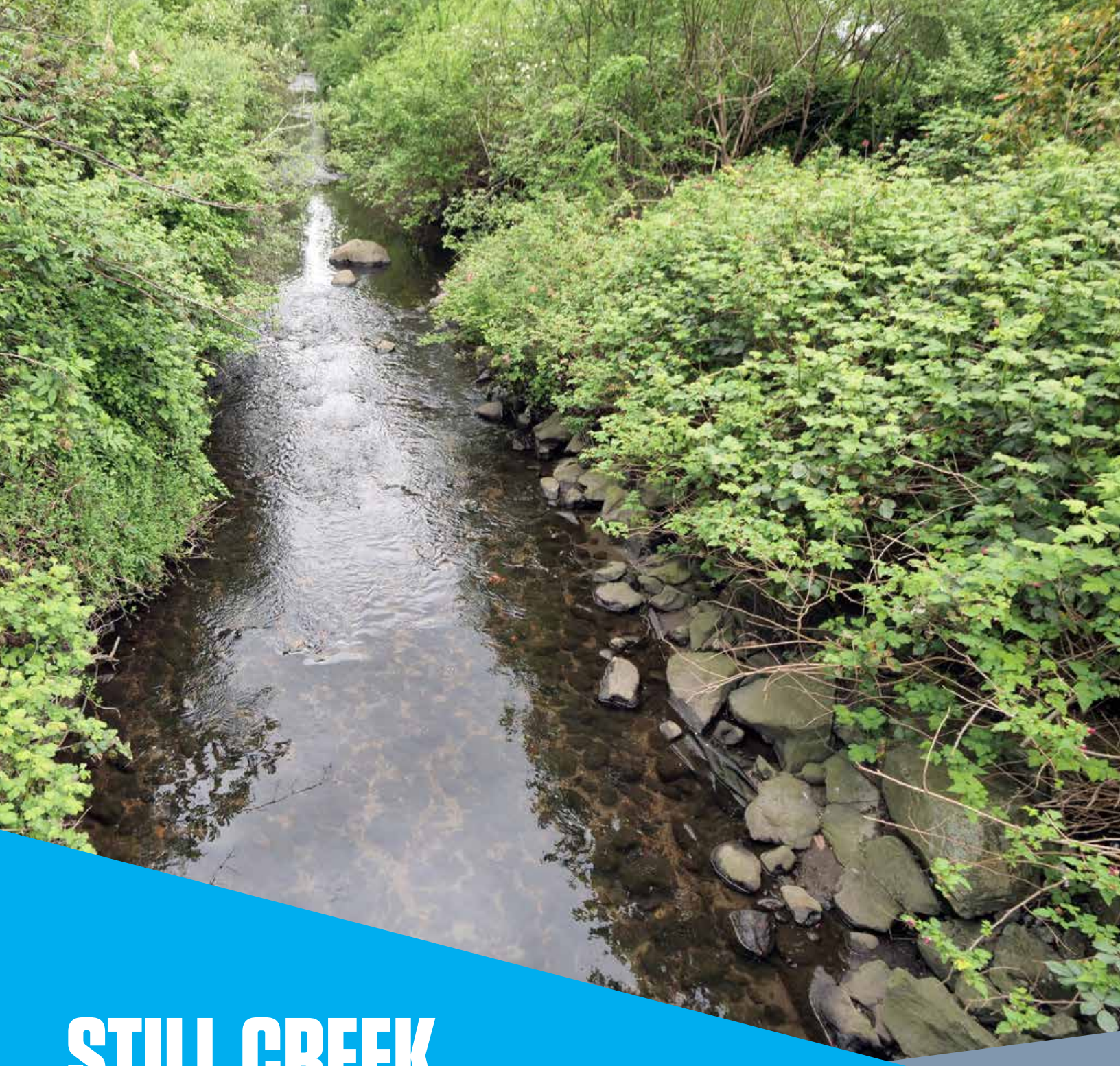

STILL CREEK

WATERSHED ENHANCEMENT OPPORTUNITIES STUDY

August 2023

CITY OF VANCOUVER

Cover image: View of Still Creek near Cornett Road at Natal Street, Vancouver (2022).

Image on page 4-5: View of Still Creek near Nootka Street at Grandview Highway, Vancouver (2022).

Report prepared by space2place design inc. and Kerr Wood Leidal

For the City of Vancouver

August 2023

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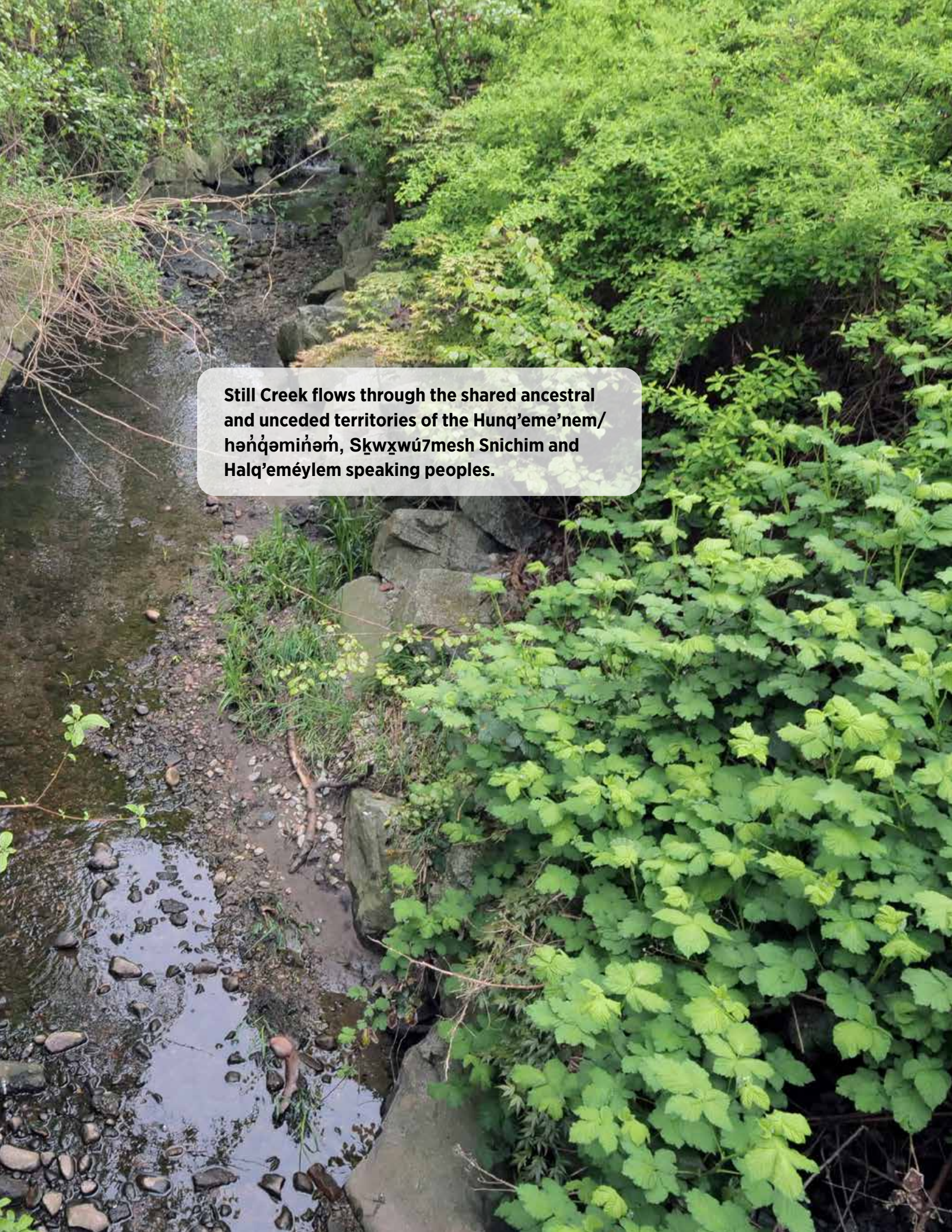
APPENDICES (COMPANION DOCUMENTS)



Still Creek flows through the shared ancestral and unceded territories of the Hunq'eme'nem/ hən̓q̓əmin̓əm̓, Sḵwx̱wú7mesh Snichim and Halq'eméylem speaking peoples.

ACKNOWLEDGEMENTS

The development of the Still Creek Watershed Enhancement Opportunities Study would not have been possible without the contributions of many people and groups. The individuals named below directly contributed to the report content. This work was also inspired by and builds on the decades of Still Creek enhancement work completed by community groups, local and regional government staff, and consultants/practitioners. Given how special Still Creek is in the Vancouver urban watershed context, the project team members are honoured for the opportunity to participate in this work and genuinely hope that this work contributes positively to the incremental enhancement of the watershed.

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EXECUTIVE SUMMARY

The purpose of the Still Creek Watershed Enhancement Opportunities Study (herein called 'the study') is to guide future work in the Still Creek watershed. The study refines and advances the vision from a previous City of Vancouver study (2002 Still Creek Rehabilitation and Enhancement Study). Since 2002, a number of City-led enhancement projects were constructed while community-led stewardship emerged as a major presence in the watershed, led by groups such as the Still Moon Arts Society and supported by the City and the Vancouver Board of Parks and Recreation. The need for this study was triggered by several factors, including an evolving understanding of watershed planning and stormwater management, and new policies and approaches adopted since 2002, including the Still Creek Integrated Stormwater Management Plan, the Rain City Strategy, VanPlay, the Climate Emergency Action Plan, and the Vancouver Plan. The study also responds to parallel initiatives including the City's work to respond to recently updated floodplain mapping for the Still Creek-Brunette River drainage area, which shows an increasing flood hazard due to climate change, and the development of the Rupert and Renfrew Station Area Plan, through which watershed planning and land use planning are being integrated to enhance the creek while enabling growth. The study used a review of background information, an updated baseline environmental assessment, and workshops to develop a refined vision and design principles for watershed enhancement. The overall vision for the Still Creek watershed is nested within the lenses of ecology, water, and community, all of which are managed in an integrated way through a watershed-based process and approach.

Watershed enhancement opportunities have been identified and described at different scales. One of the big opportunities is to enhance the creek corridor between Renfrew Street and Boundary Road through replacing portions of the creek flowing in underground pipes with naturalized creek channels open to the surface (a process called daylighting) and establishing a wide riparian area. This is an opportunity to use more naturalized drainage and flood management approaches, restore ecological processes, and integrate native plant species. Rehabilitating and expanding natural systems in Vancouver, and restoring some of the diversity of flora and fauna from pre-European settlement, can help make space for xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh Nation) to engage in their cultural uses and practices, in alignment with the City's United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Strategy. Elsewhere in the watershed, a list of opportunities has been developed to implement district-scale green rainwater infrastructure (GRI) projects on public lands. These are opportunities to restore natural watershed processes to slow down rainfall runoff and treat it before it reaches the creek channel, while also increasing tree canopy, biodiversity, and community connection to the watershed. Eight sites were advanced to concept design in the study. Four of these are projects funded in 2023 by the City and Infrastructure Canada through the Natural Infrastructure Fund; these will be constructed in the coming years. Supplementing the opportunities for physical enhancement projects, the study also re-establishes the importance of connecting with the community. Opportunities have been identified for the City to work more closely with the community to expand the presence of Still Creek into surrounding neighbourhoods through engagement, education, and public art.

Through the combination of these enhancement opportunities at different scales and enabling integration with land use planning and other initiatives, the study aims to improve ecological, cultural and social values for Still Creek, the surrounding neighbourhood and the city overall.

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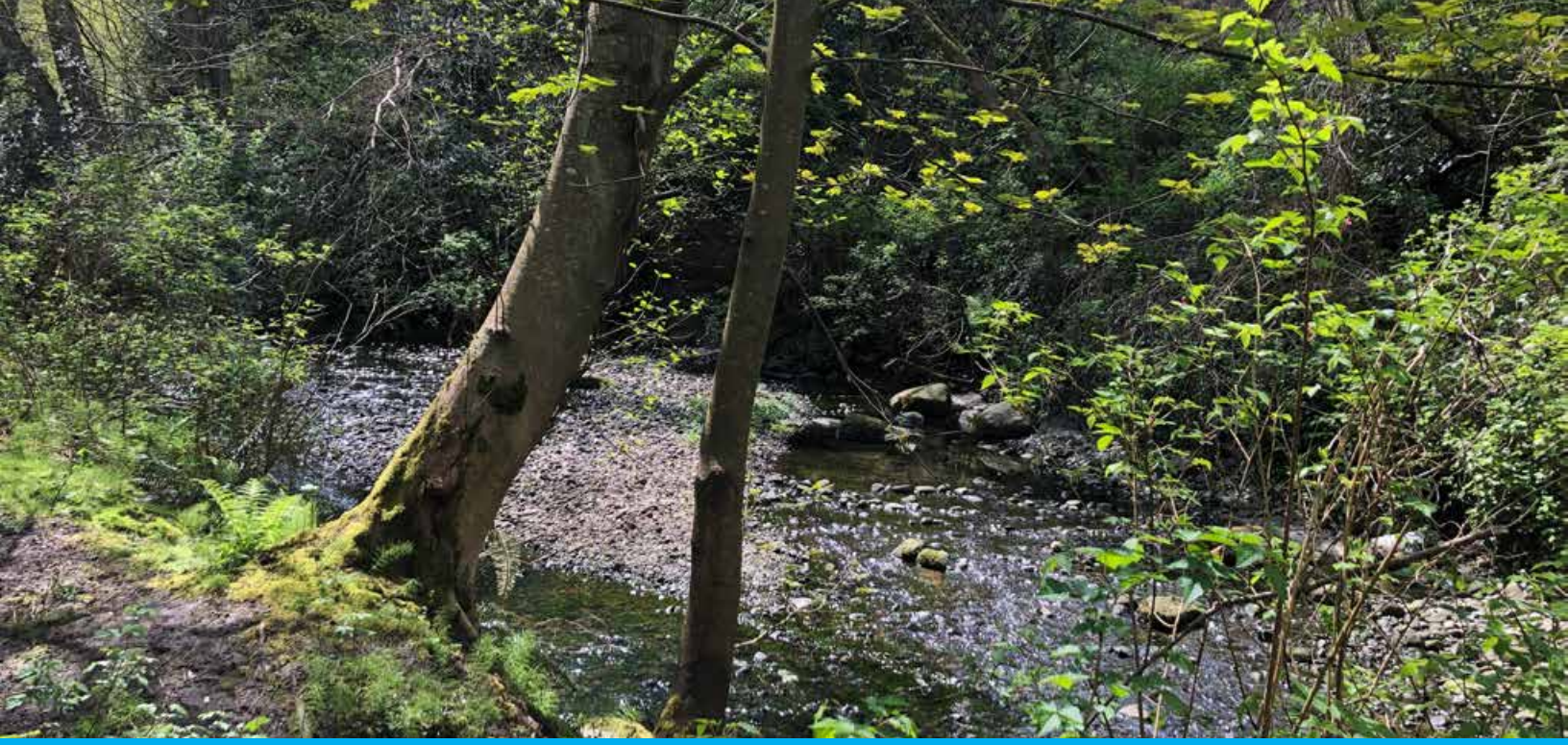

1.0 INTRODUCTION

1.1 PURPOSE

Since 2002, when the first Still Creek Rehabilitation and Enhancement Study was endorsed by Vancouver City Council and the Vancouver Board of Parks and Recreation, many enhancement projects have been undertaken by the City and by community groups. Several projects have been implemented in the Still Creek corridor between Renfrew Street and Boundary Road, and these projects have helped raise awareness of Still Creek's tremendous importance in the city.

The current project, the Still Creek Watershed Enhancement Opportunities Study builds on the vision from the 2002 study, creating an updated and fully daylit creek corridor concept, and identifying a suite of GRI project opportunities across the watershed that would improve the health of the waterway, while increasing the broader ecological, social and cultural values related to the creek.

The study seeks to identify opportunities to improve the ecological health of Still Creek by improving instream and riparian habitat, water quality, and water flow volumes through a combination of work within the corridor between Renfrew Street and Boundary Road, and GRI projects across the watershed.

Specific objectives of the project that were set out included:

1. Review and update Still Creek enhancement objectives in the context of current science, practice and policy.
2. Review the current applicability and feasibility of the concepts provided in the 2002 Enhancement Study.
3. Develop an updated concept plan for full creek daylighting between Renfrew Street at 14th Avenue and Boundary Road/Highway 1, to be integrated with the Rupert and Renfrew Station Area planning process.
4. Identify potential GRI sites and develop concepts for standalone projects in the urban watershed with a focus on water quality improvement and flow attenuation.
5. Summarize enhancement concepts for input into the Rupert and Renfrew Station Area planning process.

Additional goals for the work include:

- Make space for the local Nations to shape detailed design, such as through incorporation of places for cultural uses, practices and knowledge-sharing.
- Enrich the broader public space value of Still Creek by improving circulation and views into the corridor, and by creating places where people can experience and learn about the creek and its watershed.
- Facilitate stewardship and connections to the creek by improving access for community organizations and creating places for limited access activities (e.g., replacement of invasive plant species with native species and fish fry releases).
- Integrate the results of updated floodplain mapping and climate change projections to ensure the redesigned creek corridor is adaptable to a more dynamic climate.
- Integrate new City policies that affect land and water management within the Still Creek watershed including the Vancouver Plan, Rain City Strategy, VanPlay, Still Creek Integrated Stormwater Management Plan, and Climate Emergency Action Plan, among others.
- Inform the Rupert and Renfrew Station Area Plan being developed in parallel to the study.

1.2 SCOPE OF WORK AND PROJECT PROCESS

The primary scope of work for the Still Creek Watershed Enhancement Opportunities Study includes:

- Conceptual design of the Still Creek corridor between Renfrew Street (at 14th Avenue) and Boundary Road/Highway 1, linked with planning that is underway for the Rupert and Renfrew Station Area Plan.
- Identification of a long list of potential watershed GRI project sites that have the capacity to improve water quality being discharged to Still Creek and to attenuate flows (i.e., slow the rate of run-off going into the creek).
- Concept design of four watershed GRI park projects that have received federal funding through the Natural Infrastructure Fund (NIF). These sites include Slocan Park, Falaise Park, Cornett Road, and Charles Park (headwaters of Chubb Creek, which is a tributary of Still Creek); detailed design of these sites is documented separately.
- Selection and concept design of three watershed GRI projects from a long list of sites based on watershed analysis and alignment with other City initiatives; chosen sites include Nootka Street, Earles Park, and Killarney Park, and some of their adjacent street rights-of-way. These individual site concepts also serve as context-sensitive typologies that can be applied to other potential GRI projects identified in the study.

The project process (Figure 1-1) has included a combination of background research, site visits, workshops with various City of Vancouver departments, engagement with community members, review by xʷməθkʷəy̓əm (Musqueam Indian Band) Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh Nation) representatuves, iterative conceptual design, high level engineering review, and documentation. A summary of the City workshops and the key outcomes from these meetings is documented in Appendix B.

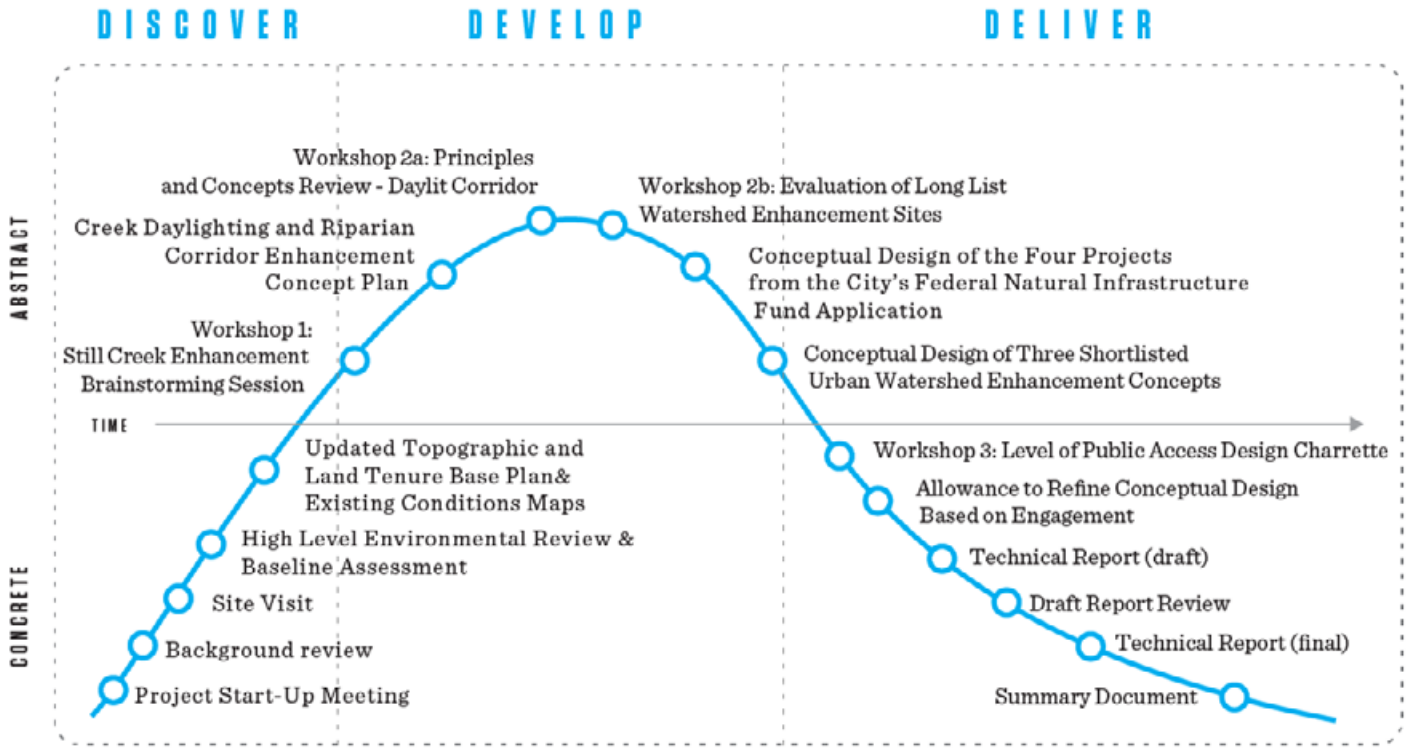

Figure 1-1 Graphic overview of the project process

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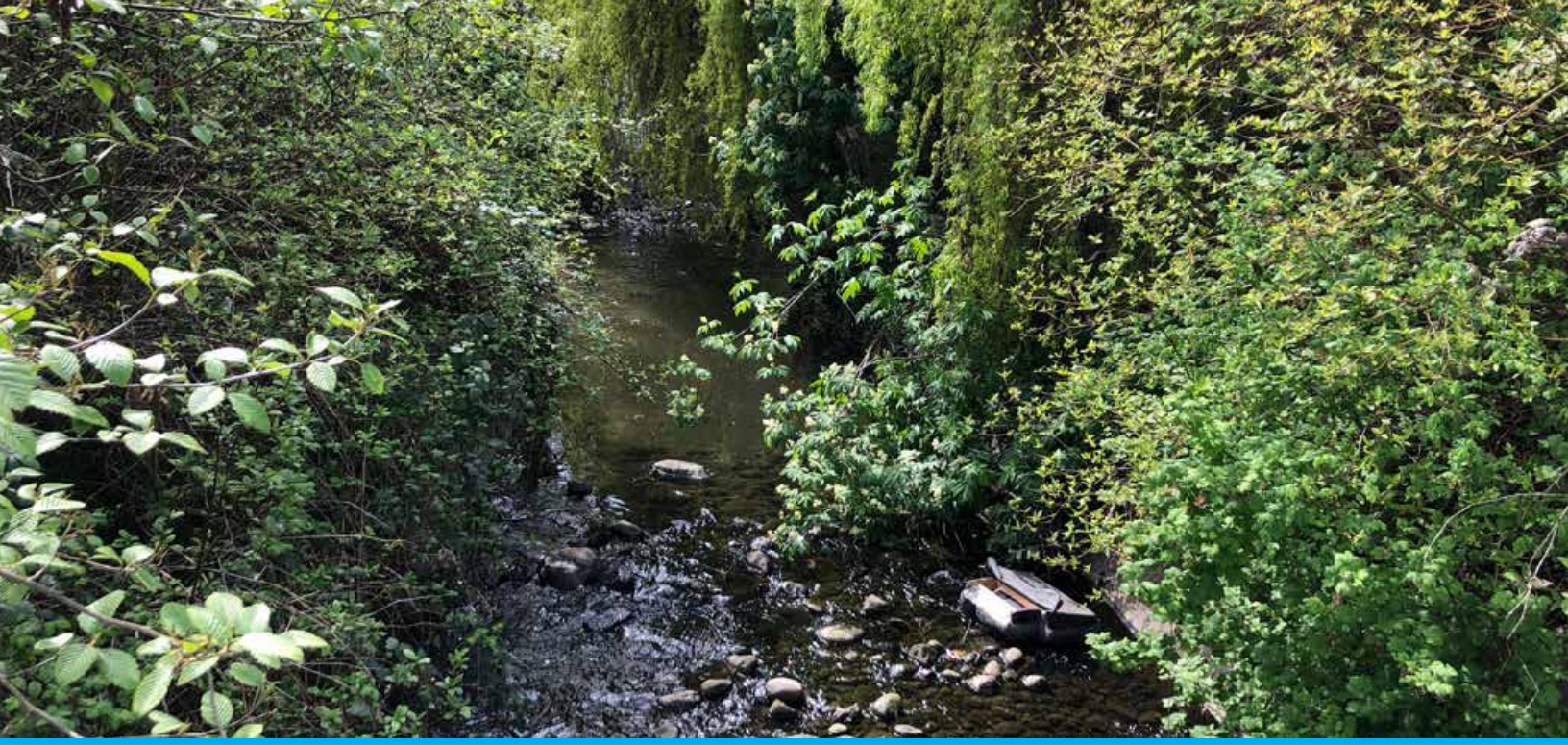


2.0 BACKGROUND & CONTEXT

STILL CREEK WATERSHED BOUNDARIES

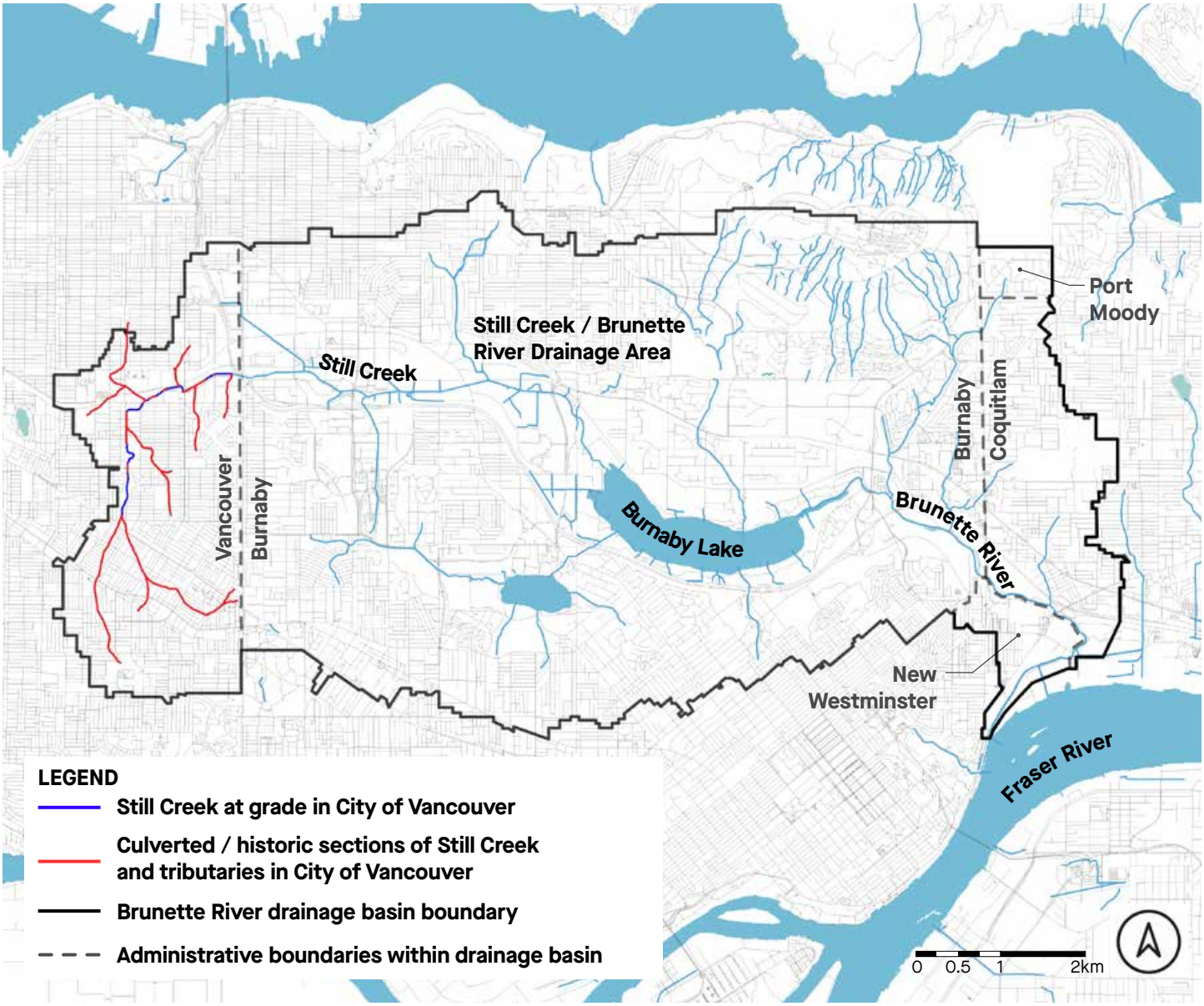


Figure 2-1 Map of the Still Creek watershed within the City of Vancouver, and the larger Still Creek-Brunette River drainage basin

2.1 HISTORICAL CONDITIONS

Still Creek is part of the larger Still Creek – Brunette River basin that drains an area of 73 square kilometres and flows through Vancouver, Burnaby, Coquitlam and New Westminster (Figure 2-1).

The Vancouver portion of the Still Creek watershed is located within the traditional, unceded territories of the xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), səlilwətaɬ (Tsleil-Waututh Nation) and Stó:lō Nation.

The local Nations' way of life and their relationship with the land and water was profoundly altered when European settlers began transforming the landscape of the Still Creek watershed through logging and settlement in the 1800s.

An early land survey of the Vancouver area from the late 1800s characterized the uplands of the watershed as temperate rainforest, with a mix of large fir, cedar and hemlock trees. Wet habitats in the Still Creek lowlands were described as having spruce, alder and cranberry bogs, with numerous beaver dams and beaver ponds. Figure 2-2 summarizes selected historic ecological features of the watershed based on this land survey and by mapping by Macdonald (1992).

In addition to the widespread presence of beavers, wildlife included bears, elk, and cougars, as well as many types of wildlife still found in the watershed today — including waterfowl, songbirds, small mammals, fish, and amphibians. Several beaver ponds were located along modern-day Grandview Highway between Renfrew Street and Lillooet Street. Another large beaver pond was documented in the Collingwood neighbourhood in the mid 1800s, referred to at the time as Collingwood Lake.

By the 1920s, development had expanded and many of Still Creek's small tributaries were buried and converted into part of the City's storm sewer system. Maps show Still Creek and one of its tributaries still extended for some distance south of 29th Avenue.

Most of the forest in the watershed had been cleared and converted to residential development in the uplands and slopes by the 1940s, with industrial and agricultural uses in the lowlands. Still Creek was straightened, cleared of vegetation, and often used as an open channel for conveying wastewater and stormwater. Salmon were reportedly still spawning in Still Creek in the early 1930s, but likely stopped returning to Still Creek due to a combination of the Cariboo Dam construction downstream in Burnaby in 1935 (which blocked fish passage) and deteriorating water quality from industrial development along the creek (Rosen 2017).

SELECT HISTORICAL FEATURES OF STILL CREEK IN VANCOUVER

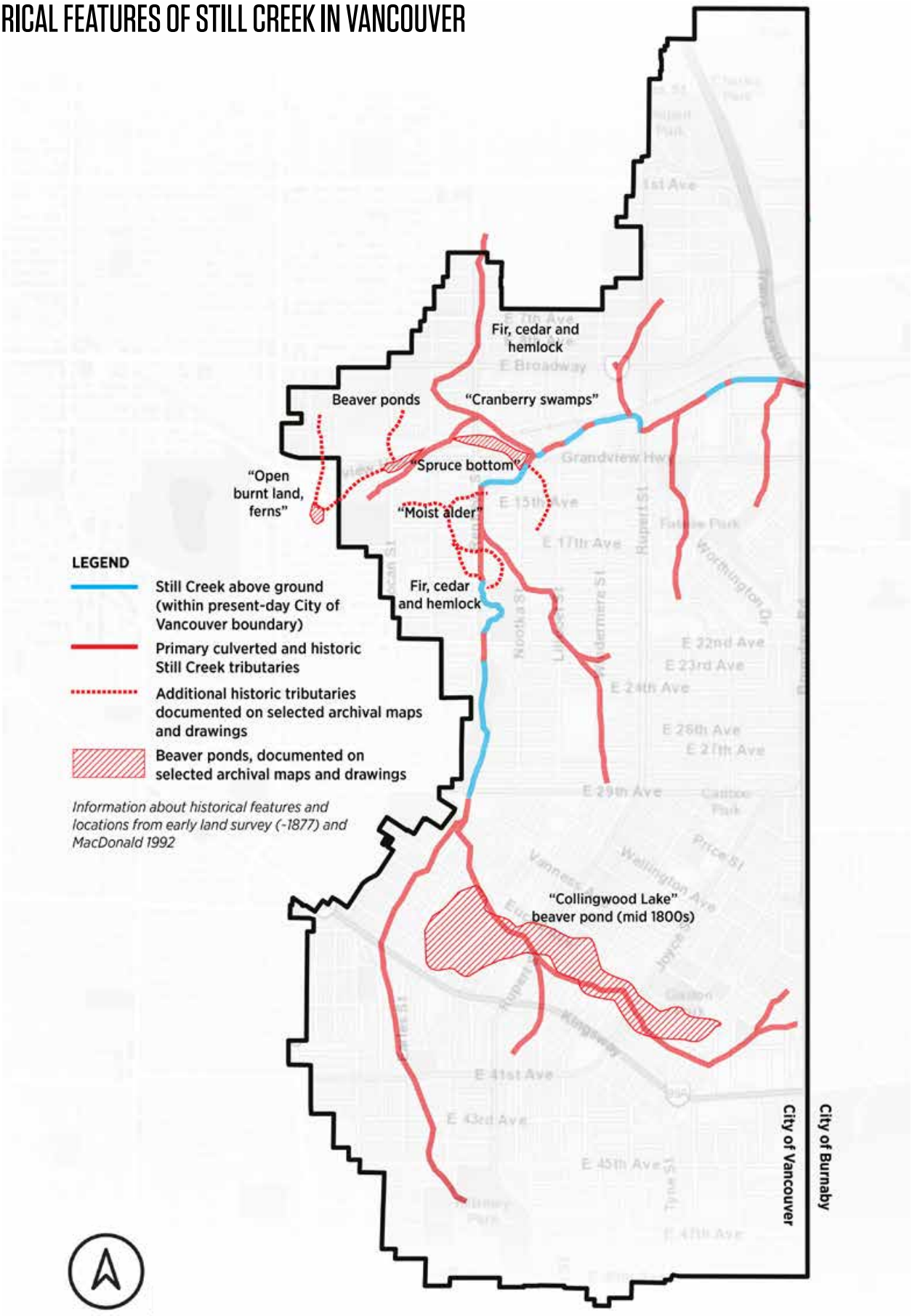


Figure 2-2 Selected historical ecological features from the 1800s (Macdonald 1992, land survey 1877), including some of Still Creek's lost tributaries, overlaid on modern-day street map

During the 1950s and 1960s extensive channel armouring of the open creek channel took place to help with erosion and degrading banks due to increasing flow volumes as the area densified. During this time, and the decades that followed, agriculture was converted to more urban uses, traffic intensities increased, and the water quality of Still Creek continued to deteriorate. Water quality monitoring documented the widespread presence of many urban contaminants (e.g., lead, copper, zinc, mercury, and polychlorinated biphenyls [PCBs]). At the same time the Province of BC developed water quality guidelines with the aim to protect aquatic health; many of these contaminants still exceed aquatic guidelines.[1] High fecal coliform levels in the creek were documented in the early 1970s prompting a decades-long initiative to reduce incorrect sewer connections leading to sewage being discharged into the creek (referred to as cross-connections), which continues to this day.

Community environmental stewardship initiatives began in earnest in the late 1990s and became embedded in the culture of the neighbourhood in the following decades. This shift in public perception towards Still Creek has led to numerous community events and public art installations related to the creek, as well as ecological restoration initiatives along the corridor in the past decade.

[1] Relevant guidelines for water quality in Still Creek include the Provincial Ambient Water Quality Guidelines (2021) and Metro Vancouver's Monitoring and Adaptive Management Framework (2014) for stormwater. Refer to Appendix A for more information about water quality studies done in Still Creek, and how results compare to these regional and provincial water quality guidelines.

2.2 PREVIOUS STUDIES AND PLANS

Still Creek enhancement work within the Vancouver watershed has been informed by many foundational plans and policies undertaken by the City of Vancouver with its partners over the past several decades. Figure 2-3 identifies the geographic scope of selected policies and plans that have informed enhancement work, including:

- Still Creek Rehabilitation and Enhancement Study (2002)
- Grandview-Boundary Mixed Employment Area Plan (2002)
- Still Creek Integrated Stormwater Management Plan (2006)
- Master Plan for Renfrew Ravine and Renfrew Community Park (2013)
- Biodiversity Strategy (2016)
- Rain City Strategy (2019)
- Integrated Blue Green Systems Planning, administrative report (2019)
- VanPlay: Vancouver's Parks and Recreation Services Master Plan (2020)
- Still Creek-Brunette River Drainage Area Flood Assessment, Floodplain Map Updates, and Flood Management Recommendations (2021)
- Vancouver Plan (2022)
- UNDRIP Strategy (2022)
- Rupert and Renfrew Station Area Plan (current, 2022-2024)

MAP OF SELECTED WORK RELATED TO STILL CREEK IN VANCOUVER

LOCAL STUDIES + PLANS

1. Still Creek Rehabilitation and Enhancement Study (2002)
2. Grandview-Boundary Mixed Employment Area Plan (2002)
3. Master Plan for Renfrew Ravine and Renfrew Community Park (2013)
4. Still Creek-Brunette River Drainage Area Flood Assessment [graphic indicates scope within City of Vancouver] (2021)
5. Renfrew and Rupert Station Area Plan (current, 2022-2024)

CITY-WIDE PLANS + STRATEGIES

Still Creek Integrated Stormwater Management Plan (2006)
Biodiversity Strategy (2016)
Rain City Strategy (2019)
Integrated Blue Green Systems Planning Report (2019)
VanPlay (2020)
Vancouver Plan (2022)
UNDRIP Strategy (2022)

COMPLETED RESTORATION WORK

- A 3003 Grandview Highway, habitat enhancement
- B 3400 Cornett Road, channel enhancements
- C 3300 Cornett Road, high flow channel
- D 2900 Nootka Street, channel / riparian enhancement
- E Falaise Park wetland

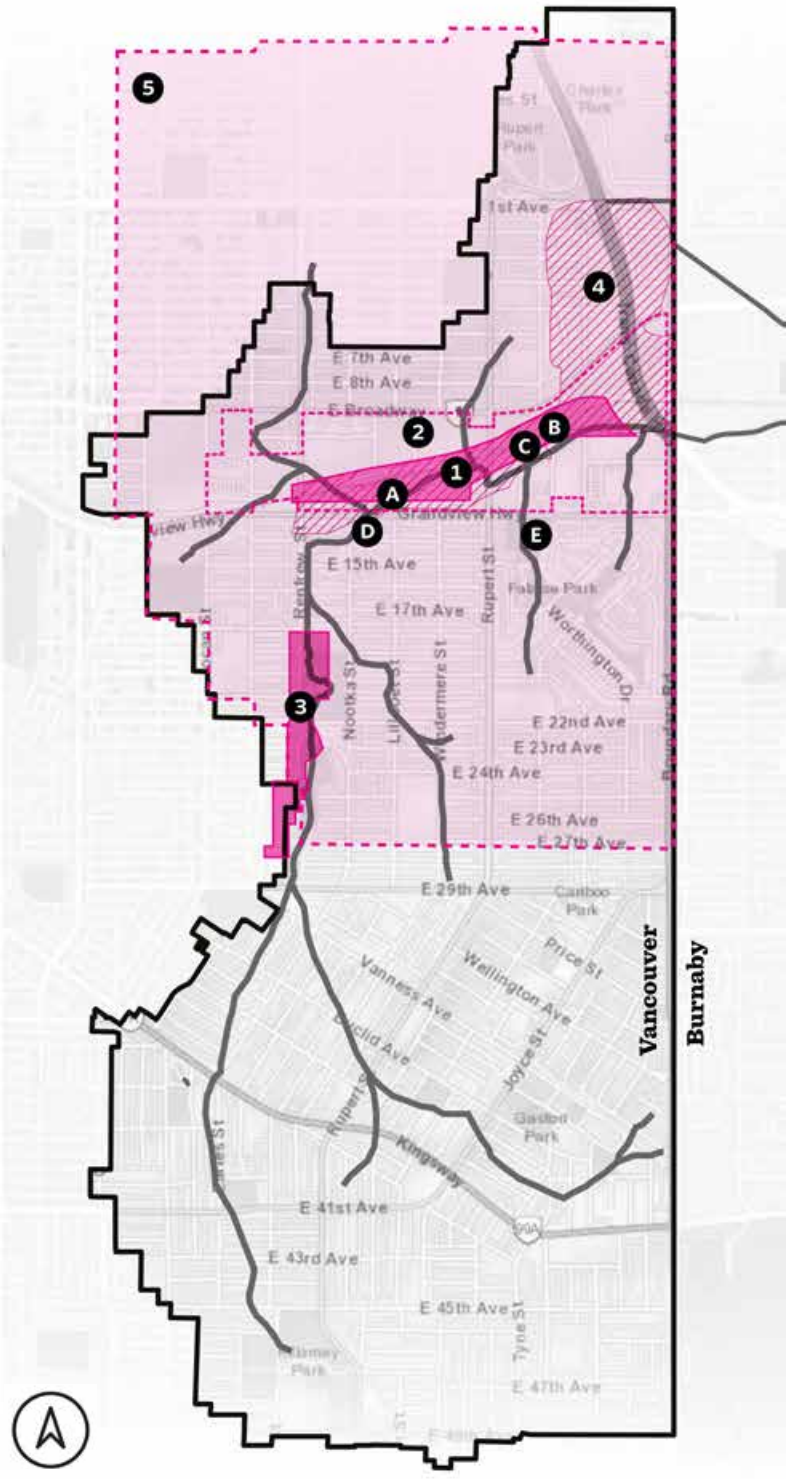


Figure 2-3 Map of selected local studies, city-wide plans, and completed restoration work

Still Creek Rehabilitation and Enhancement Study (2002)

This study (Lees and Associates 2002) was the first in Vancouver to look comprehensively at opportunities along the Still Creek corridor between Renfrew Street and Boundary Road (Figure 2-4) to improve stream and riparian ecology, maximize recreational and amenity opportunities in order to enhance the ecological health of Still Creek. The study also considered high level ways of improving stormwater management within the watershed as a whole.

Goals of the 10-year action plan for the main study area, which extended from Nootka Street north of Grandview Highway to Boundary Road, included improving stormwater management, enhancing recreation, and increasing awareness of Still Creek through public art, events, and educational kiosks.

Longer term goals (10 to 50 years) were to enhance riparian habitat, improve water quality, decrease stormwater peak flows and flood risk, expand recreation opportunities, improve pedestrian and cycling connections to surrounding active transportation routes, and increase the presence of nature in the city through ongoing art installations and events. The creek corridor concept and other content from the study were incorporated into the Grandview Boundary Mixed Employment Area Plan.

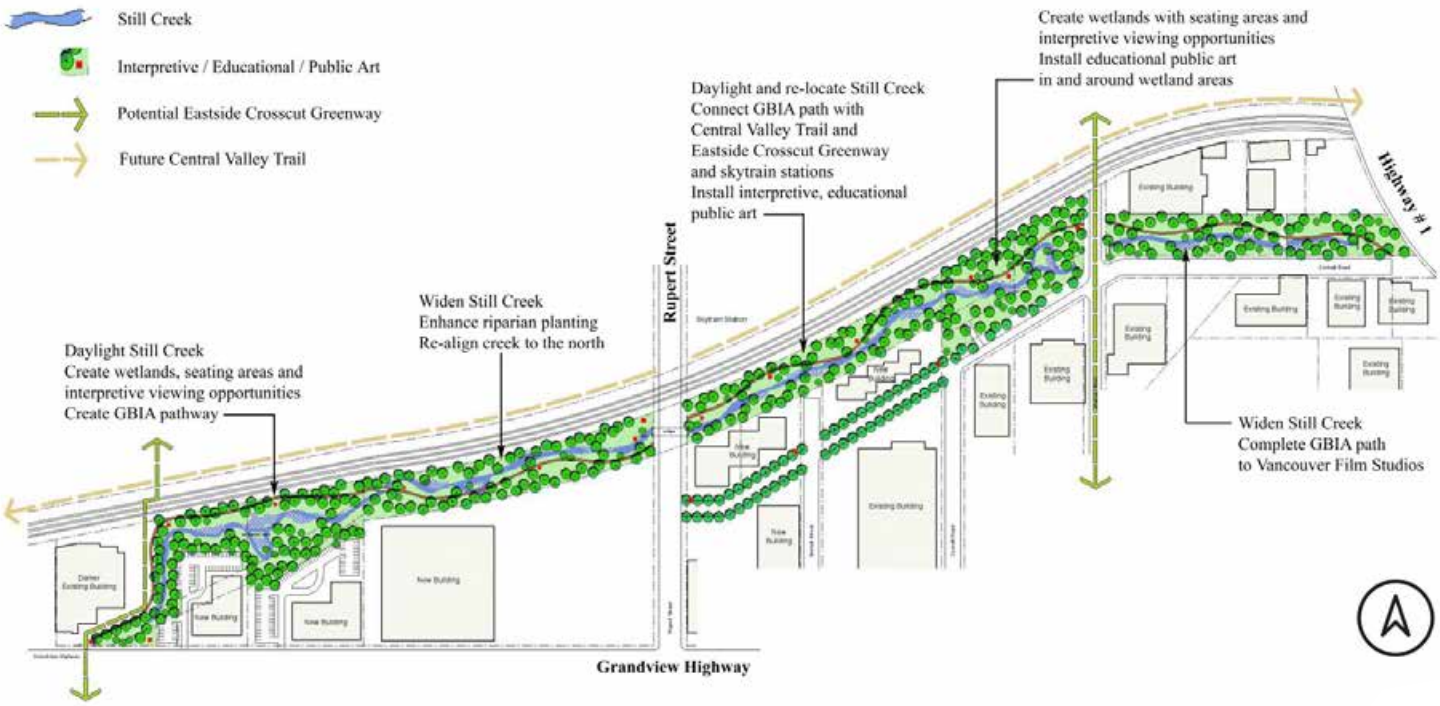


Figure 2-4 The 2002 Still Creek Rehabilitation and Enhancement Study's vision for 10 to 50 years

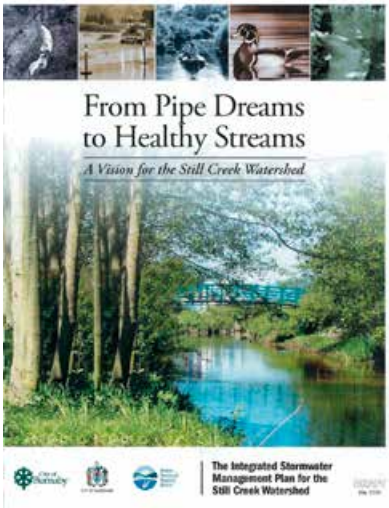
Grandview-Boundary Mixed Employment Area Plan (2002)

The Grandview-Boundary Mixed Employment Area (GBMEA) guides land use planning in the part of Vancouver roughly bounded by Broadway, Grandview Highway, Boundary Road and Slocan Street. The plan envisions increased mixed-use density, particularly at the Renfrew and Rupert SkyTrain station hubs, and outlines specific design guidelines to help foster more vibrant and pedestrian-friendly public space. The GBMEA plan was originally adopted by Vancouver City Council in 2002, and has been amended several times since, most recently in 2023.

The plan identifies opportunities to enhance Still Creek as a significant public amenity and recreation space within the area. The GBMEA plan incorporates the recommendations from the 2002 Still Creek Study, and identifies potential to implement the short-term (10 year) and long-term (10-50 year) enhancement actions through redevelopment opportunities and public space additions in the area. Various components of the plan also set out urban design guidelines for development in the vicinity of Still Creek to guide stormwater management, landscape design, creek buffer zones, and daylighting of buried sections of the creek.

The plan aims to incrementally achieve Still Creek enhancements and additions of public recreation space integrated with an expanded daylit creek corridor, as sites redevelop over the long-term.

Still Creek Integrated Stormwater Management Plan (ISMP), From Pipe Dreams to Healthy Streams: A Vision for the Still Creek Watershed (2006)



The 2006 Still Creek ISMP was initiated in response to a provincial mandate for stormwater management plans to be produced in the region (McElhanney et al 2007). The overarching goal for the Still Creek ISMP was to help guide development in the watershed in a way that protects and improves the water quality in Still Creek.

The 2006 Still Creek ISMP articulated a vision "To protect or enhance the aquatic and terrestrial ecosystems and the human populations they support in an integrated manner that accommodates growth and development." The ISMP documented strategies, actions, and the following goals to achieve that vision:

- Goal 1: Reduce flood impacts on people, property and the stream channel and strive to restore a more natural flow regime.
- Goal 2: Reduce stream erosion and downstream sedimentation to levels approaching a more natural stream.
- Goal 3: Protect and enhance streamside and aquatic habitats.
- Goal 4: Protect and enhance forests and trees in the watershed.
- Goal 5: Protect and improve water quality.
- Goal 6: Maintain and increase native species biodiversity.
- Goal 7: Connect people to the watershed and its streams.
- Goal 8: Provide stream-related education.

All of the above goals are advanced by actions in the Still Creek Watershed Enhancement Opportunities Study, with a focus on goals 1, 2, 3, 5 and 6.

Within the ISMP was a design concept for part of the Still Creek corridor in Vancouver, highlighting opportunities for further daylighting, water quality treatment facilities, fish access improvements, and alternative alignments for the daylit corridor. The study also identified opportunities for GRI projects in the vicinity of the corridor (i.e., Falaise Park, Renfrew Community Park, and others), as well as enhancement opportunities for the larger Still Creek watershed downstream to Burnaby Lake.

Master Plan for Renfrew Ravine and Renfrew Community Park (2013)

The Master Plan for Renfrew Ravine and Renfrew Community Park, developed in 2013, is a long-range master plan for these parks, located along Renfrew Street from 19th Avenue to 29th Avenue, and separated by the intersection of East 22nd at Renfrew Street. The Master Plan was approved by the Vancouver Park Board in September 2013.

Still Creek runs through Renfrew Ravine as a natural channel within a wide forested ravine and through Renfrew Community Park as a narrower channel with a natural bed and stone and concrete side slopes. The master plan guides future capital planning and restoration projects, including features like creek and vegetation enhancement, paths, gathering spaces, signage, seating, creek crossings, and recreational facilities.

Specific implementation timing was not specified, apart from a high-level suggested phasing of actions, and is to be determined iteratively based on the need to replace existing amenities and the availability of funding. Work to date includes upgrades to the pedestrian network with several new staircases accessing the trails along the creek, a new creek crossing, habitat fencing, benches, and wayfinding (2018). Ongoing invasive species removal has been coordinated with local community groups throughout the area.

Biodiversity Strategy (2016)

The City of Vancouver's Biodiversity Strategy identifies ways to increase the amount and ecological quality of natural areas to support biodiversity and access to nature (Axys Environmental 2016). The Strategy set a goal of restoring or enhancing 25 hectares of natural areas by 2020, which has now been achieved. Natural areas include marine/shoreline, wetlands, riparian, forested areas and intertidal zones, natural managed areas in parks and street rights-of-way.

The Strategy proposed to achieve this through various tools, including protecting and enhancing existing natural areas, increasing the ecological diversity of parks, encouraging the creating of natural habitat on private property, and supporting biodiversity within parks, streets, and other city-owned land.

In particular, the Strategy highlights the importance of restoring the forest and creek habitat in Renfrew Ravine and continuing to improve the health of Still Creek, recognizing that these areas are important biodiversity hotspots in the City. Ongoing collaboration with community groups and increasing public education are recognized as important tools that will help with these ambitions.

Rain City Strategy (2019)

The Rain City Strategy represents a significant paradigm shift for how rainwater is managed in the City of Vancouver. Instead of seeing rainwater as a problem and removing it from properties and streets as quickly as possible, the Strategy seeks to embrace rainwater as a valued resource for the City and for supporting natural ecosystems.

The Strategy promotes capturing and treating rainwater as close to where it falls as possible, utilizing GRI to clean the water, removing contaminants from urban rainwater runoff, increasing urban biodiversity, improving the quality of public spaces by adding more trees and vegetation, and reducing flood risk.

Two of the targets set out in the Strategy are to capture and clean 48 mm of rainwater per day from public and private land, and to capture and clean 40% of runoff from impervious surfaces by 2050. To achieve this requires the development of new street design standards, and for GRI to be incorporated into redevelopment of public and private property.

Integrated Blue Green Systems Planning Report (2019)

This report outlines a vision for blue green systems (BGS) planning, which seeks to integrate several concurrent City planning initiatives related to rainwater management and greenways in the City, including watershed planning, greenways planning, and preliminary scoping for the False Creek to Fraser River Blueway.

The vision of BGS is to develop a network of water management streets, parks and open spaces that prioritize people, active transportation (walking, cycling), GRI, and space for increasing urban biodiversity while picking up overland flow routes. The resulting blue green corridors seek to align and optimize the co-benefits of multiple City priorities.

BGS study areas that are within the Still Creek watershed include the False Creek to Fraser River Blueway and the East Side Crosscut. Conceptual work on these areas has led to a draft BGS layout within the Still Creek watershed, which identifies potential street rights-of-way for GRI, active transportation, urban tree canopy expansion, and other urban biodiversity enhancements. This work has also led to the current project that seeks other opportunities for enhancing the Still Creek watershed.

VanPlay: Vancouver's Parks and Recreation Services Master Plan (2020)

The vision outlined in VanPlay is "to be a leader in parks and recreation by connecting people to green space, active living and community." Selected goals of VanPlay with direct relevance to Still Creek enhancement work include:

- Grow and renew parks and public spaces.
- Protect existing parks and recreation spaces.
- Prioritize the delivery of resources to underserved areas.
- Adapt our parks and recreation amenities to a changing climate.
- Create a green network (i.e., by increasing the connectivity of parks and green spaces).
- Restore and enhance Vancouver's wild spaces and vital biodiversity.
- Seek truth as a foundation for reconciliation with Musqueam, Squamish and Tsleil-Waututh Nations.

Through the development of VanPlay, much of the Still Creek watershed was identified as underserved by parks and recreation opportunities, bringing even more importance to expanding the Still Creek corridor, incorporating more recreation and access opportunities within the corridor, and creating a multi-functional blue green network through GRI and active transportation.

Still Creek-Brunette River Drainage Area Flood Assessment, Floodplain Map Updates, and Flood Management Recommendations (2021)

Rainfall intensity is increasing due to climate change, which is increasing the risk of flooding within the Still Creek-Brunette River Drainage Area. Metro Vancouver commissioned an update to the Still Creek – Brunette River Drainage Area floodplain mapping. The updated floodplain mapping shows that the floodplain in Vancouver is getting larger in extent and the flood hazard severity is increasing due to climate change. In response to the updated floodplain mapping, the City updated the designated Still Creek floodplain and associated building requirements (referred to as Flood Construction Levels) in the Vancouver Building By-law in March 2023.

Through a separate and follow-up technical study commissioned by the City of Vancouver, the potential impact of development on flood risk was studied in support of the Rupert and Renfrew Station Area Plan. This work (NHC, 2022) identified that creek daylighting and corridor widening would help reduce food hazard and enable development in the floodplain by providing more room for water. This is discussed further in Section 5 and separately through the integrated water management planning work supporting the Rupert and Renfrew Station Area Plan.

Vancouver Plan (2022)

The Vancouver Plan was adopted by City Council on July 22, 2022 and provides an overarching plan to guide land use in the City over the next 30 years. The plan outlines an ambitious vision for ecology within the City: "Vancouver has reshaped its relationship to nature and restored its ecological health to the benefit and resilience of all."

The Plan recognizes climate protection and restored ecosystems as one of the fundamental ideas guiding the long term vision. Ecological systems are also recognized as a foundational building block for the land use strategy, and the plan envisions "...a system of existing, enhanced and future habitat areas, corridors, and blue green networks that enhance ecosystem function, biodiversity, and allow residents to connect with nature in their daily lives." This vision is captured in Figure 2-5 from the Vancouver Plan, below.

All of the land use decisions that emerge from the eleven priority areas will affect the Still Creek watershed, with particular relevance to the plan's work on ecology, watersheds and water resources, and transportation.

Figure 2-5 Vision for future ecological corridors from the Vancouver Plan (2022)

UNDRIP Strategy (2022)

The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) was adopted by the UN General Assembly in 2007. Today, UNDRIP is the most comprehensive international instrument on the rights of Indigenous Peoples. In October 2022, Vancouver City Council approved the City of Vancouver's UNDRIP Strategy, which includes Calls to Action on social, cultural, and economic well-being; ending Indigenous-specific racism and discrimination; self-determination and inherent right of self-government; and rights and title of Indigenous people. It includes several Calls to Action that relate to the management of water in the City, including:

- Action 1.6: Prioritize access to cultural sites for Musqueam, Squamish, and Tsleil-Waututh people.

  a) Barrier Removal: Identify and address barriers including but not limited to parking fees and time limits; public access limitations (e.g. limited hours, fenced off locations such as cultural sites in parks); environmental interventions and impacts (e.g. buried streams, prohibited water access, wastewater contamination); lack of privacy; policing/regulation of cultural activities and use.

  b) Access to water: Work with Musqueam, Squamish, and Tsleil-Waututh to identify options to ensure access to clean marine and freshwater sites for cultural purposes. This could include contaminant mitigation and addressing physical/built barriers to accessing and using the waterfront.

- Action 4.7: Identify ways to support Musqueam, Squamish, and Tsleil-Waututh to practice their traditions on the land, including but not limited to:

  d) Support the restoration of self-determined cultural practices and food sovereignty, through reducing entry of contaminants into air, waters and soils to meet benchmarks protective of Indigenous values (e.g. Burrard Inlet Water Quality Objectives), and through remediation of contaminated areas.

  e) Work with Vancouver Board of Parks and Recreation and other jurisdictions to restore ecologies of traditional harvesting sites, on land and foreshore and intertidal areas, and support/follow Musqueam, Squamish, and Tsleil-Waututh self-determination on governance, use, and access to those sites.

The ongoing restoration of Still Creek presents an important opportunity to advance reconciliation by honoring and incorporating the knowledge, traditions, and cultural practices of the xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh Nation).-Past restoration projects have resulted in the return of salmon to the creek, continuing this work aligns with a number of the actions listed above. The local Nations have expressed interest in cultural recognition in public viewing spaces and increased access to Still Creek's shorelines to support cultural practices and uses as the riparian habitat and water quality improves.

The UNDRIP Strategy was co-authored and endorsed by the Musqueam, Squamish, and Tsleil-Waututh Councils, along with the City of Vancouver Council. The UNDRIP Strategy was approved mid-way through the development of the Still Creek Watershed Enhancement Opportunities Study, and as such, this study will not fully reflect the actions in the Strategy. City staff will continue to look for options to further the UNDRIP Strategy's actions through the implementation of projects identified in this study.

The Rupert and Renfrew Station Area Plan (current, 2022-2024)

The City has initiated a land use planning program centred around the Rupert and Renfrew SkyTrain stations. This area plan boundary is within part of the Still Creek watershed. At the time of this report, the goals for the Rupert and Renfrew Station Area Plan are to build on the directions set out in the Vancouver Plan and previous planning work in the area. Through the first two rounds of public engagement for the plan, residents shared many positive sentiments towards Still Creek with many interested in protecting and restoring the creek, and creating more spaces for residents to experience the creek. The plan is scheduled to be completed in 2024, and once adopted, will guide development in the area, influencing land use, housing, transportation, community services, and parks - including space allocation for daylighting buried sections of the creek and widening the existing channel where feasible. This study serves as an important input into the development of the land use plan.

While the Rupert and Renfrew Station Area Plan community engagement process did not specifically ask questions about Still Creek, feedback received through this process identified Still Creek as a community heart and a special part of the community. Addressing the key issues identified in Section 3.3 of this study will help support the longevity of this publicly identified community asset.

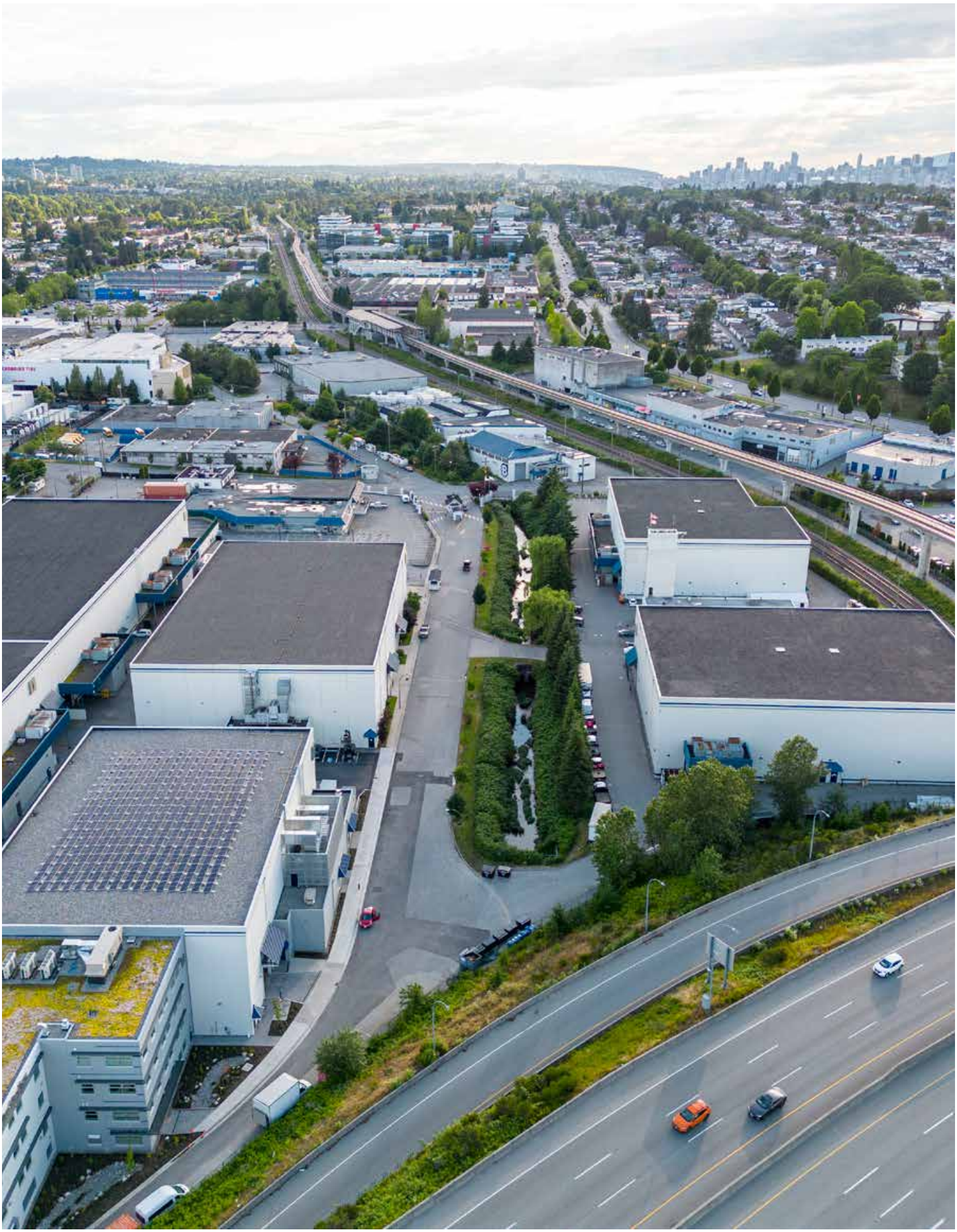


Figure 2-6 Aerial view of Still Creek (2022) looking west from Highway 1 at Boundary Road

2.3 ENHANCEMENT WORK DONE TO DATE

Several enhancements have been completed within the Still Creek Watershed over the past two decades, including work within the Still Creek corridor from Renfrew Street to Boundary Road, work in Renfrew Ravine and Renfrew Community Park, and Green Rainwater Infrastructure (GRI) projects in various locations. In part, the rehabilitation efforts have been informed by ecological monitoring work in the watershed, which has improved the understanding of water quality and creek health. A summary of previous ecological studies is included in Appendix A.

Since the completion of the original Still Creek Rehabilitation and Enhancement Study (2002), four City-led restoration projects have been advanced between Renfrew Street and Boundary Road, along Grandview Highway (Figure 2-7). These projects have been funded from several sources, including regional partnerships, private grants and the Still Creek Greenway Enhancement Fund. The Still Creek Greenway Enhancement fund was established in June 2000 and consists of annual payments from leased city-owned land in the industrial area. The fund is to be used for initiatives toward achieving Council objectives to protect, enhance, and daylight Still Creek.

Figure 2-7 Implementation of enhancement projects to date along Still Creek between Renfrew Street and Boundary Road

Figure 2-8 3003 Grandview project in 2005, post-construction, after planting event, looking west

Figure 2-9 3003 Grandview project in 2005, post-construction, before planting, looking east

Figure 2-10 3003 Grandview project looking east in 2022

3003 Grandview Highway (2005)

Restoration works in this section focused on:

- Channel and riparian enhancement and naturalization
- Habitat complexity structures
- Invasive species removal

The first restoration project after the original Enhancement Study's completion was north of Grandview Highway between Nootka Street and Lillooet Street. This project was constructed in July and August 2005, followed by community planting activities which were completed in October 2005. Previously, the creek ran through a narrow channel lined with concrete rip-rap and overgrown blackberry brambles. As a result of this enhancement project, approximately 75 meters of the creek-side habitat now feature native plantings, a naturalized south bank, a planted centre island, and a small side channel. The site also features a public viewing platform with interpretive signage to promote public awareness.

The project was funded through the Still Creek Greenway Enhancement Fund, Greater Vancouver Regional District (GVRD, now known as Metro Vancouver), and grants from TD Friends of the Environment, Public Conservation Assistance Fund (PCAF), and Pacific Salmon Foundation. The Evergreen Foundation, Still Creek Stewardship Society, and Vancouver Technical School students provided in-kind support to the project through community planting and education efforts following the completion of project construction.

Figure 2-11 3400 Cornett Road in 2007, post-construction, looking east.

Figure 2-12 3400 Cornett Road in 2022, looking east.

Figure 2-13 3400 Cornett Road aerial photo in 2022, looking west.

3400 Cornett Road (2007)

This was the second restoration project towards implementing the 2002 Enhancement Study and was completed after the Still Creek Integrated Stormwater Management Plan (McElhanney et al 2007) was developed.

The scope of this project included the removal of two abandoned rail bridges along the creek, widening the riparian area, replacement of invasive plant species (primarily Himalayan blackberry [*Rubus armeniacus*]) with native shrubs and trees, improvements to the stream bed, and installation of fish habitat features (including rock weirs and lunker structures).

Before this project, the creek bank had failed along the north side of the creek and GVRD (now known as Metro Vancouver) had allocated funds towards maintenance, which partially funded this project. The remaining funding came from the Still Creek Greenway Enhancement Fund.

Figure 2-14 3300 Cornett Road condition pre-daylighting

Figure 2-15 3300 Cornett Road in 2009, post-construction

Figure 2-16 3300 Cornett Road aerial photo in 2022, looking south east

3300 Cornett Road (2009)

As part of the rezoning for the site at 2820 Bentall Street (Canadian Tire), through the Grandview Boundary Mixed Employment Area Plan policy, approximately 75 metres of creek was to be daylit with a dedicated road right-of-way parallel to the creek, which extended Cornett Road further west.

A new stream side channel was completed with riparian habitat and tree coverage.

Figure 2-17 2900 Nootka condition pre-construction, looking upstream.

Figure 2-18 2900 Nootka in 2011, post-construction, during planting, looking upstream.

Figure 2-19 2900 Nootka aerial photo in 2022.

2900 Nootka Street (2011)

The most recent major City-led enhancement project took place east of Nootka Street, south of Grandview Highway, and was completed in 2011, with a focus on channel and riparian enhancements.

This project included the removal and reconstruction of the concrete creek bed and banks to improve stormwater capacity, while providing more naturalized habitat for fish and other species. It also included the construction of a small wetland, seating area, pedestrian bridge, and a permeable and accessible asphalt pedestrian path for public access. These features provided a new pedestrian connection in the neighbourhood connecting Nootka Street to Grandview Highway. This project was a collaboration between Metro Vancouver and the City of Vancouver, with support from neighbouring property owners, the Still Creek Stewardship Society, Evergreen, and the Province of B.C.'s Trees for Tomorrow program.

In addition to initiatives in the City of Vancouver, actions have been taken in neighbouring municipalities by other jurisdictions that have also had positive impacts on the Still Creek watershed. These included the installation of a fish ladder at the Cariboo Dam (downstream outlet of Burnaby Lake) and, as part of the Highway 1 Gateway Program, the Province of BC installed baffles in the culverts underneath Boundary Road to facilitate fish passage.

Green Rainwater Infrastructure Projects in the Still Creek Watershed

GRI installations completed in the Still Creek watershed to date include:

- Bioretention bulges in the upper watershed, at 41st Avenue and Rhodes Street, 45th Avenue and Rupert Street, and Graveley Street and Boundary Road
- Infiltration trench on 17th Avenue between Slocan Street and Penticton Street at the south end of Beaconsfield Park (installed in 2020)

Community Watershed Initiatives

Still Moon Arts Society has been a long-standing advocate for Still Creek, and has been working in the Still Creek Watershed and the Renfrew-Collingwood neighbourhood since 2004. Their work has helped to bring conversation, art, and awareness to Still Creek and its watershed.

Two of Still Moon Arts Society's mandates are (1) to promote and engage in activities that educate the community, raise environmental awareness, and enhance and restore sustainable natural environments and (2) to promote and engage in activities that link arts, community and environment (Still Moon Arts Society 2022).

Through their restoration work, they have helped enhance sections of Still Creek's riparian vegetation, partnered with different organizations to support fish and water quality sampling, worked with the Park Board to advocate for public art installations, and hosts the annual Renfrew Ravine Moon Festival. Community art installations include the Renfrew Ravine Labyrinth, Lost Stream Street Murals (2014-2017), and Beaver Pond(er)ing Lodging (2021-2024).

The Still Creek Streamkeepers are a part of the Still Moon Arts Society. Their stewardship work, including garbage removal, invasive species removal, and riparian planting has made noticeable improvements to Still Creek. These stewardship activities primarily take place in Renfrew Ravine and along Cornett Road, between Skeena Street and Natal Street.

Another community organization that has recently become engaged in work in the Still Creek Watershed is Hives for Humanity Society, a non-profit based in the Downtown Eastside focused on community-engaged beekeeping and pollinator gardening. Hives for Humanity are currently stewarding a native berry patch at Beaconsfield Park, for which initial planting took place in September 2022. This work is partially funded by the Vancouver Park Board through their Neighbourhood Matching Fund grant.

Figure 2-20 View of Still Creek near Cornett Road at Skeena Street (2022) looking west

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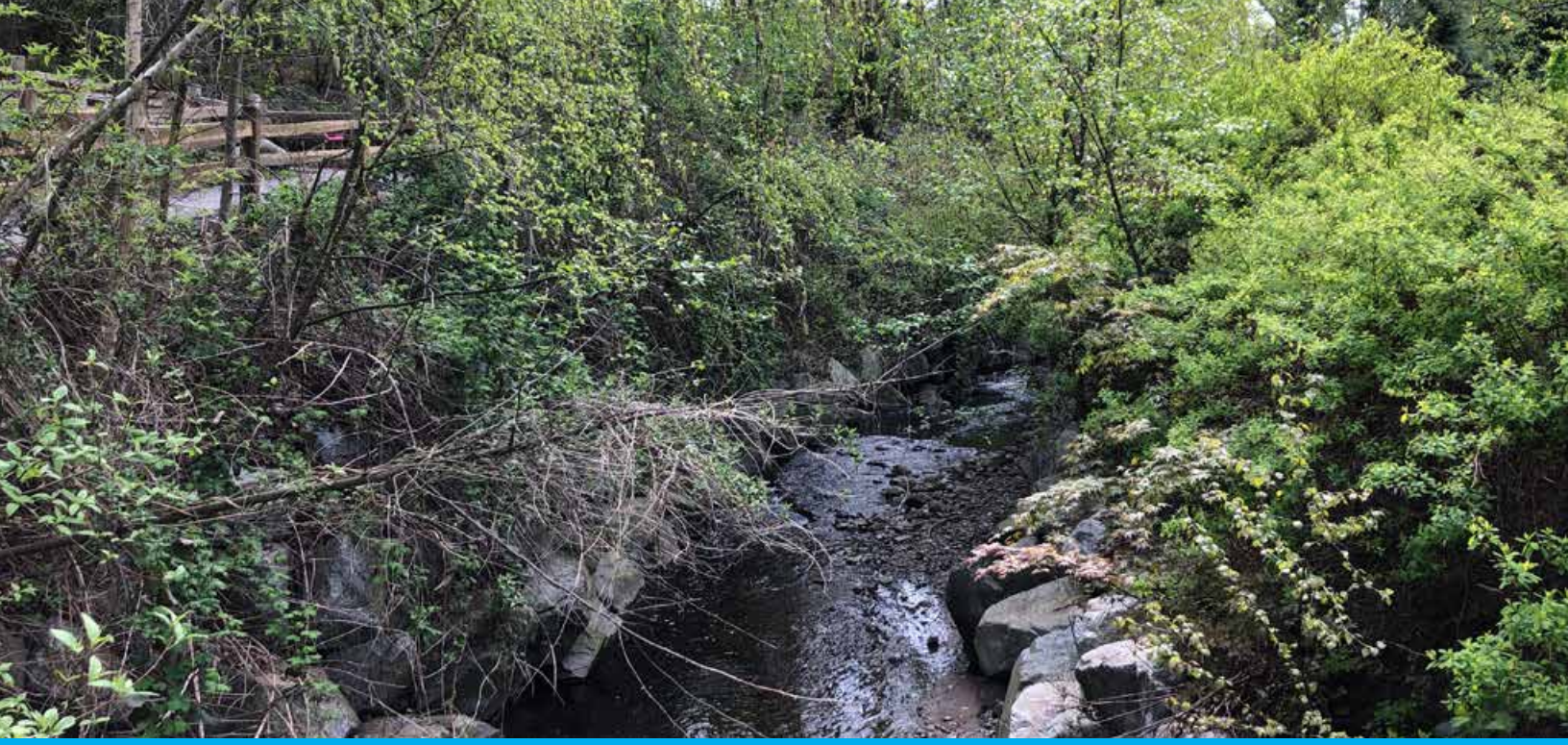

3.0 EXISTING CONDITIONS & KEY WATERSHED ISSUES

3.1 STILL CREEK WATERSHED CONDITIONS

Vancouver Context for Lost and Surviving Streams

Prior to European settlement the area now known as Vancouver had over 50 streams, with a total length of over 120 kilometers combined (Proctor 1989), represented in Figure 3-1. Many of these supported spawning salmon and trout, and descriptions by early settlers describe an incredible abundance of fish in these streams (Proctor 1989). Over the past century of development most of these living systems were converted into wastewater and stormwater pipes, with only a few streams remaining in the City of Vancouver today. Surviving streams include Still Creek, Musqueam Creek, Spanish Banks Creek, Beaver Creek, and Vivian Creek.

The Still Creek-Brunette River Drainage Basin

The drainage area for Still Creek within the City of Vancouver covers an area of 994 hectares; at under 10 square kilometers, it is a relatively small part of the 73 square kilometers that make up the overall Still Creek-Brunette River drainage area (Figure 3-2). The overall Still Creek-Brunette watershed is described as being heavily urbanized with 60% impervious area (NHC 2021).

The mainstem of Still Creek originates near Central Park in Burnaby, passes through Renfrew Ravine, flows east parallel to Grandview Highway to Burnaby, then eventually flows into Burnaby Lake. The Cariboo Dam controls the flow exiting Burnaby Lake and entering the Brunette River, which eventually drains into the Fraser River at Cumberland Point, near Sapperton Landing in New Westminster.

Buried and Surviving Portions of Still Creek

Within the City of Vancouver's portion of the Still Creek watershed, most of Still Creek's former tributaries have been buried and converted into the City's storm sewer pipe network. Still Creek begins flowing at grade north of 29th Avenue, north of Slocan Park, and flows mostly at grade through Renfrew Ravine Park and Renfrew Community Park, before passing through a culvert to 14th Avenue. From Renfrew Street and 14th Avenue it flows east through the lowland corridor, alternating between at grade and culverted sections below grade.

SURVIVING AND FORMER STREAMS IN VANCOUVER

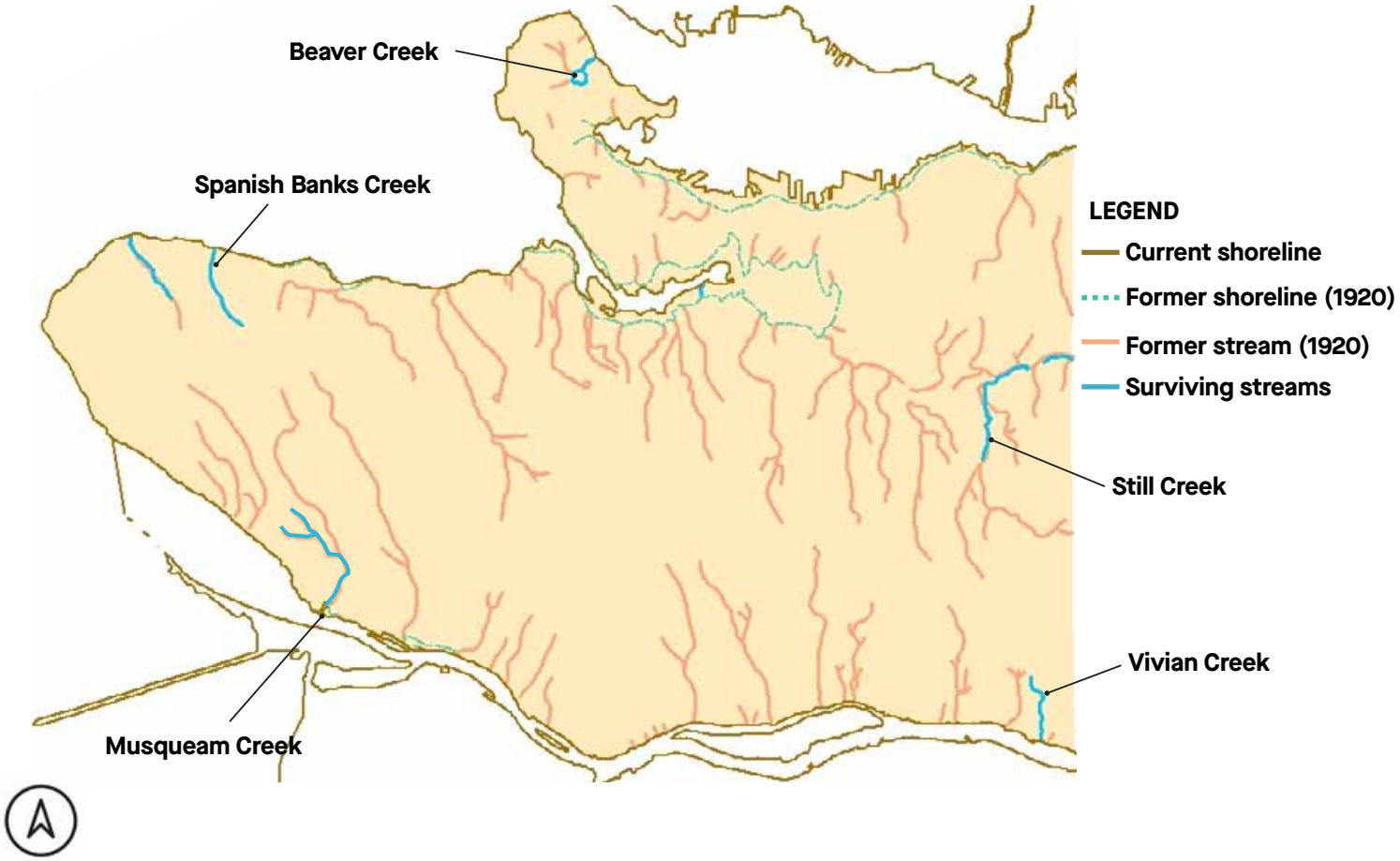

Figure 3-1 Map of Vancouver's surviving and former (1920) streams, and current versus former (1920) shoreline (adapted from Vancouver Lost Streams Restoration Assessment Abacus Public Data, CANMAP GEOG 311)

Topography and Overland Flow

Figure 3-2 shows the existing topography of the Still Creek watershed (1-m elevation contours, CGVD28 datum), showing the highest elevations in the south of the catchment, where many of Still Creek's buried tributaries originate. Overland flow paths (City of Vancouver 2022) are paths that water would follow if the storm sewer system did not exist or if it was not able to drain rainfall runoff under an extreme rainfall event. Several overland flow paths converge in a shallow depression that generally follows the alignment of Kingsway; this low area corresponds to the location of former Collingwood Lake, which was reportedly formed due to a beaver dam at its western edge (Rosen 2017).

In the north area of the catchment the overland flow paths follow the topography and enter into Still Creek at various points along its length. North of the Renfrew Street to Boundary Road corridor most overland flow is intercepted by Hebb Avenue and the rail corridor, where the flow paths travel east until the water enters the creek at Rupert Street.

OVERLAND FLOW PATHS

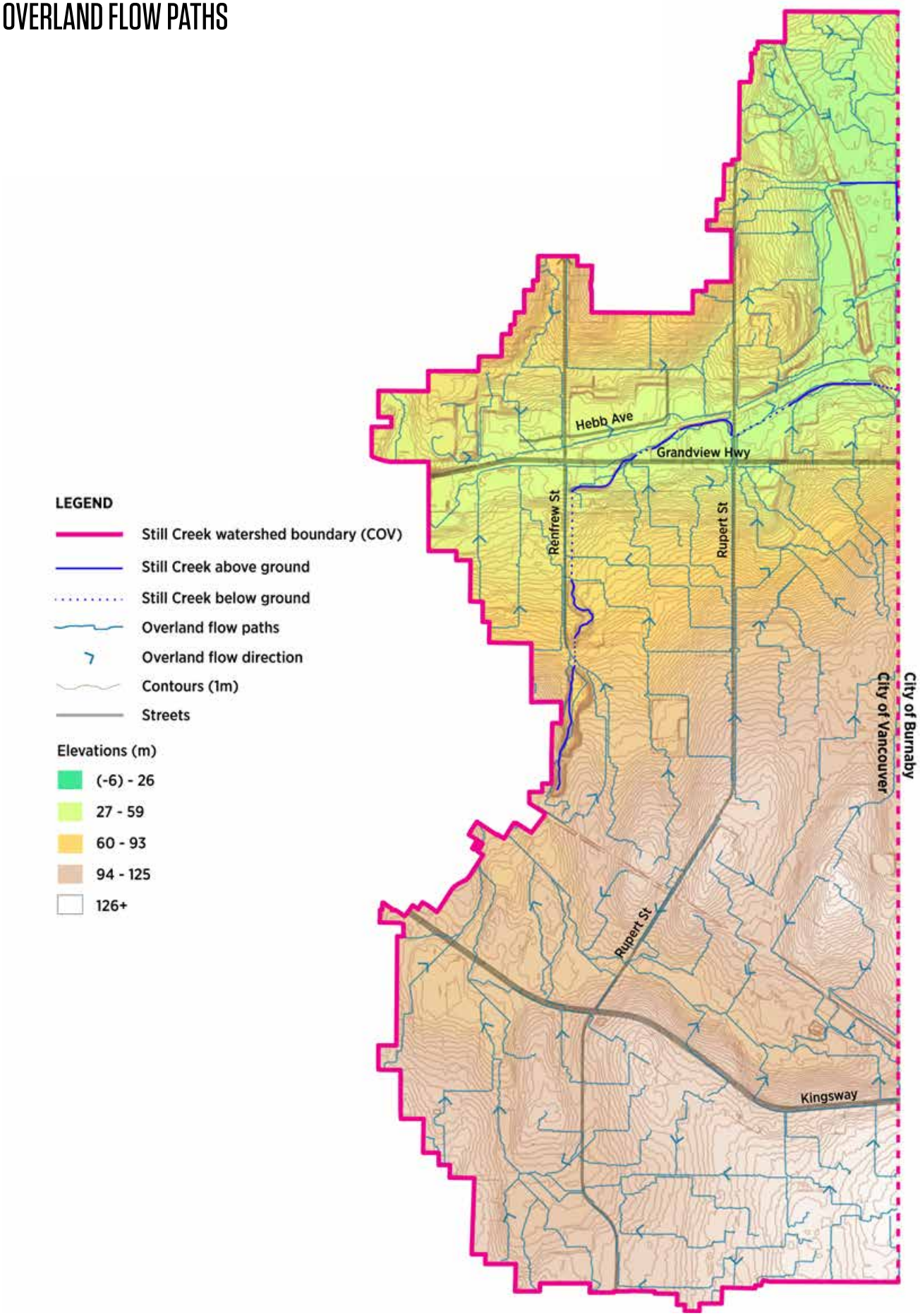

Figure 3-2 Overland flow paths, elevations, and 1-m contours for the Still Creek Watershed (portion within COV)

Storm Sewer Catchments

The storm sewers within the Still Creek watershed can be grouped by catchments that lead to outfalls into the creek channel. This is shown on Figure 3-3, with the corresponding storm pipe catchments labelled, and the general drainage direction represented within each subcatchment from white to purple. This figure shows the large southernmost catchments of Killarney-Renfrew Ravine and Collingwood-Renfrew Ravine which contribute a large amount of flow to Still Creek as it enters Renfrew Ravine.

Also notable from this figure is the large Falaise catchment area, which brings runoff through storm pipes under Falaise Park and into Still Creek east of Rupert Street.

SUBSURFACE DRAINAGE PATTERNS AND SUBCATCHMENT AREAS

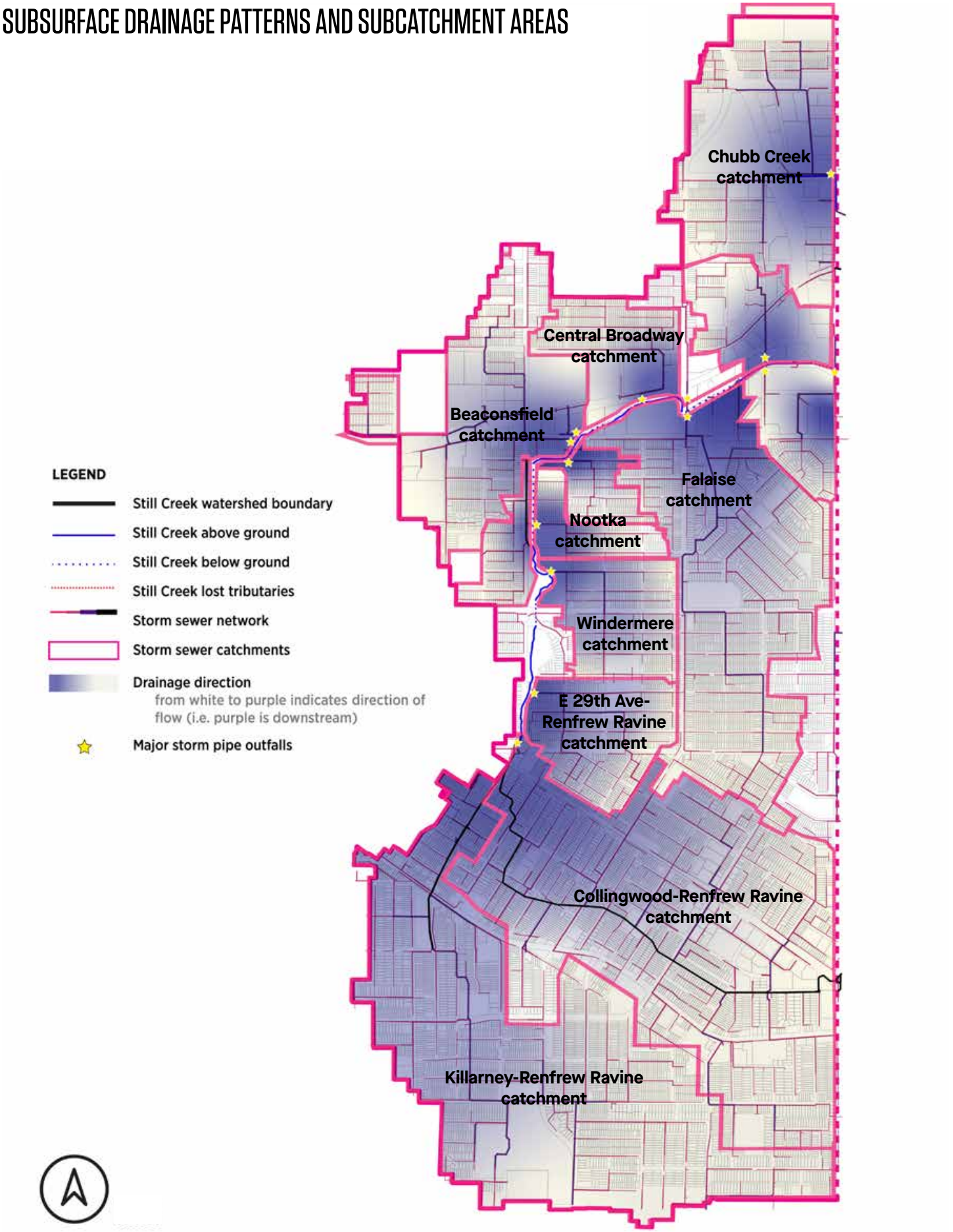

Figure 3-3 Subsurface (piped) flow paths for the Still Creek Watershed (portion within COV)

Geology, Soils and Infiltration

Most of the Still Creek watershed has been characterized as till (Figure 3-4), made up of Vashon Drift with overlying Capilano sediments (Geological Survey of Canada 1979). This type of deposit is noted in GIS reference data provided for the study as having predominantly low infiltration potential, whereas areas shown in blue are noted as having moderate infiltration potential overall (City of Vancouver 2022c).

Despite these high level patterns in geology and infiltration, site-specific infiltration tests are still important to inform the infiltration capacity of an individual site, as infiltration rates are highly variable on a local scale due to a combination of site conditions and site history.

Groundwater and Baseflow Considerations

Still Creek flows year-round, including during the dry summer months. This dry-weather flow is called baseflow (the water in the creek channel between rain events). Baseflow is a result of the surrounding groundwater in the Still Creek watershed feeding water into the channel.

As part of the Rupert and Renfrew Station Area planning process, the City commissioned a groundwater study (AECOM 2023) to get a better understanding of the subsurface conditions. The results identify the presence and contribution of groundwater on the hydraulic regime of Still Creek and confirms how important groundwater is to the long-term health and function of Still Creek. Within the designated floodplain of Still Creek, the permanent groundwater table is located within one metre from the ground surface (AECOM 2023).

Groundwater dynamics are important because as redevelopment occurs the City will need to evaluate the impacts of traditional foundation and parkade construction on groundwater and baseflow. If building construction uses a traditional foundation drain, it may pull water away from the creek and lower the water table.

Without mitigation this could reduce the amount of baseflow in the creek, and cause the creek to dry up during periods without precipitation. This could also be exacerbated in the summer by climate change predictions of decreased precipitation. The study was also able to identify the different capture zones around Still Creek that feed groundwater into the creek (AECOM 2023). These areas are important to protect to help maintain the creek's baseflow.

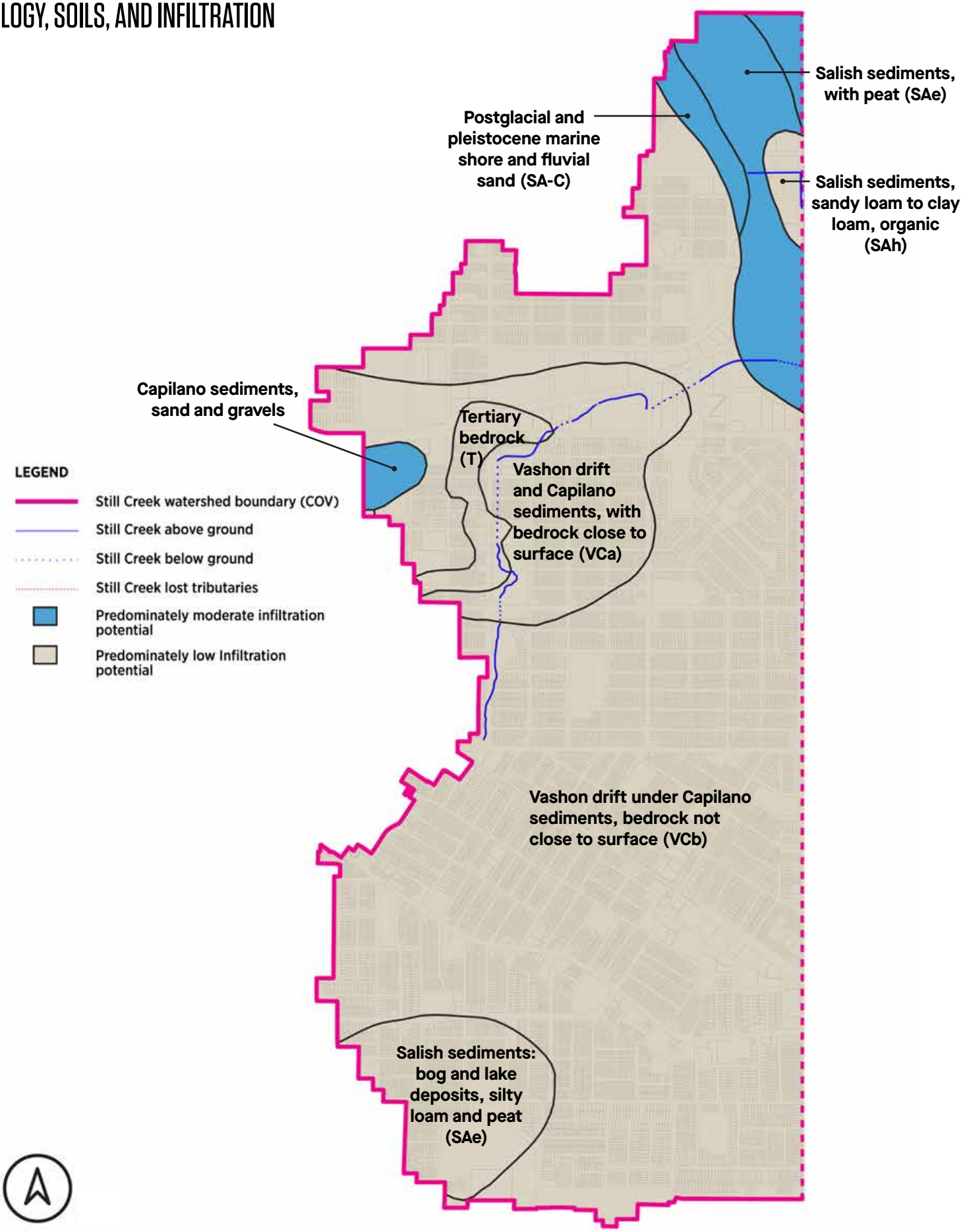

Figure 3-4 Surficial geology and general infiltration potential in the Still Creek Watershed (portion within COV)

Impervious Surface Cover and Streets with High Traffic Volume

The Still Creek watershed within the City of Vancouver has an average impervious surface cover of 55%, and roads are estimated to make up 32% of the watershed (City of Vancouver 2019). Areas within the watershed that have the highest impervious cover and streets with the highest traffic volumes are shown in Figure 3-5. This figure reveals both high impervious cover and high traffic streets within the Still Creek Renfrew Street to Boundary Road corridor, which indicates the potential for high amounts of contaminated runoff being generated immediately adjacent to Still Creek.

IMPERVIOUS SURFACE COVER AND HIGH TRAFFIC STREETS

Figure 3-5 impervious surface cover extents in the Still Creek Watershed (portion within COV)

Figure 3-6 Aerial view of Still Creek (2022) looking east from Renfrew Street, near Grandview Highway

3.2 EXISTING CONDITIONS IN STILL CREEK
RENFREW STREET TO BOUNDARY ROAD

In May 2022 Kerr Wood Leidal (KWL) undertook an environmental review and baseline assessment for the Still Creek corridor between Renfrew Street and Boundary Road, as part of this study. The environmental review consisted of the characterization of seven reaches along the corridor between Renfrew Street and Boundary Road, and the analysis of water quality samples from each reach collected on a single day.

In 2021 and early 2022 KWL had previously been engaged to undertake wet season and dry season monitoring, with several sampling sites near or in Still Creek; Reach 1 begins at the downstream extent of the study corridor at Boundary Road / Highway 1, and Reach 7 extends upstream to Renfrew Street.

The main findings from the study area are summarized in Figure 3-7 and Table 3-1, and highlights are summarized below. The full baseline environmental assessment report is attached as Appendix A.

Riparian Habitat

The riparian habitat throughout the Renfrew Street to Boundary Road corridor is, for the most part, narrow and dominated by invasive Himalayan blackberry (*Rubus armeniacus*), which limits species diversity, structural complexity and nutrient inputs to Still Creek. The sections of the creek that have had some riparian enhancements done - primarily between Natal Street and Skeena Street (Reach 2) and in the area by 3003 Grandview Highway (Reach 6) - both have some well-established native shrubs, and overhanging vegetation cover, but the other reaches within the corridor lack vegetation cover and are dominated by invasive plant species.

Substrate

Much of the substrate within the corridor is described as embedded, meaning that the gravel or cobbles have been buried and/or the void space between the gravel has been filled in with fine sediment. The embeddedness of the gravel and cobble in the fine sediments makes the coarser sediments hard to move and impedes the ability for fish to create redds (nest-like structures where eggs are deposited). The sections of the creek between Natal Street and Skeena Street (Reach 2), the area next to 3185 Grandview Highway (Reach 5), and the area by 3003 Grandview Highway (Reach 6) all have some areas of substrate that are less embedded and therefore have more substrate habitat value.

Cover Habitat

The corridor has limited cover habitat, thereby limiting the ability for fish and other aquatic species to hide from predators and/or seek refuge from heat or high-velocity flows. The sections of the creek between Natal Street and Skeena Street (Reach 2) and by 3003 Grandview Highway (Reach 6) both have some overhanging native vegetation (~20 to 50%) but there is little cover in the form of boulders or instream vegetation.

ENVIRONMENTAL INVENTORY - REACH SUMMARY

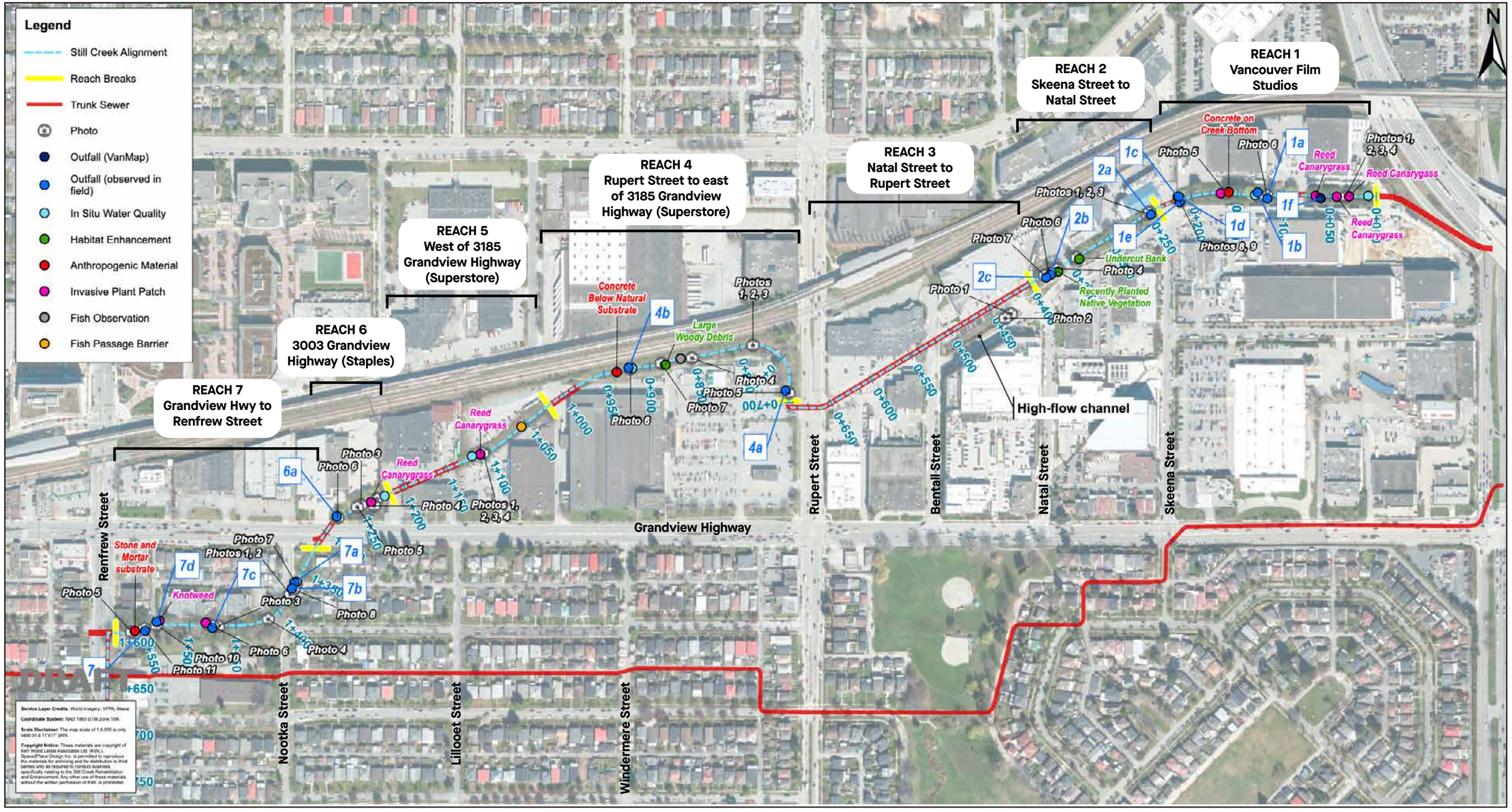

Figure 3-7 Summary of the baseline assessment of environmental conditions in Still Creek's Renfrew Street to Boundary Road corridor (source: KWL)

Fish Passage

One barrier to fish passage was noted within the corridor (in Reach 5, by 3185 Grandview Highway). Existing culverts elsewhere in the corridor appear passable for fish, although some sections are very long (i.e., 300 m length of culvert between Rupert and Natal) which can create higher water velocities and limited areas for respite which can be challenging for fish passage.

Channel Banks

Several sections of channel bank along the Renfrew Street to Boundary Road corridor have been armoured with concrete or mortared boulders (e.g. Reach 5, west of 3185 Grandview Highway; Reach 6, at 3003 Grandview Highway; Reach 7, Grandview Highway to Renfrew Street) resulting in lower quality habitat, reduced channel complexity, increased flow velocities, restricted channel movement, and impeded riparian vegetation growth.

Water Quality Assessment

Water quality in the reaches from Renfrew Street to Boundary Road was assessed by KWL (May 11, 2022). Test parameters included dissolved oxygen, pH, water temperature, conductivity, and turbidity. Results were then compared to the Metro Vancouver publication Monitoring and Adaptive Management Framework for Stormwater (2014) which provides a framework to classify results as good, satisfactory or needs attention. Table 3.1 provides a summary of the 2022 Still Creek water test results, colour-coded to identify the high-level assessment of existing conditions, ranging from very poor to very good.

Key findings from the one-day assessment include:

- Temperature and pH were largely good for all reaches, as the temperatures were under 12 °C and pH was between 6.5 and 9 (except pH of 6.26 in Reach 1).
- Dissolved oxygen was considered only satisfactory because it was under 11 mg/L (except for Reach 2, where it measured 12.11 mg/L).
- Turbidity levels for all reaches were mostly satisfactory (between 5 and 25 NTU), but reaches downstream of some outfalls were at the “need attention level” (>25 NTU).

While the results from in-situ water quality testing in the spring of 2022 appear favourable, results from KWL’s 2021 water quality monitoring indicate that the stormwater entering Still Creek is generally of poor quality, particularly during the dry season. For instance, many of the dry season samples (collected from the piped storm system within the Still Creek watershed) met Metro Vancouver’s criteria for ‘needs attention’ for almost all water quality parameters, including: pH, water temperature, conductivity, turbidity, *E. coli*, fecal coliforms, copper, iron, and zinc (KWL 2021b). Wet season samples showed concerns with elevated water temperature, *E. coli*, fecal coliforms, copper, iron, and zinc (KWL 2021a).

Table 3-1 Summary of existing conditions within Still Creek, Renfrew Street to Boundary Road corridor

Reach # (from downstream to upstream)	a. Riparian habitat	b. Substrate	c. Cover habitat	d. Fish passage	e. Channel banks	Overall habitat quality	Water quality based on observed parameters*
① Vancouver Film Studios	High invasive plant cover	Highly embedded	Low cover	No barriers	Boulders, bedrock, soil	Poor	Satisfactory to good
② Skeena to Natal	Mostly invasive plant cover	Embedded	High cover (20%)	No barriers	Boulders, bedrock, soil	Adequate	Turbidity needs attention
③ Natal to Rupert (side channel)	Dense blackberry	Small gravel	High cover from blackberry	Dry (not accessible to fish)	Steep gabions, plastic mesh	Very poor	Not applicable as channel was dry
④ east of 3185 Grandview Hwy (Superstore)	Patches of native plant cover	Highly embedded	Low cover	No barriers	Gabion baskets, riprap	Adequate	Satisfactory to good
⑤ west of 3185 Grandview Hwy (Superstore)	Narrow.High invasive plant cover	Adequate	Very low cover	Barrier present	Boulders / mortar with concrete	Poor	Satisfactory to good
⑥ 3003 Grandview Hwy (Staples)	Good	Less embedded	Over 50% cover	Single culvert at Grandview	Concrete retaining	Good	Satisfactory to good
⑦ Grandview to Renfrew	Almost all blackberry	Poor	10-30% over-hanging	No barriers	Riprap / concrete	Overall poor to adequate	Turbidity needs attention

Cell colour indicates a high-level summary of existing conditions:

Very Good ⟷ Very Poor

* Water quality parameters included: temperature, pH, dissolved oxygen, turbidity and conductivity

Wet season monitoring in 2022 (March and April) again revealed that several water quality parameters were at the 'needs attention' level, including conductivity, *E. coli*, and fecal coliforms; turbidity, copper and zinc levels were elevated but at the 'satisfactory' level (KWL 2022a).

3.3 KEY ISSUES FACING STILL CREEK

Over the past century the floodplain of Still Creek has been filled in and the creek has become largely confined to a narrow, steep-sided channel, dominated by invasive plant species. As the watershed cover changed from forest to city, storm flows have increased while summer base flows have decreased, and water quality has been impacted by a number of urban contaminants. Despite these impacts, however, Still Creek has managed to endure as one of the city's few surviving streams, providing a well-loved ribbon of biodiversity within the City.

Key Issues Identified in Workshops

In addition to the scientific and engineering analysis of Still Creek from Renfrew Street to Boundary Road, several workshops with city staff were held to discuss challenges and key issues from various perspectives. The following summary identifies key themes amongst input received, identifying what is and is not working well with respect to the Vancouver portion of Still Creek. Detailed feedback received from the workshops has been documented in Appendix B of this report.

Working well

Things that were identified as working well with Still Creek and its watershed include:

- Ongoing environmental stewardship initiatives in parts of the watershed (such as volunteer-led invasive species removal).
- The caring community that supports Still Creek.
- The presence of salmon in Still Creek in recent years was highlighted as a sign that ecological conditions are gradually improving.
- Renfrew Ravine Park is valued as a gem in the neighbourhood, providing access to nature and a refuge during hot weather.
- Still Creek is an important part of the community and an asset.

Not working well

Things that were have identified as not working well include:

- Poor water quality, and the need for work to continue on sewer cross-connection investigations.
- A lack of continuous maintenance and/or monitoring.
- Poor pedestrian and cycling connectivity, including difficulty accessing nature along Still Creek, along with the disconnected walking and cycling paths and public spaces.
- Lack of riparian cover and lack of off-channel / floodable habitat.
- High percentage of impervious cover in the watershed which directly impacts biodiversity.
- Lack of coordination and collaboration across jurisdictions, and challenges with municipal boundaries and siloed bureaucracy, which conflict with the interconnected nature of the watershed.
- Poor implementation of guidelines and rules to protect and restore Still Creek.
- Invasive species management; many vegetated areas are dominated by Himalayan blackberry (*Rubus armeniacus*).

Still Creek's key issues has been organized into the following themes:

- Altered urban hydrology.
- Poor water quality.
- Loss of a functional hyporheic zone.
- Narrow riparian corridor.
- Loss of Still Creek floodplain, and increasing flood hazard.
- Impacts to social and cultural values.

Altered Urban Hydrology

Still Creek is a highly developed watershed which behaves characteristically with more rapid runoff responses to rainfall compared to pre-disturbance conditions. This characteristic results from the high proportion of impervious area, estimated to be 55% (City of Vancouver 2019), with few source controls or opportunities for infiltration. Reduced infiltration and evapotranspiration have led to an increase in runoff volumes, resulting in more frequent and larger peak flows within Still Creek, reduced groundwater recharge and baseflow and higher summer stream temperatures (e.g., KWL 2021b).

As an urbanized watershed, Still Creek can be described as a flashy system, where flows increase and decrease very quickly because of runoff from hard surfaces. These higher magnitude peak flows can result in localized erosion (i.e., where banks have not been armoured), mobilization of sediment, embedded substrates in stream channels, and the flushing of beneficial organic matter downstream.

Where fish spawning habitat is present, prolonged exposure to extreme variability of flows can impact the viability of incubating fish eggs. With a lack of refuge habitat along Still Creek, peak flows can also impact the residence of fish species.

Poor Water Quality

The large extent of urban impervious areas in the Still Creek watershed, especially roads, results in a persistent source of metals and hydrocarbons from automotive sources to the creek. The Still Creek watershed has an estimated cover of 32% roads (City of Vancouver 2019), resulting in high particulate contaminant loads that can be quickly conveyed to the creek.

KWL's instream water sampling in May 2022 revealed high levels of turbidity, and some reaches had low levels of dissolved oxygen (Table 3-2).

As mentioned above, KWL also undertook water quality monitoring for the City of Vancouver in the wet and dry seasons of 2021 (piped stormwater system) and in the dry season of 2022 (stream sampling).

Samples for the 2021 wet and dry season monitoring were collected from the piped stormwater system near Renfrew Ravine Park, Renfrew Community Park, Natal Street, and Skeena Street. Findings for both the wet season and dry season revealed water temperature, turbidity, *E. coli*, and selected metals (e.g., copper and zinc) were all generally elevated in the samples (Table 3-4, Table 3-4). Water quality was generally worse in the summer, with several parameters at the 'needs attention' level (Table 3-4), likely owing to infrequent rain events that flush accumulated material from impervious surfaces into the storm system, and less dilution of the contaminants.

The elevated metals observed in the stormwater (copper, iron, zinc) can have direct and indirect impacts on the health of salmonids, as can hydrocarbons and tire wear particles (not sampled). Copper and tire particle derivatives are toxic to salmonids at very low levels. Sub-lethal levels of copper may also interfere with olfactory senses critical for navigation. Indirect effects are those that reduce benthic invertebrate population levels and diversity. Benthic invertebrates are the principal food source for juvenile salmonids and other riparian wildlife.

Elevated *E. coli* levels are associated with fecal matter contamination originating from sanitary sewers, dogs and urban wildlife. While the Still Creek watershed in Vancouver has separate storm (rainwater) sewers and sanitary (wastewater) sewers, there is still the potential that wastewater is entering Still Creek through storm sewers due to incorrect property-level service connections. These incorrect service connections are referred to as 'cross-connections' and are the result of different scenarios, such as a property's sanitary service being mistakenly connected to the City's storm sewer.

To find and address cross-connections, the City has been working on a cross-connection investigation program in alignment with the 2006 ISMP actions. Most recently, the City's crews conducted targeted investigations in 2014-2016 and 2021. Finding cross-connections is a very challenging and slow exercise as wastewater contamination found in one location in the storm sewer network may be associated with single or multiple properties in a vast upstream area. Recent investigations have focused on upstream areas of the watershed. The City's investigation methodology involves visual checks of the storm sewer network and physical inspections of upstream properties to narrow down the list of properties that may be contributing. The City plans to research alternative investigation methodologies in the coming years which may provide new tools to use in the Still Creek watershed.

In addition, sanitary sewer leaks intercepted and conveyed through storm mains may be an additional source of *E. coli*. Although not acutely toxic to fish, waters that contain high levels of *E. coli* may be associated with depressed oxygen levels, excessive instream plant and microbial growth and toxic substances such as cleaners, disinfectants, and other contaminants from household wastewater.

Loss of a Functional Hyporheic Zone

The hyporheic zone is often referred to as a gut or a liver of a river (Gies 2022). It is a unique ecosystem located below and along the sides of rivers and creeks, where surface water and groundwater meet and mix. The large surface area provided by sediments in the hyporheic zone, along with the microorganisms that inhabit it, form a reactive area where various biological and biochemical processes occur such as pollutant transformation. Living organisms within the zone absorb nutrients and create interstitial spaces, allowing water to mix and helping contribute to temperature regulation.

The hyporheic zone of Still Creek is likely impaired due to historical channel alterations, including piping, straightening, confinement and armouring. Furthermore, alterations to the flow and sediment regime due to urbanization have resulted in a high proportion of the channel bed becoming a "pavement" of immobile gravel and cobble embedded in fine sediments. This bed condition is a barrier to the stream's exchange of flows with groundwater and to other benefits that a healthy hyporheic zone would provide.

Table 3-2 In-situ water quality results from May 11, 2022 sampling in Still Creek

REACH	CHAINAGE	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)	pH	TURBIDITY (NTU)	NOTES
1	(0+009)	10.8	10.99	6.26	6.99	
1	(0+131)	10.8	10.57	6.26	7.54	
2	(0+286)	10.9	12.11	7.14	5.34	
2	(0+367)	11.7	10.86	7.09	26.30	
4	(0+920)	12.3	8.85	7.20	5.36	Immediately downstream of outfall at (0+375)
5	(0+120)	11.3	10.44	7.30	7.38	
6	(0+224)	11.5	9.81	7.42	11.00	
7	(0+365)	11.7	10.48	7.47	28.4	Immediately downstream of outfall at (1+365)

Table 3-3 2021 wet season water quality monitoring program results (piped stormwater system)

PARAMETER (UNIT)	RENFREW RAVINE PARK	RENFREW COMMUNITY PARK	NATAL ST.	SKEENA ST.
Physical Water Quality Parameters				
DO (mg/L)				
pH	7.4	7.2	7.7	7.5
Water Temperature (°C)	7.7	6.7	6.5	5.8
Conductivity (mS/cm) (4 samples)	0.065	0.076	0.164	0.014
Turbidity (NTU) (4 samples)	10	12	23	2.5
Total Suspended Solids (TSS, mg/L)	17	14	31	3.0
Nutrients				
Nitrate, N-NO_3 (mg/L)	0.23	0.31	0.55	0.48
Bacteria				
E. coli (MPN/100 mL)	1,500	190	140	21
Fecal Coliforms (MPN/100 ml)	1,900	220	190	31
Metals				
Cadmium, total (mg/L)	<DL	<DL	<dl	<dl
Copper, total (mg/L)	0.0080	0.0050	0.016	0.0064
Iron, total (mg/L)	0.41	0.52	1.2	0.065
Lead, total (mg/L)	0.0018	0.0012	0.0026	<dl
Zinc, total (mg/L)	0.018	0.020	0.081	0.042

Cell colour indicates the classification of water quality according to Metro Vancouver Monitoring and Adaptive Management Framework for Stormwater:

Good Level | Satisfactory Level | Needs Attention Level

*There are no AMF guidelines for Total Suspended Solids
<DL = below detection limit
Mean values averaged over 5 samples; the geomean was calculated for microbial parameters

Narrow Riparian Corridor

A riparian corridor provides many ecosystem services including stream temperature regulation, absorption of surface water and pollutants, erosion protection, maintaining soil moisture, carbon sequestration, providing a source of leaf litter and insect drop to streams, and habitat to terrestrial species such as birds. Riparian width should be maximized for numerous reasons related to stream health including water uptake, nutrient uptake, aquatic and terrestrial benefits, stream stability and geomorphic function.

Urbanization in the Still Creek watershed has resulted in a narrowing of its riparian corridor through the encroachment of surrounding development and channel modifications. The confinement, armouring and straightening of Still Creek have resulted in the loss of riparian habitat and reduced channel complexity. Several sections of the creek corridor are also dominated by invasive species, such as Himalayan blackberry (*Rubus armeniacus*).

Loss of Natural Floodplain and Increasing Flood Hazard

A floodplain is a low-lying area, adjacent to a watercourse or waterbody, which can be inundated under certain hydrologic conditions. Still Creek has a topographically well-defined floodplain valley that extends from Grandview Highway near Renfrew Street to Burnaby Lake. In a natural setting, a floodplain is an important component of a watershed that provides different functions related to sediment, nutrients, and habitat. In an urban setting, the intersection of overbank flooding, people, property, and infrastructure creates flood risk. While there are no recent observations of overbank flooding along Still Creek in Vancouver, there is still potential for significant flooding under extreme rainfall conditions as assessed through floodplain mapping (Figure 3-7). Nuisance flooding occurs regularly along portions of Still Creek in the city of Burnaby in the wet season, which is a relevant consideration for Vancouver as it is upstream of Burnaby.

Metro Vancouver completed a floodplain mapping project for the Still Creek and Brunette River system in 2021 (NHC 2021), which provides an important update to the previous floodplain mapping done in 1998. The updated floodplain map, which incorporates climate change projections, shows a larger floodplain extent as compared to the 1998 mapping. On February 1, 2023, City Council approved recommendations in a staff report to update the City's Still Creek designated floodplain and flood construction level requirements to reflect the updated floodplain mapping.

It is important to note that the 2021 floodplain mapping was based on existing development and did not assess the potential for flood hazard to increase due to land use intensification. Land use intensification may replace open spaces (e.g., surface parking lots) with buildings, resulting in the loss of floodplain storage. This is an important consideration in Vancouver as the Rupert and Renfrew Station Area Plan is developed.

The potential increase in flood risk from development was assessed in a separate study for the City, which confirmed the potential for development to increase flood hazard (NHC 2022). The study also indicated that daylighting buried portions of the creek and widening the creek corridor may significantly reduce the overbank flood hazard by providing more room for water within the corridor.

Table 3-4 2021 dry season water quality monitoring program (piped stormwater system).

PARAMETER (UNIT)	RENFREW RAVINE PARK	RENFREW COMMUNITY PARK	NATAL ST.	SKEENA ST.
Physical Water Quality Parameters				
pH	7.4	7.5	7.8	5.9
Water Temperature (°C)	21	21	23	19
Conductivity (mS/cm)	0.127	0.226	0.412	0.156
Dissolved Oxygen (mg/L)	7.6	7.6	7.3	7.3
Turbidity (NTU)	2	2	44	23
Total Suspended Solids (TSS, mg/L)	7	2	146*	27
Nutrients				
Nitrate, N-NO_3 (mg/L)	0.9	1.1	1.0	1.3
Bacteria				
E. coli (MPN/100 mL)	5,725	564	818	112,000
Fecal Coliforms (MPN/100 ml)	4,845	325	331	19,400
Metals				
Cadmium, total (mg/L)	All <DL	All <DL	0.0003	0.00008
Copper, total (mg/L)	0.003	0.002	0.056	0.040
Iron, total (mg/L)	0.1	0.1	7.8	1.4
Lead, total (mg/L)	0.001	All <DL	0.011	0.003
Zinc, total (mg/L)	0.008	0.008	0.19	0.07

Cell colour indicates the classification of water quality according to Metro Vancouver Monitoring and Adaptive Management Framework for Stormwater:

Good Level | Satisfactory Level | Needs Attention Level

*There are no AMF guidelines for Total Suspended Solids; red colour font indicates levels that exceed CoV Bylaws and National Stormwater Quality Database
<DL = below detection limit
Mean values averaged over 5 samples, except for Skeena St. (1 sample); the geomean was calculated for microbial parameters. To calculate means, concentrations below detection limit were replaced by DL/2.

Impacts to Social and Cultural Values

Equity and reconciliation

The profound alteration of the Still Creek watershed in the past centuries has impacted the relationships between the local Nations and the land and water, affecting opportunities for cultural practices and uses, learning, and knowledge sharing. In addition, several areas within the Still Creek watershed have been identified as being tree canopy deficient and in need of low-barrier recreation opportunities (City of Vancouver VanPlay 2020).

Out of sight, out of mind

Opportunities for people to connect with the daylit sections of Still Creek in Vancouver can be challenging to access. The primary area for viewing and connecting with the creek is in Renfrew Community Park and Renfrew Ravine Park. Smaller viewing opportunities are present along the Still Creek corridor between Renfrew Street and Boundary Road with no linear walking path. Despite the creek being out of sight there have been concerted efforts to shed light on Still Creek by Still Moon Arts Society and Nookta Elementary School reminding the community of the existence and significance of the creek.

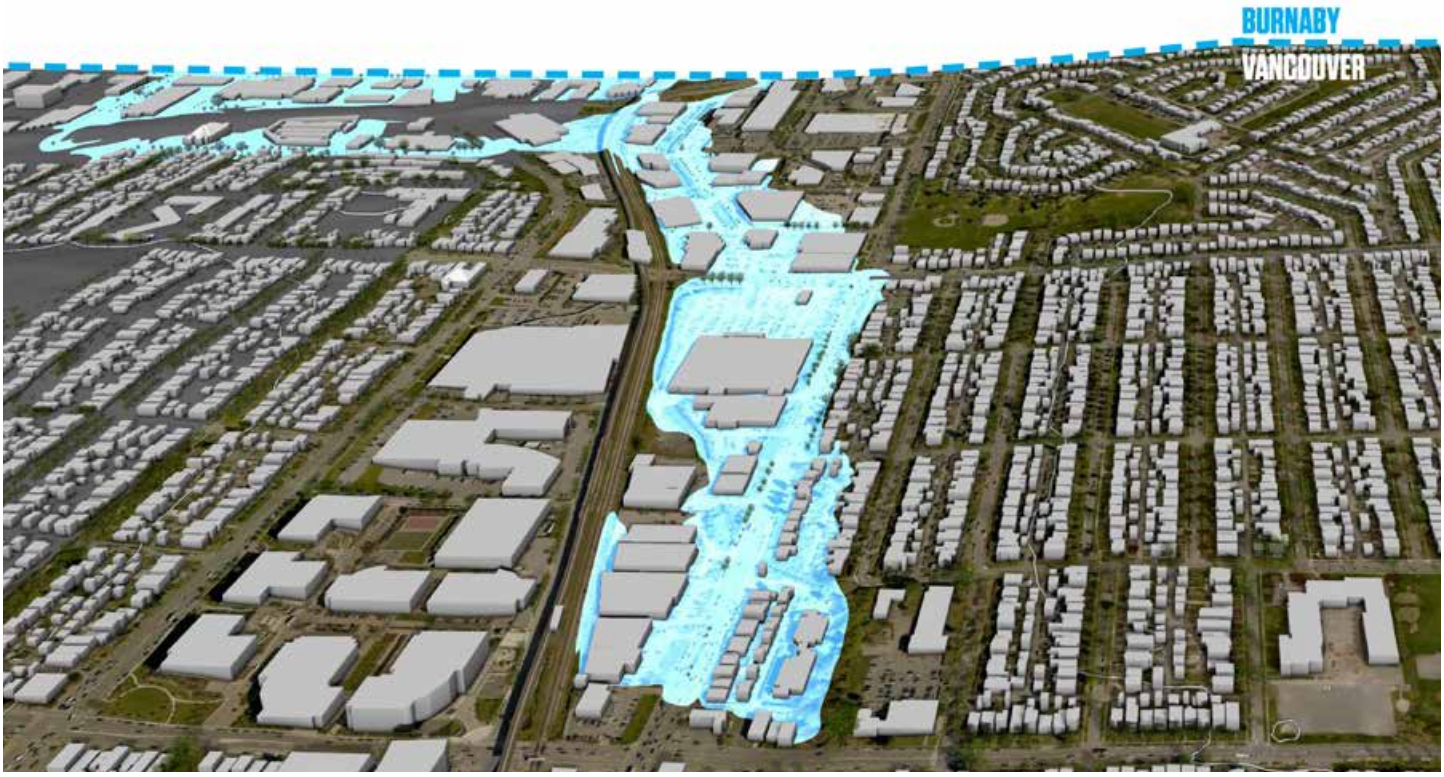

Figure 3-7 3D model of Still Creek in an extreme flood event under future climate projections (200-year return period / 0.5% annual probability), looking east from Renfrew Street

Physical barriers to access and connectivity

Pedestrian access to the Still Creek corridor between Renfrew Street and Boundary Road is limited by the configuration of the urban fabric and large industrial sites surrounding the creek, with the rail corridor to the north, busy arterial streets to the west, south, and east, and large blocks with few pedestrian crossings.

There are two at-grade railway crossings connecting pedestrian traffic from Broadway to Still Creek. The distance between the two crossings (one at Renfrew Street and one on Rupert Street) can make accessing Still Creek by foot from Broadway challenging.

East of Bentall Street the creek is more accessible with a gravel path along its southern edge between Bentall Street and Skeena Street. This section of the creek is separated from the western half by Rupert Street, and lacks a linear connection to the creek and to broader circulation patterns (e.g., to Rupert Street, to the Central Valley Greenway) limits the accessibility to this part of the corridor. While there is better access in this area, there are also issues related to garbage being dumped along and into the creek.

As a result of these physical barriers and lack of public circulation, the Renfrew Street to Boundary Road corridor lacks accessibility as a public space and recreational amenity for residents.

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4.0 VISION FOR THE STILL CREEK WATERSHED

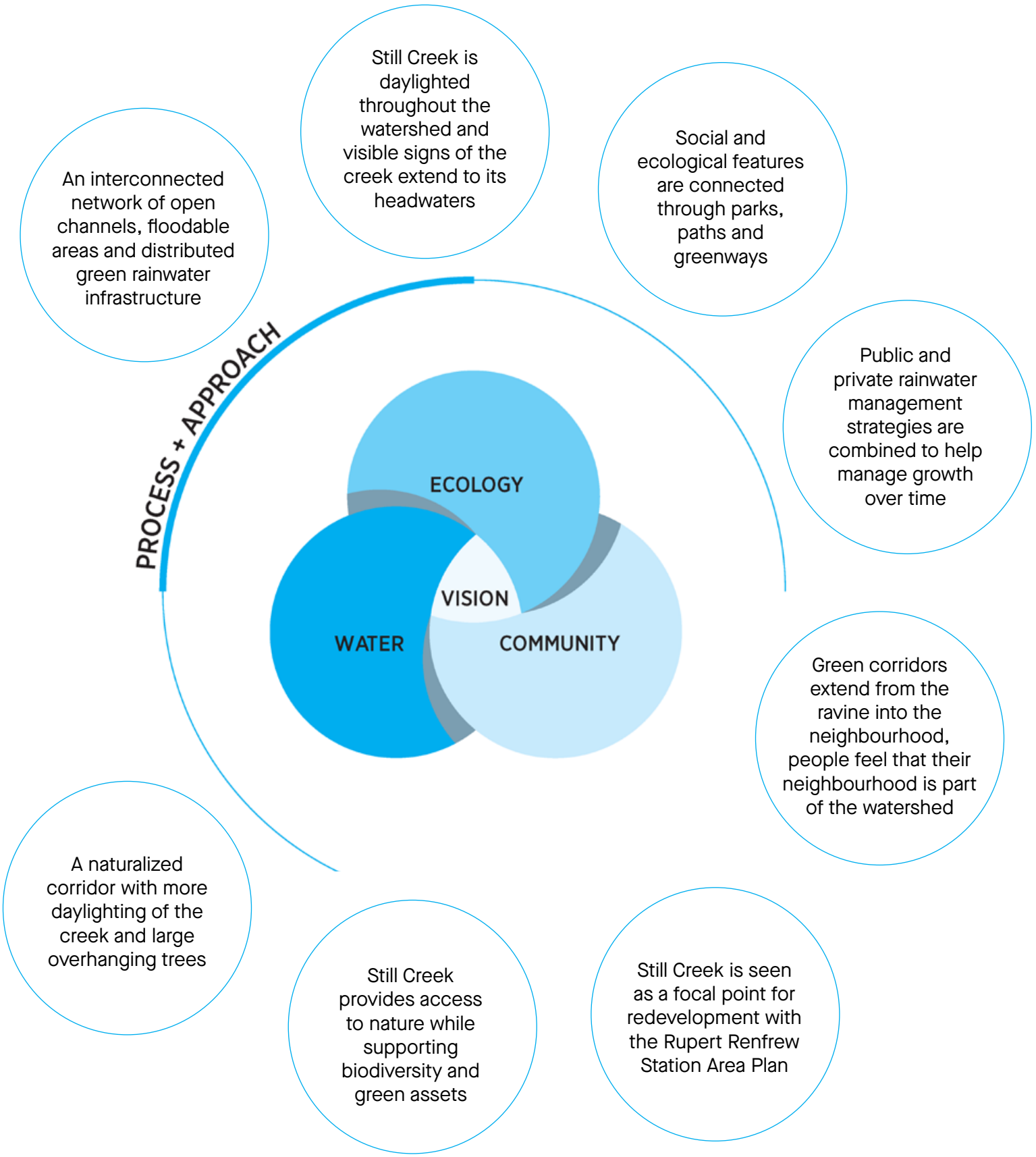

Figure 4-1 Common themes for the vision of the Still Creek Watershed; the vision for Still Creek is at the heart of the integrated lenses of water, ecology, and community

4.1 VISION

The overall vision for the Still Creek Watershed is nested within the lenses of ecology, water, and community, all of which are managed in an integrated way through a watershed-based process and approach.

Ideas for the long-term vision of Still Creek that emerged through project workshops and engagement are captured in Figure 4-1.

4.2 DESIGN PRINCIPLES AND ACTIONS

Through city workshops, a series of design principles, or objectives, emerged. They are organized through the lenses of PROCESS + APPROACH, ECOLOGY, WATER, and COMMUNITY, although many of the principles overlap across lenses. The principles are listed below and illustrated in Figure 4-2, and accompanied by recommended actions to advance each of the principles.

Overall Process and Approach

Work Across Scales

- Support big moves at the land-use planning scale with smaller-scale initiatives throughout the watershed.
- Use pilot projects to test restoration tools in a local context.

Work Across Boundaries

- Reflect a holistic understanding of the watershed as a living system by integrating work across municipal departments and governmental jurisdictions.

Maintain an Open Process

- Maintain an open project planning and design process that welcomes the participation of rights-holders and community stakeholders, to align efforts with the City's UNDRIP Strategy priorities, allow iterations of priorities if identified by the Nations and further the work of reconciliation.

Community

Foster Stewardship

- Provide opportunities for people to develop a relationship with Still Creek and its watershed, and support those who steward its health.
- Incorporate elements that support environmental stewardship work, including access, storage, and limited access to the creek.

Re-imagine Urban Tributaries

- Re-imagine Still Creek's urban tributaries as social and ecological corridors, or 'Contributaries' as described on page 81 of this report, recognizing their vital contributors to the health of the creek.

Ecology

Improve Connectivity

- Layer GRI, biodiversity enhancements and active transportation corridors to enhance the movement of people, water, and wildlife.
- Provide safe routes for people to access the Still Creek corridor while limiting the extent of fragmentation.

Nourish Biodiversity

- Focus on improving the quality of water and soil.
- Establish the conditions to nourish life and diversity, rather than designing for a specific, focal species.
- Increase the width of riparian habitat areas.
- Remove invasive plants and increase the amount of native plant cover.
- Increase tree canopy cover.

Enhance Instream Habitat

- Remove fish passage barriers.
- Improve instream habitat complexity by adding instream cover features, such as large woody debris, and large boulders.
- Create refuge habitats within the creek, such as off-channel ponds or wetlands.
- Increase floodplain habitat area.
- Re-establish the hyporheic zone once watershed conditions have been improved (e.g., reduced sediment input from the watershed).
- Initiate a hyporheic zone restoration pilot project to better understand existing conditions and restoration opportunities.

Water

Make Room for Water

- Re-create an urban floodplain that layers uses and integrates places for periodic inundation.

Improve Water Quality

- Keep water as close to where it falls as possible.
- Integrate GRI space throughout the watershed for overland flows to be filtered and cleansed.
- Intercept and treat storm sewer flows where possible to supplement keeping water as close to where it falls.
- Identify and address sanitary cross-connections.
- Incentivize water management best practices on private property.
- Use end-of-pipe treatment at outfalls draining into Still Creek.
- Prioritize GRI on high traffic/high pollutant road areas.

In Sight, In Mind

- Uncover lost and buried creek connections to clearly show where the water flows to strengthen a culture of awareness, understanding and care.

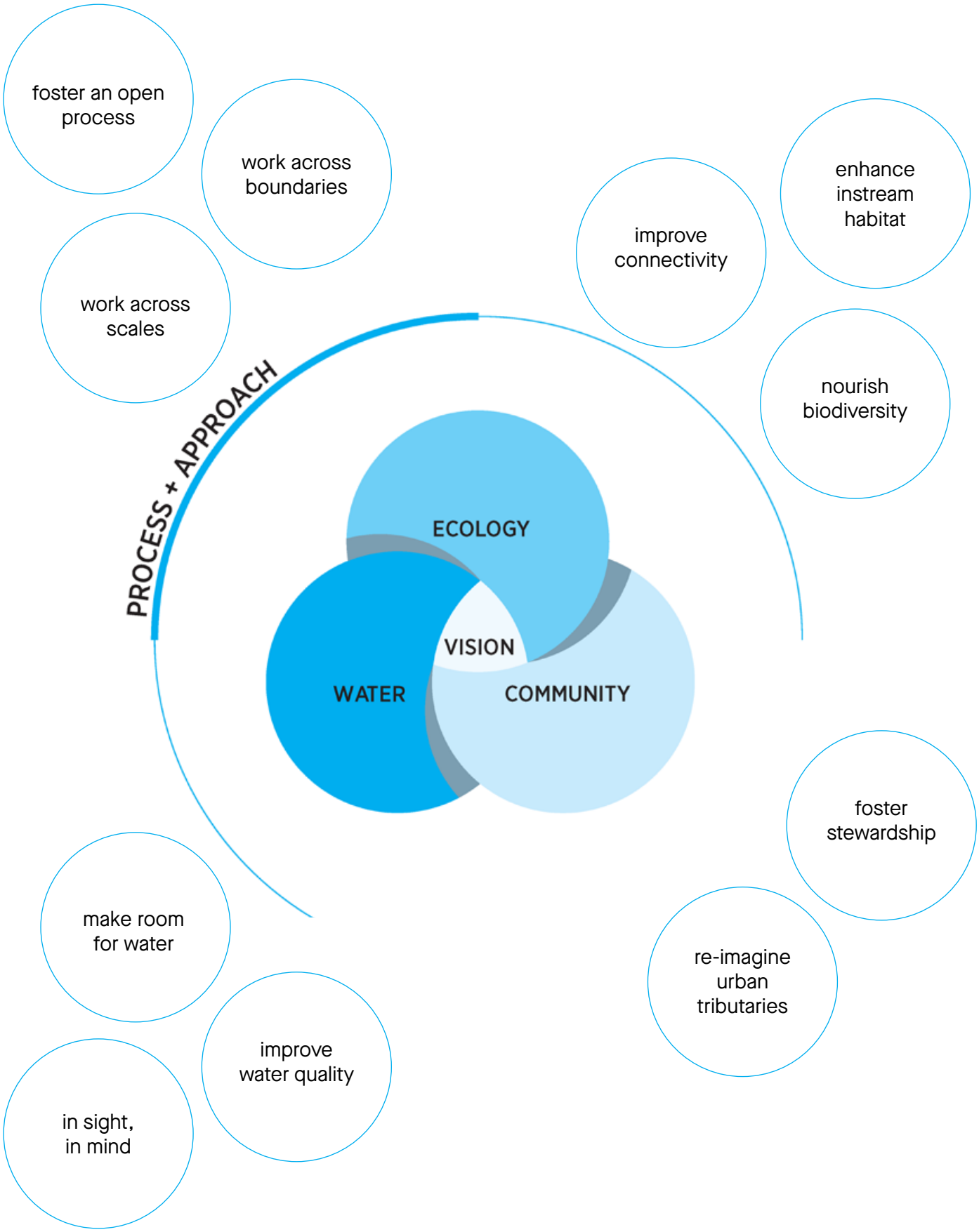

Figure 4-2 Design principles for the Still Creek Watershed

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5.0 ENHANCEMENT ACROSS SCALES

5.1 ENHANCING THE STILL CREEK CORRIDOR
RENFREW STREET TO BOUNDARY ROAD

Figure 5-1 Aerial view of existing Still Creek corridor (2022) looking west from Natal Street

5.1.1 OVERALL VISION

The concept plan for enhancing the Still Creek corridor between Renfrew Street and Boundary Road seeks to transform Still Creek into a fully daylit channel with a naturalized floodplain that reduces flood risks, enables growth, and is adapted to climate change; has enhanced instream and riparian habitat; provides water quality treatment within the corridor; and incorporates improved access and connections to the creek. The plan also incorporates opportunities to restore the hyporheic zone - a critical part of a stream ecosystem that becomes degraded in many urban streams. The enhanced corridor will provide an expanded natural area and public amenities in a part of the city that is canopy deficient and has access limited access to low-barrier recreation (City of Vancouver VanPlay 2020).

The renewal of this section of Still Creek will give the community more access to nature and new green space. By continuing to daylight and restore this creek, the concept plan will deliver a 'green vein' of ecological and community value for the neighbourhood around Rupert and Renfrew. Through this project, the City is investing in the sustainability, resilience, and liveability of Vancouver's growth.

The following annotated site plan presents the overall 30-year vision for the Still Creek channel corridor, from Renfrew Street to Boundary Road, incorporating a range of key features or big moves that will enhance the creek's ecological and recreational value over the coming decades. These big moves include:

- Making room for water and resilient growth
- Enhancing instream habitat
- Treating water within the corridor (treatment terraces)
- Restoring the hyporheic zone
- Expanding the presence of the creek
- Improving access
- Designing for ecological zones

The study has been developed in parallel with the Rupert and Renfrew Station Area planning process, and it is envisioned that the study and concept will inform the broader Rupert and Renfrew Station Area Plan over the next 30 years.

A class D opinion of probable costs to construct the Still Creek corridor concept plan, from Renfrew Street to Boundary Road, has been prepared for the City separate from this report.

Following page

Figure 5-2 Still Creek Daylighting and Enhancement Plan, Renfrew Street to Boundary Road

STILL CREEK DAYLIGHTING AND ENHANCEMENT PLAN

RENFREW STREET TO BOUNDARY ROAD

1. Proposed Viewing Platform
2. Existing Pedestrian Path and Bridge
3. Expanded Riparian Corridor
4. Opportunity for Enhanced Pedestrian Crossings at Nootka Street and Lillooet Street to improve connections.
5. Potential future East Side cross-cut connection
6. High Treatment Terrace: open, level areas with clear sight lines to the creek channel, with opportunities to integrate seating, interpretive signage and public art. Vegetated tiers filter and slow down rainwater from local catchment areas.
7. Gravel Bar: paths from the top of bank to pebble shoreline areas along the lower floodplain. These sites provide limited access to the water and support stewardship initiatives including water for stewardship purposes (e.g. water quality monitoring and fish fry release) and cultural practices only. General public access will be restricted (e.g. habitat fencing).
8. Multiuse Path: 4 m wide paved accessible path, for cyclists and pedestrians.
   Green Rainwater Infrastructure: opportunity along Hebb Avenue, to provide pretreatment to rainwater before it enters Still Creek.
9. Green Rainwater Infrastructure: opportunity along Hebb Avenue, to provide pretreatment to rainwater before it enters Still Creek.
10. Stewardship Centre: opportunity to integrate space that supports Still Creek stewardship initiatives.
11. Maintenance Path: narrow gravel path (< 2 m wide) with limited access, for maintenance purposes only.
12. Public Art Area: support ongoing initiatives in this area.
13. Low Treatment Terrace: tiered vegetated areas with boulder retaining wall, designed to slow and filter water from existing pipe outfalls in the creek corridor.
14. Potential Cornett Road Connector to be determined through the Rupert and Renfrew Area Plan.
15. Stewardship Resources Storage Area: to be integrated with future pump station upgrade.
16. Green Rainwater Infrastructure: opportunities along streets leading to the Still Creek.
17. Creek Crossings: coordinate with future redevelopment to identify opportunities to remove existing bridges, while maintaining access to the sites.
18. Falaise Park: Green Rainwater Infrastructure opportunity in park, with existing pedestrian crossing.

Figure 5-3 View of Still Creek corridor concept, looking northeast from Renfrew Street

Figure 5-4 View of Still Creek corridor concept, looking northeast from Grandview Highway

Figure 5-5 View of Still Creek corridor concept, looking southwest from Boundary Road

Figure 5-6 View of Still Creek corridor concept, looking southwest from Natal Street

5.1.2 BIG MOVES

Making Room for Water and Resilient Growth

One of the big moves for revitalizing the Still Creek corridor is helping to re-establish a more naturalized floodplain for the creek. Due to the history of development over the past century, the section of Still Creek from Renfrew Street to Boundary Road has become confined to a narrow, steep-sided channel, with some sections in long culverts. The geometry of the creek results in inadequate flood storage and conveyance, rapid flows during flood events, bank erosion, downcutting of the channel bed, and poor conditions for aquatic life. The loss of the floodplain has also removed vegetation that naturally slows and filters water, and provides bank stabilization. Under healthy conditions, this riparian vegetation helps to mitigate flooding and sediment build-up.

During periods of extreme rainfall events and high water, a constrained creek channel can overtop its banks, causing unpredictable flooding and disruption in adjacent areas. This occurrence is increasingly apparent downstream of Boundary Road/Highway 1 in Burnaby, where flooding occurs regularly due to flatter topography and less grade change between the creek and adjacent uplands. Climate change is increasing rainfall intensities in the region, resulting in higher flow volumes in Still Creek and greater flood risks overall.

To address these risks, preliminary flood modelling is informing the expansion and naturalization of the floodplain. Expanding the width will allow additional room for the creek and support slowed filtered flows. Sediment will settle out on the new floodplain, nourishing new riparian vegetation. In turn, the expanded riparian area will increase the ecological health of the corridor. Overall, re-establishing some of the historic floodplain will help mitigate flood risk.

Through a parallel flood study undertaken by the City of Vancouver (NHC 2022), it has been identified that daylighting the buried portions of the creek and widening the creek corridor would provide significant reductions to overbank flood hazard exposure in the floodplain, by providing more floodwater storage and conveyance area.

The flood study assessed the performance of a widened corridor concept, which was developed initially by City staff based on the 2002 Still Creek Enhancement Study and other considerations.

The results of the model showed potential for significant reductions in flood depth and a reduced extent of flooding across a range of flood events, ranging from a flood under current climate conditions with a 10-year return period (10% annual probability) to a future climate 200-year return period flood (0.5% annual probability).

Additional future flood assessments are required to refine the analysis and optimize the nature-based flood mitigation value of the creek daylighting and corridor enhancement concept.

This concept is also closely linked with the Rupert and Renfrew Station Area Plan as a growth-enabling nature-based flood mitigation drainage project. The technical study (NHC, 2022) also revealed that without the daylighting and corridor widening concept, the addition of more buildings into the floodplain would increase the flood hazard. Therefore, the concept serves to enable additional buildings to be added to the floodplain through the land use planning exercise while avoiding increasing flood risk. The concept provides room for water that would otherwise be lost due to the addition of new buildings where there are currently open spaces (e.g. surface parking lots). This linkage is studied and described further through the integrated water management planning work in support of the Rupert and Renfrew Station Area Plan. This big move enables resilient growth to occur in the rest of the floodplain.

Treating Water Within the Corridor (Treatment Terraces)

The concept design for the Still Creek channel from Renfrew Street to Boundary Road integrates treatment terrace opportunities to slow stormwater before it enters the creek, offering the potential for some level of water quality improvement.

Two types of treatment terraces are proposed: high treatment terraces and low treatment terraces. The treatment terraces as shown in the concept are indicative, and have not been sized based on expected stormwater inflows or based on a designed level of water quality treatment.

High Treatment Terraces

High treatment terraces are integrated with public space along the top of the creek bank and function primarily as gathering spaces along the edge of the riparian corridor. They are envisioned as spaces for people to enjoy views of the Still Creek, learn more about it, and gather for community stewardship activities. The high terraces are envisioned to be distinct in the landscape, with angled stone walls that provide a clearing among the more lush riparian vegetation of the corridor to allow views of the open water channel.

The terraces are set back from the top of the creek bank and are also intended to incorporate features that can receive and slow rainwater runoff, in order to potentially improve water quality. Pre-treatment facilities, such as sediment vaults, are recommended to reduce long-term maintenance of the terrace treatment system. In this concept vegetated swales are integrated into the banks of the high terraces, providing potential water quality improvements to stormwater before it flows into Still Creek. Small volumes of runoff may be able to be treated by allowing water to flow perpendicularly through the riparian planting (similar to filter strips) with terraces

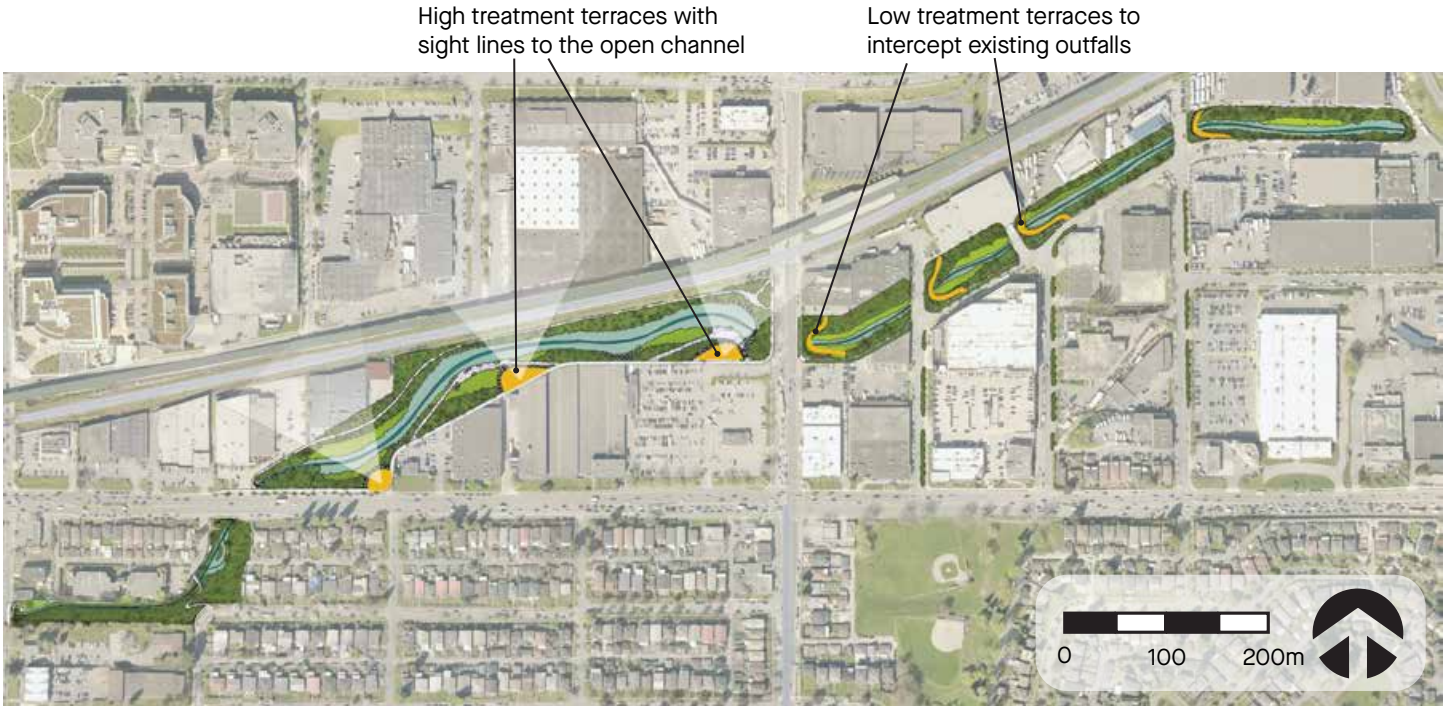


Figure 5-7 Still Creek corridor concept: sight lines, high treatment terraces and low treatment terraces.

Figure 5-8 Perspective of a high treatment terrace, showing an elevated viewpoint overlooking the creek
*Stewardship Centre representation is illustrative only; design to be determined.

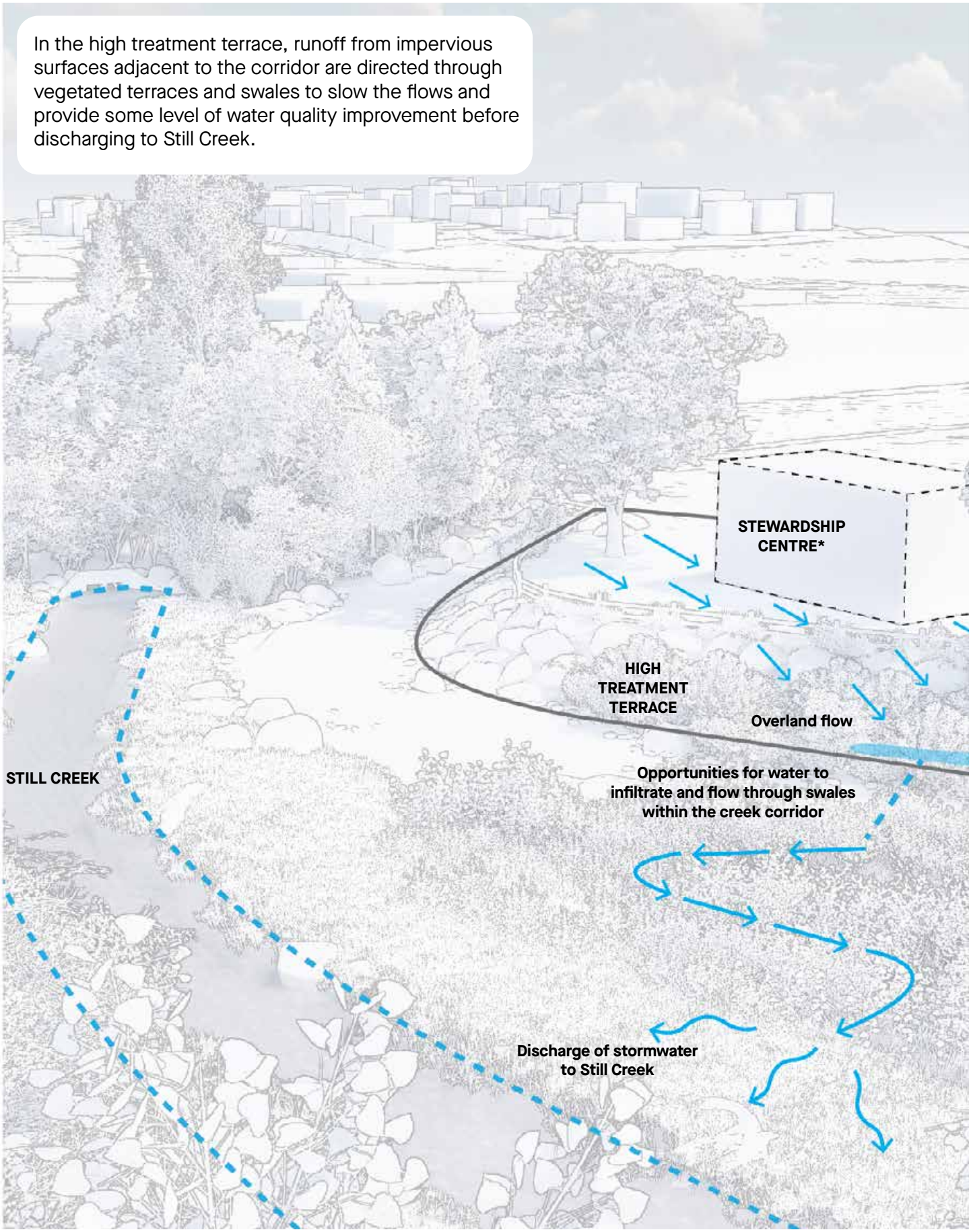


Figure 5-9 Schematic diagram showing how the high treatment terrace can receive and slow overland runoff before it enters the creek
*Stewardship Centre representation is illustrative only; design to be determined.

Figure 5-10 Perspective of a low treatment terrace, showing a swale parallel to the creek to intercept storm outfalls

created by logs or retaining rocks. Larger volumes of water may be best treated through armoured swales with long linear flow paths, parallel to the creek (Figure 5-9). Detailed design of these features will require an engineering analysis of the anticipated volumes and water quality parameters of the inflows, to design the terraces to accommodate the anticipated volumes and provide a desired level of water quality treatment.

Low Treatment Terraces

Low treatment terraces are located at the elevation of existing stormwater pipe outfalls. These terraces are intended to receive, slow and dissipate stormwater from the piped system before it discharges into the creek. End-of-pipe pre-treatment facilities are recommended upstream of the outfall locations, to allow for the removal of sediment before the stormwater enters the treatment terrace; pre-treatment facilities (such as oil and grit separators or more complex proprietary systems) should be located in adjacent road rights-of-way for easy maintenance access. During high water conditions, flows will bypass the treatment terraces (Figures 5-10 and 5-11).

Both high and low treatment terraces are envisioned to function like swales parallel to the creek with weirs to step down the grades. High flows could be directed to armoured bypass channels.

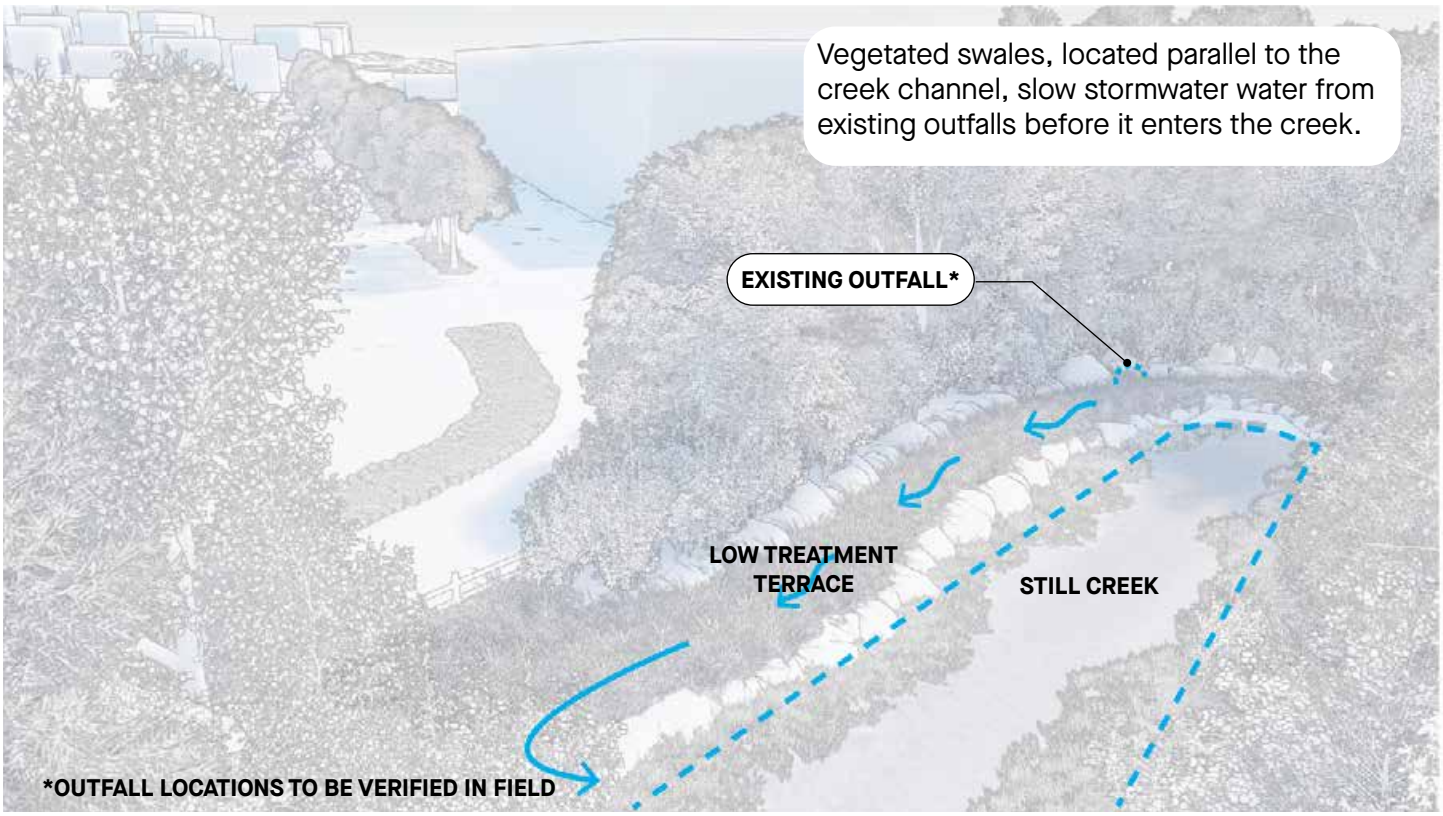


Figure 5-11 Schematic diagram showing how a low treatment terrace can receive and slow stormwater from outfall pipes before it enters Still Creek.

Design development considerations for high and low treatment terraces include:

- Diversion of low flows from the piped stormwater system into the treatment terraces.
- The size of treatment terrace relative to the rate of stormwater inflow.
- Anticipated velocities of water runoff and erosion protection recommendations.
- Identifying upstream water treatment, and whether more capacity for treatment is needed within the terrace.
- Access for maintenance.
- The integration of stepped terraces, providing stepped level surfaces to help slow and filter water through vegetation.
- Long linear treatment pathways parallel to creek (swales) or zig-zag paths down slope.
- Culverts where flows will intercept paths.
- Materials for terracing, including raised berms of compacted soil, logs, large boulders or stacked rocks.

Figure 5-12 Perspective of creek channel with naturalized floodplain and restored hyporheic zone

Restoring the Hyporheic Zone

The hyporheic zone (HZ) is the area beneath and adjacent to a stream where surface water and groundwater mix and exchange in the porous space of the sediment. It is an important aspect of stream restoration because it can increase water quality, provide important habitat for aquatic organisms, and enhance streamflow dynamics. HZ restoration is often overlooked in stream restoration projects where the primary focus has historically been on visual 'instream' and 'riparian' components, as opposed to subsurface system(s). Yet, these unseen or hidden components are critical to the function of a stream ecosystem. While HZ restoration is considered a novel approach, emerging literature on the subject suggests that the ecological function of highly impacted urban streams can greatly benefit from proper HZ restoration (e.g., Lawrence et al. 2013, Bakke et al. 2020).

The function of the HZ is well understood to provide many ecological functions and ecosystem services including nutrient cycling, water quality and pollution mitigation, and water temperature regulation. A critical parameter of the HZ's function is residence time - as water in the HZ moves much slower than water in the stream channel, the processes described above have an opportunity to occur. However, the urbanization of streams compromizes the function of the HZ, impacting the stream's ability to carry out these ecosystem services.

Still Creek likely has impaired HZ function due to historical channel alterations including piping, straightening, confinement and armouring. Furthermore, alterations to the flow and sediment regime due to urbanization have resulted in a high proportion of the channel bed becoming a 'pavement' of immobile gravel and cobble embedded in fine sediments. This bed condition is a barrier to the creek's exchange of flows with groundwater and to other benefits that a healthy HZ would provide.

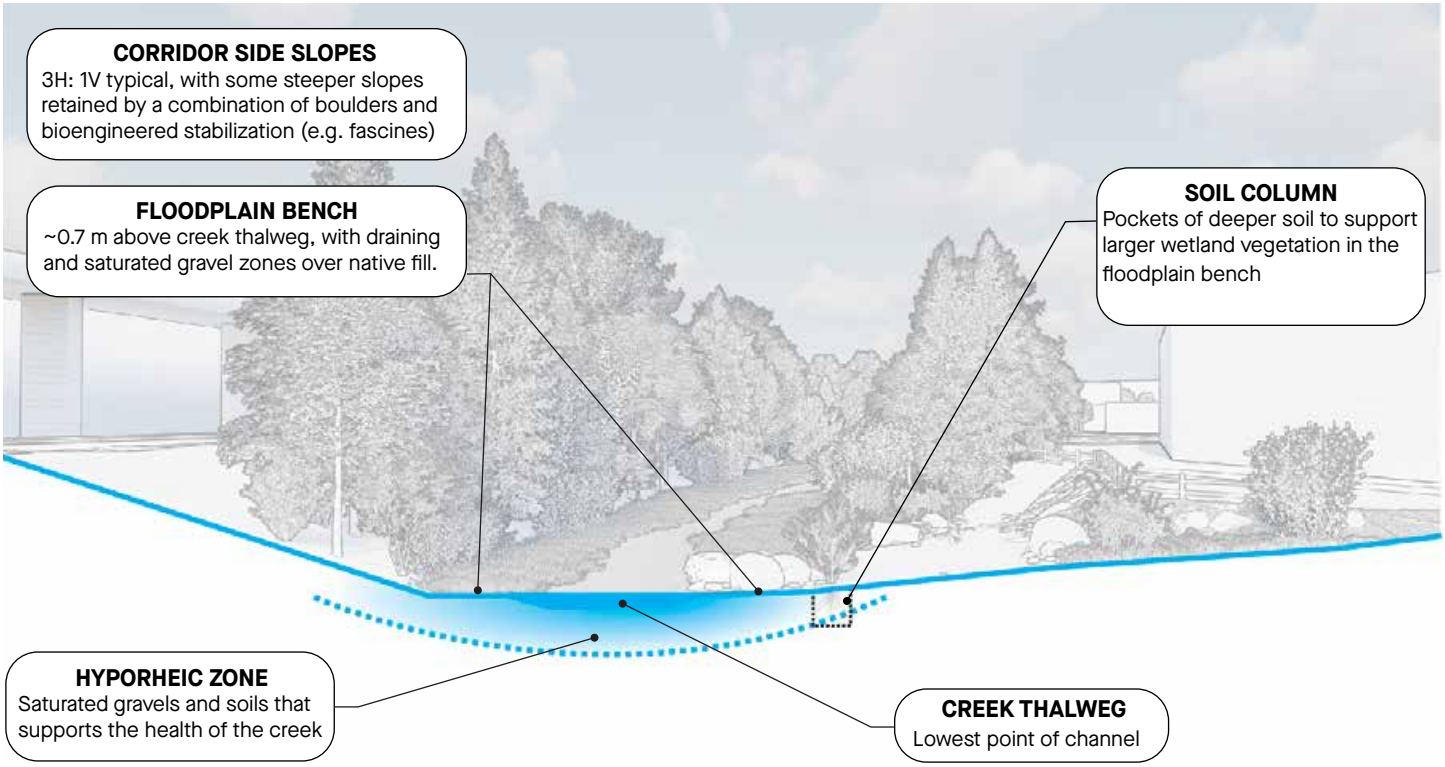


Figure 5-13 Schematic diagram showing potential elements of hyporheic zone restoration for Still Creek

Considerations for Hyporheic Zone restoration

In the 2002 Still Creek Rehabilitation and Enhancement Study the HZ was excluded from design considerations. Few local examples of HZ restoration exist, leading to uncertainties if this approach should be undertaken as part of Still Creek's restoration. The City may consider contacting other jurisdictions that have undertaken HZ restoration projects, such as Seattle, Washington, to learn from their experiences.

A pilot HZ restoration project may be warranted to test implementation on a smaller scale in Still Creek and to collect data on existing conditions, such as underlying and adjacent soils and groundwater elevations. A pilot project could provide valuable insight into the design and construction processes and its performance could inform future, large scale HZ restoration projects in Still Creek.

Hyporheic zone restoration is only effective in areas that are regularly inundated, therefore investigations are required to determine stream channel dimensions and understand local conditions, such as groundwater elevations, stormwater inputs and potential or future root zone interactions.

Understanding the legacy soil conditions of the area is another key consideration in HZ restoration projects. Soil conditions may have varying implications both from a functional perspective (e.g., whether soils/substrate are appropriate to support HZ recovery) and from a cost/implementation perspective (e.g., costs associated with soil contamination).

Considering the long-term viability of a restored HZ is important. A feasibility-level assessment should determine whether a restored HZ could retain its function under the expected flows and fine sediment loading of the Still Creek watershed.

Similarly, further exploration of the channel-level hydraulics (e.g., structural components such as large boulders, logs and root wads, and the channel platform) would be required. Instream structures force water to turn, plunge and aerate, thereby forcing water into the HZ. Desired channel alignment and instream structures to support the HZ would need to be assessed based on available area, potential land use issues, utility conflicts, and flooding implications.

Careful consideration should be given to incorporating HZ as part of an overall phased restoration approach, as HZ restoration is likely a first step (i.e., before riparian or other works). At the same time, successful HZ restoration requires that watershed improvements have been made, to reduce the amount of suspended sediment coming into the creek.

Costs are one of the most significant considerations associated with HZ restoration. Key components include:

- Understanding the potential for surrounding soils/substrate to be contaminated, since the disposal of contaminated material can increase costs significantly.
- Additional costs of excavation beyond what is required for creek restoration. All removed material would have to be reused or disposed of (depending on its quality) and new clean material for HZ function imported and placed.
- Understanding underlying conditions and volumes of excavation required to restore a functional HZ, depending on what depth of new substrate is required (i.e., the depth of new substrate required may be as little as 20 cm, or as much as 200 cm).
- Underlying or adjacent utilities and their potential relocation or protection to accommodate the HZ zone.

Expanding the Presence of the Creek

> *"Extend green corridors from the ravine into the neighbourhood so that people feel that their neighbourhood is part of the watershed."*
>
> Carmen Rosen, Still Moon Arts Society

Part of the renewed vision for the Still Creek corridor is to increase its presence and ecological values within the surrounding neighbourhood fabric. This move is envisioned as a means to strengthen social and ecological connections with Still Creek, and can be achieved in tandem with redevelopment as part of the Rupert and Renfrew Station Area plan over the next 30 years.

One way that the presence of the creek will be expanded into the neighbourhood is by integrating GRI into adjacent parcels and streets, allowing surface and subsurface (piped) runoff to be intercepted, slowed, and partially treated before it flows into Still Creek. This is particularly important for the corridor as it is currently surrounded by large expanses of impervious surfaces with very little tree canopy cover.

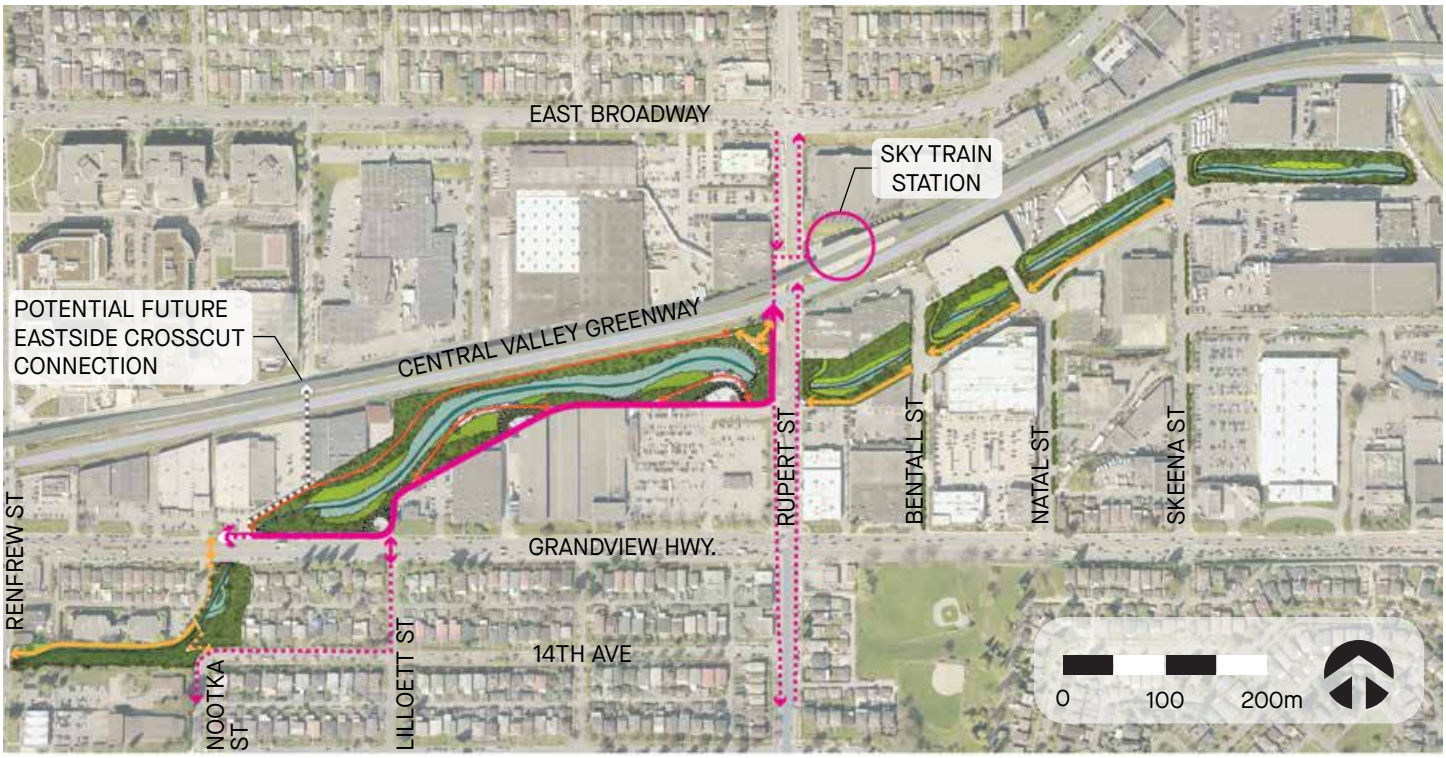
Through the current study the term 'Contributaries' has been coined to begin discussions on reimagining streets connecting to Still Creek's riparian corridor as recreated 'tributaries' within the urban fabric. These social and ecological corridors could link people and water to Still Creek, enhancing the health of the creek and the surrounding community. They could also be designed to support carbon sequestration through an expanded urban tree canopy and the use of amended soils where feasible. These corridors aim to create a better pedestrian experience in the neighbourhood by improving connectivity and creating a green park-like street experience and encourage active modes of transportation.

Figure 5-14 Schematic diagram showing the extension of the Still Creek corridor into the surrounding neighbourhood, to increase its physical and experiential presence.

Improving Access

A number of different transportation opportunities were explored through this study. Some of these opportunities are shown on Figure 5-15. Future alignments will be coordinated through the Rupert and Renfrew Area Plan.

The presence of the Still Creek corridor between Renfrew Street and Boundary Road is also increased in the neighbourhood by connecting the creek linearly with a pedestrian trail and by establishing connections to the broader active transportation network surrounding the corridor.



LEGEND

Proposed Multiuse Path
4 m wide paved accessible path, for cyclists and pedestrians

Proposed Pedestrian Route
<2m wide public pedestrian path, permeable surface when within corridor

Limited Access Path
<2m wide gravel path for maintenance and restricted access to gravel bars

Existing Cycling Route
shared use lanes and painted bicycle lanes in corridor area

Existing Pedestrian Route
<2m wide pedestrian path, within corridor

Figure 5-15 Still Creek corridor concept: circulation routes

A 4-metre wide multi-use all ages and abilities path is envisioned along the south edge of Still Creek between Nootka Street and Rupert Street, providing an important link to Rupert Skytrain Station and to two active transportation routes: the west end will connect to a planned blue green system and bike route on Nootka Street south of Grandview Highway, and the east end will connect to cycling infrastructure on Rupert Street and the Central Valley Greenway north of the rail corridor.

On the east side of Rupert Street, a 1.5 m to 1.8 m wide gravel path is proposed along the south side of Still Creek. This expanded trail will improve local circulation next to the creek, and will link to the improved north-south 'contributary' streets (Bentall Street, Natal Street and Skeena Street) to bring people to and from the creek corridor.

Any new creek crossings will be limited in extent to reduce habitat fragmentation impacts and maintenance costs. Future decisions regarding the Eastside Crosscut active transportation route will be decided through the Rupert and Renfrew Area Plan; this alignment would also require approval of an at-grade rail crossing at this location.

Trail access down to the open channel and along gravel bars in the lower floodplain is envisioned to be restricted, and not open to the general public, in order to help protect ecologically sensitive habitat and salmon spawning grounds. The corridor is further protected by perimeter fencing, to help protect the area from dog activity. Within the corridor, narrow gravel paths provide access for cultural practices/ activities, maintenance and creek-related community stewardship work such as native planting and fish fry release.

Through engagement, Musqueam Indian Band specifically highlighted support for sheltered and limited-access areas for ecological protection and restoration, away from pedestrians and cyclists. Musqueam has also requested that space be reserved and included in future detailed designs for cultural practices and uses.

Figure 5-16 Still Creek, north of Grandview Highway (2022)

Enhancing Instream Habitat

Within Still Creek several instream habitat enhancements are proposed to increase the ecological health of the creek and support greater biodiversity within the corridor.

Large Woody Debris (LWD)

- Integration of large-diameter logs with root wads can increase ecological benefits, such as providing shelter for fish and other aquatic organisms.
- Placement should consider the effects on surrounding stream velocities and sedimentation so that the woody material does not cause unintended scour or erosion. Woody debris should be securely anchored such that it stays in position during large flood events.
- If the woody debris is placed in an area that can slow the stream flow and induce sedimentation, provision for maintenance access should be incorporated.

Riffles and pools

- The integration of pools and riffles in parts of the creek corridor can be considered to help improve oxygenation of the water, provide areas of cooler water temperatures (i.e., in pools of deeper water), and provide resting areas for fish and other aquatic species.
- Although there is sufficient gradient, riffle/pool sequences will need careful design to avoid creation of extremely low velocity pool segments that are prone to fine sediment accumulation.

Pocket wetland

- Pocket wetlands can be incorporated into the gravel floodplain bench to provide targeted areas for filtering stream water, and creating greater habitat complexity and diversity.

Modifying stream substrate

- Removing areas of hardened stream substrate and replace with appropriately sized gravel and cobbles can help slow the water, promote infiltration, and support the health and function of the stream ecosystem.

Figure 5-17 Perspective of creek corridor showing different ecological zones

Designing for Ecological Zones

Vegetation along the Still Creek corridor is comprised of several zones, with plant species suggestions based soil saturation, ability to establish in urbanized sites, value for urban wildlife, and potential value for Indigenous cultural uses and practices. Additional engagement with xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations will help to refine the plant palette through design development phases.

Base flow channel

The base flow channel is envisioned as remaining in its current location for some reaches and shifting to a more central alignment in other reaches. The optimal location of the channel centreline will depend on several factors, including available space on either side of the existing channel, adjacent land use and infrastructure, and adjacent subsurface conditions (e.g., if there are areas of soil contamination, bedrock, or otherwise unsuitable subsurface conditions to be avoided). Relocating the creek centreline in some reaches, where suitable, could allow improved creek substrate conditions and for the embedded channel to be rejuvenated. Creek centreline relocation can be done in conjunction with restoration of channel side slopes and creation of floodplains.

Floodplain bench

The floodplain bench will allow high water levels to overtop the base channel and spread out, allowing sediment to settle and nutrients to be taken up by the floodplain vegetation. The newly created floodplain bench is to be largely composed of gravel with occasional soil columns to create pocket wetlands. An invasive plant management strategy for reed canarygrass subspecies (*Phalaris arundinacea*) is recommended for the floodplain bench, particularly in locations where conditions are favourable for this invasive grass. Shading the floodplain bench, through tree planting on adjacent riparian

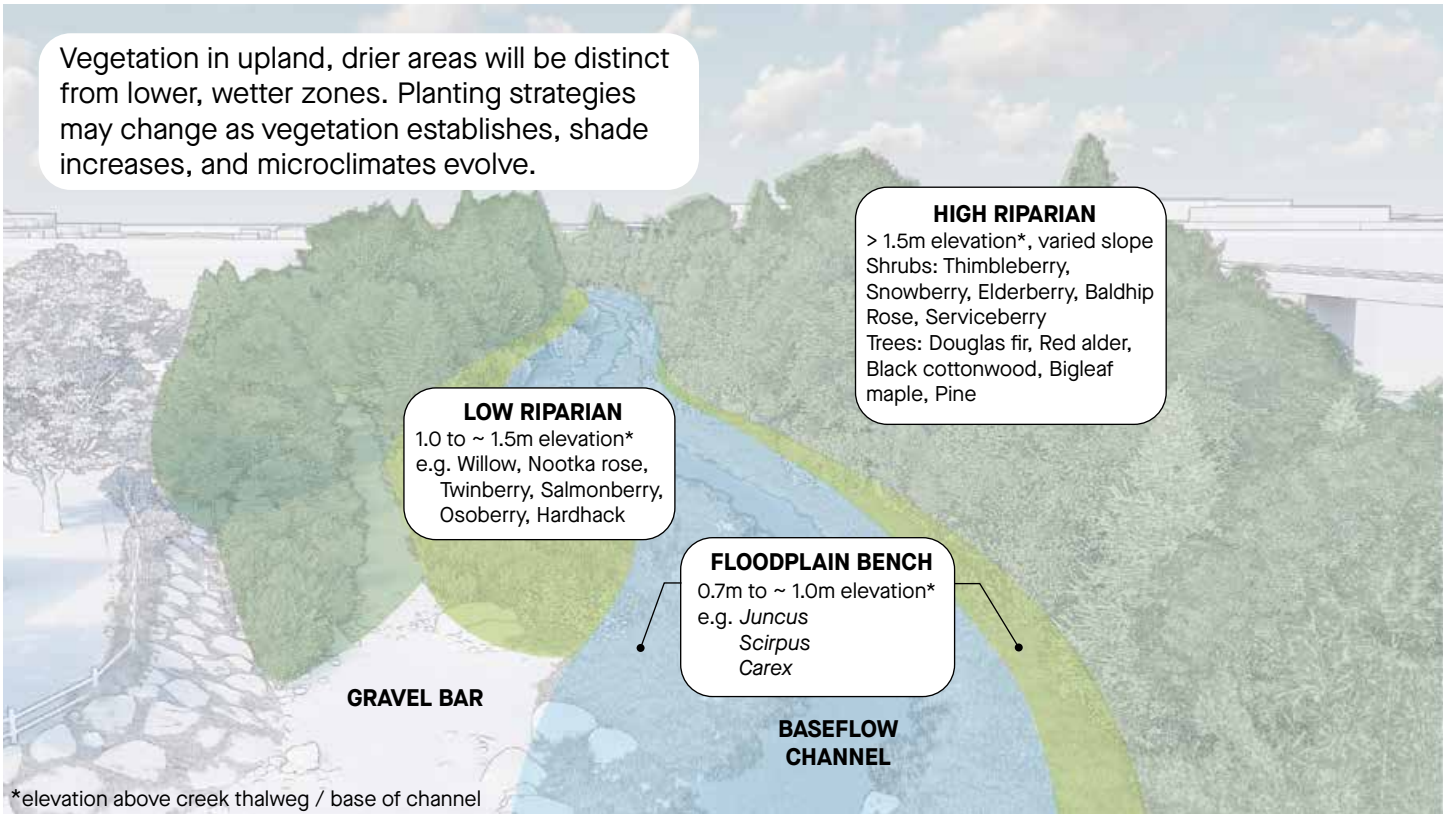


Figure 5-18 Schematic diagram showing ecological zones within the enhanced Still Creek corridor

banks, will help reduce the colonization of reed canarygrass. Similarly, establishing hummocks or high points in the floodplain, through anchored root wads or mounds, can increase the diversity of the floodplain vegetation. Typical herbaceous plants on the floodplain bench may include *Juncus*, *Scirpus*, and *Carex* species.

Low riparian zone

The low riparian zone will support species that require more soil moisture, such as willow (*Salix spp.*), myrica (*Myrica gale*), red-osier dogwood (*Cornus sericea*), Nootka rose (*Rosa nutkana*), twinberry (*Lonicera involucrata*), salmonberry (*Rubus spectabilis*), vine maple (*Acer circinatum*), osoberry (*Oemleria cerasiformis*), hawthorn (*Crataegus douglasii*), and hardhack (*Spiraea douglasii*).

High riparian zone

In drier high riparian conditions, shrub species for newly established sites may include thimbleberry (*Rubus parviflorus*), snowberry (*Symphoricarpos albus*), red elderberry (*Sambucus racemosa*), baldhip rose (*Rosa gymnocarpa*), and serviceberry (*Amelanchier alnifolia*). Douglas fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), pine (e.g., *Pinus contorta*) and bigleaf maple (*Acer macrophyllum*) are suitable pioneer tree species in low and high riparian zones.

In areas with established vegetation, shade, and good soil moisture, western red cedar (*Thuja plicata*) trees can be interplanted to increase shade and habitat complexity; this species is sensitive to climate change and therefore is best planted in areas with cooler microclimates.

Different forms of plant material can be used depending on species availability, time of year for planting, availability of water for irrigation during establishment, and planting methods. Collecting and propagating plant material from seeds and cuttings sourced from within the Still Creek watershed can help maintain local genetic diversity.

5.1.3 ENGINEERING AND GEOMORPHOLOGY CONSIDERATIONS

Coordination with Existing Utilities and Transportation Corridor

There are several utility crossings and relocations that would need to be reviewed and addressed to implement the Still Creek corridor concept plan. Through project design the utility conflicts will need to be reviewed and managed with the appropriate service providers. These include but are not limited to:

- FortisBC gas lines
- BC Hydro lines
- Metro Vancouver Water Transmission Main on Rupert Street
- Two sanitary pump stations (Nootka Street and Skeena Street)
- Communications and power throughout the corridor

The existing railway and SkyTrain corridor between Still Creek and the Central Valley Greenway is another element requiring coordination. The railway corridor would need to be protected against settlement issues during and after construction. In addition to these geotechnical requirements, significant consultation with the railway companies would be needed.

Corridor Size and Flooding Considerations

The City retained Northwest Hydraulic Consultants (NHC) to investigate the sensitivity of the flood hazard to potential daylighting concepts, including a nominally 45 m wide creek corridor. The assessment showed that creek daylighting, creek widening with a lowered floodplain bench, and culvert modifications has the potential to significantly reduce the flood hazard.

Based on the findings from the NHC study (2021), the expanded channel reduces overbank flooding along the corridor, but does not eliminate flooding completely. Thus, additional investigations are needed to reduce or mitigate overbank flooding.

These findings have informed the Still Creek corridor concept from Renfrew Street to Boundary Road. The widened corridor, combined with upgraded culverts, provides larger flow areas, reductions in flood levels, and reduced extents of flooded areas throughout the corridor. Additional hydrotechnical analysis of the Still Creek corridor concept, from Renfrew Street to Boundary Road, is required to confirm the flood performance of the proposed corridor geometry and to identify additional refinements.

Geomorphology Aspects of the Proposed Corridor Concept

Existing conditions

The highly impervious character of the Still Creek watershed, combined with extensive culverting and hardening of remaining open channel sections, has reduced potential natural sediment inputs to Still Creek. Further study is needed to confirm the source of sediment found in the Vancouver portion of Still Creek; it is likely that a significant volume of sediment is supplied from road runoff, which is a combination of fine mineral matter (gravel, sand, silt, clay) with metals, microplastics, asphalt particles, and other contaminants. There are very few sources of coarse sediment (i.e., gravels and cobbles) for the creek. Gravel and cobble currently located within the channel are generally embedded, and unlikely to mobilize.

Based on field observations and discussions with City staff, it is understood that a significant proportion of the fine sediments within Still Creek are transported through Vancouver and deposited within the reach between Boundary Road and Burnaby Lake. The frequency or volume of sediment removal by Metro Vancouver is unknown. The volume and characteristics of sediment transported through the Still Creek system was not measured or studied and is an area for future work as discussed in Section 6 Next Steps and Other Initiatives.

When streams become urbanized it is common for natural, size-variable (sand to cobble) sediments within streams to become replaced with fine-grained anthropomorphic sediments; this results in significant changes to instream conditions, as follows;

- Sediment will be in motion more frequently since high-stream energy (due to urbanization) can easily move the fine grains.
- Remaining coarse sediments may initially experience increased erosion as the supply of coarse sediment is reduced.
- Fine sediment infiltrates into the existing cobble and gravel, creating embedded (less permeable) conditions and reducing intra-gravel water flow. The loss of this intra-gravel flow has negative impacts for benthic invertebrate production and salmon egg survival.

Considerations for the proposed corridor concept

Existing, impacted substrate conditions can be replaced with improved substrate conditions, but without making concurrent changes to the prevailing flow and sediment regime these new channel conditions may quickly be altered. Similarly, the transport and deposition of sediment in the new channel will be influenced by the designed morphology of the new corridor.

Detailed design will require sizing the new creek bed material appropriately, and placing it in the new stream channel so that it does not get washed away during peak flows. Additional modelling will help to anticipate the inputs of fine sediment and inform ways for the enhanced stream corridor to mitigate excess fine sediment.

Fine sediment capture and removal

Design choices (width, grade, weir spacing, and height) can induce or prevent sediment deposition, although the success of these design strategies will be influenced by the magnitude and grain size distribution of the sediment supply.

If fine sediment is not removed before entering the enhanced creek corridor, more maintenance will be required in areas where flows are slowed and sediment settles out. Considerations should be given during the detailed design phase to direct sediment to accumulate in designated areas (i.e., designated areas where flows slow, and where there is good maintenance access).

Sediment traps could be incorporated into rebuilt or daylit sections of channel, but this would not completely mitigate the impacts of fine sediment to stream health. Removal of sediment from these traps will require environmental permitting, flow bypassing, and will be restricted during certain seasons.

In the conceptual plan for Still Creek, storm outfalls are routed through treatment terraces (e.g., rain gardens, wetlands and other green infrastructure facilities). These may, with appropriate design, induce settling of fine sediments from road runoff before they reach Still Creek. The integration of forebays or sumps for pre-treatment is advised to prevent the volume of sediment from overwhelming the proposed GRI.

If fine sediment capture is not accomplished before stormwater reaches Still Creek, it will continue to have deleterious effects on the aquatic ecology of the creek.

Dynamics and mobility of an enhanced still creek channel

The Still Creek channel would have been mobile prior to stream modifications and channelization, with a dynamic equilibrium of erosion and deposition that would have allowed for the movement of the channel within its floodplain. Today, Still Creek's hydrology is highly modified and there is very limited supply of coarse sediments, resulting in a stable channel.

The design of the new channel banks and floodplain are intended to work with the urbanized biophysical processes. Vegetation will require thoughtful species selection and specialized planting techniques to maintain resilience under urbanized stream conditions. Planting may include a variety of bioengineering techniques to anchor side slopes while increasing biodiversity and habitat values. Stream substrate may require periodic replenishment or decompaction to increase substrate habitat values. Additional study is required to understand the opportunity and challenges with different approaches to the selection of stream substrate for the concept. It may not be feasible to restore the system to a natural mobile bed system.

With future improvements in water quality and watershed hydrology, the Still Creek channel can provide conditions suitable for salmonid habitat.

5.1.4 LONG-TERM VISION FOR THE STILL CREEK CORRIDOR

The vision developed through this study for the Still Creek corridor builds on the long-term vision of daylighting Still Creek from the 2002 Rehabilitation and Enhancement Study and further expands the width of the corridor to extend from Renfrew Street to Boundary Road. The updated corridor vision utilizes a new alignment that maximizes opportunities to become a more robust, resilient ecological corridor in the city, providing even more space and opportunities for reconciliation, climate change adaptation, flood mitigation, water quality treatment, carbon sequestration, public space benefits, urban biodiversity, and other benefits. The updated version of the study also takes a watershed inclusive approach to create a long-term vision.

The vision was also able to incorporate some larger city objectives identified in the Rupert and Renfrew Area planning process, with the goal of future integration into the final Area Plan. The Rupert and Renfrew Station Area Plan will guide development in the area until the year 2050, influencing land use, housing, transportation, community services and parks - including space allocation for the Still Creek corridor.

Some of the longer-term ambitions for Still Creek may include:

- Expanding the width of the corridor to 75 m or wider for optimal creek health and restoration of the floodplain. This width is based on observed widths of the Still Creek corridor downstream, where less urban development has taken place. It also allows for the creation of 30 m-wide riparian buffer zones on each side of the creek's high water mark, in line with provincial goals for Streamside Protection and Enhancement Areas along fish-bearing streams (Riparian Areas Protection Regulation, BC Reg 178/2019). Expanding the width of the corridor over time will also allow it to better accommodate projected flooding with climate change.
- Extending the daylighted length of Still Creek to maximize ecological connectivity. This may include replacing culverts with clear span bridges, and exploring ways to create a daylit corridor between Renfrew Community Park and Renfrew Street at 14th Avenue.
- Increasing the presence and ecological values of Still Creek within the watershed by advancing the City's blue green systems planning and developing new typologies for Still Creek's urban tributaries within the neighbourhood fabric. Through engagement, Musqueam Indian Band voiced a strong support for this systems approach to the watershed.
- Increasing the ecological services and functions offered by the expanded Still Creek corridor by further layering park space, recreation opportunities, Indigenous cultural practices, educational opportunities, and water quality treatment within the corridor.

Continuing to expand the presence of Still Creek and its tributaries within the watershed over the coming century offers the opportunity to directly support numerous related City of Vancouver policies including the Vancouver Plan, VanPlay, Rain City Strategy, Biodiversity Strategy, Climate Emergency Action Plan, and others.

5.2 GREEN RAINWATER INFRASTRUCTURE (GRI) ON PUBLIC PROPERTY

5.2.1 POTENTIAL SITES IN THE WATERSHED FOR GRI

Site Identification Process

Improving the health of Still Creek requires changing the way rainwater is managed in the broader watershed — this involves capturing and filtering rainwater before it is received by the creek, and managing run-off and infiltration to improve flows in the creek.

As part of this phase of work, criteria were developed to inform the selection of potential GRI sites.

The long list of candidate GRI sites were ones that were deemed to have greater potential to capture and filter water before it enters Still Creek, and to attenuate water flows (i.e., to make the water flows in Still Creek less flashy and more consistent throughout the year). For the purpose of this study, sites were also required to be publicly-owned parks, street rights-of-way, or other publicly-owned property where potential GRI could be implemented. The goal was to include a mix of each of these types of sites to explore how GRI could be incorporated into a variety of public land types.

Watershed maps were analyzed to examine overland flow paths, subsurface piped flows, impervious surface cover, high-traffic volume streets, and the distribution of public lands, such as parks, street rights-of-way, and other city-owned parcels (see Section 3 for selected watershed maps).

Based on these conditions, sites were identified that met some or all of the following criteria:

- Areas with high overland or piped stormwater flows, typically in locations with large upstream catchment areas.
- Areas with high-traffic streets (correlated with high sediment loading and high rates of runoff).
- Within or adjacent to parks, or within public rights-of-way.
- Potential to integrate with existing active transportation routes.
- Potential to strengthen existing or new ecological corridors.
- Alignment with preliminary blue green systems network.
- Locations that may provide higher potential stewardship and education opportunities, such as schools and childcare facilities, community centres, community resource centres, locations easily accessed by public transit, and locations with good general accessibility.
- Alignment with historic reaches of Still Creek or its tributaries, which have since become integrated into the City's storm sewer system.
- Opportunity to daylight buried or culverted sections of Still Creek, such as in between adjacent reaches of daylit creek.

Long List of GRI Sites

Based on the above criteria, combined with opportunities identified by the City of Vancouver, 14 sites throughout the watershed were identified as potential GRI sites. These are listed in Table 5-1 with icons to show which criteria were met.

Selected GRI Sites for Concept Design

Of the long list of sites, the following three sites were selected to be advanced for concept design:

- Nootka Street, between E 22nd Avenue and E 17th Street
- Earles Park and adjacent street rights-of-way
- Killarney Park and some adjacent street rights-of-way

Additional GRI Sites Selected by the City (NIF Sites)

In addition, five sites within the Still Creek watershed were identified by the City as project sites for GRI. These were identified as potential candidate sites to be funded through a federal Natural Infrastructure Fund (NIF). These sites include:

- Cornett Road
- Charles Park (headwaters of Chubb Creek, a tributary of Still Creek)
- Slocan Park
- Falaise Park
- Beaconsfield Park (concept design prepared separately, and not documented in this study)

See Figure 5-19 for the locations of the long list sites.

Table 5-1 Long list of potential GRI sites in the Still Creek Watershed

LEGEND

- Aligned with bike route (existing or proposed)
- High traffic route (high sediment loading)
- Opportunity to daylight stormwater pipe
- Aligned with blue green systems
- Close to school or community center
- Adjacent to park or other natural area
- High surface flow or large upstream storm sewer catchment
- Near path of lost/piped creek

	POTENTIAL SITE	RELEVANT CRITERIA AND COMMENTS	SITE PHOTO
1	Rupert Street, between Grandview Highway and E Broadway	• Alignment with important north-south active transportation route • High overland flow and large upstream storm sewer catchment • High traffic route (high sediment loading)	
2	Natal Street, south of Cornett Road	• High overland flow • Aligned with proposed blue green system • *Note that this concept site was incorporated into the Cornett Road concept area*	
3	Hebb Avenue, between Renfrew Street and Rupert Street	• Alignment with active transportation route (Central Valley Greenway) • High overland flow, receiving overland flow from several of the catchments to the north of Still Creek • Aligned with proposed blue green system	
4	Vancouver Technical School, southeast corner of property	• Identified as potential GRI site • *Note that this site was excluded from further consideration due to its location on Vancouver School Board property*	
5	Renfrew Street, between Renfrew Community Park and 14th Avenue	• High traffic street (high sediment loading) • High overland flow and large upstream storm sewer catchment • Aligned with path of culverted section of Still Creek watercourse, and potential for daylighting • Proximity to Nootka Elementary School and Renfrew Community Park • Opportunity for affordable housing redevelopment	
6	Nootka Street, between 22nd Avenue and 17th Avenue	• Aligned with future active transportation route • High overland flow and large upstream storm sewer catchment • Aligned with proposed blue green system • Proximity to Nootka Elementary School and Renfrew Community Park	

	POTENTIAL SITE	RELEVANT CRITERIA AND COMMENTS	SITE PHOTO
7	Cassiar Street to E 22nd Avenue to Rupert Street	• Active transportation route along Rupert Street • High overland flow and large upstream storm sewer catchment • Alignment with path of historic tributary • Proximity to Renfrew Elementary School • Potential synergies with commercial redevelopment at Rupert Street and E 22nd	
8	Nootka Street to 26th Ave outfall	• High overland flow • Alignment with path of historic tributary • End-of-pipe treatment at outfall provides opportunity for water quality improvements and flow attenuation	
9	Horley Street to Euclid Street	• Alignment with path of historic tributary • High overland flow and large upstream storm sewer catchment	
10	Vanness Avenue near Joyce Skytrain station	• Alignment with active transportation route • Aligned with proposed blue green system • High accessibility	
11	Collingwood Park, south edge	• Alignment with path of historic tributary • Aligned with proposed blue green system • Adjacency to park	
12	Norquay Park, along Rhodes Street	• High overland flow and large upstream storm sewer catchment • Aligned with proposed blue green system • Alignment with path of historic tributary • Adjacency to park	
13	Earles Ave / Earles Park	• Aligned with active transportation route • Aligned with proposed blue green system • Adjacency to park • Alignment with path of historic tributary • High overland or subsurface flow	
14	E 45th Avenue at Killarney Park and George Weir school	• Aligned with active transportation route • Aligned with proposed blue green system • Alignment with path of historic tributary • Adjacency to large park, community centre and elementary school • High overland or subsurface flow	

LONG LIST OF WATERSHED GRI OPPORTUNITIES

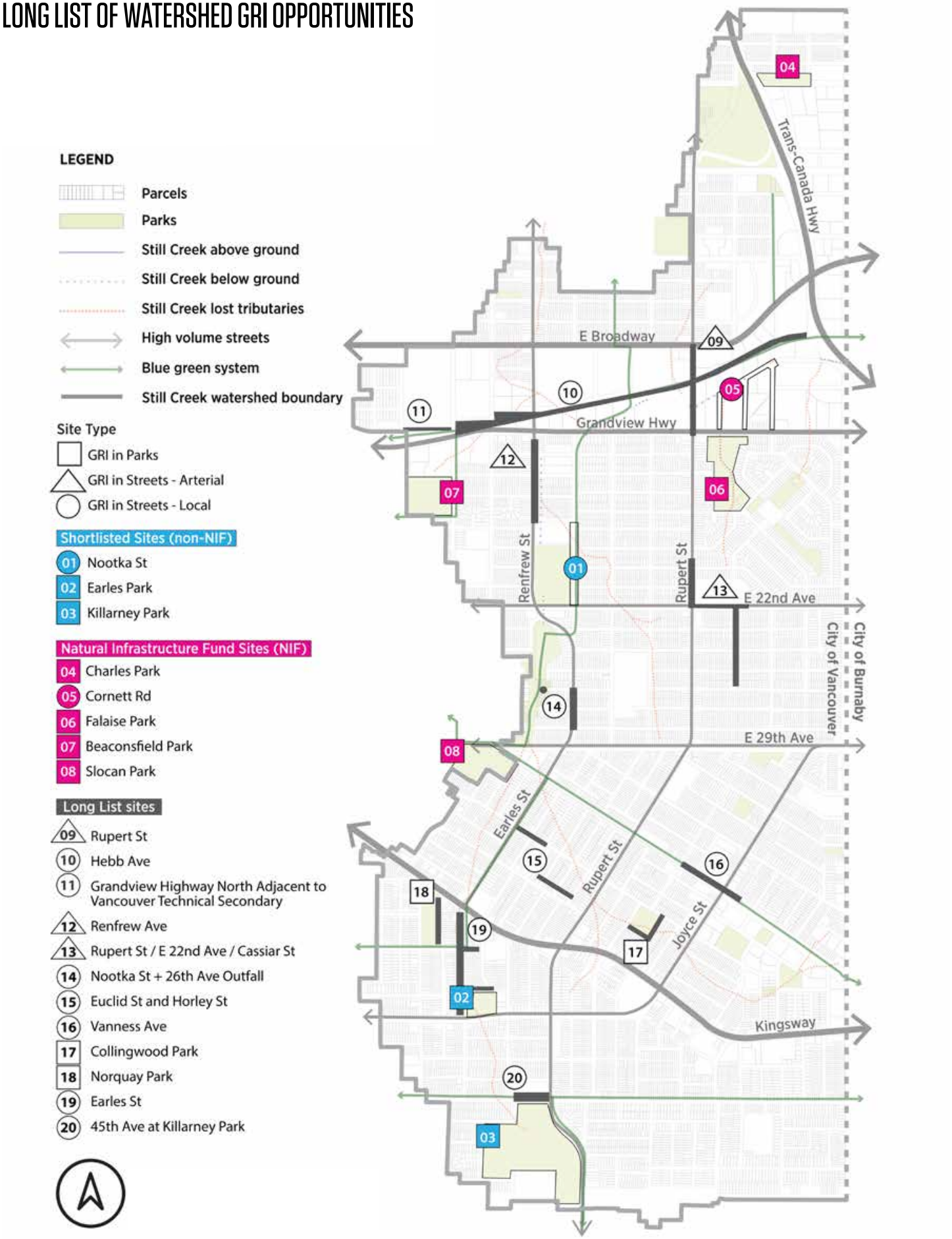


Figure 5-19 Potential watershed Green Rainwater Infrastructure (GRI) sites

SELECTED SITES FOR CONCEPT DESIGN

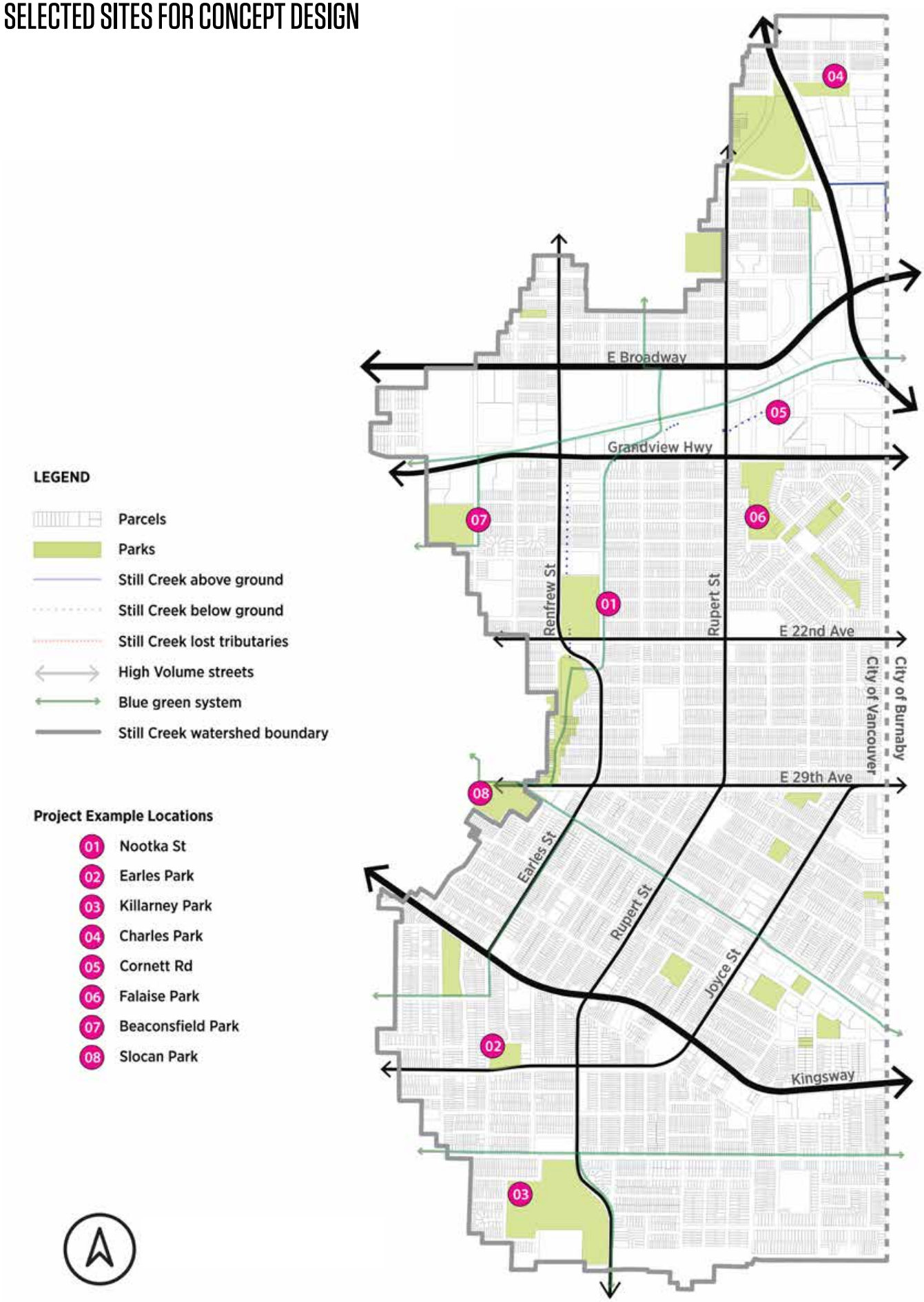


Figure 5-20 Watershed Green Rainwater Infrastructure (GRI) sites selected for concept design

5.2.2 WATERSHED GRI SITES - CONCEPT DESIGNS

The following pages document the concept designs developed for the eight watershed GRI sites. The spread for each concept design includes an overview narrative, representative perspective section, and annotated concept plan(s).

Each concept design utilizes public space located in public parks and/or street rights-of-way, and identifies site-specific strategies to slow the flow of water, daylight where feasible, filter water through soil and vegetation, and increase rainwater storage capacity. In locations where storm water pipes are intercepted, pretreatment is provided before diverting water to GRI.

Design Typologies

Two primary typologies were identified to guide concept design of the eight GRI sites (Figure 5-19), to help develop examples of GRI design that could be repeated on similar site types. The typologies selected were GRI in Parks, and GRI in Streets.

GRI in Parks

Corresponding design sites:

- Charles Park
- Earles Park
- Falaise Park
- Killarney Park
- Slocan Park

The park typology encompasses a variety of GRI tools suited to capture, filter and infiltrate rainwater in public park space. GRI tools in parks can include rain gardens, constructed wetlands, surface flow channels, subsurface infiltration areas, subsurface piped stormwater daylighting, and end of pipe treatment systems. Parks located near historic stream alignments are often located along existing low points, which makes them well-situated to capture and treat rainwater. Special considerations for incorporating GRI in parks include maintenance access and balancing competing park uses.

GRI in Streets

Corresponding design sites:

- Cornett Road Area
- Nootka Street

This typology documents ways to incorporate GRI into street rights-of-way, strengthening active transportation networks and expanding the urban tree canopy where possible. The typology can be applied to a range of street types, from local neighbourhood streets to arterial streets. GRI tools in streets can include rain gardens (such as linear rain gardens or rain gardens in street bump-outs), infiltration trenches, subsurface piped stormwater daylighting into infiltration trenches, reduction in the extent of impermeable surface, and increased extents of tree canopy and other vegetated areas.

Side streets next to parks with GRI are well-suited for additional GRI tools to increase the effective area of GRI while reducing the footprint that such tools occupy within parks.

GRI on side streets adjoining the Still Creek corridor are another special condition whereby GRI tools can help improve water quality and attenuate flows prior to stormwater being discharged to the creek. These side streets are envisioned as urban tributaries that can function as social and ecological corridors, connecting people and water to Still Creek. The term coined in this study for this unique condition of GRI in adjoining side streets is 'contributary' — referring to how these streets can contribute to improving the social and ecological health of the broader neighbourhood surrounding Still Creek, by improving pedestrian and cycling connectivity while improving the water quality discharging to Still Creek.

Special considerations for incorporating GRI in streets include balancing space demands for parking and traffic movement, and ensuring safe maintenance access in such a way that adjacent traffic flow is not impeded (particularly for arterial streets).

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CHARLES PARK

NEIGHBOURHOOD PARK TYPOLOGY

EXAMPLE OF PERMEABLE LANE ENVISIONED ADJACENT TO CHARLES PARK

Concept Overview

Charles Park is located east of Highway 1 on the border between Vancouver and Burnaby. This neighbourhood park features a pond in the center of a treed landscape with winding paths. The pond was once supplied with potable water, but is now only fed by groundwater as part of a water conservation initiative. This recent transition is allowing the Park Board to begin monitoring the pond levels and see how the ecosystem responds to the new dynamics.

Opportunities to direct additional rainwater into the pond are limited by the site's topography, existing mature trees, and subsurface utilities. Initial design concepts explored the feasibility of diverting piped stormwater in the area to an expanded pond; however, due to the depths of the pipes, this would require significantly lowering the base of the pond. To minimize impacts on existing mature trees in the park and to avoid steep pond banks, alternate renewal opportunities were explored.

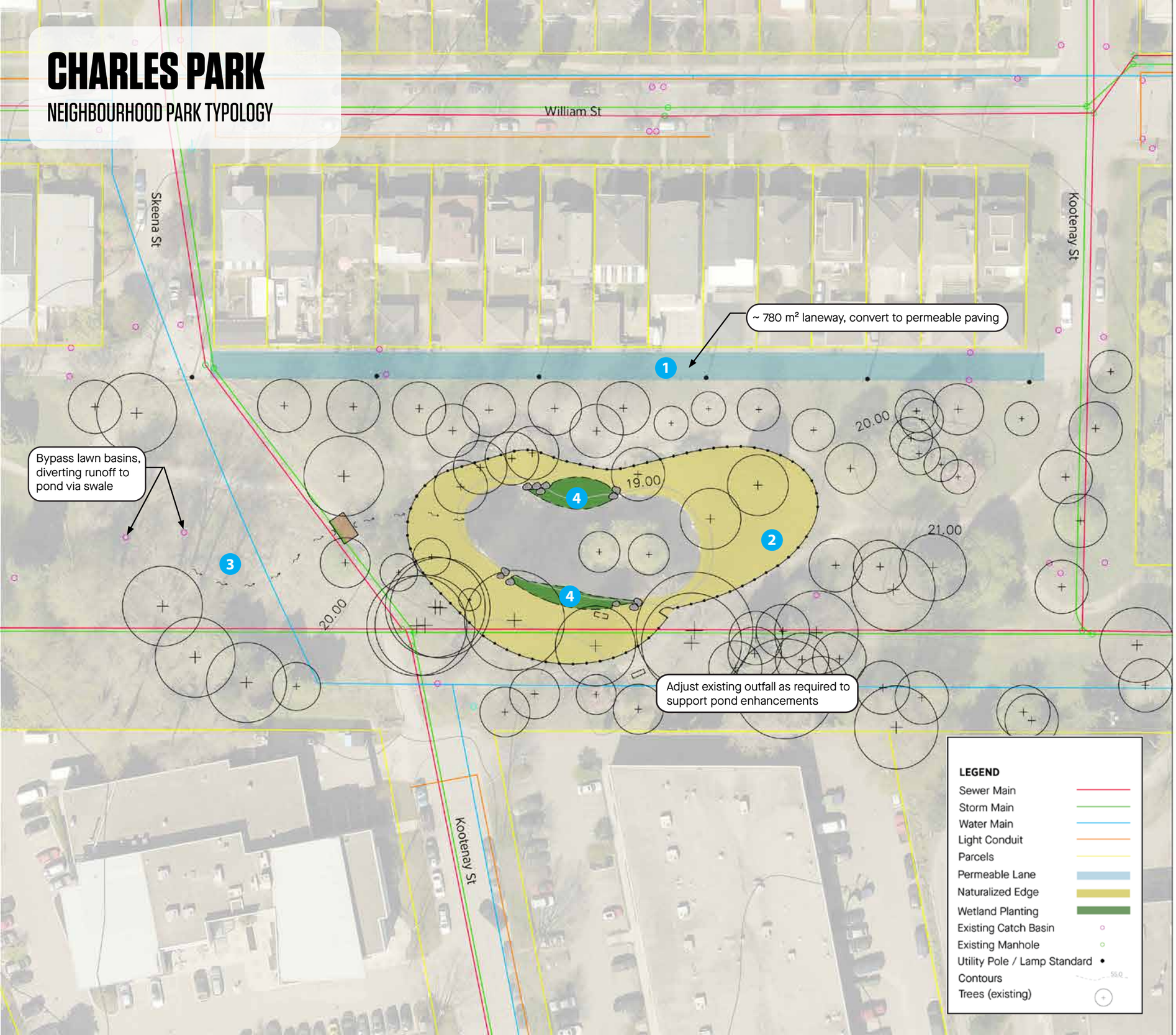
Similarly, opportunities to redirect surface runoff into the park are limited by the park topography and vegetation. This concept design proposes a new swale to redirect surface runoff from the west side of the park into the pond.

The east-west laneway that runs along the north edge of the park provides a key opportunity to promote infiltration in the area, which helps indirectly feed the pond. The concept design envisions permeable paving along the lane to provide a highly permeable surface suited to the traffic volumes, while establishing a visual message about the unique ecology of this place.

Parts of the pond will be enhanced to increase the ecological richness of the area and to help improve water quality.

CHARLES PARK

NEIGHBOURHOOD PARK TYPOLOGY



1 Permeable Lane

- Convert existing laneway along the north side of the park to a permeable paved surface.

2 Pond Perimeter

- Provide a wildlife friendly split rail fence with wire mesh infill, to protect the habitat surrounding the pond. Remove invasive plant species, and replace turf grass in this area with native riparian plantings and meadow.

3 Bypass Lawn Basins within the Park

- Bypass existing drain inlets located within the park, directing surface runoff to the pond via a shallow grass swale. Integrate a pedestrian bridge where the swale intercepts the existing gravel path.

4 Pond Enhancements

- Identify opportunities to enhance biodiversity, improve water quality and expand pond footprint. Review opportunities to adjust the pond outfall to support enhancement initiatives, and consider slightly lowering pond to receive diverted stormwater.

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EARLES PARK

NEIGHBOURHOOD PARK TYPOLOGY

KEY PLAN

WETLAND SECTION VIEW LOOKING WEST

Concept Overview

Earles Park is located along an historic tributary of Still Creek. This has shaped the site's topography and the overland flow patterns that drain into the park.

This concept design envisions the integration of a vegetated wetland into the park while maintaining current recreational activities, including the use of the baseball field. The wetland would receive stormwater from the subsurface piped system, intercepted on the south side of the park and diverted to a pretreatment unit prior to the wetland.

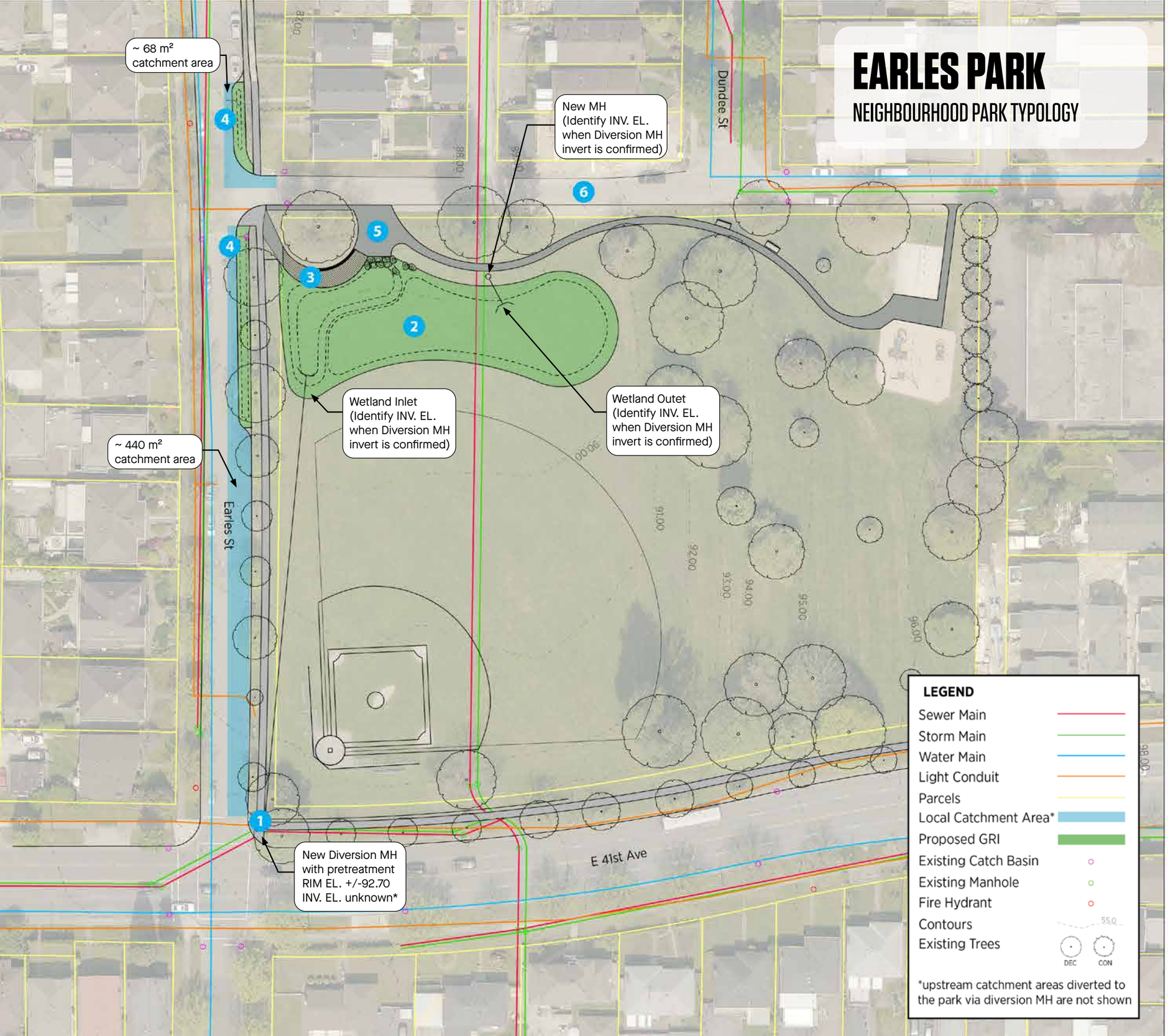
The vision for the wetland area includes a cantilevered deck feature with integrated seating. This feature would strengthen the connection between the adjacent streetscape and the park, helping unify the public space. The location highlights one of the notable mature trees along the park's north edge, and provide opportunities for people to rest in its shade.

A gravel pad provides vehicle access to the wetland forebay from East 40th Avenue, and the gravel path extends to the park playground. This provides pedestrian circulation while maintaining the curbless condition along this road, allowing infiltration from the paved road right-of-way.

Earles Street, located along the west edge of the park, is a local street bikeway. This concept identifies opportunities to integrate GRI in the street right-of-way, aligned with the blue green system network supporting the city's goals to co-locate active transportation routes with rainwater management systems.

EARLES PARK

NEIGHBOURHOOD PARK TYPOLOGY



Sitewide Recommendations:

- Avoid re-grading existing boulevard with mature trees; professional arborist to review all site work within tree canopy dripline.
- Traffic analysis to confirm road geometry.

1 Diversion MH with Pretreatment Unit

- Pretreatment device for wetland flow. Location to be accessible for maintenance.

2 Wetland

- Wetland configuration to be informed by survey elevations, and recommendations whether to line the feature to be informed by future geotechnical investigations. Lower wetland area ~ 150 m2 plus upper wetland area ~ 750 m2 level base, with 3:1 side slopes. Existing storm lines below wetland, at approximately el. 82.20.

3 Deck Feature

- Distinct surfacing elevated over planted area, with custom bench seating.

4 Earles Street Bioretention

- Replace 2.5 m wide parking lane with rain garden at mid-block location. Approx. 47 m2 level base required for catchment area shown along south portion of Earles St, and 7 m2 level base required for north portion. Consider extending rain gardens further north, integrated with the blue green system.

5 Gravel / Permeable Surfacing

- Provide maintenance vehicle access to wetland, with new path to playground.

6 East 40th Avenue

- Maintain existing curbless condition, with no paved sidewalk to allow sheet flow into park.

0 50m

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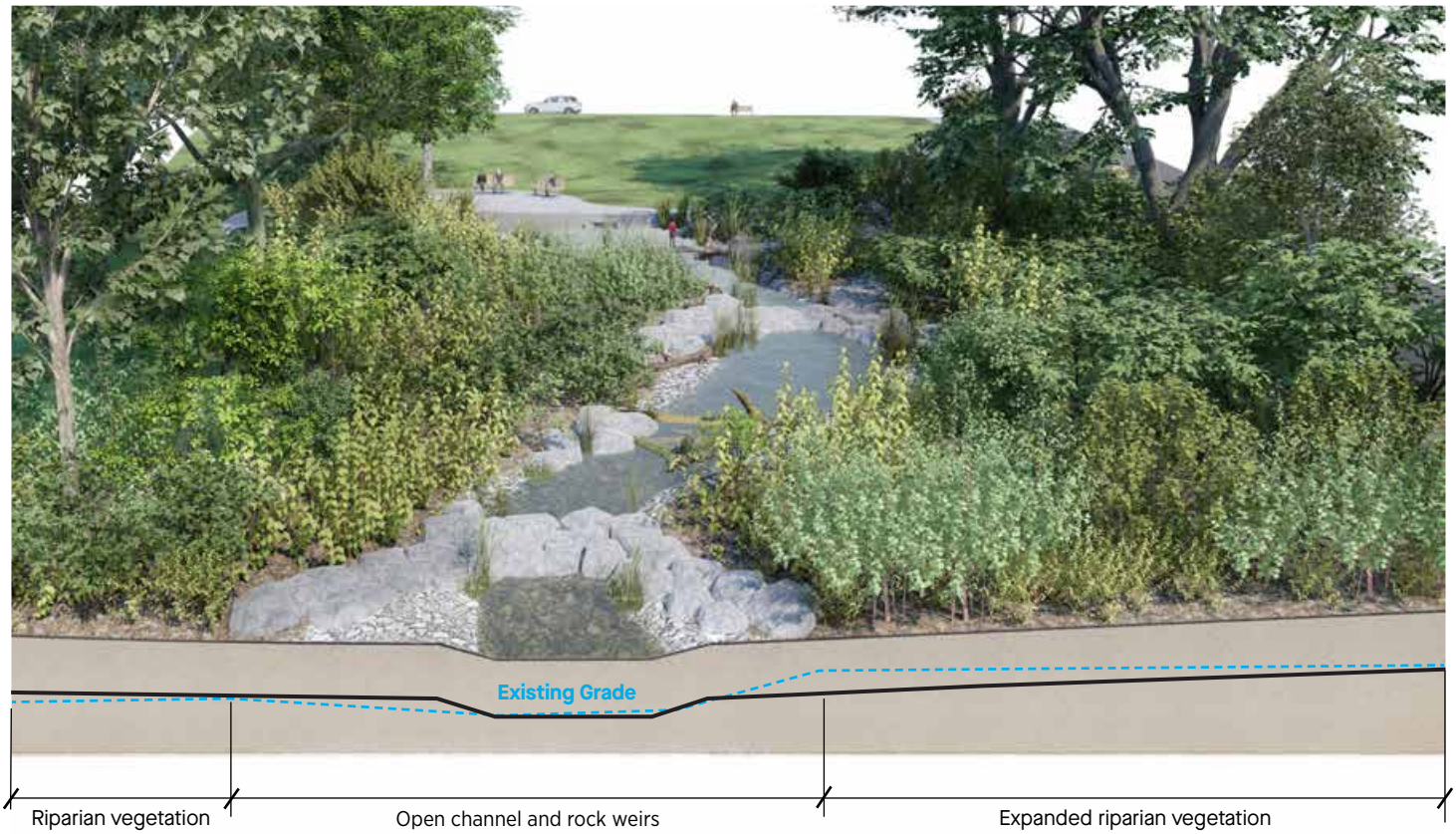
FALAISE PARK

LARGE-SCALE PARK TYPOLOGY

KEY PLAN

WETLAND GARDENS SECTION VIEW LOOKING NORTH



Concept Overview

Falaise Park is an important public green space in the vicinity of the Still Creek corridor (south of Grandview Highway), where a historic tributary of Still Creek once flowed. In 2005, rainwater-fed wetland gardens were constructed along the west edge of the park.

A significant volume of water from the catchment upstream of the park flows beneath the park in underground pipes. This presents an opportunity to divert a portion of the upper catchment's stormwater to planted features that help slow the flow, filter water through soil and vegetation, and increase biodiversity.

The concept design for Falaise Park intercepts and diverts subsurface stormwater to an open channel through an expanded riparian corridor featuring native plants, paths, and seating designed in areas to provide clear sightlines.

As the open channel flows down the slope the water is slowed by a series of rock weirs. At the bottom of the slope the water flows into level tiers created by low retaining walls. These vegetated level terraces help filter the water before it flows to an existing wetland area, which will be re-designed to receive the water before it flows to Still Creek via subsurface pipes.

The baseball diamonds located on the north side of the park provide a future opportunity to store water below the baseball fields in large subsurface storage tanks. Subsurface GRI could also integrate passive irrigation to these large lawn areas. Strategies to store excess water during the fall and winter months could help reduce the flashiness of Still Creek by slowing down and controlling how quickly water enters the creek during heavy rains, which also mitigates erosion.

FALAISE PARK SOUTH

LARGE-SCALE PARK TYPOLOGY

1 Diversion with Pretreatment

- Intercept stormwater and provide pretreatment for low flow diversion into rain garden feature.

2 Viewing Terrace

- Level lawn area with seating and gravel path connections to the sidewalk. The diversion outfall is integrated with a retaining wall.

3 Riparian Corridor with Open Channel

- Rainwater flows down the slope along an open water channel that is slowed by a series of stone weirs. A broad riparian corridor planted with native vegetation enhances the ecology of the site, and new trees along the east edge help shade the corridor.

4 Pedestrian Bridge and Seating Area

- New paths, bridge crossing over the open channel, and seating area.

5 Treatment Terraces

- Broad level tiers — created with low, curved retaining walls — provide vegetated areas that slow and filter water.

6 Shallow Wetland and Outlet

- Overflow from the treatment terraces is directed to the existing shallow wetland area, where grading and vegetation will be modified to receive the water. The outfall will tie into the existing stormwater system.

0 20 50m

FALAISE PARK NORTH

LARGE-SCALE PARK TYPOLOGY

Potential location for outlet to tie into storm

Grandview Hwy

Matapan Cres

LEGEND

- Sewer Main
- Storm Main
- Water Main
- Light Conduit
- Parcels
- Subsurface Detention
- Existing Catch Basin
- Existing Manhole
- Fire Hydrant
- Contours
- Existing Trees

CONTEXT PLAN

The concept design for the north portion of Falaise Park identifies future opportunities to support the health of Still Creek by integrating subsurface detention below the level sports fields.

1 Subsurface Detention Opportunity

- Investigate groundwater conditions to identify stormwater management opportunities. Preliminary investigations note confining soils and perched groundwater 0.5m below grade.
- Upstream catchment area is approximately 15,000 m^2, assuming a 60% impervious cover. Consider detaining the greatest volume possible, with a controlled base flow release (the Rain City Strategy target 48mm would require ~ 8,000 m^3 detention).
- Baseflow release of 0.25 l/s/ha equals 7.5 l/s (CoV records indicate 0 mm/hr infiltration rate observed on site). If infiltration is considered, include pretreatment such as an engineered underground forebay or alternate proprietary pretreatment systems.

2 Diversion Opportunity

- Divert low flows (6 mo - 2 yr) through detention facility with controlled orifice. Improve water quality by directing higher flows into existing 750 mm storm pipe in order to bypass the detention tank and limit resuspension of fines.

3 Circulation Enhancement Opportunities

- Identify opportunities to improve safety and enhance connectivity for pedestrians and cyclists, linking existing crossing at Grandview Highway with circulation paths in and around the park.

4 Laneway Edge

- Maintain existing curbless condition along the laneway, allowing for sheet flow of surface runoff into the park.

0 50m

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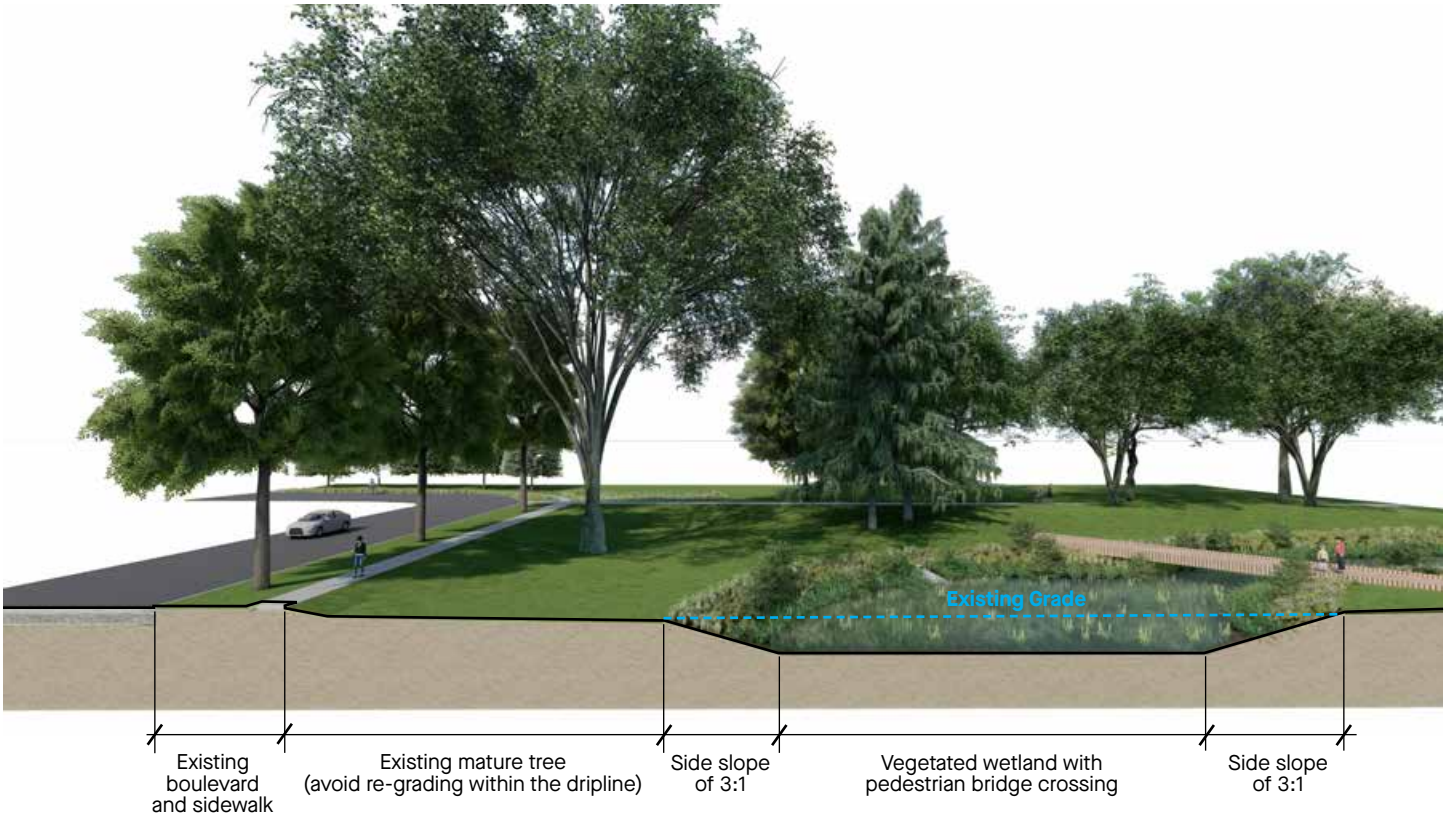
KILLARNEY PARK

LARGE-SCALE PARK TYPOLOGY

KEY PLAN

WETLAND SECTION VIEW LOOKING SOUTHWEST



Concept Overview

Killarney Park is located along an historic tributary to Still Creek. This informs the site's topography and is reflected today in overland flow patterns.

This concept identifies opportunities to intercept rainwater from the sizable catchment area to the southeast, and to utilize the area below the running track for subsurface detention, with controlled baseflow release.

Portions of the existing meadow area — located at the northwest corner of the park where grades are low and water collects — are envisioned as a new wetland area. The wetland would receive rainwater diverted from the subsurface piped stormwater system, from adjacent streets, and from within the park.

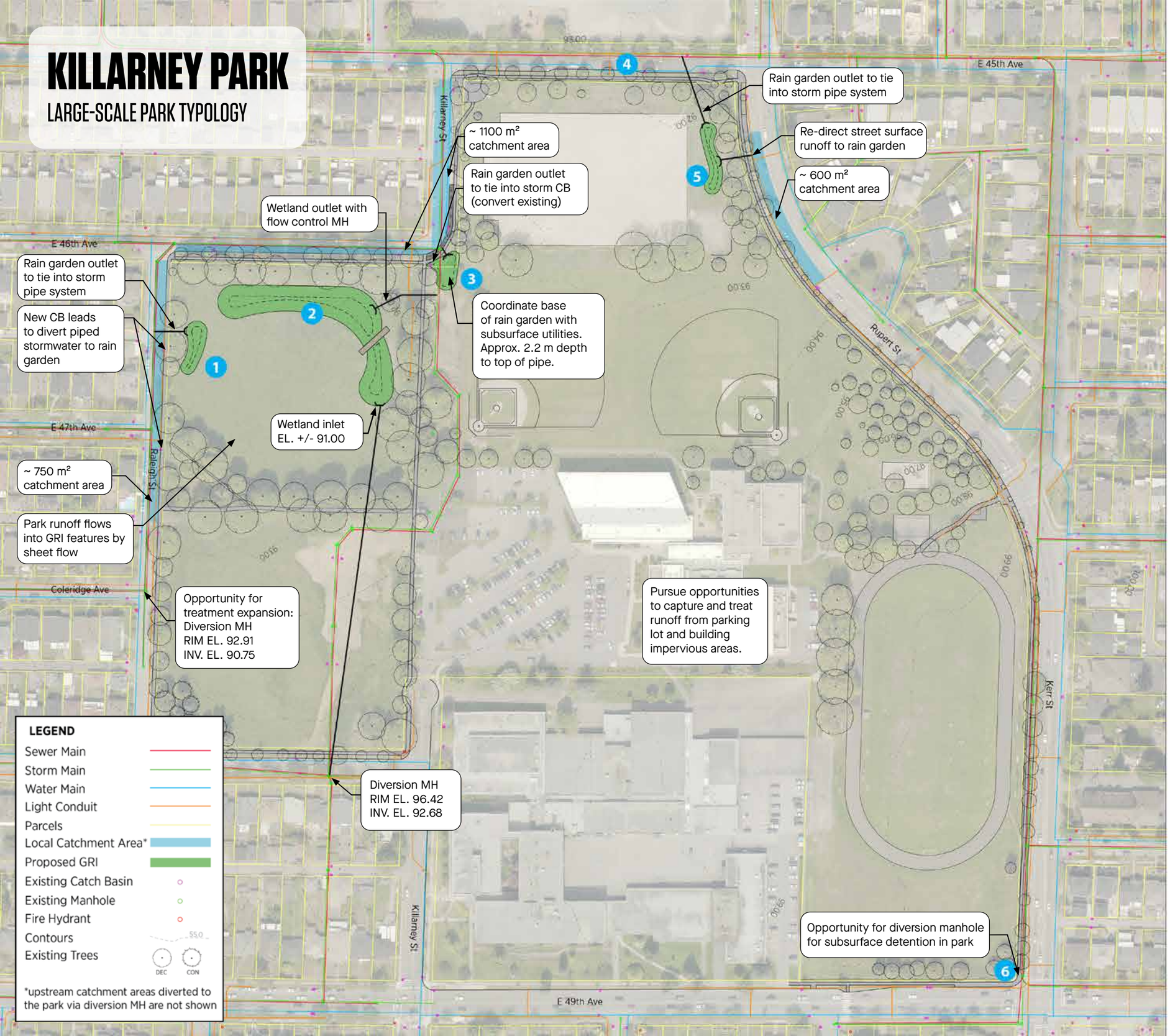
A smaller rain garden area is proposed on the northeast side of the park, expanding the existing wet zone into a rain garden that would filter rainwater runoff from Kerr Street.

The rain gardens and wetland envisioned at Killarney Park would enhance the character and appeal of the park by expanding its biodiversity, providing engaging learning opportunities, and boosting the city's climate resilience.

These GRI features will also cleanse and infiltrate water as it passes through soil and vegetation, while also helping recharge local groundwater.

KILLARNEY PARK

LARGE-SCALE PARK TYPOLOGY



LEGEND

- Sewer Main
- Storm Main
- Water Main
- Light Conduit
- Parcels
- Local Catchment Area*
- Proposed GRI
- Existing Catch Basin
- Existing Manhole
- Fire Hydrant
- Contours
- Existing Trees

*upstream catchment areas diverted to the park via diversion MH are not shown

CONTEXT PLAN

Sitewide Recommendations:

- Manhole intercepts to divert low flows from upstream storm system, with pretreatment to provide 80% TSS removal from 90% of average annual flow.

1 Raleigh Street

- New rain garden to treat +/- 750 m^2 catchment along Raleigh Street, with 74 m^2 level base.

2 Wetland

- Wetland configuration to be informed by survey elevations, and recommendations whether to line the feature to be informed by future geotechnical investigations.
- Divert water from stormwater pipes to a wetland area with +/- 470 m^2 level base. Provide flow control manhole (base flow release) with overflow structure for high flows. Consider pedestrian bridge crossing for greater connectivity.

3 Killarney Street at East 46th Avenue

- Re-pave Killarney Street to direct runoff to rain garden via new paved or lined swale (infiltration limited by water service line)
- New rain garden to treat +/- 1100 m^2 catchment from Killarney Street and E 46th Ave, with 115 m^2 level base. Qty: 1 conifer tree to be removed, and replace within park.

4 East 45th Avenue

- Street upgrades and GRI opportunities are being identified separately by CoV

5 Rupert Street

- New rain garden to treat +/- 600 m^2 catchment along Rupert Street, with 60 m^2 level base.

6 Diversion Opportunity

- Opportunity to divert some piped stormwater to subsurface storage, with controlled baseflow release: see Appendix C.

50 0 50 100m

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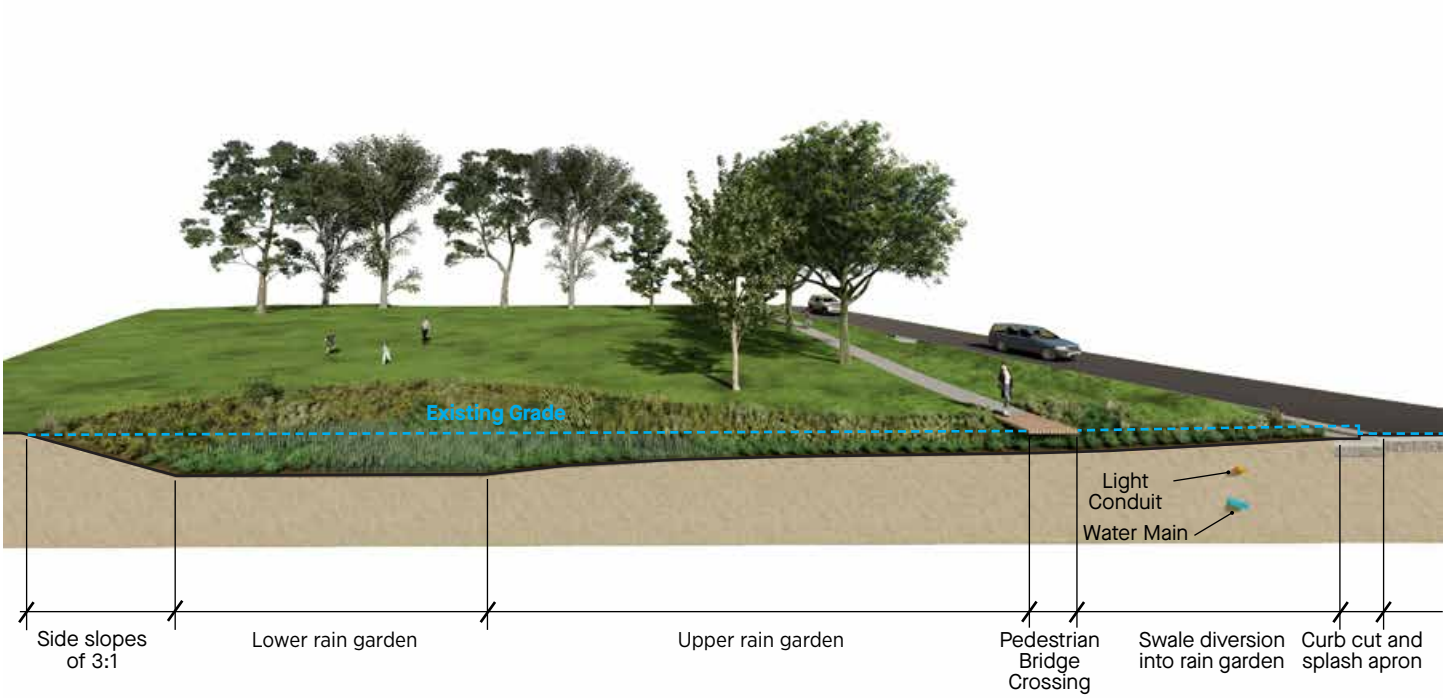
SLOCAN PARK

NEIGHBOURHOOD PARK TYPOLOGY

KEY PLAN

RAIN GARDEN SECTION VIEW LOOKING SOUTH



Concept Overview

Slocan Park is located at the western edge of the Still Creek watershed along East 29th Ave and Slocan Street. The park's fieldhouse is home to the Alder Eco-Arts Hub, which is coordinated by Still Moon Arts Society. This organization has fostered community stewardship of Still Creek for many years.

The design for this site presents an opportunity to extend the presence of Still Creek to the edges of its watershed and have water inform the character of the park.

This concept utilizes the existing grades in the northwest corner of the park and re-shapes this naturally low-lying area into a rain garden to slow and filter water, while enhancing the site's biodiversity. In addition to capturing surface water, runoff from the Slocan Street right-of-way is also diverted to the rain garden. Further, the design anticipates future upgrades of the playground and skate park, so that runoff from these paved areas would be directed to the rain garden.

There may also be an opportunity to intercept drainage from the irrigated sports fields located on the northeast side of the park and direct it to the rain garden.

The rain garden featured in this concept is envisioned as a broad and shallow feature that supports playful interaction as park visitors explore the ecosystem it supports. Vegetation around its perimeter is envisioned as meadow-like, with longer grass areas that would be mown infrequently to further support biodiversity in the area.

SLOCAN PARK

NEIGHBOURHOOD PARK TYPOLOGY

Park renewal expansion area
~ 1100 m² catchment

Rain garden outlet
to tie into storm

Conveyance swale /
subsurface drainage pipe

~ 340 m²
catchment area

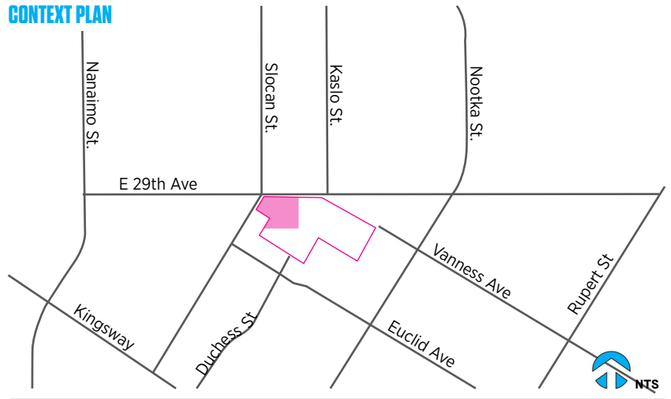
Redirect CB to GRI
(sump to remain)
CB RIM EL. +/- 87.25
daylight at top end of GRI

1
2
3
4
5
6

LEGEND

- Sewer Main
- Storm Main
- Water Main
- Light Conduit
- Parcels
- Catchment Area
- Naturalized Edge
- Base Planting
- Slope Planting
- Existing Catch Basin
- Existing Manhole
- Fire Hydrant
- Contours
- Trees
  - Relocated
  - Existing

CONTEXT PLAN



1 Slocan Street

- Replace existing CBs with double-wide curb cuts with pretreatment pads, and direct water to new rain garden.

2 Sidewalk Crossing

- Water to enter rain garden under bridge (within sidewalk) or via culverts below sidewalk.

3 Gravel Surfacing

- Expanded gravel surfacing improves circulation and provides flexible interim condition for future upgrade of BC Parkway. Area may include seating and interpretive signage.

4 Rain Garden

- Divert water from Slocan Street catchment, park features to the east, and potentially 29th Avenue if feasible based on subsurface utilities. Rain garden area as shown includes a ~200 m^2 level base. Provide flow control manhole (base flow release) with overflow structure for high flows.

5 Rain Garden Inlets

- Integrate rainwater management with park renewal plans, directing runoff from paved surfaces to the rain garden.
- Assess feasibility of diverting the existing sports field CB (located east of skate park) to the rain garden.
- Gravel perimeter with stone edging provides a mow strip and helps filter sediments prior to discharging into rain garden.

6 Naturalized Edge

- Planting around the rain garden to be meadow-like, and mowed infrequently.

0 5 10 20 30 40

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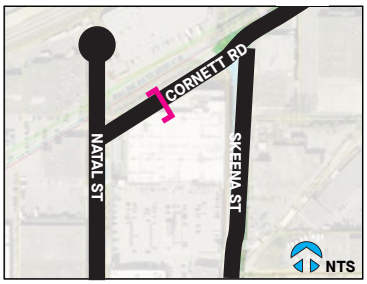
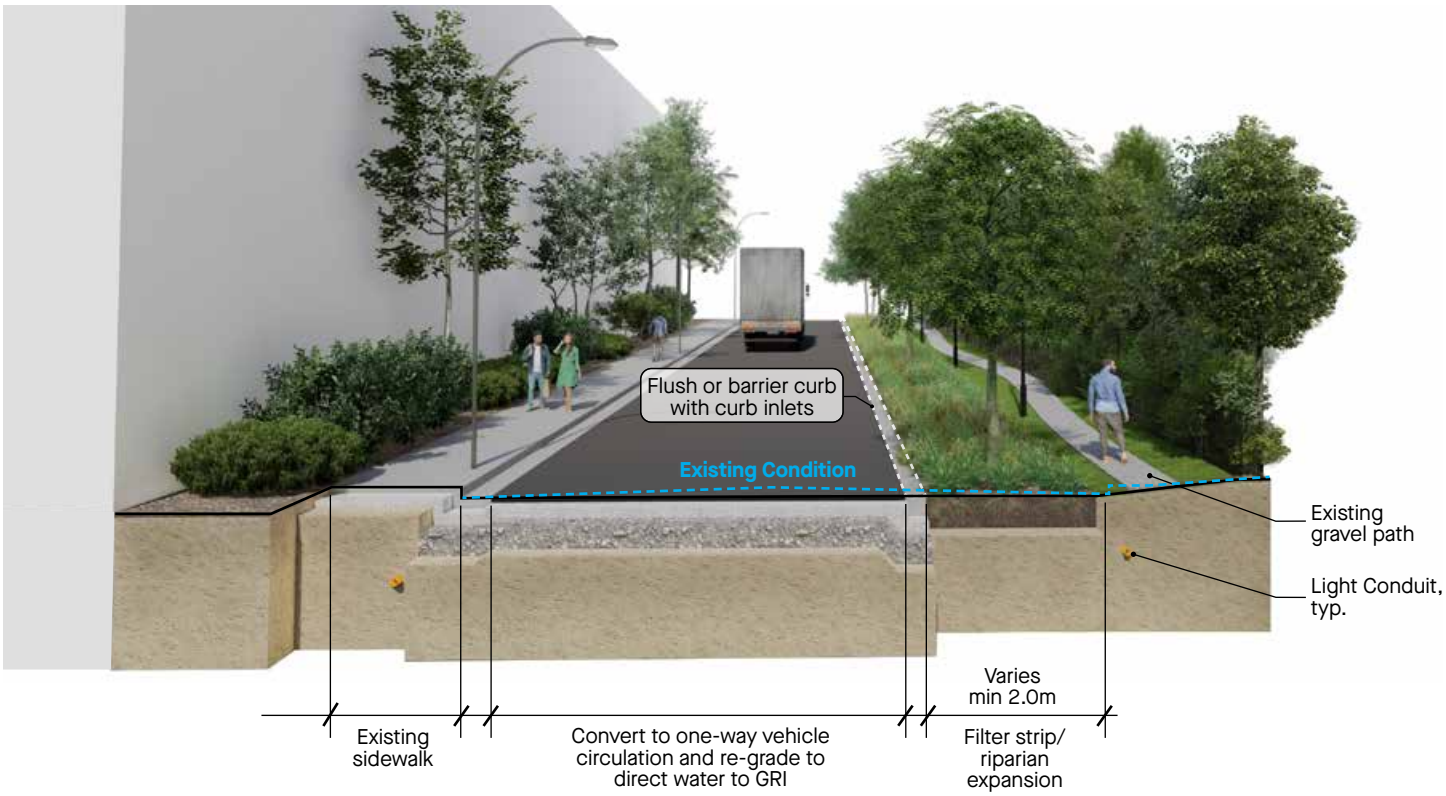
CORNETT ROAD AREA

CONTRIBUTARY AND CORRIDOR TYPOLOGY

KEY PLAN



CORNETT ROAD SECTION VIEW LOOKING WEST



Concept Overview

This concept includes Cornett Road between Bentall Street and Skeena Street, and the right-of-way along Bentall Street, Natal Street and Skeena Street.

This area borders the Still Creek corridor, and therefore is a key location to improve water quality of runoff before it enters Still Creek.

The adjoining side streets that connect with Cornett Road present an opportunity to extend the presence of the creek into the surrounding area. These streets, specifically Bentall Street, Natal Street, and Skeena Street, capture and treat surface rainwater runoff from the street right-of-way, and improve pedestrian connections to Still Creek.

Natal Street also incorporates a perforated low-flow diversion in a granular tree trench, designed to receive pre-treated stormwater from the subsurface piped system. Bioretention systems are proposed to replace existing parking lanes on these streets where feasible, to be identified through future transportation analysis.

As Cornett Road borders the south edge of the Still Creek riparian corridor, it presents an opportunity to narrow the street right-of-way and expand the riparian corridor. Cornett Road is envisioned with no parking lanes, while continuing to support transportation demands. The road surface would be re-graded to direct rainwater to a new filter strip and riparian buffer on the north side of the street right-of-way.

The vision for the existing riparian corridor north of Cornett Road, including the side channel, is presented in the Still Creek corridor concept plan, from Renfrew Street to Boundary Road. The concept plan includes an expanded riparian corridor, improved pedestrian and cycling connections, and end-of-pipe water quality improvement strategies at outfall locations.

CORNETT ROAD AREA

CONTRIBUTARY AND CORRIDOR TYPOLOGY

Integrate outfall improvements with future creek corridor enhancement plans.

~ 800 m² catchment area

Pump station area provides opportunities to integrate features that support Still Creek Stewardship, while retaining maintenance vehicle access; refer to future creek corridor enhancement plans.

~ 600 m² catchment area

~ 1160 m² catchment area

Rain gardens to be connected via perforated pipe through the bioretention areas and solid pipe at driveway crossings (Typ.)

Pretreatment MH for diverted flows. Outflow discharges to perforated pipe in bioretention underdrain areas and solid pipe at driveway crossings (Typ.)

~ 1600 m² catchment area

Retrofit ex. MH RIM EL. = 29.43 with new diversion. Add'l outlet pipe at NE. INV = 27.62 Install standpipe on north pipe to allow low flow into bioretention drain rock layer and higher flows into roadway storm system.

Drain rock layer at base of bioretention layer is 1.8 m below grade at south end of rain garden to receive diverted flows. Provide min. slope downstream to chase grades until optimal depth achieved.

~ 1880 m² catchment area

Redirect CB to GRI (sump to remain) CB RIM EL. +/- 27.20 daylight at top end of GRI.

Cornett Rd

Bentall St

Natal St

Skeena St

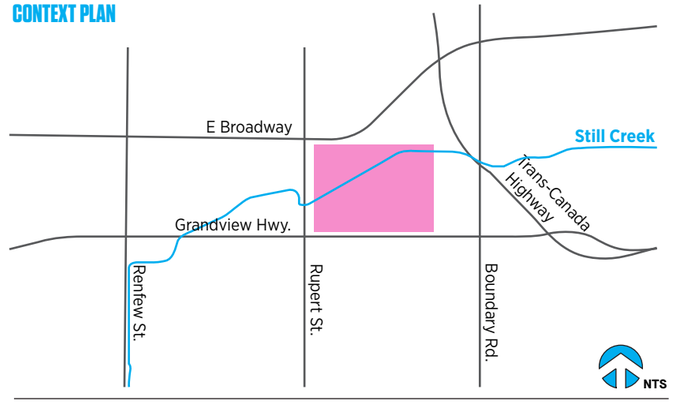
E 11th Ave

Grandview Hwy

LEGEND

- Sewer Main
- Storm Main
- Water Main
- Light Conduit
- Parcels
- Catchment Area
- Proposed GRI
- Existing Catch Basin
- Existing Manhole
- Fire Hydrant
- Contours
- New Trees*

CONTEXT PLAN



Sitewide Recommendations:

- Aim to expand tree canopy cover, as feasible with overhead utility limitations. *Arborist assessment is recommended when tree replacement is being considered.
- Aim to provide >20 m^3 soil volume per tree. Consider soil cells and/or structural soil where volumes are limited.
- Protect all existing utilities including but not limited to electrical conduit, BC Hydro ducts, fiber optic ducts.

1 Manhole Intercepts

- Provide a diversion MH to divert low flows from upstream storm system, with pretreatment to provide 80% TSS removal from 90% of average annual flow.

2 Bentall Street, Natal Street and Skeena Street

- Replace east parking lane - where feasible while meeting transportation demand - with tiered, level bioretention systems to capture and treat surface runoff from local catchments (indicated in blue). Where parking lane removal is not feasible, provide stormwater tree trenches within existing boulevard and below parking lane.
- Redirect CBs along west side of road to GRI where feasible (sumps to remain)
- Connect rain garden outlets/overflows to existing storm sewer.

3 Cornett Road

- Revise to 6 m wide one-way vehicle circulation, westbound pending traffic analysis. Realign gravel path east of Natal Street.
- Regrade to direct surface runoff to filter strip.
- Expand the Still Creek riparian corridor.

4 Vegetated Area

- Opportunities for bioretention are limited in this area due to subsurface utilities. Excavation extents within the vegetative area should include an impermeable line, per CoV Engineering Design Manual.

0 50 100m

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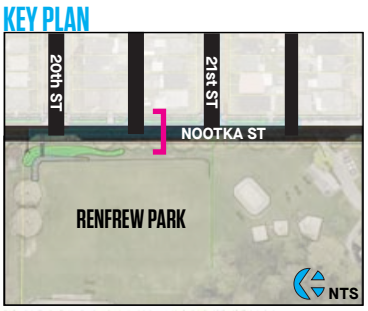
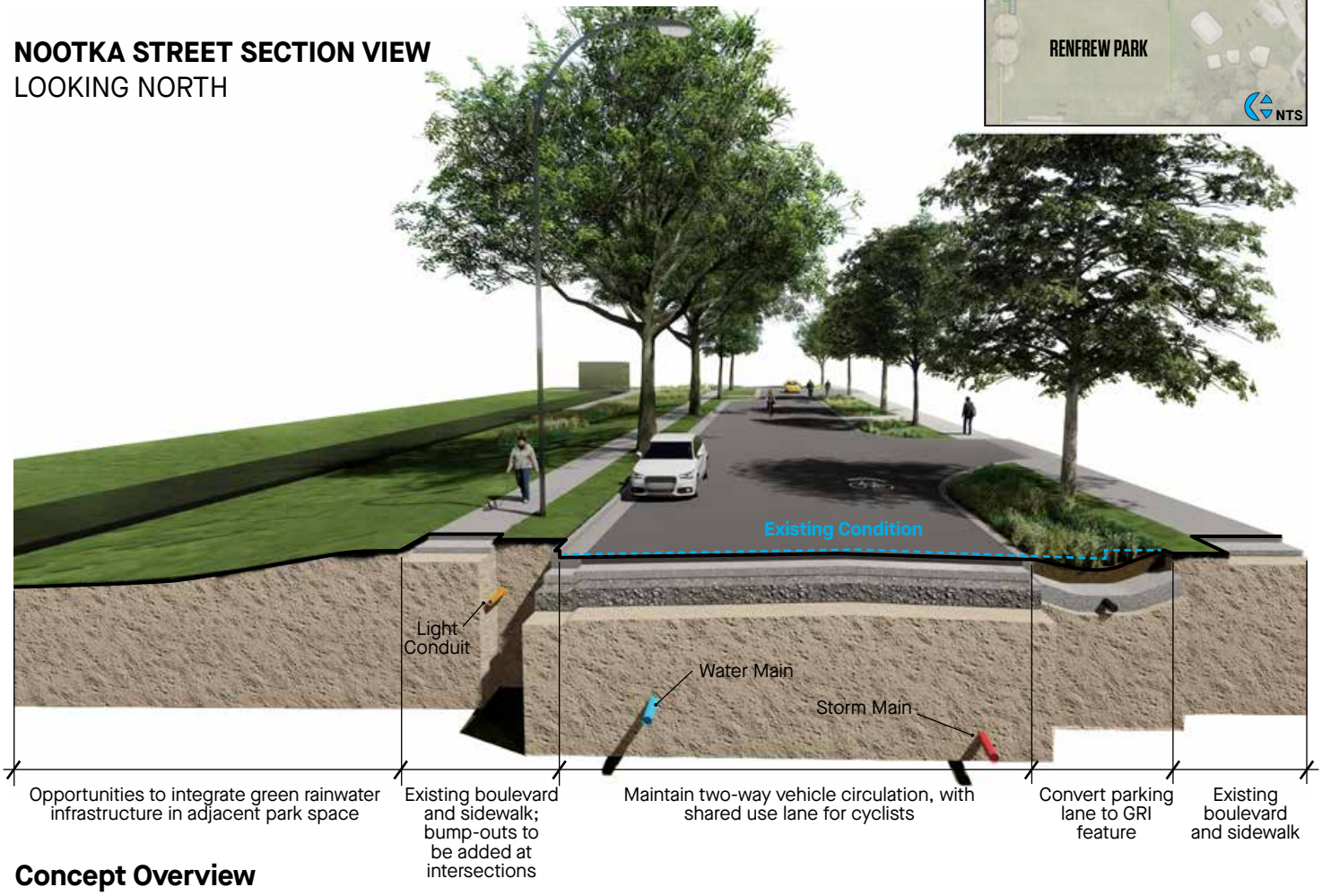
NOOTKA STREET

NEIGHBOURHOOD BLUE GREEN SYSTEM TYPOLOGY



NOOTKA STREET SECTION VIEW
LOOKING NORTH



Concept Overview

Nootka Street borders the east edge of Renfrew Community Park, which is home to a daylit stretch of Still Creek. This street presents an opportunity to expand the presence of Still Creek beyond the riparian corridor and into the surrounding community. As part of the envisioned blue green system network, this corridor would include an active transportation route with enhanced vegetation, opportunities to expand the urban tree canopy, and GRI to filter and infiltrate rainwater.

The concept design for this portion of Nootka Street envisions the parking lane along the east side of the road being replaced with GRI, such as rain gardens. Runoff from the east side of the street is directed to the GRI features via sheet flow over a flush curb or curb cuts with pretreatment pads.

Opportunities to locate GRI in the street right-of-way will need to be evaluated on a block by block basis, as subsurface utilities may constrain implementation. For instance, in this area of Nootka Street, the water main runs along the west side of the road; minimum setback distances need to be accommodated to separate infiltration features from water mains.

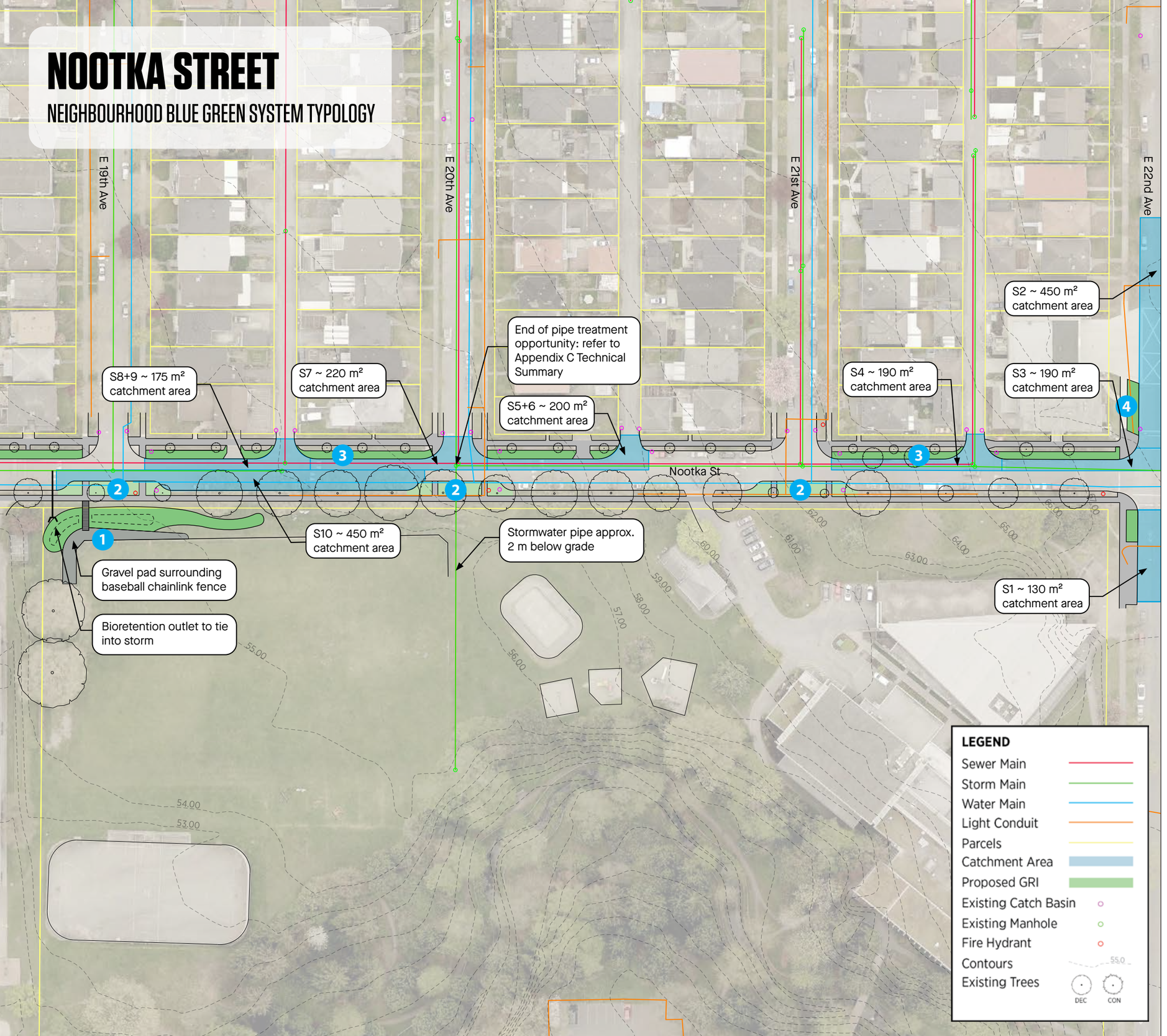
Pedestrian and cyclist safety is enhanced with the integration of curb bump-outs along the west edge of the street at street intersections. These would not be designed to infiltrate runoff in this portion of Nootka Street, due to the location of the water main.

When co-located along public parks, there may be opportunities to integrate GRI within the park space. This concept for Nootka Street integrates the vision to integrate a small rain garden area at the north end of Renfrew Community Park, as was envisioned in the park Master Plan.

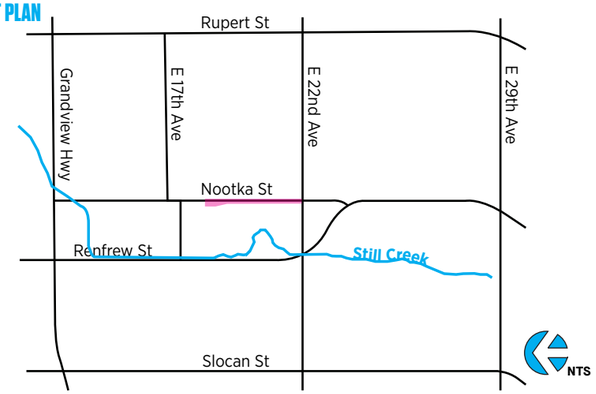
It is recommended that a professional arborist be engaged to assess the health of the existing trees adjacent to the proposed rain gardens and to identify opportunities to expand the urban tree canopy.

NOOTKA STREET

NEIGHBOURHOOD BLUE GREEN SYSTEM TYPOLOGY



CONTEXT PLAN



1 Nootka Street Bioretention

- Direct runoff from west side of street to new rain garden; approx. 40 m^2 level base required for catchment area shown. Consider pedestrian bridge or culvert crossing between sidewalk and ball field, for improved connectivity.

2 Curb Bulges

- Maintain the parking lane along the west side of Nootka street, and protect existing mature street trees by expanding the boulevard at intersections, as shown. These bump-outs are not suitable for infiltration unless they are lined, due to the location of the water main.

3 Nootka Street East

- Replace 2.5 m wide parking lane along east side of street with rain gardens. Layout to be informed by vehicle circulation requirements, including access assessment to community center parking lot.
- Direct runoff from east side of street to GRI via sheet flow over flush curb, or curb cuts with pretreatment pads. Approx. 20 m^2 level base required per 200 m^2 catchment area.
- Consider replacing street trees along east side of street with larger species, subject to arborist assessment and site constraints. Avoid re-grading boulevard where existing trees are to be retained.

4 East 22nd Avenue at Nootka Street Intersection

- Direct runoff from north side of street to GRI

S# Subcatchment Area

- See Technical Summary in Appendix C for catchment characteristics.

10 5 0 50m

5.3 GREEN RAINWATER INFRASTRUCTURE (GRI) ON PRIVATE PROPERTY

Rainwater management on private property is an important consideration in watershed management and is reflected in guiding Still Creek studies and plans, including the Integrated Stormwater Management Plan (2006). Reviewing or changing private realm rainwater management policies are outside the scope of this study.

The City has an existing policy and process for the application of rainwater management on private property, which is guided by the Rain City Strategy (2019) goals and senior government regulatory requirements. The authority that specifies private-realm rainwater management requirements is exercised through the Vancouver Building By-law (VBBL) which regulates runoff volume and peak flows as part of the City's plumbing regulations at the Building Permit stage. This policy was approved by Vancouver City Council on July 11, 2023 and comes into full effect January 1, 2024. Previously, similar requirements were held within the Rainwater Management Bulletin. These requirements are applicable city-wide to all new Part 3 (complex) buildings.

The key objectives for building-scale rainwater management are peak flow control and runoff volume reduction, which are summarized below.

Runoff Volume Reduction

- Capture and detain 24 millimetres of rainfall in 24-hours from the site area. This goal will typically be achieved by detention storage but may be supplemented by retention or other practices, including infiltration through landscape features, green roofs, or rainwater harvesting systems.

Peak Flow Control

- The post-development year 2100 10-year return period Intensity-Duration-Frequency (IDF) peak flow discharge to sewer shall be designed as to not be greater than the pre-development 5-year return period IDF (as per the Engineering Design Manual) peak flow discharge to sewer.

It is anticipated that there will be future updates to include Part 9 buildings (simpler structures) and explore additional requirements for Part 3 buildings.

Rainwater management on private property at the city-wide scale generally encourages rainwater harvesting and reuse. However, in the Still Creek watershed, this may not be an optimal practice due to the potential impact on summer baseflow in the creek and therefore deserves further study.

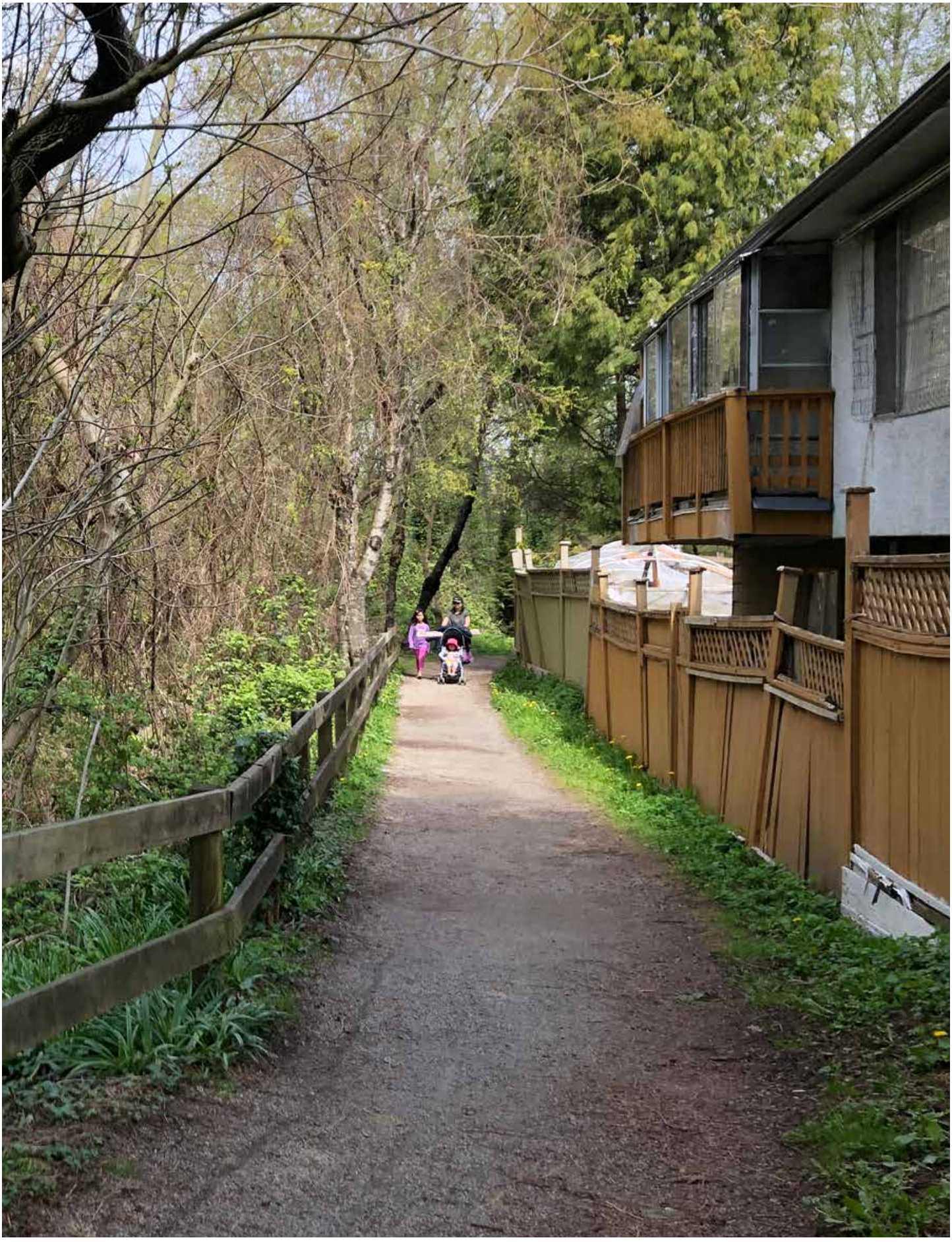


Figure 5-19 View along east edge of Renfrew Ravine Park, near East 28th Avenue (2022)

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6.0 NEXT STEPS & OTHER INITIATIVES

6.1 RUPERT AND RENFREW STATION AREA PLAN

The Rupert and Renfrew Station Area planning process has been proceeding in parallel with the current project work, and this presented the opportunity to coordinate the creek corridor concept development with the land use plan.

While the creek corridor concept presented in this study is not directly linked with the land use plan, it has become a significant consideration in the plan providing multiple co-benefits for the area. If actualized, the Still Creek corridor plan would offer a range of benefits to the watershed, including improved drainage services, reduced flood risk, a unique community amenity featuring recreational and respite spaces, and an ecological corridor, among others.

Integrating the Still Creek corridor plan with the Rupert and Renfrew Station Area planning process has resulted in more constraints placed on the feasible creek corridor width, based on what the City has deemed to be feasible for implementation within a 30-year time horizon. The current work will help to shape the redevelopment of the private properties surrounding the creek in a way that makes room for a fully daylit and expanded Still Creek corridor.

6.2 ADDITIONAL STUDIES

Site Investigations and Technical Feasibility Assessments

In order to advance the Still Creek corridor and watershed GRI site concepts, additional site investigations and technical feasibility assessments are needed. An overview of these studies is provided below.

- Environmental site investigations to assess the potential presence of contaminated sediment in and adjacent to areas of proposed excavation and infiltration, particularly along the Still Creek corridor where the floodplain is to be naturalized and large quantities of fill material are to be removed.
- Utility studies to verify locations, conditions, and requirements for implementing work around existing utilities, particularly for FortisBC gas lines, Metro Vancouver transmission main along Rupert, and sanitary pump stations.
- Field verification of outfalls discharging into Still Creek, and confirmation of their upstream storm catchment areas.
- Further investigations into sewer cross-connections to reduce or eliminate fecal coliform loading to Still Creek, and to GRI sites where subsurface piped stormwater is intended to be intercepted and daylighted for treatment.
- Geotechnical investigations to inform creek corridor design, including slope stabilization.
- Geotechnical studies including soil infiltration assessments to inform the design of the creek corridor and GRI sites.
- Studies to inform the design of the interface between the creek corridor and the adjacent rail corridor will be particularly important, and extensive consultation with railway management will be required.
- Geomorphology studies to better understand how the future Still Creek channel will behave under new site conditions, how sediment may move through the system, where potential areas of erosion or sediment build-up may occur, and how to adapt to and mitigate these outcomes.
- Detailed engineering design of the high and low treatment terraces within the Still Creek Corridor, to ensure the resulting designs will accommodate anticipated inflows and will perform water quality treatment to the desired level.
- Sediment studies identifying sources, composition and options for interception and/or removal.
- Pilot projects and studies to evaluate treatment terraces and other options for end of pipe treatment (i.e. for TSS removal and other water quality improvements), and HZ restoration pilot.
- Estimate the carbon sequestration value of the projects identified in the study in relation to the Climate Emergency Action Plan Big Move 6 targets.

6.3 MONITORING & RESEARCH PARTNERSHIPS

Multiple organizations within the Still Creek watershed are working towards equitable and sustainable watershed management, with a common interest in improving the health of Still Creek. The City needs to establish strong partnerships with allied organizations to collectively achieve shared goals.

As part of engagement on this draft of the study, the City has started engaging with a variety of organizations to explore potential partnership opportunities. This includes community stewardship groups and local academic institutions with an interest in watershed restoration research and education.

City staff has had early conversations with researchers from British Columbia Institute of Technology (BCIT), University of British Columbia (UBC) and Langara College to identify potential research interests in Still Creek. The City is well positioned to facilitate academic partnerships, and one approach may be for the City to organize a regularly occurring (e.g., annual) Still Creek research forum, to facilitate knowledge sharing among participating researchers. Researchers from each of these institutions have expressed interest in different types of ecological monitoring in Still Creek, including:

- Water quality (e.g., dissolved oxygen, pH, temperature, conductivity, turbidity, heavy metals, *E. coli*, etc.),
- Riparian habitat (e.g., native plant abundance, amount of cover habitat), and
- Presence/absence of different fish species and other aquatic organisms.

There is potential for undergraduate environmental science classes to participate in collecting data, and helping to build a long-term monitoring database. Monitoring activities during the academic year can be undertaken by students as part of educational training, and activities during the summer months could present the opportunity for student employment if external funding is secured. Long-term ecological monitoring will help to understand how Still Creek's ecological health is changing over time, and how it may be positively responding to restoration initiatives. Building a collective understanding of Still Creek's health will help to increase people's connection to the creek and foster a sense of stewardship for the watershed.

Building public awareness and understanding of Still Creek's ecological health is an ongoing process, and will help to improve public support for future enhancement and restoration projects in the watershed.

6.4 COMMUNITY EDUCATION, AWARENESS & ART PARTNERSHIPS

Still Creek Watershed Awareness

Still Creek is part of a larger watershed. Actions upstream and in areas that drain to the creek have impacts on the water quality and ecosystem health. Actions in the watershed such as car washing, using road salt on the sidewalks and roads in the winter, and illegal dumping into the storm sewers all have impacts on Still Creek. These actions negatively impact the water quality, and in some cases, create a toxic environment for the organisms that live in Still Creek. Alongside the implementation of the various enhancement projects presented in this study, a comprehensive awareness campaign should be explored to help mitigate unintended negative impacts on the creek. This would build on previous and ongoing City of Vancouver community engagement programs (e.g. Adopt a Catch Basin).

Urban Watershed Community Education

The Still Creek watershed is Vancouver's only fully separated urban watershed. Wastewater from toilets, showers, and sinks goes west to Metro Vancouver's Iona Island wastewater treatment facility, while stormwater from rain and road runoff joins Still Creek and heads east to Burnaby Lake before making its way to the Fraser River. The unique journey of water in the Still Creek watershed is not well known by the public. Through future design and implementation of projects outlined in this study, there is an opportunity to make Still Creek more visible within the community and host different types of educational events. Still Creek can be highlighted as a unique and cherished watershed as part of the City's urban watershed and One Water initiatives, including the Healthy Waters Plan.

After an 80-year absence, chum salmon returned to the Vancouver portion of Still Creek in 2012. Since then, they have come back intermittently to spawn. Another opportunity to support salmon recovery beyond the physical projects and goals outlined in this study is through community education. Salmon are sensitive to many external factors including noise and disruptions to the creek bed. The creek daylighting concept (see Figure 5-2) includes areas of limited access to keep dogs and people out of these sensitive spawning grounds to protect salmon for future generations. The creek's conceptual design includes viewing areas to see the creek while limiting physical interaction and disruption of ecological processes. These viewing areas are excellent locations for signage explaining the environmental sensitivities of aquatic and riparian ecosystems. During spawning runs (October to November) the City of Vancouver can work with the community and local groups to hold public events celebrating Still Creek and salmon. These will be especially important as the creek's ecosystem is rehabilitated and opportunities to see spawning salmon increase in frequency.

Updated Signage

Through the proposed projects there are opportunities to work with the community and across City departments to provide signage and other educational materials. As projects are developed, there should be a consistent theme and design that ties the area together and helps the community find and navigate Still Creek. Still Creek's 2000s-era logo included a dragonfly stencilled into sidewalks near and along the creek helping with wayfinding. Additionally, steel signs (Figure 6-1) were used to mark daylit portions of the creek. Continued production and installation of these markings will help make the creek and its tributaries more visible in the community.

Streamkeepers and Community Stewardship

Still Moon Arts Society has been supporting Still Creek riparian habitat restoration through their Still Creek Streamkeepers group. This group actively maintains stretches of creek-side riparian habitat removing invasive species, planting native species, and removing garbage and debris. The Streamkeepers have conducted invertebrate sampling and water quality monitoring in partnership with Fisheries and Oceans Canada, and participated in other research projects related to the creek. Still Moon Arts Society works hard to secure grant funding and partnerships to support their ongoing creek restoration work. They have also organized events, including annual fry releases in Renfrew Ravine helping support the salmon population for generations to come. As a next step of the project and through implementation, the City should meet with the Streamkeepers to

Figure 6-1 Example of signage that highlights the presence of Still Creek (photo: Chelsea Emerson, 2021)

understand how the City can support their work going forward. The City will also work with the Streamkeepers and the larger Still Moon Arts Society to understand how they would like to be engaged through implementation. An example action that has been previously identified through discussions includes incorporating tool storage into city infrastructure near the creek. As is common practice in other communities, the City should also offer to meet with the Streamkeepers regularly.

Arts and Culture

Arts and culture are powerful tools to advance Still Creek enhancement goals, raising awareness about the significance of the creek and supporting community-based environmental stewardship. The cultural values associated with the creek's restoration and stewardship have grown over time, deeply embedding the creek in the neighborhood's culture with community-led advocacy and environmental stewardship. Still Moon Arts Society has notably contributed to the creek's stewardship through all-ages artistic programs and initiatives that integrate eco-arts, public art, and ecological restoration, hosting the annual Renfrew Ravine Moon Festival, community art installations, and restoration activities. Ongoing restoration and stewardship of Still Creek should further integrate arts and cultural infrastructure, local Nations' self-determination, creative interventions, and partnerships to activate public space and inspire the community to engage with and care for the creek.

For information about City-wide arts and culture policies that support and align with the Still Creek Watershed Enhancement Opportunities Study, see:

- Culture|Shift: Blanketing the City in Arts and Culture
- Making Space for Arts and Culture: Cultural Infrastructure Plan
- City of Vancouver's UNDRIP Strategy

Public Art

Still Moon Arts Society has been the primary organization involved in curating and organizing public eco-art activations within the Still Creek watershed since 2004. They utilize a variety of different art forms and materials to create works such as The Labyrinth (2002), Lost Stream Street Murals (2014-2017), and Beaver Pond(er)ing Lodge (2021-2024). Still Moon Arts Society also hosts a variety of eco-art workshops, events, and other community-building activities within the watershed. For more information about their initiatives visit StillMoonArts.ca.

Future public art opportunities are being discussed through the development of the Rupert and Renfrew Area Plan. At the time of this report, the City's Arts, Culture, and Community Services department shared their current vision for future public art opportunities which will be finalized through the area planning process. Early ideas from the first round of public engagement and existing City strategies include utilizing public art as a mechanism to visually highlight and signify the ecological importance of Still Creek, while simultaneously reviving its traditional, cultural significance to the local

Nations. This could be delivered by prioritizing the commissioning of for xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh) artists utilizing natural materials to create land-based art forms of various sizes that will speak to the significance of the creek, through history and present day. Public art locations and opportunities should be in strategic locations along Still Creek and future public pathways to create a unique experience in the community. The City's Arts, Culture, and Community Services department will also look for public art activation opportunities along Still Creek's tributaries, ecological corridors, and throughout the watershed.

Stewardship Centre

One idea proposed through engagement with the Still Moon Arts Society was the incorporation of a Stewardship Centre that could support local organizations and artists supporting Still Creek. During the early conceptual design process, ideas to include a stewardship centre along the creek corridor were proposed (see Figure 5-2). Through the Rupert and Renfrew Area planning process and furture design work, there is an opportunity to explore this concept further. Some early ideas include a non-profit operated hub for artists, local organizations, streamkeepers, local Nations, and community members to collaborate and engage with Still Creek's restoration. The centre could offer educational and artistic programming on local ecology and stewardship of the creek and the revival of cultural practices for the local Nations. The stewardship centre should be a space of open dialogue, knowledge exchange and art creation, and contribute to reconciliation, self-determination, community building and sustainability objectives. It could provide spaces for cultural practices, art production, and public gathering. Other use opportunities, such as space for storage for tools and materials, could also be included to support ecological restoration and streamkeeper activities. The Corrigan Nature House at Maplewood Flats and the Lynn Canyon Ecology Centre, both in the District of North Vancouver, serve as examples of facilities that provide services such as educational and artistic programming for natural ecosystem conservation.

6.5 ENGAGEMENT ACTIVITIES

Targeted engagement for this study took place in 2023 and included organizations that are active in the watershed, including watershed researchers, watershed stewards and regulators. Referrals were also submitted to xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh). Engagement activities aimed at the general public were not directly within the scope of this study given its technical focus on environmental conditions and enhancement concepts. However, the Still Creek watershed was highlighted as part of the public engagement for the Rupert and Renfrew Station Area Plan and community feedback on the importance of the watershed and creek was captured and considered as part of the incorporation of this study into the land use plan.

The purpose of the engagement for this study was to provide information about the goals and deliverables in the spirit of transparent decision-making and relationship-building and to receive input on the deliverables from knowledgeable individuals involved in local watershed management and Still Creek advocacy.

A brief summary of engagement conducted as part of this project follows:

- Individual meetings were held with: Still Moon Arts Society / Still Creek Streamkeepers, academics from the University of British Columbia, Langara College, and British Columbia Institute of Technology, Fisheries and Oceans Canada, and Musqueam Indian Band.
- During an intergovernmental summit between the City of Vancouver and Musqueam Indian Band, City staff provided high-level information about the study as it was one of many topics discussed.
- The 95% draft of the study was submitted to Musqueam Indian Band and Tsleil-Waututh Nation at their request. Both reviewed the document and provided comments and support for the study. Squamish Nation received the draft report with an update to the Rupert and Renfrew Area Plan.
- Musqueam Indian Band provided comments and recommendations that have been integrated into the body of the report. City staff also provided written responses directly to Musqueam. Topics included water quality, requests for additional information on City plans and strategies, spaces for cultural practices and support for specific aspects of the study. In a follow up meeting, Musqueam Indian Band also provided additional comments and questions which related to other citywide initiatives and emerging topics, including the UNDRIP strategy and watershed co-governance. These comments and questions are being addressed outside of the development of this study.
- Tsleil-Waututh Nation expressed general support of the study and requested continued updates as Still Creek watershed enhancement work continues, as well as cultural recognition for public viewing spaces along the creek.
- Squamish Nation provided comments supporting the long-term ecological monitoring of Still Creek suggesting it has the potential to improve climate change adaptation and urban resilience in this area by re-naturalizing and improving the functionality of lost ecosystem services. The Squamish Nation would like to stay up to date on the progress of the study and future implementation and work with the City to participate in rehabilitation/ revegetation works and/or ecological monitoring opportunities.

Please refer to Appendix B for further information about engagement activities conducted as part of the Still Creek Watershed Enhancement Opportunities Study.

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