Seymour Salmonid Society

Lower Seymour River Visionary Masterplan



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nhc northwest hydraulic consultants

LEES + ASSOCIATES

Lower Seymour Visionary Masterplan
July 2025

FINAL

Acknowledgements

The creators of this report respectfully acknowledge the original peoples of these lands and waters, specifically the səlilwətaɬ (Tsleil-Waututh), Sḵwx̱wú7mesh Úxwumixw (Squamish), and xʷməθkʷəy̓əm (Musqueam), on whose unceded ancestral lands the Seymour River and Estuary is located. We value the opportunity to learn, share, and serve our community on these unceded lands.

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1.0 Introduction

This project takes place in Ch'ich eliwxih: the area including Mt. Seymour watershed and the village at the mouth of the Seymour River and specifically focuses on the lower Seymour River from the Seymour Parkway Bridge down to and including the estuary. The Seymour River, estuary, and adjacent lands have been severely impacted by land uses and industrial activity. The loss of estuary habitat, channel straightening, and the creation of the dam at Seymour Falls have all significantly impacted salmonids. While some habitat improvements have been made in recent years, such as planting native species and establishing a saltwater wetland, much more can be achieved through collaboration and the assistance of partners.

The project process included visioning workshops with the Society board and staff, engagement with First Nations, government agencies, and conservation groups, many of whom have been long-term partners of the Society. Local consultants Northwest Hydraulic Consultants Ltd. (NHC) and LEES+Associates provided technical expertise and facilitation. The resulting Visionary Masterplan identifies eight potential enhancement projects on the lower Seymour River and estuary and considers the benefits of each project for salmonids, overall biodiversity, and the community, as well as the priorities and practical considerations of rights holders, stakeholders, and partners.

Who We Are

The Seymour Salmonid Society (the Society) works to enhance salmon and steelhead populations and encourage sustainable management of fisheries in the Seymour River. Our mission is to educate our community about the value of the Seymour River and the salmonids it supports as a resource for everyone. We have worked on habitat protection, creation, and rehabilitation efforts for nearly three decades. Together with partners, we have helped create over 40, 000 square meters of habitat on the Seymour River. An overview of successful projects implemented in the area is included in Figure 1, some of which include rock slide mitigation and estuary restoration.



Figure 1: Projects Completed in the Seymour Estuary

2.0 Vision and Objectives

- Supporting salmonids
- Supporting fish migration
- Supporting biodiversity and habitat gains
- Developing partnerships with First Nations, community groups, government agencies, and conservation groups
- Supporting opportunities for people to experience and learn about nature

2.1 Vision

To restore a complete and interconnected river system that facilitates fish migration, enhances biodiversity, and improves habitats to support salmonids and other aquatic species throughout different stages of life. To create diverse habitats, foster meaningful partnerships with First Nations, government agencies, and conservation groups, and provide opportunities for the public to experience and learn about nature — ensuring a sustainable and resilient ecosystem for future generations.

2.2 Objectives

Habitat restoration efforts aim to establish continuous and interconnected habitats from the estuary to the lower river. These initiatives prioritize ensuring fish passage, providing sufficient cover, and supporting food sources such as benthic invertebrates, falling insects, and leaf litter. Developing diverse habitat types is critical to meeting the ecological needs of both salmonids and their food sources, thereby improving overall biodiversity and ecological resilience. Protecting water quality is also a key objective, with a particular emphasis on implementing measures to treat urban and industrial runoff before it enters the river system. Additionally, restoring and expanding native vegetation will further contribute to the long-term health and sustainability of the watershed.

The proposed projects are guided by a cohesive and comprehensive vision for the lower Seymour River that integrates urban planning and landscape design. This approach aims to connect the public to nature while minimizing disruptions to existing users. The projects outlined in this plan are compatible with a phased implementation strategy, allowing individual components of a project to be completed as funding becomes available.

The long-term monitoring and maintenance of projects is key to achieving a healthy and interconnected river system. All the projects, particularly the constructed wetlands, will be most effective with ongoing adaptive management and invasive species removal. To support this approach, lessons learned from completed projects should inform future initiatives. Collaborating with local communities and First Nations is essential to ensure observations are communicated, recorded, and incorporated into both new projects and the maintenance of existing ones.

3.0 The Seymour River

3.1 Physical and Ecological Characteristics

The lower Seymour River extends 19 kilometers downstream from the Seymour Falls Dam to Burrard Inlet (DFO, 1997). For much of this distance the river flows through a flat-bottomed valley bordered by steep bedrock slopes before transitioning to a lower-gradient reach below Mount Seymour Parkway (DFO, 1999). The river was classified as endangered by Precision Identification Biological Consultants (PIBC) as part of the Fisheries and Oceans Canada (DFO) 1997 Fraser River Action Plan and faces challenges such as water diversion, a water supply dam, urbanization, and channel modifications. Addressing these issues requires a multifaceted approach that considers the historical context, urban development pressures, and climate change considerations.

Despite historic and ongoing impacts, the lower Seymour River retains promising habitat potential for salmonid spawning and rearing, with over 50 tributaries located below the dam (DFO, 1999). The upper Seymour River watershed is classified by PIBC as wild and protected for water supply (DFO, 1997). It is inaccessible to natural upstream migrating species due to the presence of the Seymour Falls Dam; however limited releases of salmon fry and adult salmon and steelhead are undertaken annually by the Society. For example, in 2024, a total of 334 adult coho salmon, 19 adult summer run steelhead and 27,000 hatchery-raised coho salmon juveniles were transported upstream of Seymour Falls Dam (Metro Vancouver, 2024).

In 2014, a natural rock slide severely restricted fish passage approximately 5km upstream from the estuary, compounding the challenges for habitat connectivity and restoration. Fish passage through the slide site was largely restored following a multi-year mitigation and monitoring program led by the Society.

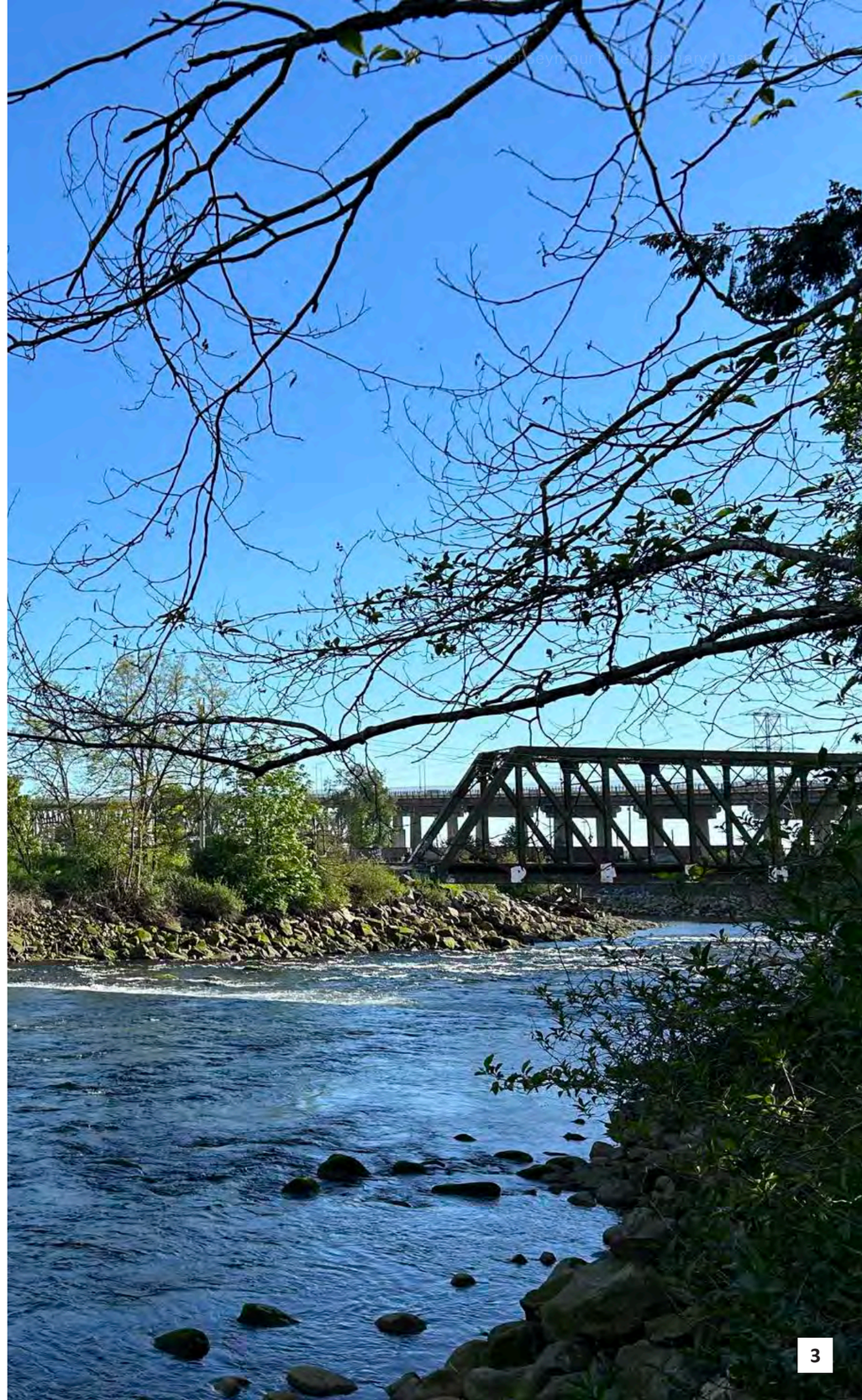
3.2 Salmonids, Other Fish, and Wildlife

The lower Seymour River supports a variety of fish species including: coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), chinook salmon (*O. tshawytscha*), cutthroat trout (*O. clarkii*), rainbow trout (*O. mykiss*), Dolly Varden (*S. malma*), and winter and summer-run steelhead trout (*O. mykiss*) (DFO, 1999). The Seymour River Hatchery, located at the dam, supports salmonid populations by rearing and releasing fry and smolts. While some fish are released upstream of the dam to enhance habitat utilization, most are released into the lower Seymour River.

Several habitat enhancement projects have been implemented to improve both adult and juvenile salmonid habitats, including improvements to Junior Creek, Bear Island, Mid-Valley, Coho Creek, Homestead and the estuary spit. Despite these efforts, salmonid survival remains low, with ongoing challenges such as predation, insufficient riparian cover, and a lack of rearing habitats. The absence of cover and suitable rearing areas is especially pronounced below the Dollarton Highway crossing, where harbour seals exploit deep waters and the lack of cover at high tides to prey on returning adults. Previous studies have also highlighted this area as having particularly low survival rates for outmigrating juvenile salmonids with the Seymour Hatchery presently releasing steelhead smolts in West Vancouver to improve survival rates (Healy, 2017).

3.3 First Nations

The Seymour River is located in the unceded traditional territory of Squamish Nation, Tsleil-Waututh First Nation, and the Musqueam Indian Band. Squamish Nation has reserve lands on the bank of the lower Seymour River. Habitat restoration is an interest of all nations, and Tsleil-Waututh has recently undertaken restoration projects in Burrard Inlet.



3.4 Human Impacts and Disturbances

The Seymour River estuary today occupies only a small portion of its historical area and faces growing threats from sea-level rise and coastal squeeze. Human-made barriers like seawalls and rock revetments prevent the estuary from naturally migrating inland, further reducing intertidal habitats essential for salmon as sea levels rise. Historical air photos, available from the early 1900s, document the estuary's dramatic loss of area and degradation of the lower reaches and foreshore that have impacted the form and function of the estuary.

Historically, the lower Seymour River estuary stretched from east of Dollarton to the west where it meets the Lynn Creek estuary. The river once meandered across a broad floodplain—from just below Grantham Bridge to tidewater—featuring low-lying intertidal benches, marshes, and channels. These natural features once extended across the North Shore, from west of Cates Point to Ambleside, shaped by the region's free-flowing rivers and streams.

Industrial development drastically altered this landscape. Logging operations, booming grounds, and railways resulted in isolation and occupation of estuarine and floodplain habitat, while port expansions dredged and filled the intertidal benches. Roads and bridges disrupted tidal connections and eliminated most of the floodplain connectivity. The river channel was shortened by removing meander loops, which steepened the river, eliminated hectares of off-channel habitat crucial for coho salmon, and destroyed gravel beds used by pink and chum salmon for spawning.

Despite lying within a largely protected watershed, the Seymour River is also impacted by flow regulation, reduced summer flows, and loss of channel-forming sediment—factors that impair its ability to support salmon and maintain productive freshwater and estuarine ecosystems. Given these historical impacts and the growing threat of sea-level rise, restoring and protecting the remaining estuary is vital for salmon species that spawn, hatch, and rear in the upstream freshwater environment.

3.5 Authorities with Jurisdiction

There are multiple authorities with adjacent and overlapping jurisdictions over the lower Seymour River and its estuary. The authorities and their area of jurisdiction include:

- səlilwətaɬ (Tsleil-Waututh Nation)
- Sḵwx̱wú7mesh Úxwumixw (Squamish Nation)
- Department of Fisheries and Oceans Canada (DFO)- Saltwater, fish, and fish habitat
- British Columbia Ministry of Environment and Parks (MOEP)- Freshwater and riparian areas
- Ministry of Transportation and Transit (MOTT)- Phibbs Exchange and Iron Workers Memorial Bridge
- Vancouver Fraser Port Authority (VFPA) - Burrard Inlet and lower reaches of the estuary
- Metro Vancouver (MV)- Seymour Dam, drinking water, and Lower Seymour Conservation Reserve infrastructure
- District of North Vancouver (DNV)- Municipality adjacent parkland
- Canadian National Railway (CN)- adjacent rail lines and bridge.

3.6 Land Use

The areas in and around the lower Seymour River and estuary accommodate a diverse range of users and land use demands, from recreational and residential to rail and heavy industry. Due to the level of urbanization in the lower Seymour River watershed, there are frequently overlapping and competing interests that need to be balanced and maintained alongside habitat restoration efforts. Each restoration project will have a distinct set of stakeholders, land use needs, and regulatory requirements that must be considered, from project scoping to implementation. Figure 1 maps land uses and businesses along the lower Seymour River.

Land holders are colour-coded to indicate regulatory jurisdiction.

Property Owners/Leasers List Colour Coding

- District of North Vancouver
- First Nations-Owned
- Vancouver Fraser Port Authority
- Province of BC
- Corporate (no colour)

Property Holders/Leasers

1 - Maplewood Creek Park
2 - Newhaven Projects
3 - The Parkway Crew
4 - Seymour River Heritage Park and Maplewood Farm
5 - Vancouver Premier Contracting Ltd.
6 - Shoreside Greenwaste Transfer
7 - Lynch Bus Lines Yard
8 - Bin There Disposal Services
9 - Squamish Nation Main Office
10 - Cutter Island Park
11 - BC Transportation and Highways
12 - Public Storage
13 - Nardone Upholstery
- PipeVision Technology
- CRS24TEKK Computers Inc.
14 - North Shore Plastics Ltd.
- Inspired Networks Inc.
- Western Windows
15 - Jastram Engineering Ltd.
- Burrard Roofing and Drainage
16 - Bosch Tankless Water Heaters & Parts
- Pike Pump and Compressor Services
- Nova Machine Works Ltd.
- Viking Automotive
17 - Falesca Importing Ltd.
18 - CN Rail
19 - Spirit Works Art Gallery
- Inside Performance
20 - Trans-Canada Highway
21 - Allied Engineering
22 - Allied Shipyards Ltd.
23 - North Shore Recycling & Waste Centre
24 - Omega Custom Furniture & Design
- Hardings Steel Company
- Hardings Security Fencing
25 - ABD Aluminum Boats
26 - Termel Industries
27 - Over the Edge Studio
- A Filthy Lot Studio
28 - Heidelberg Materials & Aggregates
29 - BA Blacktop Ltd. - Asphalt Plant

Map Legend

- Lot Lines
- Railways
- Major Roadways
- Seymour Creek Indian Reserve 2
- Seymour River
- Auxiliary
- Commercial
- Industrial
- Institutional
- Residential/Developed
- Park
- Existing Hydro Right of Way
- New Hydro Right of Way

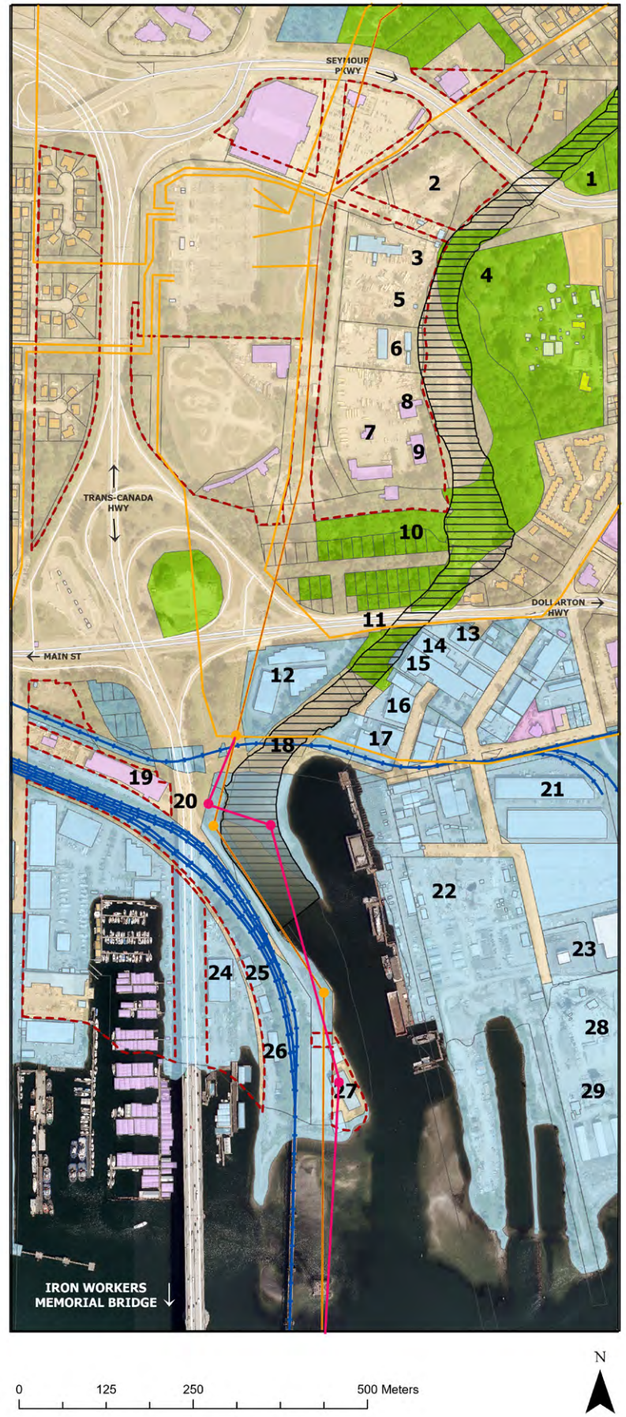
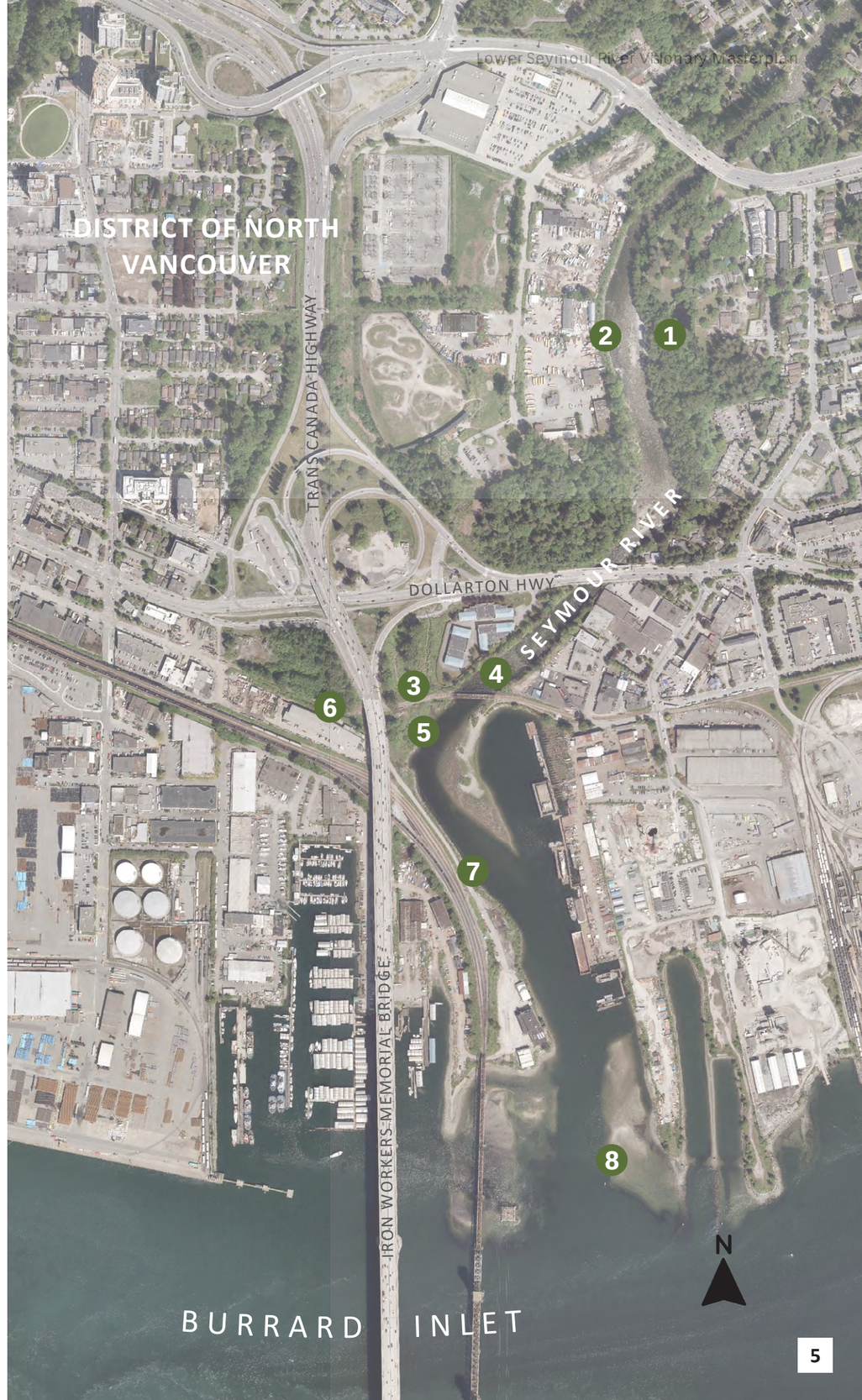


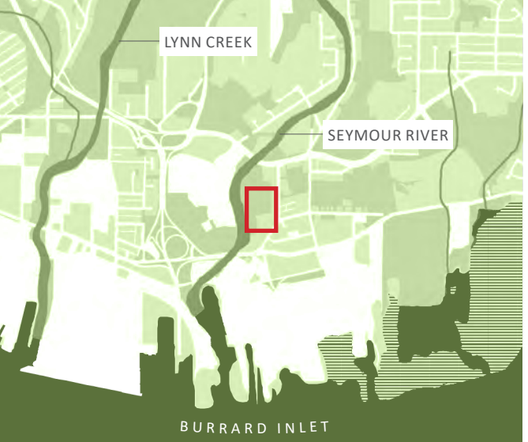
Figure 2: Land uses and businesses adjacent the lower Seymour River.

4.0 Restoration Projects

4.1 Project List

1. Heritage River Park Back Channel
2. Right Bank Habitat Complexing
3. Interchange Saltwater Marsh
4. Dollarton Large Woody Debris/Boulder Clusters
5. Sedge Bench
6. Barrow Street Stormwater Treatment
7. Railway Street Riparian Planting
8. Burrard Inlet Juvenile Refuge





1 Heritage River Park Back Channel

Side channels and back channels have been constructed in most feasible areas along the lower Seymour River mainstem (DFO, 1999).

Maplewood Creek is located approximately 1.5 km upstream from the mouth of the river. It is one of the only salmonid spawning tributaries on the lower Seymour River and has been identified as a potential opportunity for a back channel intervention. However, recent developments on nearby lands have reportedly impacted the discharge volumes in the tributary. An investigation into groundwater levels and inflow volumes should be conducted prior to project implementation, including a test well in the location of the proposed project.

The creek is situated between the Seymour River Heritage Park and Maplewood Farm and flows through an existing pond. The proposed concept would connect to the existing pond via a short back channel and would be located in the open grassy field of Seymour River Heritage Park.

This restoration concept aims to establish an optimal environment for juvenile salmonid rearing by providing essential habitat features that support early growth stages. The elevation of the park relative to the existing pond is conducive to creating a backwatered channel-pond complex from the existing pond, allowing juvenile fish access to sheltered rearing habitat after they leave the spawning grounds above Maplewood Farm. These backwatered areas would offer feeding and rearing opportunities, as the slow-moving waters accumulate nutrients, supporting high densities of invertebrates.

The channel-pond complex would be filled with large woody debris (LWD) structures and planted with riparian and marsh vegetation to create a dynamic lentic ecosystem, while also providing nesting and feeding opportunities for other species in the area.

Current Condition

- The area is grass field.
- Off-channel habitat has been largely removed from the lower Seymour River.

Proposed Enhancement

- Creation of off-channel habitat (rearing pond/channel).
- Connect Maplewood Pond as elevations are too high to connect Seymour River.

Benefits to Salmonids

- Add rearing habitat on only spawning tributary in the lower Seymour River.

Ecosystem Benefits

- Increase biodiversity and habitat types in the park.
- Amphibian habitat creation.
- Waterfowl and riparian bird habitat creation.



Figure 4: Existing Conditions



Figure 3: Existing Conditions



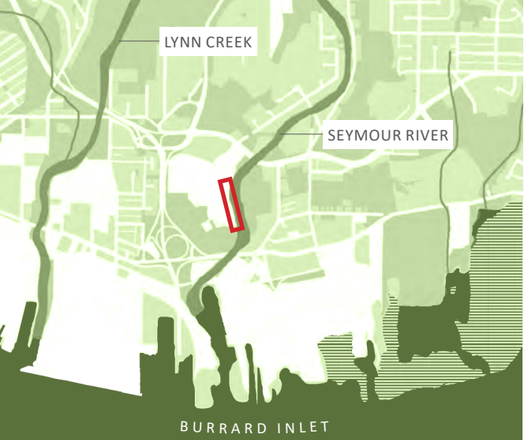
1 New Pond
2 Back Channel
3 Existing Pond
4 Viewpoints

Figure 5: Plan view illustration of Heritage River Park Back Channel

Heritage River Park Back Channel



Figure 6: Section showing new pond and back channel at Heritage Park



2 Right Bank Habitat Complexing

This restoration concept involves habitat complexing along the right bank to enhance conditions for salmonid migration and improve overall habitat quality in the reach between Mount Seymour Parkway and Dollarton Highway. The current bank is steep, armoured with riprap, and dominated by invasive species, offering little complexity or overhanging cover habitat.

Strategically placed wood structures would create sheltered areas and eddies that serve as resting points for instream salmonids migrating upstream to spawning grounds, as well as for juvenile salmonids moving out of the system. These structures would provide critical cover from predators and reduce local flow velocities, making the migration process less energetically demanding.

Where feasible, nature-based bank and erosion protection should replace riprap to further naturalize the bank, and a planting bench should be established. The planting bench would support riparian tree growth to offer shade, cooler water temperatures, additional habitat complexity, and support insects. These integrated features are designed to support a resilient, accessible migration corridor for salmonids, as well as foster broader ecosystem benefits by providing increased connectivity between riparian and upland areas.

Current Condition

- High riprap banks along the main channel.
- Low hydraulic complexity in the main channel.
- No cover or holding habitat in the main channel.

Proposed Enhancement

- Adding LWD complexing in main channel.
- Creating a planting bench for riparian tree growth.

Benefits to Salmonids

- Add predation cover and holding habitat in the main channel.

Ecosystem Benefits

- Increased LWD for benthic invertebrates.
- Increased riparian area promotes connection along the river-upland ecotone.

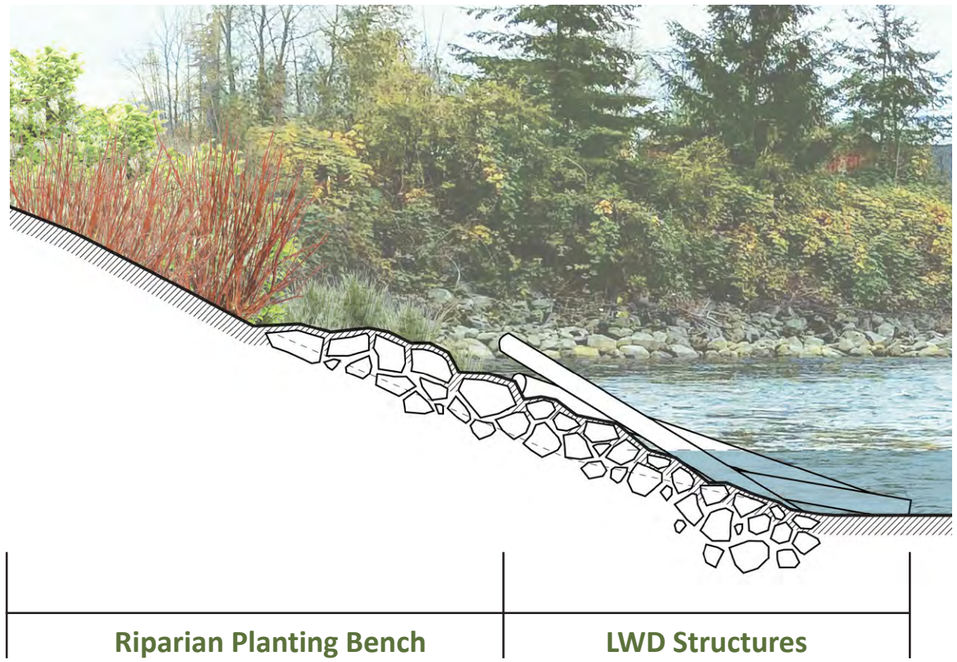


Figure 9: Section describing LWD and riparian planting relationship.



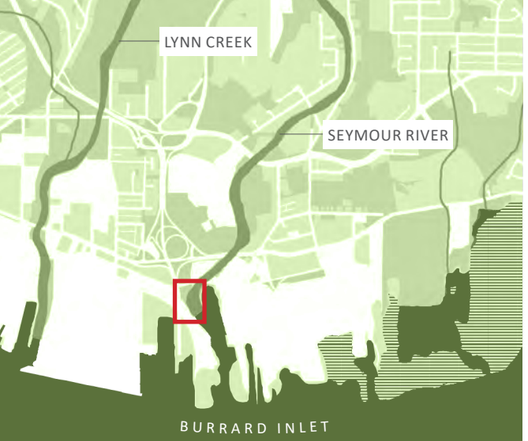
Figure 7: Existing Conditions



Figure 8: Existing Conditions



Figure 10: LWD precedent image



3 Interchange Saltwater Marsh

Current Condition

- Existing corrugated steel pipe (CSP) culvert is deteriorated (invert fully eroded).
- Bed elevations inside culvert are high.
- Much of the land upstream is too high to be wetted by tides.
- Channel is headcutting towards the twin culverts.

Proposed Enhancement

- Replace CSP culvert with lower box culvert with nature-like embedment.
- Regrade upstream channel to allow fish access and supply water to establish wetland habitat.
- Regrade overbanks to allow the area to be wetted through a larger portion of the tidal range, creating additional wetland habitat.

Benefits to Salmonids

- Adds rearing habitat in intertidal zone.

Ecosystem Benefits

- Remove invasive riparian species.
- Increase habitat for tidal marsh species.
- Improved access to tidal marsh for aquatic species.
- Create new wetland habitat for waterfowl and riparian bird species.

This proposed project is situated between the north bound offramp of the Trans-Canada Highway, Public Storage on Dollarton Highway, and the CN Rail line. An existing stream runs from north to south and is supplied by two culverts that cross beneath Dollarton Highway. It is expected that the stream receives inflows from stormwater drainage including potentially harmful road runoff. The existing site is largely dominated by invasive plant species, except for a small wetland area immediately upstream of the CN Rail culvert at the south end of the site.

This proposed restoration concept involves upgrading the existing CN Rail culvert with a naturalized box culvert and regrading the area around the existing wetland to increase the areal extents of the tidal marsh and improve rearing conditions for juvenile salmonids. Lowering the invert elevation of the culvert will enhance the tidal influence on the site and extend the hydroperiod of the tidal marsh. Estuarine back channels may also be created from the existing stream, creating further in-stream habitat. By extending the hydroperiod, tidal marshes are flooded for longer periods of time which can enhance the growth of wetland plants, improve water quality, and provide more stable and accessible habitat for aquatic species, particularly juvenile salmonids.

Lowering the CN Rail culvert invert and re-profiling the upstream channel would also improve fish access and utilization of the tidal marsh upstream of the culvert.

Should the existing stream's water source be found to be harmful to salmonids, a portion of the vegetated area on the north side of the site could be used to implement a constructed wetland. The wetland would be planted with species such as *Typha latifolia*, which can filter pollutants and improve water quality before the water reaches the estuary. In the case that the source water is not in need of pollutant filtration, the upper portion of the site can be lowered to extend the estuarine wetland and channel habitat.

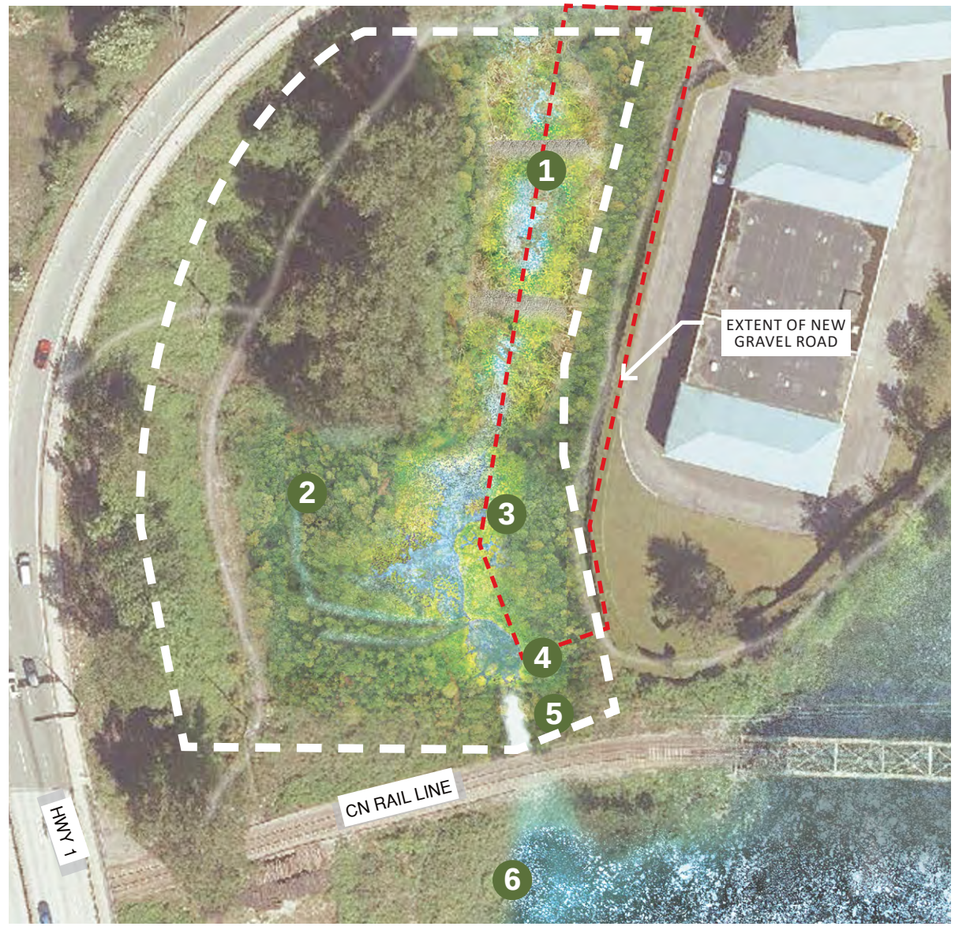
A new gravel road was constructed within this project site in the spring of 2025, the extent of which is shown in red on Figure 13. The road may be related to construction of BC Hydro's Second Narrows Crossing project to relocate the transmission towers on the north side of the Burrard Inlet – consultation with BC Hydro will be required.



Figure 11: Existing Conditions



Figure 12: Existing Conditions



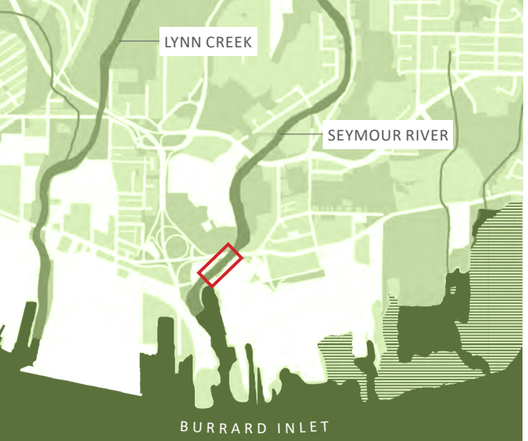
1. **Constructed Wetland**
2. **Potential Estuarine Off-Channels**
3. **Estuarine Wetland Habitat Expansion**
4. **Existing Wetland Habitat**
5. **Lowered Box Culvert**
6. **Connect to Sedge Bench (Concept #6)**

Figure 13: Plan view illustration of Saltwater Interchange Marsh

Interchange Saltwater Marsh



Figure 14: Section showing habitat creation and connection of saltwater interchange through new box culvert



4 Dollarton Large Woody Debris (LWD)/ Boulder Clusters

To reduce predation pressure on migrating salmonids, LWD structures or boulder clusters would be installed along the straight section of the lower Seymour River, extending from the area above the rail bridge to the Dollarton Highway bridge and further upstream to the river bend. This section of the river has deep, slow-moving water at high tides and has been observed as a frequent hunting ground for harbour seals preying on adult salmon. Strategically placing LWD or boulder clusters along the cobble benches in this stretch would offer cover for both migrating juvenile and adult salmon which would increase their chances of avoiding predation from harbour seals and other predators.

Previous research has identified the lower Seymour River as a high mortality zone for outmigrating salmonids (Healy, 2017), making these proposed interventions important for improving survival rates. This area of the river is also used as a training area for beginner kayakers and has an old slalom course along the proposed works section, making it a popular run for kayakers. The addition of boulder clusters could provide a similar benefit to salmonids whilst also creating conditions amenable to kayaking. Consultation with user groups will be required for design.

Current Condition

- A straight, deep, and simplified section of river.

Proposed Enhancement

- Install LWD or boulder cluster structures along the cobble benches and riprap banks.
- Increase cover along the exposed section of river.
- Reduce chances of predation along high mortality section of out migration route.

Benefits to Salmonids

- Provides cover and substrate for invertebrates and detritivores.
- Provides cover for other aquatic species.
- LWD provides nutrients that promote primary production.
- Provides cover for salmonids from predation in the lower river and estuary.

Ecosystem Benefits

- Increase habitat complexity in the estuary.

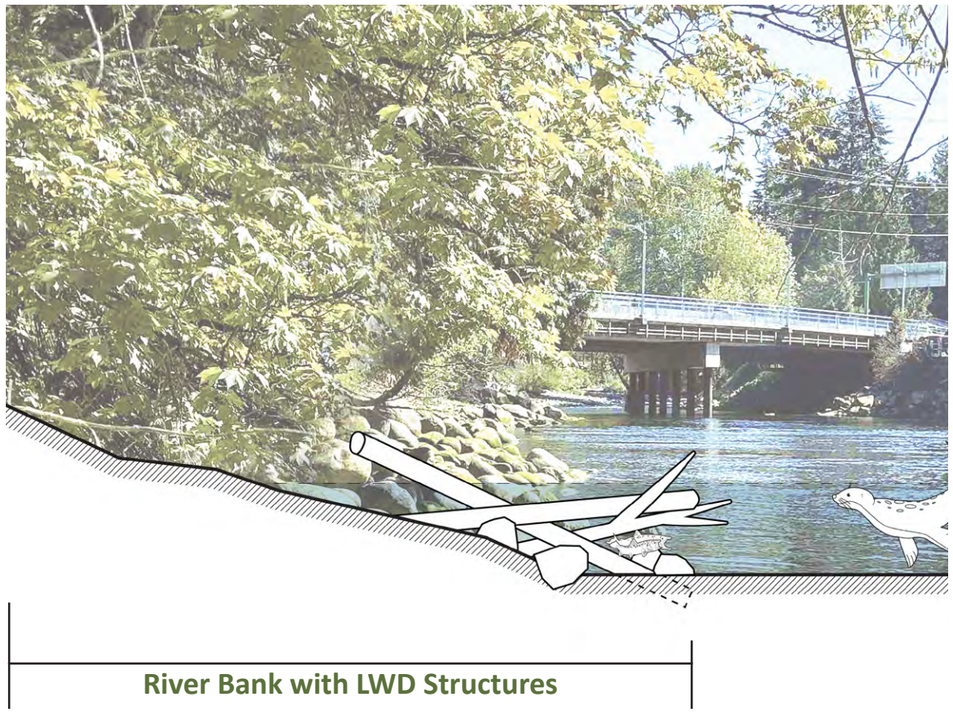


Figure 17: Section showing LWD and Boulder Cluster placement



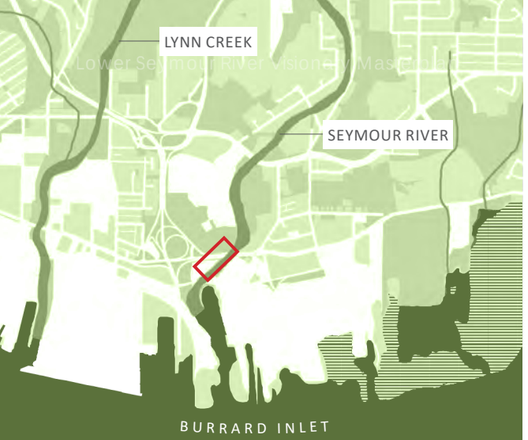
Figure 15: Existing Conditions



Figure 16: Existing Conditions



Figure 18: Example of Large Woody Debris.



5 Sedge Bench

Current Condition

- Invasives dominant on-site.
- Not typically wetted due to elevated bench.
- Old rail crossties and other debris laying in area.
- BC Hydro transmission tower adjacent to project site and power lines overhead.

Proposed Enhancement

- Gradually slope the site to be wetted more frequently.
- Plant with native vegetation.
- Add logs for complexing/to deter Canada Goose predation.
- Remove dumped material (CN, etc.).

Benefits to Salmonids

- Access to intertidal habitat at the mouth of the Seymour River.
- Intertidal habitat provides cover and foraging for juvenile salmonids.

Ecosystem Benefits

- Addition of organic material to the estuary.
- Supports invertebrates and detritivores that contribute to overall biodiversity.
- Increase habitat complexity in the estuary.

The proposed Sedge Bench concept is located in the Seymour River estuary below Ironworkers Memorial Bridge and across from estuary restoration works completed on the spit in 2014. The existing site is above the range of tidal influence and is almost entirely occupied by invasive vegetation. The objective of this concept is to enhance cover and shelter for outmigrating juvenile salmonids and returning adults, promote the growth of estuarine vegetation, and expand the intertidal zone.

This concept would involve the extensive removal of existing invasive vegetation and regrading of the overbank to provide a constant grade from the upper riparian zone down to the high marsh and low marsh zones. The re-graded and re-planted area would connect to the existing marsh in Concept #3, forming continuous tidal marsh habitat and receiving inflows from Concept #6. The regraded zone would be planted with *Carex lyngbyei* or other salt-tolerant sedges that thrive in brackish conditions which would promote sediment stabilization and increase habitat diversity, as well as provide an important source of insect prey to outmigrating juvenile salmonids.

To discourage Canada Geese from grazing on these new plantings, a substantial amount of LWD would be strategically secured around and within the planted areas. This LWD placement would provide both a physical barrier to deter geese and add structural complexity to the sedge bench, which would provide cover to aquatic species when submerged. Observations from past restoration works on the MacKay Creek estuary suggest that a significant amount of LWD may be required to effectively protect the plantings, and evidence from this site can inform the design's requirements for LWD volume and arrangement. Temporary goose deterrent measures such as using eco-cultural enclosures may be implemented until the plantings reach maturity.

If necessary, engineered log jams or other nature-based bank protection could be installed on the site to protect the tidal marsh zones from erosion and scour. The extent of intervention required will be determined through detailed engineering design.



Figure 19: Existing Conditions



Figure 20: Existing Conditions



Figure 21: Example of sedge bench.

Sedge Bench

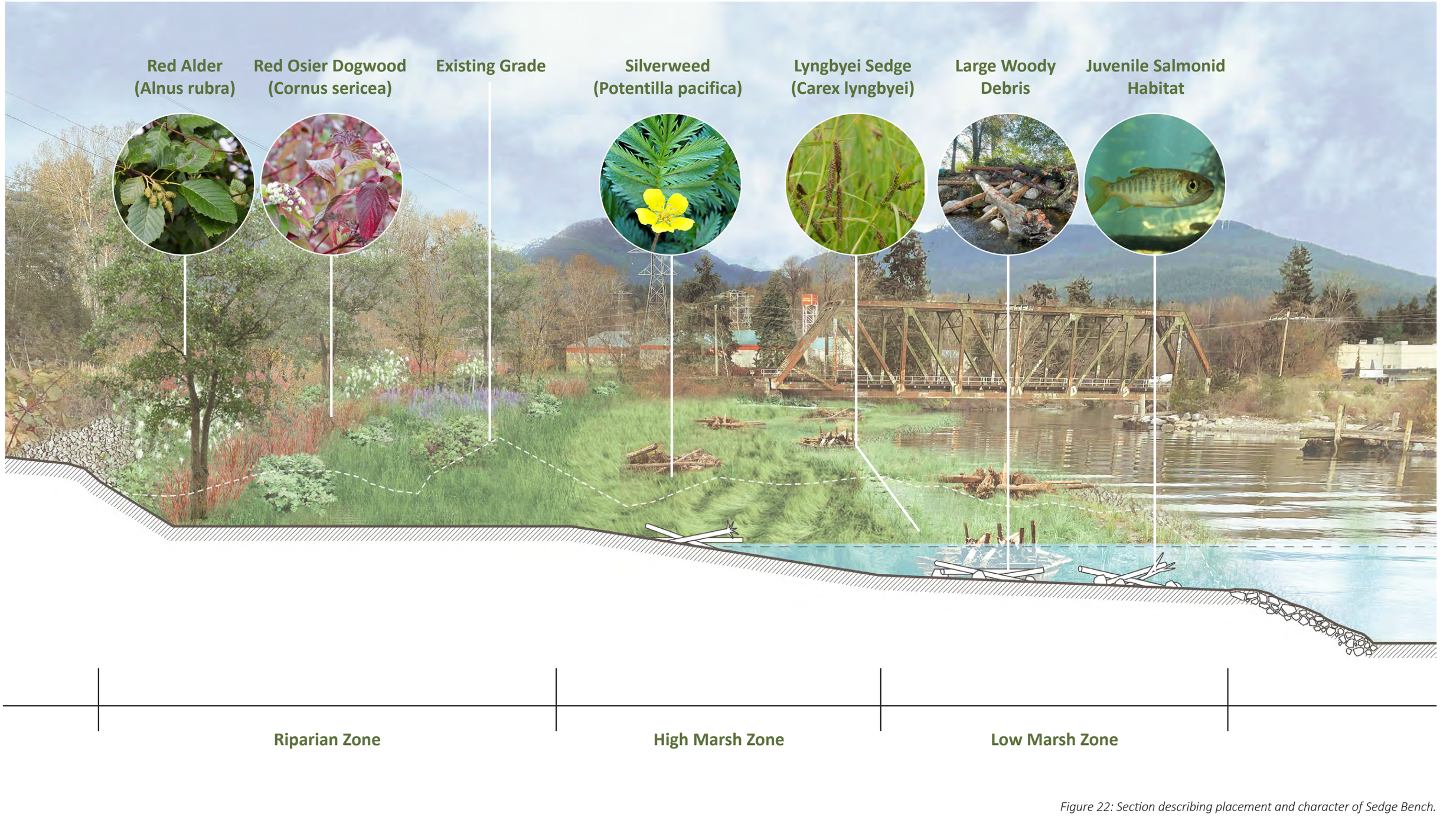
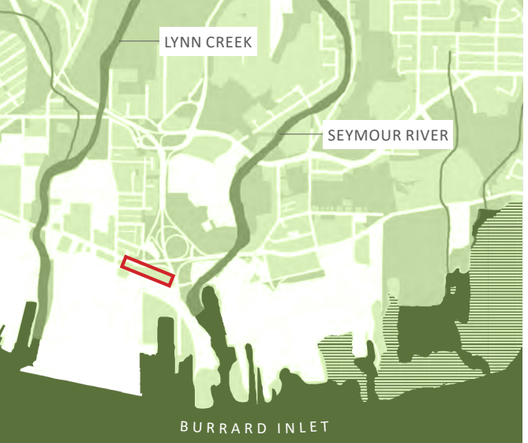


Figure 22: Section describing placement and character of Sedge Bench.



6 Barrow Street Stormwater Treatment

This proposed concept would convert the ditch that flows between Railway Street and the CN Rail line into a widened treatment wetland. The purpose of this concept is to treat the polluted waters that reportedly enter the ditch from the nearby light industrial land and discharge into the Seymour River Estuary.

Presently, the ditch receives runoff from roads and nearby industrial areas and flows eastwards below the Ironworkers Memorial Bridge, before passing through a series of culverts and discharging into the estuary. The area is dominated by invasive knotweed and the section beneath the bridge contains discarded railway ties and industrial material.

In this concept, the ditch would be widened and re-planted with vegetation known for its phytoremediation properties, such as *T. latifolia* which can filter pollutants and improve water quality before the water reaches the estuary. Gravel berms would be installed widthwise across the ditch to create segmented treatment cells, which increases the treatment efficiency and provides additional physical filtration and biofilm surface area for microbial breakdown of pollutants. The project could optionally be extended beneath the bridge, where the ditch passes under an existing gravel road through a culvert. The project would terminate by tying into Concept #5.

Current Condition

- Straight ditch overgrown with invasives, no filter media.
- Old culvert discharging to estuary.

Proposed Enhancement

- Install treatment cells along ditch.
- Planting in treatment cells and invasive removal.

Benefits to Salmonids

- Water being discharged into estuary is treated.

Ecosystem Benefits

- Water being discharged into estuary is treated.



Figure 25: Section describing stormwater ditch in relation to rail track.



Figure 24: Existing Conditions



Figure 23: Existing Conditions



Figure 26: Example of a stormwater swale. Image and design by Ruekert & Mielke, Inc.

Barrow Street Stormwater Treatment

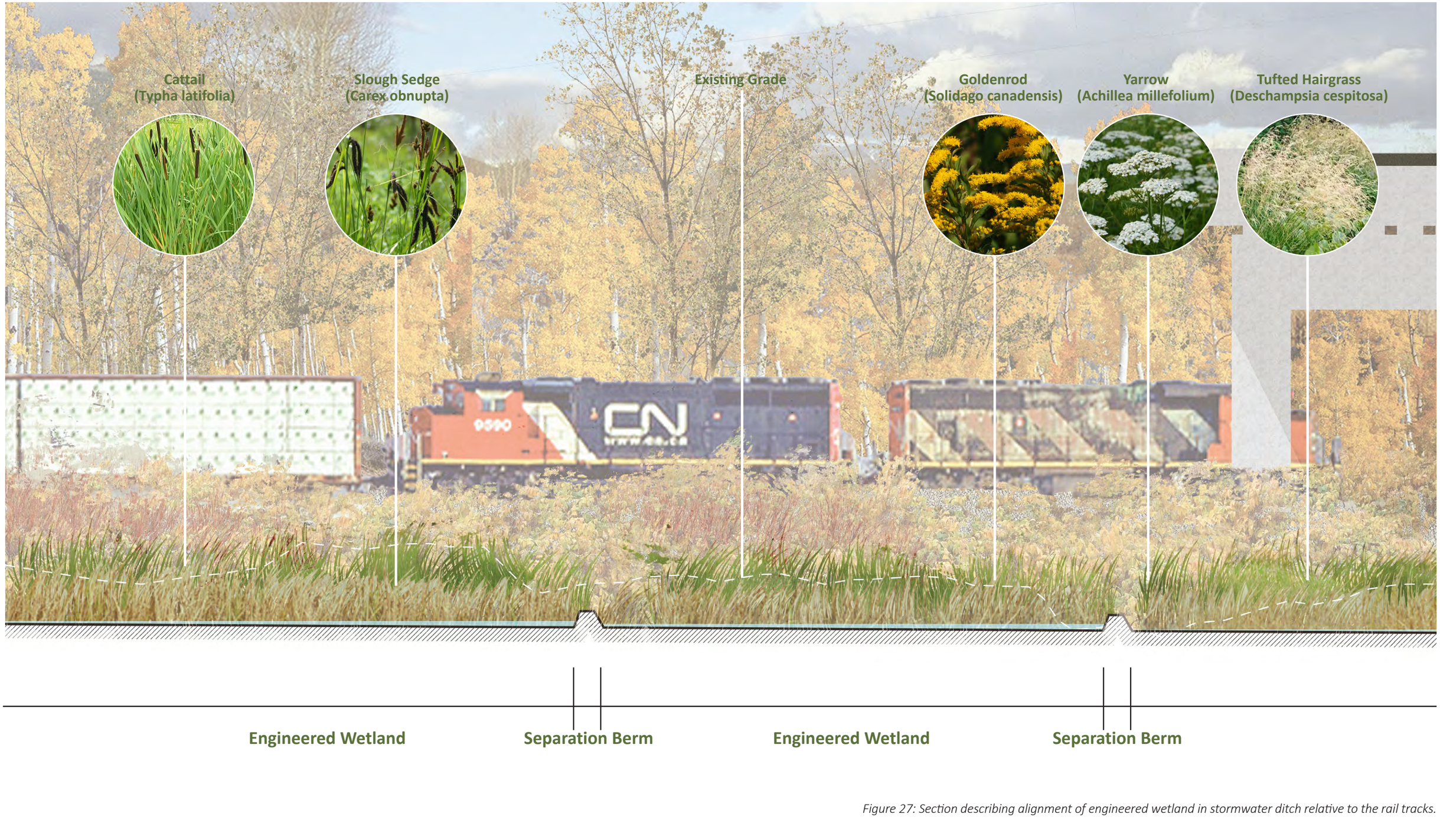
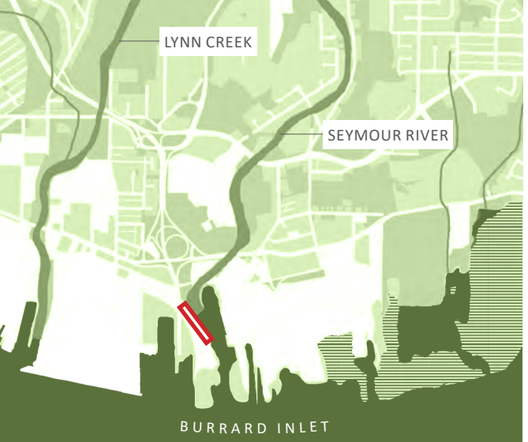


Figure 27: Section describing alignment of engineered wetland in stormwater ditch relative to the rail tracks.



7 Railway Street Riparian Planting

This restoration concept design incorporates targeted structural and habitat modifications to enhance ecological function along the estuary right bank, parallel to Railway Street. Cover habitat in this transitional reach is non-existent with the existing bank featuring steep riprap with invasive species along the top of the bank and the shipyards occupying the opposite side of the river estuary.

This restoration concept involves adjusting the existing riprap accompanied by the removal of invasive species to establish a planting bench for riparian vegetation. This planting bench would provide similar habitat benefits to Concept #2. Low elevation benches may also be created where the river widens into the estuary to facilitate juvenile fish movements and create additional nearshore estuarine habitat to support the species on which juvenile fish feed.



Figure 28: Existing Conditions



Figure 29: Existing Conditions

Current Condition

- Straight riprap banks.
- Invasives prevalent.

Proposed Enhancement

- Plant native vegetation along the riprap banks.
- Remove invasives.
- Create a low elevation bench to assist with migration/foraging of juvenile salmonids.

Benefits to Salmonids

- Provide cover for salmonids against predation in a very straight and simple section of the estuary.

Ecosystem Benefits

- Provide cover for a variety of fish species in the simplified lower estuary.
- Removal of invasives and planting of native vegetation increases habitat niches for native species.

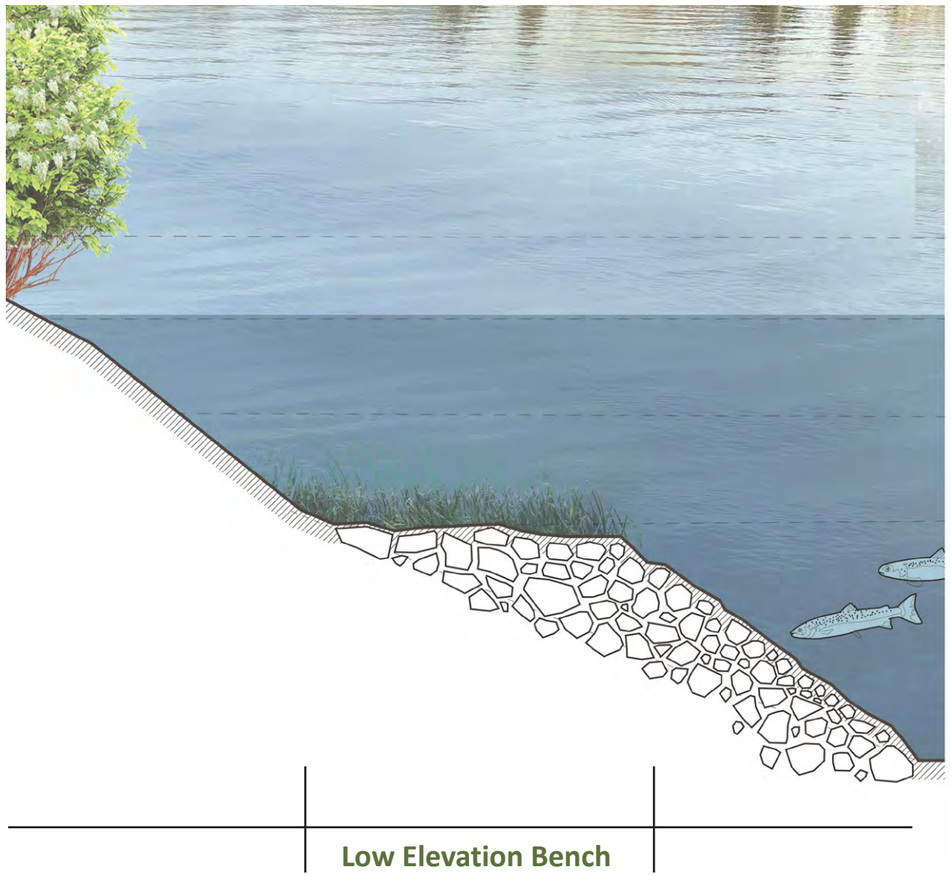
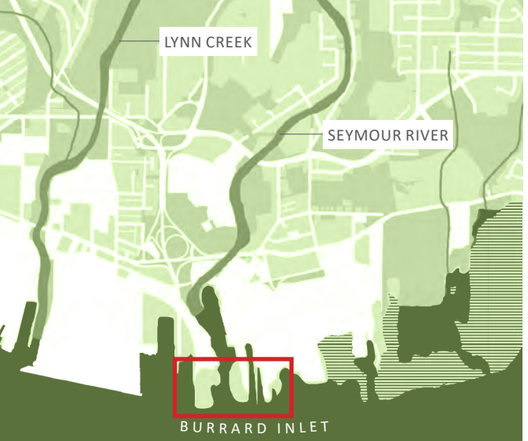


Figure 30: Section describing water level fluctuation and riparian planting.



Figure 31: Example of existing riparian bank with low elevation bench on the lower Seymour River.



8 Burrard Inlet Juvenile Refuge

Current Condition

- Low-complexity intertidal zones.

Proposed Enhancement

- Complexing of intertidal areas.
- Moving existing sediment to create a variety of elevations.
- Reef enhancements to encourage macroalgae.
- Protected salt marsh with fine sediments for forage fish and juvenile salmonids.

Benefits to Salmonids

- Refuge for juvenile salmon at different tidal elevations.
- Increased cover along outmigration route.
- Increased forage opportunities in the intertidal region.

Ecosystem Benefits

- Provide cover for a variety of fish species in the simplified lower estuary.
- Support for a variety of invertebrates, forage fish, and other benthic organisms by encouraging the growth of marine vegetation.

This proposed restoration concept design incorporates several interventions aimed at enhancing habitat diversity and supporting local marine species. The existing site consists of low-complexity, large-grained gravel beds under the CN Rail bridge and along the eastern spit, as well as steep sloping sections of low-complexity substrate off the ends of each of the eastern spits. The current habitat provides minimal suitable substrate for macroalgae, benthic invertebrates, or other intertidal species, and offers almost no cover for outmigrating juvenile salmonids. This lack of cover poses a particularly acute risk at this location, as outmigrating juvenile salmonids pass under the largest colony of double-crested cormorants (*Phalacrocorax auritus*) in British Columbia—known for being prolific predators of juvenile salmonids—that nest under and on the Ironworkers Memorial Bridge.

This concept would involve four components:

1. To increase habitat complexity under the rail bridge, install boulder gardens to support the growth of macroalgae species which serve as important cover features for juvenile salmonids.
2. Contour the East Spit in a manner similar to the NHC's work on the Tsleil-Waututh Nation's intertidal habitat restoration efforts on the Maplewood Flats in North Vancouver. This method would create lobes of intertidal habitat with elevations and substrates specifically tailored to supporting clam bed development.
3. Recontour and plant the upper intertidal zone of the East Bay with salt marsh species less palatable to Canada Geese, such as *Distichlis spicata, Plantago maritima, Triglochin maritima, Salicornia virginica, Hordeum jubatum,* and *Juncus balticus*. Planting this selection of species would aim to reduce grazing pressures and promote the resilience and stability of the restored salt marsh area.
4. Install "Rocky Reef Fingers" of large boulder substrate off the ends of both the East Spit and East Bay to provide stable holdfasts for macroalgae and foster biodiversity within the reef areas. This method is similar to the NHC designed marine habitat offsetting works within the Lynn Creek Estuary.

This restoration concept would provide increased cover to vulnerable juvenile salmonids during their outmigration as well as provide potential feeding opportunities and cover in improved intertidal habitats along the East Bay. The project can be approached in the phases outlined above, with each phase completed separately as funding opportunities arise.



Figure 32: Existing Conditions



Figure 33: Existing Conditions



Figure 34: Example of Boulder Cluster installation (Photo source: Seaspan).

Burrard Inlet Juvenile Refuge

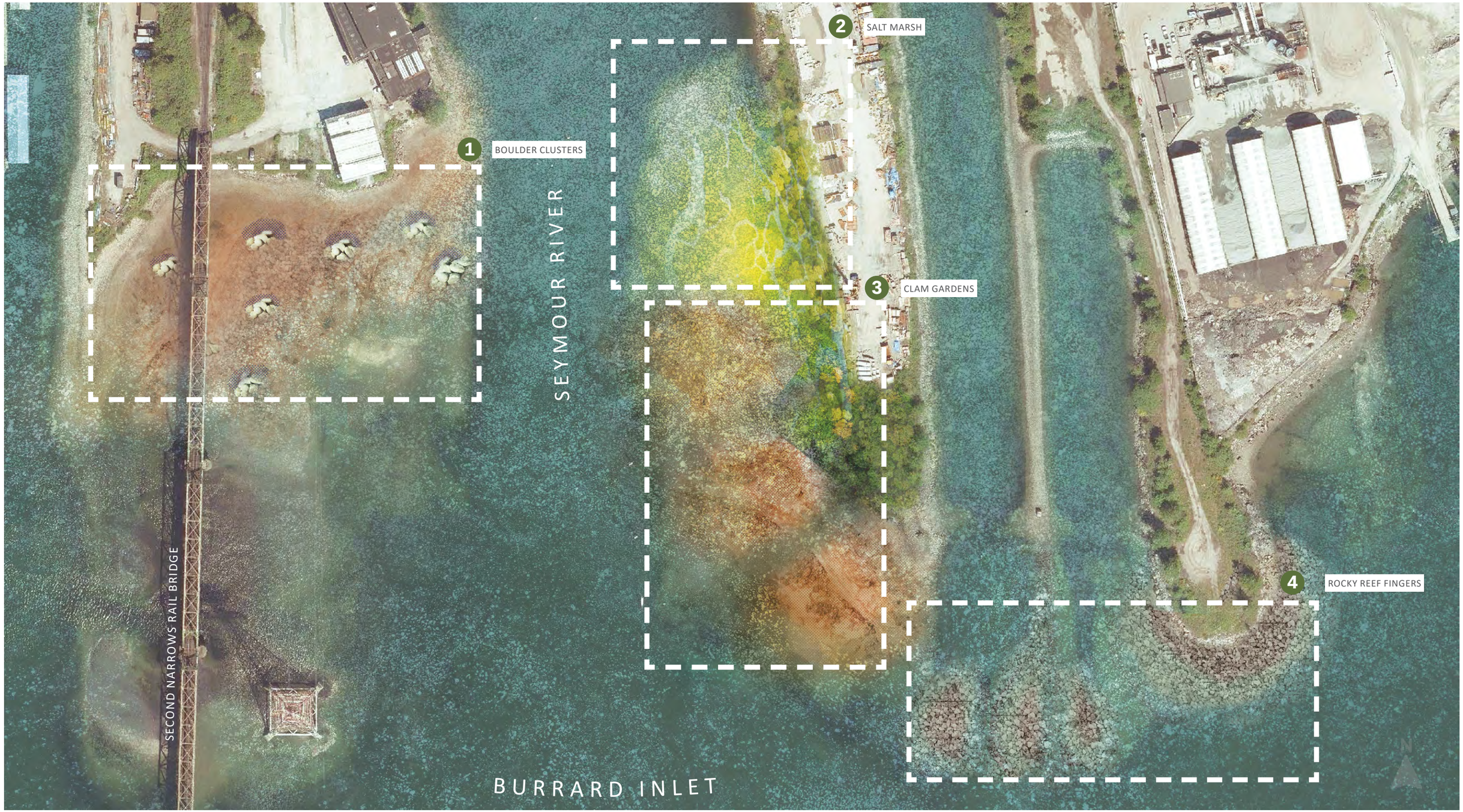


Figure 35: Plan view of Burrard Inlet Juvenile Refuge installations.

5.0 Implementation

The projects outlined in the previous chapter represent many years of potential efforts. Restoration projects will be carried out over time as opportunities arise, such as partnerships, funding possibilities, and infrastructure upgrades. To provide guidance on implementing the projects, this chapter summarizes high level capital costs, phasing, level of effort, habitat benefits, regulatory requirements, and the engagement needed for each project to proceed.

5.1 Overview

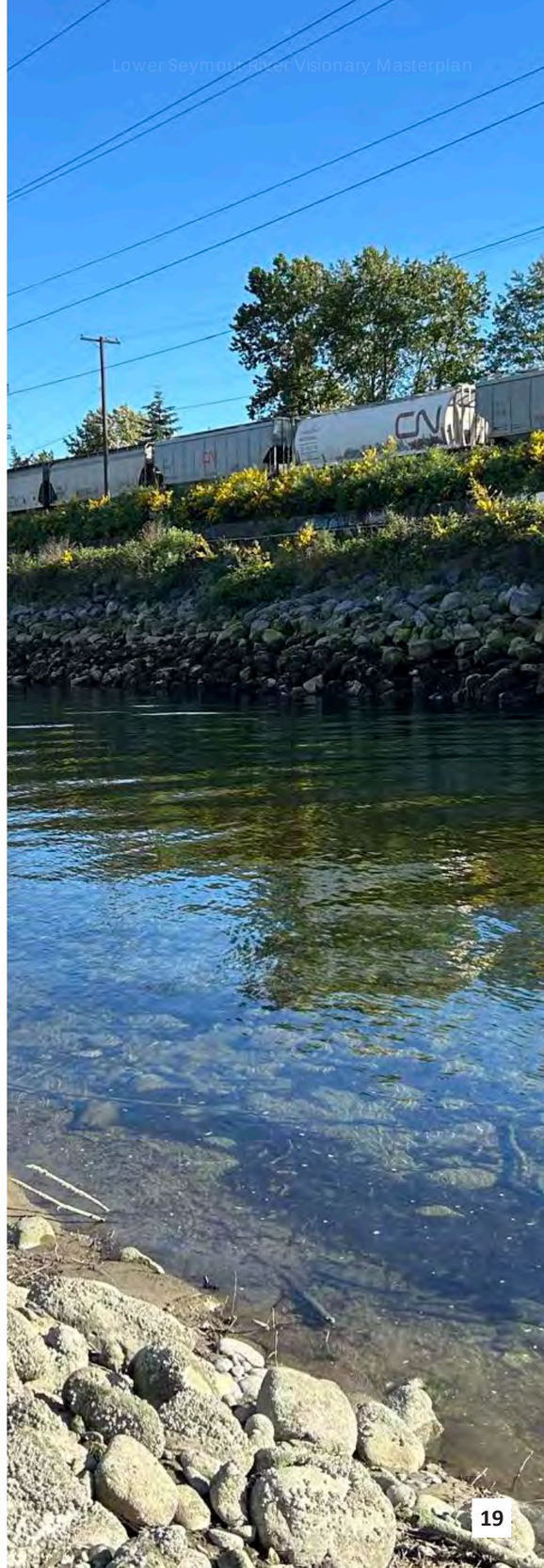
Table 1 provides a reference for potential funders, community members, and project leaders to identify the requirements for each project.

Project	Habitat Benefits	Constraints	Capital Cost*	Construction Phasing	Anticipated Regulatory Effort	Land Ownership/ Leaseholder**
Heritage River Park Back Channel	Instream complexing Rearing habitat Expanded riparian and wetland habitat	Tributary channel inflows and potential loss of hydraulic connectivity	$$	Single-Phase	High	District of North Vancouver (DNV)
Right Bank Habitat Complexing	Instream complexing Riparian habitat	Spatial and construction access constraints Recreational impacts	$	Single- or Multi-Phase	Moderate	First Nations
Interchange Saltwater Marsh	Intertidal instream habitat Expanded riparian and wetland habitat	Coordination to replace CN Rail culvert	$$$	Single-Phase	Moderate	Provincial CN Rail
Dollarton LWD/Boulder Clusters	Instream complexing	Recreational impacts (kayak/canoe groups)	$	Single- or Multi-Phase	Moderate	GVRD
Sedge Bench	Intertidal instream habitat Expanded riparian and wetland habitat	Bank stability Grazing by geese during planting establishment	$$	Single-Phase	High	GVRD
Barrow Street Stormwater Treatment	Improved water quality Riparian habitat	Ongoing management of invasive species due to proximity to railway	$$	Single-Phase	Low	First Nations Provincial
Railway Street Riparian Planting	Estuarine and marine habitat Riparian habitat	Spatial constraints	$	Single- or Multi-Phase	Low	First Nations Provincial
Burrard Inlet Juvenile Refuge	Estuarine and marine habitat Instream complexing	Construction access – placement by barge	$-$$$	Multi-Phase	High	First Nations DNV Corporate VFPA

Notes:
1. Anticipated construction costs under each project are classified as follows:
- *"$" = under $250,000*
- *"$$" = between $250,000 - 1,000,000*
- *"$$$" = over $1,000,000*

2. Land Ownership/Leaserholder information is based on the DNV GeoWeb and may be incomplete or inconsistent with other records. Projects may also overlap multiple properties and require further investigation once project extents are determined.

Table 1: Project comparison and implementation



5.2 Regulatory Overview

The implementation of each project requires adherence to a complex regulatory framework that encompasses federal, provincial, and municipal jurisdictions. These regulations ensure that restoration activities meet legal standards for environmental protection, species conservation, and land use management. Anticipated permitting and approval requirements are summarized in the following table. Regulatory requirements should be verified before the implementation of each project.

Federal Permits and Approvals

- Fisheries Act Authorization (FAA) – required for projects that are likely to cause harmful disruption, destruction, or alteration to fish and/or fish habitat, including riparian vegetation. Applies to most projects involving instream construction. Authorizations issued by DFO.
- Canadian Navigable Waters Act (CNWA) approval – required for projects on navigable waters. Approvals issued by Transport Canada.

Provincial Permits and Approvals

- Water Sustainability Act (WSA) Section 11 approval – required for any project involving works in and about a stream. Approvals issued by BC FLNRORD.

Regional/Municipal Permits

- District approvals – secure agreements to construct on DNV park lands.
- Vancouver Fraser Port Authority – secure approval to construct within port jurisdiction.

	Federal		Provincial	Regional/Municipal	
Project	**Fisheries Act Authorization**	**Canadian Navigable Waters Act**	**Water Sustainability Act**	**District of North Vancouver**	**Vancouver Fraser Port Authority**
Heritage River Park Back Channel	●		●	●	
Right Bank Habitat Complexing	●		●	●	
Interchange Saltwater Marsh	●		●		
Dollarton LWD/ Boulder Clusters	●		●	●	
Sedge Bench	●		●		
Barrow Street Stormwater Treatment				●	
Railway Street Riparian Planting	●	●	●		●
Burrard Inlet Juvenile Refuge	●	●	●		●

Table 2: Regulations in relation to each project

5.3 Engagement

First Nations, government agencies, and stakeholders were engaged early in the planning process through interviews and workshops, contributing to the selection of restoration projects that have been presented. Later in the planning process, a roundtable event was held to gather further feedback. A summary of What We Heard, outlining the interests of those who participated, can be found in Appendix A.

First Nations, DNV, DFO, and the Province will also be involved in and/or consulted for all projects as part of the regulatory approvals process. In addition to these First Nations and government agencies, each project has specific stakeholders that should be consulted, as outlined in Table 4. Stakeholders other than those listed in Table 4 may exist; relevant stakeholders should be confirmed prior to project initiation.

Project	Recreation Users	CN Rail	VFPA	Metro Vancouver	BC Hydro	Adjacent Businesses
Heritage River Park Back Channel	●					
Right Bank Habitat Complexing	●					●
Interchange Saltwater Marsh		●			●	
Dollarton LWD/ Boulder Clusters	●			●		●
Sedge Bench		●			●	
Barrow Street Stormwater Treatment		●				
Railway Street Riparian Planting			●		●	●
Burrard Inlet Juvenile Refuge			●	●	●	●

Table 3: Additional stakeholders in relation to each project



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Appendix A - What We Heard

Organization	Shared and Relevant Interests	Funding/Partnership Opportunities
Squamish Nation	• Environmental restoration and protection • Collaboration	• TBD
Tsleil-Waututh Nation	• Stewardship • Habitat gain • Fish migration in Burrard Inlet	• Habitat restoration partnerships • Letters of support
District of North Vancouver	• Healthy ecosystems • Stormwater management • Flood risk • Park operations	• Habitat restoration project partnerships
Metro Vancouver	• Fish habitat restoration • Water services facilities (Seymour Dam, Second Narrows Water Supply Tunnel)	• Habitat restoration project partnerships • In-kind contributions (staff, equipment, materials)
Vancouver Fraser Port Authority	• Maintaining port operations • Healthy environment including water and biodiversity	• Centerm Community Fund Grants
Maplewood Farm	• Outreach and education	• Hosting outreach and educational events
CN Railway	• Maintaining railway operations • Habitat offsets • Fish passage	• Habitat offset funding • Fish passage funding • Environmental initiatives funding
Recreational Users	• Healthy ecosystems • Recreation access • Safety	• Consult on design inputs



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