

Squamish Estuary: reconnecting ocean and river

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What is happening?

The Squamish estuary is located at the confluence of the Squamish River and the northern end of Átl'ka7tsem/Txwnéwu7ts/Howe Sound. Over the past century, the estuary has undergone numerous changes including infilling to create the townsite of Squamish, construction of roads, rail, and industrial ports and logging. Today, less than 50% of the original estuary remains (see [Squamish Estuary](#), Ocean Watch Howe Sound Edition [OWHS] 2017).

Organizations such as the Squamish River Watershed Society (SRWS) have been working to restore the estuary. Activities include reconnecting tidal



A view down Átl'ka7tsem/Txwnéwu7ts/Howe Sound, with the Squamish Estuary shown in the bottom right. (Credit: Rich Duncan)

channels to the river through installation of culverts across roads and a man-made bermⁱ; removing brownfieldsⁱⁱ; and, wherever possible, restoring habitat for fish and wildlife. The goal of restoration is to re-establish a healthy, vibrant and resilient estuary that can withstand sea-level rise and climate change, and remain an important breeding and rearing ground

for migratory and resident species, including the myriad of birds that inhabit the estuary, such as the iconic bald eagle (*Haliaeetus leucocephalus*) and the blue heron (*Ardea herodias*), as well as migratory salmon. A healthy, thriving estuary is central to supporting the wealth of species that use this beautiful habitat.

What is the current status?

In 2017, the SRWS, together with Skwxwú7mesh Úxwumixw/Squamish Nation and Fisheries and Oceans Canada (DFO), began work on the Central Estuary Restoration Project (CERP). Past industrialization and development continue to limit habitat function and fish access in the Squamish estuary. For example, the training berm is “flushing” juvenile salmon into Átl'ka7tsem/Txwnéwu7ts/Howe Sound faster than they would otherwise migrate, potentially impacting their survival.

CERP is a three-phase project designed to reconnect and restore estuary habitat to support the outmigration of Pacific salmon, especially Chinook (*Oncorhynchus tshawytscha*). Chinook is the main prey species of southern resident killer whales (*Orcinus orca*),¹ an iconic B.C. species that is currently in serious decline. In addition to improving access and habitat for Pacific salmon, other ecosystem benefits will likely occur. Examples include improvements to water quality; flood mitigation and coastal resilience; increased sediment deposition and carbon sequestration potential; and

increased support of known species at risk within the project area due to improved habitat quality.

The three phases of CERP are broken down as follows:

PHASE 1. Upgrade the existing culverts in the training berm to improve fish access;

PHASE 2. Modify the lower section of the training berm to reconnect the lower estuary; and

PHASE 3. Install a flow control device under the Canadian National Railway (CN) rail spur to re-water historical channels.

Work on Phase 1 commenced in 2018. Phase 1 focused on replacing an underperforming culvert crossing with a larger fish-friendly crossing. The most effective location for the culvert upgrade was determined based on modelling of sediment transport and a 2D flood model of the Squamish River.² Of the nine culverts installed over the past 20 years, the best location for the upgrade was determined to be the third culvert from the north end. This culvert was a twin 1.2-

i) Berm – a flat strip of raised land bordering a body of water.

ii) Brownfield – a former industrial or commercial site.



Construction preparing for the new box culverts. (Credit: Squamish River Watershed Society)

m diameter corrugated steel pipe that was installed in the early 1990s. This culvert was replaced with a 3 m x 3 m concrete box culvert that would permit flow, and thus fish passage, for over 80% of the daily tidal exchange.

During construction, inflows from the river were obstructed with a cofferdamⁱⁱⁱ. However, the site could not be completely isolated and was inundated by daily tides. Consequently, work was limited to the low tide periods each day. Riprap^{iv} was placed at the inlet and outlet of the box culvert to limit scouring of the channel during tidal exchange. Upon completion, the cofferdam was removed, and water began flowing from the river to the estuary.

Prior to construction work beginning, an extensive monitoring program was undertaken to establish

baseline data. This included monitoring for fish passage and presence; water parameters such as salinity, pH, temperature and dissolved oxygen; and vegetation colonization. Monitoring will continue during 2020 and into 2021 to establish the effectiveness of the culvert upgrade.

Design and planning for Phase 2 (realignment of the spit to open up over 77 hectares of tidal habitat for juvenile Chinook salmon) and Phase 3 (to install flow control structures under the CN Spur Line to improve water quality and fish habitat in the Cattermole Slough/Bridge Pond) are underway for 2019/2020. Once approvals and permits are received, physical works should commence from 2021.

The SRWS takes a holistic approach towards watershed management and considers the entire water-

iii) Cofferdam – a temporary enclosure in or around a body of water that allows the water to be pumped out, creating a dry environment for construction to take place.

iv) Riprap – large boulders and rocks.

shed when working on restoring fish productivity and habitat. Work in the Squamish estuary is directly tied to restoration activities the SRWS and other organizations have undertaken throughout the watershed to improve fish habitat, in particular for steelhead (*O. mykiss*) and salmon. Examples of work the SRWS have been a part of since 2017 include restoration activities in the upper Elaho River, where physical barriers to salmon migration were removed; and restoration of fish habitat in the Ashlu, Shovelnose and Cheakamus rivers, which were impacted by logging, dikes, hydro-electric facilities and roads. All of these rely on a healthy estuary for juvenile salmonids to migrate through on their way to the ocean.

A concurrent project is examining the greenhouse gas offsetting potential of the Squamish estuary salt marsh habitats. Salt marshes cover approximately 180 ha of Squamish estuary. Salt marsh ecosystems are globally recognized as important “Blue Carbon,” or ocean carbon, sinks. Their management, restoration and protection can help to offset impacts that would occur if they were destroyed or altered by development.^{3,4} The SRWS is investigating both the blue carbon potential of the Squamish estuary and the changes in carbon sequestration capacity from constriction in the area of the training berm. Results will inform local carbon storage capacity and rates of sequestration, which will contribute to an overall understanding of carbon dynamics of the Squamish estuary.



A box culvert installed in the dike to increase connectivity between the Squamish River and the estuary. (Credit: Edith Tobe)

What are the potential impacts of climate change on the Squamish estuary?

Rising sea levels will inundate low-lying areas, including estuaries, and alter the tidal range. Ocean acidification may change the salinity of these brackish water areas, rendering them unsuitable for some, and more suitable for other species. Increased precipita-

tion could lead to an increase in water and stormwater run-off, increasing erosion processes and introducing larger volumes of nutrients and/or pollutants into the estuary. Increased freshwater input could also alter the salinity in estuaries.⁵

What has been done since 2017?

The table below reports on progress made on recommended actions from the previous 2017 article, where identified. Many of these require ongoing action.

2017 ACTION	ACTION TAKEN
INDIVIDUAL AND ORGANIZATION ACTIONS	
Increase educational and awareness campaigns that support widespread understanding of the importance of estuary health to all life in Átl'ka7tsem/Txwnéwu7ts/Howe Sound.	Signage has been posted by the SRWS and other organizations along various trails within the Squamish estuary.
GOVERNMENT ACTIONS AND POLICY	
Continue to support and facilitate education, monitoring and restoration activities of local groups in Átl'ka7tsem/Txwnéwu7ts/Howe Sound. Provide funding assistance and partnership opportunities where feasible.	DFO has partnered with SRWS and provided staff support on the CERP.
Reclaim and rehabilitate estuary habitat that has been modified by past development.	This is being achieved for example by the work of the SRWS, e.g., CERP as outlined above; the Nature Conservancy of B.C. is working to enhance B.C. estuaries (see: https://www.naturetrust.bc.ca/our-projects/enhancing-bc-estuaries); Skwxwú7mesh Úxwumixw/Squamish Nation is actively involved in estuary restoration projects.
Recognize the importance of estuary habitat for spawning and rearing salmon.	DFO has partnered with the SWRS to restore and reconnect the estuary to improve habitat function and fish access.

What can you do?

A detailed overview of recommended actions relating to climate change is included in *The path to zero carbon municipalities* (OWHS 2020). In some cases, no progress was identified on previous recommended actions; these remain listed below.



Individual and Organization Actions:

- Volunteer individually or as an organization with one of the local environment groups (i.e., Squamish Streamkeepers, Squamish Environment Society, Squamish River Watershed Society, or Squamish Climate Action Network) and learn about the estuary on a walk with any of these organizations.
- Report ecological information to local citizen science programs (see [Citizen Science](#), OWHS 2020).



Government Actions and Policy:

- Increase educational and awareness campaigns that support widespread understanding of the importance of estuary health to all life in Átl'ka7tsem/Txwnéwu7ts/Howe Sound. Ensure accurate and comprehensive information is available and reviewed by area planners and decision makers.
- Explore the possibility of increasing the size of the Skwelwil'em Wildlife Management Area or create more Wildlife Management Areas to increase protection throughout the estuary.
- Protect all estuary habitats from residential, commercial, or industrial development.

Methods

Restoring, protecting and enhancing natural habitats, such as the Squamish estuary, often fall on local non-profit organizations or First Nations. The works described here are the result of decades of collaboration, pushing political priorities within the federal and provincial mandates, and having patience to wait for

projects to be realized. For more information on the Squamish estuary, please refer to the SRWS website (see Resources). Additional information and background have been provided by Edith Tobe, Executive Director of the SRWS.

Resources

This list is not intended to be exhaustive. Omission of a resource does not preclude it from having value.

Squamish River Watershed Society
<https://www.squamishwatershed.com/>

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Signage on a walk within the Squamish estuary. (Credit: Aroha Miller)