicators.

In 2013, the City was requested to develop a plan to accommodate a new, enhanced public notification system that would provide a near real-time indication of CSO notifications with overflow occurrences and duration by December 31, 2015 to comply with Clause 10 of EA No. 3042. The *CSO Public Notification System Plan*, describing the development and implementation plan of the enhanced public notification system, was submitted to the Province on December 15, 2015 and was later approved.

The enhanced public notification system was in the development phase between 2017 and 2021 to test it for reliability and accuracy of the CSO notification predictions. It is linked to the most current hydraulic model for the City of Winnipeg combined sewer (CS) system, along with rainfall and outfall instrumentation data at each of the 46 of the 76 combined sewer outfalls. The City engaged with the Province in May 2022 and launched the enhanced public notification system in July 2022. The City of Winnipeg CSO Public Notification Tool notifies the public when a CSO is occurring and estimates its duration in near real-time. Further information related to the tool is available on the City of Winnipeg website:

https://legacy.winnipeg.ca/waterandwaste/sewage/csoNotification.stm.

5.10. Regulatory Engagement

The City worked closely with the Province to develop the *CSO Master Plan*. During the development phase of the Master Plan, the City met with two different regulatory groups, a regulatory liaison (management) group and a regulatory working group to raise challenges, report on project progress updates, and to promote collaboration with the regulator to ensure successful program delivery.

5.11. District Engineering Plans

The District Engineering Plans (DEPs) were developed to provide conceptual solutions for the Control Option No. 1 performance target (85 percent capture in a representative year) for each of the 43 combined sewer districts.

The DEPs are ongoing, live documents. Each of the districts will undergo preliminary and detailed levels of design based on the solutions recommended in the DEPs, and will be updated throughout the implementation phase as required. The current version of the DEPs can be found in the *CSO Master Plan* Part 3B.

6. Capital Cost Summary

A conceptual level Class 5 estimate was developed for the *CSO Master Plan*. A Class 5 estimate is defined by the *American Association of Cost Engineers International,* (AACE) *Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries* (AACE, 1997) as having a project definition of zero to two percent to be used in a conceptual study with an expected range of accuracy from -50 percent to +100 percent.

The total capital cost to implement the *CSO Master Plan,* including the 10 percent GI allowance, is estimated as $1,150,400,000 in 2019 dollars. Applying the class 5 estimate, this gives a program cost range of $575,200,200 to $2,300,800,000.

7. Funding Strategy

Based on the recommendation from the CEC for sharing the cost equally between the Municipal, Provincial, and Federal governments, the *CSO Master Plan* was developed with the following three funding scenarios. See the *CSO Master Plan* for more details on the funding scenarios developed at the time.

- Scenario 1 – Tri-level funding agreement between the Government of Canada, Manitoba Government, and the City of Winnipeg
- Scenario 2 – Bi-level funding agreement between the City of Winnipeg and either the Manitoba Government or the Government of Canada
- Scenario 3 – City-only funding

In 2022 and 2023, City Council directed the Public Service to work towards the Provincial deadline of 2045 and to prepare a City-only funding plan to meet the 85% capture. Various funding scenarios were provided in the *2024 to 2027 Water and Sewer Rates Administrative Report* to illustrate the potential rate impact over the range of a Class 5 cost estimate (-50 percent to +100 percent). The current level of funding is approximately equivalent to the 2019 cost estimate of $1.15 billion.

The City's current funding strategy is based on a typical annual investment of $30 million; from 2029 onwards it will be escalated by three percent annually. Along with an additional $60 million in funding between 2024 and 2027, this is estimated to accumulate nearly sufficient funds to match the class 5 estimate of $1.15 billion (2019 dollars) by 2045. Funding is adjusted annually as part of the Capital Budget process and is based on anticipated contracts for the coming years. The Public Service will continue to review required funds and work towards the 2045 deadline, proposing rate adjustments as required through the annual budget process. The City will continue to seek external funding sources to limit the impact of this critical work on rate payers.

The City is working to commit existing budget dollars by advancing district designs to create more 'shovel-ready' contracts. Many of the designs remain conceptual at this stage, so estimating an overall program cost is difficult. As designs progress, the accuracy of the cost estimate to construct the CSO mitigation options will improve.

8. Design Development of Proposed Projects

The *CSO Master Plan* and the DEPs were developed to a conceptual level of detail. The individual project selections and designs are based on the hydraulic model evaluations and high-level assessments of constructability. It is expected that the proposed projects identified will change and adapt as further information is collected during the program implementation and individual project design studies. This process is illustrated in Figure 2.

Figure 2 - Key Design Stages in Life of a CSO Project

The City plans to complete a number of additional evaluations based on the details presented in the DEPs to form the basis for further design and construction within each of the sewer districts. Each of the proposed projects will undergo a preliminary and detailed design stage to confirm their constructability. A potential approach to the design process would be for several adjacent sewer districts to be further refined as a package during the preliminary design phase. Additional detail would be collected and evaluated to fully understand the existing sewer system surrounding each specific district prioritized and confirm selection of the optimal CSO control technology. This would be followed by detailed design where the parameters of the control technology would be finalized for construction.

Each of the combined sewer districts with the solutions constructed will be monitored to determine the level of performance achieved. This information will be input into the current hydraulic model and applied as part of future design evaluations. CSO volume monitoring and operation and maintenance of sewer systems will continue for the life of the infrastructure.

9. Program Implementation Strategy

In addition to the program criteria, an implementation strategy has been defined in the *CSO Master Plan* documentation to balance resources, risks, and costs of the projects. Additionally, projects were scheduled based on the funding scenario.

Sewer separation work is an ongoing priority for the program implementation due to the high benefits and low risks. As cost escalation can have significant impact to the cost of long-term programs, completing more expensive work upfront can reduce the relative impact of cost escalation. Sewer separation reduces basement flooding risk and reduces wet weather runoff to the combined sewer system. It addresses the required CSO reduction targets, while also improving the basement flooding level of service for the area.

There are additional opportunities which require further investigation as part of program implementation, such as GI solutions and floatable management.

GI was assessed separately from the other control options. It has not been included in the base solutions because of unknowns and uncertainty with its application. Each district will require a detailed assessment of potential GI locations and will require the development of policies and design standards with engagement and buy-in from residential, commercial, and industrial customers to optimize opportunities. The analysis of the main technology evaluations and pilot studies are scheduled to be completed within the first ten years. This will provide confirmation that these proposed options are appropriate and suitable for the Winnipeg sewage system. GI and sustainable solutions should be reviewed for consideration as part of every sewer infrastructure project to comply with Clause 8 of EA No. 3042. However, not all projects will be suitable for a GI component. It is anticipated that GI projects will offer performance improvements towards meeting CSO volume capture targets, and will assist with mitigating detrimental impacts from climate change. An allowance of 10 percent of the total *CSO Master Plan* capital cost estimate has been included for future implementation

The floatables management approach in the *CSO Master Plan* is based on outfall screening. Screening is not the most effective approach for many of our sewer districts due to many factors including the surrounding environment and the sewer system hydraulics. Floatables management is required for outfalls where combined sewage is discharged. For districts where complete sewer separation is to be completed,

combined sewage will no longer be discharged from the outfalls in these districts and floatable management will not be required.

The City has identified an alternative approach to screening to address the floatable management requirements, which is similar to a successful program run by the City of Ottawa. This proposed new approach targets source control as a potential alternative to screening. This is expected to achieve similar or better results while eliminating end-of-pipe screening. The alternative floatables management plan provides a significant opportunity to achieve the intended results, while avoiding the high capital and long-term operations and maintenance costs of screening facilities.

Additional sewer storage and mechanical controls solutions are scheduled to follow sewer separation work. In order to appropriately size and operate this type of infrastructure, sewer network, power, communications, monitoring, and operational infrastructure need to be in place to allow for a detailed understanding of network performance.

10. Schedule

The schedule is based on funding and the evaluation of the scope of work involved with each of the districts, CSO volume detriment, cost-benefits analysis, and district prioritization. Further details on the implementation can be found in the Master Plan (section 7 of the Abstract) and within the annual report for updated information.

11. Capital Projects Overview

To achieve 85 percent CSO volume capture in a Representative Year, sewer separation work is a major component and is proposed for 15 districts. A breakdown of the cost for each control technology applied in the *CSO Master Plan* is shown on Figure 3.

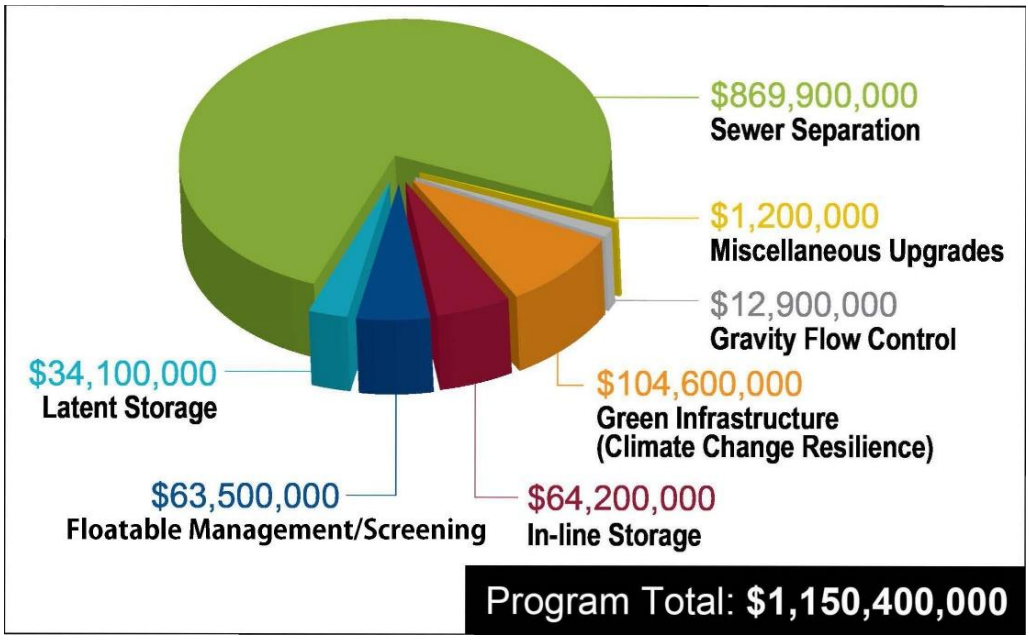

Figure 3 - CSO Master Plan Capital Cost Summary (2019 Dollars)

Figure 4 provides an overview map of the location of the proposed control options for each district.

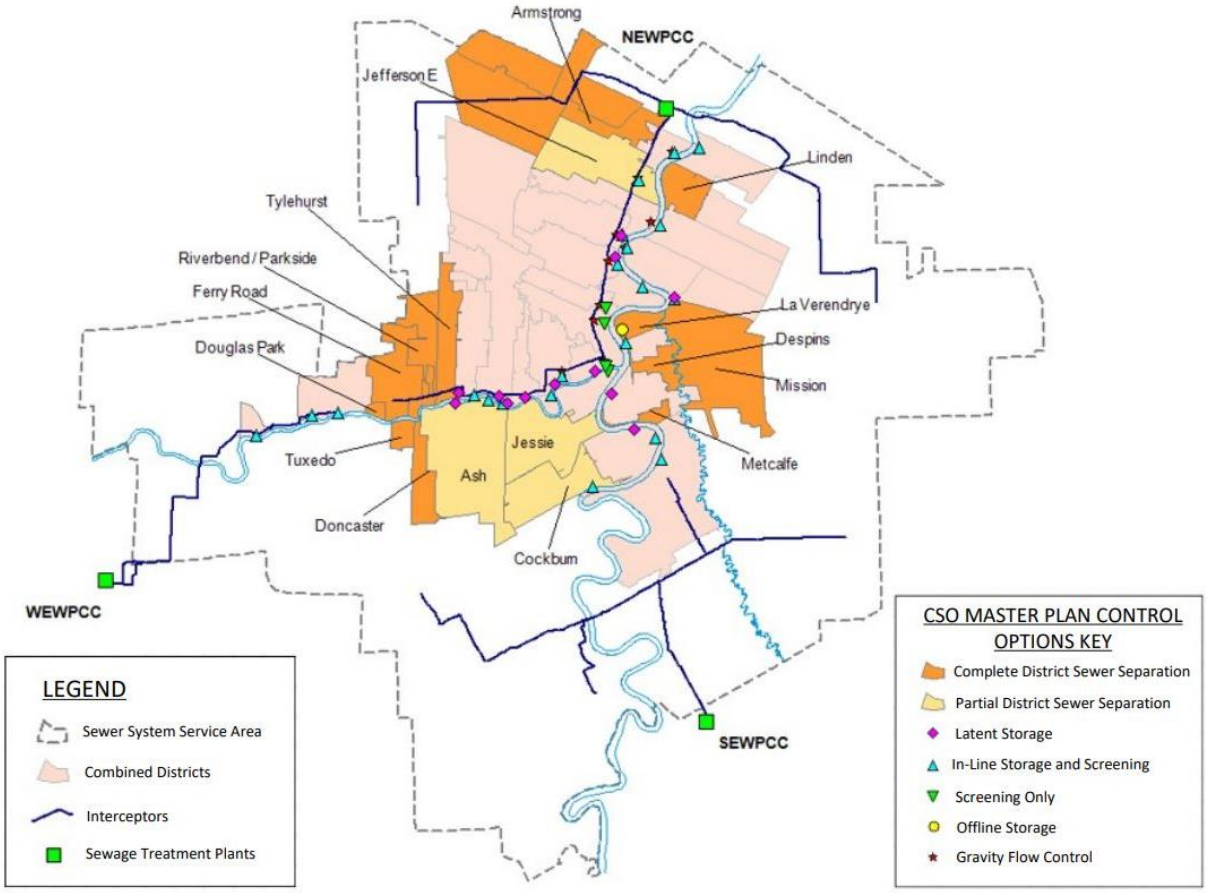

Figure 4 - CSO Master Plan Project Overview Map

12. Risks and Opportunities

This section provides an overview of the risks and opportunities identified in the development of the Master Plan.

12.1. Risks

Program Implementation

Factors that may pose a risk to the program implementation are as follows:

- Funding – There is a risk that funding from other levels of government will not be available over the life of the *CSO Master Plan*. This would put the burden of paying for the work on rate payers and does not align with the CEC recommendations. The City will continue its work with the available allocated annual budget.
- Technology – There is a risk that implementation of the green and innovative technologies as per Clause 8 of EA No. 3042 may not perform as expected. Technologies that are proven to be successful in other jurisdictions may not apply the same to Winnipeg due to the environment. The City will undertake research and seek experience and knowledge from other jurisdictions on the technologies prior to implementation.
- Resource – Market fluctuation and insufficient local resources may pose a risk to a cost increase and a delay in the implementation schedule.
- Schedule – There are many sources of risk associated with the planning and execution of the program. Such risks include funding shortages or high bid costs, limitation of engineering and construction service capacity, and extended project approvals.
- Migration to Control Option No. 2 – The change in performance target (from Control Option No. 1 to Control Option No. 2) would increase costs and likely increase the timeline of the Master Plan due to the increased level of effort required for the additional CSO volume reduction.

Climate Change

An increase in extreme weather events is a potential risk to the performance of the *CSO Master Plan* program. The program is based on a 1992 Representative Year. Long-term monitoring of rainfall trends will continue during the execution of the Master Plan to monitor any trends.

Basement Flooding

A major objective of the *CSO Master Plan* is to avoid compromising basement flooding protection or system operability through the modification of infrastructure, or installation of new equipment. These risks can be mitigated by identifying alternative technologies for control gates, latent storage, screening, and real-time control (RTC), followed by completing pilot studies to prove and validate the installations prior to implementing across several districts.

Program Feasibility and Sustainability

Factors to be considered regarding the feasibility and sustainability of the program are as follows:

- Affordability – The City's finances its capital and operating budgets for the sewer utility on a user-pay basis through sewer rates. To ensure that the rates are affordable to rate payers, the City takes a longer-term view of rates. The rates have steadily been rising for several years and are expected to continue to rise due to wastewater treatment plant upgrades and replacement and refurbishment of aging infrastructure.
- Public Impact – Sewer separation projects are planned throughout the combined sewer system and will encompass large sections of the sewer districts. Each of these will include large programs that will each take several years to complete. This may pose an impact on both the residents and businesses.
- Construction Capacity – With the additional construction project demand, there is a risk that Winnipeg may not be equipped with sufficient local construction industries to undertake the work in a timely manner.
- Services Overlap – There are multiple competing infrastructure needs within the City to consider as well as the possibility of additional

requirements in the future that cannot be forecast. Coordination with other City services will be required to minimize impacts and identify planning overlaps.

- Control Option re-evaluation – As technologies evolve over time, there is a risk that the selected control option may need to be re-evaluated to validate the best control option available. This implies that there is a possibility of rejection, which may lead to the need for more costly substitutes.

District Engineering Plan Risks

The District Engineering Plan is comprised of individual conceptual solutions to CSO mitigation for each of the combined sewer districts. Each of the risks and opportunities applicable to the control solutions recommended within each sewer district to meet Control Option No. 1 are documented in the Part 3B – District Engineering Plans of the *CSO Master Plan*.

Any changes to the control solution could cascade to a reevaluation of risks associated with each of the specific projects.

12.2. Opportunities

A number of opportunities to improve the volume percent capture during the program were identified during the development of the *CSO Master Plan*. The following section describes the main areas that the City could benefit from during the development of the Master Plan.

Green Infrastructure

Clause 8 of EA No. 3042 requires the use of green technology in the design and operation of all new and upgraded infrastructures. GI technologies will be evaluated to promote additional CSO volume storage and sustainability. A budget of 10 percent of the capital program is included in the *CSO Master Plan* budget for the implementation of the GI technology. An example of a GI study conducted by the City is the North East Exchange District Engineering Study.

North East Exchange District Engineering Study

The City undertook a pilot study in 2017 using a soil retention green technology, Strata cells, for the reconstruction of the John Hirsh Place in the North East Exchange District. Past studies have demonstrated that Strata cells promote tree growth and reduce loading on combined sewers. To demonstrate tangible benefits from the study, the City undertook flow monitoring prior to construction and completed post-construction flow monitoring in 2022 to evaluate performance.

The 2022 flow monitoring data showed a delay in runoff response from the catchment aligned with expected performance. Future monitoring will be undertaken to understand how the solution performs.

Floatable Management

Clause 12 of EA No. 3042 requires the Master Plan to demonstrate the prevention of floatable materials in CSO effluent. The Master Plan proposed investigating the use of both screening and the alternative floatable management approach to prevent floatable materials from entering the river.

Real-Time Control

Real-time control (RTC) provides a method of increasing system performance by improving the operation of the system. With Winnipeg's flat topography and large diameter pipe network, application of RTC becomes very valuable as it can adapt and balance the system for real precipitation events that are spatially and temporally distributed. The incorporation of RTC and monitoring instrumentation will provide an increased understanding of operation and a better control on a real-time basis, and an optimization of flows in the system and to the treatment plants.

Stakeholder Collaboration

Working together with other stakeholders including industry groups and the public will provide partnership opportunities that may provide additional benefit to the *CSO Master Plan*. Furthermore, this will provide an opportunity to further engage, communicate, and educate the community on the ongoing work with the program.

Further details associated with both the risks and opportunities of the program can be found in the *CSO Master Plan*.

13. Other Initiatives

Undertaking major sewer infrastructure upgrades in an interconnected sewer network is complex as changes in flow and capacity of one area of the system impacts other areas. During the execution of the *CSO Master Plan*, it is important to consider all ongoing initiatives. The following section describes the ongoing initiatives that are considered while delivering the *CSO Master Plan*.

13.1. *OurWinnipeg*

The *OurWinnipeg 2045 Development Plan* is the City's 25-year development plan that provides the vision, goals, and policies to increase the quality of life for all residents. It guides growth and change for the City to accommodate future residential growth in a sustainable manner. To support the successful delivery of the vision, *Complete Communities 2.0* was developed.

The *Complete Communities 2.0* is a direction strategy of *OurWinnipeg*. It is a city-wide secondary plan that guides growth, development, and land use in Winnipeg. With the population increasing, the treatment and conveyance demands are also expected to increase. There is a demand for more capacity to service future population growth. The *CSO Master Plan* incorporates a 35-year design horizon into the design and planning of sewer infrastructure. It uses the City's Planning and Land Use Model (PLUM) forecast data to account for future development and population growth.

13.2. Pollution Prevention Plan and Sewer By-Law

The City has a Pollution Prevention Program to protect the sewage collection and treatment system, our rivers and lakes, and the environment. This is a process that shifts the focus from municipal wastewater treatment to the control of pollutants at the source by:

- Avoiding the use of pollutants wherever possible
- Reducing the amount of pollutants that reach the wastewater system, if avoiding is not possible
- Eliminating pollutants wherever possible by replacing products with more environmentally friendly products

Businesses that are a part of the Pollution Prevention Program are required to submit a Pollution Prevention (P2) Plan outlining the source of the pollutants and measures to prevent, eliminate, or reduce the discharge of those pollutions to the wastewater and/or land drainage system. The City will perform inspections, collect samples, provide reviews, and approvals of the P2 Plans to ensure proper measures are in place to protect the environment.

The purpose of the City of Winnipeg Sewer By-Law is to protect public safety, the environment, and the City infrastructure by setting and regulating sewage discharge limits into the sewer systems and natural water courses.

For further information, refer to the following webpages:

- Winnipeg Pollution Prevention Plan webpage:

  http://www.winnipeg.ca/waterandwaste/sewage/pollutionPrevention/default.stm

- Winnipeg Sewer By-Law webpage:

  https://winnipeg.ca/waterandwaste/sewage/projects/sewerBy-law/default.stm#tab-background

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Appendix A – Small Scale Development Runoff Estimate Tables

Pre and Post Development Land Drainage Runoff Flow Estimate Example 1 for Two Duplexes

SFD to 2 duplexes						
Lot	**"C"-value**	**Existing**	**Post Lot 2**	**Post Lot 1**	**Post Total**	**Increase**
Total Area		557 m²	279 m²	279 m²	557 m²	
Building and Paved Area	0.9	180 m²	120 m²	140 m²	260 m²	
Gravel Area	0.5	0 m²	0 m²	0 m²	0 m²	
Pervious Area	0.1	377 m²	159 m²	139 m²	297 m²	
Weighted C-value		0.36	0.44	0.50	0.47	
Storage		21.7 m3			22.4 m3	0.7 m3
Q_{stm}		**6.1 L/s**	**3.8 L/s**	**4.3 L/s**	**8.0 L/s**	**32.07%**

Note: Q uses t_c of 10 min and intesity of 109.5 mm/hr

Note: Storage is for a 5 year event

Pre and Post Development Land Drainage Runoff Flow Estimate Example 2 for Two Duplexes

SFD to 2 duplexes						
Lot	**"C"-value**	**Existing**	**Post Lot 2**	**Post Lot 1**	**Post Total**	**Increase**
Total Area		557 m²	279 m²	279 m²	557 m²	
Building and Paved Area	0.9	130 m²	150 m²	150 m²	300 m²	
Gravel Area	0.5	0 m²	0 m²	0 m²	0 m²	
Pervious Area	0.1	427 m²	129 m²	129 m²	257 m²	
Weighted C-value		0.29	0.53	0.53	0.53	
Storage		21.3 m3			22.8 m3	1.5 m3
Q_{stm}		**4.9 L/s**	**4.5 L/s**	**4.5 L/s**	**9.0 L/s**	**85.18%**

Note: Q uses t_c of 10 min and intesity of 109.5 mm/hr

Note: Storage is for a 5 year event

Pre and Post development Land Drainage Runoff Flow Estimate Example for Two SFDs

SFD to 2 SFD						
Lot	**"C"-value**	**Existing**	**Post Lot 2**	**Post Lot 1**	**Post Total**	**Increase**
Total Area		474 m²	238 m²	238 m²	475 m²	
Building and Paved Area	0.9	151 m²	130 m²	130 m²	260 m²	
Gravel Area	0.5	0 m²	0 m²	0 m²		
Pervious Area	0.1	323 m²	108 m²	108 m²	215 m²	
Weighted C-value		0.35	0.54	0.54	0.54	
Storage		18.5 m3			19.5 m3	1.0 m3
Q_{stm}		**5.1 L/s**	**3.9 L/s**	**3.9 L/s**	**7.8 L/s**	**51.94%**

Note: Q uses t_c of 10 min and intensity of 109.5 mm/hr

Note: Storage is for a 5 year event

Pre and Post Development Land Drainage Runoff Flow Estimate Example for Two SFDs with Secondary Suites

SFD to 2 SFD w/ Secondary Suites						
Lot	**"C"-value**	**Existing**	**Post Lot 2**	**Post Lot 1**	**Post Total**	**Increase**
Total Area		557 m²	280 m²	280 m²	559 m²	
Building and Paved Area	0.9	200 m²	138 m²	138 m²	276 m²	
Gravel Area	0.5	0 m²	0 m²	0 m²	0 m²	
Pervious Area	0.1	357 m²	142 m²	142 m²	283 m²	
Weighted C-value		0.39	0.49	0.49	0.5	
Storage		21.9 m3			22.6 m3	0.7 m3
Q_{stm}		**6.6 L/s**	**4.2 L/s**	**4.2 L/s**	**8.4 L/s**	**28.27%**

Note: Q uses t_c of 10 min and intensity of 109.5 mm/hr

Note: Storage is for a 5 year event