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Lower Suter Brook

Conceptual Enhancement Plan

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Prepared for:
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List of Acronyms

AM	Adaptive Management
AMF	Monitoring and Adaptive Management Framework
BGZ	Biogeoclimatic Zone
BMP	Beaver Management Plan
BIMES	Burrard Inlet Marine Enhancement Society
BMN	Burke Mountain Naturalists
CC	Climate Change
CCTV	Closed Circuit Television
CPR/CP	Canadian Pacific Railway
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
ENGO	Environmental Non-Governmental Organization
FA	*Fisheries Act*
ISCBC	Invasive Species Council of British Columbia
ISMP	Integrated Stormwater Management Plan
KWL	Kerr Wood Leidal Associates Ltd.
LWD	Large Woody Debris
MOF	Ministry of Forests
MSE	Mechanically Stabilized Earth
Onni	Onni Property Management Services Ltd.
PSF	Pacific Salmon Foundation
RAR	Riparian Areas Regulation
RAPR	Riparian Areas Protection Regulation
RFR	Request for Review
RoW	Right-of-Way
SAR	Species at Risk
SSRES	Salish Sea Research and Education Society
WSA	Water Sustainability Act

1. Introduction

This report provides guidance and opportunities for environmental enhancement of Lower Suter Brook Creek. The opportunities identified in this report represent an ecological-based approach that utilizes natural processes for beneficial effect. A sequential approach is proposed to guide enhancement of the area. The approach considers each opportunity as connected or linked to the preceding one, providing Port Moody with a start and end point.

A key concept discussed in this report is adaptive management, which is the systematic process of decision making when there are unknowns. This concept will be critical in the success of any enhancement opportunity identified as needing to "adapt" to changes such as those posed by climate change.

The high-level enhancement strategy presented in this document views the ecosystem as a whole, whose function depends on the health of the overall system. Thus, the enhancement approach is not focused on a single species but rather recognizes that different species or aspects of the system are interconnected and dependent on each other. It considers flora and fauna equally and emphasizes the symbiotic role that each species or system plays in the overall health of an ecosystem.

While the strategy is to enhance and/or promote natural processes to take place and shape the ecosystem, it should be noted that the area is no longer natural. Anthropogenic alterations have shaped the current system, and infrastructure within and adjacent to the system will continue to influence it. This context has been considered and is reflected in this report and strategy.

2. Background

Kerr Wood Leidal Associates Ltd. (KWL) was retained by the City of Port Moody (Port Moody) to develop a concept-level ecological enhancement and implementation plan for Lower Suter Brook Creek. The enhancement plan is intended to provide guidance to the City of Port Moody for planning and implementation of ecosystem-based, ecological enhancements in the Lower Suter Brook Creek natural area.

2.1 Description

The project area referenced in this report as Lower Suter Brook Creek is bounded by Murray Street to the south, the Inlet Center Firehall to the east, the Civic Centre to the north, and Shoreline Trail and a CP Rail crossing to the west (Figure 1). The area forms a small ecological hub within the City's centre and provides residents with easy access to a small patch of nature. Within the area, a trail network connects Murray Street to Port Moody's recreation complexes (e.g., community center, tennis courts, fields, public library) along with access to the Shoreline Trail. The area is heavily utilized by the public for recreational purposes.

Suter Brook Creek is a small, second order watercourse draining the northern slopes of the Mundy Park/Chines neighbourhoods of Coquitlam and Port Moody. It is approximately 1.7 km in length from headwaters to estuary; the creek enters Burrard Inlet at the east end of Port Moody Arm. The watershed is highly urbanized with residential and commercial development and is adjacent to and crossed by significant transportation corridors throughout most of its alignment. Although Suter Brook Creek is confined to a narrow riparian corridor over most of its length, the watercourse is daylighted, flows through an intact and functional backshore forest, and retains a semi-natural intertidal estuary, a rarity among Burrard Inlet streams.

Water quality assessment and benthic invertebrate sampling as part of Metro Vancouver's Monitoring and Adaptive Management Framework for Stormwater (AMF) have determined that Suter Brook Creek is in fair to poor condition (Dillon Consulting, 2019). An Integrated Stormwater Management Plan (ISMP) is currently under development to fully characterize watershed stressors and drainage infrastructure.

There have been several habitat restoration projects in Suter Brook Creek over the years, including:

- Compensation habitat construction for the SkyTrain expansion (2014/2015).
- Bioswale construction to manage stormwater runoff from the new Firehall site to the Firehall Tributary and pond (2013/14).
- Compensation habitat construction for impacts associated with Onni development (2003).
- Daylighting of the lower portion of the creek (mid-1990s) north of the current Port Moody Works Yard (A. Crampton, personal communication, April 2022). A culvert with baffles was installed during this period to aid the passage of fish under the railway tracks (Fisheries and Oceans Canada, 1999).

Local enhancement and stewardship groups have been monitoring and working to improve the ecological health of Suter Brook Creek for decades. This includes removal of invasive plant species, installing bird and bat boxes, releasing salmon fry in the watershed, and monitoring fish and wildlife presence.

Between 2018 and 2020, North American beavers (*Castor canadensis*) established residency in Lower Suter Brook Creek, and mitigative measures were installed and are still present (e.g., levelling devices, tree caging). A Beaver Management Plan was developed in 2019 by wildlife management consultants, City staff, and local stewardship groups, who also participated in beaver monitoring and management actions. The Beaver Management Plan provides guidance to the city on how to manage and coexist with beavers on City lands and rights-of-way (JBL Environmental Services Ltd., 2019). Beavers moved residency sometime in 2020 and are not currently present in the area. The Beaver Management Plan is considered in the Lower Suter Brook Enhancement Plan to ensure principles of co-existence are followed and beavers could be accommodated should they inhabit the area in the future.

Figure 1: Project Area

2.2 Project Scope and Objectives

The City of Port Moody is seeking conceptual design and implementation plans to guide ecological enhancement and trail improvements on City land adjacent to Lower Suter Brook Creek.

The goal of the project is to improve the ecological function of the area through enhancement activities, utilizing an ecosystem-based approach balanced with other uses and infrastructure needs in this corridor. A broad-based ecosystem approach is consistent with feedback from initial consultations with the stewardship community undertaken during this project. Key considerations include developing a plan that provides safe, year-round access through the area for residents and maximizing riparian and forest characteristics, while ensuring that the ecosystems of Lower Suter Brook Creek are resilient to change.

In addition to the above, it is important to recognize that creek corridors are dynamic and Lower Suter Brook Creek exhibits characteristics typical of urban natural areas (e.g., urbanized creek flows, invasives species, human impacts, water quality degradation). The plan will need to be adaptable. Changes in the system will happen over time, through both natural and anthropogenic processes. The plan developed must be flexible to adjust to those changes through Adaptive Management (AM). AM is the process of decision-making when there are unknowns, in which monitoring of responses to actions informs and shapes subsequent actions (Government of British Columbia, 2022). It is an iterative approach that recognizes that the first response will rarely be right the first time (Figure 2), and monitoring and adapting are expected (see Section 6.3.4). An AM approach is a key component emphasized in the Beaver Management Plan as well.

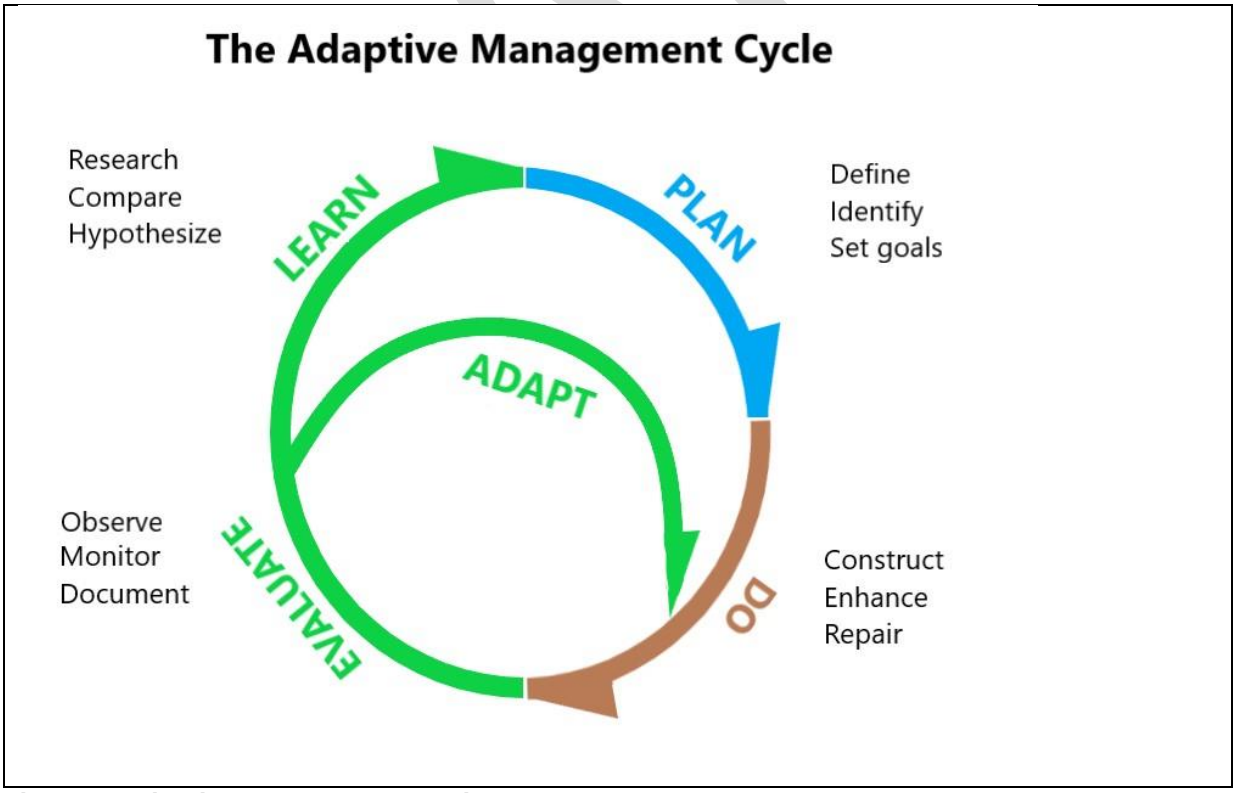


Figure 2: Adaptive Management Cycle

3. Assessment Process

KWL staff undertook a desktop study and field review of Lower Suter Brook Creek and its watershed. The desktop study included a review of historic air photos, online databases (e.g., Habitat Wizard, EcoCat, BC Species and Ecosystem Explorer – Species at Risk), Port Moody GIS resources, past reports, management plans, and discussions with City Staff and local stewardship groups. Municipal infrastructure around the watercourse was closely studied to determine how this infrastructure might provide but also limit enhancement opportunities.

A field review of the lower reaches of the watercourse and tributary was undertaken by KWL on February 3 and 23, 2022. KWL was joined by City Environment, Parks, Operations, and Engineering staff.

In addition, consultation with the Burke Mountain Naturalists (BMN) and the Salish Sea Research and Education Society (SSRES) occurred on February 23, 2022. Consultation with the Burrard Inlet Marine Enhancement Society / Mossom Creek Hatchery (BIMES) occurred on March 2, 2022 (via Zoom). During all of these meetings, Port Moody and KWL gathered information on the history of the area and collected perspectives and input to be incorporated into the concept plan.

An additional survey of the upper reaches of Suter Brook Creek and its tributaries was conducted on April 9, 2022, to gain an understanding of upstream conditions and inputs. As they are outside of the scope of this project, conditions within the upstream areas are not further discussed; however, findings have been utilized to inform enhancement opportunities and implementation in the project area and shared with the team responsible for the Integrated Stormwater Management Plan currently under development.

4. Current Conditions

The following sections provide a high-level overview of watercourses present in the project area. Figure 3 provides a detailed map of the watercourses within the project area that are referred to in the subsequent sections.

Figure 3: Current Watercourses and Alignments in Project Area

4.1 Observations

4.1.1 Lower Suter Brook Creek

Lower Suter Brook Creek and its vegetated corridor were inspected from approximately 20 m upstream of Murray Street to approximately 10 m below the Canadian Pacific Railway (CPR) tracks. This is a confined reach with an incised channel occupying a narrow riparian corridor between the City of Port Moody Works Yard and developed trail, lawn, and tennis courts. Lower Suter Brook Creek wetted width averages approximately 2 m with wetted depths varying from 10 - 40 cm. Channel morphology is best described as very straight and confined within the area (Appendix A – Photo 1). A single sharp left bend is located at the approximate midpoint of the creek's length within the project area. Sand is the dominant substrate in the channel with sparse exposed gravel associated with scour. Small erosion nick points are common below the high-water mark. Instream complexity is very limited and is primarily provided by large woody debris (LWD) and exposed tree root systems.

At the Murray Street crossing, the two offset 900 mm x 29 m culverts appear to be undersized in capacity as shown by evidence of surcharging upstream, bank erosion downstream, and submergence of the lower culvert (Photo 2). A storm outfall adjacent to the crossing[1] was discharging turbid grey water at the time of the assessment on February 3, 2022.

Riparian vegetation is present in most areas, with extensive, recent shrub replanting near Murray Street (Photo 3); however, riparian areas were observed to be impaired by several factors. Riparian widths are limited by the presence of the Works Yard and trail. Invasive, non-native species such as Himalayan blackberry (*Rubus discolor*) and English ivy (*Hedera helix*) are widespread throughout most of the area. Many of the mature trees present in the area are afflicted by disease and/or show evidence of

[1] Discharges of turbid water or other inputs from this outfall have been investigated on numerous occasions since 2017 (A. Crampton, personal communication, April 2022).

environmental stress. Tree cover on the north side of Lower Suter Brook Creek (adjacent to the tennis courts) is poor. Dead or fallen trees in the area may provide habitat for small mammals and/or forage and cavity-nesting opportunities in wildlife trees for avian species.

Immediately downstream of the left bend in the creek near the upstream corner of the tennis courts, an old flow levelling device is present in the channel. It is currently not needed for maintaining flows and may act as a debris catcher in its present condition. Between the Works Yard and the tennis courts, approximately 10 - 20 m upstream of the CPR right-of-way (RoW), a remnant beaver dam was observed (Photo 4). Much of the structure has been carried away by higher stream flows, however wood debris and sediment from the dam are still present, forming a partial weir. There is also remnant material (e.g., rebar, metal plates) from an old fishway that was constructed around the dam (Photo 5). Immediately downstream of this debris, extensive cottonwood root mats underlain by concrete is present. This concrete is likely protecting a shallow sanitary sewer pipe crossing at this location. The infrastructure is acting as grade control, limiting natural stream processes both upstream and downstream of the crossing. In its current state and without a functioning/appropriate fishway, the channel gradient created by this infrastructure, root mats, and remnant dam material may present a partial to full barrier to upstream fish passage (depending on species, fish size, and flow conditions).

Downstream of the sanitary sewer crossing, Lower Suter Brook Creek enters a concrete box culvert passing under the CPR tracks, railway maintenance road, and Port Moody's Shoreline Trail (Photo 6). The culvert was inspected and found to be equipped with offset baffles to assist fish passage. Another culvert discharges to a parallel channel immediately north of Lower Suter Brook Creek, on the downstream side of the CPR tracks. This culvert is fed by upstream sources (including stormwater and remnant creek channels from areas east of Noons Creek, and storm and groundwater from Newport Village and Civic Centre) and does not originate from or connect with Lower Suter Brook Creek.

No fish were observed during the field review, partially due to the turbidity of the creek along with seasonal timing during the assessment. Evidence of wildlife utilization in the areas adjacent to Lower Suter Brook Creek was evident through visual observation of songbirds, raptors, and waterfowl. Scat was observed off main trail areas but was not identified. Many trees throughout the reach were caged with wire wrap to prevent beaver foraging.

4.1.2 Firehall Tributary

The Firehall Tributary is approximately 100 m in length and flows east to west from the west side of (behind) Port Moody Firehall No. 1. It passes under the walking trail through a small, deteriorated culvert before its confluence with Lower Suter Brook Creek immediately upstream of the sharp left bend on the mainstem (Photo 7). The small tributary stream originates from a constructed wetland adjacent to the Firehall property, where a 1 - 2 m vertical lock-block retaining wall is present along the eastern boundary of the wetland. The source of water to the pond and outflow tributary is groundwater seepage and several stormwater pipes, some of which capture groundwater. The tributary is generally less than 1 m wide and 10 cm deep, with substrates comprised primarily of fine sand and silt. Approximately 5 - 10 m downstream of the lock block headwall, a remnant beaver dam and flow control structure are present, both of which currently maintain a higher average water level in the wetland/pond than seen in recent years (Photo 8). The current configuration of the old dam and flow control structure is not passable to aquatic species.

Downstream of the pond, the tributary passes through an old road culvert, with the former road surface now covered in growing trees (Photo 9). The culvert is not a barrier to fish passage but does impair riparian development. Further downstream, there are wetland areas along the northern or right bank.

These wetted areas support skunk cabbage (*Lysichiton americanus*) and have a thin film of surface seepage flowing into the tributary.

The tributary and its surrounding area have potential to provide high-quality fish and wildlife habitat (e.g., overwintering habitat for juvenile salmonids, amphibian habitat, and small mammals) but is small in extent, depth, and cover. There is also significant presence of invasive plant species, particularly on the southern or left bank areas of the tributary, currently limiting habitat potential.

The upland areas of the Firehall Tributary represent some of the best terrestrial habitat for small mammals and avian species. Moderate-aged coniferous tree species such as western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*) are dominant with deciduous species interspersed throughout. Evidence of woodpecker foraging was observed in dead and decaying trees (i.e., wildlife trees) and the area likely represents valuable habitat for woodpecker species. Mallards (*Anas platyrhynchos*) were observed in the constructed wetland adjacent to the firehall.

4.1.3 Old Firehall Tributary

The Old Firehall Tributary originates from a storm outfall adjacent to the vacant lot off Murray Street (former firehall). It flows north for approximately 30 m along the western side of the vacant lot before a slight left turn into the forested area where it joins the Firehall Tributary. Adjacent to the small channel, the largest section of upland urban forest is present (between this tributary and the path along Lower Suter Brook Creek). This small, likely ephemeral channel is approximately 0.5 m in width and substrate consists of organic detritus with iron ochre microbial growth (Photo 10). This condition is indicative of groundwater flow through buried organic matter, such as a former wetland or bog beneath urban development.

Invasive plant species are common along this small tributary and current water quality conditions may impair full aquatic species utilization. The upland areas adjacent to the Old Firehall Tributary are similar to those described above, however, invasive plant species are much more prominent in this area.

4.2 Key Limiting Factors

Based on the desktop review, field assessment, and interviews with Port Moody staff and stewardship groups, a list of key limiting factors for the natural area of Lower Suter Brook Creek has been developed. Key limiting factors identified include:

1. **Urban Hydrology** – The effects of upstream urban development and stormwater infrastructure are very visible in Lower Suter Brook Creek. Water quantity and quality are both negatively affected. Imperviousness (e.g., roads, rooftops, etc.) has altered precipitation run-off patterns by increasing peak flows and reducing low flows. Pollutants from impervious surfaces are conveyed directly to the stream with no settling, adsorption, or biological processing. As shown by benthic invertebrate monitoring, Suter Brook Creek has been highly impacted by development. This adversely affects salmonids and stream-associated wildlife species such as kingfishers, dippers, and the endangered Pacific Water Shrew (*Sorex bendirii*).
2. **Narrow Riparian Setbacks and Sparse Riparian Vegetation** – The benefits of riparian areas on stream health are well studied and quantified. Riparian areas contribute nutrients (via litterfall), invertebrates, LWD, channel stability, and cover to streams. Within the project area, Lower Suter Brook Creek has a narrow riparian setback, dominated by young deciduous trees, and many dead or dying trees. The area also has limited amounts of dense understory shrub cover decreasing its suitability for songbirds and secretive animals.

3. **Invasive Non-native Species** – Invasive non-native plant species are prominent throughout most of the project area. Their presence limits natural processes including succession and impacts natural ecological function by limiting colonization by native species and creating a monoculture condition. In addition, the presence of invasive plant species may limit foraging opportunities for small birds and mammals.
4. **Urban Wildlife Predators** – Urban adapter species such as crows, coyotes, raccoons, and skunks likely exist at higher densities than in wilderness settings and increase predation upon the eggs and chicks of wild birds.
5. **Limited Ecological Complexity** – Ecological complexity is the interaction of natural systems or components and how their presence or absence affects the system. In Lower Suter Brook Creek, both aquatic and terrestrial complexity are limited. In streams, channel roughness can create complex flow patterns, scour, and sediment sorting, all of which are beneficial to aquatic productivity. Resident salmonids typically utilize roughness to reduce swimming effort while feeding and as hiding places to avoid predators. Terrestrial areas are predominantly pioneer species and lack coarse wood debris due to past land clearing. This limits diversity of habitats that could be utilized by terrestrial species. In addition, a lack of complexity limits the system's resilience to change.
6. **Human and Canine Presence** – The limited terrestrial patch size, presence of trails, and high amount of off-trail access by dogs and people in the project area likely favours urban adapter species of birds and mammals and limits the presence of solitary or shy animals. In addition, the off-trail access has impacted vegetation and channel banks, widening the trail over time, limiting riparian growth, promoting spread of invasive plant species, and disrupting the aquatic environment.
7. **Channel Morphology** – The incised linear channel, historic relocation, culverts, and daylighting has resulted in the creek channel being unnaturally straight and incised, with soft erosive banks. Natural channel forms typically have a floodplain / overbank region adjacent to the channel that accommodates high flows, reducing velocities and erosion, and providing low-velocity refuge areas for fish. Overbank areas may also be depositional zones for fine sediments. The current configuration of Lower Suter Brook Creek does not provide these benefits; however, the plan(s) presented herein address these current issues.
8. **Wetland Areas** – There are indicators of wetland habitat in the project area, however, they are not functioning as effectively as they could. Invasive species, tree removal, and hydrology are likely limiting the development of these areas into wetland habitats that could be utilized by a wide variety of species.
9. **Water Quality –** Linked to urban hydrology, water quality as indicated by AMF benthic monitoring data for Suter Brook Creek indicates a degraded watershed. This affects the population and diversity of stream-dwelling benthic invertebrates that are a critical food source for many species. Water quality impacts are a direct result of upstream urban development and this needs to be addressed in the ISMP.
10. **Danger Tree Management –** Requirements to remove overmature and dead trees within the project area for safety reasons limits the potential to retain trees for terrestrial wildlife use during their standing decomposition phases. Woodpeckers, bats, and small mammals may all have reduced habitat. The addition of trail networks may require the removal of danger trees to maintain public safety, however, impacts will only be limited to those areas and removed danger trees can potentially be utilized/repurposed to create wildlife habitat elsewhere within the site.

11. **Fine Substrates** – The constant input of sand from upstream reaches has very negative effects on salmonid egg and larval survival and reduces the benthic invertebrate productivity of the streambed. Although the sand is naturally occurring, input has likely been increased through urban stormwater hydrology, railway drainage infrastructure, and stream channel confinement. The ISMP that is in development should address point source sediment.
12. **Infrastructure** – Adjacent infrastructure including roads, rail corridors, parking lots, and piped systems limit the expansion of ecological features in the area. Road and train traffic will contribute to higher mortality rates for mammals.
13. **Fish Passage** – The steep cascade over the area around the sanitary sewer line (adjacent to the Works Yard) is a partial barrier to returning adult salmonids and a full barrier to juvenile salmonids ascending the watercourse. Although spawners of some species may be able to pass over during some flow conditions, delays waiting for passability may increase their vulnerability to predators and be a physiologic stressor. Passability by juveniles is important to allow natal and non-natal juveniles, such as coho salmon and cutthroat trout, to seasonally occupy and benefit from habitat in Suter Brook Creek. Such fish may move between Noons, Mossom, and Suter Brook creeks as seasons and conditions change. Water temperatures, flow levels, and food availability frequently motivate such movement.
14. **Limited Instream Cover** – Existing cover for fish within the creek is limited. Cover may be enhanced by instream complexing elements or low and overhanging vegetation. Cover may benefit fish through protection from predators and as a source of terrestrial invertebrates for feeding.

5. Ecological Enhancement Opportunities

Through consultation with Port Moody staff and members of local stewardship groups, KWL has developed a list of potential ecological enhancement opportunities. The opportunities take into consideration the limiting factors identified above and endeavour to achieve some ecological resiliency to external forces such as climate change and co-existence with keystone species, which supports the City's Beaver Management Plan (JBL Environmental Services Ltd., 2019). The opportunities are ranked in terms of short-, medium- and long-term priorities enabling Port Moody to plan over an extended period. A comprehensive list of opportunities and associated parameters are summarized in a matrix format in Appendix B.

5.1 City and Stakeholder Objectives

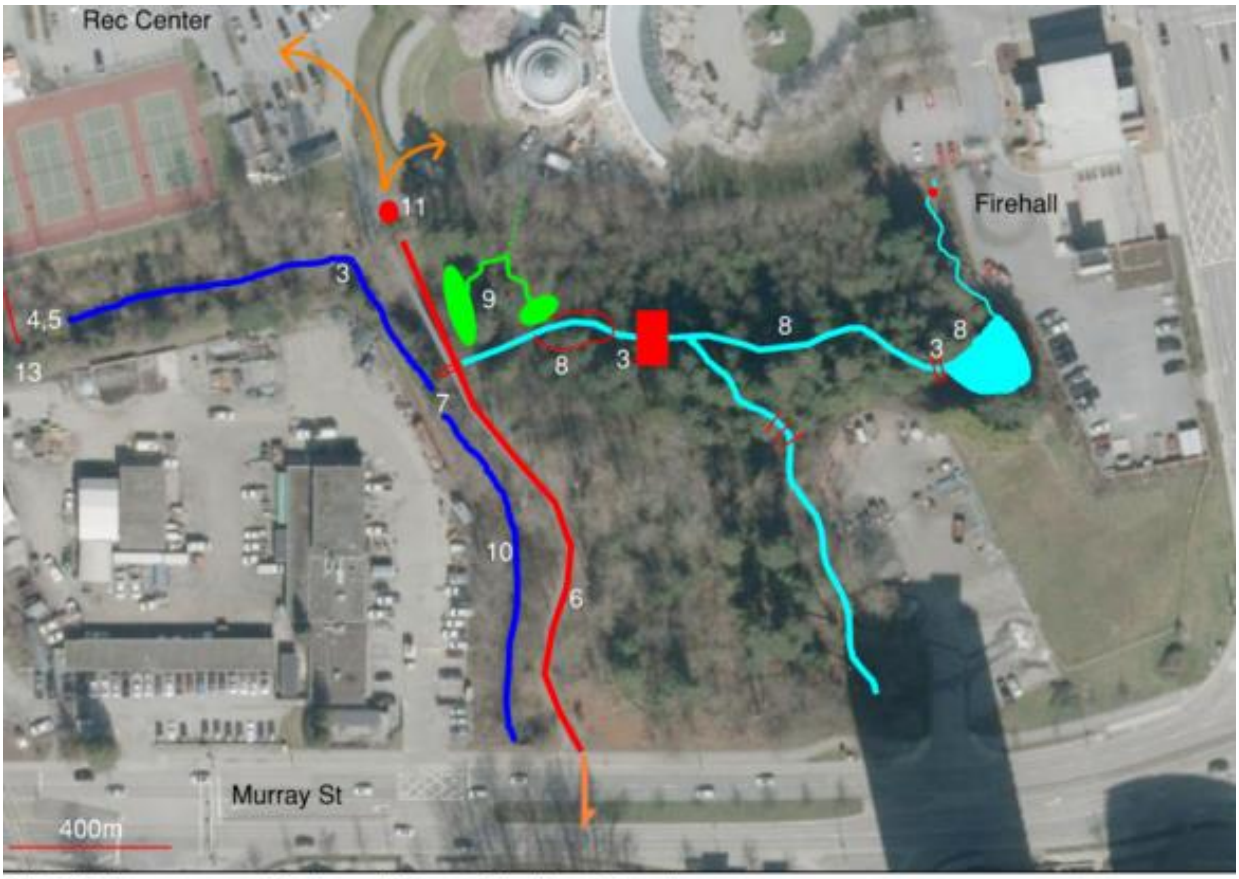
During the project consultation, KWL heard a variety of perspectives from staff and stewardship groups who provided a valuable lens through which the opportunities were developed. Considering these various viewpoints, the following high-level objectives were developed:

1. Maximize ecosystem (multispecies) benefits through natural processes and enhancement of natural assets.
2. Improve resiliency of park and ecosystems to external forces (i.e., climate change, human access, stormwater inputs).
3. Improve passive park experience through creation of a world class "Nature Hub".
4. Enhance high-profile urban aquatic and terrestrial habitat.

5.2 Opportunities

The opportunities presented in this section are intended to provide ecosystem enhancement that will benefit a variety of native animal and plant species. In addition, the opportunities have been developed with climate resiliency in mind and endeavour to address flow variation and flooding, water quality mitigation through natural infrastructure, and adaptation through selecting appropriate plant and tree species. While a comprehensive list of species known to be present in the project area has not been developed as part of this scope, a high-level review of available online resources was utilized to provide indication of potential species present in the area, particularly species at risk (e.g., Western Toad, Green Heron, Pacific Water Shrew).

Figure 4 below provides an overview of potential short- and medium-term enhancement opportunities and their location.



SBC Enhancement Options (Short / Medium Term)

1. Invasive plant control (throughout)
2. Enhancement planting (throughout)
3. Instream debris cleanup
4. Sanitary sewer crossing channel improvement.
5. Sanitary sewer fish passage improvement
6. Trail renovations
7. Fire hall tributary culvert replacement.
8. Tributary enhancements
9. Groundwater habitat
10. Mainstem enhancement
11. Educational kiosk

Figure 4: Suter Brook Creek Enhancement Opportunities – Short/Medium Term

1. **Invasive Plant Control** – Invasive plants are an ongoing threat to vegetational diversity and native species growth. In extreme cases, a single invasive species may establish a monoculture, resulting in losses to food and habitat opportunities for native fauna. In ecologically sensitive areas, ongoing mechanical removal through hand labour is typically used. This presents an excellent public involvement or seasonal student project with low regulatory and financial barriers to starting. Organized “ivy pulls” and other drop in events have been successful in many other municipalities and were initiated in the project area in 2021.
2. **Enhancement Planting** – The natural areas around Lower Suter Brook Creek have areas with low vegetation diversity and many evenly aged trees. Although natural native vegetation recruitment may occur, it is equally likely that invasive species may occupy the gaps. Shading provided by planted trees will provide some suppression of sun-loving invasive species and bolster ecological values. As demonstrated by western red cedars planted previously, moist, and semi-shaded conditions within much of the forest patch are conducive to reforestation. Conifer planting for succession and infill planting to enhance the shrub layer should be done throughout forest areas. This complements invasive plant control and may be undertaken concurrently. Considerations for enhancement planting are provided in Appendix C. A forest health assessment should be considered as a first step to inform enhancement planting.
3. **Instream Debris Clean-up** – Flow control structures not in use, steel rebar, and the truck chassis in Lower Suter Brook Creek and the Firehall Tributary are detrimental to the aesthetics and ecological values of the area. They should be removed. Flow control structures should be kept in City storage so they can be re-installed in a timely manner if needed per the Beaver Management Plan.
4. **Sanitary Sewer Crossing Channel Improvement** – Thick root mats, organic debris, and the sanitary sewer crossing infrastructure have created a hydraulic bottleneck and impair both natural stream processes and upstream passage of various species and life stages of fish. The organic covering also impairs visual inspection of the pipe crossing. Debris removal and root-mat pruning, as directed by a certified arborist, should be undertaken. The presence of the sanitary sewer will require caution to avoid damage.

   The organic debris may be beneficially reused above the top of bank adjacent to the tennis courts. Placement of decomposing wood in this area may be beneficial for terrestrial amphibians. Long-term planning should consider rerouting the sanitary sewer crossing to avoid future issues.
5. **Sanitary Sewer Fish Passage Improvement** – The existing boulder weirs were likely designed and installed to facilitate passage of adult salmon past the concrete apron over top of the sanitary sewer. In its current configuration, the weirs likely do not allow passage by most juvenile fish species. A nature-like rocky ramp is recommended for the area to create more natural fish passage past the sanitary sewer. These structures are passable at many flow levels by different life stages and do not require the maintenance associated with box type fishways. The natural substrate will reinforce the sewer crossing and contribute to benthic invertebrate production.

Figure 5: Example of Concept of Rock Ramp Over Top of and Around Sanitary Sewer Crossing

6. **Trail Renovations** – The north-south trail linking Murray Street to the Civic Center area is vulnerable to flooding and contributes to uncontrolled public access to forest and riparian areas. Off-trail pedestrian and dog access contributes to vegetation trampling and suppression, erosion, and dog feces deposits in this area. Renovations would include fencing the trail, creation of strategically placed observation platforms, trail surface raising at the Lower Suter Brook Creek / Firehall Tributary confluence, and potentially trail relocation in some sections to increase riparian width. A raised trail and/or elevated boardwalk would also add resilience to future extreme weather events and/or channel blockages. Trail raising is proposed to be undertaken with Mechanically Stabilized Earth (MSE) Wire Wall retaining wall units that will limit the required width of fill and allow vegetation to establish on the new slope. As an alternative, an elevated boardwalk in select locations may provide a viable option to the MSE trail, aiding in animal movement, reducing vegetation impacts, and restricting access to ecologically sensitive areas.

   The observation platforms proposed are localized widenings with several features such as a decorative wildlife-themed panel (jet cut patina steel), cultured log round pavers, and interpretive signage. Each observation platform also serves as a maintenance access point since the panel is hinged or removable. Observation platforms to be refined (i.e., quantity, location) based on future access needs and maintenance requirements.

Figure 6: Conceptual Rendering of Trail Side Fencing and Viewing Platform

7. **Firehall Tributary Culvert Replacement** – Presently, two small culverts pass under the trail but are small and not amenable to wildlife usage. An embedded and oversized (relative to hydraulic requirements) 1.5 - 2 m wide concrete box culvert with wildlife passage benches could enhance wildlife passage and reduce the likelihood of debris blockage. A larger culvert with strategic inverts can also provide stormwater attenuation into the constructed wetland upstream. By placing the culvert below the creek channel invert and backfilling with natural substrate, a structure equal to a bridge in performance and appearance can be more easily and economically installed[2]. It would also allow flexibility of invert elevation in the event of channel grade changes in Lower Suter Brook Creek. Providing wildlife passage through the culvert would be essential if trail fencing is installed. The crossing may be visually emphasized by varying the fence / railing design and/or utilizing a different surfacing type. Interpretive signage may also be an educational asset at this location.

[2] Replacement of the current culvert with a larger bridge structure would be more costly and require more regulatory approvals, but with no significant ecological gain.

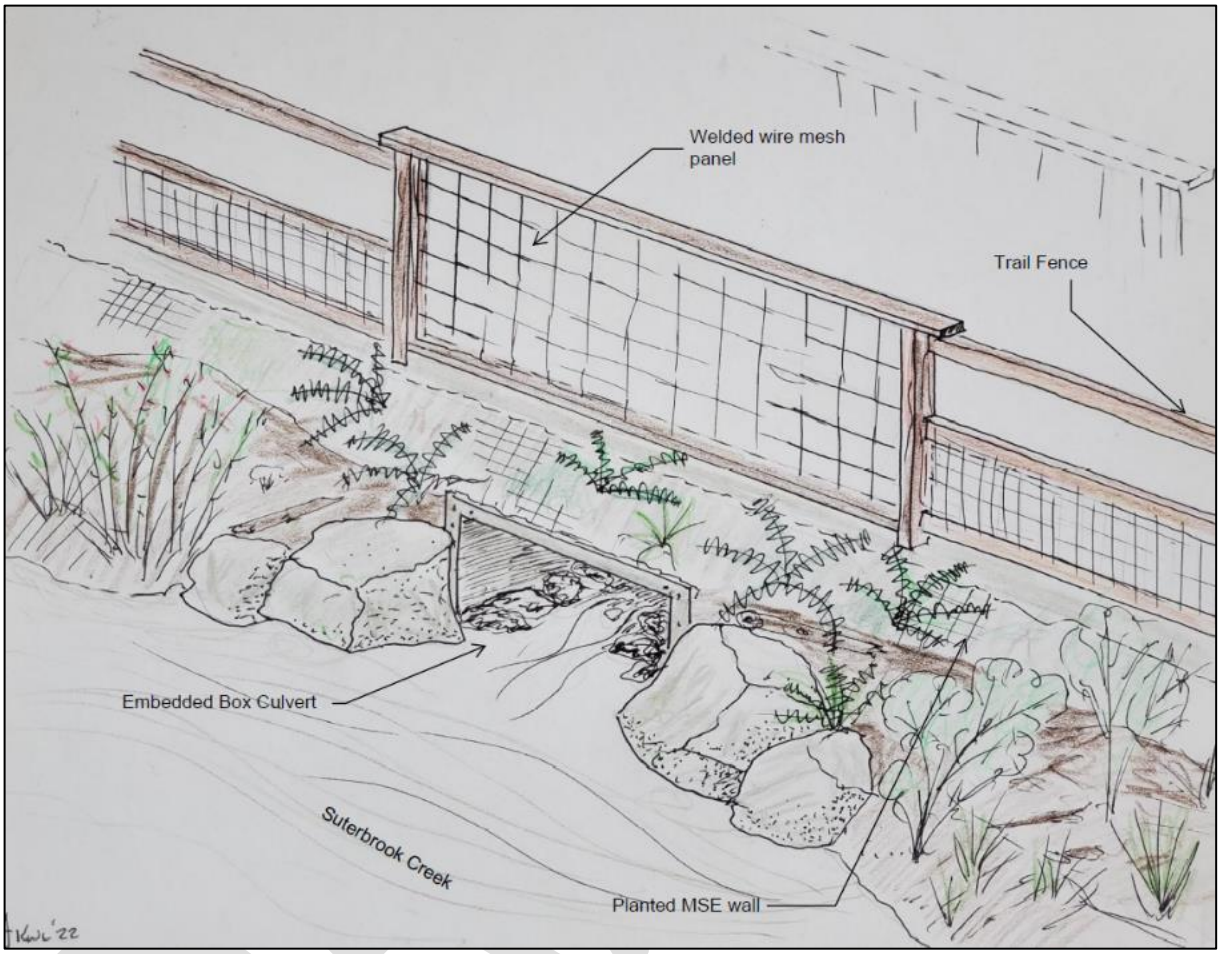


Figure 7: Conceptual Rendering of Tributary Culvert and Wildlife Crossing

8. **Tributary Enhancements Including Pond and Wetland Features** – The Firehall Tributary has excellent potential for ecological enhancement with benefits to amphibians, waterfowl, juvenile salmonids, and small mammals. It is buffered from mainstem flooding and water quality and may provide a summer cold water refuge and has potential to provide water quality mitigation and stormwater attenuation via natural systems. Recommended work includes:

   a. Stormwater sediment removal from the Firehall bioswale (and ongoing sump maintenance in future).

   b. Yellow Flag Iris (*Iris pseudacorus*) control in the constructed wetland and potential replacement with cattail (*Typha sp.*)

   c. Adjustment of the pond level for optimal aquatic and riparian function (since the pond receives direct stormwater inputs, we recommend that flood prevention and biological treatment of deleterious substances be a priority. As noted in the Beaver Management Plan, a threshold elevation must be determined for this pond based on flood risk assessment).

d. River gravel addition to the incised channel below the firehall pond outlet for erosion protection and invertebrate habitat.

e. Partial or full removal of the old roadbed culvert and naturalization of channel.

f. Pond excavation and LWD addition below confluence with Old Firehall Tributary.

g. Riparian planting.

h. Step weirs in Old Firehall Tributary for oxygenation of ochre (iron oxide) drainage.

Figure 8: Conceptual Rendering of Firehall Tributary Pond Adjacent to Former Roadbed

9. **New Groundwater Habitat Features** – The stormwater main located between the Firehall Tributary and City Hall flows year-round with stormwater and groundwater from developed areas east of Noons Creek. A small, piped diversion from the nearest manhole to the riparian area may allow for construction of a larger and more complex trailside wetland pond (where saturation is presently occurring) and augment flow to the wetland seeps located north of the Firehall Tributary. Flow would be very moderate, likely similar to a garden hose. To buffer against potential negative water quality, some form of passive bio-filtration is recommended.

Figure 9: Conceptual Rendering of Trailside Wetland

10. **Mainstem Enhancement** – Opportunities for mainstem instream works are limited due to the confined channel, high flows, and erodible side slopes (see #17 below for longer term options). However, opportunities exist for protection of erosion nick points with bioengineering and boulders in some areas.

11. **Installation of an Educational Kiosk** – Interpretive and informational signage, combined with art and landscaping as a focal point where trails meet would be a community asset and could contribute to volunteer involvement and ownership. In addition, features such as a rain garden/pollinator zone in proximity to the educational kiosk can be incorporated to provide a transitional zone into the trail network.

A number of enhancement opportunities are longer term and tied to larger land use and/or infrastructure changes in the area. These works would help address key limiting factors in Lower Suter Brook Creek and include:

1. **New East-West Trail** – A new trail aligned to the south of the Firehall Tributary, connecting the existing trail to Ioco Road would allow additional viewing of the Firehall Tributary enhancements

while discouraging off-trail exploration. This trail would be narrower than the existing trail. Fencing would be essential for habitat protection. Future uses of City lands to the south would need to be considered.

2. **Rerouting of the Sanitary Sewer** – The sanitary sewer pipe that crosses Lower Suter Brook between City Hall and the Shoreline Trail creates an unnatural channel grade control within a reach that is periodically subject to sand deposits. By relocating the sewer, the channel gradient could be slightly increased to increase sand flushing and coarsen the substrates.
3. **Interception of Clean Groundwater** – The iron-rich water forming within the Old Firehall Tributary is likely caused by groundwater flowing through organic soil at or under the old Firehall site. If this property is redeveloped, interception of groundwater before flow through organic sediments and conveyance to surface and eventually Lower Suter Brook Creek should be investigated.
4. **Replace Murray Street Culverts** – The Murray Street culverts and headwalls are undersized and showing signs of structural failure. The current culverts surcharge during peak flows (pond water at the inlet) and create a high velocity erosive discharge at the outlet. In addition, there is no capacity for wildlife usage. We anticipate that this will also be a key recommendation in the ISMP.
5. **Repair or Replace Poorly Functioning Stormceptor** – The Stormceptor immediately downstream of Murray Street may be experiencing impaired performance based on observations of discharges over the past five years. Repair of this may be possible when the Murray Street culverts are replaced.
6. **Realign and Widen Lower Suter Brook Creek Channel** – The current channel location downstream of Murray Street is an artifact of the previous culvert at this location. The alignment along the Works Yard boundary impairs the riparian potential and the complexity in the channel is limited by the narrow width, steep, erosion prone slopes and lack of channel meander. If adjacent the property or properties are redeveloped and in tandem with replacement of the Murray Street culverts, realignment of the channel and trail could be considered to create a wider riparian corridor along with a more naturalized floodplain bench in the area. This more naturalized version would be more resilient to changing climatic patterns (e.g., more frequent storm flows), provide better stormwater management and treatment via natural infrastructure, improve ecological health through increasing available area for revegetation, and provide an example of community infrastructure that is adaptable, resilient, and serves multiple purposes (e.g., social, environmental, economic).

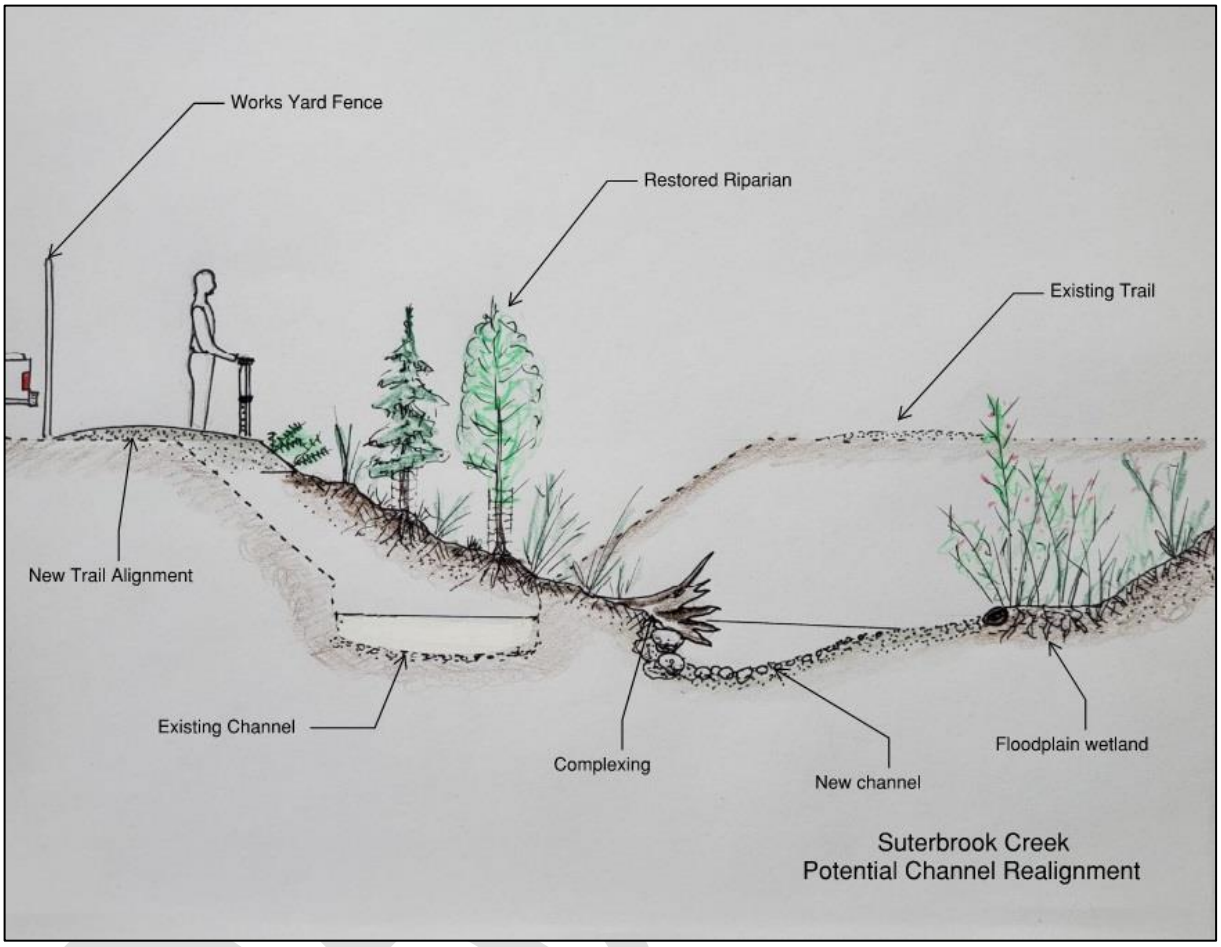
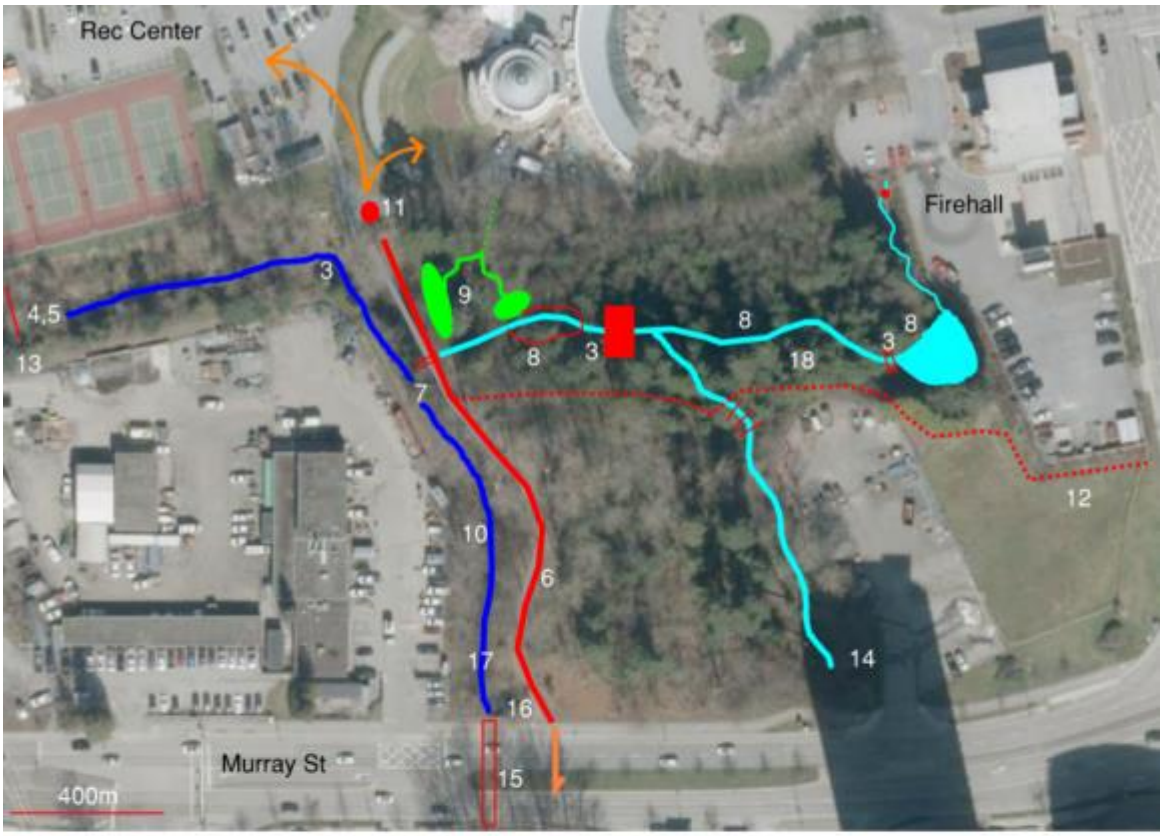


Figure 10: Conceptual View of Suter Brook Mainstem Re-alignment

7. **Wetland Delineation** – Delineating existing wetlands should be undertaken by the City if adjacent land development occurs (see Section 6.3 below).



SBC Enhancement Options (Short / Medium / Long Term)

1. Invasive plant control (throughout)
2. Enhancement planting (throughout)
3. Instream debris cleanup
4. Sanitary sewer crossing channel improvement.
5. Sanitary sewer fish passage improvement
6. Trail renovations
7. Fire hall tributary culvert replacement.
8. Tributary enhancements
9. Groundwater habitat
10. Mainstem enhancement
11. Educational kiosk
12. New east west trail
13. Rerouting of the sanitary sewer
14. Interception of clean groundwater
15. Replace Murray Street culverts
16. Repair stormceptor
17. Realign and widen SBC channel
18. Wetland delineation

Figure 11: Suter Brook Creek Enhancement Opportunities – Short/Medium/Long Term

6. Implementation

The opportunities identified above should be undertaken through a bottom-up/sequential approach, implementing priority actions from the lowest point of the system upstream. This approach will ensure linkages between enhancement and natural processes occur in succession and allow adaptive management to happen before implementation of new enhancement opportunities. It should be noted that removal of invasives and enhancement planting can occur at any time, and should occur regularly, regardless of implementation options. Enhancement planting should, however, consider upcoming projects to ensure that effort and resources are not wasted (e.g., areas needed for construction access are not re-planted).

For efficiency and planning purposes, it is recommended that enhancement opportunities identified above are "batched" (e.g., projects and/or components in one geographic area are completed at the same time) to reduce mobilization costs, impacts, and disturbance. In addition, projects should be undertaken in a logical order if the outcomes of one (i.e., adjustments in channel gradient) will potentially affect another. Enhancement opportunities have also been ranked in conjunction with batching as either short-term, medium-term, and long-term. Table 1 below provides an overview of the criteria.

Table 1: Time Horizons for Enhancement Implementation

Time Horizon	Timeline (Months)	Rationale
Short-term	6–12 months	Combination of ecological urgency, low/moderate costs, and immediate benefits. Most require minimal design or permitting.
Medium-term	12–36 months	Moderate to major ecological benefit, moderate costs. Require additional planning, design, minimal to moderate permitting, and capital funding. These projects include small-scale infrastructure improvements and ecological enhancements.
Long-term	36–60 months	Significant ecological benefit, moderate/high costs. Require additional planning, engineering, more involved permitting, and capital funding. These projects generally represent major infrastructure improvement projects and may be contingent on longer horizon land use and/or infrastructure changes.

6.1 Costs

Without detailed design, projected costs are difficult to assign in conjunction with current (2022) labour and supply unknowns. As a result, a high-level cost analysis or range is assigned to each potential opportunity. The table below provides an overview of projected cost ranking.

Table 2: Project Cost Ranking (in 2022 Dollars)

Cost	Symbol	Estimated Range
Low	$	$10,000 - 40,000
Moderate	$$	$40,000 - 200,000
High	$$$	$200,000+

6.2 Batched Enhancement Opportunities

Based on the research, assessments, conversations with City staff, and various stewardship groups, the following batch enhancement opportunities should be considered in sequential order.

Note that a detailed design is needed as a first step for most of the works described below, to ensure concepts can be implemented, input gathered, regulatory requirements met, and budgets secured.

6.2.1 Lower Reach

Time Horizon – Short Term

The lower reach of Suter Brook Creek includes the areas from the CPR RoW to the bend immediately downstream of the confluence with the Firehall Tributary. Actions in this area should include:

1. Removal of debris including **($)**:
    a. Metal plates and rebar.
    b. Organic debris* hung up on root mats and concrete; and
    c. Removal of flow control devices.

    **Utilize organic debris removed from channel to create upland refuge areas and hibernacula for small mammals and amphibians*
2. Sanitary sewer crossing enhancement (i.e., creation of rocky ramp) **($)** (sanitary crossing re-alignment should be considered, however, this is captured in longer term time horizon due to engineering requirements – see Appendix B).
3. Removal of invasive plant species **($)**.
4. Enhancement planting along the reach to supplement existing native vegetation and aid in suppressing invasive plant growth **($)**.

Enhancement in this lower section should occur in the short term and as a first step. As any enhancement will result in change, it is critical to understand these changes and adapt to them, before designing or implementing the next set of projects (e.g., Firehall Tributary). A forest health assessment is recommended prior to development of a comprehensive enhancement planting plan (for all areas).

6.2.2 Firehall Tributary

Time Horizon – Medium Term

The Firehall Tributary area includes the constructed wetland, Old Firehall Tributary, and the Firehall Tributary up to the confluence with Lower Suter Brook Creek including the trail crossing. Actions in this area should include:

1. Removal of invasive plant species **($)**.
2. Firehall Tributary culvert replacements **($)**.
3. Removal of old truck chassis **($)**.
4. Tributary enhancements including pond and wetland bench **($$)**.

5. Enhancement planting to supplement existing native vegetation and aid in suppressing invasive plant growth **($)**.

To minimize disturbance and optimize elements such as mobilization, monitoring, and construction phase water diversion, we recommend that all construction in this area occur as one project. To facilitate easy access and reduce impact, it should occur before trail fencing and resurfacing.

6.2.3 Trailside Wetland with Groundwater Input

Time Horizon – Medium Term

The trailside wetland includes the area adjacent to the existing trail (side) at the (north) extent of the site and extends to the confluence with the Firehall Tributary. Actions in this area should include:

1. Construction of trailside wetland **($$)**.
2. Groundwater input connection **($$)**.
3. Removal of invasive species **($)**.
4. Enhancement planting to supplement existing native vegetation and aid in suppressing invasive plant growth **($)**.

6.2.4 Trail and Park Entry Renovations

Time Horizon – Short, Medium, and Long Term

Trail renovations include all existing trails along with any new access or viewpoint and/or kiosk proposed. The alignment of the trail and anticipated renovations will need to be determined during detailed design but cannot be completed until after the tributary and wetland work noted above. Actions in this area should include:

1. Trail renovations including raising and/or boardwalk construction (in certain locations), relocating to maximize streamside setbacks (where possible), fencing, and creation of observation platforms **($ - $$$)**.
2. Installation of kiosk and interpretive signage **($$)**.
3. Rain garden or pollinator zone at entrance **($$)**.

6.2.5 Upper Reach

Time Horizon – Short, Medium, and Long Term

Upper Suter Brook Creek extends from immediately below the Firehall Tributary confluence to Murray Street. Actions in this area could include:

1. New East-West Trail (protecting Firehall Tributary) (Med/Long term - **$$ - $$$)**.
2. Replace Murray Street Culverts (Long term - **$$$**).
3. Mainstem repair/enhancement (Short/Medium term - **$ - $$**).
4. Repair or replace dysfunctional Stormceptor (Short/Medium term - **$$**) (also see Section 6.3.3).
5. Realign and widen Lower Suter Brook Creek channel (Long term - **$$$**).

6. Removal of invasive species (**$**).
7. Enhancement planting to supplement existing native vegetation and aid in suppressing invasive plant growth (**$**).

Note that consideration should be given to the location of planting areas if the realignment and widening of this upper reach is anticipated.

6.3 Additional Investigations

Additional investigations will provide information (e.g., data, trends, etc.) and guidance for future planning. The time horizon and costs associated with these miscellaneous projects may vary based on numerous factors including funding, availability of staff, and resources.

6.3.1 Wetland Delineation and Streamside Setback Updates

A streamside setback update memorandum was produced by Hemmera in 2017. The purpose of the memorandum was to identify streamside setbacks associated with Lower Suter Brook Creek and two of its tributaries based on the provincial Riparian Areas Regulation (RAR). Since the memorandum in 2017, the RAR was replaced with the Riparian Areas Protection Regulation (RAPR) in 2019. While changes were made, the overall assessment process remains consistent with the RAR. No formal submission under the RAR was submitted at the time of the assessment.

The wetlands within the existing project area do not appear to be captured in the 2017 assessments, likely a result of changes in the project area since 2017. In its current state, a revised setback assessment should occur as the 2017 results are now inaccurate and not valid. It should also be noted that the Hemmera report referenced that the watercourse locations presented in ViewPort, the City's online mapping system, were not accurate and survey would be required to accurately delineate the Streamside Protection and Enhancement Areas (SPEA) (Hemmera, 2017).

6.3.2 Storm Infrastructure Investigation

Stormwater runoff deleteriously affects water quality in urban streams impacting lower trophic level productivity, carrying acutely toxic substances, and degrading the natural state of watercourses. Given some of the observations along with anecdotal information from City staff and stewardship groups, we recommend that the City perform a detailed inspection of stormwater infrastructure that discharges to Lower Suter Brook Creek, in particular the Murray Street Stormceptor. Specialized equipment such as Closed-Circuit Television (CCTV) inspections can provide insight into potential infrastructure issues, including sanitary cross-connections. This work should be included in recommendations from the ISMP.

6.3.3 Data Assembly and Collection

This task includes collating all existing information and data for Suter Brook Creek and completing a gap analysis to inform future data needs. This may include but not be limited to compiling available water quality data, fish and animal utilization, an inventory of trees and plants in the area, and repositing it into a database (e.g., GIS). Additional components for consideration may include:

1. Installation of data loggers (e.g., temperature, water levels, etc.) at select locations.
2. Formalized adult spawner surveys.
3. Formalized bird counts.

4. Photo-point monitoring.
5. Formalized invasive plant mapping and monitoring.
6. A detailed topographic survey of the area and infrastructure (see Section 6.3.1).
7. Others as directed by community interests.

6.3.4 Monitoring and Maintenance

Monitoring is an essential component of the adaptive management cycle and will be critical in implementing effective enhancement opportunities now and in the future. Many or most of the options presented above should be monitored as part of the adaptive management cycle to identify trends and learn from any of the enhancement opportunities. This monitoring, learning, and understanding will be critical to inform management/future implementation decisions and when or when not to alter approaches. Monitoring should occur prior to, during, and after implementation of any enhancement opportunity to evaluate success and also inform requirements for regular or routine maintenance. Components of the monitoring program may include but not be limited to:

- annual spawner surveys;
- inventories of invasive species;
- monitoring of restoration planting survivorship and success;
- fish presence and utilization monitoring (e.g., various life stages);
- presence of instream debris, including accumulation of sediment for annual removal during instream work windows;
- biannual visual inspections to look for beaver sign (e.g., gnawed trees, dams, visuals) and check water levels (as recommended in Beaver Management Plan);
- routine water quality monitoring (e.g., AMF sampling and follow-up investigations, instream water loggers);
- installing and inspecting staff gauges for water level inspection and measuring flow;
- regular stream inspections to identify any morphological changes;
- regular inspection/review of plant/tree health in the area; and
- inventories/visual observations of wildlife utilization.

7. Regulatory Considerations

Works in and about water are regulated by the provincial and federal governments and may, at times, be governed by municipal bylaws or development permits. However, with the exception of significant channel relocation or culvert works, the majority of concepts detailed within this report are likely to be relatively routine. Local governments may proceed by way of the *Water Sustainability Act* (WSA) Notification for most of the short- and medium-term instream works; larger and longer horizon opportunities such as realignment of the upper reach or replacement of the sanitary sewer would require a WSA Change Approval for Works In about a Stream. A DFO Request for Review for any project that interfaces with fish and fish habitat will also be required. In all cases, technically sound and well-developed plans, following best management plans and mitigation practices, should move through regulatory review without objection.

The table below provides a list of relevant legislation, governing bodies, and considerations for any enhancement opportunity.

Table 3: Applicable Regulations and Regulatory Considerations

Legislation	Agency	Consideration
Fisheries Act (FA)	Fisheries and Oceans Canada	Any enhancement opportunity that interfaces with fish and fish habitat is potentially subject to review under the FA (e.g., Request for Review – RFR). It is not anticipated that any opportunity proposed would result in an authorization request from DFO. *RFR timelines ~ minimum of 60 days lead time.*
Migratory Birds Convention Act	Environment and Climate Change Canada	Any tree or brush clearing should be conducted outside of the bird nesting period (as also reiterated in City of Port Moody Tree Management Policy, Birds Nest Protection Policy, Development Permit Area 4 Guidelines).
Species at Risk Act	Environment and Climate Change Canada	Protects listed Schedule 1 species and their critical habitat. During desktop review, six SAR occurrences were identified within 3 km of the project area. These occurrences range from the late 1800s to as recently as 2019. Consideration for SAR and species of conservation concern have been considered in options presented and should be considered for any other enhancement option developed. During regulatory submission, a detailed review of SAR and any permitting requirements should occur.
Water Sustainability Act	Ministry of Forests	Regulates activities being carried out in and about a stream. Authorized changes in and about a stream listed in Part 3 of the Water Sustainability Regulation can generally be undertaken under Notification “low-risk changes in and about a stream that has minimal impact on the environment or third parties”. *Typical notification timelines ~ 45 days.* For any other projects, a Change Approval is required. Change Approvals are written authorization with conditions attached to make complex changes in and about a stream. *Typical approval timelines ~ 12–18 months.*

Legislation	Agency	Consideration
Weed Control Act		Requires landowners to control the spread of noxious weeds on their lands. Knotweed species are identified as noxious weeds and have been treated by the City in the project area. Special care may be needed if excavation is happening in areas with knotweed infestations.
Wildlife Act		Protects most vertebrates from direct harm, harassment, and disturbance, including bird eggs and nests. Any tree removal will need to confirm presence of nests protected under the Wildlife Act (if required). Salvage permits under the Wildlife Act will be required for instream works. *Typical timelines ~30–60 days.*
Riparian Areas Protection Regulation	Ministry of Environment & Climate Change Strategy	Directs local government to protect riparian areas during new residential, commercial, and industrial development. Project work would not be considered development and is on public land, but City projects aim to follow the intent of existing regulations. Wetland setbacks will need to be determined. Existing trails should be shifted outside RAPR minimums where possible or demonstrate environmental gain.
Zoning Bylaw	City of Port Moody	Provides setbacks for development near watercourses, including ditches. Project work would not be considered as development and is on public land, but City projects should follow the intent of existing regulations. Trail and creek crossings will occur within the 20 m Riparian Protection and Enhancement Area for Suter Brook Creek, as defined in the Zoning Bylaw. Wetland setbacks will need to be determined. All setbacks should aim to meet RAPR minimums as a best practice or demonstrate net environmental gain.
Stream and Drainage System Protection Bylaw	City of Port Moody	Prohibits discharge of prohibited substances. Any enhancement opportunities will need to implement measures to prevent erosion and discharge of sediment-laden water to receiving environments, and an erosion and sediment control plan should be developed.

Legislation	Agency	Consideration
Official Community Plan	City of Port Moody	Supports OCP goals, including: • 6.5 (13) – The City will continue its efforts to restore and enhance habitat based on community priorities and available resources, particularly in areas of the City where natural areas have been modified or ecological functions have been impaired. Of particular relevance are access for fish populations, the restoration of watercourses and riparian vegetation and the daylighting of creeks. • 6.13 (51) – The City will manage Streamside Protection and Enhancement Areas by avoiding the disturbance of soils and the creation of impervious surfaces within the riparian area. Impacts will be strictly limited or mitigated by: retaining or replanting or maintaining vegetation in riparian protection and enhancement areas to meet fish protection objectives; and avoiding the placement or creation of harmful substances in streamside protection areas. • 6.13 (53) The City of Port Moody shall strive to manage all Class A and B natural watercourses as open streams (no culverting). Any proposals for culverting or realignment of streams shall require approval from applicable authorities, in addition to City Council. • 6.13 (55) – The City will encourage the restoration of natural habitats to enhance ESAs, particularly those which are under City control. • 6.13 (56) – The environment and habitat of all fish-bearing watercourses shall be maintained in order to protect them as fish-bearing watercourses.
Development Permit Area 4: ESAs	City of Port Moody	Helps ensure the City is meeting all senior regulations, best management practices, and other City directions. Work would not be considered as development and is on public land, but City projects aim to follow the intent of existing regulations.
Tree Management Policy	City of Port Moody	Outlines the process for tree removal and replacement on City lands. Detailed design should identify trees to be removed and replacement requirements. Retain LWD and wildlife trees.
Bird Nest Protection Policy	City of Port Moody	Restricts tree and brush removal to outside of the general nesting period (March 1 – August 31)
Naturescape Principles Policy	City of Port Moody	Identifies principles that should be incorporated into landscaping in and around ESAs, including invasive plant removal, retention of LWD and wildlife trees, use of native plants for wildlife habitat, etc.
Climate Action Plan	City of Port Moody	Outlines community-wide actions to help the City and its residents adapt to climate change and reduce greenhouse gas emissions. Actions include projects to protect, restore, and connect ESAs, which is the overall goal of the Lower Suter Brook Enhancement Plan.

Legislation	Agency	Consideration
Beaver Management Plan	City of Port Moody	Advises the City on how to manage existing and potential future beaver populations on City lands and provides a decision-making framework for taking appropriate actions in response to beaver activity. Detailed designs for the project area should be vetted against considerations in this plan to ensure beaver habitat is enhanced where suitable and co-existence is supported (e.g., vegetation type, fencing type, culvert protection considerations, potential for flow levelling devices).
ESA Management Strategy (2003)	City of Port Moody	The following ESA Management Strategy management objectives for Lower Suter Brook Creek should be considered: • Protect forested nature of the site through tree retention. • Prevent the introduction of non-native plants and fish. • Protect integrity of creek.
Parks and Recreation Master Plan	City of Port Moody	Aligns with the following goals and objectives: • 1(c) Protect and celebrate nature as a destination. • 1 (e) Support and encourage stewardship and nature education.

8. Local Stewardship

Local stewardship groups and volunteers in Port Moody have been involved in the protection and enhancement of Suter Brook Creek for many years, including Port Moody Ecological Society, Burrard Inlet Marine Enhancement Society, and Burke Mountain Naturalists. Continued community involvement and stewardship will be critical to the success of the enhancement actions proposed in this report. A well-informed volunteer group can assist with data collection and monitoring (Section 6.3.4), and, with experience, begin to initiate projects and apply for funding. They can also fulfill a valuable liaison role between the public and City staff.

Volunteer roles can be diverse and range from energetic weed pulls to passive bird counts. Integration of students into the area can range from guided visits to senior-level capstone projects. In all cases, there are opportunities for community building and development of a sense of ownership and pride in the natural area that remains within a dense and growing neighbourhood.

Committed volunteers and educated park users can fulfill a valuable role in protecting natural and civic assets by observing and reporting issues such as illegal storm sewer dumping, erosion, dangerous trees, and fires. They are motivated to protect “their park”.

Local examples of integration between municipalities, environmental non-governmental organizations (ENGOs) and students in nature-based initiatives can be found in the Township of Langley and City of Surrey. Langley Environmental Partners Society (LEPS) and Salmon Habitat and Restoration Program (SHaRP) may provide models for future initiatives within the City of Port Moody.

9. Potential Grant Opportunities

Some potential sources of initial project funding that have been identified include:

- EcoAction Community Funding Program (Environment and Climate Change Canada) – funds projects which encourage Canadians to take action to address clean air, clean water, climate changes, and nature issues, and to build the capacity of communities to sustain these activities into the future.
- Habitat Stewardship Program for Species at Risk (Environment and Climate Change Canada, Fisheries and Oceans Canada) – provides funding to stewards for implementing activities that protect or conserve habitats for species at risk and for priority species that are not at risk to prevent them from becoming a conservation concern.
- National Wetland Conservation Fund (Environment and Climate Change Canada) – supports projects that restore degraded or lost wetlands, enhance degraded wetlands, scientifically assess, and monitor the health and functionality of wetlands and the species that use them, and encourage stewardship and wetland appreciation by a wide variety of partners to build support for future wetland conservation and restoration activities.
- Environmental Damages Fund (Environment and Climate Change Canada) – supports the restoration of natural resources and environment, and wildlife conservation projects in the same geographic area where environmental damage has occurred, and funds were received as compensation for that damage.
- Habitat Conservation Trust Foundation (HCTF) – fund projects that focus on freshwater wild fish, native wildlife species and their habitats, have the potential to achieve a significant conservation outcome while maintaining or enhance opportunities for fishing, hunting, trapping, wildlife viewing and associated outdoor recreational activities.
- Pacific Salmon Foundation (PSF) – makes grants to organizations that undertake Pacific salmon conservation and restoration or science and research.
- Federation of Canadian Municipalities (FCM) – funding program with a variety of funding streams for Pilot Projects, Studies, Capital, and Planning Projects.
- Infrastructure Canada (Natural Infrastructure Fund, Green Infrastructure funds) are available to support enhancement of natural assets and hybrid infrastructure.

Report Submission

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Statement of Limitations

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Revision History

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B	September 9, 2022	Final Draft		EB
A	June 24, 2022	Draft	Issue for client review.	EB

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consulting engineers

Appendix A

Photographs

Appendix A - Photographs

Photo 1: Linear channel morphology observed in Lower Suter Brook Creek

Photo 2: Murray Street culverts submerged during February 11, 2022 field visit

Appendix A - Photographs

Photo 3: Recent planting near Murray Street (February 11, 2022)

Photo 4: View of remnant beaver dam upstream of CP RoW (February 11, 2022)

Appendix A - Photographs

Photo 5: Concrete box culvert under shoreline trail (February 22, 2022)

Photo 6: View of remaining portions of metal fishway (left bank) taken February 11, 2022

Appendix A - Photographs

Photo 7: Firehall tributary crossing of trail

Photo 8: Firehall pond and leveler intake (February 11, 2022)

Photo 9: Deteriorated culvert conveying the Firehall tributary (February 11, 2022)

Photo 10: Old Firehall tributary and ochre observed in the winter of 2022

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Appendix B

Options Evaluation Matrix

Batch	MAP #	OPPORTUNITY	Rationale	HABITAT TYPE	REGULATORY	TIME HORIZON	DESIGN	CONCEPT FIGURE #	COST	Comments
Lower Suter Brook Creek	4,5	Imprcve sewer crossing fish passability	Invert elevation of sanitary sewer impacting channel morphology and creating erosion potential, impacting riparian corridor and natural processes.	Fish + wildlife	WSA Notification + DFO-RFR	Short - Long	Design required for longer-term lowering project	5	$-$$	Sewer realignment/reconfiguration requires Eng. Design (Long-term). Grade control reconfiguration can be concept/field fit if survey data is not available.
	3	Removal of instream debris (e.g.,flow control devices)	Remove/reduce obstructions, flow control devieccs no longer in use or required. May present a debris catcher and result in erosion and/or blockage of the stream.	Aquatic	WSA Notification + DFO-RFR	Short term	N/A		$	Limited impact and cost to remove debris and structures. Should be stored and readily available should the need for re-installaton occur.
	3	Repair and replant north slope of creek (remove invasives)	Most trees dead, channel very confined and incised.	Riparian + fish	WSA Notification + DFO-RFR	Short term	Minor slope treatment, planting plan		$	Any significant regrading would likely require Geotech input and should be avoided wherever possible. Plan should include utilizing existing dead trees for wildlife trees and or wildlife structures.
	5	Amphibian + reptile hibernacula	Ecosystem approach, utilize logs removed from lower section to create rock/log piles.	Terrestrial - amphibian/small mammals	N/A	Short term	Concept design		$	Material should be strategically placed to provide both cover and basking opportunities.
	1,2	Invasive plant species removal, understory and conifer interplanting (throughout area)	Riparian and forest areas being overtaken, conifers needed for shade and succession	Multi	N/A	Short - Long	Species plan		$-$$	Mimic species present on site and in adjacent areas. Current and future use should be considered when selecting species composition for any given area.
	all	Bird/Bat boxes	Opportunity to enhance other species, provide educational opportunities through signage etc…	Terrestrial - birds, small mammals	N/A	Short term	N/A		$	Develop plan with community groups to build and install, species specific requirements required for boxes and target species
Firehall Tributary	6	Relocate north portion of trail and replace tributary culvert	Present alignment may flood and limits riparian width, culvert may be fish barrier.	n/a - adjacent terrestrial and aquatic	WSA Notification + DFO-RFR	Med term	Eng. required	7	$$	Culvert recommended. Clear span bridge required to avoid WSA approval and lengthy timelines. Due to flood prone areas, a large clear span would likely be required to avoid abutments/footings below average HWM resulting in significant costs. Engineering requirements for bridge crossing likely more significant then an oversized box culvert. Trail relocation and or constrcution of new trails should be planned in accordance with restoration works.
	8	Enhance wetland bench	With micro-channels, existing skurk cabbage and sedge bench could be improved juvenile habitat.	Fish, amphibian		Med term	Design required		$	This includes enhancing wetland plant species, adding complexity in the form of woody debris and creating small dendritic channels within the bench area.
	8	Impound / excavate tributary, complex	Improve and expand overwintering habitat.	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med term	Design required	8	$$	Formalize tributary complex to include, a diversity of habitat types, including riffle, pool, pond. Add LWD, substrate supplements and riparian planting.
	3	Culvert removal – tributary (old truck chassis)	Naturalize stream corridor and increase productive area.	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med term	Design required		$$	Remove old culvert and truck chassis, formalize natural channel through area.
	14	Aerate ochre stream	Improve WQ.	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med term			$	Crest cascaces/turbulence within channel to aerate and treat organics in the small stream. Should be planned in conjuntion with adjacent land redevelopment.
	3,8	Adjust pond level for optimal aquatic and riparian function	Optimize pond elevaticn for WQ gain and ensure permanence of it.	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med term	Design required		$$	Appropriate water levels to be developed to accommodate static conditions along with storage. As per Beaver Management Plan, a thrieshold elevation must be determinedfor this pond based on flood risk assessment.
	1,2,8	Vegetate pond (pond beside fire hall)	Plant Typha latifolia for WQ benefits, remove invasives (e.g., YFI)	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med term	Planting plan		$	Remove invasives and plant species for WQ attenuation. Enhance area to provide habitat for avian, amphibian and small mammals through addition of adjacent planting to bolster canopy, understory and ground cover.
	8	Reconfigure inflow with sediment sump and flow spreaders (adjacent to fire hall)	Road grit flowing into pond.	Aquatic/Terrestrial - Fish, Amphibian, small mammal, bird		Med term	Design required		$$	Create a capture area/velocity diffusion at outlet to trap sediment prior to discharge into pond.
	1,2	Invasive plant species removal and conifer interplanting (throughout area)	Riparian and forest areas being overtaken, conifers needed for shade and succession	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird	N/A	Short - Long	Species plan		$-$$	Species composition to mimic existing native tree and plant species in area. Current and future use should be considered when selecting species composition. Upland area should consider conifer species with lower lying areas utilizing moisture tolerant species.
Trailside Wetland	10	Trailside wetland	Existing wet area with good proximity for viewing, habitat for other species (amphibians etc..).	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird	WSA Notification + DFO-RFR	Med term	Eng. required, grading and re-veg	10	$$	Potential recipient of diverted low flow stormwater. Depth + seasonality TBD
	10	Low flow pipe from storm system to the north	Divert water for beneficial use / bioremediation, supplement low flows.	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird		Med - Long	Eng. required		$$	Divert small amount of groundwater from existing culverted system; likely to attenuate warm summer pond/stream temperatures. Inlet bioswale or primary treatment may be required.
	1,2	Invasive plant species removal and conifer interplanting (throughout area)	Riparian and forest areas being overtaken, conifers needed for shade and succession	Aquatic/Terrestrial - Fish, amphibian, small mammal, bird	N/A	Short - Long	Species plan		$-$$	Species composition to mimic existing native tree and plant species in area. Current and future use should be considered when selecting species composition. Upland area should consider conifer species with lower lying areas utilizing moisture tolerant species.
	6	Trailside fencing	Riparian area protection, gain some riparian area by narrowing to minimum width wherever possible.		N/A	Med - Long	Design required	6	$$	Trailside fencing to enclose trail and prevent access/egress to environmentally sensitive area; viewpoints to be incorporated to provide access to areas.
	6	Renovate trail with alcoves rather then internal trail network, options for elevated boardwalk	Maintains ecological internal integrity in inner zone but provides access and viewing areas (e.g., fire hall pond, trail pond and wetland).			Med - Long	Design required	6	$$$	Review trails network and renovate with alcoves for viewing and maintenane access. Opportunites for elevated baordwalk in lower area should be reveiwed for feasibilty.
	4,5	Viewing platform in lower reach (upstream of railway)	Chum spawning reach to provide viewing without disturbance to riparian area.			Med - Long	Eng. required	6	$$	Potential to add viewpoint overlooking linear stretch of channel to allow park patrons to observe spawning, and other natural features including wildlife trees, cavity nesters etc… could also de designed to provide routine maintenace access.

Batch	MAP #	OPPORTUNITY	Rationale	HABITAT TYPE	REGULATORY	TIME HORIZON	DESIGN	CONCEPT FIGURE #	COST	Comments
Trails and Parks	**12**	Create park entry feature including rain garden and pollunator zone/features	Focal point for park users with potential eco-educational components. Transition/buffer from grass to forest, WQ, pollination etc..	N/A	N/A	**Med term**	Concept Plan then sub to LA		**$$**	Park entry feature can be designed in collaboration with community groups and provide a sense of ownership to the area. Can include an artistic feature and/or information regarding Lower Suter Brook Creek history etc.. Could connect roof and parking lot runoff from adjacent areas
	6	Works Yard fence retrofit (cloth, inserts or new fence) and grub out blackberry roots	Provide artificial shade to reduce blackberry growth and intrusion through fence.		N/A	**Short - Med**	N/A		**$**	Low cost option that can be implemented at anytime. Should occur in conjunction with blackberry removal.
	1,2	Invasive plant species removal and conifer interplanting (throughout area)	Riparian and forest areas being overtaken, conifers needed for shade and succession	Multi	N/A	**Short - Long**	Species plan		**$-$$**	Species composition to mimic existing native tree and plant species in area. Current and future use should be considered when selecting species composition. Upland area should consider conifer species with lower lying areas utilizing moisure tolerant species.
	9	New East -West Trail	Trail connecting the east and west and perimeter access		N/A	**Med - Long**	Design required			Trail would eliminate access/egress into environmentally sensitive areas and connect the internal trail network to other areas of Lower Suter Brook Creek .
Upper Suter Brook Creek Reach	**15**	Murray Street culvert renewal	Culverts likely undersized, too deep, timber headwalls rotting, causing erosion d/s, vulnerable to debris blockage	Fish (wildlife if configured)	WSA Change Approval + DFO-RFR	**Long term**	Eng. required		**$$$**	Tie into ISMP; this is a big ticket item but important. Ideally, nothing else would be contingent on this item because it is such a big project and probably longer term. Raise invert elevation to improve d/s channel grade (conflicted with other utilities?)
	17	Relocate/rebuild channel from Murray Street to tributary	existing channel straight, incised, and eroding with limited riparian on west	Multi	WSA Change Approval + DFO-RFR	**Long term**	Eng. required	**10**	**$$$**	Very large project requiring engineering, planning and regulatory review.
Miscellaneous	**16**	Storm infrastructure investigation	Camera infrastructure to identify potential cross-connections and sources of pollution		N/A	**Short term**	N/A		**$**	Potential link to ISMP
	all	Data assembly/collection	Data will be utilized to assess success or failure of any enhancement undertaken. Also utilized to assess trends over time	N/A	N/A	**Short - Long**	N/A		**$**	Port Moody has a significant amount of data for the area and watershed. Gap analysis required to identify any limitations of existing data.
	8	Wetland delineation	Setback/development implications.		N/A	**Short term**	N/A		**$**	Anything related to this should also note that should development proceed and encroach on existing wetland setbacks, compensation would be required. GW impact also needs investigation

		$ = 10-40K	**$$ = 40-200K**	**$$$ = 200K+**						
		Short Term : 6-12 months	**Medium Term : 12-36 months**	**Long Term : 3-5 years**						

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Appendix C

Enhancement Planting Considerations

Revegetation Considerations

SBC is located in the Coastal Western Hemlock (CWH) biogeoclimatic zone:

The CWH is, on average, the rainiest biogeoclimatic zone in British Columbia (Table 4). The zone typically has a cool mesothermal climate: cool summers (although hot dry spells can be frequent) and, like the Coastal Douglas-fir zone (CDF), mild winters (Figure 19). Mean annual temperature is about 8°C and ranges from 5.2 to 10.5°C among the CWH subzones. The mean monthly temperature is above 10°C for 4-6 months of the year. The mean temperature of the coldest month is 0.2°C and ranges from -6.6 to 4.7°C among the subzones. Mean annual precipitation for the zone as a whole is 2,228 mm, and ranges from 1,000 to 4,400 mm (and probably more in some areas). Less than 15% of total precipitation occurs as snowfall in the south, but as much as 40-50% in the northern parts of the zone (BC Ministry of Forests , 1991).

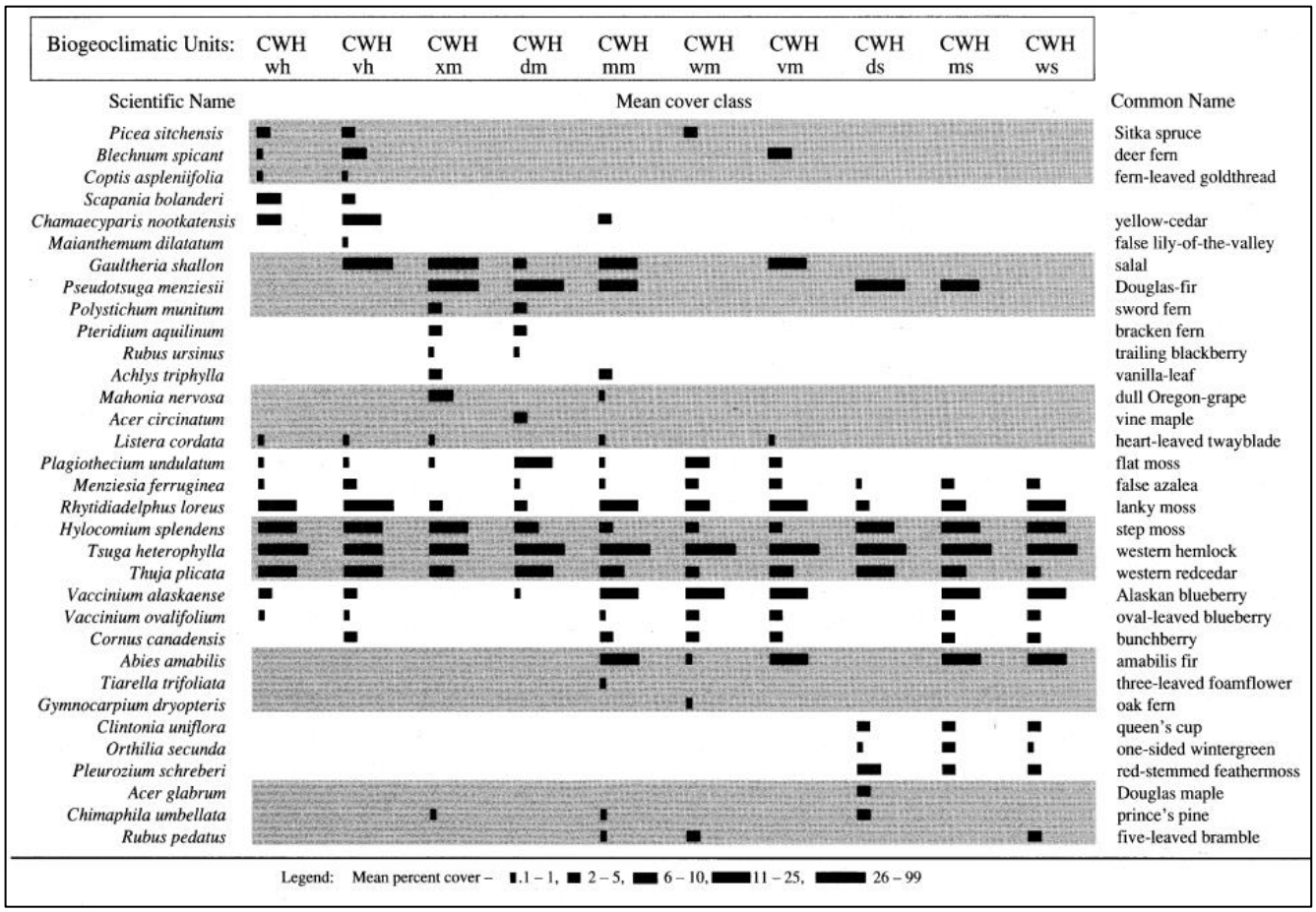
The vegetational composition of the study area has likely been disturbed multiple times from original logging through various stages of urban development. Currently, the forest canopy is still successional in character with a high prevalence of red alder, western hemlock and correspondingly low amount of western red cedar and Douglas fir. It likely is also influenced hydraulically by stormwater infrastructure and soil removal and/or compaction associated with past land use. For these reasons, it may not show the full complement of typical CWH understory shrub development. Deficiencies of well-rotted coarse wood and heavy foot traffic may be particularly injurious to mosses that otherwise characterize the zone.

It should be noted that there are ten sub-variants of the CWH that differ based on annual precipitation and proximity to the marine coast. Tree species such as shore pine, yellow cedar, and mountain hemlock may only occur at the extreme variants and caution should be exercised in plant selection for CWH without knowledge of site-specific conditions. Insight may be gained by observations of successful species within close proximity to SBC that have not been as highly disturbed. The forest immediately downstream of the culverts (railroad and shoreline trail) or ravines upstream may be appropriate.

Revegetation with long-lived tree species should consider the impacts of climate change (e.g., seasonal variations). Predictions for future weather trends include warmer, wetter winters and drier, hotter summers. Moist ground conditions around wetlands may mitigate summer drought but the adaptability of species should be considered. Western red cedar has been notable in its dieback locally after successive summer droughts. However, in locations with moist ground, such as wetland fringes, it has not declined. Microsite conditions may provide refuges during climate change for species that would otherwise not survive.

Planning for climate change will require a thorough understanding of tree species habitat requirements, vulnerabilities, and methods to mitigate these, through modification of rooting conditions, moisture availability, and planting location. Where mitigation is not possible, utilizing species that are more prevalent in a dryer sub-variant of CWH may have potential for success. In sites that are highly variable, a “shotgun” approach with a diverse selection of species, small sizes, and high numbers (and the awareness that some may not survive), may be advisable.

Successional processes may also play a role in climate change resilience for trees. Succession is the natural cycle in which hardy and adaptable pioneer species, such as red alder, precede and prepare the ground for transitional and climax conifers. They do this by amending soils with organic matter (litterfall, roots and eventually rotting wood), fixing atmospheric nitrogen and establishing vast networks of symbiotic fungus. During the period of pioneer dominance, sapling conifers may appear suppressed but are benefiting from shade and shared nutrients via the fungal network. With pioneer tree decline and death, conifers have developed deep roots within an improved soil structure and likely possess superior health and resilience, compared to seedlings planted in bare ground.



Vegetation of the Coastal Western Hemlock Zone
Source: **(BC Ministry of Forests, n.d.)**