CITY OF VANCOUVER

REPORT

Report Date: January 12, 2023
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Meeting Date: February 1, 2023
Submit comments to Council

TO: Standing Committee on City Finance and Services

FROM: General Manager of Engineering Services

SUBJECT: Update on the Development of a Sewage and Rainwater Management Plan for Vancouver (the "Healthy Waters Plan")

RECOMMENDATION

A. THAT Council approve the Strategic Framework of Guiding Principles, Goal Areas and Objectives, as outlined in this report, to guide development of the Healthy Waters Plan.

B. THAT Council direct staff to report back in 2024, with a progress update on the outcomes of Phase 2 work and key directions for Council to inform long-range investments, policy and other actions in sewage and rainwater management in the coming years.

REPORT SUMMARY

This report is a follow-up to Council direction received in 2020 to develop a comprehensive sewage and rainwater management plan for Vancouver. This initiative, now referred to as the "Healthy Waters Plan", will guide long-range investments, policy, and partner collaboration to address pollution from combined sewer overflows ("CSOs") and urban rainwater runoff, meet the growth needs of the city and address key risks related to climate change and aging infrastructure.

Based on extensive analysis and partner engagement during Phase 1 of this project, this report recommends the adoption of a Strategic Framework of Guiding Principles, Goal Areas and Objectives for the Healthy Waters Plan. This Strategic Framework will serve as the foundation for the evaluation of different investment strategies, policy, and other actions for sewage and rainwater management in Phase 2, and will guide plan implementation.

The appendices of this report provide an overview of Phase 1 work, including the assessment of the current state of sewage and rainwater management, and a preliminary financial forecast to establish the context for planning work to follow. In addition, the appendices identify a range of priority actions to be pursued in parallel to achieve positive water quality outcomes.

COUNCIL AUTHORITY/PREVIOUS DECISIONS

This report is a follow-up to Council's direction to staff on May 26, 2020, to proceed with development of the Healthy Waters Plan. In addition, the Healthy Waters Plan needs to consider a number of previous directions from Council and the Park Board, including:

- The Vancouver Plan (2022)
- The Rain City Strategy (2019)
- Council Motion – Accelerate combined sewer overflow mitigation (2019)

CITY MANAGER'S/GENERAL MANAGER'S COMMENTS

The Healthy Waters Plan project team has undertaken comprehensive engagement process with the Musqueam Indian Band, the Tsleil-Waututh Nation, Metro Vancouver and other levels of government, and stakeholder groups including community and non-profit organizations. The City Manager recommends approval of the foregoing.

REPORT

Background/Context

In May 2020, Council directed staff to develop the Healthy Waters Plan to address the following key issues:

- Combined sewer overflows ("CSOs") and polluted urban runoff[1] impact aquatic ecosystem health and public access to water. Vancouver has a regulatory requirement to eliminate CSOs by 2050, and it is also a Council and Park Board priority to increase public access to water.

- A comprehensive and integrated planning effort is required to ensure that sewer and drainage infrastructure services can sustainably support the growth contemplated in the Vancouver Plan, as well as adopted community plans.

- Climate change, including the increasing intensity and frequency of rainfall events, sea level rise and drought, adds further strain on sewage and rainwater management services.

- Significant and continued investment will be required to renew and adapt the city's aging sewers infrastructure. Despite substantial planned increases in investment, we anticipate that the rate of asset deterioration will continue to exceed the rate of renewal until the mid 2030s.

[1] Pollutants present in urban runoff include hydrocarbons, automobile tire dust, litter, micro-plastics, heavy metals, sediments, and biological matter.

- Concurrently, major regional investments including the $9.9B[2] upgrade to the Iona Wastewater Treatment Plant by Metro Vancouver add a substantial financial burden to the City's tax and rate payers.

- Water is a vital resource and life force for communities and ecosystems. For millennia First Nations communities have developed around their relationships with water. Post-contact, through land development, de-forestation, the burying of streams and development of modern sewer and drainage infrastructure, our relationships with water, the land and natural systems have been disrupted. The Healthy Waters Plan will provide the vision for the sewer and drainage system with the foundational principles of Vancouver Plan: Reconciliation, Equity, and Resilience, while strategically target investments and policies to mitigate risk and maintain affordability.

The City and Metro Vancouver Regional District jointly provide sewage and drainage services, with the City providing local infrastructure and Metro Vancouver managing regional conveyance and wastewater treatment. The Healthy Waters Plan should allow investments and outcomes across both systems to be optimized and align with the pending 2024 update to the Metro Vancouver Liquid Waste Management Plan ("LWMP"), which serves as a regulatory plan for the regional government and its members.

Project Work Plan and Status Update
Partner, stakeholder and public engagement are being tailored to each phase of the plan development. Appendix A provides an overview of the project work plan and engagement structure. The three phases of the Healthy Waters Plan development are as follows:

- **Phase 1 – Current State Assessment and Priority Action Plan (completed):** Includes the development of the Strategic Framework of Guiding Principles, Goal Areas and Objectives. It also includes an assessment of the current state of sewage and rainwater management (Appendix B) and a Priority Action Plan (Appendix C) which identifies "no regrets" near-term actions to improve water quality.

- **Phase 2 – Pathway Development (underway, with target completion Q1 2024):** This phase includes a staged and comprehensive analysis of a range of alternative infrastructure and policy solutions at different scales, utilizing the Strategic Framework of Guiding Principles, Goal Areas and Objectives developed in Phase 1. At the conclusion of this phase, a "preferred pathway" consisting of an investment strategy, policies and other actions will be identified for further refinement and prioritization in Phase 3.

- **Phase 3 – Finalize the Adaptive Plan (target completion Q2 2025):** This includes the development of a financial strategy, along with a long-term roadmap for infrastructure investments, operational improvements, policy and regulation and frameworks to support future watershed planning and aligned with the Vancouver Plan.

Strategic Analysis

Phase 1 work has been substantially completed, and includes a Current State Assessment of the sewage and rainwater management for the City, along with a Strategic Framework of

[2] Greater Vancouver Sewerage and Drainage District, Board of Directors Meeting Minutes, March 25, 2022 - http://www.metrovancouver.org/boards/GVSDD/SDD_2022-Mar-25_MIN.pdf

Guiding Principles, Goal Areas and Objectives. This work provides a foundation for the planning to follow in Phases 2 and 3. In addition to comprehensive technical analysis, this work also required a high level of collaboration with the Musqueam and Tsleil-Waututh Nations, Metro Vancouver, senior government representatives and stakeholder groups.

Summary of Findings from the Current State Assessment

The Current State Assessment includes a detailed analysis on key subject areas relevant for Sewage and Rainwater Management, including: (1) Regulatory Context, Governance, and Decision Making; (2) Aquatic Health Considerations from Sewage and Rainwater Discharges, (3) Sewage and Drainage Networks (VSA) – Metro Vancouver and City of Vancouver, (4) Monitoring and Modelling, (5) Policies, Programs, and Projects, (6) Funding, Costs and Financing Mechanisms and (7) Risk and Impacts Analysis. It also includes the report titled "Foundations for a Healthy Waters Plan[3]," which provides a summary of Phase 1 findings, including a look-ahead for Phase 2 work. Appendix B provides a summary of key findings from the Current State Assessment.

Proposed Strategic Framework of Guiding Principles, Goal Areas and Objectives

In May 2020 Council directed staff to develop a comprehensive plan for sewage and rainwater management. At that time, staff recommended that the plan be developed in accordance with preliminary goal areas, which were the starting basis for partner and stakeholder engagement to develop the Guiding Principles, Goal Areas and Objectives for the Healthy Waters Plan (see Appendix A).

Guiding Principles

Guiding Principles are critical to all stages of the Healthy Waters Plan development. They will inform how the engagement work is conducted, how various pathway options will be defined in Phase 2, and how the plan is implemented including the prioritization of investments. These include (1) Equity, (2) Reconciliation, (3) Resilience, (4) Collaboration and (5) Stewardship.

Goal Areas and Objectives

Goal Areas describe the high-level vision for the Healthy Waters Plan. Each Goal Area has an associated set of specific Objectives that and describe what matters in achieving a Goal Area. Table 1 presents the proposed Goal Areas and Objectives, which will guide the development and evaluation of different infrastructure strategies, policies and associated actions in Phase 2. Not all Objectives are of equal importance, and based on further analysis and engagement, Phase 2 will assign appropriate weightings to the various Objectives.

[3] The report titled "Foundations for a Healthy Waters Plan" is viewable at the following location: https://vancouver.ca/home-property-development/healthy-waters-plan.aspx

TABLE 1. PROPOSED GOAL AREAS AND OBJECTIVES FOR THE HEALTHY WATERS PLAN

Goal Area	Objectives
1. Healthy Waterways	1.1 Work towards elimination of pollution of waterways due to combined sewer overflows 1.2 Work towards elimination of pollution of waterways due to sanitary sewer overflows 1.3 Reduce the pollution of waterways due to urban runoff 1.4 Minimize rainwater and groundwater conveyed to Metro Vancouver Wastewater Treatment Plants 1.5 Reduce improper discharges into the sewage & drainage system
2. Healthy and Liveable Watersheds	2.1 Increase the retention and infiltration of rainwater into the ground 2.2 Increase the amount of naturalized areas within the rainwater management system 2.3 Reduce the impact of drought on street trees and other natural assets 2.4 Increase the connectivity of naturalized areas and green rainwater infrastructure
3. Adapt to Risk and Uncertainty	3.1 Minimize sewer back-up risk to people, critical infrastructure, and property 3.2 Minimize overland flooding risk to people, critical infrastructure, and property 3.3 Minimize flooding risk due to sea level rise, storm surges and king tides disrupting drainage services 3.4 Minimize seismic risk to sewage and drainage services 3.5 Minimize system capacity risk due to growth, development and climate change
4. Affordable and Optimal Service Delivery	4.1 Minimize the cost of public infrastructure to taxpayers and ratepayers 4.2 Minimize the cost of private infrastructure to property owners and development 4.3 Maximize the equity of cost distribution 4.4 Maximize the adaptability of investments to manage future uncertainties

These Goal Areas and Objectives are subject to adjustment based on outcomes from Phase 2 technical work and engagement, and any subsequent direction from Council.

Implications/Related Issues/Risk

Financial

The City and the region (notably the Vancouver Sewerage Area served by Metro Vancouver) are facing significantly increasing cost pressures associated with maintaining, renewing, and meeting capacity requirements for sewer and drainage infrastructure. The City's 2023-2026 Capital Plan includes ~$656 million of planned sewer related investments (excluding developer delivered in-kind upgrades), an over 70% increase compared to ~$380 million of investments approved during the 2019-2022 Capital Plan[4].

Metro Vancouver forecasts expenditures associated with capital programs for the Vancouver Sewerage Area to increase almost 200% from ~$42 million in 2022 to ~$125 million by 2026. These forecasts have not incorporated significant funding towards Metro Vancouver's

[4] Includes an 80% increase in tax and fee funding for renewal and upgrades of the sewer network from ~$200 million in the 2019-2022 Capital Plan to ~$360 million in 2023-2026 Capital Plan.

renewal and upgrade of the Iona treatment plant estimated at $10 billion overall, which will put significant additional upward pressure to the City's utility rates.

Future infrastructure investments necessitated by population growth, asset renewal, water quality, and climate change adaptation are expected to be in the billions of dollars over the coming decades. This challenge necessitates significant trade-offs, along with increases in utility fees and taxes. There is a financial, social, and environmental imperative to examine how the City can optimize investments to manage risks while delivering services efficiently and affordably.

An approved multi-year capital project budget of $7.4M is already in place to fund staffing and consultancy work to complete Phase 1 and a portion of Phase 2 of the Healthy Waters Plan. An additional $5.4M of planned funding to complete the Healthy Waters Plan remains unallocated from the 2023-2026 Capital Plan and is subject to future approval by Council.

Environmental

Despite significant progress over recent decades, billions of litres of CSOs are still discharged every year into receiving water environments that ultimately flow into the Salish Sea. The Vancouver Sewage Area has one of the largest volumes of CSO discharges across the country and has a regulatory requirement to eliminate CSOs by 2050. Sewage infrastructure and discharges impact the environment and are one potential factor under investigation related to summertime beach advisories. It is also recognized that polluted urban runoff can result in ecological impacts. The development of the Healthy Waters Plan is essential for addressing these issues.

In addition, the impacts of climate change, including increasing intensity of rainfall events, sea level rise, and drought create significant risk for the City, its people, and ecosystems. The Healthy Waters Plan will deliver a roadmap for adapting the City's sewage and rainwater management services to a changing climate. Building on the framework of the Rain City Strategy, the Healthy Waters Plan will define how policies and integrated investments in conventional and green infrastructure will restore the natural water cycle and reduce pollutant discharges to our waterways, including surface streams, False Creek, Burrard Inlet and the Fraser River.

Legal

Vancouver has regulatory obligations it must meet around the elimination of combined sewer overflows, implementing its Integrated Stormwater Management Plan and reducing the impacts of our sewer and drainage system on local receiving waters. The City's efforts to meet its LWMP commitment to eliminate combined sewer overflows requires an accelerated and diversified investment approach. The development of the Healthy Waters Plan is essential for charting Vancouver's path to meeting its regulatory obligations.

CONCLUSION

In this report, staff have appended key findings from Phase 1, and recommend the adoption of a Strategic Framework of Guiding Principles, Goal Areas and Objectives for the Healthy Waters Plan. This Strategic Framework will be foundational for the evaluation of different sewage and rainwater management pathways to be considered in Phase 2, and will guide plan

implementation activities to follow. In addition, the appendices of this report provide an update on Phase 1 outcomes and priority actions being pursued while planning.

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APPENDIX A: PROJECT WORK PLAN AND ENGAGEMENT FRAMEWORK

Project Work Plan

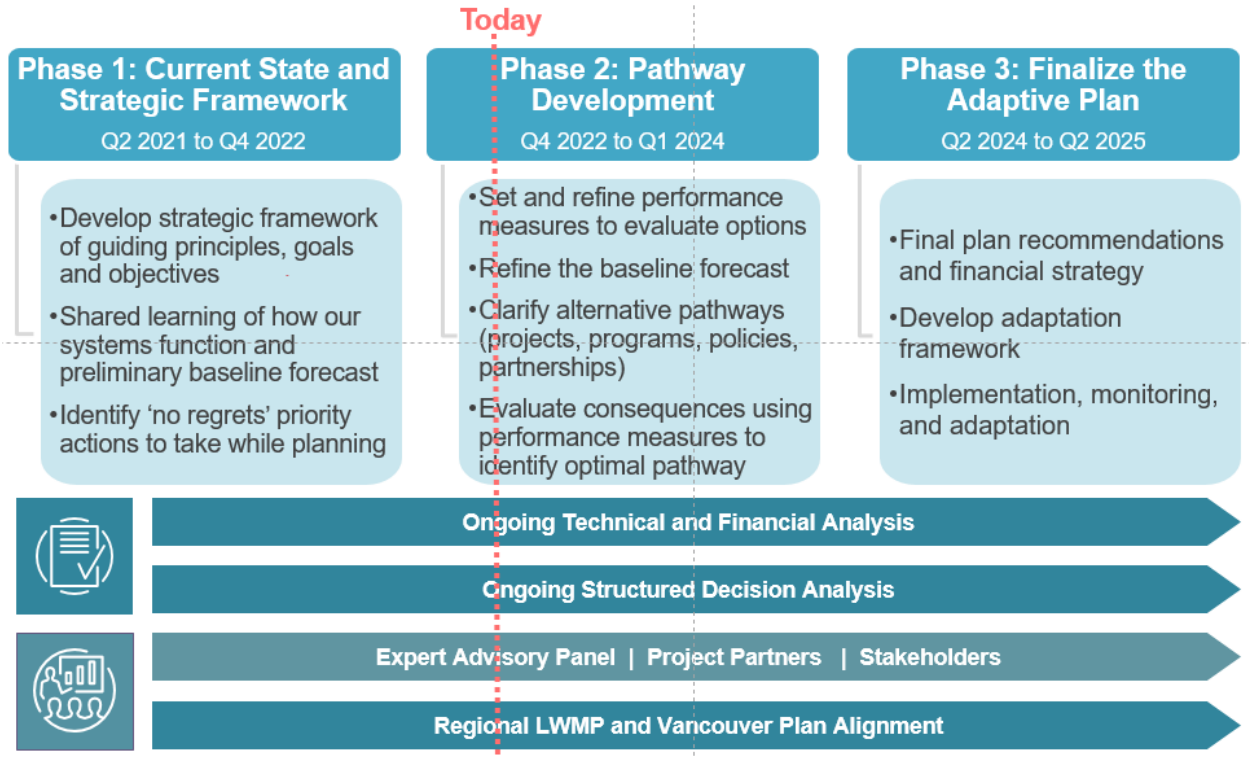
Partner, stakeholder and public engagement are being tailored to each phase of the plan development. The three phases of the Healthy Waters Plan development are as follows:

- **Phase 1 – Current State Assessment and Priority Action Plan (completed):** Includes the development of the Strategic Framework of Guiding Principles, Goal Areas and Objectives. It also includes an assessment of the current state of sewage and rainwater management (Appendix B) and a Priority Action Plan (Appendix C) which identifies "no regrets" near-term actions to improve water quality.

- **Phase 2 – Pathway Development (target completion Q1 2024):** The next phase of work will focus on completing a staged and comprehensive analysis of a range of alternative infrastructure and policy solutions at different scales, utilizing the Strategic Framework of Guiding Principles, Goal Areas and Objectives developed in Phase 1. At the conclusion of this phase, a "preferred pathway" of actions will be identified for further refinement and prioritization in Phase 3.

- **Phase 3 – Finalize the Adaptive Plan (target completion Q2 2025):** This includes the development of a financial strategy, along with a long-term roadmap for infrastructure investments, operational improvements, policy and regulation and frameworks to support future watershed planning and aligned with the Vancouver Plan.

FIGURE A1. A PHASED APPROACH TO PLAN DEVELOPMENT



Engagement Framework
The Engagement Framework describes who is involved in the Healthy Waters Plan planning process, and in what capacity. It is guided by the City of Vancouver's core values for public participation, which are informed by the International Association for Public Participation ("IAP2"). The Healthy Waters Plan commits to an engagement process that: advances reconciliation, is equity-infused, is integrated and coordinated, and is collaborative. The following table summarizes each engagement committee and level of engagement.

TABLE A1 - ENGAGEMENT FRAMEWORK

Project Advisory Group *IAP2 Level: Involve, Collaborate*	**Who:** Staff from the Government of Canada, Province of BC, Metro Vancouver, Musqueam Indian Band, development community, Port of Vancouver, Vancouver Coastal Health, BC Housing, and NGOs and advocacy groups. **What:** The Project Advisory Group represents the interests of those who will be affected by project decisions, and will significantly inform the goals, objectives and performance measure for the Healthy Waters Plan.
Leadership Forum *IAP2 Level: Collaborate*	**Who:** Senior managers and staff from Metro Vancouver, City of Vancouver, Province of BC, Government of Canada, Musqueam Indian Band, Tsleil-Waututh Nation **What:** The Leadership Forum is a venue for higher-level discussions around regulatory matters, related financial and investment considerations, and linked decision-making pathways around the Healthy Waters Plan and the Integrated Liquid Waste Resource Management Plan
Technical Working Group *IAP2 Level: Involve*	**Who:** Technical staff from the City of Vancouver, Metro Vancouver, Musqueam Indian Band and Tsleil-Waututh Nation **What:** The Technical Working Group meets to review technical deliverables from the Current State Assessment, and achieve shared, inter-jurisdictional learning occurs, and support collaboration across jurisdictions
Expert Advisory Panel *IAP2 Level: Involve, Collaborate*	**Who:** A multi-disciplinary group of experts with no vested interest in the outcomes of the project, from other wet-weather cities, academic expertise, Traditional Ecological Knowledge and experience of environmental justice efforts from the United States and Canada **What**: The Expert Advisory Panel provides independent advisory support to help define and expand the envelope of what is possible within the Healthy Waters Plan. The Expert Advisory Panel helps to fill knowledge gaps and provide best practices.

Indigenous Engagement
The project team followed the City of Vancouver Indigenous Engagement Protocol in establishing respectful and reciprocal relationships with Host Nations. The project team submitted formal referrals to the Musqueam, Squamish and Tsleil-Waututh Nations and to the Metro Vancouver Aboriginal Executive Council ("MVAEC") in May 2021 and in August 2021.

Further to the referral process, the project team developed capacity-funding agreements with Musqueam Indian Band and Tsleil-Waututh Nation to support their full participation throughout the development of the Healthy Waters Plan. As of spring 2022, MVAEC has not formally responded to the City's referrals. Staff are in early conversations with the Squamish Nation regarding their potential involvement in upcoming phases of work.

Phase 1 Engagement Work Completed: Strategic Framework of Guiding Principles, Goal Areas and Objectives

In May 2020 Council directed staff to proceed with a comprehensive plan for sewage and rainwater management. At that time, staff recommended that the plan be developed with the following preliminary goal areas, subject to revision following engagement with partners, stakeholders and the public:

1. **Address pollution** arising from CSOs and urban runoff, strategically based on environmental risk and access to water priorities

2. **Minimize risks** to service levels and affordability associated with aging infrastructure, population growth, seismic events, and climate change including sea level rise, increased rainfall intensity, and drought

3. **Enhance biodiversity and improve health and well-being** through fostering natural systems

4. **Ensure efficient, cost effective investments and regulations** that deliver value and support prosperity for current and future generations

5. Support **Equity** for all Vancouverites, **and Reconciliation** with Indigenous communities

These preliminary goal areas set the scope for the work program to follow, and were used to engage with partner and stakeholder organizations around the Guiding Principles, Goal Areas and Objectives for the Healthy Waters Plan.

Staff would like to acknowledge the contributions of partners and stakeholders in this foundational work. Their advice helps to ensure that this framework is sufficiently comprehensive, addressing core needs of the community and environment. Their participation is also necessary to achieve alignment with First Nations and other levels of government who have a role in sewage and rainwater management, stewardship and regulation.

APPENDIX B: KEY FINDINGS FROM THE CURRENT STATE ASSESSMENT AND PRELIMINARY BASELINE FORECAST

Phase 1 work, nearing completion, has focused developing a Current State Assessment, to present the historical and current day context of sewage and rainwater management in the city. It also includes a Preliminary Baseline Forecast, to understand the future context for planning work. This is critical foundational analysis to identify key considerations for the work to follow in Phases 2 and 3.

1. Current State Assessment

Phase 1 work has largely focused on assessing the current state of sewage and rainwater management, factoring in both City of Vancouver and Metro Vancouver infrastructure services. This serves to set a foundational understanding of sewage and rainwater management to guide options analysis and planning work in Phases 2 and 3.

1.1 The Evolution of Sewage and Rainwater Management in Vancouver

Following settler colonization, the first sewers were constructed in 1889, with the primary purpose to convey sanitary waste away from the new city and reduce the frequency of water-borne disease outbreaks. This system was expanded over time to serve new development. Streams were culverted and buried to allow for this widespread development, and were connected to the sewer system. This combined sewer system conveyed mixed sanitary and rainwater directly to receiving waters.

Driven by emerging concerns regarding sewage pollution in Vancouver waterways, in 1953, the "Rawn Report" recommended the construction of interceptor pipes to convey sewage from the city to a new wastewater treatment plant at Iona Island (referred to in this report as the "Iona Island WWTP"). Subsequent to the Rawn Report, the Greater Vancouver Sewage and Drainage District[5] (referred to in this report as "Metro Vancouver") was established to provide regional conveyance and treatment services.

Since the 1960s, the City began the practice of installing separated sanitary and storm pipes when new neighbourhoods were developed. Beginning in the 1970s, the City began replacing existing combined pipes with separated pipes in targeted areas of the Downtown and West End to address water quality issues. Within the 2011 regional Liquid Waste Management Plan ("LWMP"), the City committed to separating 1% of its sewer inventory on an annual basis, with the target of eliminating Combined Sewer Overflows ("CSOs") by 2050.

In response to water quality issues and Council direction, the City and Park Board have also implemented a number of actions to reduce sources of pollution and improve ecological conditions in False Creek. To better coordinate actions and ensure a comprehensive approach in False Creek, the City established an interdepartmental action program, the False Creek Water Quality Improvement Initiative, in 2017 which is ongoing.

[5] The Greater Vancouver Sewage and Drainage District was incorporated by the Province in 1956. Its predecessor, the Vancouver and Joint Districts Sewerage and Drainage Board, had been incorporated in 1914. The GVS&DD assumed all assets and liabilities of the Vancouver and Joint Districts Sewerage and Drainage Board.

In late 2018 and 2019, a number of Council imperatives around resilience, climate adaptation, climate emergency, watershed revival, blue green systems and accelerating action on CSOs emerged. The Vancouver Park Board ("Park Board") commissioners also passed a number of resolutions urging the City to accelerate efforts to address CSOs and improve the water quality in False Creek and other waters surrounding Vancouver.

In November 2019, Council approved the Rain City Strategy, which directs Staff to accelerate the implementation of green rainwater infrastructure solutions to reduce pollution from urban runoff, adapt to climate change impacts, reduce the volumes of CSOs and ease the burden on infrastructure associated with increased rainwater volumes and urbanization. The Park Board endorsed this strategy in February 2020. The Rain City Strategy builds upon provincial regulatory obligations and nearly two decades of green rainwater infrastructure leadership, pilot and demonstration projects developed by the City, Park Board, community, industry and academia in Vancouver.

In February 2020, Council approved the Aquatic Environments Action plan. This plan set out an integrated approach to improve aquatic environmental health by advancing: strategic planning and policy work by the Vancouver Plan and the City's Healthy Water Strategy, as well as the delivery of concrete actions implemented through the City's water quality and environmental improvement programs and initiatives.

The Park Board, through its VanPlay, Parks and Recreation Services Master Plan, has continued to emphasize the importance of natural systems, flow of water connectivity, and urban biodiversity as foundations for thriving cities and ecosystems. VanPlay offers a vision for integrated water multi-functionality: access to nature, rainwater management, ecosystems, recreation etc., and relies on clean water.

Today, the City's sewage and drainage infrastructure consists of 93,000 service connections from homes and businesses, 42,000 catch basins, 24 pump stations, 2,130 km of pipes and 300 green rainwater infrastructure installations, with a replacement value of approximately $7.6 billion.

1.2 Vancouver's Regulatory Obligations

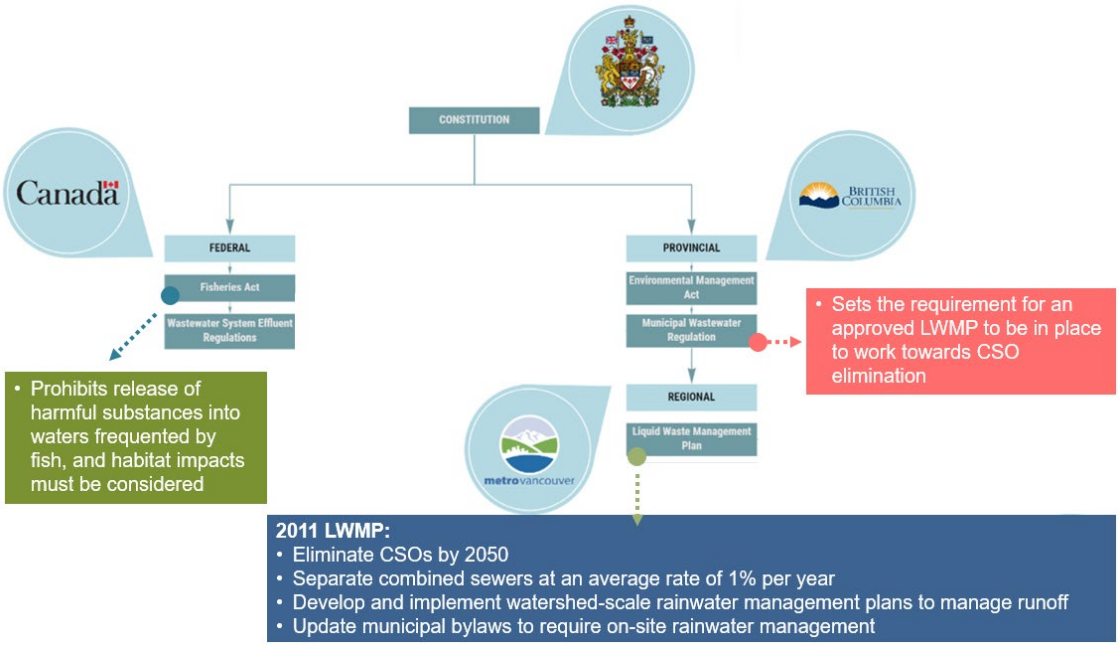
Figure C.1 provides an overview of the key environmental regulatory requirements for sewage and rainwater management. Under the Provincial *Environmental Management Act*, liquid waste discharges are prohibited unless in compliance with Municipal Waste Water Regulations or an approved LWMP.

In 1990, following approval by the Province, the "Stage 1" regional LWMP was established, which was necessary to meet the requirements of the Provincial *Environmental Management Act*. Further updates were brought forward in 2000 and 2001, to outline commitments towards sewer separation, eliminating CSOs and upgrading the Iona Island Wastewater Treatment Plant. In 2011, the Province approved the updated LWMP, a ten-year plan which sets regulatory obligations for Vancouver around:

i. eliminating CSOs by 2050;
ii. replacing 1% of mainline sewers with separated sewers on an annual basis;
iii. developing and implementing an Integrated Rainwater Management Plan; and
iv. monitoring and mitigating water quality impacts from polluted urban runoff.

The LWMP also requires that all municipalities in Metro Vancouver must also have Integrated Rainwater Management Plans and provide reports to the Province, through Metro Vancouver biannually, on their progress and compliance. In 2016, the City of Vancouver's Integrated Rainwater Management Plan was adopted by Council, with a focus on runoff water quality and addressing the impacts of the sewer and rainwater management system on local receiving waters and aquatic ecosystems. The Integrated Rainwater Management Plan established a long-term target to capture and reduce runoff pollutants from 90% of the volume of runoff from effective impervious areas for Vancouver's average annual rainfall. The Plan included a strong emphasis on green rainwater infrastructure approaches that utilize a combination of source controls, engineered solutions and ecosystem service methods to better manage rainwater volume and water quality. Further to this, in 2019 Council adopted the Rain City Strategy, which included implementation of rainwater management requirements for new development and development of tools for existing buildings, as well as a range of actions for streets, public spaces and parks.

FIGURE B1. KEY ENVIRONMENTAL REGULATIONS TO GUIDE THE HEALTHY WATERS PLAN



Metro Vancouver has initiated the process of updating the LWMP, with the final plan due to be submitted to the Province for review by Q3 2023. Subject to approval by Metro Vancouver Boards, Vancouver City Council and the Province, the updated LWMP will establish a new regime of regulatory requirements for Metro Vancouver and its members, including the City of Vancouver.

1.3 The Current Status of Sewer Separation Work

While newly developed areas of the city were built with separated sanitary and rainwater pipes beginning in the 1960s, the separation of existing combined sewers did not begin until the 1970s, taking a targeted approach to address sewage pollution in waters adjacent to Downtown. While decision making around which sewers to separate

had a water quality focus early on, starting the 1990s, decision-making factors were broadened to include prioritizing the need to renew aging and failing pipe infrastructure.

Figure B2 shows how sewer separation work has progressed over the years. This work involves the separation of mainline sewer pipes in the streets, as well as the connection pipes and associated plumbing of the properties served by the system. Mainline sewer pipes are separated through the City's asset renewal program, and a small portion through upgrades to serve growth. Property plumbing connections are separated at the time of property redevelopment or major renovations. Today, 56% of Vancouver's mainline sewers are separated, and approximately 60% of its property plumbing connections are separated. Vancouver has faced challenges in keeping up with renewing deteriorating assets at a sustainable rate, and in meeting the 1% per year rate of separation target due to significant construction cost escalation as well as the need to fund other essential public services.

FIGURE B2. PROGRESS ACHIEVED ON SEWER SEPARATION

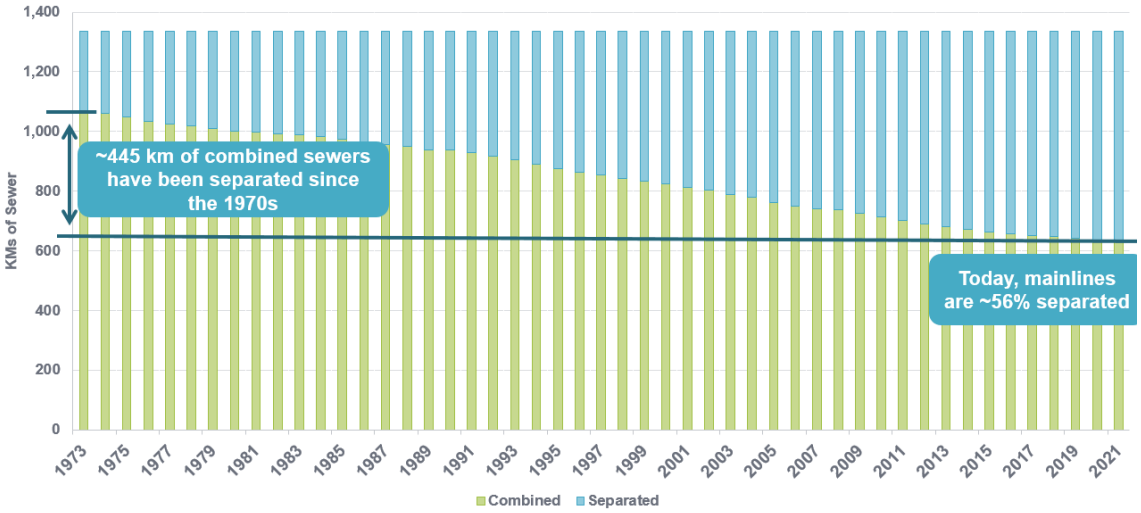
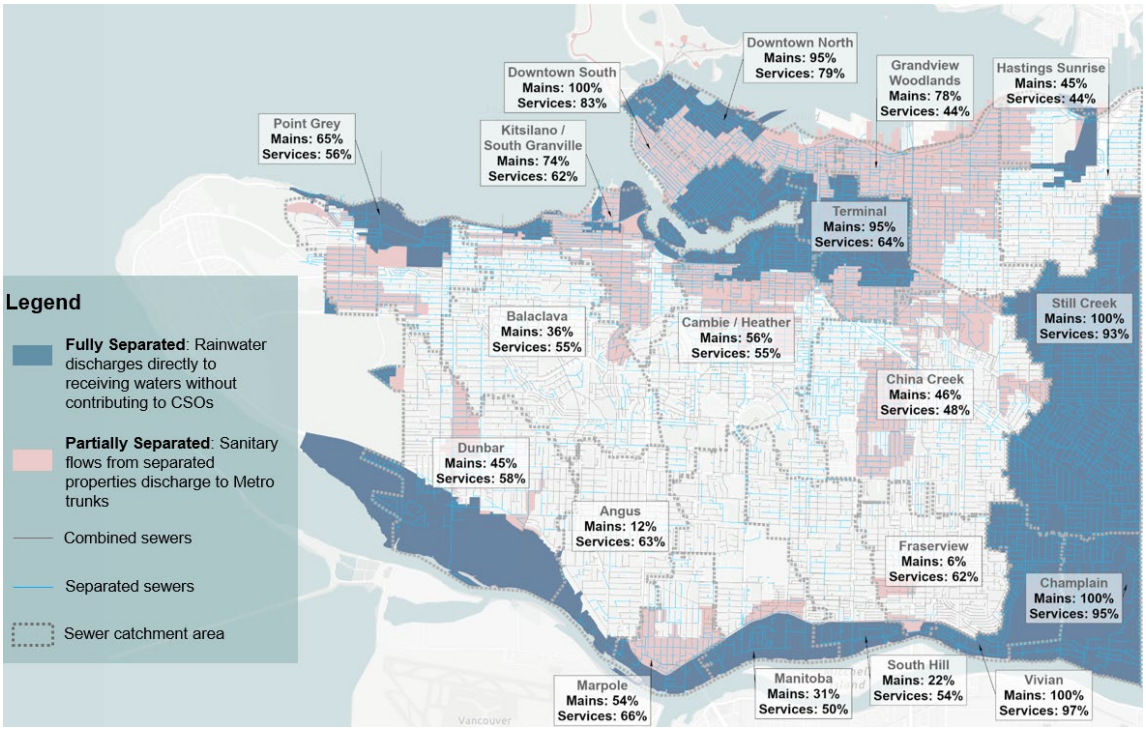


Figure B3 shows the current status of sewer separation across the city:

1. Areas of the City that are not shaded are considered to be **functionally combined**. These areas have some mainline sewer pipes that are separated, and private properties that have been redeveloped will have separated sanitary/rainwater plumbing connections. However, these areas still drain into downstream combined sewers and contribute to CSO events when it rains.

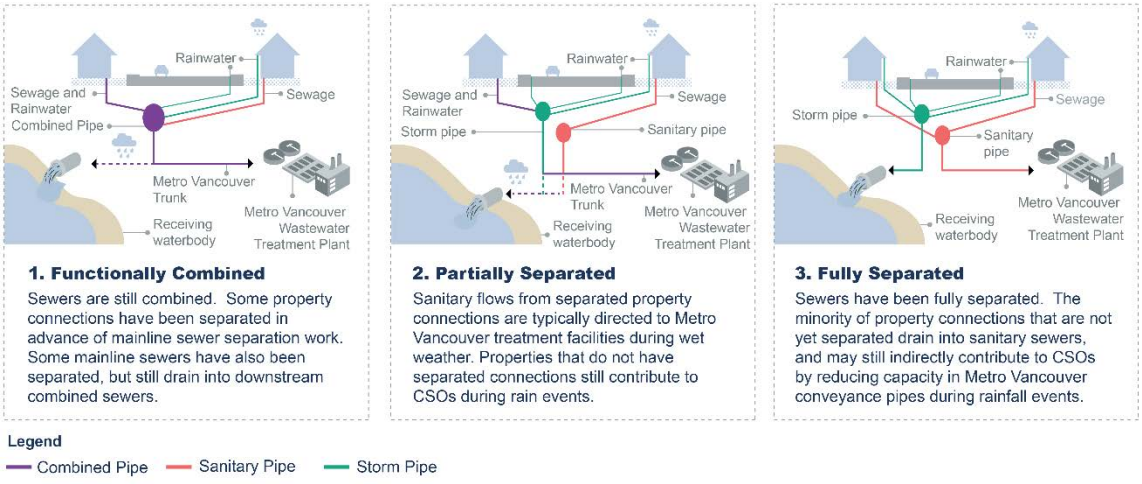
2. Areas shaded in pink are **partially separated**. In these locations, the sanitary flows from private properties that have separated sanitary/rainwater plumbing (i.e. through redevelopment) are directed to Metro Vancouver treatment facilities. Rainwater from streets and properties that do not have separated sanitary/rainwater plumbing connections still contribute to CSO events when it rains.

FIGURE B3. CURRENT STATUS OF SEWER SEPARATION



3. Areas shaded in dark blue are considered **fully separated.** All rainwater from streets, as well as from properties that have separated sanitary/rainwater plumbing, is diverted to receiving waters and does not contribute to CSOs. For properties that do not yet have separated plumbing, the rainwater flows into the sanitary system and can indirectly contribute to CSOs by reducing capacity in Metro Vancouver conveyance pipes during rainfall events.

FIGURE B4. TRANSITION FROM COMBINED TO SEPARATED PIPE NETWORKS



Barriers to completing sewer separation work include:

1. the need to address the remaining inventory of combined connections from private properties, which are currently separated through the cycle of property redevelopment;

2. the need to construct stormwater trunks and outfalls for some areas to create a conduit for the urban rainwater runoff to discharge into the receiving water bodies. Consequently, these areas continue to primarily discharge to Metro Vancouver interceptors and contribute to a higher frequency of CSOs during certain rain events; and

3. the escalation of construction costs and the need to balance CSO elimination objectives with affordability.

1.4 Current Status of CSOs and Urban Runoff Pollution

Municipal sewage includes a range of pollutants from households, businesses, industries, and institutions. In 2020, approximately 32 million cubic metres (32 billion litres) of CSOs were discharged[6] in the Vancouver Sewerage Area from Metro Vancouver CSO outfalls. An additional 6 million cubic metres (6 billion litres) of CSOs was estimated to have been discharged from City of Vancouver outfalls in 2020. Figure B5 provides a map showing the estimated frequency of CSO events, and Figure B6 shows the estimated volumes of mixed sanitary and rainwater discharged at different CSO outfalls in 2020.

In 2020, approximately 75% of CSO volumes were discharged into the inner harbour of Burrard Inlet, as per Figure B7. The disproportionately high volumes of CSOs discharged into Burrard Inlet was raised as a concern by partners and stakeholders in the Healthy Waters Plan engagement process. The re-opening of food fisheries in Burrard Inlet and Indian Arm has been identified in the Burrard Inlet Action Plan as a high priority for the Tsleil-Waututh Nation and will require among other regional interventions, sewer overflows from the Vancouver Sewerage Area, to be addressed.

[6] The Vancouver Sewage Area includes the joint municipal and regional system that serves Vancouver, parts of Burnaby and the University of BC Endowment Lands. CSO discharges include a mixture of rainwater, estimated at approximately 90% of CSO volume on average, and sanitary sewage, which is estimated approximately 10% of CSO volume on average. However, the proportion of the sanitary component in CSO discharges varies significantly between outfalls, with East Vancouver CSOs to the Inner Harbour discharging a higher fraction of sanitary effluent vs. west side CSOs to the Outer Harbour.

FIGURE B5. ESTIMATED FREQUENCY OF CSO EVENTS FOR 2020[7]

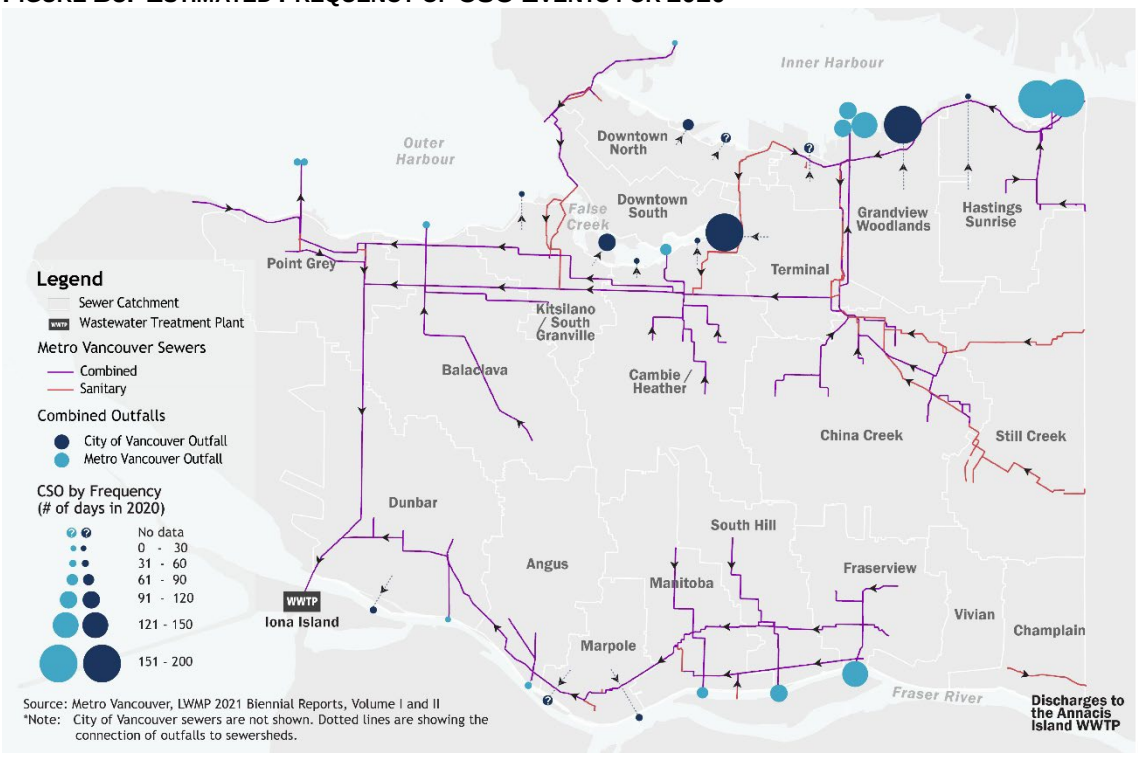
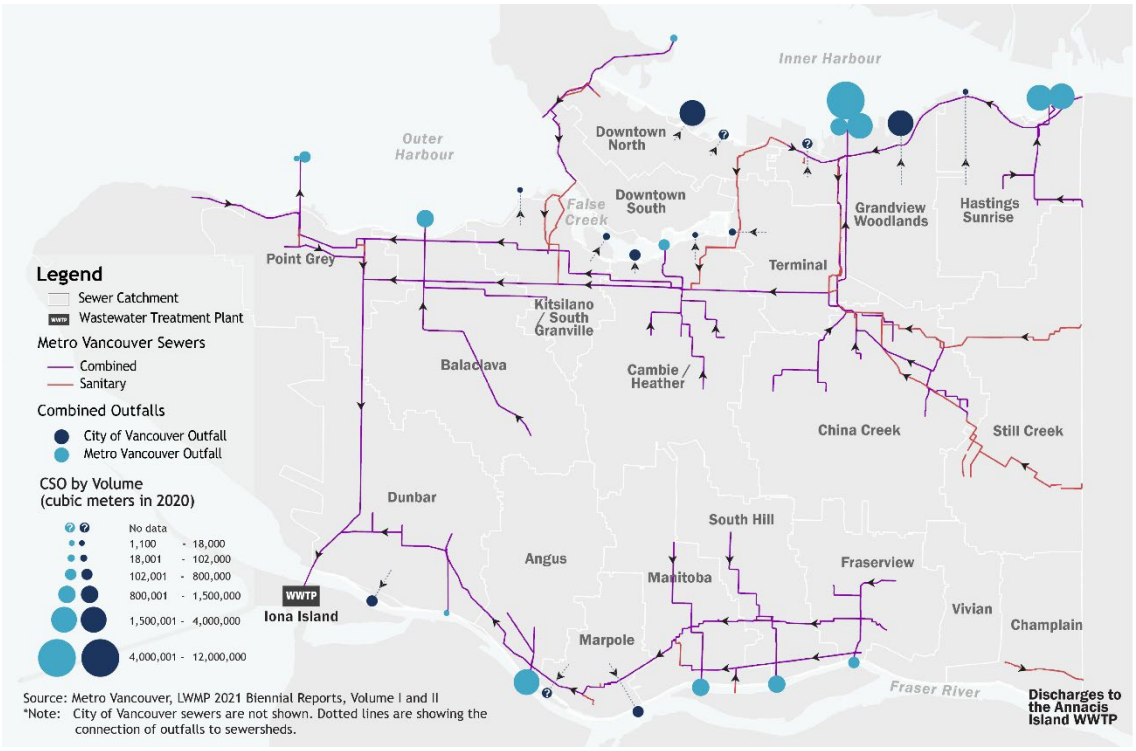
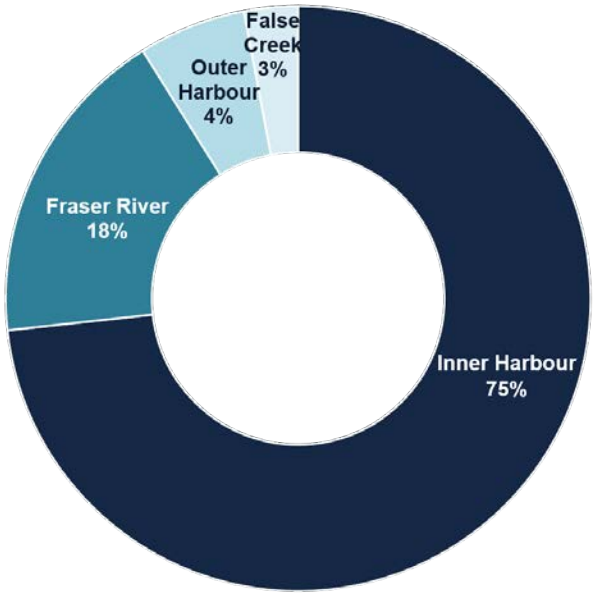


FIGURE B6. ESTIMATED VOLUME OF CSO EVENTS FOR 2020



[7] Figures B5 and B6 present information based on measured flow values at combined sewer outfalls, as well as estimated values for outfalls that do not currently have flow monitoring in place. The City is actively expanding its monitoring to all of its combined sewer outfalls in the 2019-22 Capital Plan, and additional monitoring investments are being proposed for the 2023-26 Capital Plan.

FIGURE B7. PROPORTION OF CSO VOLUMES DISCHARGED TO DIFFERENT RECEIVING WATERS (2020)



A smaller but still significant frequency and volume of CSO events also occur in English Bay, False Creek and the Fraser River. West side beach areas have much lower frequency and volume of CSO events, primarily because the system has been designed and operated over the past decades to prioritize the protection of public health in areas popular for swimming and other recreational activities. While total discharge volumes are a key factor influencing degree of impacts, other important considerations include pollutant types and concentrations.

In addition to sanitary sewage constituents, water quality in receiving environments can be adversely impacted by pollutants carried in urban runoff, such as sediment, hydrocarbons, micro-plastics, heavy metals, litter, and biological pollutants. Stormwater outfalls currently provide minimal to no treatment of runoff pollutants prior to discharge, and as work continues to separate sanitary and storm pipes, the volume of untreated runoff entering receiving waters will increase if source control interventions are inadequate. However, due to the combined nature of much of the system today, the base flow of combined sewage and rainwater (first flush) is often directed to the Iona Island Wastewater Treatment Plant.

The accelerated deployment of green rainwater infrastructure helps to reduce the pollutant loading on receiving waters associated with urban runoff. The City also has erosion and sediment control programs, waste discharge quality control programs and source control measures designed to prevent pollution at the front-end.

The amount of impervious area in a city also has a significant impact on the volume of rainwater runoff and the amount of pollutants that are carried into receiving waters. This is because, rainwater runoff picks up pollutants as it flows across streets and other

areas in the urban landscape. Currently, 49% of the city consists of impervious surfaces[8].

1.5 Sewage and Urban Rainwater Runoff Impacts on Receiving Waters

For thousands of years, the region was stewarded by Indigenous Peoples. With colonization, the health of Vancouver's receiving waters has been impacted in many areas, including as a result of urban and industrial development, culverting and burying streams, infilling coastal areas, hardening of shorelines, losing riparian areas, altering water flow regimes, presence of invasive species, and pollution from various human activities on land and within water bodies (e.g. CSOs and illegal cross-connections of sewers, illegal boat discharges, animal faecal matter, and legacy contamination from historical land uses). Impacts have also occurred from activities outside of the City, including marine shipping and other Vancouver Port activity. This has all combined to significantly alter the health of Vancouver's receiving waters.

In 2020, Council directed staff to proceed with development of the Aquatic Environments Action Plan, with a focus on holistic aquatic environmental health. Whereas the scope of the Healthy Waters Plan covers the sewage and drainage system, the scope of the Aquatic Environments Plan covers the complex and interdependent drivers (sewage and drainage being one of many) that impact water quality as well as broader biodiversity objectives for Vancouver's receiving bodies.

Pollutants behave differently and pose varying risks to human and ecological systems. Some pollutants biodegrade, while others accumulate in sediments and/or tissues of marine organisms. Some interact with each other and have additive or synergistic effects. Based on studies led by Metro Vancouver, it is understood that microbial pollution can travel a significant distance and persist for several days following a CSO event, while the impacts of non-microbial pollutants are more often observed in areas closer to outfalls. Even the most advanced wastewater treatment systems cannot remove all pollutants and as such, communities must also work in partnership to invest in source-control programs to prevent certain pollutants from entering the sewage and rainwater management system (e.g. pharmaceuticals, chemical contaminants). In addition to being more effective, source control measures, when available, also tend to be much more cost-effective than alternative treatment options.

In addition to pollutant type, the extent of human health and ecological impacts associated sewage and rainwater runoff pollution depends upon a variety of other factors including the type and concentration of pollutants and sensitivity of the receiving waterbody. Differing human uses and ecological considerations are also major factor, requiring a strategic and tailored approach for each receiving water body.

Recently, updated ambient water quality objectives have been set for Burrard Inlet. This work was led by the Tsleil-Waututh Nation, in collaboration with the B.C. Ministry of Environment and Climate Change Strategy, the B.C. Ministry of Land, Water and Resource Stewardship and the B.C. Ministry of Health. The Burrard Inlet Water Quality Objectives define conditions that represent levels of low risk to a set of designated water uses. The 'designated water uses' or water 'values' to be protected include:

[8] Approximate. Source: the 2019 Rain City Strategy - https://vancouver.ca/files/cov/rain-city-strategy.pdf

- **Aquatic life and wildlife**: Water quality supports biodiversity, and viable, healthy populations of species in the long-term. Species and habitats are found at multiple locations and represent the range of species and habitats once more broadly present.
- **Human consumption of shellfish**: Healthy, wild shellfish can be harvested safely by present and future generations.
- **Human consumption of finfish**: Healthy, wild finfish can be harvested safely by present and future generations.
- **Cultural practices and recreational uses**: Water and sediment are safe and clean for cultural, spiritual, and recreational activities including primary contact and secondary contact activities
- **Institutional or commercial uses**: Water uses meet institutional or commercial needs without negatively affecting water quality at intake sites, outflow sites or the receiving environment

The Provincial water quality objectives, considering these uses, will need to be considered in development of the Healthy Waters Plan, along with key policy directions from the Vancouver Plan, the Aquatic Environments Action Plan and the regional Liquid Waste Management Plan. In addition, the Healthy Waters Plan needs to consider recent work completed by Metro Vancouver to assess human health and ecological risk impacts associated with its CSOs,

1.6 Sewer Backups

Sewer backups are caused by a variety of factors including blocked, clogged, and damaged pipes; undersized pipes with inadequate capacity; and heavy rainfall events that exceed the design capacity of the sewers. Based on the staff's operational knowledge, the leading causes of sewer backups in Vancouver is tree root intrusion into pipes, as well as oil, fat, and grease build-up. Blockages on property service connection pipes are the most common form of backup event. However, backups can also occur for mainline sewers that have exceeded their design capacity due to flows from heavy rainfall, high tide and high groundwater levels; a risk that is increasing with aging infrastructure and climate change.

On average, the City receives about 1,100 service requests per year for sewer backups through the 311 service request line. While back-up prevention devices have been required for all new buildings since 2018, most properties are not protected from sewer backups.

1.7 Overland Flooding

Vancouver is exposed to overland flooding hazards from various sources, including high coastal water levels, high river and creek levels, and high rainfall intensity and volume. The severity of these hazards is increasing with climate change.

Overland flooding in Vancouver typically results from drainage system limitations during heavy rainfall events, particularly when the soil is already saturated. Operational issues can also result in overland flooding, such as catch basins being plugged by leaves and sediment during the fall. The drainage system capacity is also increasingly being limited by high coastal water levels, which are occurring more frequently due to sea level rise and storm surge events. Under extreme rainfall events, overland flow will occur primarily on the road network along similar paths to historic streams that were buried.

Many cities utilize roads for managing overland flow, but in the City of Vancouver overland flow via roads is not at this time considered a part of the rainwater conveyance network due to existing system design limitations. Regardless, when the roads and underlying drainage have insufficient capacity, overland flooding can impact people, properties, and infrastructure.

Overland flooding risk from coastal and Fraser River sources has been assessed through the Coastal Flood Risk Assessment and Coastal Adaptation Plan programs, which are informing on-going planning work. This work has been based on provincial recommendations to plan for 0.5m of sea level rise by 2050 and 1 metre of sea level rise by 2100. Work is also underway to update overland flood assessment and related planning for the Still Creek floodplain in Vancouver. For extreme rainfall flood hazard and risk in areas with buried streams, operational knowledge and on-going overland flow modelling work have been informing utility planning. However, a comprehensive risk assessment is still required as a foundation for policy and investments for managing overland flood risk.

2. Looking Ahead – Preliminary Baseline Forecast

A Preliminary Baseline Forecast has been developed to better understand our future planning context considering asset management needs, water quality and complying with regulations for CSO elimination, uncertainties related to climate change and population growth, and financial considerations.

2.1 Forecasting Investment Requirements for Asset Renewal and Pollution Control

The 2011 LWMP commits the City to separating 1% of its sewers on an annual basis, as well as eliminating CSOs by 2050. The 1% separation rate was determined based on a generalized assumption that pipe assets have an average lifecycle of 100 years and therefore require an average 1% per year renewal rate, and as such, system separation can take place concurrently as part of system renewal. In recent years the City has fallen short of achieving the 1% renewal rate due to significant cost escalation associated with sewer construction and the need for affordable service delivery. Starting in 2018, the introduction of the Utilities Development Cost Levy (“UDCL”) has enabled the City to dedicate funds for major neighbourhood scale growth-triggered system upgrades. This levy enables the City to expand its ability to address the sewer and drainage system demands, and to have “growth pay for growth”.

In order to provide an approximate overview of upcoming costs to achieve full system separation, a hypothetical scenario was created to assess the financial implications associated with achieving 100% sewer separation by 2050. This scenario considers how much of the sewer system is separated today, but does not consider the amount of separation progress that may be achieved through the growth program to serve new development. It also does not consider that extent to which complementary tools like green rainwater infrastructure may contribute to CSO mitigation. Key scenario assumptions to achieve 100% system separation by 2050 that inform Figure B8 include:

- An average renewal and separation rate of 1.6% of the system per year, between 2022 and 2050.
- Private property plumbing and connection pipes are separated at the time of redevelopment (analysis assumes 1% of inventory separated per year)

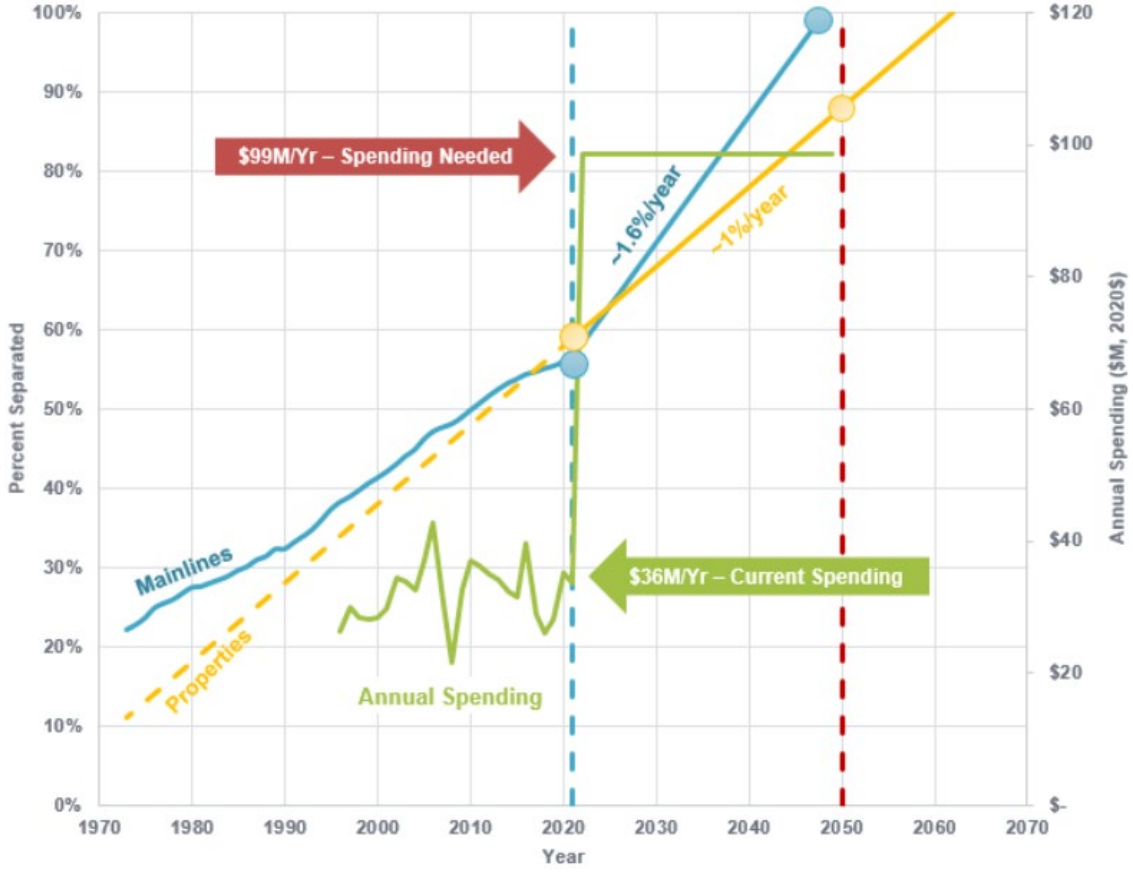
Key conclusions from Preliminary Baseline Forecast:

- To achieve 100% sewer separation by 2050, annual spending would need to be increased by 175% above 2019-2022 Capital Plan[9] Sewer Renewal programs, excluding cost escalation (increasing from $36M per year to $99M per year)

- Based on redevelopment alone, a portion of combined private connections from existing properties will not be separated by 2050 (our analysis forecasts property connection separation is unlikely to be achieved until after 2060). Therefore, additional City spending and/or regulatory measures would need to be advanced to complete separation of private side combined connections.

- Concurrently, concentrating investment on sewer separation alone will increase the amount of urban runoff flowing directly to receiving waters, with implications for water quality. It will also not serve to reduce flood risks in low lying areas where drainage capacity is limited. Mitigating policies and complementary investments will be needed concurrently to address flood risks and runoff water quality.

FIGURE B8. PRELIMINARY BASELINE FORECAST – 100% SEWER SEPARATION BY 2050



[9] For the approved 2023-26 Capital Plan, the allocation to the Sewer Renewal and Targeted Sewer Separation Programs has been increased to $63M per year, to separate an average of 11km of sewer pipes per year.

- This scenario may also result in some mainline sewer assets being renewed well ahead of their end of life, reducing the value achieved from infrastructure investments made in past years.

This baseline forecast indicates that 100% sewer separation by 2050 is unlikely to achievable and would be unaffordable. Sewer separation alone may also exacerbate flood and runoff water quality risks, creating significant cascading risks that further exacerbate affordability challenges, particularly around flood-prone areas of the city.

In 2019, the Rain City Strategy was adopted, setting the target for green rainwater infrastructure to manage 40% of impervious areas by 2050. Implementation of green rainwater infrastructure to date has focused on removing contaminants from urban runoff, preserving pipe capacity and a range of social and ecological co-benefits. Further analysis is required within the Healthy Waters Planning process to define the role of green rainwater infrastructure for CSO elimination and for the Liquid Waste Management Plan update.

2.2 Managing Growth

Between 1991 and 2016, Vancouver's population grew by 34 percent and added 160,000 people and more than 100,000 jobs—the largest increase in the region[10]. Currently, 662,000 people reside in Vancouver and is forecasted to add 7,000 new residents per year growing to 920,000 people by 2050[11].

Managing growth for sewage and rainwater management services requires cost recovery streams to fund growth in system capacity, and appropriate development policy to mitigate the impacts of this growth:

- **Funding Growth**: Growth-driven system capacity improvements have historically been funded by developers via the rezoning process, capital improvements with sewer utility rates and property taxes, and beginning in 2019, via the Utilities Development Cost Levy charged to new developments. The 2023-2026 Capital Plan forecasts approximately $282 Million in developer-funded capacity improvements for the sewage and rainwater system.

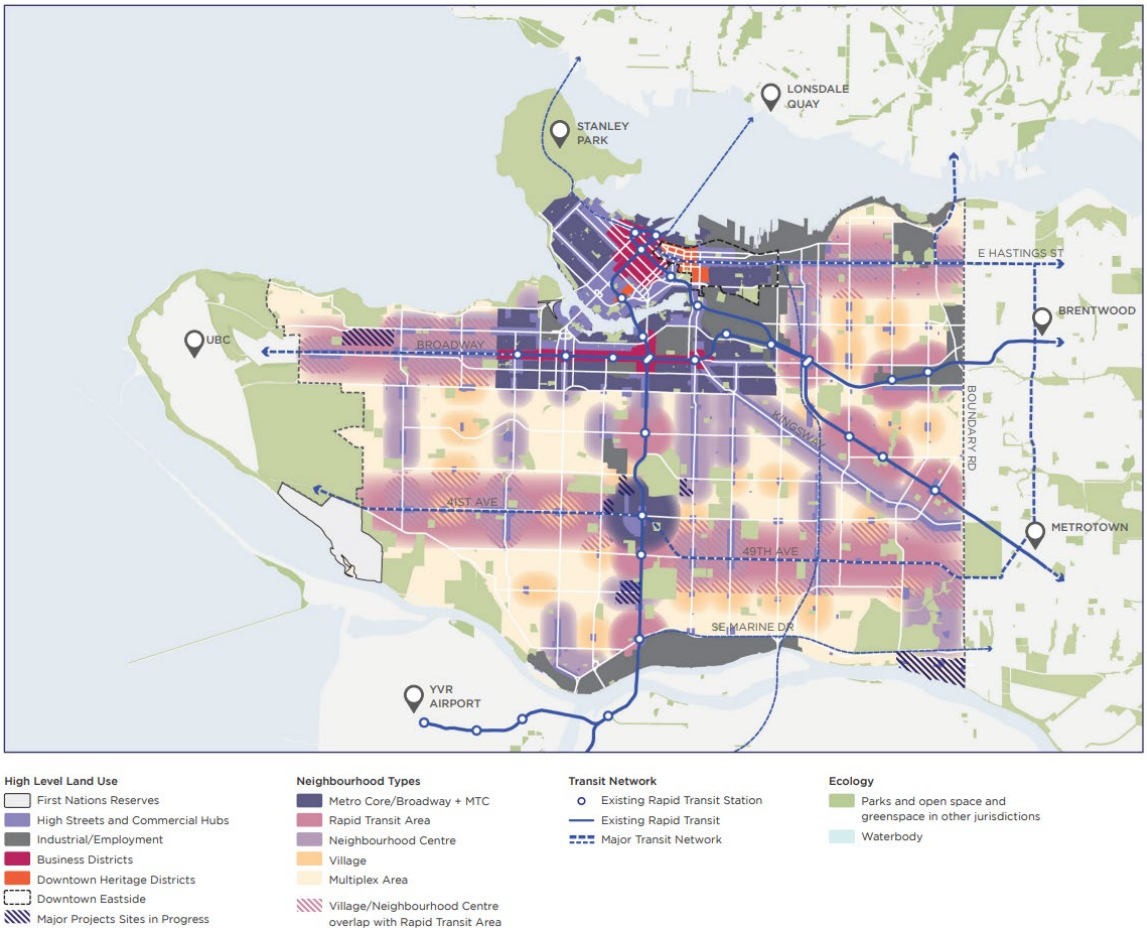
- **Development Policy to Mitigate the Impacts of Growth**: A range of policy tools are already in place to help mitigate increases to sanitary flows and urban rainwater runoff into the system. This includes water conservation policies which reduce the volumes of sanitary flow, as well as Rainwater Management Bulletin requirements which reduces the rainwater loading on the drainage system from larger developments. When low density areas of the City are redeveloped, it typically results in a significant increase in the amount of impervious areas which can significantly increase rainwater runoff loading. The current Rainwater Management Bulletin requires that new developments manage the first 24mm of rainwater, and further evaluation will be done under the Pathways Study in Phase 2 of Healthy Waters Plan to assess the viability of more stringent requirements. This work is critical to mitigate the need for costly investments in the drainage system, manage flooding risk in low-lying areas, and CSOs. In addition, work is underway as part of

[10] Vancouver Plan 2050
[11] Population Projections Technical Background, 2022.

a groundwater management strategy to evaluate tools to prevent groundwater discharges and better manage discharges when they cannot be avoided (e.g., construction dewatering).

In July 2022, Council approved the Vancouver Plan, which guides density and land use going forward in the city. The Vancouver Plan also defines a range of policy directions, including ones that address equity, resiliency, climate protection and restored ecosystems. The Healthy Waters Plan, along with subsequent more detailed watershed planning, will need to deliver adequate capacity as well as identify necessary funding and development policies to serve and manage this growth.

FIGURE B9. VANCOUVER PLAN LAND USE STRATEGY



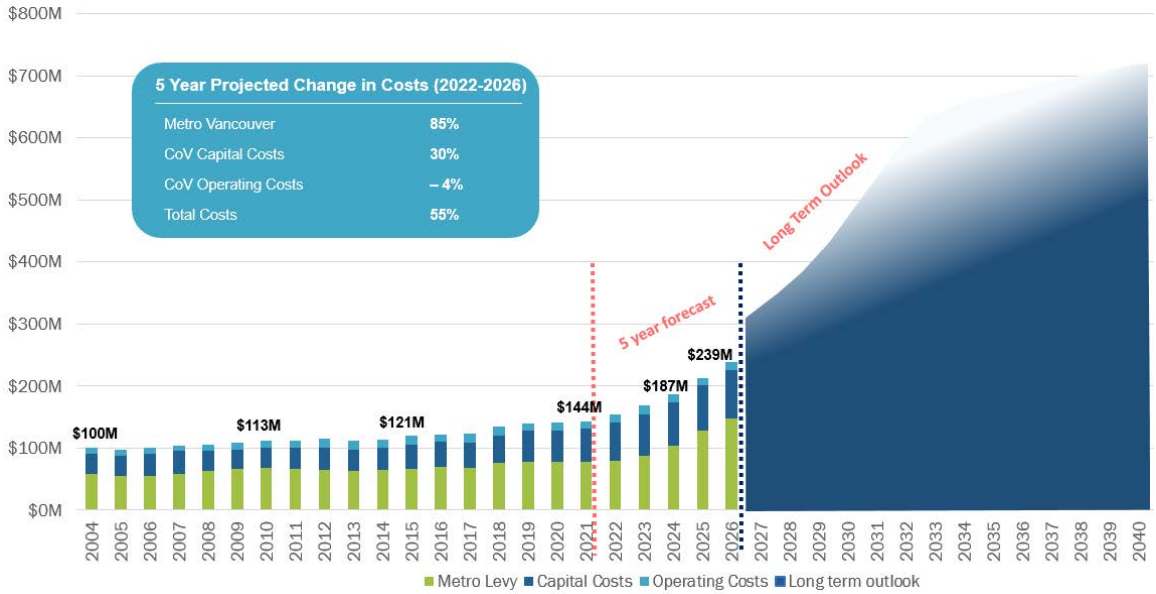
2.3 Rising Costs

Figure B10 shows how the City's sewage and rainwater management costs have changed over the years, normalized to 2020 dollars. It also includes a five-year forecast, which incorporates Metro Vancouver's most recent five-year forecast for its costs to be recovered from the Vancouver Sewerage Area, as well as the City's forecast costs, based on the current capital plan and operating spend trajectory.

A key driver for Metro Vancouver's forecast cost increase is the upgrade of the Iona Island WWTP to secondary or tertiary treatment. To comply with federal regulations,

Metro Vancouver must upgrade the facility to significantly reduce pollutant loading from the Vancouver Sewerage Area ("VSA") into the Salish Sea. This project is currently estimated to cost approximately $10 billion, factoring in future inflation and contingencies. While Metro Vancouver has a regulatory requirement to complete the project before 2030, the earliest viable time that the project could be completed is 2034.

FIGURE B10. SEWAGE AND RAINWATER MANAGEMENT COSTS (2020$)[12]



It is anticipated that this project will require significant Vancouver Sewerage Area sewer levy increases that will continue beyond the five year horizon shown in Figure B10. At this time, the cost implications for the City of Vancouver and its sewer utility customers are not known. Other regional liquid waste infrastructure upgrades will also have uncertain cost implications for Vancouver.

[12] The forecasted cost increases from 2022 to 2026 are based on Metro Vancouver's 5-year forecast (presented as part of the Metro Vancouver 2022-26 Financial Plan in October 2021), as well as the forecast presented to Council in the 2022 Sewer Rate Report.. For 2027 to 2040, the forecast has a high level of uncertainty around how the Iona Island WWTP project will be funded. Key assumptions regarding the Iona WWTP that are factored into the 2027-2040 forecast include: (1) total project cost of $9.9 billion, with Vancouver's share being 65% of the total and no senior government funding allocation; (2) operating cost of $100 million per year, beginning in 2035 when secondary and tertiary treatment plant operations are anticipated to commence; (3) project fully debt-funded at current market debt rates; and (4) project substantially complete by 2034, with ongoing capital works at the site completing by 2040.

APPENDIX C: PRIORITY ACTION PLAN

This appendix provides a summary of early priority actions within the sewage and rainwater management system to improve water quality. These actions have in some cases been initiated already, and will be proceeding in parallel with the Healthy Waters Plan's Phase 2 development. Council's approval of these projects occurs outside of this report and within the budgeting process.

Table C1 provides a summary of priority actions while planning, including:

- **Capital Investments Towards Accelerated Water Quality Outcomes**: The 2023-26 Capital Plan includes a number of initiatives that target reductions in CSOs and urban runoff pollution that aim for accelerated water quality outcomes, as well as collaboration with Metro Vancouver on key trunk sewer projects.

- **Improved Planning and Decision Making**: This includes improved data management and modelling tools and development of a comprehensive watershed planning framework to address pollution and other management objectives

- **Public Communications and Outreach**: This includes expanding monitoring to all of Vancouver's CSO outfalls, implementing a public notification system, and developing a communications and engagement plan to improve public awareness and action around reducing pollution and other sewage and rainwater management objectives.

- **Demonstration Projects**: includes a range of projects that manage rainwater, targeting CSO and urban runoff pollution reduction and a range of environmental and social co-benefits. These projects will be closely monitored, and outcomes will inform planning decisions for other parts of the city.

TABLE C1. PRIORITY ACTIONS

Category	Actions
Investments in accelerated water quality outcomes	1. New priorities included in the 2023-26 Capital Plan: o Address CSOs and urban runoff pollution through targeted CSO reduction investments (Crowe St, Charleson Catchment, Renfrew Creek and SW Marine) o Increased resources for cross connection and pollutant source investigations 2. Progressively increase the rate of sewer renewal from 0.6 to 0.8% annually during the 2023-2026 Capital Plan, including separation of ~38km or 2.7% of the combined system. Anticipating a continued increase from 0.9% to 1.2% from 2027 to 2032, with the separation of ~85km or 6.2% of the combined system. (Refer to Figure C1) 3. Support Metro Vancouver on Manitoba Trunk Separation/Upgrade and Willow Storm Trunk projects 4. Implement distributed green rainwater infrastructure projects.

Improved planning and decision-making	1. Develop city-wide modeling strategy and continue with expansion of modeling tool. 2. Expand monitoring to all 20 of the City's combined sewer outfalls. 3. Procure data management platform. 4. Evaluate potential tools to achieve separation of combined property connection pipes as part of sewer separation projects. 5. Complete Green Rainwater Infrastructure Pathways study, to inform improved rainwater management practices and requirements for new development. 6. Develop the City's first Groundwater Management Strategy, with the objectives of protecting and making wise use of this limited resource, while identifying options for reducing groundwater infiltration into the City's sewage and drainage system and preserving system capacity. 7. Develop a watershed planning framework, to achieve consistent and holistic watershed planning that address pollution control and other water management objectives.
Public communications and outreach	1. Implement public notification system for the City's CSO outfalls 2. In collaboration with the Vancouver Park Board and Vancouver Coastal Health, implement water quality awareness signage at Vancouver beaches and key False Creek locations. 3. Develop public communications plan to improve public awareness around reducing pollution and achieving improved rainwater management on private properties.
Priority and/or demonstration projects to contribute to reduced CSOs and urban runoff pollution while providing a range of environmental and social benefits **(As shown in Figure C2, on next page)**	1. Complete the Hastings Creek/Renfrew Creek urban creek renewal project, which will manage rainwater from 100 hectares of the city and renew an urban creek. 2. Complete the Alberta Street and Columbia Park Blue Green System, which will preserve system capacity in the Oakridge Town Centre area and create enhanced public spaces. 3. Implement the Tatlow Creek Sewer Separation and Daylighting, which will separate local area sewers reducing CSOs and removing pollutants from urban runoff, as well as a range of co-benefits. 4. Following subway construction, implement the Broadway Complete Street, which will include green rainwater infrastructure and 119 large canopy street trees in the blocks around new subway stations. 5. Implement the St. George Rainway, which will include a series of green rainwater infrastructure practices, located in the same location as a historic creek and has been initiated by the local neighbourhood. 6. Pilot a Green Rainwater Infrastructure Laneway near Harriet St. and 30th will utilize an infiltration trench system and potentially create a template for other laneways in the city. 7. Pilot a porous asphalt parking shoulder on East 52nd Ave. between Vivian St. and Wales St. will be used to reduce the impervious area of the street while addressing a problem drainage area of the road.

	8. Test the effectiveness of different catch basin designs at preventing litter and debris from entering the storm sewer system. 9. Explore the implementation of a "Downspout Disconnection" pilot project, to incentivize the detention and retention of rainwater from roof-tops on private property, and reduce the amount of rainwater entering the sewage and drainage system. Portland and Toronto are recent examples.

Table C2 provides a summary of projects targeted to specific water bodies, which are being coordinated with the Aquatic Environments Action Plan. These actions focus on water bodies with known pollution, where it is anticipated that positive outcomes are viable in the short to medium term. In addition, these projects are not anticipated to require extensive planning processes or large-scale capital investments to achieve positive results. Targeted water bodies include Still Creek, Musqueam Creek, Vivian Creek and False Creek.

TABLE C2. ACTIONS TARGETED TO SPECIFIC WATER BODIES, IN COORDINATION WITH THE AQUATIC ENVIRONMENTS ACTION PLAN

Category	Actions
Still Creek A salmon-bearing creek with deep community interest and known biological pollutants.	1. **Proceed with the Still Creek Rehabilitation and Enhancement Study:** this study will guide future work in the Still Creek watershed to improve the health of the waterway including physical instream habitat, riparian habitat and water quality while benefiting ecological, social, and cultural values. 2. **Implement Distributed investments in Green Rainwater Infrastructure:** This work will improve management of rainwater runoff, reducing contaminant loading from City of Vancouver streets as well as managing flow rates. 3. **Cross-Connection and Pollutant Source Investigations**: Over recent years, cross connection investigations have identified a number of locations where sanitary connections from private properties enter storm drainage pipes that flow into Still Creek. The catchment area is large, and more work is required to identify other potential cross connections in the area.
Musqueam Creek A salmon-bearing, creek of cultural significance to the Musqueam Indian Band, with potential biological pollutants.	1. **Proactively engage and support Musqueam Creek Working Group**: This group was established to investigate potential sources of pollution in the Creek. It includes representatives of the Musqueam Indian Band, Metro Vancouver and the City of Vancouver. 2. **Investigative Work** to identify any potential pollutant sources. 3. **Targeted Elimination of Pollutant Sources**: remediate any sources of pollution identified.

Vivian Creek **Biological pollutants** arising from potential cross-connections	1. **Investigative Work**: to identify any potential pollutant sources 2. **Targeted Elimination of Pollutant Sources**: remediate any sources of pollution identified.
False Creek A heavily used waterway for recreation, with poor circulation and elevated **biological pollutants**	1. **Ongoing Investigations**: to identify potential pollution sources from the sewer and drainage system 2. **Targeted Elimination of Pollutant Sources**: remediate sources of pollution identified. 3. **Review of System Operations**: review of operating parameters for weirs, pump stations etc. to understand if the operation can be modified to reduce overflow events 4. **Targeted Sanitation and Street Sweeping**: continue resource deployment of sanitation and street sweeping in areas with separated storm sewers that drain into False Creek 5. **Complete Sewer Separation**: in the Charleston sewer catchment area (see “Investments Targeted to Accelerated Water Quality Outcomes” in Table D2

FIGURE C1. MAP OF SEWER RENEWAL AREAS

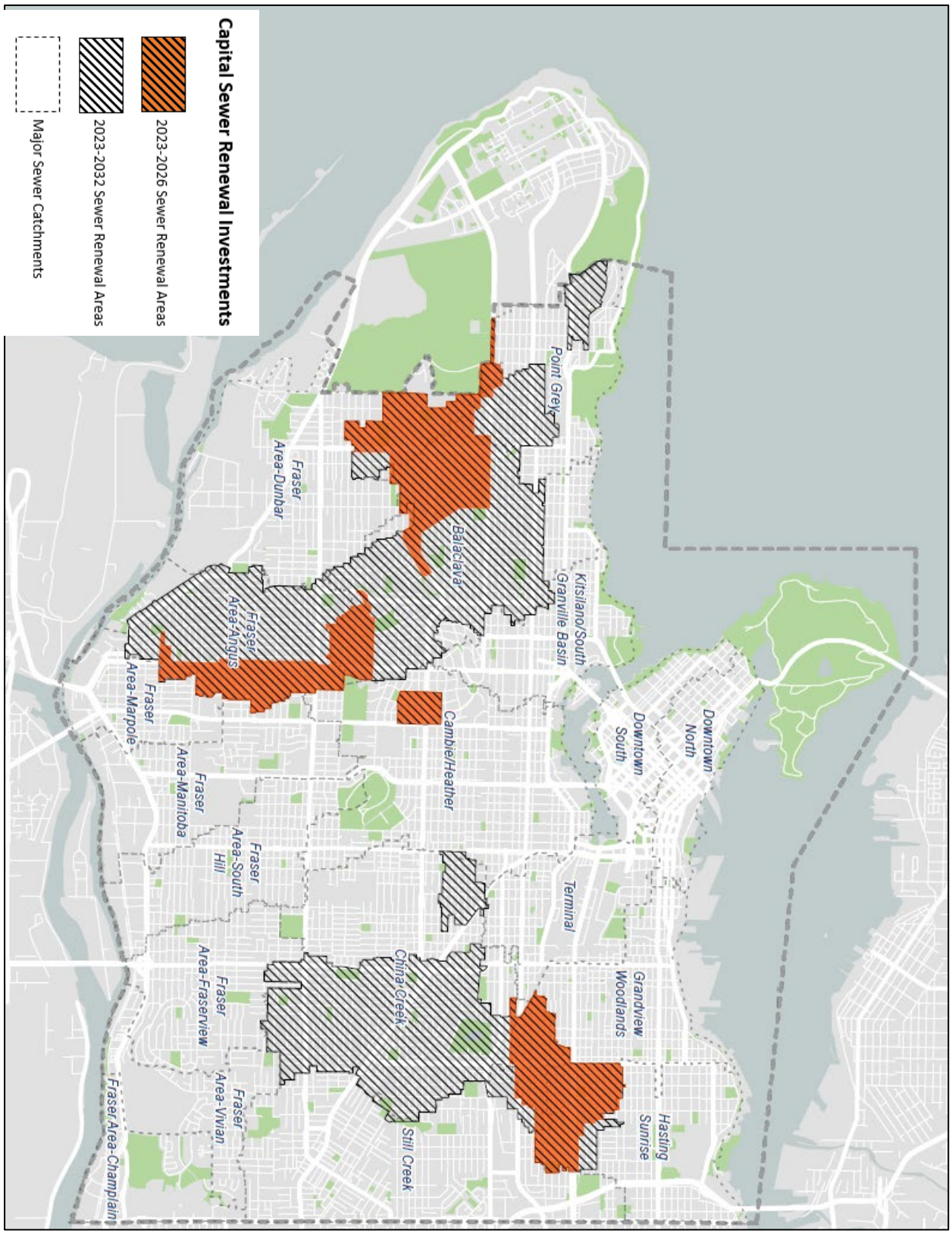


FIGURE C2. MAP OF OTHER PRIORITY ACTIONS