GCA Working Paper Series: #3

Beaver Creek Restoration Plan

Pebble Beach Reserve - Galiano Island

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Learning From the Best

Bringing the Beaver back to Beaver Creek

• Restoration Plan - Brief •

In the early 2000's, beaver (*Castor canadensis*) could be found up and down the length of "Beaver Creek" on Galiano Island, catalyzing the recovery of wetland and riparian ecosystems that had been degraded by decades of clear-cut logging, drainage, and road construction. In the upper watershed (upstream of the reserve), beaver were initiating the flooding of the "Great Beaver Swamp", which they continue to maintain today. In the lower watershed (within the reserve), they had established at least 10 dams, transforming the creek into a complex series of pools that accumulated sediment and supported a rich riparian ecosystem (***Fig. 1-2***).

Around the late 2000s, beaver abandoned the lower watershed for unknown reasons. Over time, their dams were breached, and the creek channel became incised, downcutting into over a meter of rich sediment that had accumulated within the floodplain. Most of the pools have been lost and the process of erosion and incision continues to deepen the creek channel (***Fig. 3***). Today, beaver remain absent from the lower watershed, and the creek channel has become disconnected from its historic floodplain, resembling and functioning more like a ditch than a creek.

Beaver are still present in the upper watershed, and the historic floodplain in the lower watershed still retains many of the key ingredients needed to support complex creek structure and function, including large woody debris and diverse vegetation. The urgent need to remove and replace a failing earthen bridge crossing (***Fig. 4***) has created an opportunity to reverse creek incision before additional damage occurs. The Galiano Conservancy Association (GCA) has purchased a bridge and secured funds to replace this crossing and initiate a restoration project.

Figure 1*: Dam on lower Beaver Creek, Feb. 2004*

Figure 2*: Dam on lower Beaver Creek, Feb. 2004*

Figure 3*: Eroding channel exposes over 1 meter of sediment on lower Beaver Creek, Apr. 2026*

Figure 4*: Failing earthen road crossing, Mar. 2025*

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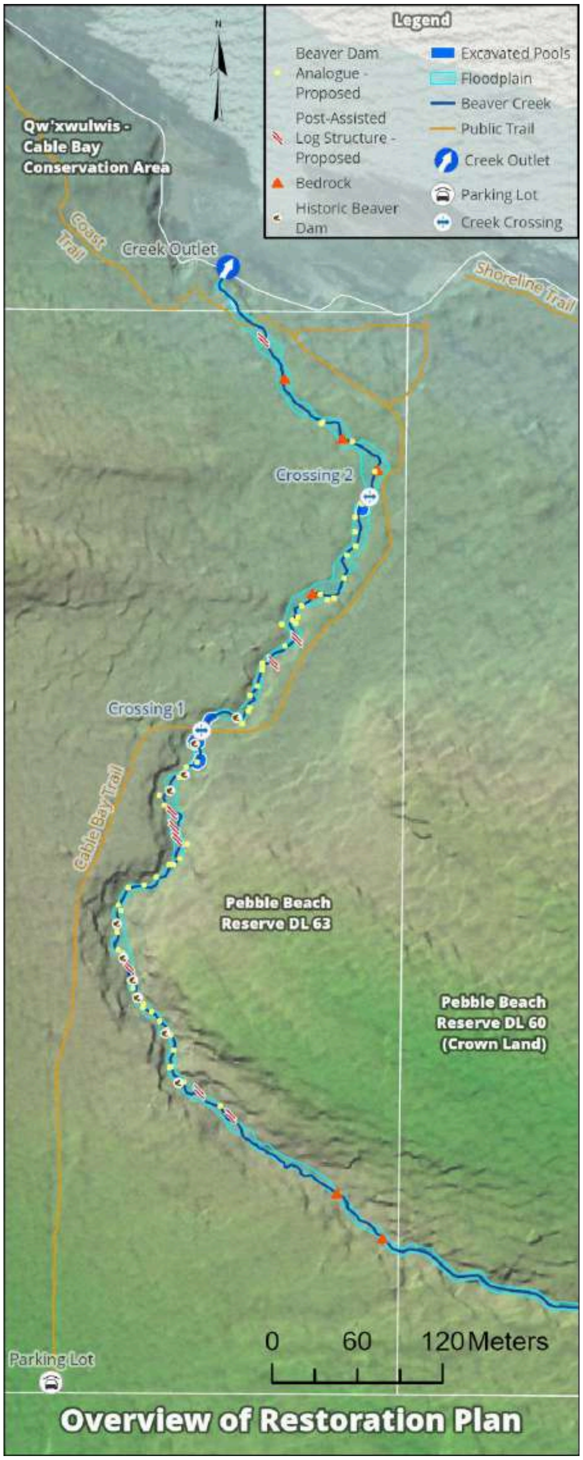


***Map 1**: Map of proposed restoration treatments*

The goal of the project is to **partner with beaver** to restore sections of Beaver Creek that have been degraded by industrial logging and road-building, using methods that will improve habitat for native wildlife, as well as freshwater quality, stream structure, and ecosystem health.

The restoration will proceed in three distinct stages. First, the GCA will use **low-tech process-based restoration** techniques to install small, short-lived structures known as beaver dam analogues (BDAs) and post-assisted log structures (PALS) in incised sections of the creek. These structures are designed to mimic beaver dams and logjams. Experts from the BC Wildlife Federation's Wetland Education Program will assist the GCA in placing these structures strategically to create pools, detain sediment, and initiate a process of creek channel widening that is essential to re-connect the creek with the historic floodplain. BDAs create inviting "starter" habitat for beaver.

Second, the GCA will renew our long-time partnership with wetland restoration specialists from *Rewilding Water & Earth* to carefully remove old logging roads and a failing bridge that are negatively impacting creek function, creating several wetland pools in their place.

Finally, the GCA will establish native vegetation in disturbed sections of the riparian area, with an emphasis on fast-growing species that are preferred by beaver for food and material. The old bridge will be replaced by a clear span footbridge.

The GCA envisions this restoration to be a long-term collaboration between restoration practitioners, community members, and beaver. There will be many opportunities to get involved, and to observe the evolution of the creek as it recovers.

Background

Cultural Significance

Galiano Island is the unceded, shared, and asserted traditional territory of Hul’qumi’num-speaking Coast Salish peoples. According to late Penelakut elder Florence James, the eastern coastline along what is now known as Cable Bay and Pebble Beach is called **Qw’xwulwis** in Hul’qumi’num, in reference to the action of paddling. It was an ideal place to camp and assemble prior to and after crossing the Strait of Georgia, and it supported very productive old-growth forests. During an interview in 2021 (Huggins & Thompson, 2022), Florence shared:

“The huge change is on the east side of Galiano Island, there's no more trees. There was old growth there - huge, huge trees. And I missed them and my husband did too, because when he fished he used those trees for a mark… like way up in the forest that rise high - the old growth. They're all gone.”

During the excavation of a B.C. Tel line in Cable Bay in the early 1990s, an archeological survey characterized a site (**DfRu 74**) along the immediate coastline as a “long-term base camp” dating back at least 2500 years, containing a “virtually unique and complex” ceremonial feature (Wilson, 1992). **The location of this site is known to the GCA, and will not be impacted by proposed restoration treatments.** The GCA works closely and communicates regularly with Indigenous people with rights and responsibilities on Galiano Island. This project creates opportunities to work together *nuts’a’maat* - with one heart and one mind - to restore ecological and cultural values, so that Qw’xwulwis can once again be a place where old-growth forests, rich freshwater ecosystems, and human relationships thrive.

Context

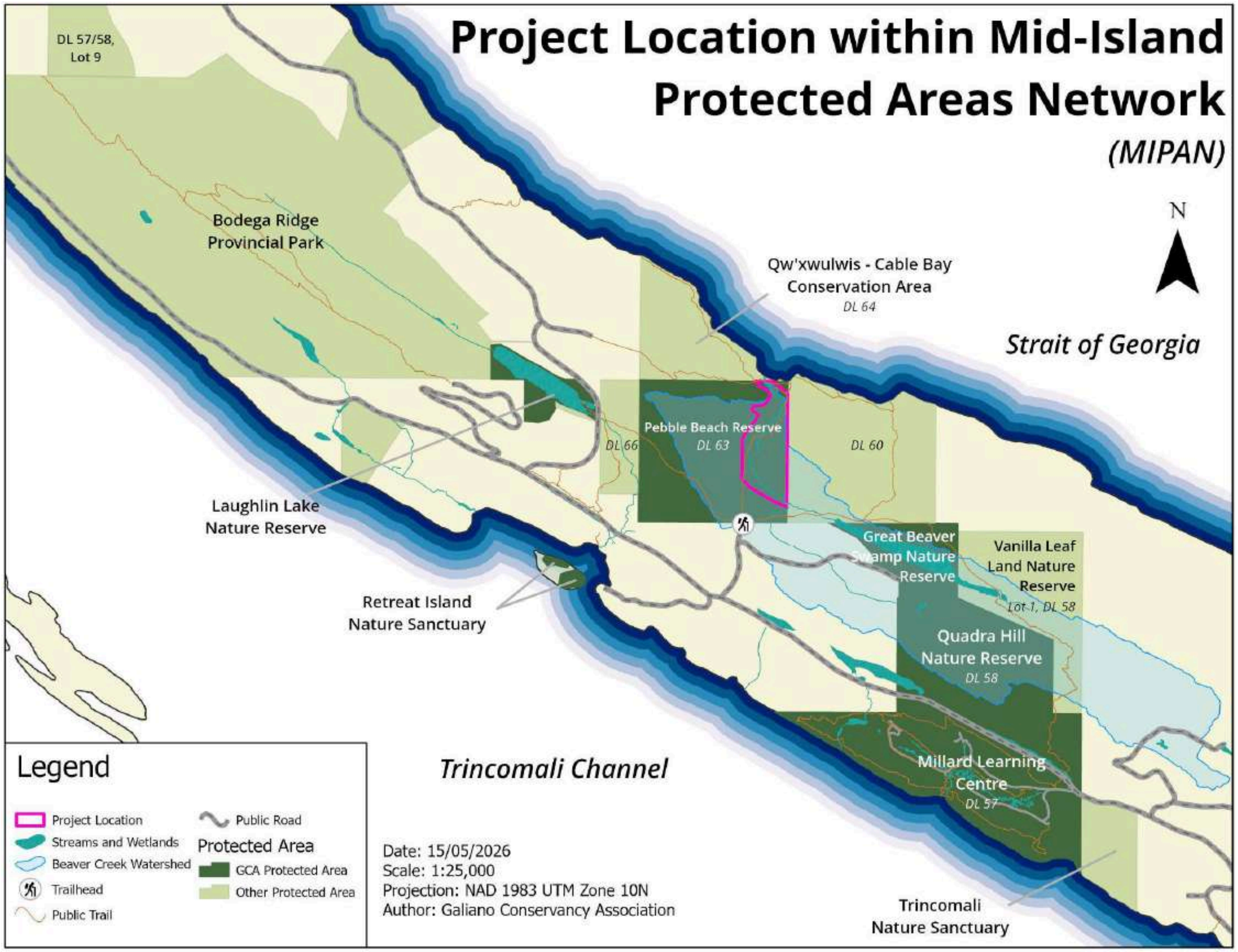
Beaver Creek Watershed

The 182 ha “Beaver Creek” watershed on Galiano Island enjoys a high level of protection and connectivity relative to other similar watersheds in the Southern Gulf Islands. Following decades of destructive industrial and land development forestry, 56% of the watershed has been protected by the Galiano Conservancy Association (GCA) and other regional conservation organizations as part of the Mid-Island Protected Areas Network (MIPAN); an additional 5% is Crown Land. Natural processes and active ecological restoration programs are both assisting in the recovery of forest and wetland ecosystems throughout the watershed. The Melissa Road neighborhood is located partially within the watershed.

At the heart of the upper watershed is the “Great Beaver Swamp”, a 6 ha shallow open water wetland complex created and maintained by beavers. This historical wetland was drained in the 20th century for agriculture, subsequently reforested, and began to flood again in the early 2000’s following the return of beaver. The Great Beaver Swamp was protected by the GCA in 2003.

The Great Beaver Swamp terminates just across the property line onto District Lot 60 (DL60), which is Crown Land. There, it is channelized beneath a gravel road through a 120 cm diameter grated culvert, forming a dividing line between the upper and lower watershed. As recently as the mid-2000s, beaver were active in both upper and lower watershed areas, but have since retreated to the upper watershed. A small beaver dam built against the grate on the grated culvert intake is currently being drained by several plastic pipes.

The lower watershed consists of a perennial creek (“Beaver Creek”) descending through a narrow, winding valley. The section of the creek that passes through the mature forests of DL60 exhibits healthy structure, with sufficient large woody



Map 2: *Location of Beaver Creek watershed and project area within the Mid-Island Protected Areas Networks (MIPAN) on Galiano Island. Note that DL 60 and DL 66 are Crown Land that have been locally zoned for 'Nature Protection'. DL 60 is listed as a 'Recreation Site' by the Province.*

debris present to maintain channel complexity. Several bedrock outcrops limit incision in this upper reach.

***Figure 5:** Complex natural creek structure in lower Beaver Creek on District Lot 60, 2025*

Shortly after the creek crosses the property line into the Pebble Beach Reserve, its condition starts to deteriorate.

Pebble Beach Reserve

All project activities will take place on the Pebble Beach Reserve property. The 61.5 ha Pebble Beach Reserve (DL63) was acquired by the GCA in 1998. The property had been logged intensively in the mid-20th century by MacMillan Bloedel: this includes clearcuts in 1968 and 1978, followed by the bulldozing of topsoil and slash into large windrows, partial combustion of the windrows, and replanting with uniform rows of genetically similar Douglas-fir (Pseudotsuga menziesii). Beaver Creek was logged to its bank in 1978, with no buffer retained. In the early 2000s, the GCA implemented a restoration program to increase the structural complexity and diversity of young Douglas-fir plantation forests found across the property. Today, the property is best known for a popular Cable Bay hiking trail that crosses and parallels lower Beaver Creek on its way to the shoreline.

The land is bound by a Section 219 covenant held by the Islands Trust Fund and the Province of British Columbia. The covenant states that any restoration or alteration to the land must be consistent with the management plan. The management plan directs the GCA to “determine and carry out any actions that may be suitable for habitat restoration or enhancement” with respect to Beaver Creek.

***Figure 6:** DL 63 following 1978 clear-cut logging by MacMillan Bloedel; location of Beaver Creek shown by blue dash line*

Lower Beaver Creek

Beaver Creek is a perennial, non-fish bearing creek that experiences high flows in the winter and very low flows during the summer drought. 916 m of Lower Beaver Creek occur within the Pebble Beach Reserve. The final 36 m of the creek occur on the neighboring Qw'xwulwis - Cable Bay Conservation Area, owned by the Nature Trust of BC and managed by the GCA. **The creek descends over a roughly 15 foot rock face into the Strait of Georgia, preventing fish passage; Beaver Creek has been surveyed many times and is not considered to be fish-bearing.**

Figure 7: *Sandstone fish barrier at outlet of Beaver Creek at Cable Bay, Galiano Island*

Between 2000 and 2004, ten active beaver dams were mapped in Lower Beaver creek, and several were photographed. Despite the relatively narrow floodplain, pools formed behind these dams accumulated over a meter of sediment in many areas. At some point in the late 2000s or early 2010s, beaver abandoned the lower watershed, and their dams were breached. Without sufficient retention features in the form of logjams and beaver dams, the creek has become channelized and incised, resulting in erosion and a disconnect between the active channel and the historic floodplain. Incision ranges from 0.5m to 1.5m.

Figure 8: *Incised channel at site of former beaver pond on lower Beaver Creek, 2025*

Figure 9: *Beaver activity on lower Beaver Creek, 2004*

There are no buildings or infrastructure located in, near, or downstream of the section of Beaver Creek creek on the Pebble Beach Reserve. The creek is crossed by old logging roads at two locations. Crossing #1 is an earthen bridge supported by massive, rotting logs. This bridge doubles as the hiking trail crossing for the Cable Bay trail. Starting in 2024, sinkholes began to form in the bridge as the support structure began to fail. The GCA has purchased a locally-made clear-span bridge and placed it to span the existing crossing in order to temporarily allow safe public use of the trail until it can be permanently installed. **There is an urgent need to remove and replace Crossing #1 before it collapses into the creek.**

Figure 10: *Sinkhole forming in Crossing #1, 2025*

Figure 11: *Reach 2, just above Crossing #2, in January of 2000; this area was a saturated floodplain, with water at or near the soil surface*

Figure 12: *Same view as Figure 11 in July of 2026; the creek is incised ~1m, salal has encroached on the floodplain, and the red alders are all dying or dead*

Figure 13: *Reach 3 in February of 2004, when two large beaver dams maintained open water wetlands within the creek floodplain*

Figure 14: *Same view as Figure 13 in July of 2026; the dams have long since washed out, and the creek has incised between 0.5 and 1m*

Figure 15: *Reach 3, just above Crossing #1, in February of 2024; this area was a saturated floodplain located upstream of several beaver dams*

Figure 16: *Same view as Figure 15 in July of 2026; the creek is incised between 0.5 and 1m, and flooded areas are no longer present*

Figure 17: *Crossing #1 in February of 2004, with beaver wetland in foreground*

Crossing #2 is an old road built directly through the floodplain. A corrugated steel culvert that allowed the creek to pass under the road was removed in the early 2000s and is still present on site. The creek remains channelized within the ditch left behind following culvert removal. Further incision has been prevented by several mature red alder (*Alnus rubra*) trees immediately downstream of the crossing, but washout of the road material during future high flow events is a concern.

Figure 19: *Channelized flow at Crossing #2 in 2025, following removal of steel culvert in 2000*

Lower Beaver Creek is one of only a few perennial creeks on Galiano Island, and one of the only creeks that flows through protected areas for most of its length. Even in a partially-degraded state, it supports healthy riparian vegetation and provides

Figure 18: *Same view as Figure 17 in March of 2025, with incised channel in foreground*

high quality habitat for native mammals, birds, and amphibians. Large woody debris, bedrock outcrops, and other elements of structural complexity are present in the floodplain. Tens of thousands of community members and visitors visit the creek every year as they hike down to Cable Bay and Pebble Beach. Beaver continue to be present in the upper watershed. Timely intervention to remove old logging roads, halt further incision, and attract beaver back to the lower watershed will safeguard existing values, improve hydrology and habitat quality, and create a highly-visible demonstration site for beaver-based restoration practices.

Beaver-Based Restoration

Land managers are increasingly working to attract and maintain beavers, the master ecosystem engineers who have regulated freshwater ecosystems across North America for thousands of years. The presence of beavers in a watershed can improve freshwater quality by securing existing fine sediments, slowing water to allow fine sediment to filter and deposit, and lengthening the residence time of water on the landscape, resulting in increased filtration of toxicants (Pollock et al., 2015; ECCC,2016).

Beaver dams in the landscape contribute to a number of positive effects in a watershed, including restoring incised streams, promoting sedimentation, increasing species richness, enhancing hydrologic function through increased local water tables, attenuating peak runoff, increasing baseflows, and enhancing overall resilience to disturbance.

Beaver activity and riparian vegetation are integral to stream ecosystems under natural conditions. Beavers will dam incised streams during low flows. However, stream power is often too high, leading to blowouts or endcuts that will widen the incision trench. An inset floodplain will form, decreasing stream power and increasing the potential for beaver dams to remain intact. Beavers are then able to build wider, more stable dams in the channel. Sediment accumulates behind these dams, allowing for the establishment of riparian vegetation. This process repeats until the beaver dams raise the water table and the stream reconnects to its former floodplain. The stream ecosystem continues to develop complexity with beaver dams, live vegetation, dead wood slowing the flow of water (Pollock et al., 2014).

To restore streams in the absence of beaver, restoration practitioners have developed a suite of practices known collectively as **low-tech process-based restoration.** The guiding philosophy behind this approach is to return missing structural attributes to degraded streams, catalyzing a long-term process of recovery where the creek (and, hopefully, beaver) do the work of restoration (Wheaton et al., 2019). These missing structural attributes are beaver dams and large woody debris accumulations. To mimic these natural structures, practitioners have developed and trialled a variety of designs for **beaver dam analogues (BDAs)** and **post-assisted log structures (PALS).** When a large number of these small structures are installed strategically in a degraded creek channel, they can initiate a recovery process analogous to that promoted by beaver activity, as described above (and see ***Figure 20***). In addition to initiating recovery for the stream, these structures also produce habitat that is more attractive to beaver, potentially leading to recolonization of the reach by beaver. Establishing desirable native species in or near the floodplain further increases the suitability of the habitat.

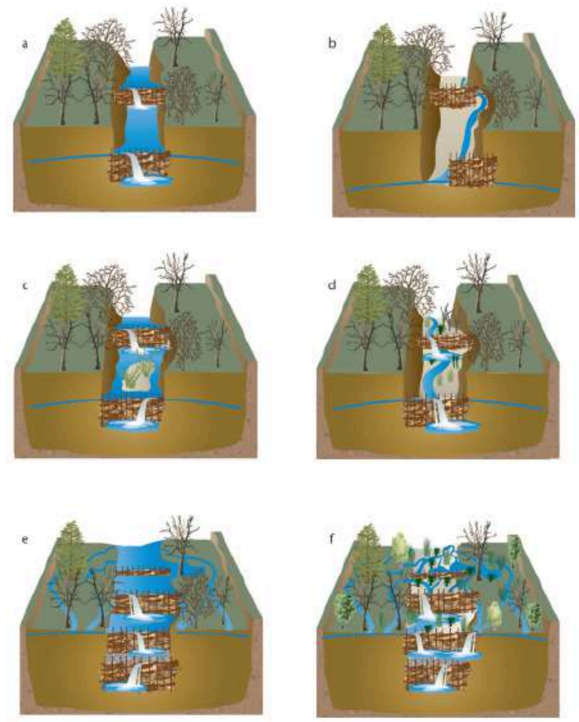


Figure 20: *Sequence of observed stream ecosystem changes when BDAs are used to aggrade a stream (Pollock et al., 2014)*

Low-tech process-based restoration was developed as an alternative to **form-based** restoration, which employs heavy machinery to re-engineer stream and wetland ecosystems. This project will employ form-based restoration where road crossings are directly impacting Beaver Creek, and low-tech process-based restoration where incision has occurred in the absence of beaver. At crossing removal sites, **vertical grade control (VGC)** will be installed to prevent headcut formation following the disturbance associated with crossing removal. VGC typically consists of clean, acid-free rock surface armouring installed to protect soils.

Ecological Restoration

Project Overview

The GCA's approach to restoration of Beaver Creek will be guided by a clear set of objectives.

Vision for Recovery

Following decades of destructive clear-cut logging, lower Beaver Creek is a complex, biodiverse freshwater ecosystem that is sustained by beaver and human stewards, supporting the recovery of productive old-growth forests and species at risk. Community members and visitors watch the creek evolve as they descend the Cable Bay trail, gathering along the shoreline to enjoy nature and practice traditional ways of life.

Goals

1. Remove defunct logging road crossings that are channelizing and negatively impacting the function of Beaver Creek
2. Catalyze the recovery of incised and channelized sections of Beaver Creek using low-tech process-based techniques that invite community participation
3. Enhance the riparian habitat to attract beavers to lower Beaver Creek, ensuring the long-term maintenance of a healthy and complex stream
4. Replace the Cable Bay trail crossing and provide interpretation, drawing attention to beaver co-existence and low-tech restoration practices
5. Create opportunities for Indigenous people, community members, and regional practitioners to work together on the land, sharing knowledge and learning new skills

Objectives

1. By September of 2026, deliver at least 3 hands-on low-tech process-based restoration workshops to diverse participants, including community members, students, youth, and Indigenous people
2. By October of 2026, install a minimum of 30 and a maximum of 70 low-tech structures in strategic locations within incised reaches of Beaver Creek
3. By November of 2026, use an excavator to carefully remove two defunct road crossings and repair channelization at crossing locations on Beaver Creek, creating three wetland pools immediately upstream and downstream of crossings
4. By November of 2026, replace road Crossing #1 with new, locally made clear-span bridge to maintain and improve the Cable Bay trail
5. By March of 2027, Establish at least 500 native plants along Beaver Creek to provide food and material resources for beavers and enhance biodiversity
6. By April of 2027, design and install at least 3 interpretive signs along the Cable Bay trail that highlight ecological and cultural values
7. By June of 2027, document the response of Beaver Creek to restoration treatments through repeat photography, amphibian egg mass surveys, acoustic monitoring, camera traps, and mapping of changes in channel structure

Project Timeline

Implementation of restoration treatments will begin in August of 2026 and conclude in March of 2027. Periodic monitoring and ongoing stewardship activities will be required for several years following implementation. The timeline will be as follows:

May - July 2026

- Schedule and advertise public workshops
- Ongoing outreach to Indigenous peoples
- Secure all required permits and covenant holder approvals
- Baseline photopoint, acoustic, and camera trap monitoring of project site
- Planning and logistics; if low-risk fire conditions emerge, clear road accesses

August 2026

- Deliver low-tech process-based workshops
- Install low-tech structures in Reach 1 and 3

September - October 2026

- Remove Crossings 1 and 2 and restore impacted sites, including shallow pool construction
- Install clear-span footbridge at Crossing #1
- Install low-tech structures in Reach 2

November 2026 - March 2027

- Establish native plants from nursery stock and live stakes in riparian area
- Monitor performance of low-tech structures and maintain as needed
- Perform amphibian egg mass surveys

April - May 2027

- Install permanent interpretive signage
- Perform post-restoration photopoint, acoustic, and camera trap monitoring

Regional Timing Windows

Fish and Fish Habitat

Beaver Creek features a rock barrier to fish passage at its outlet and is not considered to be a fish-bearing stream. Nevertheless, work will be targeted for the reduced risk timing window to prevent potential impacts to fish habitat and all life stages of fish, should any be present. Instream project activities are planned between July 2026 and October 2026. Low-tech structure installation will be initiated between August 1 to September 15 to reduce the potential for harm, and to coincide with the lowest seasonal flows in Beaver Creek.

In the seasonally dry Coastal Douglas-fir zone (CDFmm), the reduced risk window for fish coincides with a period of extreme fire danger. Machine work cannot be conducted (or only conducted with significant limitations) during this timing window (see Wildfire Risk, below). The project manager will monitor wildfire conditions closely during the reduced risk window, and initiate machine work as early as possible in September. Depending on fire danger conditions, machine work may need to be delayed to late September or early October.

Amphibians and surrounding habitat

Amphibians have the potential to occupy the habitat even if proposed works are conducted during the least risk timing window. To mitigate this, a General Wildlife Permit will be obtained and any amphibians or reptiles encountered during construction in September through October will be safely relocated out of the path of construction. This work will be carried out by a Qualified Professional following the Best Management Practices for Amphibian Reptile Salvages in British Columbia Guidelines.

Birds

Under the Migratory Birds Regulation (Government of Canada, 2022), it is illegal to capture, kill, take, injure, harass a migratory bird or attempt to do so (Section 5(1)(a)), destroy, take, or disturb a live egg (Section 5(1)(b)), or damage, destroy, remove or disturb a nest, nest shelter, eider duck shelter or duck box that contains a live bird or egg unless the nest was built by a species listed on Schedule 1 (Section 5(1)(c) and (2)). In BC under the Wildlife Act (B.C. MOE, 1996), it is illegal to possess, take, injure, molest or destroy a bird, its egg, or nest occupied by a bird or its egg, unless the nest was made by an Eagle, Peregrine Falcon, Gyrfalcon, Osprey, Heron or Burrowing Owl, in which case the nest is protected in perpetuity (Section 34).

The project site occurs within the Northern Pacific Rainforest (BCR 5) nesting zone and occupies forest and wetland habitats. All machine work will be conducted in the least risk timing window between August 16th and March 30th. No tree containing a Great Blue Heron nest, or Pileated Woodpecker nest cavity will be removed. Danger trees and any additional thinned trees for low-tech structure materials will be felled between June and early August. A Wildlife Danger Tree Assessor will survey each tree to be removed to ensure no nests are present in the tree, and that no nests that may be present in nearby trees will be disturbed.

Wildfire Risk

Some project activities carry a risk of wildfire ignition, especially during the summer seasonal drought on Galiano Island. Schedule 3 of the Wildfire Regulation provides clear guidelines for operating machinery, such as the hydraulic- or gas-powered post pounders, chainsaws, or heavy machinery in extreme danger class ratings (B.C.M.O.F, 2005). These kinds of machinery cannot be operated if the project site is situated within an extreme danger class that had a rating of extreme for three consecutive days, unless the machinery is operated before 1pm and a 2 hour fire watch is maintained after their use.

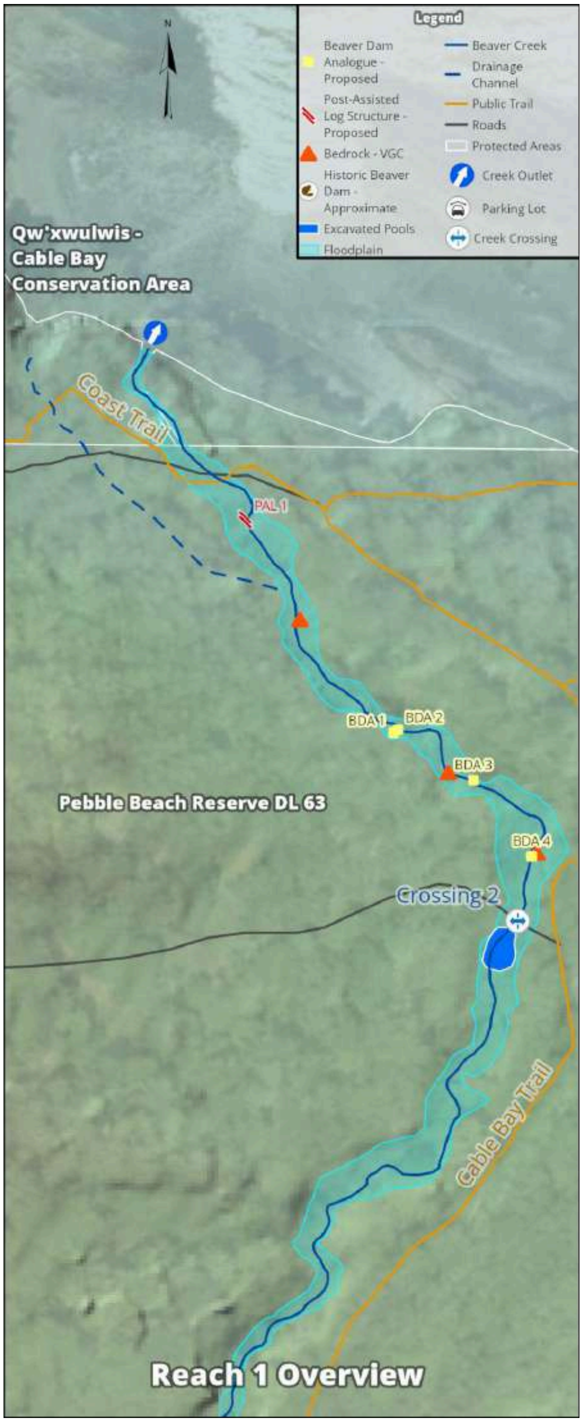
The following mitigation measures will be applied to minimize risk of initiating a wildfire during restoration activities:

- The project manager will monitor the local fire risk ratings, adhere to local restrictions, and work with the Galiano Volunteer Fire Department (GVFD) to ensure that all project activities are compliant.
- Work requiring chainsaw operation or mechanical post pounding will be completed prior to 1 pm, and a 2 hour fire watch will be implemented.
- Machine work will commence in September or early October, as soon as local fire restrictions end. If low-risk fire conditions emerge between May and July, road clearing activities may take place.
- Emergency fire suppression equipment will be on site prior to any work which carries fire risk, and will include:
    - a piss pump
    - fire extinguisher rated B-C, stored at the refuelling location for any gas-powered equipment
    - hand tools for suppressing fire
- During machine work, several pumps will be present on site to transport water around crossing removal and VGC installation sites, and can be employed to suppress fire if needed.
- Should a fire ignite and not be controlled, staff will immediately notify the GVFD and BC Wildfire Service, and will work to suppress the fire until they arrive.

Project Sites

Lower Beaver Creek - Reach 1

Length: 222 m **Average Slope:** 10%



Map 3: *Map of Reach 1 of project site, from creek outlet up to Crossing #2*

The lowest reach of Beaver Creek extends from the outlet on the steep sandstone shoreline of Cable Bay up to Crossing #2. It is crossed in one location by the "Coast Trail", over a small wooden boardwalk. No activities will take place below the trail crossing, as bedrock and well-established tree roots are currently serving to stabilize the channel.

Figure 21: *Beaver Creek, just above outlet to Cable Bay*

Above the trail crossing, Reach 1 is a narrow, steeply sloping channel pressed between two low sandstone ridges running roughly parallel to the shoreline. Bedrock grade control is present in several locations, as is large woody debris in the channel. Four BDAs and one PALS are proposed for Reach 1, with the intent to recover incised channel sections and capture any suspended sediment from upstream restoration activities. Low-tech structures will be installed in Reach 1 before any other instream activities take place.

An approximately 2m wide and 2m deep diversion channel was excavated parallel to Reach 1 for an unknown purpose in the past. It has partially revegetated, and was "plugged" with a chunk of clay soil that is now secured by the roots of several mature red alder (*Alnus rubra*) trees. Flow is intermittent in winter and dry in summer. If resources and time allow, this diversion will either be partially back-filled to disable it as a ditch, or re-activated and enhanced using additional low-tech structures as a side channel to the creek.

Lower Beaver Creek - Reach 2

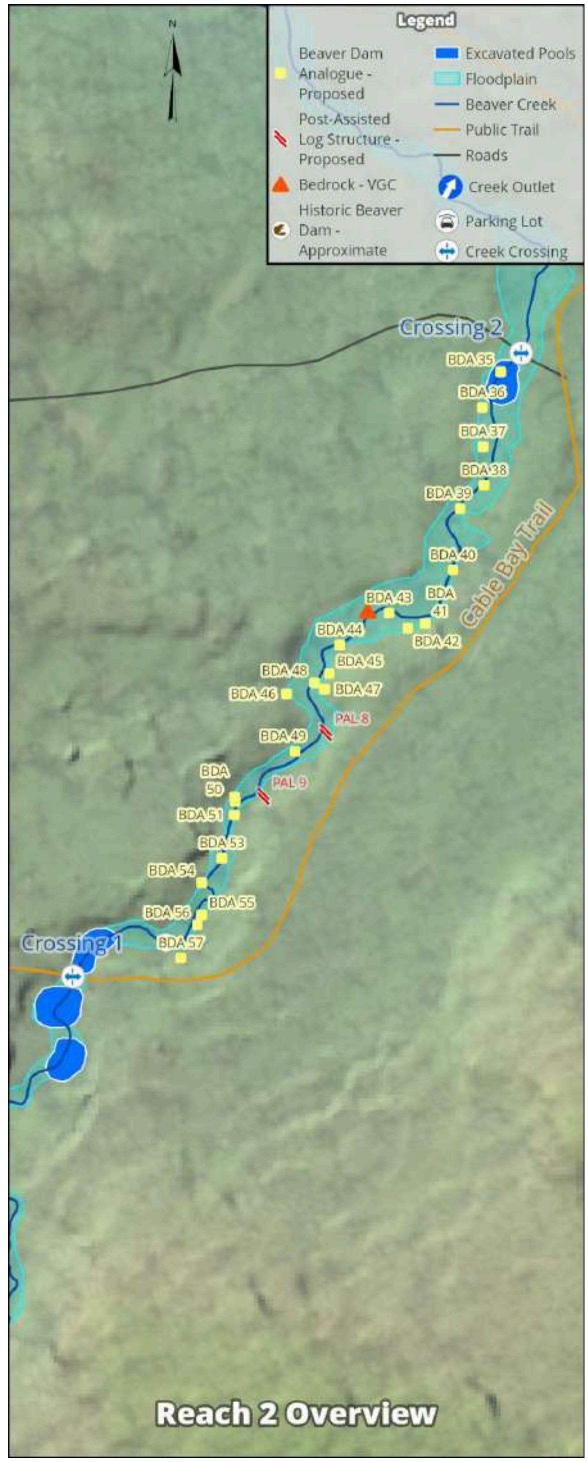
Length: 250 m **Average Slope:** 5%

Reach 2 extends from Crossing #2 up to Crossing #1, and has the lowest average gradient, creating a significant opportunity to recover the historic floodplain. It is also the reach that has experienced the most human disturbance from logging and road construction. The popular Cable Bay trail is routed down an old logging road that parallels this reach to the east.

Figure 22: Incised channel in Reach 2

23 BDAs and two PALS are proposed for Reach 2. These low-tech structures are intended to create pools and catalyze widening of the incision trench, redistributing floodplain sediments over time and allowing the creek to aggrade sufficiently to connect with the historic floodplain.

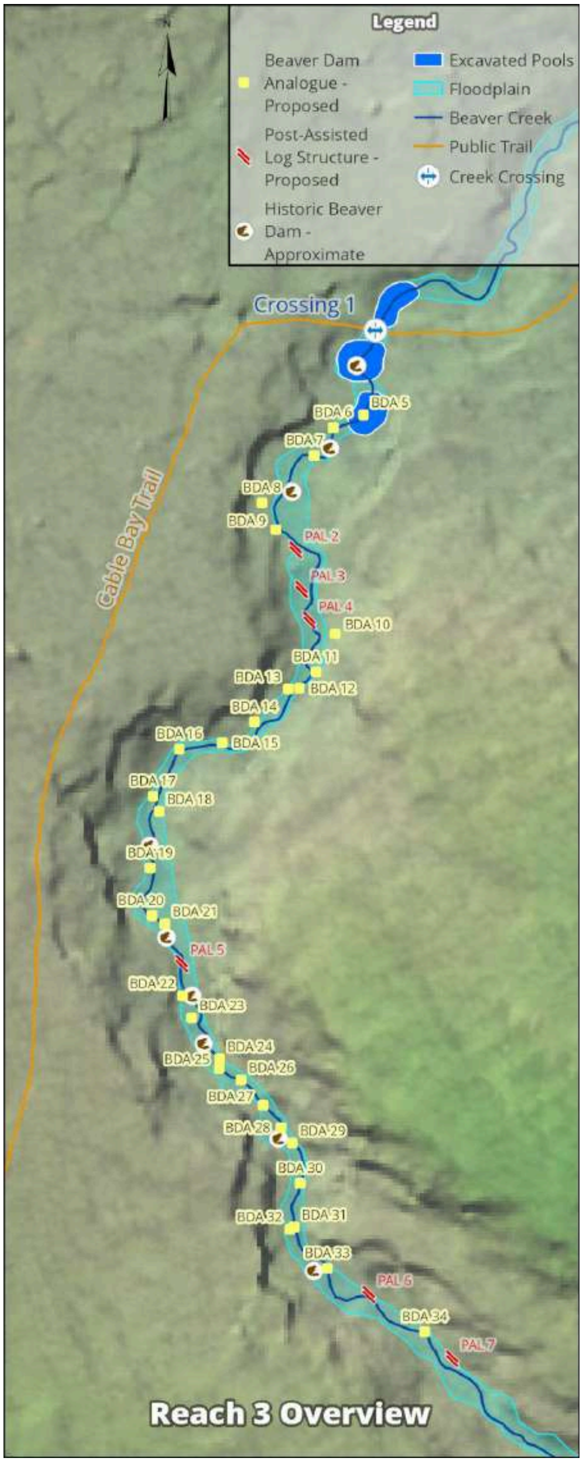
Reach 2 will have the highest public visibility. Low-tech structures here will be installed after restoration at Crossings #1 and #2, in order to avoid any flooding or waterlogging of soils prior to machine work. Placement of low-tech structures may be modified slightly in response to creek behaviour following crossing removal and restoration activities. Depending on available resources and creek response, some structures may be installed later, in 2027.



Map 4: Map of Reach 2 of project site, from Crossing #2 up to Crossing #1

Lower Beaver Creek - Reach 3

Length: 537 m **Average Slope:** 7.5%



Map 5: *Map of Reach 3 of project site, from Crossing #1 up to end of project area*

Reach 3 extends from Crossing #1 up to the edge of the project area, roughly 200 m downstream from the property line. It is intermediate in slope between Reaches 1 and 2, and includes both narrow steeper sections and broader sections with thick layers of deposited sediment. Remains of historic beaver dams have been documented on all three reaches, but Reach 3 is where 9 out of 10 historic beaver dams mapped in 2000 were found.

Figure 23: *Location of breached historic beaver dam in Reach 3, with incised channel more than 1 m below historic floodplain*

30 BDAs and six PALS are proposed for Reach 3. These low-tech structures are intended to create pools and catalyze widening of the incision trench, redistributing floodplain sediments over time and allowing the creek to aggrade sufficiently to connect with the historic floodplain. Structure siting was based in part on the mapped location of historic beaver dams. Low-tech structures will be installed after those in Reach 1, and before removal and restoration of Crossings #1 and #2. Due to easy access to materials and sufficient space to work within the floodplain, Reach 3 will be the target reach for hands-on public workshops on low-tech process-based restoration.

Above Reach 3, the structure of the creek improves and becomes more natural. Several bedrock outcrops provide for natural vertical grade control, and no additional actions are proposed.

Crossing #1

The restoration design for Crossing #1 includes careful removal of the collapsing old log bridge, installation of rock vertical grade control (VGC) and excavator-built beaver dam analogue (EBDA), and construction of up to three wetland pools immediately above and below the crossing site. Excavated pools will provide inviting starter habitat to attract beaver. The sequence will be as follows:

- Prior to machine work, low-tech structures will have been installed downstream (see Reach 1, above) to capture and settle any sediment created during upstream restoration activities.
- Wetland #1 upstream of the crossing removal site will be built first, followed by wetland #2. While the stream is filling these shallow wetland pools, there will be an operational window to remove the crossing and build the rock VGC with very little flow, as most of the flow will be taken up with filling the two upstream wetlands.
- Any excess flow from wetland pools will be pumped around the crossing site and deposited immediately downstream during removal of Crossing #1
- The excavator will gently scrape the 70cm layer of road-bed material (coarse sand and gravel) in thin layers from the surface of the old log bridge. This material will be set aside on high ground where it will not be mobilized by the stream. If it is too difficult to remove this material with an excavator without causing the logs to collapse, workers will hand shovel the road surface material into the excavator bucket. The excavator will swing the removed material onto higher ground.
- Once the road-bed material has been completely removed from the logs, the excavator will carefully remove the cross logs, followed by the bridge footing logs. These logs will be used as **coarse woody debris (CWD)** in Wetlands #1 and #2.
- Rock VGC will be installed using up to 50 m^3 of 30-50 cm sediment-free rock to protect the elevation of the outlet of Wetland #2, and stabilize the base elevation and path of the stream where it flows under the replacement footbridge.
- Immediately after the construction of the rock VGC, an EBDA will be installed at the downstream end of the rock VGC. This will capture any sediment flow from the rock VGC and allow it to settle out.
- While the EBDA is being built, a hand-built BDA will be installed approximately 17 m downstream to form Wetland #3. This will ensure that most sediment created by the VGC construction and other upstream works will be captured and settled in situ.
- A 10 m metal clear-span footbridge will be installed to replace the old crossing. The bridge will be provided with adequate clearance, rock-armored banks, and lockblock anchors.

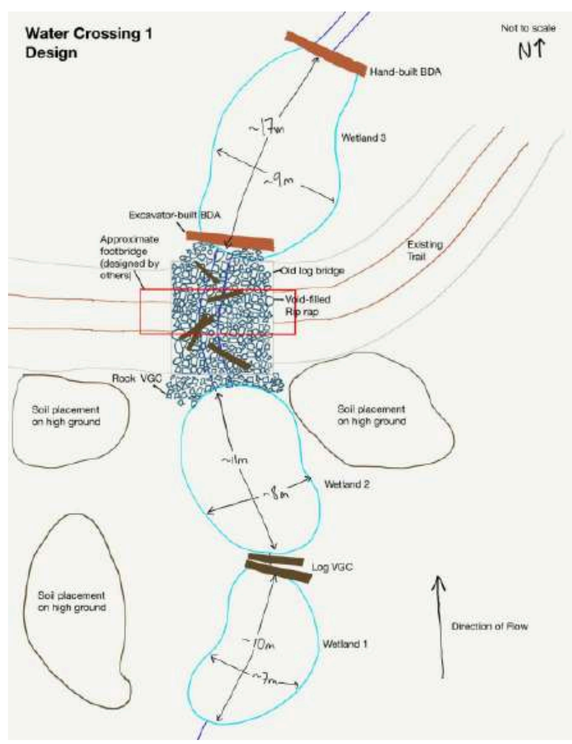


__Figure 24:__ Restoration design for Crossing #1 (Rewilding Water & Earth)

Crossing #2

Crossing #2 was likely the site of a historical beaver dam, with an upstream beaver pond that captured a layer of sediment approximately 60-100 cm deep. With the loss of beaver, the stream has become incised, mobilizing the sediment deposited in the former beaver pond. 10 to 18m Downstream from Water Crossing #2, exposed bedrock is present, functioning as an unerodeable VGC for the creek. The restoration design for Water Crossing #2 includes removing and de-compacting the road prism material that was placed in the stream and floodplain when the road was built, as well as construction of a VGC at the road removal site and construction of a wetland pool upstream of the road removal. The sequence will be as follows:

- First, the road will be physically decompacted and left rough and loose. Road material will be placed on high ground where it cannot be mobilized by the stream.
- Adjacent to the stream is a popular public trail. To prevent the stream from flowing into the trail during construction, the elevation of the road east of the creek, which is currently preventing water from flowing into the trail, will be maintained. The road material will be made rough and loose. Any organic soils from the upstream wetland excavation will be placed on the loosened road prism and top dressed with coarse woody debris to facilitate revegetation.
- After de-compacting the road prism material, a wetland will be built upstream of the road removal / VGC installation site to create habitat for amphibians, birds, and bats. This wetland habitat will also support beaver reoccupation. The wetland will be constructed by re-shaping the floodplain on either side of the incised stream channel, while leaving the stream undisturbed.
- After the wetland is shaped, the channel will be breached to allow the constructed wetland to fill from the incised stream channel. Excess soil will be placed on higher ground on either side of the creek. Soil placed will be shaped in naturally appearing ridges and mounds and top-dressed with coarse woody debris to facilitate revegetation.
- While the wetland pool is filling with stream flow, an operational window will be created when the rock VGC can be constructed while there is very little or no stream flow. Rock will be harvested onsite.
- The VGC will be constructed at the road removal site, grading down to the exposed bedrock downstream. The placement of this VGC will prevent channel incision and erosion downstream. Additionally, it will protect the newly excavated wetland upstream of the road removal site from washing out.

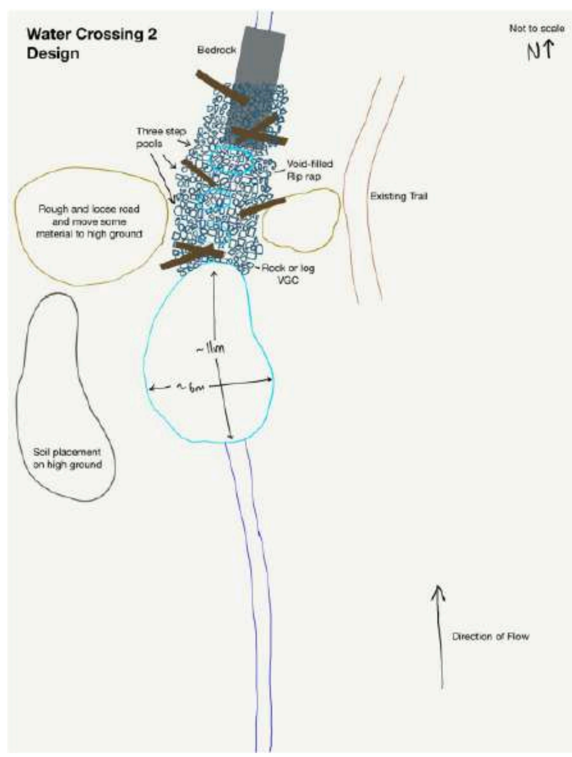


Figure 25: *Restoration design for Crossing #2 (Rewilding Water & Earth)*

Riparian Planting

Healthy native riparian vegetation is already present in all three reaches of Beaver Creek. Planting efforts will be directed towards:

- Ensuring rapid and dense revegetation of native trees, shrubs, and herbs on all areas disturbed by road removal, wetland pool construction, and VGC installation
- Establishing productive populations of native shrub and trees species that are desirable to beavers for food or materials throughout the Beaver Creek floodplain

Plant establishment will be via live-stakes collected on nearby sites and nursery plants grown from seed collected on Galiano Island in the GCA nursery. Planting will take place in stages between October of 2026 and March of 2027, based on the best time to establish distinct species groups in the GCA's experience. At least 500 plants will be established.

Select plants established at Crossing #1 and #2 following road removal will require browse protection from deer during establishment, and will be caged. Plants established to attract beaver will not be caged; instead, CWD generated from danger tree removal and selective thinning of overstocked young Douglas-fir immediately upland of the riparian area will be strategically placed to create browse barriers that discourage deer from accessing densely planted sections of the floodplain (see Whyte et al., 2019).

Upland Road Removal

As time and resources allow, defunct logging road segments upstream of lower Beaver Creek may be removed following restoration of Crossing #2. Road segments will be physically de-compacted and left rough and loose, and CWD will be incorporated into loosened soils from the immediate surroundings. Any roadbeds deemed beneficial for future firefighter access or ongoing land stewardship activities will be retained.

Low-Tech Structure Design

Beaver Dam Analogues (BDAs)

BDAs are temporary, permeable, channel-spanning structures that can be built with or without posts, using a combination of woody vegetation, sediment, and rock (Wheaton et al., 2019). They are intended to mimic the structure and function of beaver dams. Design and construction techniques can vary based on flow regime, material availability, and project objectives. BDAs are typically installed in groups for redundancy, reducing the importance of any single structure.

BDA construction, alongside road removal and riparian vegetation restoration, is a proven approach to restoring beaver populations. BDAs are known to temporarily provide many of the benefits of beaver dams, improving habitat conditions in anticipation of their return (Corline et. al, 2022). Beavers are often attracted to habitat that has been enhanced by BDAs, and are likely to maintain, improve, and expand upon these structures, increasing their function and longevity.

BDAs promote local flooding and sediment deposition. Most BDAs proposed in this project do not exceed 50 cm in height, and each BDA floods only a small area. The maximum extent of potential flooding in Beaver Creek is limited by the narrow valley in which the creek is situated; see ***Maps 3-5*** for the mapped extent of the historic floodplain.

Materials for BDA construction will be sourced onsite from the overstocked plantation forests immediately bordering the floodplain of Beaver Creek. Certified Fallers will be directed to thin select Douglas-fir trees from these areas, falling them into the floodplain near where low-tech structures are to be installed in order to minimize disturbance from material transport. Thinning these trees will also create canopy gaps to allow the establishment of riparian plantings that require ample sunlight, such as willows and cottonwoods.

The GCA has partnered with the BCWF to train staff in siting and constructing low-tech structures. A list of low-tech structures is found in **Appendix I.** Conceptual designs for BDAs to be used in this project are found in **Appendix II**.

Post-Assisted Log Structures (PALS)

PALS are flexible wood structures that can be oriented to promote sinuosity within a straightened channel, capture sediment and wood, and/or generate sediment. They are designed to mimic and promote wood accumulation in riverscapes. Construction requires woody material of various sizes pinned together by wooden posts vertically driven into the streambed. They can be built in a variety of shapes and sizes, be channel spanning, bank-attached, or mid-channel depending on desired function. PALS can be used to achieve a range of restoration outcomes including: creating high flow refugia for aquatic species; increasing channel-floodplain connectivity at high flows; increasing physical complexity by altering patterns of erosion and deposition; and promoting channel incision recovery by forcing channel widening and aggradation (Wheaton et al., 2019)

Materials for PALS construction will be sourced similarly to that of BDAs (see above).

Access, Mitigation, and Safety

Access

Access to the project area is via the Pebble Beach Reserve parking lot, at the end of McCoskrie road on Galiano Island.

Machine access to Crossing #1 is via a 500 m segment of the Cable Bay trail, which was built on an old logging road surface and is still passable by trucks and heavy machinery.

Machine access to Crossing #2 is via approximately 2 km of old MacMillan Bloedel logging roads within the Pebble Beach Reserve that were never fully decommissioned. Some effort is required to clear fallen logs and brush off of sections of these roads to enable an excavator to pass. Following restoration of Crossing #2, any roadways no longer in use will be restored as the excavator exits the site, and any roads that are desirable to provide access for future land stewardship activities will be retained but blocked off until needed in the future.

Archaeological Chance Find

Prior to commencement of machine work, GCA staff and contractors will be familiarized with the Islands Trust's chance finds protocol, and proceed accordingly. The land manager with Penelakut Tribe has been made aware of the project, and the GCA will employ environmental monitors from Penelakut Tribe if the proposed sites for machine work overlap with sites of high potential within the provincial RAAD database. All project activities take place upstream of DfRU-74 and are not anticipated to have any impact on the site.

Development Permit Areas

The Galiano Island Official Community Plan includes seven Development Permit Areas (DPAs) to protect natural values and sensitive ecosystems on Galiano Island. The entirety of the project site falls within DPA 1 - Riparian Areas and DPA 3 - Tree Cutting and Removal; portions of the project site also fall within DPA 5 - Sensitive Ecosystems, and DPA 7 - Steep Slope (Moderate Hazard).

The activities proposed in this plan are considered to be exempted from any requirement for a development permit.

- Danger tree removal is exempted as follows: "the removal of trees that have been examined by an arborist and certified to pose an immediate threat to life or property."
- Restoration and bridge replacement activities will be exempted as follows: "ecological restoration and enhancement

projects undertaken or authorized by a public body" and specifically, following securement of a Section 11 Change Approval, "changes in or about a stream authorized under Section 9 [now Section 11] of the Water Act [now Water Sustainability Act]."

- All thinned Douglas-fir trees will be felled from upland areas outside of the riparian zone, retained on site for use in restoration treatments, and will not exceed the thresholds outlined in DPA 3

Erosion Control and Mitigation

Erosion and deposition are natural processes and essential parts of healthy stream function. The purpose of this project is to reduce current high levels of erosion due to channel incision resulting from the absence of beaver in this stream reach: specifically, the project is designed and intended to prevent failure and mass erosion of road crossings in the short term, as well as chronic erosion of rich accumulations of sediment in the floodplain over the long term. To achieve project goals, however, floodplain sediments must be dynamically redistributed through a well-defined process of widening and aggradation (Pollock et al., 2014) to reverse two decades of channel incision. BDAs and PALS are situated strategically within Beaver Creek to mobilize and then catch sediment, initiating this recovery process.

Some localized erosion within each project reach is an expected and intended outcome of restoration treatments. While there are risks of erosion being triggered by the project works, the risk of erosion from taking no action is significantly greater. Crucially, low-tech structures installed in Reach 1 at the beginning of the project will be designed specifically to capture any excess sediment mobilized through the installation of upstream low-tech structures in Reach 2 and Reach 3. Every effort will be made within the design and construction process to ensure that intentionally mobilized floodplain sediments will be captured by low-tech structures within the floodplain farther downstream, and not lost to the ocean. The project manager will monitor water quality during instream restoration activities, including excavation and low-tech structure installation, and halt work if turbidity, total suspended solids, or pH are anticipated to exceed provincial standards (BC, 2023).

Disturbed soil will be left "rough and loose" to maximize percolation and prevent erosion. Burlap will be used to temporarily protect exposed banks that are determined to be at risk of erosion. Rock VGC will be installed at both crossing removal sites to stabilize the channel following road removal. Standard soil bioengineering practices employed as needed to mitigate any unintended erosion that is observed during regular inspections in the months following restoration activities. All sites made rough and loose during machine work will be top-dressed with CWD and planted with native riparian trees, shrubs, and herbs.

Machine work will be performed as early as possible after regional fire bans conclude to ensure that creek flows are as low as possible during restoration. For Crossing #1, two upland wetland pools will be built first, allowing an operational window to remove the failed bridge and build rock VGC while the pools fill. Any excess flow will be pumped around the crossing removal site until after the rock VGC is complete. After construction of rock VGC, an excavator built beaver dam analogue (EBDA) will be installed immediately downstream to capture any sediment flow from the rock VGC and allow it to settle out. While the EBDA is being built, a hand-built BDA will be installed at the downstream end of the wetland #3. This will ensure that most sediment created by the VGC construction and other upstream works will be captured by the constructed wetland.

For Crossing #2, road removal and excavation work will be performed on either side of the incised creek, keeping the stream flow in the incised channel until the last step to reduce the mobilization of sediment into the stream. Once the incised creek channel is breached to allow the upstream wetland to fill, the rock VGC will be installed at the road removal site while the upstream wetland is filling. Several BDAs will be installed upstream and downstream to mitigate any mobilized sediment from exposed soils postconstruction.

Safety for Workers and Volunteers

All staff and volunteers working on the project will be oriented to the site and made aware of potential hazards prior to engaging in hands-on restoration work. Work will be led by staff with Wilderness First Aid or higher.

Danger trees, assessed at LOD 2 for Reaches 1-3 and LOD 3 for Crossings #1 and #2, will be identified by certified assessors and removed by certified fallers prior to restoration activities. Where possible, felled trees will be utilized in construction of low-tech structures and as CWD in constructed wetland pools.

Spill Preparedness, Response and Recovery

The proposed form-based restoration work will be carried out by a contractor who meets the requirements described in the definitions of a regulated as well as a responsible person under the Environmental Management Act. The contractor will be responsible for stocking a spill response kit, being trained in spill response, having a spill contingency plan, and responding to any spill event accordingly. Any necessary fueling will take place away from the creek channel and sensitive areas.

Monitoring and Stewardship

The Galiano Conservancy employs a full-time Restoration Coordinator, Conservation Coordinator, and seasonal technicians who will manage and monitor the restored areas long term, including invasive species control, plant care, live staking of native species, BDA and PALS repair and enhancement, and other management actions as needed. Effectiveness monitoring will include baseline data collection and implementing an upstream control site to assess the success of restoration efforts.

Beaver

Field surveys and deployment of motion triggered camera traps are currently being used to monitor beaver presence in the project area and will continue post-construction. Systematic searches for lodge construction, BDA improvement, bank burrows, active foraging sites, and any other additional habitat indicators will take place multiple times throughout the year to support existing baseline reporting. Camera traps will be installed near suspected active habitat to confirm usage.

Low-Tech Structures

Enhancement and repair of low-tech structures will take place based on regular assessments within the first two years post installation. After this period, based on the assessment of the project manager, natural processes will be permitted to take over. The GCA will observe how the stream responds to structures decaying or being actively maintained by beavers. Monitoring will occur multiple times during the year with an emphasis on site visits during peak and low flow conditions. Soil bioengineering techniques will be used to mitigate any unintended erosion found during monitoring.

Low-tech structures included within this plan but not constructed in 2026 may be constructed at a later date, provided conditions are appropriate.

Amphibians

Following the completion of initial restoration activities, a visual survey for egg masses will take place during the typical breeding windows during

February and March for the first two years of initial restoration works.

Birds and Bats

Specialized passive acoustic monitors will be deployed for determining the presence of various species of birds and bats. These Autonomous Recording Units (ARUs) will be deployed during the core activity season. For bats, typically late summer to fall, and for birds targeting the breeding season in spring to early summer. Recordings will be analyzed using automated classification software, and contribute to an existing record of acoustic monitoring on the Pebble Beach Reserve.

References

BCWF. (2026). Restoration Design & Mitigation Plan: Criss Creek Low-Tech Process-Based Restoration. BC Wildlife Federation. Version 2.

Corline, N. et al. (2022). When humans work like beavers: riparian restoration enhances invertebrate gamma diversity and habitat heterogeneity. *Restoration Ecology* 31(1)

Erickson, K. (1998). Pebble Beach Reserve Management Plan. Galiano Conservancy Association. Accessed at: https://galianoconservancy.ca/wp-content/uploads/2022/10/Pebble-Beach-Reserve-Management-Plan-1998.pdf

Gaylor, N., Scholz, O., & Erickson, K. (2002). Restoration Plan for District Lot 63 of the Pebble Beach Nature Reserve, Galiano Island. Galiano Conservancy Association. Accessed at: https://galianoconservancy.ca/wp-content/uploads/2024/09/Complete-DL-63-Restoration-Plan-final.pdf

Huggins, A., & Thompson, M. (2022). One Island, One Earth: An Ecological Footprint and Fingerprint for Galiano Island. Galiano Conservancy Association. Accessed at: https://galianoconservancy.ca/wp-content/uploads/2023/07/One-Island-One-Earth-Final-Report.pdf

Galiano Island Local Trust Committee. (2026). Official Community Plan Bylaw No. 108, 1995. Islands Trust. Accessed at: https://islandstrust.bc.ca/document/galiano-ltc-ocp-bylaw-no-108/

Pollock, M., et al. (2014). Using Beaver Dams to Restore Incised Stream Ecosystems. *BioScience* 64: 279-290.

Wheaton, J., et al. (2019). *Low-Tech Process-Based Restoration of Riverscapes: Design Manual.* Utah State University. Version 1.0.

White, H.. & Lusk, C. (2019). Woody debris in treefall gaps shelters palatable plant species from deer browsing, in an old-growth temperate rainforest. *Forest Ecology and Management* 448: 198-207.

Wilson, I. (1992). Excavations at DfRU 74, Cable Bay, Galiano Island Permit 1991-76. B.C. Telephone / Teleglobe Canada.

Appendices

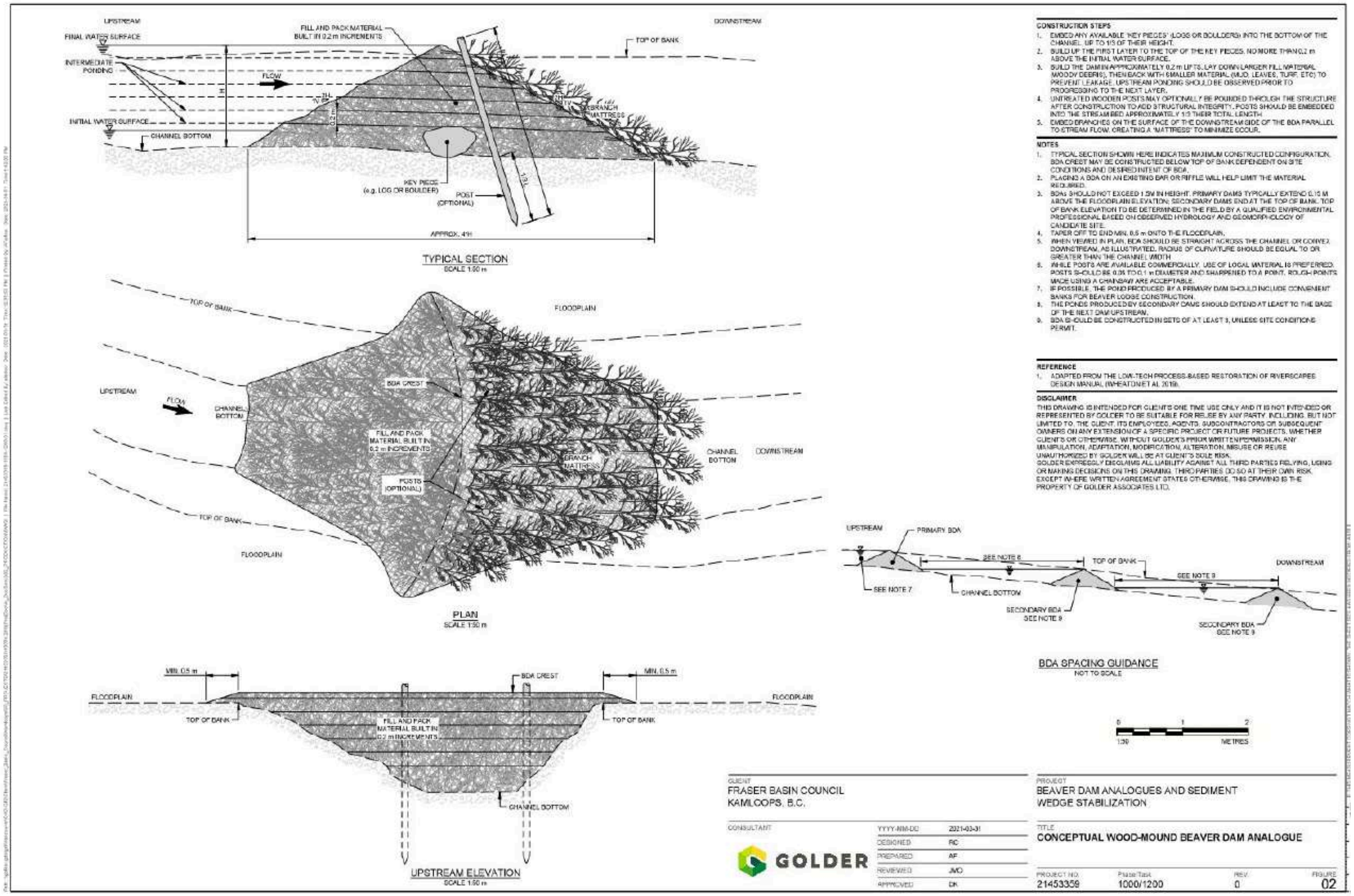
Appendix I: Proposed Low-Tech Structures

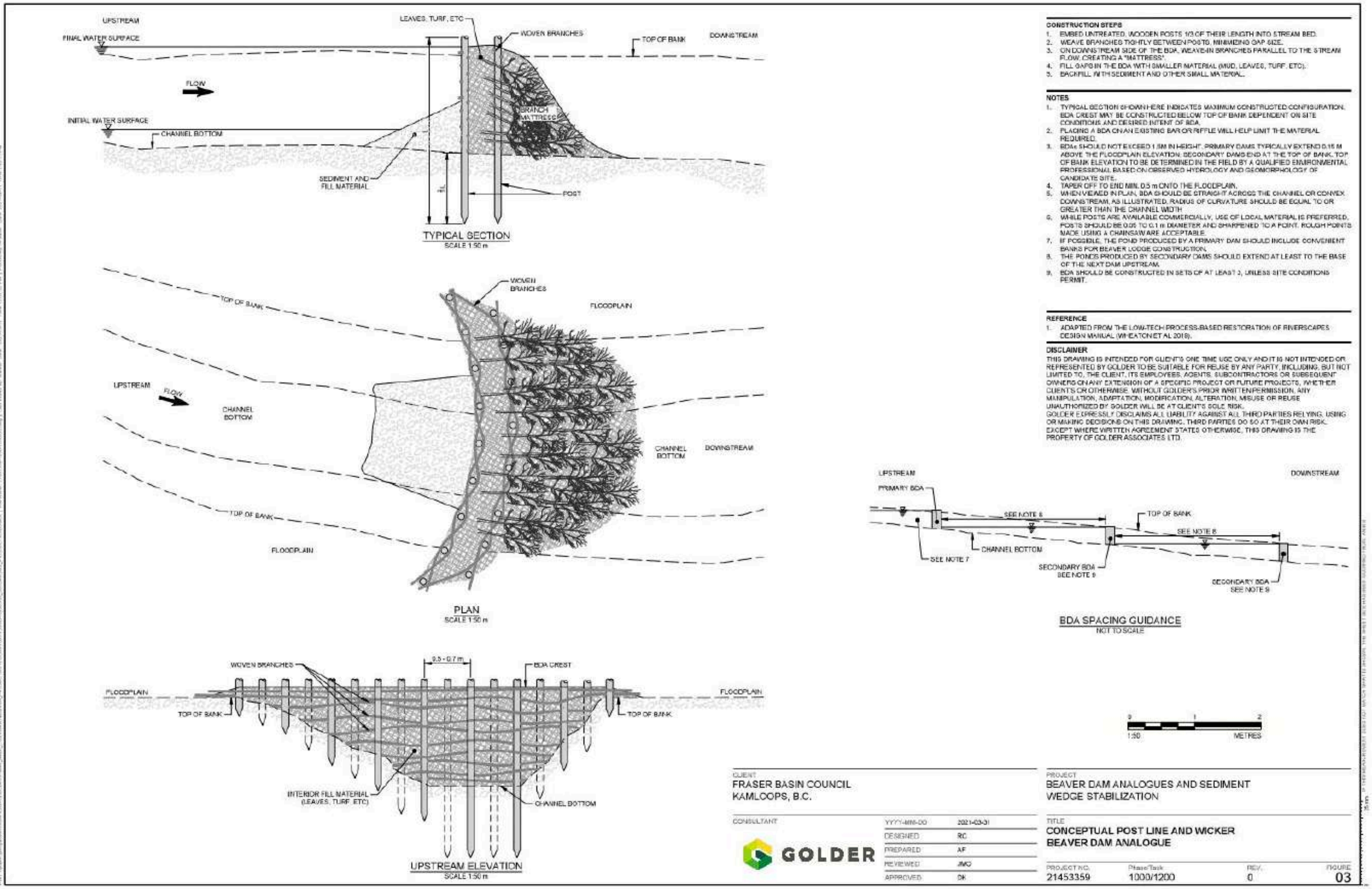
Reach	Structure	#	Width (m)	Height (m)	Comment
1	BDA	1	1.20	0.67	Supporter BDA for BDA 2, built on a riffle
1	BDA	2	0.76	0.55	Historic beaver dam location; utilize existing CWD on and above this location
1	BDA	3	1.50	0.55	
1	BDA	4	1.30	0.53	Supporter BDA, just above bedrock outcrop and below Crossing #2
3	BDA	5	1.40	0.50	To flood and initiate recovery of incised channel
3	BDA	6	1.90	0.60	To flood and initiate recovery of incised channel
3	BDA	7	2.17	0.53	To activate sediment on left bank of stream
3	BDA	8	2.15	0.37	Height can be increased to 0.77 m at a later date
3	BDA	9	1.90	0.50	Install on top of half buried log across channel
3	BDA	10	2.00	0.50	To flood and initiate recovery of incised channel
3	BDA	11	1.45	0.50	To flood and initiate recovery of incised channel
3	BDA	12	1.75	0.45	To flood and initiate recovery of incised channel
3	BDA	13	2.15	0.50	To flood and initiate recovery of incised channel
3	BDA	14	1.90	0.60	To inundate to the accessible right floodplain
3	BDA	15	2.40	0.50	To flood and initiate recovery of incised channel
3	BDA	16	2.15	0.60	To flood and initiate recovery of incised channel
3	BDA	17	1.70	0.50	To flood and initiate recovery of incised channel
3	BDA	18	1.60	0.60	To flood and initiate recovery of incised channel
3	BDA	19	1.80	0.50	To flood and initiate recovery of incised channel
3	BDA	20	2.20	0.55	To flood and initiate recovery of incised channel
3	BDA	21	1.90	0.60	To flood and initiate recovery of incised channel

3	BDA	22	1.5	0.60	To flood and initiate recovery of incised channel
3	BDA	23	1.15	0.50	To flood and initiate recovery of incised channel
3	BDA	24	2.00	0.40	To flood and initiate recovery of incised channel
3	BDA	25	1.80	0.55	To flood and initiate recovery of incised channel
3	BDA	26	2.25	0.75	To flood and initiate recovery of incised channel
3	BDA	27	1.70	0.42	To flood and initiate recovery of incised channel
3	BDA	28	2.20	0.63	To flood and initiate recovery of incised channel
3	BDA	29	2.00	0.45	To flood and initiate recovery of incised channel
3	BDA	30	1.40	0.45	To flood and initiate recovery of incised channel
3	BDA	31	2.80	0.45	To flood and initiate recovery of incised channel
3	BDA	32	2.00	0.42	To flood and initiate recovery of incised channel
3	BDA	33	2.50	0.80	To flood and initiate recovery of incised channel
3	BDA	34	1.8	0.70	To flood and initiate recovery of incised channel
2	BDA	35	1.45	0.50	To flood and initiate recovery of incised channel
2	BDA	36	1.5	0.45	To flood and initiate recovery of incised channel
2	BDA	37	1.00	0.50	To flood and initiate recovery of incised channel
2	BDA	38	1.50	0.50	To flood and initiate recovery of incised channel
2	BDA	39	1.60	0.45	To flood and initiate recovery of incised channel
2	BDA	40	1.25	0.40	To flood and initiate recovery of incised channel
2	BDA	41	3.00	0.45	To flood and initiate recovery of incised channel
2	BDA	42	1.40	0.40	To flood and initiate recovery of incised channel
2	BDA	43	2.70	0.50	To flood and initiate recovery of incised channel
2	BDA	44	1.80	0.50	To flood and initiate recovery of incised channel
2	BDA	45	2.80	0.35	To flood and initiate recovery of incised channel
2	BDA	46	2.60	0.35	To flood and initiate recovery of incised channel
2	BDA	47	1.00	0.30	To flood and initiate recovery of incised channel
2	BDA	48	3.00	0.60	To flood and initiate recovery of incised channel

2	BDA	49	1.10	0.50	To flood and initiate recovery of incised channel
2	BDA	50			To flood and initiate recovery of incised channel
2	BDA	51	1.90	0.45	To flood and initiate recovery of incised channel
2	BDA	52	1.70	0.52	To flood and initiate recovery of incised channel
2	BDA	53	2.70	0.55	To flood and initiate recovery of incised channel
2	BDA	54	1.70	0.50	To flood and initiate recovery of incised channel
2	BDA	55	2.00	0.45	To active sediment on right bank of stream
2	BDA	56	1.85	0.50	To flood and initiate recovery of incised channel
2	BDA	57	1.55	0.50	To flood and initiate recovery of incised channel
1	PAL	1			Channel spanning to capture all upstream sediment
3	PAL	2			To activate sediment on right bank of stream
3	PAL	3			To active sediment on right bank of stream
3	PAL	4			Channel spanning; tie into existing CWD
3	PAL	5			To activate sediment on left bank of stream
3	PAL	6			To activate sediment on left bank of stream
3	PAL	7			To activate sediment on left bank of stream
2	PAL	8			To active sediment on right bank of stream
2	PAL	9			T activate sediment on left bank of stream

Appendix II: Generic Structure Conceptual Design




UPSTREAM
FINAL WATER SURFACE
LEAVES, TURF, ETC
WOVEN BRANCHES
TOP OF BANK
DOWNSTREAM
FLOW
BRANCH MATTRESS
INITIAL WATER SURFACE
CHANNEL BOTTOM
SEDIMENT AND FILL MATERIAL
POST
TYPICAL SECTION
SCALE 1:50 m
WOVEN BRANCHES
TOP OF BANK
FLOODPLAIN
UPSTREAM
FLOW
CHANNEL BOTTOM
CHANNEL BOTTOM
DOWNSTREAM
TOP OF BANK
FLOODPLAIN
PLAN
SCALE 1:50 m
0.5 - 0.7 m
WOVEN BRANCHES
BDA CREST
FLOODPLAIN
FLOODPLAIN
TOP OF BANK
TOP OF BANK
INTERIOR FILL MATERIAL (LEAVES, TURF, ETC)
CHANNEL BOTTOM
UPSTREAM ELEVATION
SCALE 1:50 m
CONSTRUCTION STEPS
1. EMBED UNTREATED, WOODEN POSTS 1/3 OF THEIR LENGTH INTO STREAM BED.
2. WEAVE BRANCHES TIGHTLY BETWEEN POSTS, MINIMIZING GAP SIZE.
3. ON DOWNSTREAM SIDE OF THE BDA, WEAVE-IN BRANCHES PARALLEL TO THE STREAM FLOW, CREATING A "MATTRESS".
4. FILL GAPS IN THE BDA WITH SMALLER MATERIAL (MUD, LEAVES, TURF, ETC).
5. BACKFILL WITH SEDIMENT AND OTHER SMALL MATERIAL.
NOTES
1. TYPICAL SECTION SHOWN HERE INDICATES MAXIMUM CONSTRUCTED CONFIGURATION. BDA CREST MAY BE CONSTRUCTED BELOW TOP OF BANK DEPENDENT ON SITE CONDITIONS AND DESIRED INTENT OF BDA.
2. PLACING A BDA ON AN EXISTING BAR OR RIFFLE WILL HELP LIMIT THE MATERIAL REQUIRED.
3. BDAs SHOULD NOT EXCEED 1.5M IN HEIGHT. PRIMARY DAMS TYPICALLY EXTEND 0.15 M ABOVE THE FLOODPLAIN ELEVATION. SECONDARY DAMS END AT THE TOP OF BANK. TOP OF BANK ELEVATION TO BE DETERMINED IN THE FIELD BY A QUALIFIED ENVIRONMENTAL PROFESSIONAL BASED ON OBSERVED HYDROLOGY AND GEOMORPHOLOGY OF CANDIDATE SITE.
4. TAPER OFF TO END MIN. 0.5 m ONTO THE FLOODPLAIN.
5. WHEN VIEWED IN PLAN, BDA SHOULD BE STRAIGHT ACROSS THE CHANNEL OR CONVEX DOWNSTREAM, AS ILLUSTRATED. RADIUS OF CURVATURE SHOULD BE EQUAL TO OR GREATER THAN THE CHANNEL WIDTH
6. WHILE POSTS ARE AVAILABLE COMMERCIALLY, USE OF LOCAL MATERIAL IS PREFERRED. POSTS SHOULD BE 0.05 TO 0.1 m DIAMETER AND SHARPENED TO A POINT. ROUGH POINTS MADE USING A CHAINSAW ARE ACCEPTABLE.
7. IF POSSIBLE, THE POND PRODUCED BY A PRIMARY DAM SHOULD INCLUDE CONVENIENT BANKS FOR BEAVER LODGE CONSTRUCTION.
8. THE PONDS PRODUCED BY SECONDARY DAMS SHOULD EXTEND AT LEAST TO THE BASE OF THE NEXT DAM UPSTREAM.
9. BDA SHOULD BE CONSTRUCTED IN SETS OF AT LEAST 3, UNLESS SITE CONDITIONS PERMIT.
REFERENCE
1. ADAPTED FROM THE LOW-TECH PROCESS-BASED RESTORATION OF RIVERSCAPES DESIGN MANUAL (WHEATON ET AL 2019).
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UPSTREAM
PRIMARY BDA
SEE NOTE 8
TOP OF BANK
SEE NOTE 8
CHANNEL BOTTOM
SEE NOTE 7
SECONDARY BDA SEE NOTE 9
SECONDARY BDA SEE NOTE 9
DOWNSTREAM
BDA SPACING GUIDANCE
NOT TO SCALE
0 1 2
1:50 METRES
CLIENT
FRASER BASIN COUNCIL
KAMLOOPS, B.C.
PROJECT
BEAVER DAM ANALOGUES AND SEDIMENT WEDGE STABILIZATION
CONSULTANT
GOLDER
YYYY-MM-DD 2021-03-31
DESIGNED RC
PREPARED AF
REVIEWED JMO
APPROVED DK
TITLE
CONCEPTUAL POST LINE AND WICKER BEAVER DAM ANALOGUE
PROJECT NO. 21453359
Phase/Task 1000/1200
REV. 0
FIGURE 03