Bonanza Biodiversity Corridor

Ecosystems Enhancement Projects

Year 1 – Restoration Management Plan

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and

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The Bonanza Ecosystems Enhancement Projects are sponsored and administered by the Slocan Lake Stewardship Society (SLSS) in New Denver, BC. In 2017, the Bonanza Biodiversity Corridor (BBC) was formally recognized as a key and critical corridor for conservation in the BC Kootenays. With the ongoing support of the Kootenay Conservation Program through its Kootenay Connect initiative, the BBC is now recognized as a Priority Place under the Canada Nature Fund, as administered by Environment and Climate Change Canada. Additional project funding has also been awarded through the Columbia Basin Trust, under their Ecosystems Enhancement Program.

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1. INTRODUCTION

Wetlands in the Bonanza Biodiversity Corridor (BBC), along Bonanza Creek between Slocan and Summit lakes, are sensitive ecosystems with high biodiversity values. These wetlands support a wide range of critical aquatic and terrestrial habitats, and contribute significantly to the hydrologic functioning of the Slocan Lake Watershed. At a landscape level, the wetland complexes targeted in this project are vitally important to the BBC, providing this region of long lakes and steep terrain one of the key hydrologic corridors in the Slocan Lake Watershed. The historic Canadian Pacific Railway (CPR) railway berm that runs the length of the BBC's valley bottom acts as a linear dam and over time has negatively impacted the dynamic wetland-riparian-floodplain system of Bonanza Creek and its tributaries.

1.1 Study Area

The target landscape for ecosystem enhancement is a portion of the 15-km-long BBC, comprising 12,865 hectares (ha) that link Slocan and Summit lakes within the upper Slocan Lake watershed (Figure 1.1-1; Plate 1.1-1). The project focuses on three wetland complexes within the BBC that have been highly impacted by the old CPR rail line constructed over 100 years ago. Wetland assessments performed during 2013 to 2015 by the Slocan Wetlands Assessment & Monitoring Project[1] (SWAMP) field research team found the BBC to have the highest priority wetland-riparian-lakeshore system in the north Slocan Valley. Based on results from 29 field plots in this corridor, SWAMP prioritized the BBC for conservation and restoration efforts due to its sensitive and diverse wetland ecosystems, species of concern, and cross-valley habitat linkage for wide-ranging species such as grizzly bear and ungulates.

1.2 Ecological Overview

The ecological important of this landscape is further described in *High-level overview of the Bonanza Biodiversity Corridor* (Mahr 2018) which states:

> *The Bonanza Biodiversity Corridor represents a broad range of the diversity present in the Inland Temperate Rainforest. It is characterized by productive interior cedar-hemlock and high elevation spruce-subalpine fir forests. The BBC's valley bottom contains a diversity of wetland types (e.g., swamps, marshes and fens) that contain some rare assemblages of plants (Durand 2015; Mahr and Durand 2015). The Bonanza Biodiversity Corridor is an important wildlife corridor within the Slocan Lake Watershed because in addition to providing good quality wildlife habitat, it is a permeable feature in a valley that is otherwise filled up with Slocan Lake that forms an enormous movement barrier to*

[1] SWAMP is a partnership of organizations including the Slocan River Streamkeepers, Slocan Lake Stewardship Society, Slocan Solutions Society, BC Wildlife Federation, Central Kootenay Invasive Plant Committee, Selkirk College, Regional District of Central Kootenay, and Ministry of Forests, Lands, Natural Resource Operations and Rural Development, with funding provided by the Columbia Basin Trust and Fish & Wildlife Compensation Program.

terrestrial wildlife. This corridor is also ecologically important because it functions both longitudinally (north-south) and laterally (east-west) across the valley.

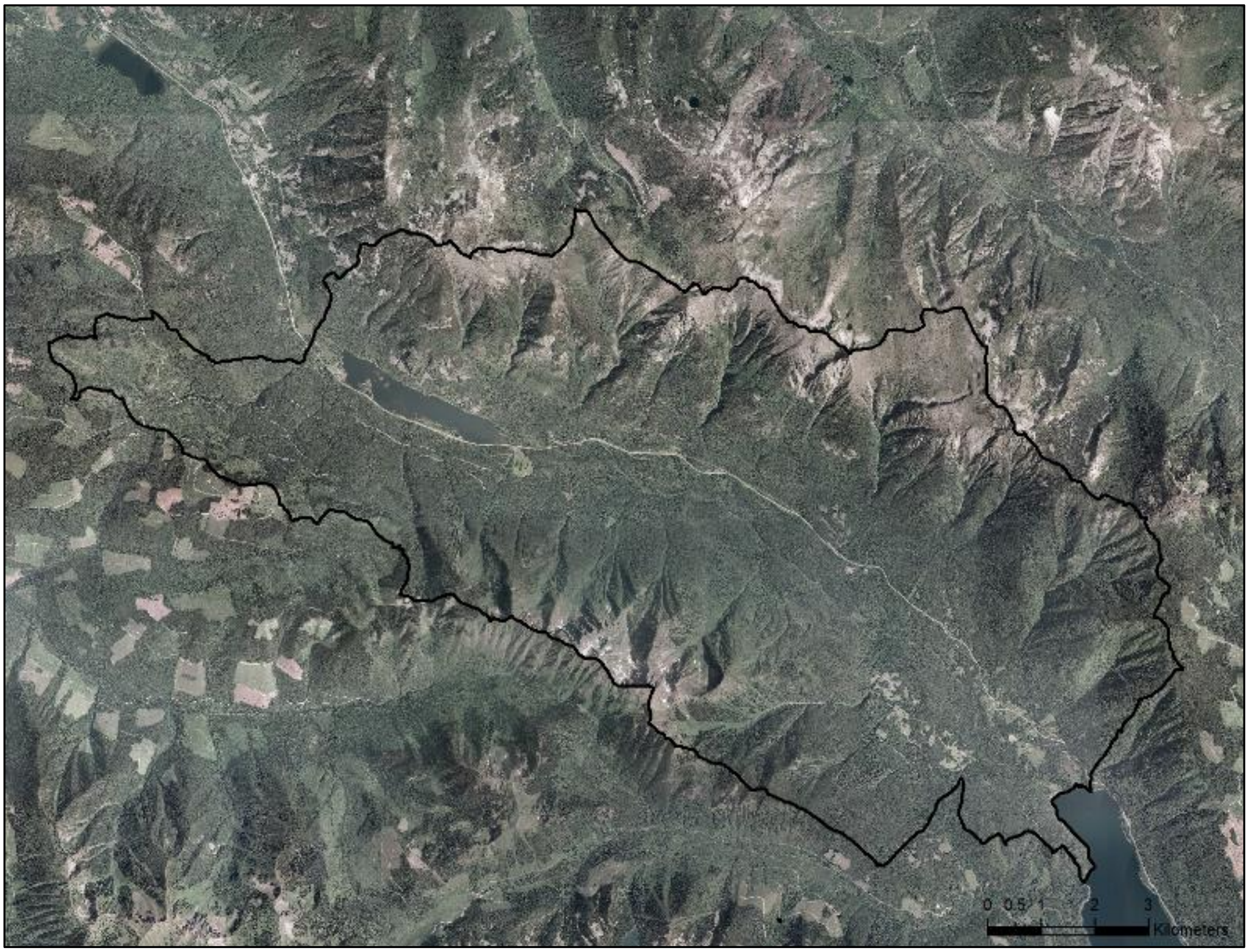

Figure 1.1-1. Bonanza Corridor study area

Plate 1.1-1. The Bonanza Corridor looking north from Slocan Lake.

The Bonanza Corridor is well known as a biodiveristy hot spot, with 48 species at risk confirmed (17), likely (4), or possible (27) to occur; an additional 5 species that are confirmed or likely to occur have recently been de-listed by the CDC, though they are still considered locally rare in the Kootenays (Durand and Ehlers 2018). Fourteen Red- and Blue-listed ecosystem types with known or potential occurrence were Identified for the project area; 13 of these are wetland ecosystems (Durand and Ehlers 2018).

The corridor contains seven biogeoclimatic units (Figure 1.2-1), with the Slocan Moist Warm Interior Cedar-Hemlock (ICHmw2) covering the majority of the area, including all of the valley bottom and wetland complexes. The ICHmw2 is one of the most common biogeoclimatic units in the Southern Interior and it includes the valley bottom to mid-slopes along most of Slocan Lake. It typically occurs from valley bottom to around 1,200 metres (m) where it transitions into the Engelmann Spruce Subalpine Fir (ESSF) zones. The ICHmw2 is located in a climate that is characterized by warm, moist summers and cool, moist winters with moderately deep, persistent snowpacks. The ICHmw2 is both productive and species-rich. Mature and old zonal forests are typically dominated by western hemlock and western redcedar, with minor amounts of Douglas-fir and western larch. Early seral stands and sites in dryer areas can contain trembling aspen, lodgepole pine, and paper birch. Wetter sites and higher elevation areas typically contain Engelmann spruce and subalpine fir, while floodplains are often dominated by black cottonwood. The ICHmw2 supports a wide range of habitat, with mature and old stands in particular providing habitat for numerous species, including species at risk (MacKillop & Ehman 2016).

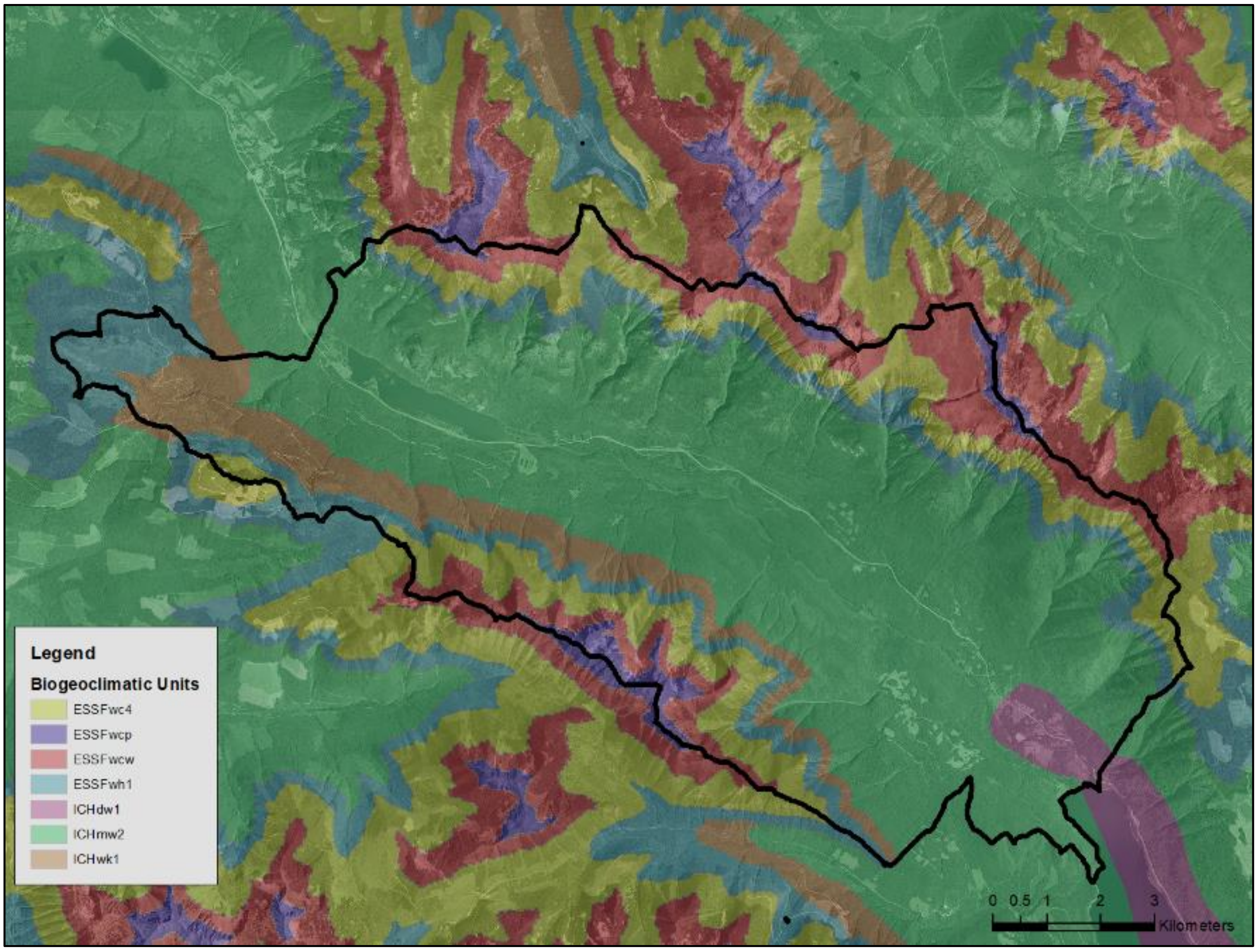

Figure 1.2-1. Biogeoclimatic units of the Bonanza Corridor

1.3 Project Objectives

The goal of this project is to improve functioning of landscape level hydrologic and ecological processes that will contribute to a healthier wetland-riparian system along Bonanza Creek and Summit Lake. To meet this goal, we will restore three key wetland complexes to enhance hydrologic connectivity and habitat continuity, and thus provide long-term ecological benefits through improved water flow and restoration of sensitive aquatic and terrestrial (wildlife) habitats.

In addition to the three restoration projects, two sub-projects were initiated during 2019: Beaver Mapping and Assessment, and Old Growth Mapping and Assessment. In 2020 two additional sub-projects will be initiated: Species at Risk Inventory and Habitat Assessments, and Bat Inventory and Monitoring.

2. RESTORATION PROJECTS

Three restoration and enhancement projects are underway in the Bonanza Corridor: Hunter Siding, Upper Bonanza Creek, and Summit Lake (Figure 2-1). The following section summarizes the work completed to date, and the activities planned for 2020.

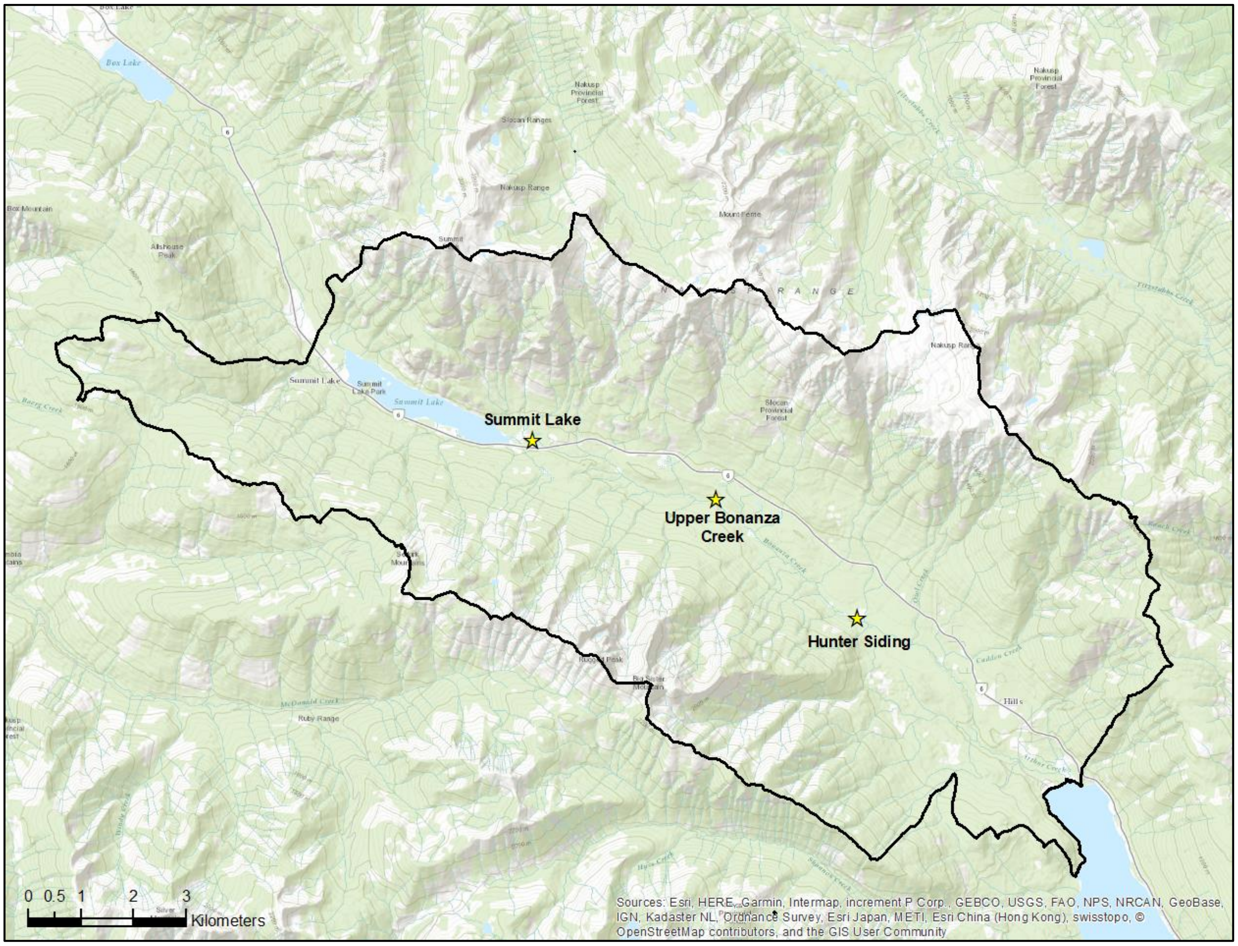

Figure 2-1. Location of the Bonanza Corridor Restoration Projects

2.1 HUNTER SIDING

2.1.1 Ecological Overview

The 2.3-ha area, locally known as Hunter Siding (Plate 2.1-1), is a key site that was identified in 2014 during the SWAMP field work. It occupies the lowest elevation of a large wetland complex that extends from Bonanza Creek to the edge of Highway 6, including large areas of shrub and forest swamps, beaver ponds, multiple permanent and intermittent watercourses, and small fens and marshes.

It is unknown what wetland type previously occurred on the site; however, it was likely a complex of Cedar – skunk cabbage treed swamp and Alder – lady-fen swamp, as these wetlands communities are present throughout the Bonanza Corridor.

Plate 2.1-1. Overview of the Hunter Siding project area looking southeast towards Slocan Lake.

The old field contains a large component of wetland species, including beaked sedge and small-flowered bulrush, along with species such as lady-fern and black twinberry that are commonly found in wet, rich areas. The site contains a mix of rich mesic organic soils over 1 m in depth, with gleyed (permanently saturated) silty loam underneath, and mineral gleysols. Soil tests during the spring of 2019 found the groundwater at or within 15 cm of the surface. Based on this evidence, we are confident that the site contains sufficient groundwater and suitable soils to re-create a variety of wetland communities and features.

2.1.2 Restoration Objectives

The goal of the project is to re-create the wetland communities that are known to occur in the area: Cedar – skunk cabbage swamps (Plate 2.1-2) and Alder – lady-fern swamps (Plate 2.1-3). The project will build on the natural post-disturbance successional processes that are well documented for these ecosystem types (MacKillop and Ehman 2016). Excellent reference sites for these wetland types occur in the immediate vicinity, providing site-specific data to model the restoration with, as well as local plant material to propagate and collect seed from. The Cedar – skunk cabbage swamp is a regionally uncommon ecosystem type that rarely occurs as mature or old forest due to historic logging and farming (Deb MacKillop pers. com. 2016). Alder – lady-fern swamps are extensive throughout the Bonanza Corridor, occurring along the majority of Bonanza Creek. The Hunter Siding area has significant biological values, with over 50 bird species identified to date (Arndt 2015), multiple rare species (Durand and Ehlers 2015), at least six types of wetland ecosystems, and several hundred species of vascular plants (Durand 2016).

Plate 2.1-2. Young successional Cedar – skunk cabbage swamp near the Hunter Siding project.

Plate 2.1-3. Typical alder – lady-fern swamp that occurs along Bonanza Creek.

2.1.3 Restoration Plan

2.1.3.1 Physical Setting

Hunter Siding is situated in the valley bottom on a gently sloping plain in a transitional area between the inactive fluvial plain of Bonanza Creek and the toe of a massive fluvial fan (Figure 2.1-1). This area is a modified wetland that has multiple old drainage channels indicating that it was historically cleared and drained, likely for agricultural purposes (Figure 2.1-2). The drainage in the area was significantly modified by the old rail bed, with a channelized stream running parallel to the eastern side of the rail bed for much of the Hunter Siding area. The stream was diverted from its original course through the Hunter Siding site during the railroad construction (Annschild 2019).

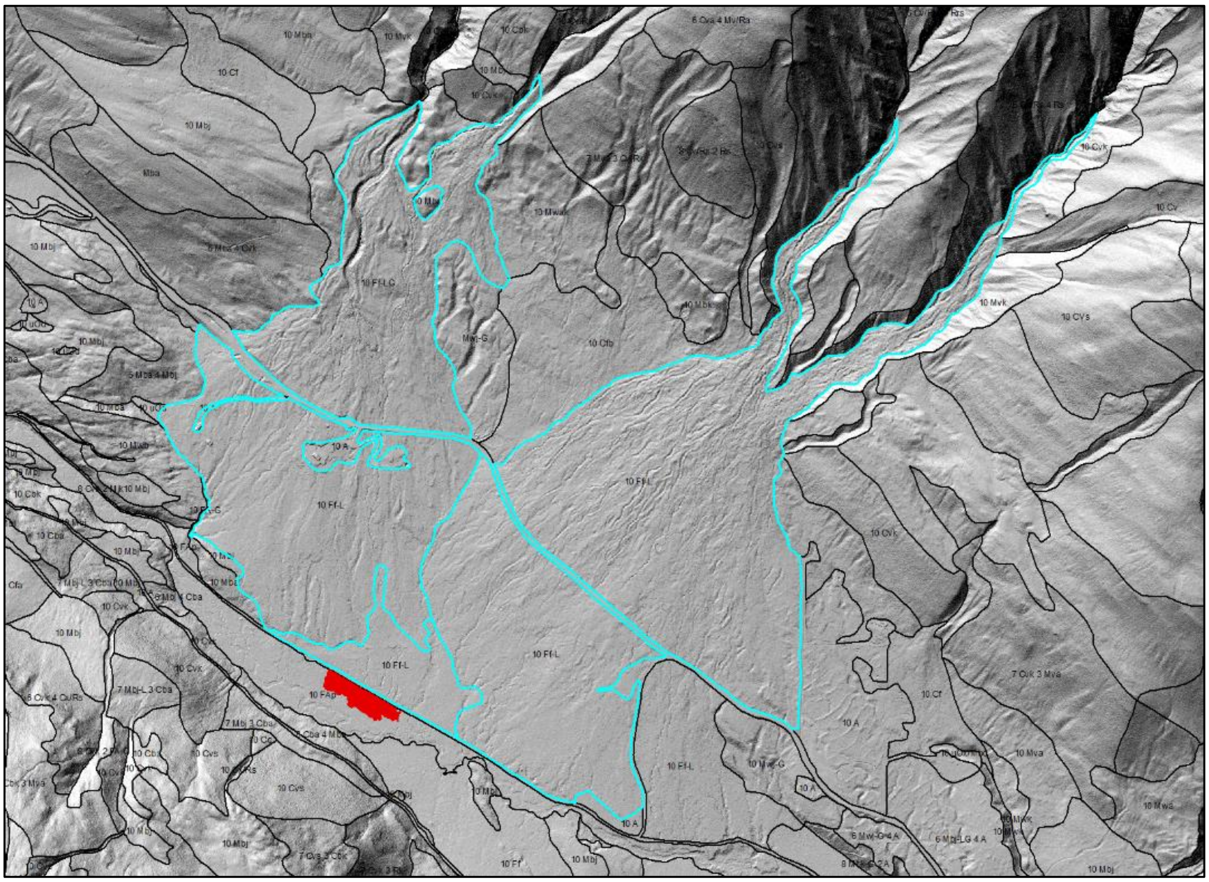

Figure 2.1-1. Terrain mapping of the Hunter Siding project showing fluvial fans (highlighted in blue) and the project area (red fill)

Figure 2.1-2. Old drainage ditches (dashed blue lines) at Hunter Siding

2.1.3.2 Conceptual Design

The conceptual design for Hunter Siding focuses on creating the physical and ecological conditions that will result in two types of swamps that naturally occur in the project site. The project site has been divided into three zones based on existing soils and hydrology (Figure 2.1-3):

1. Zone 1 – Cedar – skunk cabbage swamp restoration
2. Zone 2 – Cedar – skunk cabbage swamp enhancement
3. Zone 3 – Alder – lady fern swamp enhancement

In the early winter of 2019, we completed a trial planting of 80 shrubs (30 western redcedar, 30 mountain alder, 10 paper birch, and 10 Engelmann spruce) along with over 100 live cuttings of mountain alder and a variety of willow species. The plants were planted in four areas within the three zones based on soil and groundwater conditions. The plants will be checked throughout 2020 to assess the viability of each species to determine if they can survive in existing physical conditions.

Zone 1 will involve the use of excavators, woody debris, and planting of native vegetation to restore the area to a Cedar – skunk cabbage swamp. This area has generally gleysolic mineral soils, including some soil modification along the edges of the old railway. We propose to create a series of excavations to lower the elevation of a portion of the area, with excess material used to create small mounds on the edges of the site. We will replicate the strongly mounded microtopography of Cedar – skunk cabbage swamps, which are characterized by an irregular mosaic of mineral soil mounds (less than 1 m high), with wet depressions containing rich peat-based humic organic soils. The mineral soil mounds form imperfectly drained sites which are conducive to the establishment of conifers that will not survive in soils that are saturated throughout the growing season. The wet depressions between the mounds have seasonally high water tables (vertical fluctuation), with surface water present during the spring, and hygric soils throughout the growing season. These depressions provide favourable growing conditions for numerous species of sedge, along with moist, rich loving herbs and shrubs.

The lowered (wet depressions) areas would be allowed to naturally regenerate with the beaked sedge and water sedge clumps that currently exist on the site, along with the abundant natural sedge seed bank that occurs in soil, and any lady fern that can be salvaged. Mineral soil from below the organic layer would be mixed with organic soils and used to create the mounds. The mounds will be planted with live stakes of willow and red-osier dogwood to provide early seral shrub cover, as well as alder seedlings (from seed collected at the site). Engelmann spruce and western redcedar seedlings and saplings will be planted on the mounds as well, under the shrub layer, replicating the natural post-disturbance successional process from the establishment of early seral species that provide the shade and growing conditions for the establishment of climax conifer species. By replicating the natural successional processes of an Interior Cedar Hemlock forested swamp, we expect a greater success of vegetation establishment.

Zone 2 contains several mature and old western redcedar and a variety of shrubs. As this area contains elements of a Cedar – skunk cabbage swamp, the project will focus on enhancing it, rather than creating excessive disturbance with heavy equipment. Infill plantings of native vegetation and the placement of large woody debris will be the focus of this area, with shallow excavation and mounding in small areas where appropriate.

Zone 3 will focus on the creation of an Alder – lady fern swamp. This area contains rich silty loam gleysols underlain by layers of fluvial sands and gravels as expected on the edge of an active floodplain, with varying depths of thin mesic to fibric organic soils overlaying it. Throughout the growing season, groundwater levels are within 15 cm of the surface, with short durations of surface flooding. Existing vegetation is variable, with wetter areas that contain beaked sedge and drier portions that include various native and introduced species of grass, lady-fern, and bracken fern.

Assuming the trial plantings in Zone 3 are viable, passive methods will be used in this zone. Groupings of native species will be planted in clumps throughout the zone in favourable microsites. As this zone currently contains wetland-like communities of beaked sedges and patches of lady-fern, the preference is to establish a swamp community using methods that minimize disturbance. As open sedge and grass-dominated ecosystems are uncommon in the Bonanza Corridor, the enhancement design will include a mosaic of shrub plantings and open graminoid areas to maximize habitat complexity and diversity.

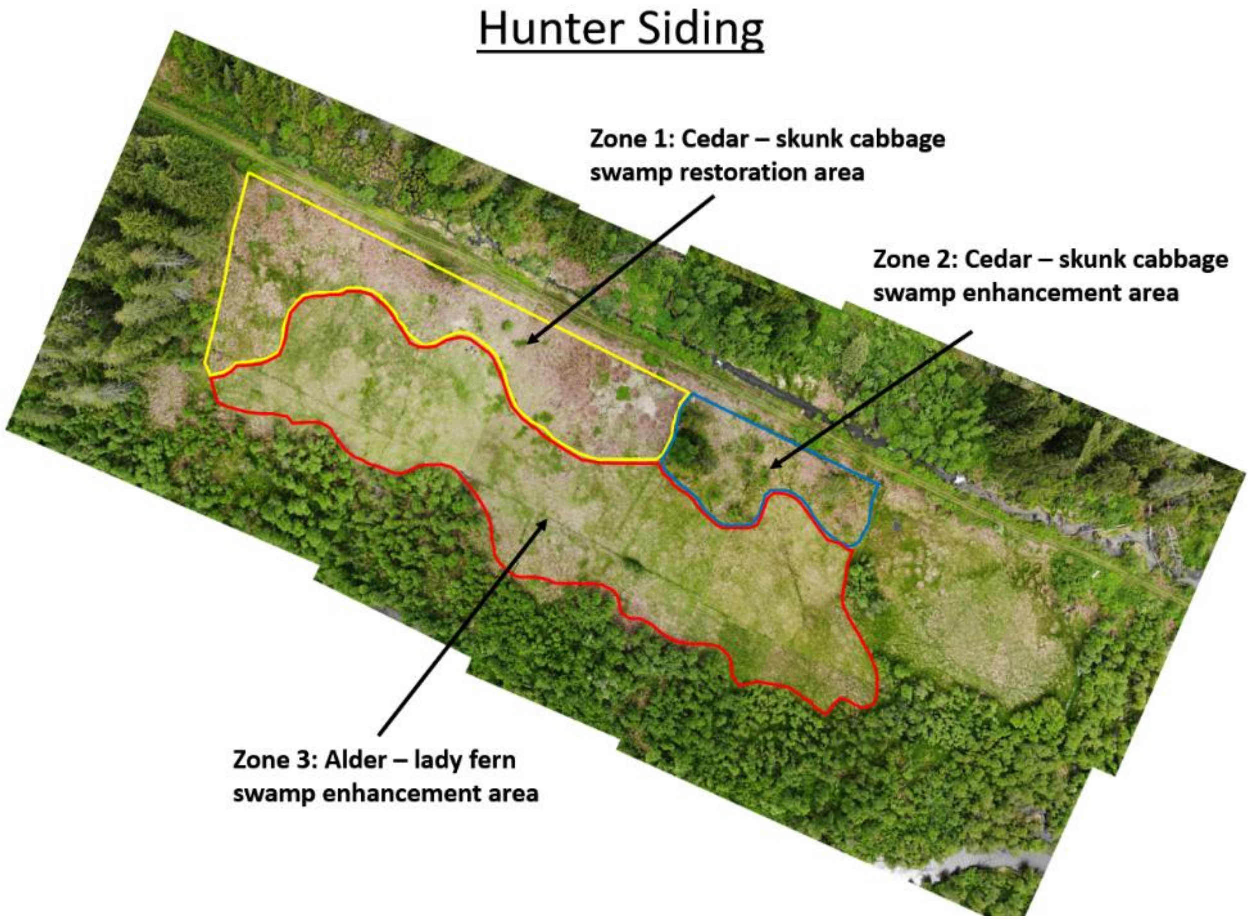

Figure 2.1-3. Hunter Siding conceptual restoration plan

2.1.3.3 Work Plan, Timeline and Construction Planning

Project construction is anticipated to start in the late summer to early fall of 2020. Consultations with local heavy equipment operators indicate that 5 to 10 days of machine time will be required (including the logistics of moving a machine to and from the site. We propose to use a large 200 series excavator; however, the equipment size will ultimately be based on access (rail trail, road and bridge constraints) and local availability.

Woody debris will be sourced opportunistically from maintenance (blow-down and danger trees along the rail trail) and potentially from access roads and adjacent logged areas. Material will be carried or dragged along the rail trail to Hunter Siding, and power washers will be used to ensure any material does not introduce invasive species to the restoration sites.

Twelve hundred native shrubs have been purchased from a local nursery for the Hunter Siding project (Table 2.1-1). Additional cutting from alder, willow, and red-osier dogwood will be sourced from the project site to supplement the plantings as needed. It is anticipated that a planting crew of two people will require up to 10 days to prepare and plant the site.

Table 2.1-1. Planned native vegetation species for the Hunter Siding project

Species (size)	Number
western redcedar (1 gal)	200
mountain alder (1gal)	200
Engelmann spruce (1 gal)	100
paper birch (1 gal)	100
black cottonwood (cuttings)	200
willows (cuttings)	200
red-osier dogwood (cuttings)	200

In addition to machine operators and planting crews, it is anticipated that the Okanagan Nation Alliance will want to have one or more observers on site during construction to ensure that cultural values are respected. A construction manager will also be required, along with an environmental monitor.

The detailed construction plan that is under preparation will also include an Environmental Management Plan (EMP) to ensure that any erosion and sedimentation prevention measures are in place, that the project will operate in the appropriate work windows (breeding birds and amphibians), and that a robust plan is in place to ensure invasive species are not introduced to the restoration site (power washing of equipment and materials, visual inspections, etc.). The EMP will also contain a hydrocarbon plan to address fuel storage, re-fueling, and spill prevention, containment, and reporting.

2.1.3.4 Supporting Studies

Numerous additional studies are required for this project, including:

- Biological inventory and assessment of the site to fully inventory the flora and fauna. This work has been partially completed, but due to the time of year in which the project was initiated in 2019 it is not complete. An important part of these studies is the completion of an amphibian survey and habitat assessment, as amphibians are the most likely wildlife to be impacted by the project.
- Complete a First Nations cultural inventory of the site. An initial screening assessment of all three restoration sites is planned for spring 2020 by the Okanagan Nation Alliance. The initial assessment will determine if more in-depth studies are required, including the need for an archaeology study.
- Fish surveys in Bonanza Creek and select tributaries. Although the Hunter Siding project will not directly impact Bonanza Creek, surveys will be completed for all three restoration sites to update

fish species and habitat knowledge. Biologists from the Okanagan Nation Alliance will undertake this study, with survey work planned for spring and fall of 2020.

2.1.3.5 Permit Requirements

We are in the process of applying for a Notification under Section 11, Water Sustainability Act for changes in an about a stream. Through consultations with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), a crown land tenure application or reserve may be required.

2.1.4 Monitoring Plans

2.1.4.1 Monitoring Program

A pre-construction biophysical baseline and post-construction monitoring program will be developed when the conceptual plans are formalized. The plan will contain, at the minimum, two methods to monitoring change over time in the restoration area: photopoint monitoring and a Floristic Quality Index (FQI).

Photopoint monitoring uses a standardized method of repeat photography to both visually and quantitatively assess change over time. It involves repeat photography over a period of time from the same location, field of view, and orientation as the original photo (Hall 2001). By precise replication of photos, change over time can be measured and assessed. This method has been used extensively throughout North America for over 20 years, including specific protocols created for the monitoring and assessment of restoration sites.

FQI is used to assess the biological condition of vegetation communities (including wetland communities in northern Canada), and tracking changes over time (Bourdaghs et al. 2006; Rooney and Rogers 2002; Washington 1984; Wilson et al. 2013). The FQI relies on a species' Coefficient of Conservation, a value assigned to local species by qualified botanists that signifies a species' habitat specificity and tolerance to disturbance. The FQI provides maximal value when comparing vegetation communities over time within the same wetland or when comparing among wetlands within the same type or class (e.g., comparing a reference wetland to a disturbed wetland of the same type in the same season).

2.1.4.2 Climate Change Considerations

Climate change is not expected to have a significant effect on this project. As the project is based on creating the conditions similar to the natural ecological communities that are immediately adjacent to the restoration site, it has a high chance of success. All plant stock that will be used for the project is locally sourced and the selected species exist in the immediate vicinity of the project. As we are planting a diversity of species in multiple physical habitats, the natural resilience to change from this complexity should allow it to adapt to any local change due to climate change. The project site is also located at the toe of a huge fluvial fan that continually feeds groundwater through the area. The planting sites have both organic and gleysolic soils that also indicate stable, high water tables are present.

2.2 Upper Bonanza Creek

2.2.1 Ecological Overview

The Upper Bonanza Creek project is a 12.9-ha wetland and riparian area along Bonanza Creek (Plate 2.2-1). Roughly 1.5 km of old rail bed pass through this area, with large portions bisecting active floodplains. The floodplain area is predominately mid-bench undescribed alder, willow, and red-osier dogwood that is common along the length of the creek. Conifer and mixed floodplain forests are not common the active floodplain, limiting future recruitment of large woody debris into the creek. The bisecting of the active floodplain by the old rail bed has further limited the opportunity for recruitment of woody debris, with few large logs observed within the creek during field assessments in the spring of 2019.

Plate 2.2-1. Portion of the Upper Bonanza Creek project with the old rail line bisecting the floodplain.

2.2.2 Restoration Objectives

The primary restoration objective is to hydrologically reconnect all areas of the floodplain that are hydrologically isolated from Bonanza Creek surface flows. The second restoration objective is to enhance and restore fish habitat in the creek that is degraded because of the rail trail alignment.

2.2.3 Restoration Plan

2.2.3.1 Physical Setting

The valley bottom section to be restored is approximately 1.5 km in length, and the width varies from 25 m to 100 m. About half of the valley bottom is isolated from the direct influence of Bonanza Creek surface flows, in particular spring freshet flows, by the 4- to 5-m-wide rail trail bed that is composed of densely packed imported fill and angular rock. The rail trail alignment is straight in most sections, and thus creek sections that flow alongside the rail trail are correspondingly straight. Riparian vegetation on the rail trail bank is limited to sedges and small bushes. No mature trees that would provide overhead cover and shade, and eventually fall into the river and provide for hydraulic complexity that fish prefer, are present on the rail trail bank.

In river sections where the creek parallels straight rail trail sections, the hydraulic and habitat complexity is relatively low. Few pools are evident, the creek bottom sediments are homogeneous across the channel and consist of sands or silts. Creek sections that are removed from the rail trail exhibit greater degrees of hydraulic complexity and channel planform. Pools and gravel bars are evident, larger organic debris is in the water column, and hydraulic characteristics include riffles, glides, and pools.

2.2.3.2 Conceptual Design

The rail trail is currently used by motorized and non-motorized recreational users. However, plans are now being developed to bypass the rail trail by the construction of a new trail along the northeast bank (Figure 2.2-1). The new trail will be for non-motorized users only. The following conceptual design (Figure 2.2-2) assumes that all rail trail users will use the new bypass as the old rail trail in this section, as described below, will be decommissioned and impassible for all recreational users.

Reconnect floodplain to creek. In order to reduce the impact the rail trail alignment has on the creek planform, short sections of rail trail will be removed by excavation. Removed sections will be located in areas that will allow the river to laterally migrate or to increase sinuosity over time, or in sections where the floodplain has been bisected. Excavated material will be placed on top of rail trail sections that can remain in place without negatively influencing the creek’s ecological function. In this way removal of excavated material from the area will be prevented.

Restore fish habitat in creek. In order to increase hydraulic diversity and to provide additional habitat for fish, large organic debris (LOD) in the form of coniferous trees will be installed in the water column at several sections. This technique is widely used and has a proven track record for improving fish habitat, especially for juvenile fish.

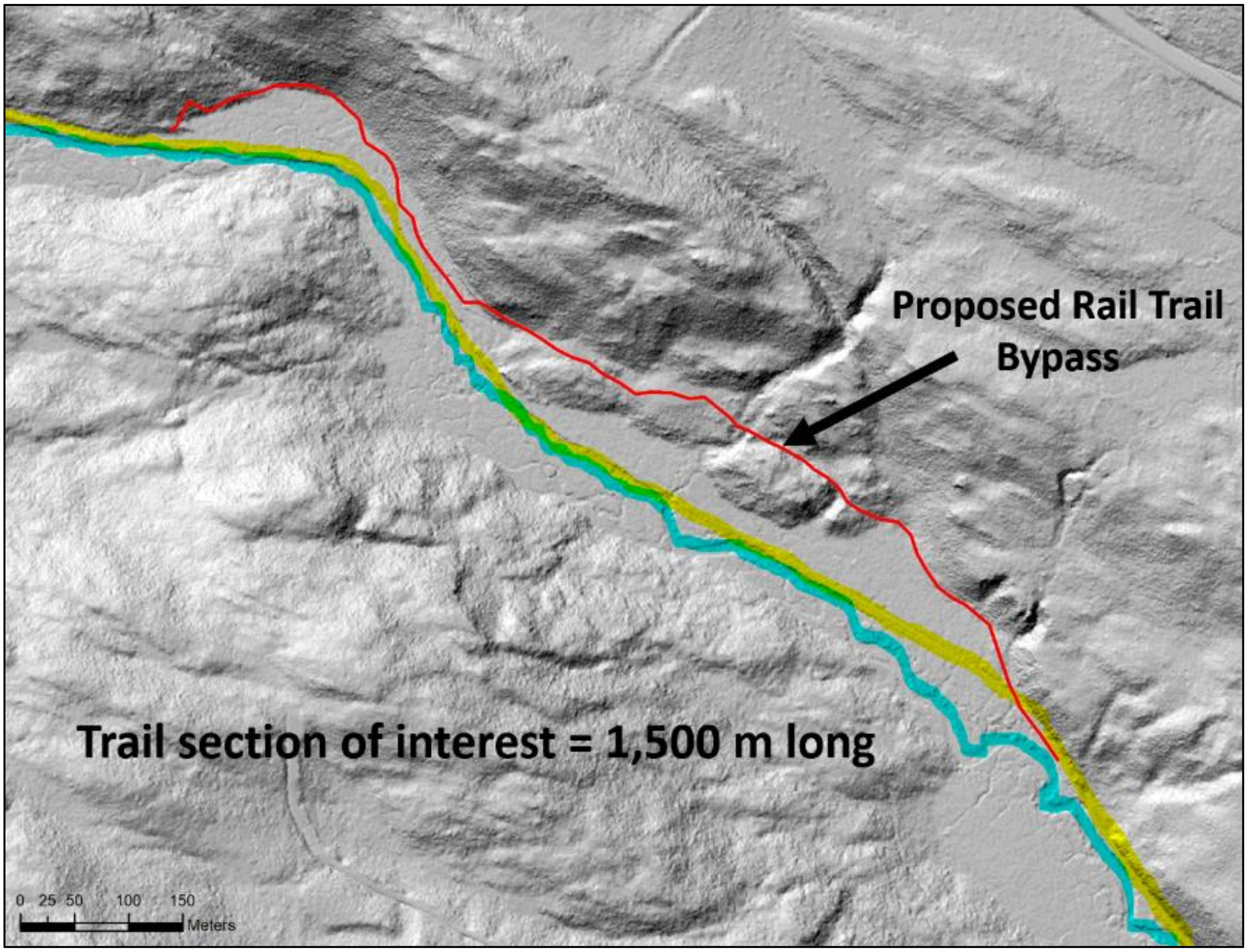

Figure 2.2-1. Proposed trail bypass

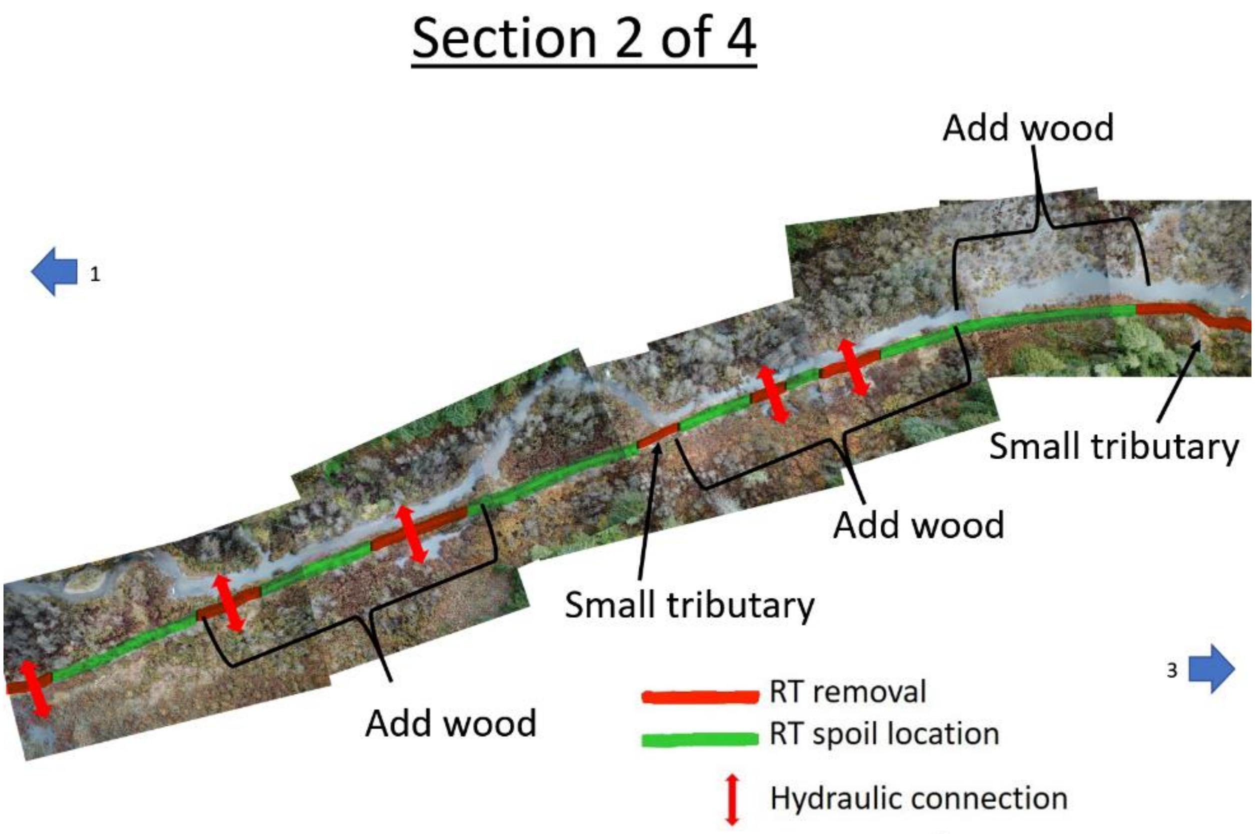

Figure 2.2-2. Portion of the Upper Bonanza Creek conceptual restoration plan

2.2.3.3 Work Plan, Timeline and Construction Planning

Plans at this time are conceptual and require additional field work to further refine and to develop as to estimates of materials and labour required to complete the proposed works. The project will be refined over the 2020 spring–fall period with ground surveys and fisheries and archaeological/cultural studies to be conducted by the Okanagan Nation Alliance. Construction is currently scheduled for the 2021 late summer/fall period depending on permitting. Detailed construction plans will be developed once the conceptual design has been completed and reviewed and agreed upon by stakeholders.

2.2.3.4 Supporting Studies

Numerous additional studies are required for this project, including:

- Biological inventory and assessment of the site to fully inventory the flora and fauna. This work has been partially completed, but due to the time of year in which the project was initiated in 2019 it is not complete. An important part of these studies is the completion of an amphibian survey and habitat assessment, as amphibians are the most likely wildlife to be impact by the project.

- Complete a First Nations cultural inventory of the site. An initial screening assessment of all three restoration sites is planned for the spring of 2020 by the Okanagan Nation Alliance. The initial assessment will determine if more in-depth studies are required, including the need for an archaeology study.
- Fish surveys in Bonanza Creek and select tributaries. Surveys will be completed for all three restoration sites to update fish species and habitat knowledge. Biologists from the Okanagan Nation Alliance will undertake this study, with survey work planned for spring and fall of 2020.

2.2.3.5 Permit Requirements

We are in the process of applying for a Change Approval under Section 11, *Water Sustainability Act* for changes in and about a stream. Through consultations with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), a crown land tenure application or reserve may be required. The permit applications are being designed in conjunction with Recreation Sites and Trails BC, and the Valhalla Hills Nordic Ski Club (local recreation tenure holder).

2.2.4 Monitoring Plans

2.2.4.1 Monitoring Program

A pre-construction biophysical baseline and post construction monitoring program will be developed when the conceptual plans are formalized. The monitoring plan will be designed to ensure that the success of the project can be measured, with a specific focus on hydrologic connectivity, and fish and fish habitat.

2.2.4.2 Climate Change Considerations

The effects of climate change have been considered in this project. In general, creating additional water storage and facilitating the slow release of stored water over drier periods is a technique meant to keep creeks and rivers watered during low flow periods, typically late summer and early fall. Climate change models for the West Kootenays indicate that spring runoff will occur earlier and with greater magnitude, and summer periods will be hotter with less precipitation. This project will increase water storage in the Bonanza Creek floodplain during the freshet or other high-water periods and then slowly release stored water during the summer and early fall periods. Downstream discharge will be better moderated both in quantity (slightly higher) and temperature (slightly cooler).

Creek water temperature during the summer and fall period is expected to increase with the onset of climate change. The installation of LOD will increase streambed scour and deepen existing pools and create new pools that are essential fish-holding habitat during low water and higher water temperature periods.

2.3 SUMMIT LAKE

2.3.1 Ecological Overview

Approximately 700 m of the historic railway passes through a large wetland complex at the southeast end of Summit Lake (Plate 2.3-1). Large portions of this section of the rail trail flood and erode each spring, predominantly due to beaver activity and changes to hydraulic flow patterns (Plate 2.3-2). This section of trail is an integral part of the annual Western Toad migration from Summit Lake eastward to the Nakusp Range, with many thousands of toadlets (Federally listed as a Special Concern status) migrating along and across the trail; it would benefit from flow and erosion management. The site occurs within a large wetland complex containing multiple wetland communities, including cattail marshes and pink spirea (hardhack) swamps that, while uncommon (the Wm05 cattail marsh is provincially blue-listed), are believed to be remnants of large disturbed areas that may have previously been cleared and farmed (Annschild 2019). The complex also contains large areas of undescribed (not formal ecosystem types as per the provincial Biogeoclimatic Ecosystem Classification system) alder, willow and red-osier dogwood swamps, adjacent cedar-skunk cabbage swamps, and abundant beaver ponds, dams, and beaver-modified swamps. The old railway forms a long, linear modification through the wetland complex, essentially acting like a long dam, with multiple watercourses bisected by the rail bed.

Plate 2.3-1. Looking south at the flooded rail trail at Summit Lake.

Plate 2.3-2. Hydraulic connectivity across the old rail trail altered by beaver activity.

2.3.2 Restoration Objectives

The site restoration objectives are to reduce flooding and erosion of the rail trail, manage the hydraulic connectivity between the upstream and downstream areas, keep recreational trail users out of the wetlands area, and reduce sediment entering downstream aquatic environments.

2.3.3 Restoration Plan

2.3.3.1 Physical Setting

Surface water that originates in the mountains immediately to the northeast of the site crosses the rail trail and enters Bonanza Creek just upstream of the Summit Lake outlet. Beaver dams immediately upstream of the railbed have raised water levels and directed surface water to flow across and along the rail trail at several locations over a 275-m-long section. Over time, these redirected flows have resulted in the erosion of the rail trail bed to the degree where the rail trail has become the stream bed. During spring and summer periods water flowing over the rail trail is 0.3 m deep.

2.3.3.2 Conceptual Design

The conceptual design involves two main elements: repairing and raising the rail trail bed to allow for dry recreational use and creating managed drainage under the rail trail at several locations (Figure 2.3-1). The rail trail bed will be raised by adding up to 0.75 m of clean and compacted fill on top of the existing rail trail bed footprint. The new fill will be of similar composition to the existing fill. Water will be directed under the rail trail at up to five locations either through open bottom culverts or under short bridges. All structures will be designed and installed to accommodate recreational vehicles as motorized recreational vehicles are permitted on this section of the rail trail.

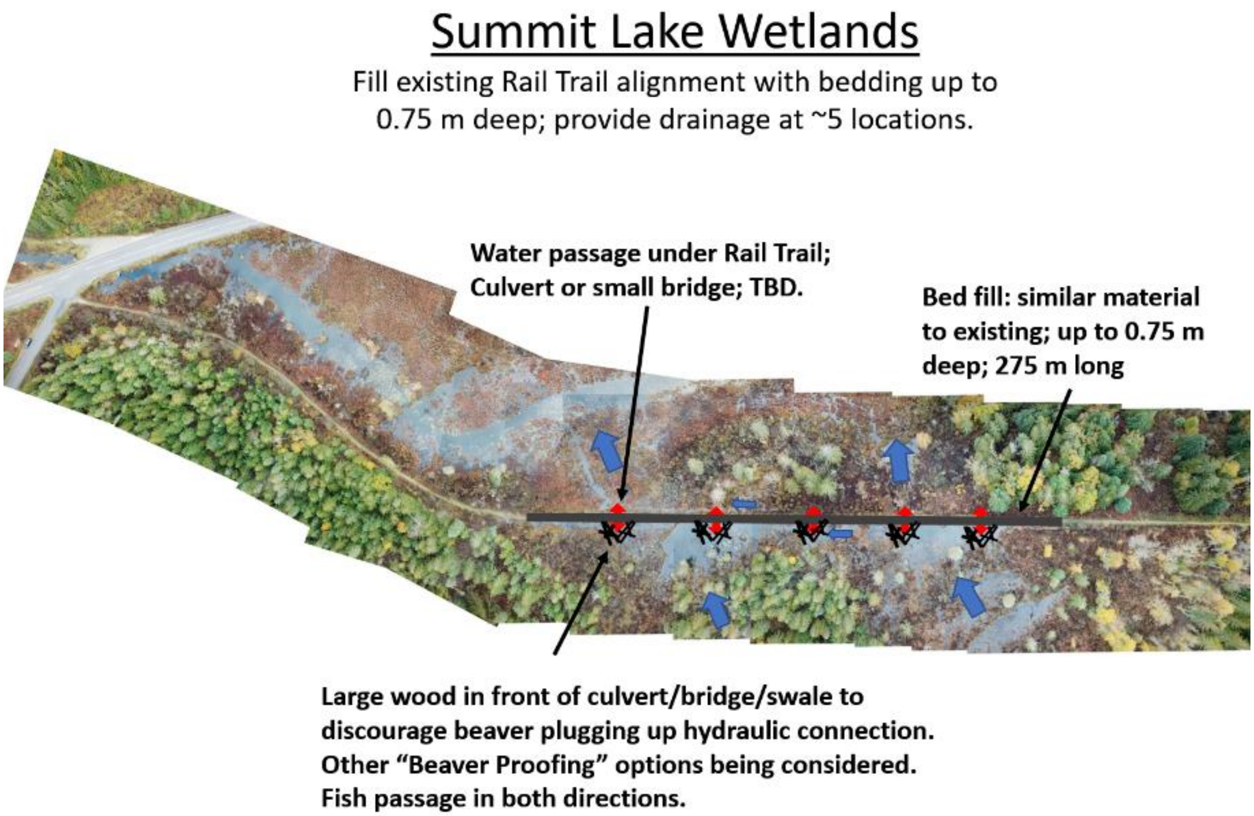

Figure 2.3-1. Conceptual plan for Summit Lake Restoration Project

2.3.3.3 Work Plan, Timeline and Construction Planning

Plans at this time are conceptual and require additional field work to further to develop estimates of materials and labour required to complete the proposed works. The project will be refined over the 2020 spring–fall period after ground surveys have been completed. Fisheries studies are to be conducted by the Okanagan Nation Alliance in the 2020 spring and summer. Construction is currently scheduled for the 2021 late summer−fall period depending on permitting. Detailed construction plans will be developed once the conceptual design has been completed and reviewed and agreed upon by stakeholders.

2.3.3.4 Supporting Studies

Numerous additional studies are required for this project, including:

- Biological inventory and assessment of the site to fully inventory the flora and fauna. This work has been partially completed, but due to the time of year in which the project was initiated in 2019 it is not complete. An important part of these studies is the completion of an amphibian survey (primarily Western Toads) and habitat assessment, as amphibians are the most likely wildlife to be impact by the project.

- Complete a First Nations cultural inventory of the site. An initial screening assessment of all three restoration sites is planned for the spring of 2020 by the Okanagan Nation Alliance. The initial assessment will determine if more in-depth studies are required, including the need for an archaeology study.
- Fish surveys in Bonanza Creek and select tributaries. Surveys will be completed for all three restoration sites to update fish species and habitat knowledge. Biologists from the Okanagan Nation Alliance will undertake this study, with survey work planned for spring and fall of 2020.

2.3.3.5 Permit Requirements

We are in the process of applying for a Change Approval under Section 11, *Water Sustainability Act* for changes in and about a stream. Through consultations with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), a crown land tenure application or reserve may be required.

2.3.4 Monitoring Plans

2.3.4.1 Monitoring Program

A pre-construction biophysical baseline and post-construction monitoring program will be developed when the conceptual plans are formalized. The monitoring plan will be designed to ensure that the success of the project can be measured, with a specific focus on hydrologic connectivity, beaver habitat, and Western Toads.

2.3.4.2 Climate Change Considerations

Climate change will have no impact on this project as the project simply involves raising the rail trail bed to well above normalized water levels and passing water underneath the newly raised trail bed. The water conveyance capacity of the culverts or bridges will pass any additional discharge of water during winter and spring periods as forecasted by climate change models.

3. BEAVER MAPPING AND ASSESSMENT

3.1 Project Overview

The objective of the Beaver Mapping and Assessment project is to "i*nventory and map all wetlands and structures, identifying lodges and estimating occupied and unoccupied beaver habitats in the Bonanza Corridor to develop a plan for beaver restoration where appropriate.*" The project will also lead to an incorporation of current and historic beaver use in the wetland enhancement projects.

3.2 Current Status

Year one of the beaver program included:

- Literature search on beaver habitat, population assessments, mapping methodology, and sampling programs (see Peyton 2020). The existing body of knowledge will then be used to create a comprehensive mapping and inventory plan for 2020.
- Initial reconnaissance inventories to locate existing beaver habitat (dams and lodges). This included initial surveys along accessible areas (the rail trail) and the use of a drone to survey high-potential habitat (Plates 3.2-1 and 3.2-2). Multiple active and inactive lodges and dams were located and mapped. These initial data will be used to develop the 2020 sampling and mapping program.
- Purchase of 10 Reconyx HyperFire 2 trail cameras, and associated security enclosures, locks, batteries, and memory cards. The cameras will be installed in known beaver habitat and used to monitor habitat and assess population numbers.

3.3 Next Steps

A comprehensive mapping and inventory program will be developed in the spring of 2020. The trail cameras will be installed as soon as the wetlands are accessible (snow-free). The cameras will be trialled, with photos downloaded on a regular basis to ensure they are capturing useful information, and moved as necessary.

Habitat mapping and field verification will be completed in conjunction with the Old Growth Mapping and Assessment and the Species at Risk Habitat projects to make field work as efficient as possible. A project-specific assessment form will be created to enable consistent data regarding habitat use, potential habitat, current and past evidence of use, and to spatially describe and map the current and potential habitat.

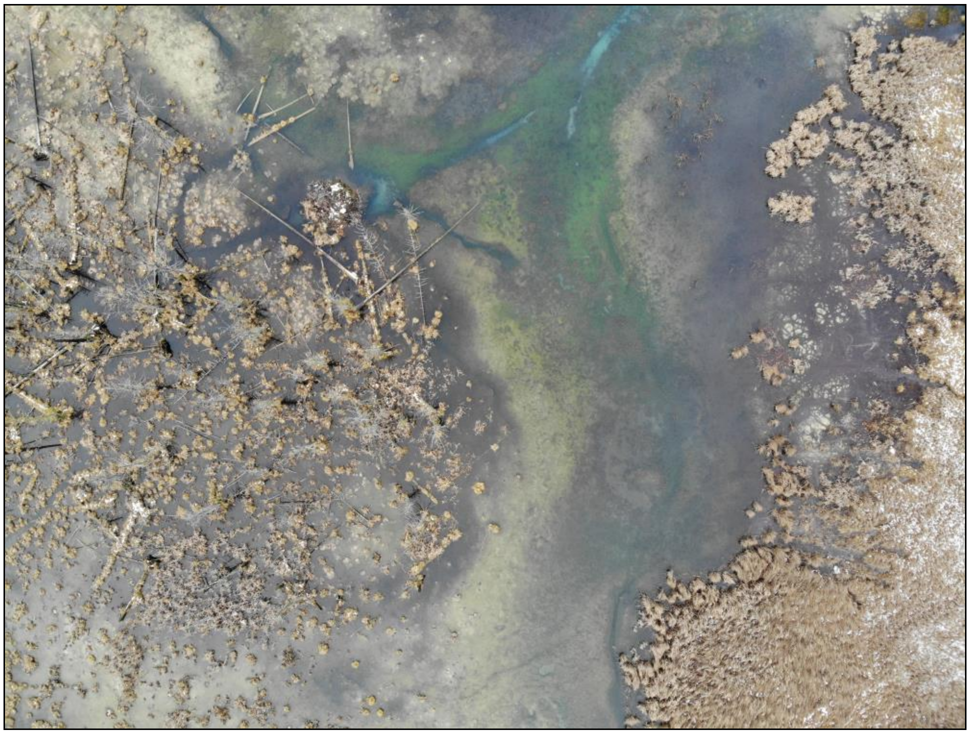

Plate 3.2-1. Active beaver lodge (upper left) identified via drone surveys in Bonanza Marsh.

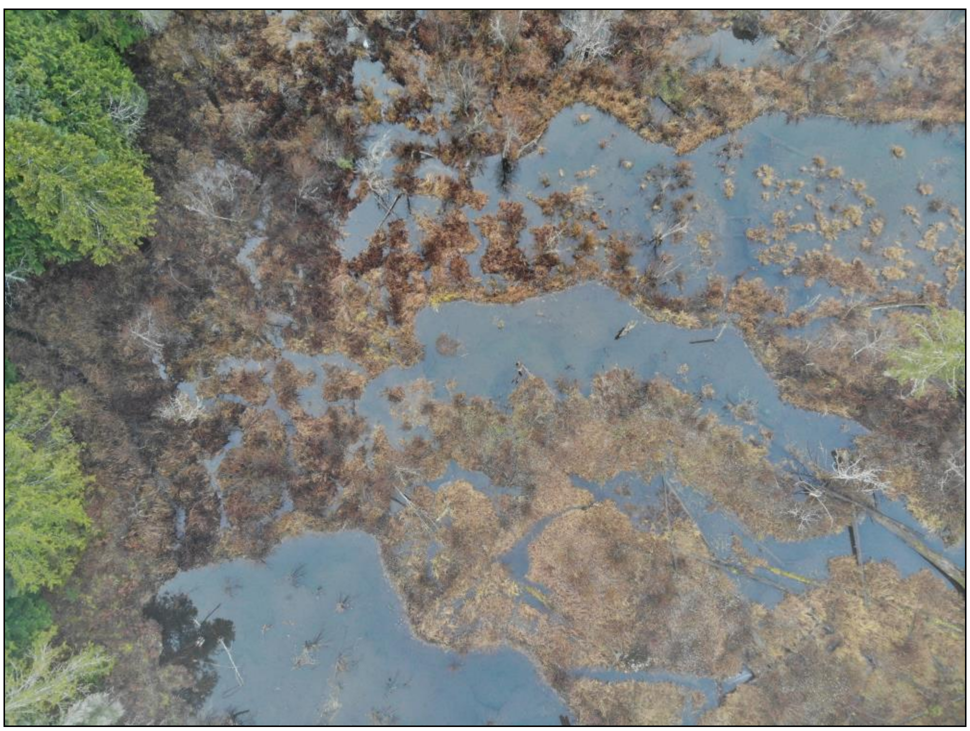

Plate 3.2-2. Old beaver dams forming a series of ponds near Summit Lake.

4. OLD GROWTH MAPPING AND ASSESSMENT

4.1 PROJECT OVERVIEW

The objective of the Old Growth Mapping and Assessment (OGMA) project is to "complete ecosystem mapping of the Bonanza Corridor to identify and map all ecosystem types, structural stage, and condition as per provincial mapping methodologies." To achieve this objective, we have initiated terrestrial ecosystem mapping (TEM) of the study area.

TEM is a standardized method for ecological classification and mapping. It uses the provincial Biogeoclimatic Ecosystem Classification (BEC) system to describe the type and extent of ecosystems within a defined study area. BEC groups ecosystems at regional, local, and chronological levels using a combination of current and expected vegetation, soil, climate, and topography. Ecosystems are classified at a local level (site series) that represent specific localized ecosystem units based on vegetation composition and soils. Multiple site series are described for each regional subzone reflecting the landscape level distribution of ecosystem based on regional climate, elevation, and physiography. Vegetation is the most important factor for ecosystem classification; however, it is based on climax and zonal theories, where the vegetation observed in a young or disturbed site may not necessarily reflect the species composition of a mature or old site (BC Ministry of Forests and Range 2010; RIC 1998).

Bioterrain mapping is the first part of the TEM process, where mapped terrain polygons are used to identify areas of similar soils and topology. Bioterrain mapping describes terrain features (Figure 4.1-1) based mainly on the type of surficial material (e.g., fluvial, glacial till, colluvium, or others) and surficial expression (e.g., blanket, veneer, plain, steep slope, fan, or terrace). Additional information describing subsurface material (e.g., glacial till over bedrock), geomorphic processes (mass movement, inundation, permafrost), and soil drainage (e.g., well, imperfect, rapid) is also described for each polygon (Figure 4.1-2). The bioterrain mapping also delineates terrain units by vegetation features to separate areas of different productivity, water deficits, or those influenced by more saturated soils. Ecosystem mapping uses the bioterrain polygons (dividing them into smaller polygons as needed) to map and classify ecosystem types, along with additional descriptors that provide information on the current state and condition of each ecosystem.

Ecosystem polygons are delineated based upon observable characteristics such as differences in slope, aspect, drainage, and vegetation structure and composition.

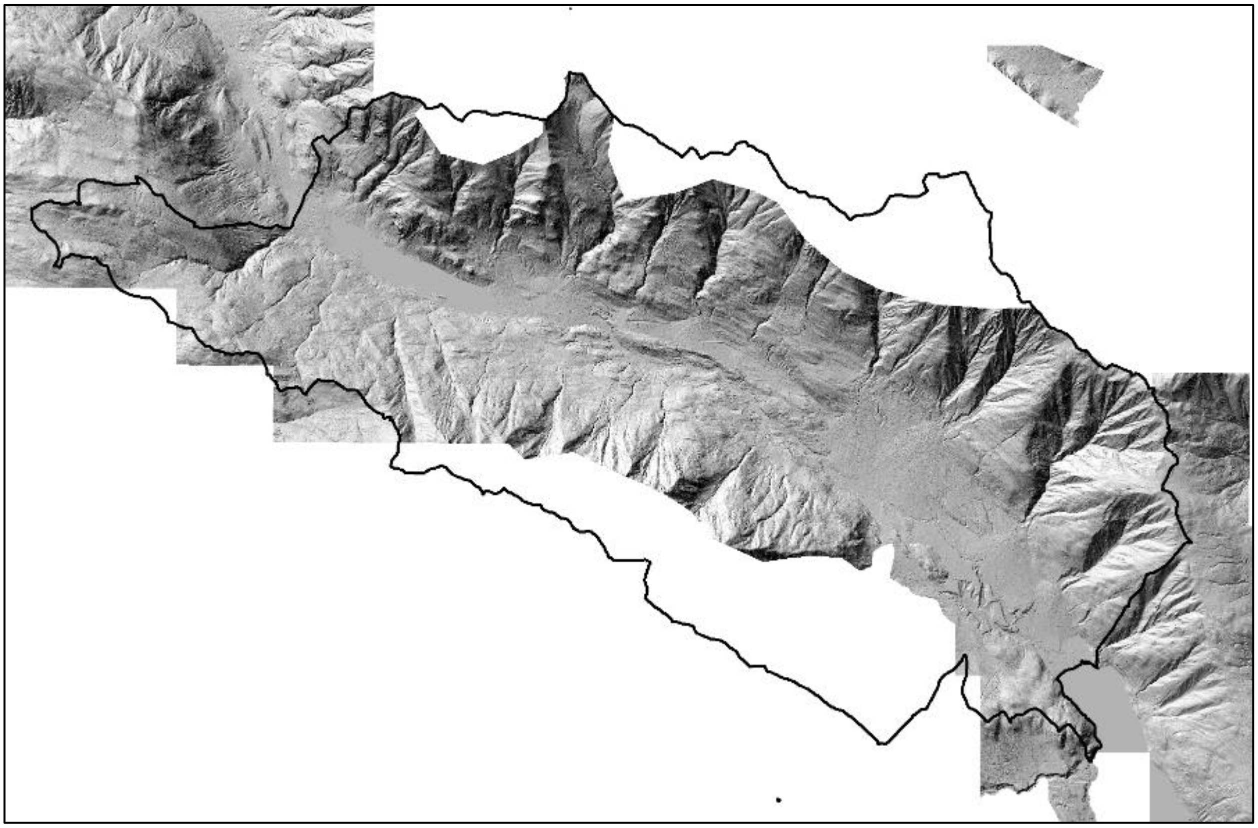

Figure 4.1-1. LiDAR coverage of the Bonanza Corridor showing the bare earth terrain

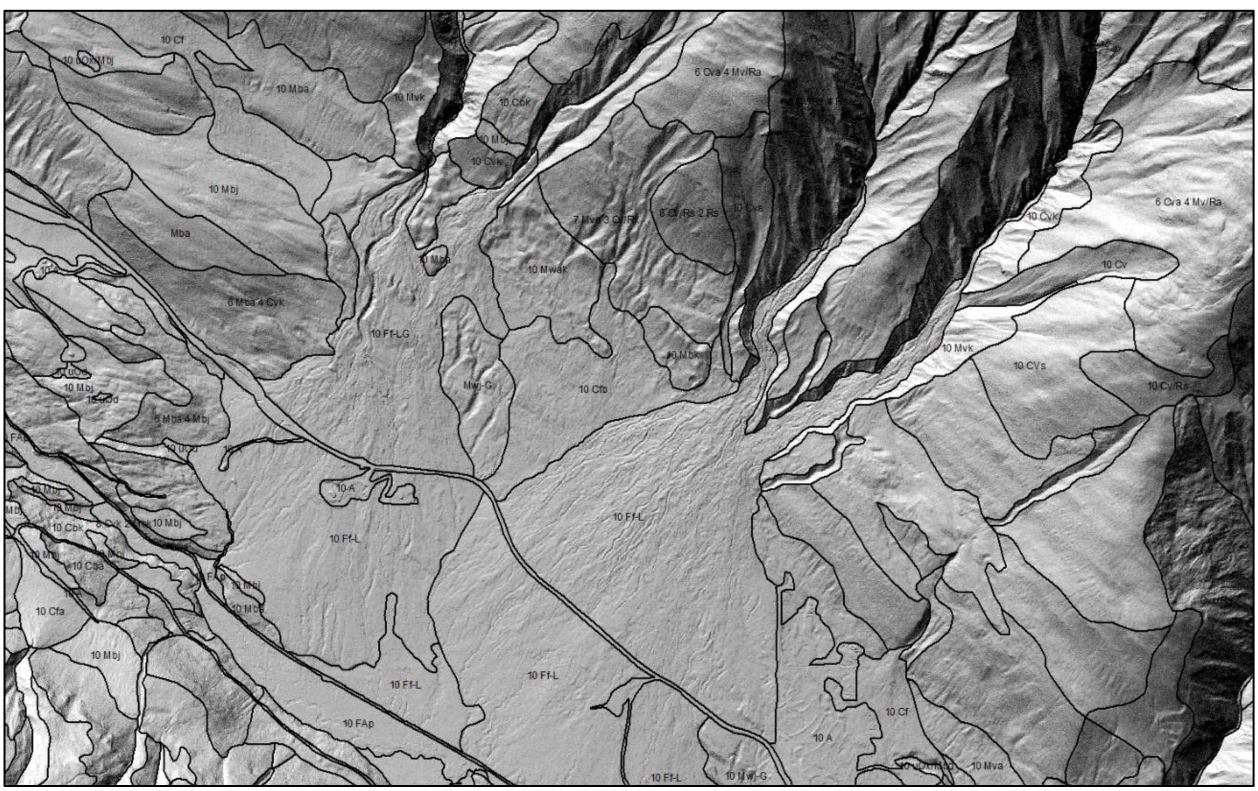

Figure 4.1-2. Bioterrain polygons overlain on the LiDAR bare earth

Each TEM polygon is attributed with ecosystem descriptions or, if it contains multiple ecosystem types, split into smaller ecosystem polygons which are attributed uniquely. Attributes include:

- ecosystem classification (e.g., site series) for up to three ecosystem types per mapped polygon using deciles (10% increments describing the amount of a given ecosystem unit present in a polygon);
- structural stage, canopy composition, and modifiers (to describe the vegetation in terms of sparse, shrub, young forest, old forest, as well as stand composition features such as conifer or mixed forest); and
- site modifiers (indicating conditions observed that differ from the expected for a given ecosystem unit).

Ecosystem polygons may be a single ecosystem type or contain a complex unit that describes up to three ecosystem types. An example of a compound ecosystem unit label is provided in Figure 4.1-3.

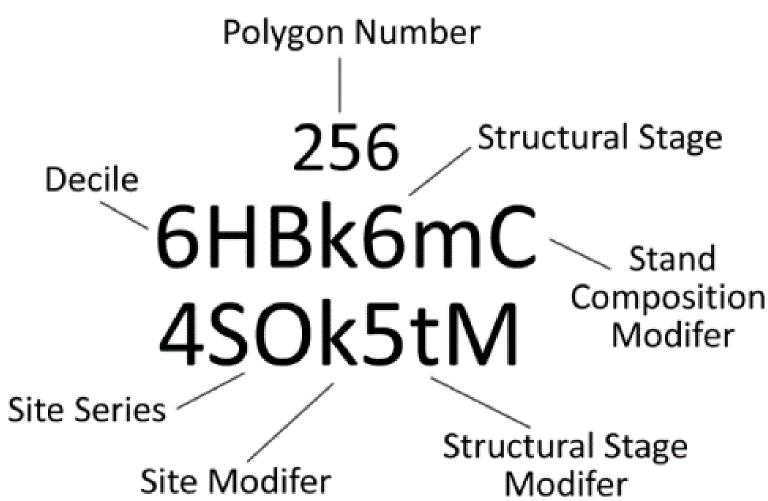

Figure 4.1-3. Compound ecosystem unit label

Bioterrain mapping and TEM are conducted by qualified professionals in accordance with provincial methodologies. Mapping was completed on BC government digital air photos and LiDAR. Stereo ecosystem mapping will be completed using an extension within ESRI ArcGIS.

All mapping will be generally completed using provincial methodologies, including:

- Standard for Terrestrial Ecosystem Mapping in BC (1998);
- Standard for TEM Digital Data Capture in BC, Version 3.0 (2000);
- Terrain Classification System for BC, Version 2.0 (1997);
- Biogeoclimatic Ecosystem Classification codes and names (BECdb version 8, Feb 2012);
- Biogeoclimatic Ecosystem Classification of Non-Forested Ecosystems in British Columbia (MacKenzie 2012);

- Wetlands of British Columbia: a guide to identification (MacKenzie and Moran 2004);
- Field Manual for Describing Terrestrial Ecosystems; 2nd Edition (BC Ministry of Forests and Range and BC Ministry of Environment 2010); and
- A Field Guide to Site Identification and Interpretation for Southeast British Columbia (MacKillop and Ehman 2016).

4.2 Current Status

Bioterrain mapping has been completed for the majority of the Bonanza Corridor (9,662 ha of the 12,865-ha watershed). A total of 943 polygons were mapped and attributed (Figure 4.2-1). This mapping will form the basis of the TEM.

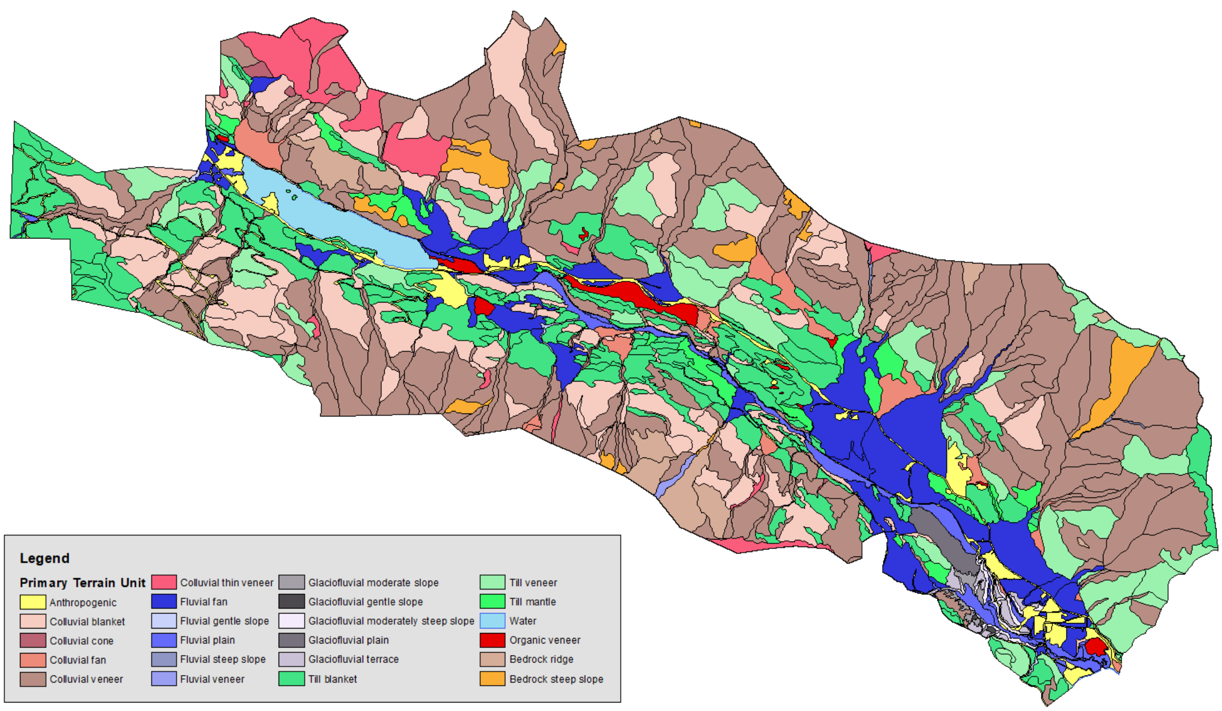

Figure 4.2-1. Bioterrain mapping of the Bonanza Corridor

4.3 Next Steps

To complete a TEM of the area, field surveys are required. These surveys will be completed in conjunction with the Species at Risk, Beaver Habitat, and restoration projects in order to maximize field time. The surveys will collect information on the full range of biophysical and ecological conditions present in the study area, and to ground-truth the bioterrain and ecosystem mapping. Field verification will be completed for soil and terrain descriptions as per the following:

- Field Manual for Describing Terrestrial Ecosystems, 2nd Edition (BC MOFR and MOE 2010);
- Terrain Classification System for BC, Version 2.0 (Howes and Kenk 1997); and

- the Canadian System of Soil Classification (Soil Classification Working Group 1998).

Ecosystem and vegetation descriptions will use:

- Field Manual for Describing Terrestrial Ecosystems, 2nd Edition (BC MOFR and MOE 2010);
- A Field Guide to Site Identification and Interpretation for Southeast British Columbia (MacKillop and Ehman 2016); and
- Wetlands of British Columbia: A Guide to Identification (MacKenzie and Moran 2004).

Data will be collected using 20 x 20 m plots established in homogenous ecosystem types. Precise plot dimensions will vary depending on the ecosystem type but will be approximately 400 m^2 regardless of shape. Three levels of data collection will be used: Ecosystem Field Form (FS882), site visit (SIVI), and visual checks. The FS882 requires detailed site, soil, and vegetation data; the SIVI requires detailed site and vegetation data but less soils data, and visual checks requires a minimum of a GPS location and ecosystem classification. Representative photos will be taken at all full plot locations.

The field data will then be used to verify the bioterrain mapping (spatial accuracy and classification) and develop the ecosystem mapping attributes. Field surveys will be completed throughout the 2020 season, with final mapping completed in fall 2020. The TEM will also incorporate beaver habitat data and species at risk habitat to create a comprehensive map.

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