SEKW'EL'WAS

Final Report 2016 - 2017
Púsluḿcw (Wet Ground) Wetland and Riparian Survey

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Prepared by:	Splitrock Environmental Sekw'el'was LP Box 798 Lillooet BC V0K 1V0
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Executive Summary

"Riparian and wetland areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered highly valuable from an ecological standpoint. They are often critical in terms of maintaining function and structure for natural systems" (BC Hydro Fish and Wildlife Compensation Program 2011).

This project was initiated by the St'at'imc communities of T'it'q'et and Sekw'el'was. The St'at'imc people have lived and worked in the Lillooet region for thousands of years, and are the caretakers of ecological, spiritual, and community values in the area. In 2015 T'it'q'et and Sekw'el'was began investigating how wetlands in the St'at'imc territory could be protected from further degradation and loss resulting from hydroelectric, agricultural, and residential development.

As in many landscapes around the world, the wetlands of the Bridge/Seton Watershed are rare yet extremely valuable habitat features. Historical and contemporary loss of wetlands to hydro projects, agriculture, and other human uses, has increased the rarity of these features in this watershed. As such it has become necessary to inventory our wetlands in order to better understand their health and function, and to prioritize the protection and conservation of these features during ongoing land management.

The main goals of this project were:

- to determine the spatial extent and occurrence of wetlands within the Lillooet region, with a focus on areas of interest of the Sekw'elwas and T'it'qet communities in 2016
- to gather a thorough accounting of site attributes including characteristics of vegetation, soils, hydrology, and amphibian occupancy on each site
- to categorize each wetland site based on FWCP guidelines. Category 1 – natural wetland habitats; Category 2 – degraded wetland habitats; Category 3 – created wetlands.
- To develop local capacity for wetland research and stewardship
- to enhance the wildlife value of the Cayoosh Elementary wetland, and the Off-Channel 3 wetland sites.

During the 2016 field season we identified over 48 wetland sites in the study area. A field survey examining soils, plant communities, hydrology, and amphibian occupancy was undertaken at all 48 identified sites. Based on the results of these surveys, each site was classified according to the provincial protocols, and rated according to health. Permanent photo monitoring points were established at 46 of the sites. The wetlands within the survey area were generally quite small in areal extent, with 16 sites less than 400 m^2, and the average area of the remaining 32 sites was 0.7 hectares. In general the provincial system of wetland classification was not applicable to the small, unique, and disturbed wetlands within this study area. We attempted to use this system, but in most cases were only able to classify each site at a higher level using the Canadian System of Wetland Classification. Of the 48 wetlands, we classified 5 as Low bench wetlands, 16 as Marshes, and 7 as Swamps. A remaining 13 plots were described loosely as springs, while 7 ponds we surveyed were unclassifiable according to either system. Of the 48 wetlands surveyed we rated 8 as Category 1 - natural wetland habitat, 30 as Category 2 - degraded wetland habitat, and 10 as Category 3 - created wetland habitat.

Based on the findings of these surveys, we have written site-specific recommendations for conservation, protection, and enhancement actions for each of the wetland sites we visited during the 2016-17 season. These recommendations are included in the site summaries attached in appendix one, and are available for use by the landowners and land managers responsible for the various sites.

At the heart of this wetland survey was the desire to increase the capacity for citizen engagement in ecological conservation within the communities of the Lillooet area. Before fieldwork began we held a two-day wetland survey workshop, and a one-day amphibian workshop. Young technicians were mentored through the process of field surveys, and the collection of wetland data. Throughout the survey process, we presented the results of our work to community gatherings in and around Lillooet. Fifteen people attended the Wetland Workshop and twelve people attended the amphibian workshop, both held in June 2016. A further eleven people attended the April amphibian survey workshop. Presentations were held with four representatives from the partner communities and with three representatives from other St'at'imc communities. A results based presentation was hosted with a total of twenty-five participants attending and engaging in the discussion around the health of our wetlands.

Presentations on the methodology and results of the wetland survey were also shared with the Nature Conservancy and with twenty-five international forestry students from UBC.

This project has been an excellent catalyst for ecological capacity building. Our goal moving forward is to collaborate with other St'at'imc communities to continue our survey across a broader area, and to continue to develop St'at'imc ecological capacity during wetland research activities.

Two sites received wetland enhancement activities in the fall of 2016. The wetland at Cayoosh Elementary, and the upland area between off-channel 3 and the James' property wetland were both planted with native plant species to improve the wildlife habitat values of these sites. Between these two sites, we enhanced an area of 1140 m^2 with the addition of 573 native plants. A total of 105 students were involved in these wetland stewardship events.

This wetland project has resulted in an increase in community knowledge of the distribution and health of wetlands and riparian zones in the Lillooet area. Our results demonstrate that wetlands are scarce, and often highly disturbed in this area. These results have generated community interest in wetlands, and a collective will to move forward in the conservation and restoration of wetland habitat.

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1.0 Introduction

1.1 Proponent information

The Cayoose Creek Indian Band Sekw'el'was are the traditional stewards of a large territory within the Fraser River tributaries of Cayoosh Creek, and Texas Creek. Membership includes 201 registered members, of which 100 live on reserve. Sekw'el'was have 720.1 hectares of reserve lands broken among three large areas. We seek to live and work in an ecologically sensitive way on our traditional territory according to both cultural and scientific knowledge. Through our business – Splitrock Environmental – we have worked on ecological conservation and restoration projects in and around our traditional territory for the past 11 years.

T'it'q'et and P'egp'ig'lha Council have partnered with Sekw'el'was on this wetland project over next three years, and their involvement has allowed a larger footprint to be assessed and community capacity building to include both communities. Membership includes 431 community members, of which 209 live on reserve. The P'egp'ig'lha clan have 1,497.8 hectares of reserve lands broken into seven areas throughout the region. Our traditional ways, values and the laws of our ancestors are held in the St'at'imc language and are written on the land. We are committed to working together to build our community, maintain our traditional ways, and live in harmony with all things.

1.2 Hydroelectric impact

In the 1950's and 1960's the Bridge/Seton watershed was subject to major alterations from hydroelectric development. These alterations have been the basis for significant habitat loss for both fish and wildlife species. Wetlands are an important habitat type, which has been impacted by hydro development within this landscape (BC Hydro 2011). Some of the changes to wetlands have been documented in the Bridge/Seton River Watershed Riparian and Wetlands Action Plan (2011):

- 283 hectares of wetlands lost within the middle and upper Bridge River
- 1182 hectares of riparian area lost within the middle and upper Bridge River
- Reduced flows on the lower Bridge River have reduced the amount of off channel wetlands, riparian habitat, and salmonid rearing ponds.

- Larger spills on the lower Seton River have degraded off channel salmonid spawning and rearing habitat, and present flows limit access to former off-channel habitat.
- The 27 hectares of land lost along shores of Seton Lake from Seton Dam impoundment included Swampy shoreline areas favoured by birds, mammals and breeding salmonids.

The loss of riparian areas and their associated wetlands has been extensive (Figure 1).

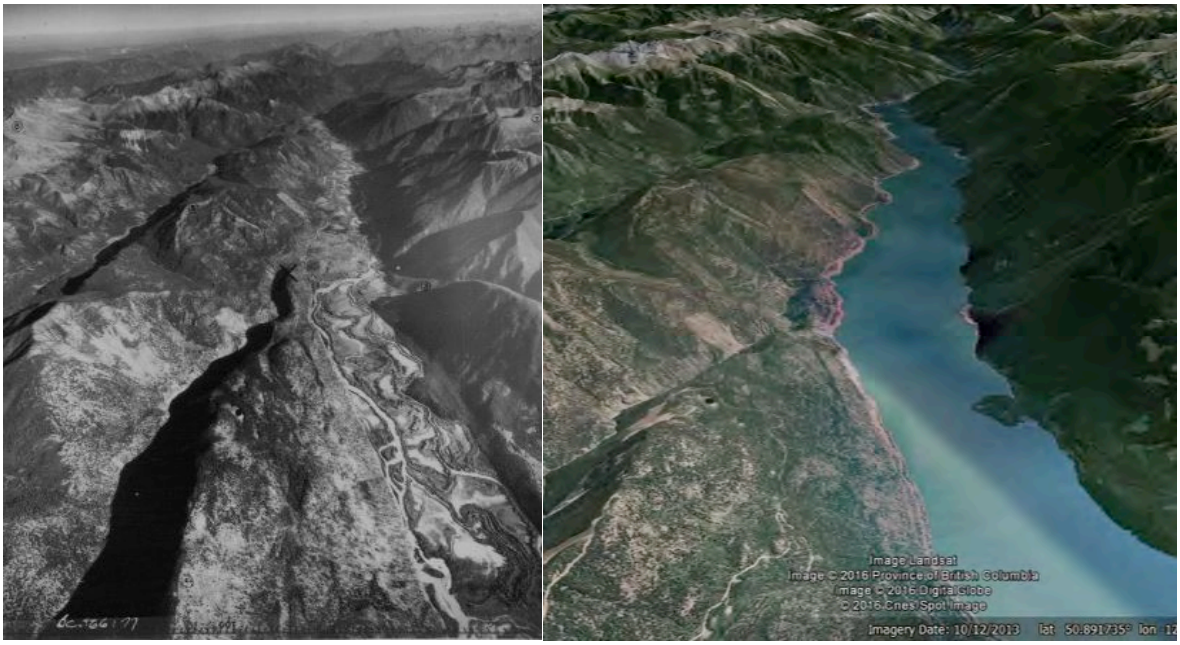


Figure 1 Historic photo of middle Bridge River and associated riparian areas, ox-bow lakes, swamps, and marshes (left). Current Google Earth generated image of the same landscape showing inundation from the Carpenter Reservoir (right).

1.4 Background: Wetlands

"Riparian and wetland areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered highly valuable from an ecological standpoint. They are often critical in terms of maintaining function and structure for natural systems" (BC Hydro Fish and Wildlife Compensation Program 2011).

Wetlands are described as areas of *"land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment"* (National Wetlands Working Group 1988). Wetland development is a complex process involving many dynamics including chemistry, topography, hydrology, and biology (National Wetlands Working Group

1997). Wetlands occur in depressions, low areas, and other places where water is present near or above the soil surface for periods of time sufficient to contribute to distinct soil chemistry and vegetational characteristics.

2.0 Goals and Objectives

As in many landscapes around the world, the wetlands of the Bridge/Seton Watershed are rare yet extremely valuable habitat features. As a result of historical and contemporary loss of wetlands to hydro projects, agriculture, and other human uses, the rarity of these features has increased within this region. As such it has become necessary to inventory our wetlands in order to better understand their health and function, and to prioritize the protection and conservation of these features within the context of ongoing land management.

The main goals of this project were:

- to determine the spatial extent and occurrence of wetlands within the Lillooet region, with a focus on areas of interest to Ske'wel'was and T'it'qet communities
- to gather a thorough accounting of site attributes including characteristics of vegetation, soils, hydrology, and amphibian occupancy on each site
- to categorize each site as Category 1, 2, 3 based on FWCP guidelines
- to develop local capacity for wetland research and stewardship
- to enhance the wildlife value of the Cayoosh Elementary wetland, and the Off-Channel 3 wetland sites.

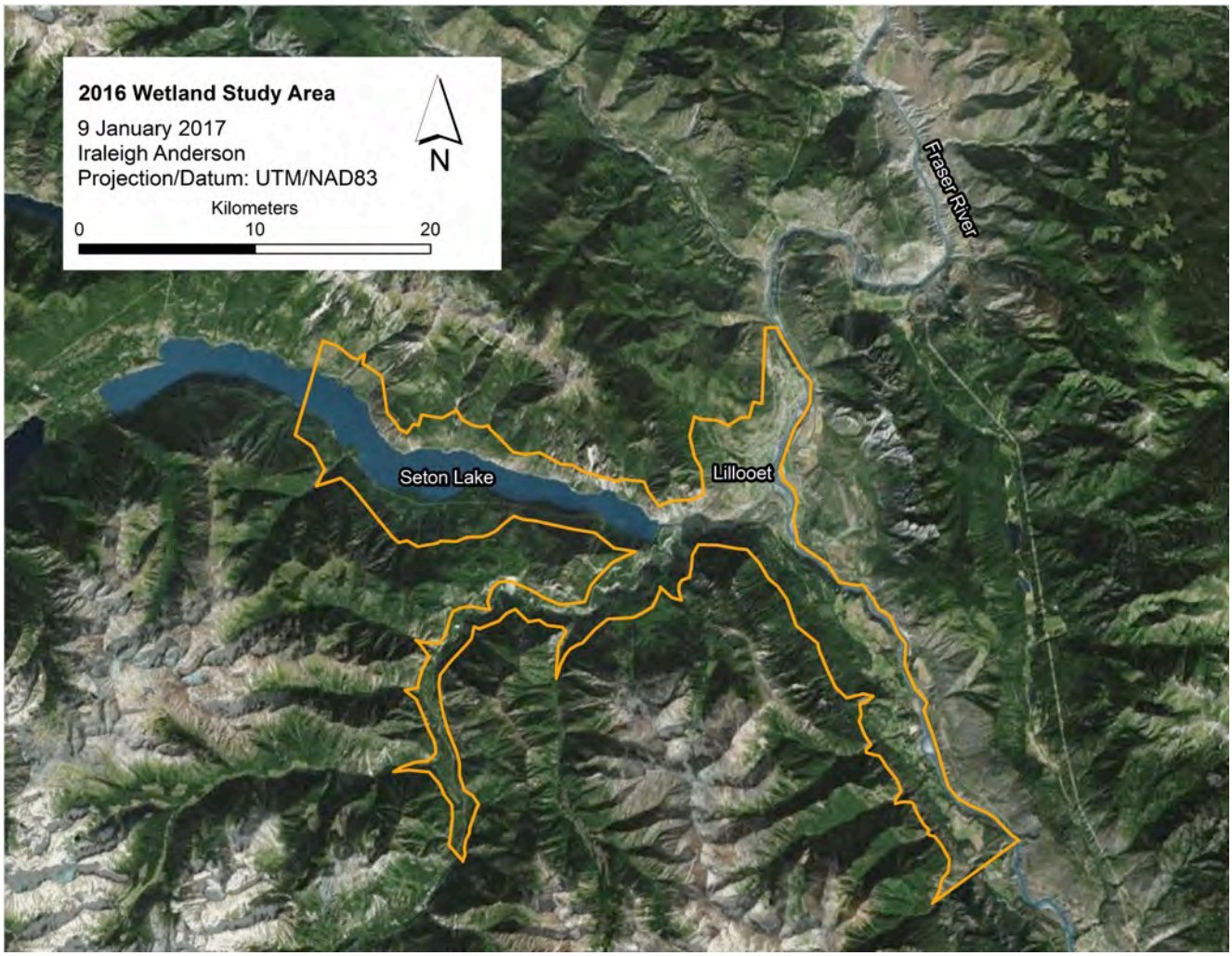
3.0 Study Area

The study area falls within the traditional territory of the St'at'imc. The study area for this project was defined in part based on the traditional territories of the St'ati'imc communities of T'it'qet and Sekw'el'was. For 2016 this study area was limited to areas within a 15 Kilometer radius of Lillooet, under 800 meters above sea level, west of the Fraser River, and not extending north past the town of Lillooet into Bridge River IR lands (Map 1). We chose an upper elevation of 800 meters because this limit corresponds with the level of flooding that has occurred at the Downton Reservoir at the upper end of the Bridge/Seton watershed. It is assumed that reservoir flooding has been a major cause of wetland loss in areas below this elevation. This

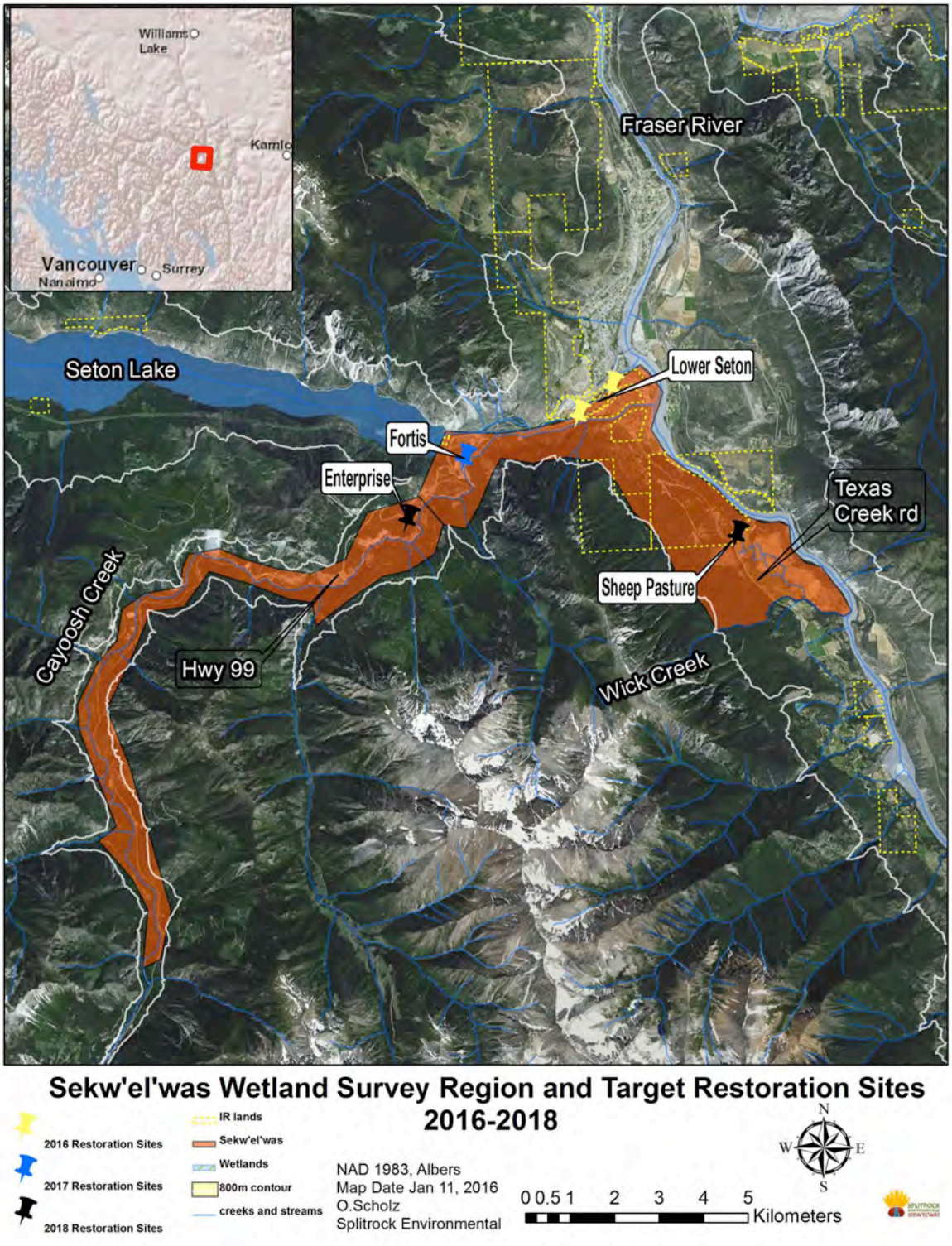
study area comprises 11,705 hectares of land primarily along Texas Creek Road south of Lillooet, and along Highway 99, which runs west from Lillooet to Pemberton.

The area ranges in altitude from 200 to 800 meters above sea level. The lower elevations fall into the Ponderosa Pine very dry hot sub zone (PPxh2; Meidinger D. and Pojar J., 1991), the driest forested zone in British Columbia with very hot summers and annual rainfall between 280-500 mm. The higher elevations fall into the Interior Douglas-fir very dry cold (IDFxc) sub zone, where the Coast Mountains cast a rain-shadow and create warm, dry summers and cool winters (Meidinger D. and Pojar J., 1991). The relative scarcity of wetlands within these subzones means that even relatively small wetlands often serve as important habitat features for amphibians, mammals, reptiles, and birds.

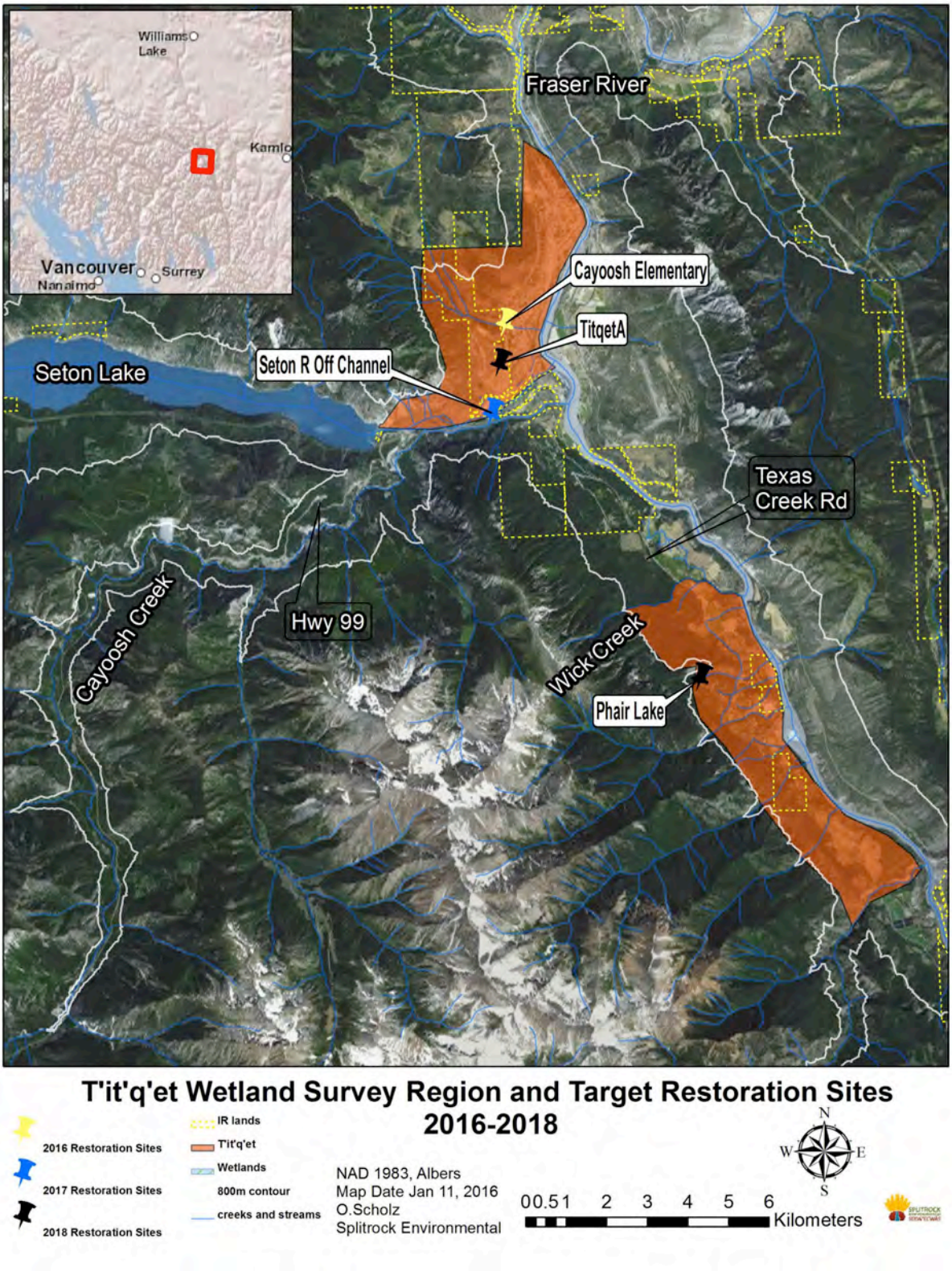
The project survey area was also broken into distinct survey polygons that each of the partner communities were designated to oversee (Maps 2 – 3). These survey areas were divided based on the proximity to each of the community's reserve lands, and included both reserve lands, private and crown land. These survey boundaries in no way reflect the title and rights of the communities; they are survey polygons that assisted in designing the wetland survey project. Also noted on the maps are the potential wetlands targeted for further enhancement and/or restoration works over the three years of the project.



Map 1 2016 Púsluṁcw wetland inventory survey study area



Map 2 Sekw'el'was Wetland Survey Region



Map 3 T'it'q'et Wetland Survey Region

4.0 Methods

4.1 Training and Community Capacity Building

Fair and effective conservation of fish and wildlife habitat, and other natural resources requires a local capacity to collect and interpret information on these resources. In addition to our data collection goals for wetlands in the Lillooet region, we had two goals specific to capacity building. The first goal was to bring the public into the process of wetland research though a series of workshops, and by inviting public participation in the wetland survey process. The second goal was to provide ongoing environmental sciences training, mentorship, and experience to a team of young technicians from local communities.

4.1.1 BC Wildlife Federation Wetland Survey Workshop

On 15-16 June 2016, Splitrock Environmental hosted a community wetland science workshop led by Ryan Durand (Ecologic Consultants), Natasha Bush (Ecologic Consultants), and Doug Newbigging (BC Wildlife Federation).

4.1.2 Amphibian Biology and Survey Workshops

On 22 June 2016 and 19 April 2017, Splitrock Environmental hosted amphibian biology workshops led by Elke Wind, of E. Wind Consulting. Elke Wind also produced an educational video on the biology of amphibians in the Lillooet area (Figure 2). The video covers the morphology and life histories of the six amphibian species which may occur in the area, and the visual survey technique we use to study them. This video will provide a valuable resource for training future technicians and community members for future amphibian survey work as a part of future phases of this wetland project.

Figure 2 Still from educational amphibian video produced by E. Wind for Splitrock Environmental.

4.1.3 Capacity Building during Field Surveys

In addition to participation in the wetland science workshops described above, the team of technicians spent several weeks of the summer conducting wetland surveys with instruction and mentorship from an experienced plant ecologist (Figure 3).

Figure 3 2016 Púsluṁcw Wetland Survey team members (Clockwise from left: Iraleigh Anderson, Matt Senger, Andrew James, Brianne Edwards, Dorian Leech, Katie Gair, and Chris Bob), 21 Jun 2016.

4.2 Site identification

In order to effectively inventory wetlands across the study area, we first had to identify known and suspected wet areas. We undertook this task in three phases:

1. Collection and review of current wetland inventory and survey data

2. Review of air photo coverage across the study area

3. Survey of community knowledge of wetland occurrence

These phases are described in the following sections.

4.2.1 Background data

We reviewed publicly available data sets for existing knowledge of wetland occurrence within the study area.

4.2.2 Orthophotography interpretation

We used ArcMap GIS software to examine 2004/2005 BC government orthophotography of the entire study area at scales ranging from 1:1000 to 1:5000. To increase the richness of visual information we also included the streams, wetlands, and lakes layers from the BC Freshwater Atlas, as well as TRIM topographic contours. A topographic wetness index (TWI) layer (Chance et al. 2015) was also included to provide predictions of relative wetness across the landscape, based on topographic position. The geographic locations of potential wetlands within the study area were determined based on visual clues such as color, vegetation structure, and topographic position.

4.2.3 Community knowledge

In order to locate small and ephemeral wetlands within the study area, we reached out to the community through posters (Figure 4), emails, and telephone calls.

Figure 4 Wetland survey poster encouraging community members to get in contact with the survey team regarding the location of small wetland features

We gathered information on wetland occurrence through a series of telephone and email interviews. Working from an initial list, we made contact with community members from T'it'q'et and Sekw'el'was, rural landowners, local biologists and naturalists, and other long-time residents of the Lillooet area. Initial interviews provided the locations of many wetlands that were not previously detected from air-photos, as well as further new contacts with potential knowledge of wetland occurrence. We assembled the results of these interviews into a database of wetland occurrence within the study area, including landowner contact information for wetlands occurring on private property, and directions to access each wetland (Table 1).

Table 1 Structure of wetland community contact database (real landowner information removed for privacy)

Wetland Name	Contact Name	Phone	Access Instructions	Address	Email	Survey Date	Land Tenure	Notes
Joe's Wetland	Joe Wells	250-256-xxxx	Follow Texas Creek road …	xx Texas Creek Road	xxxx@gmail.com	2016-06-16	Private	Joe asked that we close the gate on our way in. Please call before arrival.

In one instance we took the opportunity to interview an elder in person using a map of the area, in order to record his knowledge of historical landscape structure and wetland occurrence within the study area. Audio recordings and hand-mapped overlays over orthophotos were used to record the interview. The interview subject has worked many years in road building, mining, and excavation and provided a trove of knowledge regarding the historical topography of the study area, particularly in the Seton Corridor (Figure 5).

Figure 5 Hand-mapping over orthophotography to record historical occurrence of wetlands, 11 Aug 2017.

4.2.4 Ground Searches

All potential wetland sites, identified during orthophotography review were subsequently visited to find and identify actual wetland sites. Further time was spent driving forestry service roads scanning for wetland areas. During these search days, crews drove all accessible roads within the study area scanning for signs of wetlands. Most of this effort was focused in priority areas identified during orthophotography review. In areas with higher potential for wetland occurrence the crews would set off from the truck on foot and attempt to locate wetlands. Two days of on the ground search effort were used in the Cayoosh Creek arm of the study area, one day of effort was spent on areas off Texas Creek Road, and a half-day was used to search the Town Creek drainage above Lillooet. In addition to this effort, another project allowed two surveyors to walk the North Shore of Seton Lake between Lillooet and Seton Portage along the BC Hydro transmission line right-of-way. During this time surveyors were able to scan this part of the study area for the occurrence of wetlands.

4.2.5 Auditory Amphibian Reconnaissance

In April 2017 we made another effort to identify more wetlands within our study area; specifically those that were being used for breeding by Pacific tree frogs (*Pseudacris regilla*), and other amphibians. During the amphibian breeding season, when Pacific tree frogs can be heard calling from potential breeding sites, we completed auditory point counts throughout the study area to attempt to locate new small wetland features that may used by breeding amphibians.

ArcGIS was used to generate points every 500 meters along every public road within the study area. These points were refined by Ken Wright and Iraleigh Anderson. During this part of the process points were moved, deleted, or created based on local knowledge of the area.

Criteria for moving, deleting, or creating points included:

- Land tenure: Points were deleted or moved when ArcGIS erroneously created points on private roads.
- Topography and substrate: Points were deleted or moved when the area within 250 meters of the point was obviously too dry, steep, or well drained for any seasonal accumulation of water.
- Safety - Points were moved when there was no safe place to park a vehicle to access the point

- Proximity to noise: Points were deleted or moved when a point was too near to a significant source of noise such as a rushing creek, or the mill site.

Between 5 April 2017 and 3 May 2017 two surveyors spent 5 minutes listening for Pacific tree frog calls at each of the points (n= 100). In order to increase our chances of detecting tree frogs, we completed a replicate 5-minute listening session on 75 of the points. During each session, surveyors located each point using GIS software on an iPad, and sat quietly listening there for 5 minutes for the sound of calling tree frogs. At the end of the survey, if calls were heard, the surveyors noted the azimuth and estimated distance to the calls so that the wetland could be re-located during daylight hours. Incidental observations of owls, bats, flying squirrels, and other wildlife were recorded. Surveyors also recorded the air temperature, Beaufort wind speed class, and a categorical measure of ambient noise at each point count station.

4.3 Site Surveys

Wetland locations revealed through orthophotography review and community interviews were visited and surveyed between June and October 2016. General site, vegetation, and soil characteristics were recorded following provincial protocols (B.C. Ministry of Forests and Range and BC Ministry of Environment 2015), and protocols from the Slocan Wetlands Assessment and Monitoring Project (Durand 2014). Photographs of each site were taken. The data fields were collected using the data form developed for the project (Figure 6), and information collected is summarized in the following sections.

púsluṁcw wetlands project		Site code:
Site Information		
Date (dd-Mon-yy):	Plot code:	Crew Members:
Wetland Common Name:		Private/Crown/ T'it'q'et/Sekw'el'was:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Crest ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Dep. ☐ Level ☐ Gully ☐ Flood		Microtopography:
Hydrology		
pH: / Conductivity:	Water Color: ☐ Yellow Brown Turbid ☐ Green Brown Turbid ☐ Tea ☐ Green Brown Clear ☐ Blue Green Clear	Water Source: ☐ Culvert ☐ Stream ☐ River ☐ Lake ☐ Groundwater (springs) ☐ Only Rain
HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ V. Dynamic	HGM Position:	% Open Water:
Soils		
Mineral Soil Texture: ☐ Sandy ☐ Loamy ☐ Silty ☐ Clayey		Humus Form: ☐ Mor ☐ Moder ☐ Mull Organic Form: ☐ Fibric ☐ Mesic ☐ Humic
Coarse Frag % / Restriction Depth/Type	☐ Gleying ☐ Mottling ☐ Seepage	O. Soil Depth: M. Soil Depth:
Von Post: 1 2 3 4 5 6 7 8 9 10 (For organic soils)	Soil Moisture: ☐ Aqueous ☐ Peraquaic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ Humid (For organic soils)	
Soil Drainage: (For mineral soils) ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly		
SMR: ☐ Moist ☐ Very Moist ☐ Wet ☐ Very Wet	SNR: ☐ Very Poor ☐ Poor ☐ Medium ☐ Rich ☐ Very Rich ☐ Hyper	
Wildlife and Landscape Notes		
Wildlife/Notes/Description		
Landscape Context (Roads, industry, agriculture, grazing, recreation, etc.)		
Disturbance (Fire, flooding, blowdown, beaver, dumping, erosion, etc.):		

púsluṁcw wetlands project		Site code:
Site Information		
Date (dd-Mon-yy):	Plot code:	Crew Members:
Wetland Common Name:		Private/Crown/ T'it'q'et/Sekw'el'was:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Crest ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Dep. ☐ Level ☐ Gully ☐ Flood		Microtopography:
Hydrology		
pH: / Conductivity:	Water Color: ☐ Yellow Brown Turbid ☐ Green Brown Turbid ☐ Tea ☐ Green Brown Clear ☐ Blue Green Clear	Water Source: ☐ Culvert ☐ Stream ☐ River ☐ Lake ☐ Groundwater (springs) ☐ Only Rain
HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ V. Dynamic	HGM Position:	% Open Water:
Soils		
Mineral Soil Texture: ☐ Sandy ☐ Loamy ☐ Silty ☐ Clayey		Humus Form: ☐ Mor ☐ Moder ☐ Mull Organic Form: ☐ Fibric ☐ Mesic ☐ Humic
Coarse Frag % / Restriction Depth/Type	☐ Gleying ☐ Mottling ☐ Seepage	O. Soil Depth: M. Soil Depth:
Von Post: 1 2 3 4 5 6 7 8 9 10 (For organic soils)	Soil Moisture: ☐ Aqueous ☐ Peraquaic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ Humid (For organic soils)	
Soil Drainage: (For mineral soils) ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly		
SMR: ☐ Moist ☐ Very Moist ☐ Wet ☐ Very Wet	SNR: ☐ Very Poor ☐ Poor ☐ Medium ☐ Rich ☐ Very Rich ☐ Hyper	
Wildlife and Landscape Notes		
Wildlife/Notes/Description		
Landscape Context (Roads, industry, agriculture, grazing, recreation, etc.)		
Disturbance (Fire, flooding, blowdown, beaver, dumping, erosion, etc.):		

Figure 6 Example of data sheet

4.3.1 Plot Definition

In order to effectively estimate and record conditions in heterogeneous landscapes such as wetlands, it is necessary to divide the site of interest into smaller, internally homogeneous plots and describe these sub-units individually. By limiting observations to individual plots, it is possible to more accurately describe soil, vegetation, and hydrologic conditions that often vary significantly within a single wetland complex.

At each site, all observations were made within a 400 m^2 plot delineated by the surveyors. The plot was defined by surveyors after walking as much of the site as possible to become familiar with its extent and variability. On sites with more than one wetland class, the initial plot was placed in the wetland class covering the largest area. Subsequent plots would have been used to describe other wetland types within each site; however, the wetlands surveyed were either too small, or too homogenous to require more than one plot. In cases where the entire wetland was less than 400 m^2 the plot was defined by the estimated wetland boundary.

4.3.2 Site Parameters

The geographic location and context of each wetland site were recorded using the following fields:

- Geographic Position (UTM)
- Elevation (m)
- Mesoslope Position
- Percent Slope
- Microtopography
- Aspect

4.3.3 Soil Parameters

A soil sample was extracted from each plot using a hand auger. Successive cores from a single hole were extracted and reassembled on the ground for visual examination. At the onset of the soil survey, the surveyors determined whether the soil was of organic, or mineral origin, this decision affected which of the following parameters were recorded for each sample (Figure 7).

Figure 7 Graham Leslie using a hand auger to extract soil samples, 22 Jul 2016.

Parameters recorded for mineral soils:

- Soil Texture
- Humus Form
- Percent Coarse Fragments
- Presence of Gleying, Mottling, & Seepage
- Mineral Soil Depth
- Soil Drainage
- Soil Moisture Regime
- Soil Nutrient Regime

Parameters recorded for organic soils:

- Organic Form
- Restriction Depth & Type
- Organic Soil Depth
- Von Post
- Organic Soil Moisture
- Soil Moisture Regime
- Soil Nutrient Regime

4.3.5 Vegetation characteristics

The species composition and structure of the plant community were recorded at each plot, following the protocols in the Field Manual for Describing Terrestrial Ecosystems (B.C. Ministry of Forests and Range and BC Ministry of Environment 2015). Each plant species was recorded and coded according to the structural layer in which it occurred. For each species in each layer, an estimate of percent cover was recorded. In addition to cover estimates, distribution codes were used to further describe the abundance and distribution of any invasive plant species occurring on site.

Finally, aggregate percent cover was estimated for all plants, trees, shrubs, herbs, and cryptogams in each plot.

4.3.4 Hydrologic Parameters

Visual surveys of each site were used to determine geomorphic factors affecting hydrology, as well as characteristics such as water color. Conductivity and pH were recorded using a Dynalene DY-PH02 digital meter.

Hydrologic parameters recorded for each plot:

- pH
- Conductivity
- Water Color
- Water Source
- Hydrodynamic Index
- Hydrogeomorphic Position
- Percent Cover of Open Water

4.3.6 Amphibian Occurrence and Habitat Surveys

Time constrained visual surveys for amphibian larvae were conducted at sites that had open water present at the time of survey. However, surveys were not conducted in sites with significant water flows. Each amphibian survey involved twenty minutes of slow moving, deliberate visual scanning of those areas of the wetland which seemed to offer the best habitat conditions for amphibian larvae (i.e., the edges between emergent vegetation and open water, areas with escape cover, and shorelines). During this time, the surveyors would attempt to catch as many amphibian larvae as possible. To increase the probability of capturing larvae while maintaining a standardized search effort, twenty sweeps with a rectangular dip net (14 x 20 cm) were made through areas of low visibility. After the standardized survey time had

elapsed, the species, life-stage, and length of each captured larvae was recorded. Survey conditions were recorded under the following fields:

- Survey start and end time
- Classification of rainfall in past 24 hours
- Air temperature
- Classification of wind speed
- Classification of precipitation
- Classification of cloud cover
- Water temperature
- Maximum water depth
- Percent of site searched
- Percent of shoreline searched
- Number of net dips (standardised at 20)
- Percent cover shrubs
- Percent cover graminoids
- Classification of graminoids (thin-stemmed or cattails).
- Percent cover herbaceous
- Presence and description of predators

The following fields were recorded for each amphibian larvae captured.

- Species
- Life-stage
- Number of individuals from each species
- Body length
- Photographs

4.3.7 Site and Landscape Observations

General site observations were recorded for each site. The data sheet included prompts to ensure that surveyors made observations of several distinct characteristics at each site, including:

- Wildlife – Any wildlife tracks, signs, habitat features, or occurrences were noted.
- Landscape Context – Surveyors used this field to note the characteristics of the landscape surrounding the site, including the presence and extent of agriculture, grazing, industrial development, roads, and other human uses occurring around and within the site.
- Disturbance – This field was used to record observations of natural and human caused disturbances such as fire, blowdown, beaver activity, and erosion.

4.3.8 Wetland Classification

Attempts were made in the field to classify wetlands using the provincial guide (McKenzie and Moran, 2004). In many cases the sites encountered in the Lillooet area did not fit well with this system; therefore, in these cases the site was classified based on the higher-level Canadian Wetland Classification System (National Wetlands Working Group 1997). This system divides wetlands into five broad classes (Bogs, Fens, Marshes, Swamps, and Shallow Waters; Table 2). These classes form the basis for higher level classification in the provincial system, where they are listed as realms. We also used the classes from the flood group of the terrestrial realm of the provincial classification system to classify some of the floodplain sites we encountered.

Table 2 Wetland classes from the Canadian System of Wetland Classification (McKenzie and Moran 2004)

Site Realm/ Group	Site Class	Environmental features	Cover types	Species groups
Wetland Realm		***Wet or Very Wet SMR***		
	Bogs	+/- ombrotrophic pH < 5.5 > 40 cm fibric/mesic peat	Conifer treed or low shrub	Sphagnum mosses, ericaceous shrubs, and conifers
	Fens	Groundwater-fed pH > 5.0 > 40 cm fibric/mesic peat	Graminoid or low shrub	Deciduous shrubs, sedges, and brown mosses
	Marshes	Mineral soils or well-humified peat Protracted shallow flooding (0.1–2.0 m)	Graminoid or forb	Large emergent sedge, grass, forb, or horse-tail species
	Swamps	Mineral soils or well-humified peat Temporary shallow flooding (0.1–1.0 m) Significant water flow	Tall shrub or forested	Conifers, willows, alders, forbs, grasses leafy mosses
	Shallow waters	Permanent deep flooding (0.5–2 m)	Aquatic	Aquatic species Emergent vegetation < 10% cover
Flood Group of Terrestrial Realm		***Riparian flood zone***		
	High bench	Benches above normal waterflow Brief flood period	Coniferous forested	Upland species of seepage sites
	Mid bench	Elevated benches flooded most years for < 21 days Areas of sedimentation	Deciduous treed or forested	Flood-tolerant decid-uous trees and shrubs
	Low bench	Site directly adjacent to watercourse Annual flood >21 days Significant annual erosion and deposition	Tall deciduous shrub	Flood-tolerant shrubs

4.3.9 Ecological Function Categorization

A component of the objective setting method detailed in the Bridge/Seton River Watershed Riparian and Wetlands Action Plan (2011), is a framework for categorizing wetlands based on function (Table 3). In order to provide support for management decision making, we grouped the sites from our survey into three categories based on a desktop review of our data.

Table 3 Categorization of wetlands by function (BC Hydro Fish and Wildlife Compensation Program 2011)

Category 1 Natural riparian or wetland habitat:	Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Category 2 Disclimax or degraded wetland or riparian habitat, or creation of habitat	Formerly natural wetland or riparian ecosystems that have lost most or all of their natural disturbance regime and are no longer functioning effectively as wetland or riparian habitat. These areas are candidates for restoration or creation or wetlands.
Category 3 Restored or created riparian or wetland habitat:	Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.

4.3.10 Riparian Connectivity

For each of the wetlands where amphibians were present in 2017 we completed a qualitative analysis of connectivity of that particular wetland to suitable riparian areas and adjacent upland foraging habitat for adult amphibians. Using a desktop review of 2004/2005 aerial photography we rated each wetland based on its proximity to mature forest. An excellent rating was achieved when the wetland was directly adjacent to a mature forest, a good rating was achieved when mature forest was within 100 meters, a fair rating was achieved for any wetlands greater than 100 meters but less than 500 meters away, and a poor rating occurred when mature forest was greater than 500 meters away.

4.3.11 Photopoint Monitoring

We established photo points to monitor anthropogenic and natural changes at each wetland site. The first year images will serve as a baseline record of the condition of wetlands in the Lillooet area in 2017. Some of these sites will undergo ecological lift from restoration and enhancement activities, while others may continue to be modified and/or diminished by human activities. Re-photographing these sites as required in the future will provide ongoing evidence of changes to our wetlands.

Permanent photo monitoring points were established at 46 of the 48 wetland sites between 23 April and 04 May 2017. The composition of each image was chosen subjectively by the field crew to document a wide view of the site that might include any foreseeable, or unforeseeable, changes in the wetland and the adjacent landscape. The location of each photo point was thoroughly documented to allow future surveyors to easily re-locate the original tripod location, and to re-position the camera.

The following attributes were documented to help relocate each photo point:

- Camera geographic location (UTM)
- Azimuth from camera to subject
- Lens height (m)
- Images of the tripod location were recorded for future reference when re-positioning tripod.
- Azimuth, and distance (m) to relatively permanent nearby features such as trees or fence-posts.
- Notes regarding how to access the area (i.e., driving directions)

In cases where the camera was placed within, or very near to the wetland site (i.e., relatively close-up images), a meter board was included in the image to allow for future photogrammetric analysis. In images which included the meter board we also recorded the azimuth and distance (m) from camera to meter board.

Where possible, we marked the tripod position with a flagged spike, and flagging in a nearby shrub or tree. However, in many cases we did not mark the position of the tripod when there were concerns regarding degradation of visual quality in public and private areas. Likewise, no spikes were placed to mark the tripod location in areas where it seemed unlikely that the spike

would remain (e.g., schoolyards, public boulevards, floodplains), or in areas where spikes could pose a hazard to humans, livestock, or wildlife.

During the establishment of each photo point, surveyors made notes on the purpose of that particular photopoint. In some cases, the purpose was to take a close look at hydrology or vegetation structure, and in other cases the purpose of the image was to document the landscape surrounding the wetland. It is hoped that these notes on the purpose of each point will help inform future surveyors of the monitoring objectives at the time of photo point establishment.

4.4 Wetland Enhancement

Two wetland sites were selected for enhancement in 2016. One was the Cayoosh Elementary School wetland (Site number CB9), which was created by the Lillooet Naturalist Society, and the BC Wildlife Federation in 2009. The second was the upland area adjacent to off-channel 3 (S2). Native plant species were added to each site to increase the habitat value of the site for birds and amphibians.

Planting on both sites followed the same procedure:

1. Environmental technicians from Splitrock distributed the potted plants across the planting site, and placed each in a location where it would be planted by volunteers. The technicians distributed the species according to the availability of microsites for planting, and to ensure a structurally diverse assemblage of species throughout the planting area.
2. Volunteers, students, and technicians worked together through the site planting each plant as they went.
3. For each plant, a hole twice the size of the root ball was dug, and the surrounding soil was loosened. The plant was then removed from its pot and placed in the hole with the crown of the plant just above the surrounding soil surface. The soil was then replaced around the root ball, and packed in to assure good soil-root contact, and with a slight depression to allow water to collect.
4. Finally, each plant was mulched and hand watered.

4.4.1 Cayoosh Elementary

The objective at Cayoosh Elementary was to increase the naturalized area in the schoolyard, and to soften the edges around the wetland by increasing the cover and structural complexity of the surrounding landscape.

On 05 October 2016, as a part of an educational Wetland Day, approximately 180 Cayoosh elementary school students, teachers, support workers and parents assisted the Splitrock crew in planting native trees, shrubs, and forbs in and around the Cayoosh Elementary wetland.

4.4.2 Off-channel 3 Connectivity Plantings

The objective at off-channel 3 (S2) was to increase the amount of upland foraging habitat for long-toed salamanders and Pacific tree-frogs which breed at this site, and to provide a connective corridor between this site and the adjacent Marsh at the James' property (AJ14) which has been known to support breeding long-toed salamanders in some years.

On 01 October 2016 we began working towards meeting this objective by stocking native plants in the area between off-channel 3 and the James' property. With the help of twenty-five students from the UBC international forestry school, we hand-pulled weeds and planted trees, shrubs, and forbs into this area.

5.0 Results

5.1 Training and Community Capacity Building

5.1.1 BC Wildlife Federation Wetland Survey Workshop.

During two days (15-16 June 2016) of lectures, demonstrations, and field trips, 15 community members and Splitrock staff were trained in protocols for collection of data on wetlands (Figure 8). The result of this workshop was that new environmental technicians and summer students learned and practiced the data collection protocols, which would be used in the wetland surveys throughout the summer, while interested community members received an introduction into wetland ecology, stewardship, and science.

Topics from this workshop included:

- The discussion on the definition and importance of wetlands.
- Training on the application of provincial (McKenzie & Moran, 2004) and federal (National Wetlands Working Group, 1997) systems of wetland classification
- Hands on application of protocols for describing vegetation, soils, hydrologic, and other terrestrial ecosystem characteristics in the field (B.C. Ministry of Forests and Range and BC Ministry of Environment. 2015)

Figure 8 Participants in the wetland survey workshop, 15 Jun 2016

5.1.2 Amphibian Biology and Survey Workshop

The June 2016 amphibian workshop was attended by twelve community members, Splitrock staff, and summer students. The purpose of this workshop was to train local technicians and community members on the application of visual survey techniques for amphibian larvae. Classroom topics focused on amphibian biology, and the identification of species occurring within this region; while the field sessions taught participants to stalk heron-like through the rushes while surveying for amphibian larvae.

Ultimately, this workshop taught our survey team the visual amphibian survey method (described in section 4.3.6 Amphibian Occurrence and Habitat Surveys), which was subsequently used throughout the wetland survey.

Eleven community members and Splitrock crews attended the April 2017 workshop. This workshop presented the same information from the 2016 workshop to a new cohort of community members and staff. In addition, this workshop also included instruction on amphibian trapping for situations where visual surveys are ineffective, information assessing amphibian needs in relation to upland habitats and restoration efforts.

5.1.3 Capacity Building during Field Surveys

A team of eight technicians was assembled for the 2016 Púslumcw Wetland Survey. These young people from the Lillooet area came from diverse backgrounds, and ranged in age from 17 to 32 years old. On the younger side of the range the team included both high-school and post-secondary summer students, while the older participants were all high-school graduates with Environmental Technician Certification who were already working locally in a technical capacity. While none of these technicians had specific wetland survey experience prior to the 2016 field season, the initial level of terrestrial survey experience ranged from zero for the summer students, to 1-2 seasons for the environmental technicians.

This team of technicians spent several weeks of the early summer and fall conducting wetland surveys with instruction and mentorship from Iraleigh Anderson, Splitrock Environmental plant ecologist. Over these weeks of survey, each member of the team was able to participate in the execution of the survey protocols on at least 4 different sites representing a range of conditions. For the team members who participated in this limited number of surveys, the experience was an introduction to wetland ecology and terrestrial data collection. However, two of the technicians, one member from each of the partner communities, were present for all days of surveying and as such were each able to work through the survey protocols on more than half of the survey sites. For these technicians the experience was an ongoing exercise in applying a large repertoire of terrestrial data collection protocols in a variety of wetland environments.

5.2 Site Identification

5.2.1 Background Data

Existing published knowledge of wetlands in the study area was limited. During our research we found no evidence of prior ground-truthed efforts to inventory the area for wetlands. However, in 2013 Elke Wind and Splitrock Environmental completed a study of amphibian breeding habitat in the Lillooet area. This study surveyed 13 wetland sites in the Seton River Corridor, and 2 sites located off Texas Creek Road. The purpose of these surveys was to look for amphibian larvae, and record general amphibian breeding habitat characteristics at each site.

Results from the most comprehensive wetland inventory of the province are available in the wetland polygon layer from the BC Freshwater Atlas (obtained from the BC data distribution

service). The wetland polygons in this layer were originally delineated from 1:20 000 orthophotos during the Terrain Resource Inventory Mapping project in 1996. The BC Freshwater Atlas includes data for only 2 wetlands within our study area. The Freshwater Atlas was of little use in locating wetlands within our study area; likely because the scale of analysis during the creation of the Freshwater Atlas (1:20 000) was too broad to capture the small wetland features that are left on the landscape today.

5.2.2 Orthophotography Interpretation

Review of 2004 and 2005 orthophotography produced the geographic location of 10 different potential wetland sites. Many of these sites were also discovered through contact with community members with knowledge of the landscape within the study area.

5.2.3 Community Knowledge

In order to find as many wetland sites as possible, we put the word out to the community through posters, email and telephone calls. In addition to those identified through orthophoto review, 29 potential wetland sites were identified during telephone contact with community members. These sites ranged in character from naturally occurring wetlands to man-made ponds and irrigation infrastructure. These features were all visited, and surveyed.

5.2.4 Ground Searches

Ground searches uncovered no new wetland sites in the Seton Lake/Cayoosh Creek arms of the study area. Likewise, this method did not uncover wetland areas in the Town Creek Drainage or along Texas Creek road.

5.2.5 Auditory Amphibian Reconnaissance

Three replicate listening sessions were conducted in early 2017. The first replicate included listening sessions at all 100 of the survey points, the second session included re-visits to 75 of the points, and only 4 of the points were revisited during the third session. We decided to omit 25 points from the second replicate based on observations during the initial survey. Each of these points was deemed either too loud (i.e., from adjacent creek noise, too difficult to access (in the case of the points up the decommissioned Enterprise FSR), or obviously located within unsuitable habitat. We choose to re-visit 4 points a third time to attempt to clear up inconclusive results during the first survey. In sum we conducted 179 point surveys, for a total of over 15

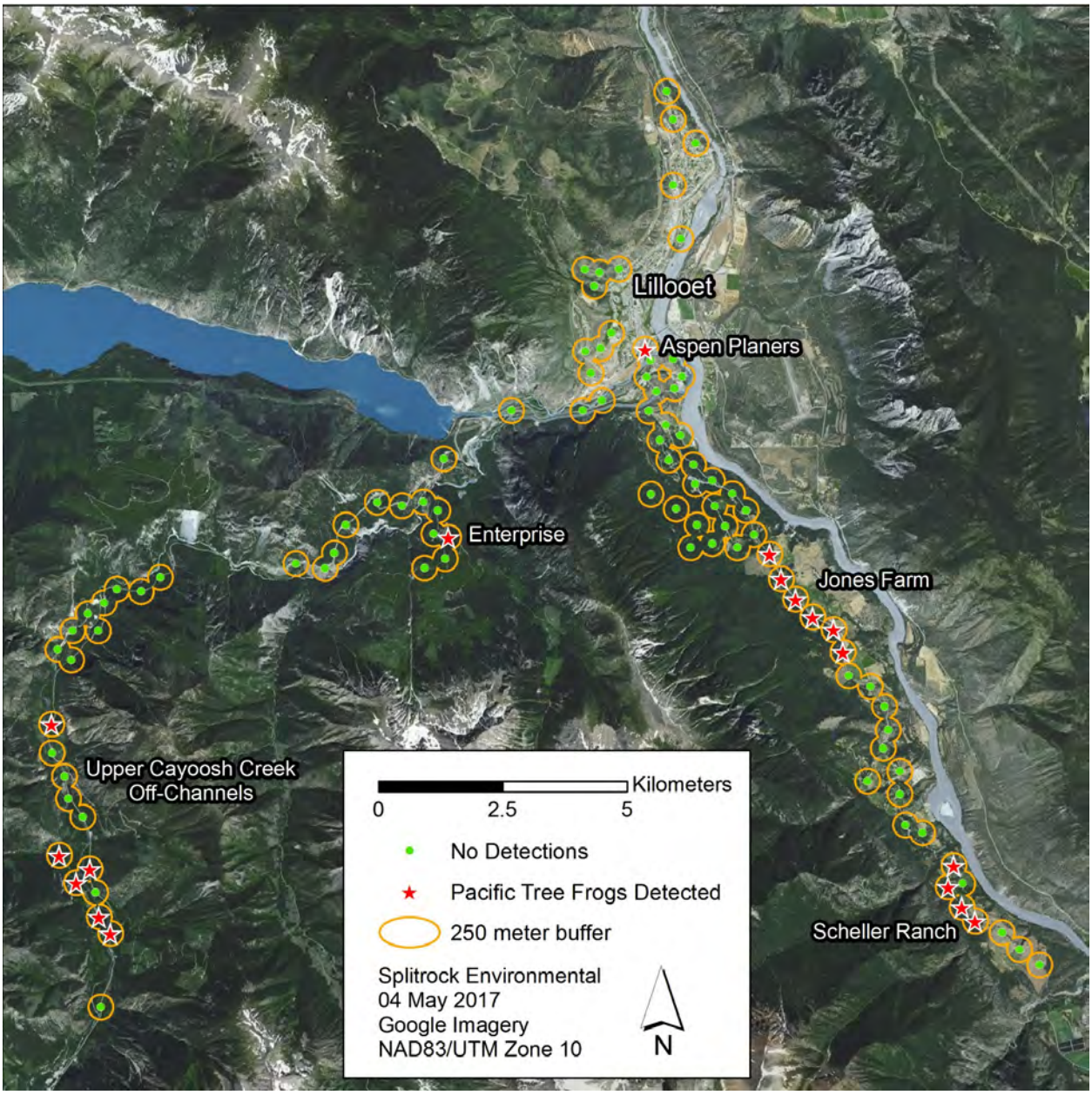
hours of listening. Based on the conservative assumption that we can effectively hear Pacific tree frog calls at distances over 250 meters, our auditory survey effort effectively sampled over 1,834 hectares.

Calls from Pacific tree frogs were heard at 18 of the 100 listening points. In the first session they were heard at 12 unique points, in the second session they were heard at 10, and there were no detections during the third session.

The detections are arranged into 5 clusters (Map 4), each one presumably representing a single wetland complex. Comments on each cluster are summarized in Table 4.

Table 4 Summary of comments on each cluster of Pacific tree frog detections from auditory surveys in April and May of 2017.

Cluster	Comments
Upper Cayoosh Creek Off-Channels	• Pacific tree frog calls were heard from 6 points along upper Cayoosh Creek. • Based on the azimuth and distance estimates we recorded at each point, we expect that these calls were coming from previously undetected back-channel wetlands along Cayoosh Creek. • We will follow up on these detections with ground-based searches down Cayoosh Creek ,and attempt to locate these un-surveyed wetlands.
Enterprise	• The previously recorded occurrence of breeding Pacific tree frogs at Enterprise Pond (S1) was confirmed from across the Cayoosh Creek valley, at a distance greater than 900 meters.
Aspen Planers	• The only auditory detection of Pacific tree frogs within the Lillooet town site occurred at a point near the access road to the mill. Based on the azimuth and distance estimate from this point, the calls were likely coming from the back flooded riparian wetland next to the bridge over Cayoosh creek (S5). • Pacific tree frogs, and other amphibians, have not been previously detected at this site during the 2013 (Wind, 2014), or 2016 amphibian survey work. • We intend to follow this auditory survey with further visual surveys in the spring and early summer to confirm occupancy, and breeding success.
Jones Farm	• The cluster of Pacific tree frog calls heard along Texas creek road west of Jones farm were undoubtedly from the complex of ponds, marshes and swamps occurring throughout this large tract of private land (Figure 9). • Though the presence of Columbia Spotted Frogs (*Rana luteiventris*), and Western Toads (*Bufo boreas*) were confirmed in the large marsh on Jones Farm in 2013 (Wind, 2014), this is our first recorded observation of Pacific tree frogs on this site. • Based on the distribution of sampling points where calls were heard, and based on the azimuth and distance estimates from these points, it is likely that Pacific tree frogs are using many of the small ponds and wet spots visible in Figure 9. • Though access to this tract of land is currently restricted, we believe that this is the area where Great Basin spadefoot toads (*Spea intermontana*) are most likely to occur within this study area. We recommend a more detailed amphibian survey in this area, when access becomes possible again.
Scheller Ranch	• Based on the azimuth and distance estimates from the cluster of points near the Scheller Ranch, we expect that the Pacific tree frog calls that we heard were coming from the swamp on this property (CB12). We intend to follow this effort up with visual surveys later in the spring to confirm the occupancy and breeding success of Pacific tree frogs, and possibly other amphibian species.



Map 4 Amphibian listening points and Pacific tree frog detections throughout the 2016/2017 wetland inventory study area.

Figure 9 Ditches draining wetland areas on Jones' farm. Note the remaining large Shallow open water/Marsh area in the top left area of the image, 12 Oct 2016.

5.3 Site Surveys

Forty-eight sites were surveyed during the 2016 season (Table 5; Map 5). Of these sites, 40 were surveyed only by technicians from T'it'q'et and Sekw'el'was, and the remaining 8 sites were surveyed by the technicians with participation from community members. Surveys were conducted during 25 days of fieldwork between 6 June 2016 and 13 October 2016. The wetland

sites within the survey area were generally quite small in areal extent, with 16 sites less than 400 m^2, the average area of the remaining 32 sites was 0.7 hectares. Due to the small extent of most wetlands, and the homogeneous conditions in the remaining ones, one plot was sufficient to record the conditions in each site. Accordingly, most sites comprised only a single class.

Of the 48 plots used to survey these sites, they were classified in the following way (May 6):

- 5 plots as Low bench wetlands
- 16 plots Marshes
- 7 plots as Swamps
- 13 plots described loosely as springs, while
- 7 ponds surveyed were unclassifiable according to the provincial system (Map 6).

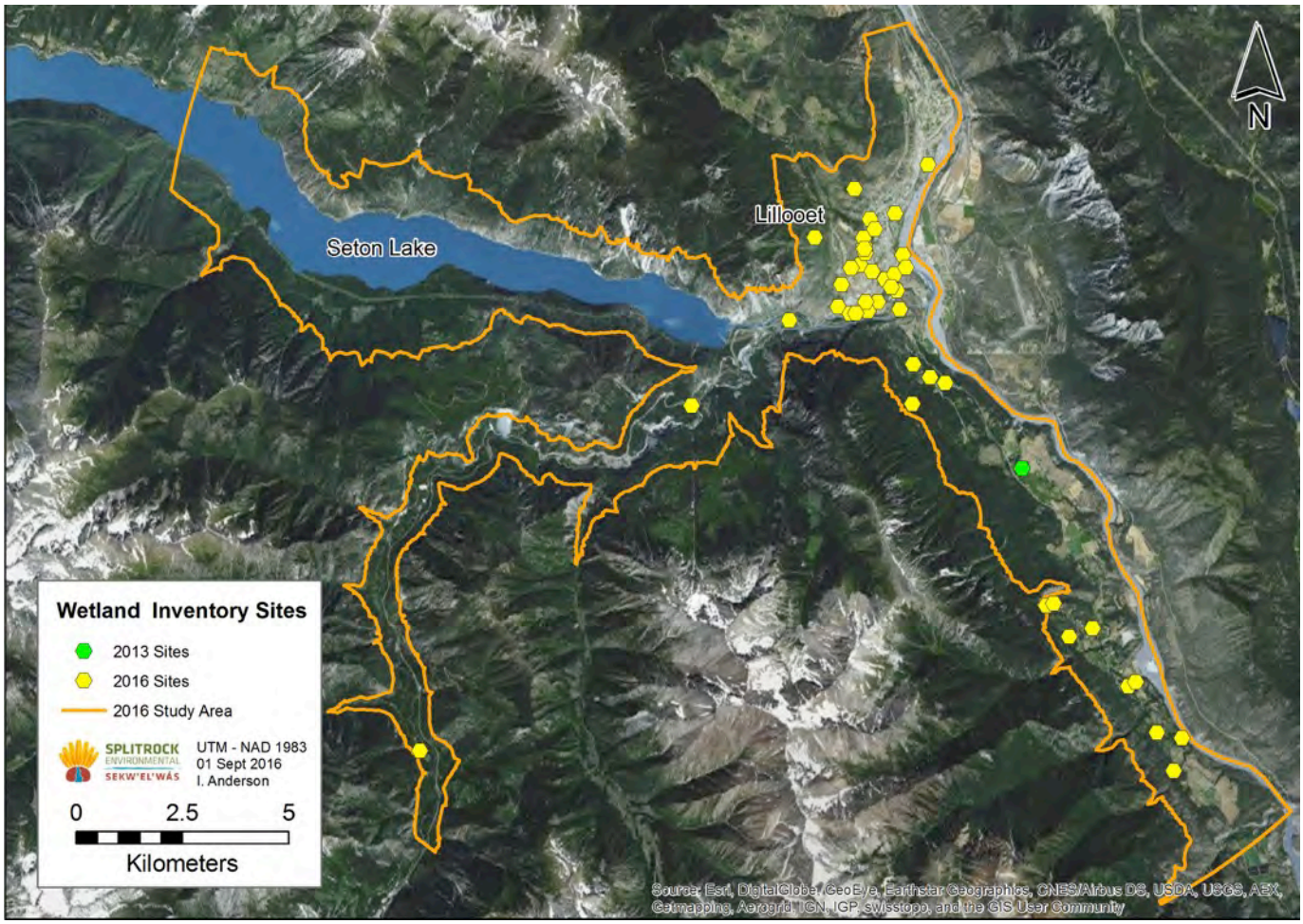
Of the 48 wetlands surveyed, they were rated based on the FWCP ecological function categories (Map 7):

- Category 1 - natural wetland habitat: 8 sites
- Category 2 - degraded wetland habitat: 30 sites
- Category 3 - created wetland habitat: 10 sites

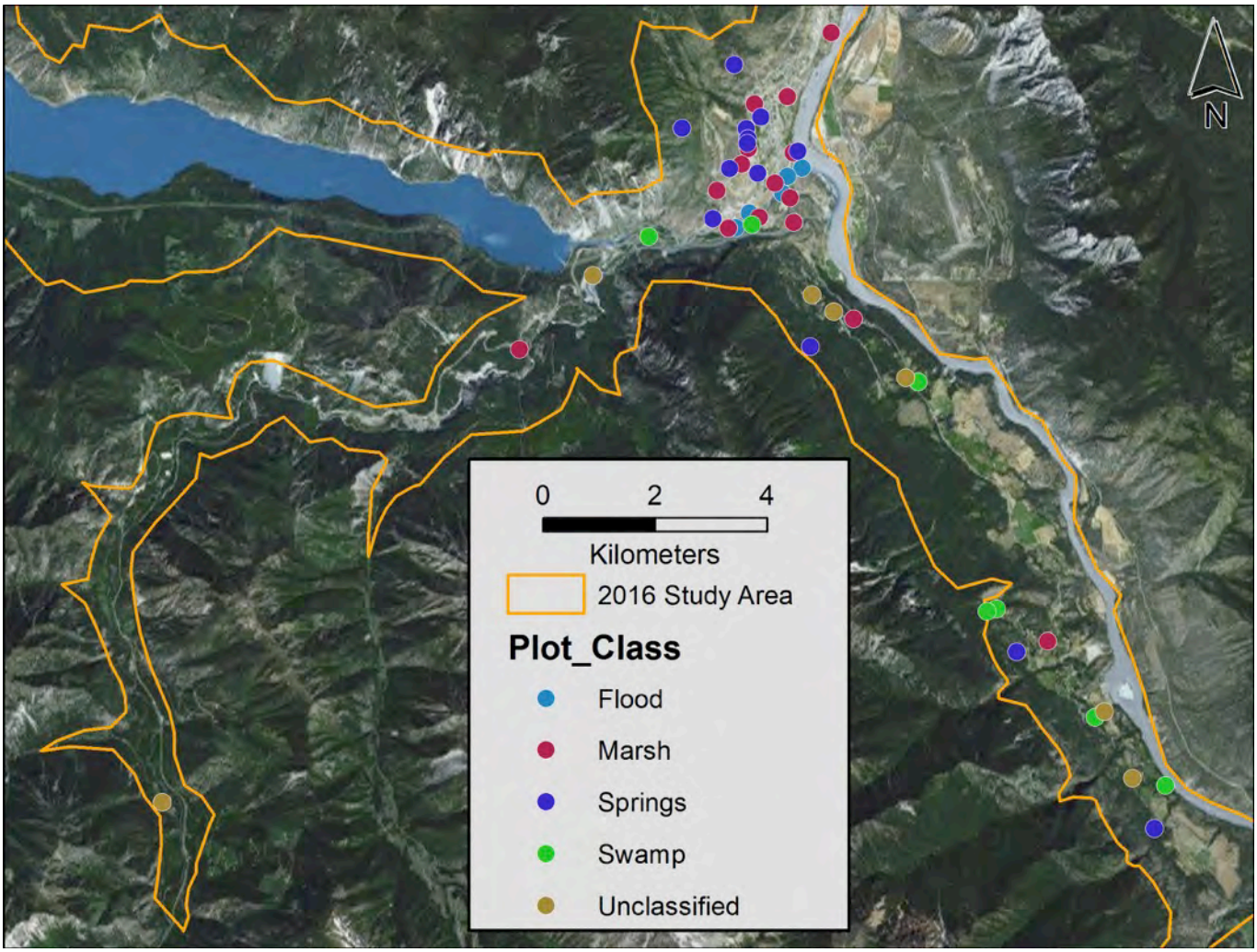
Table 5 Summary of each wetland site surveyed during the 2016 field season, including: Classification, categorization, area (m2), and geographic location (UTM Zone 10).

Plot	Date	Plot Classification	FWCP Category	Area (m2)	Easting	Northing
S2A	2016-06-06	Low Bench	1	3471	575253	5614417
S3A	2016-06-21	Low Bench	2	924	574657	5614072
CB2A	2016-06-27	Low Bench	2	3935	575601	5614875
S5A	2016-06-23	Low Bench	2	1350	575339	5614720
S4A	2016-06-21	Low Bench	2	809	574422	5613814
AJ36A	2016-07-22	Marsh	1	10956	562652	5598983
IA2A	2016-06-29	Marsh	2	455	574645	5615214
AJ21A	2016-07-13	Marsh	2	<400	579986	5606466
CB25A	2016-09-12	Marsh	2	3331	575444	5615142
IA8A	2016-07-06	Marsh	2	<400	576119	5617275
AJ12A	2016-07-04	Marsh	2	<400	575456	5613904
AJ14A	2016-07-05	Marsh	2	<400	575390	5614342
AJ16A	2016-07-07	Marsh	2	<400	576525	5612187
AJ1A	2016-06-27	Marsh	2	6283	574083	5614476
CB1A	2016-06-27	Marsh	2	6236	574523	5614939
CB16A	2016-07-27	Marsh	2	<400	575116	5614606
T2A	2016-06-23	Marsh	2	2057	574293	5613802
IA12A	2016-10-12	Marsh	3	<400	574842	5613996
CB9A	2016-06-29	Marsh	3	<400	574753	5616007
IA3A	2016-06-30	Marsh	3	<400	575343	5616141
S1A	2016-06-16	Marsh	3	1085	570558	5611651
AJ34A	2016-07-22	Springs	1	NA	574393	5616707
AJ13A	2016-07-05	Springs	1	NA	573457	5615582
AJ11A	2016-07-04	Springs	2	NA	575526	5615172
AJ24A	2016-07-14	Springs	2	NA	574605	5615567
AJ25A	2016-07-14	Springs	2	NA	574870	5615773
AJ23A	2016-07-14	Springs	2	NA	574629	5615399
AJ26A	2016-07-14	Springs	2	NA	574807	5614782
AJ32A	2016-07-16	Springs	2	NA	574624	5615312
IA1A	2016-06-29	Springs	2	NA	579443	5606273
T1A	2016-06-16	Springs	2	NA	581900	5603136
AJ17A	2016-07-08	Springs	2	NA	575748	5611693

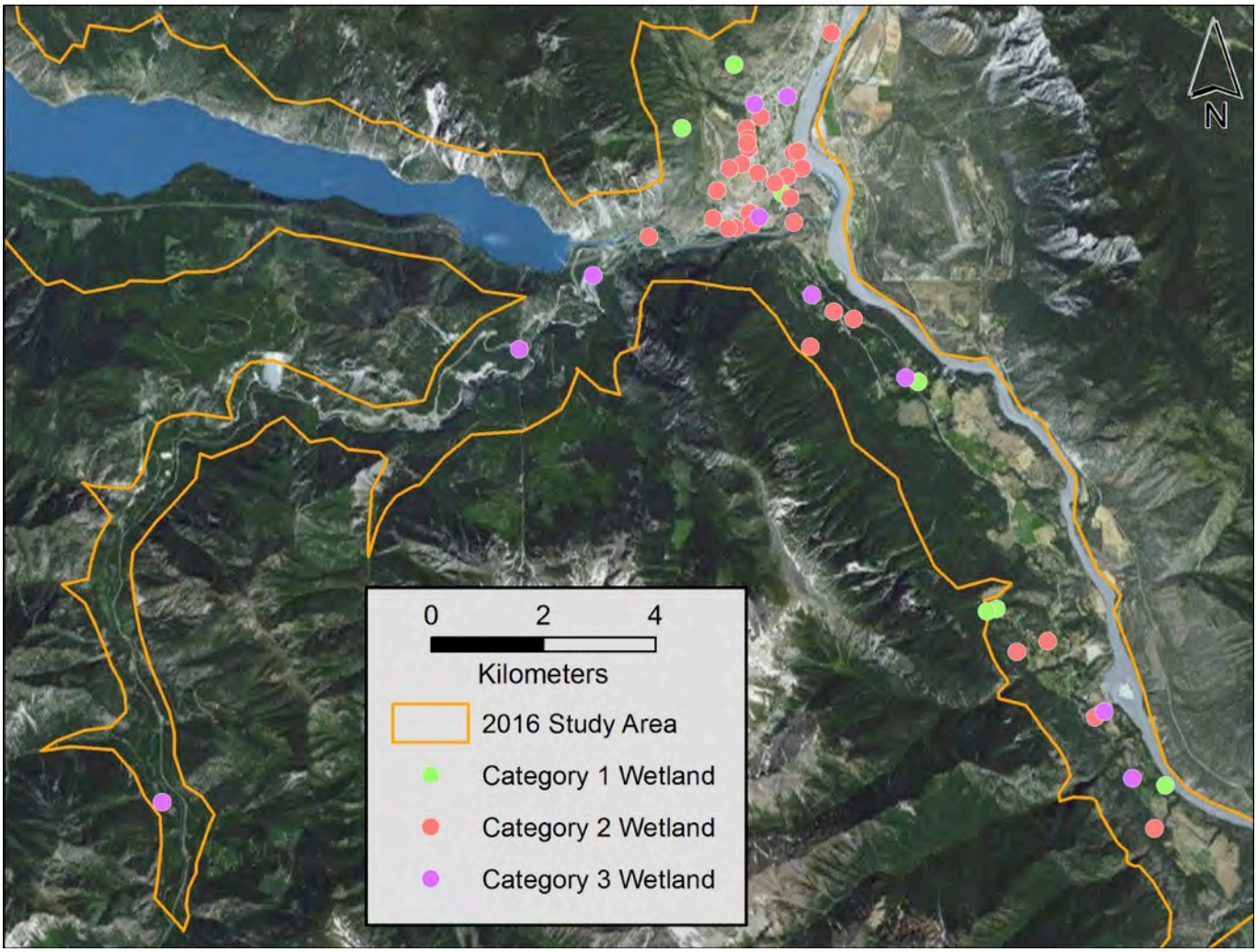
Plot	Date	Plot Classification	FWCP Category	Area (m2)	Easting	Northing
AJ35A	2016-07-14	Springs	2	NA	574311	5614868
CB17A	2016-07-27	Springs	2	NA	574009	5613966
AJ18A	2016-07-11	Swamp	1	23029	579077	5607041
AJ29A	2016-07-15	Swamp	1	<400	578906	5606991
CB12A	2016-07-08	Swamp	1	<400	582096	5603905
IA14A	2016-10-13	Swamp	1	48623	577676	5611070
S6A	2016-06-24	Swamp	2	<400	572860	5613649
S7A	2016-06-24	Swamp	2	<400	574706	5613865
CB15A	2016-07-26	Swamp	2	2238	580836	5605109
AJ15A	2016-07-06	Unclassified	2	5652	576167	5612321
AJ30A	2016-07-18	Unclassified	3	2585	564170	5603607
AJ20A	2016-07-12	Unclassified	3	960	581006	5605217
AJ22A	2016-07-06	Unclassified	3	<400	575777	5612620
IA7A	2016-07-06	Unclassified	3	<400	581508	5604031
IA40A	2016-09-12	Unclassified	3	1424	571871	5612965
IA13A	2016-10-13	Unclassified	3	<400	577452	5611151



Map 5 Distribution of survey sites within the 2016 survey area. Jones' farm, a major wetland site, which was surveyed in 2013 (Wind 2014), but not 2016 is also included and marked with a green circle.



Map 6 Geographical distribution of wetland classes.



Map 7 Geographical distribution of wetland health categories.

5.3.1 Marsh Sites

Following the provincial and national wetland classification systems we classified graminoid and forb dominated sites with protracted seasonal flooding as Marshes. Within out study area, sixteen plots were classified as Marshes. In general the Marshes were small, and the plot generally comprised the entire wetland area. In some other cases the Marshes occurred along the fringe of permanently flooded ponds. In general these ponds lacked the aquatic vegetation of Shallow open water wetlands, and were unclassifiable.

Within our study area Marshes were surveyed between elevations of 192-789 meters above sea level. Among these wetlands, water pH ranged from 7.2-8.6, and conductivity ranged from 92-930 us.

Tree cover in the Marshes was 10% on average, and was generally observed in the peripheral areas of the plot near the boundary with adjacent ecosystems. Likewise, shrub and herbaceous cover were 18% and 52% respectively. Cover values for species ranged considerably. The most frequent plant species in Marsh plots were common horsetail (*Equisetum arvense*), and common cattail (*Typha latifolia*).

In general the Marshes fell into Category 2 - degraded wetland habitat. These sites were typically disturbed by residential development, industrial operations, road building, mowing and agriculture. Exotic plant species were almost always present. Only one Marsh was rated as Category 1 - natural wetland habitat (Site AJ36 Top of Duffy). Though native species were dominant on this site, and the soil profile showed evidence of a regular flood regime from Cayoosh Creek, the vegetation community on site did not fit any of the site series classifications.

5.3.2 Low bench Sites

Low bench wetlands are a class of floodplain wetlands according to the provincial system. We classified those sites directly adjacent to rivers, with tall shrub cover, and regular flooding in the Low bench class. Five plots were recorded in the Low bench wetland class. Four of these sites were backchannel wetlands on the Seton River, and one was a large area of floodplain on the Fraser River. All observed Low bench sites were low elevation, ranging from 197-211 meters above sea level. Soils were typically silty to sandy with some organic horizons in areas where vegetation develops. Conductivity in the Low bench wetlands ranged from 220-462 us, and water pH ranged from 7.7-8.2.

Tree cover was 31% on average in Low bench class wetlands, with balsam poplar and mountain alder occurring on most sites. Average shrub cover was 18%, and average herbaceous cover was 52%. Mountain alder (*Alnus incana*) and red-osier dogwood (*Cornus stolonifera*) were the dominant shrubs. Scouring rush (*Equisetum hymale*) was the dominant herbaceous species with an average cover of 35%, often in dense monocultures.

In general these wetlands were rated as Category 2 - degraded wetland habitat, because of anthropogenic changes in the Seton River flow regime which is a key disturbance process giving rise to the soil and vegetation characteristics of backchannel wetlands.

5.3.3 Swamp Sites

Sites with temporary shallow floods and dominant cover in the tree and shrub layers were classified as Swamps. Seven Swamps were sampled in this survey. Swamps ranged from the lowest areas surveyed to the highest; from 208-759 meters above sea level. Within this range, some sites occurred where springs met depressional areas and flooded forested zones, and sometimes adjacent to larger bodies of water, such as the Swamp at the west end of Phair Lake/AJ18. Though mountain alder was often present in the Swamps, many of the other indicator species such as skunk cabbage (*Lysichiton americanum*), and pink spiraea (*Spiraea douglasii ssp. menziesii*) were absent, and so we were not able to classify any of our sites to the site series level. Conductivity in Swamps ranged from 139-486 us, and water pH ranged from 7.4-8.1.

Tree cover was generally high, with an average of 42%, likewise average shrub cover was high at 45%. Herbaceous cover was 26% on average, and the most common and abundant species were scouring rush and common horsetail. Twenty species of shrubs and trees were recorded in the Swamp plots, the most common were black cottonwood *(Populus trichocarpa)* and red-osier dogwood.

Many of the Swamp sites were rated as Category 1 - natural wetland habitat, and were relatively unimpacted by human disturbance. One site is within a grazing area and receives some disturbance from grazing and trampling by cattle, while three others have had their hydrology and extent modified by road building.

5.3.4 Springs

Because we had no minimum site size, and because we relied heavily on community knowledge to find wetlands within our study area, many of the sites that we visited and surveyed differed strongly from those sites which are typical of wetlands as commonly conceived. Thirteen plots surveyed during this project were classified loosely as "Springs." These sloping forested areas with runoff originating from springs were surveyed and found lacking either the hydrophytic vegetation, or hydric soil characteristic of true wetlands. The water on these sites was present at the soil surface only in distinct channels whereby the water was flowing off the landscape. The springs we visited were concentrated in the town of Lillooet where community knowledge of wet areas helped us find many of these sites. The springs in our study area ranged in elevation from 208-709 meters above sea level. The substrate was generally sandy mineral soil with a high percentage of coarse fragments. Conductivity ranged from 246-617 us, and water pH ranged from 7-8.6.

Obligate wetland plant species were not observed at these sites, however the composition and abundance of deciduous shrubs on these sites typically differed from the surrounding hillsides on which they occurred. The most common species on these sites were black cottonwood, red-osier dogwood, and Kentucky bluegrass (*Poa pratensis*).

Generally, the springs in our study area were rated as Category 2 - degraded wetland habitat, with the most common disturbances being road building, and residential development. In almost all cases the hydrology of springs had been significantly altered by humans. In some cases the spring-water was collected and moved for the purposes of irrigation and livestock watering, and in other cases the natural flow patterns of springs were diverted to create residential buildings sites and roadbeds. The data for these sites is included with the wetland database with recognition of their importance as habitat features in the dry climate characteristic of the study area.

5.3.5 Unclassified

Seven ponds of anthropogenic origin were recommended for inclusion in our inventory by community members. These sites did not have the fluctuating water levels characteristic of Marshes, or the aquatic plant cover of Shallow open water wetlands. Though we were unable to classify these sites using the provincial or national systems, we did perform site surveys. In

most cases the site survey methodology was altered and a representative area of shoreline was surveyed instead of a typical 20x20 m plot.

We surveyed unclassified wetlands between 246 - 671 meters above sea level. Conductivity in these systems ranged from 157-693 us, and water pH ranged from 7-8.4.

Average tree cover was 31%, average shrub cover was 18%, and average herbaceous cover was 52%. Red osier dogwood was the most common riparian shrub species occurring in four plots, however common red raspberry (*Rubus idaeus*) also occurred in four of the unclassified plots. The occurrence of this upland plant in several of our plots is a testament to the difficulty of delineating some wetland types from the adjacent uplands. Many of these excavated ponds sloped sharply from the wet areas to the adjacent uplands, leaving no flat low-lying areas for the development of wetland soils, or a wetland plant community. As such, the wetland function of these sites is limited. Without providing for extensive, productive riparian or wetland habitat, these sites nevertheless provide foraging opportunities for some species of birds, and in some cases breeding habitat for amphibians.

In general these sites were rated as Category 3 - created wetland habitat. Disturbance was typically high around these sites, as they occurred in the midst of human dwellings, recreational, and industrial areas.

5.3.6 Amphibian Surveys

Nineteen sites were visually surveyed for amphibian larvae during the period 22 June to 27 July 2016. An additional two sites were surveyed in mid-September, even though detection of larvae during this period was unlikely. Amphibian larvae were observed at 5 unique sites during 2016 (Table 5). Of these sites, one was classified as a Marsh, one as a Low bench wetland, one as a Swamp, and two were unclassified. Two species were observed; Long-Toed Salamanders (*Ambystoma macrodactylum*; 4 sites; Figure 10), and Pacific Tree Frogs (2 sites).
Four of the sites where amphibian larvae were observed in 2016 are new sites, which builds upon the most recent amphibian survey efforts in the area in 2013 (Table 6) (Splitrock Environmental 2014). Columbia Spotted Frog and Western Toad Larvae were not observed, though they are known to breed within the study area (Splitrock Environmental, 2014). Juvenile Western Toads were reported by a member of the public in the study area during the summer of 2016. The location of this sighting was over 8 kilometers from the nearest known breeding pond

for this species, and so we suspect that there is likely another breeding area for this species that we did not find. Though perhaps this breeding site occurred beyond the boundary of our study area.

Table 6 Amphibian Detections 2013 and 2016

Site	Amphibian Species Detected	Classification	2013	2016
S2/Off-Channel 3 (AMP05)	Long toed salamander Pacific tree frog	Low Bench	Yes	Yes
AJ14/James Place (AMP13)	Long toed salamander	Marsh	Yes	No
S4/Off-Channel 7 (AMP04)	Long toed salamander	Low Bench	Yes	No
S1/Enterprise (AMP12)	Long toed salamander Pacific tree frog	Marsh	Yes	No
AJ36/Top of Duffy	Long toed salamander	Marsh	N/A	Yes
AJ18/Phair Lake	Pacific tree frog	Swamp	N/A	Yes
AJ15/Blue Hill Switchback	Long toed salamander	Unclassified	N/A	Yes
Jone's Pond	Columbia spotted frog Western toad	N/A	Yes	N/A
Downton Ponds	Long toed salamander	Unclassified	N/A	Yes

Figure 10 Long-toed salamander larvae recorded at the Downton ponds site, 18 Jun 2016.

5.3.10 Riparian Connectivity

Each of the wetlands where amphibian larvae were detected in 2016 was also within 100 meters of mature forest. Amphibians need good quality upland habitat to forage and so where amphibians were found in 2016, each site received a connectivity rating of excellent, good, fair or poor (Table 7).

Table 7 Amphibian Sites and Riparian Connectivity Rating

Site	Amphibian Species Detected 2016	Connectivity Rating
S2/Off-Channel 3	Long toed salamander & Pacific tree frog	Excellent
AJ36/Top of Duffy	Long toed salamander	Excellent
AJ18/Phair Lake	Pacific tree frog	Excellent
AJ15/Blue Hill Switchback	Long toed salamander	Excellent
Downton Ponds	Long toed salamander	Good

The Low-bench wetland at off-channel 3 is surrounded by one of the remaining stands of riparian forest in the Lower Seton Corridor. Though this stand is not extensive, or laterally connected to riparian areas upstream or downstream it certainly provides foraging habitat for some number of adult long toed salamanders and Pacific tree frogs. We planted shrubs above this area in the fall of 2016, with the goal of increasing forest cover near this wetland, and increasing connectivity to another wetland and forested area to the south.

The Top of Duffy site occurs within the intact riparian area of Upper Cayoosh Creek. Foraging habitat exists up and down the creek, and does not appear to be limited.

The swamp at Phair Lake is directly connected to a large West facing hillside of mature Douglas-fir forest. Access to a wide area of upland habitat does not appear to be limited on this site.

The ponds at the Blue Hill switchback occur directly in the midst of mature fir forest. The forest in this area is limited by the development of Blue Hill Road, and nearby Cooks road. Despite a limited amount of forest in the area immediately adjacent to this wetland the forest which does exist here forms unbroken corridors with extensive forested areas both upslope and downslope.

The Downton ponds occur in a neglected corner of an old gravel pit. The entire landscape surrounding the ponds are disturbed from gravel extraction with a high cover of bare gravel, and exotic weeds. Despite the paucity of high quality foraging habitat directly adjacent to the ponds, mature forest is still within 100 meters. This site is well connected within the landscape and exists at the junction of the riparian corridors of Downton Creek and Cayoosh Creek.

5.3.11 Photopoint Monitoring

Forty-Six photo points were established. The baseline image from each point is presented below along with the date it was established, and the azimuth of camera lens to subject.

Marriage Rock/AJ1 24-April-2017 71°

Bridge of 23 Camels/AJ11 02-May-2017 214°

Texas Creek Rd. Canal/ AJ12 28-April-2017 12°

Leech Property/ AJ13 27-April-2017 170°

James' Property/ AJ14 24-April-2017 320°

Blue Hill Switchback/ AJ15 27-April-2017 64°

Blue Hill/ AJ16 27-April-2017 310°

Above Blue Hill/AJ17 27-April-2017 350°

Phair Lake/AJ18 27-April-2017 147°

Maxwell Pond/AJ20 26-April-2017 232°

Sussums Pond/AJ21 28-April-2017 82°

Cooks Pond/AJ22 27-April-2017 156°

LSS Spring 1/AJ23 24-April-2017 296°

LSS Spring 2/AJ24 28-April-2017 70°

Hospital Wetland/AJ25 24-April-2017 156°

Leslie Place/AJ26 28-April-2017 294°

Phair Lake/AJ29 27-April-2017 181°

Downton Ponds/AJ30 25-April-2017 138°

Red Rock Spring/ AJ34 28-April-2017 250°

Spiritual Center Wetland/AJ35 02-May-2017 260°

Top of Duffy/ AJ36 25-April-2017 °358

Bill Machel's Place/CB1 24-April-2017 104°

Gord's Pond/ CB12 26-April-2017 290°

Jorgeson Fork/ CB15 26-April-2017 98°

Aspen Planes North/CB16 25-April-2017 366°

Aspen Planers South/ CB17 25-April-2017 252°

Cayoosh Campground/ CB2 28-April-2018 170°

Station Hill/ CB25 27-April-2017 210°

Cayoosh Elementary/ CB9 24-April-2017 120°

Armit Brook/ IA1 27-April-2017 265°

Lower Spawning Channel Marsh/ IA12 26-April-2017 164°

Wet Ditch/ IA13 27-Apri-2017 302°

Wayne's Swamp/ IA14 27-April-2017 60°

LSS Field/ IA2 29-April-2017 166°

Galliazzo Pond/IA3 24-April-2017 270°

Campground Ponds/ IA40 25-April-2017 158°

Brigman Ponds/ IA7 26-April-2017 156°

Enterprise/ S1 25-April-2017 186°

Off Chanel 3/ S2 28-April-2017 50°

Off Chanel 5/ S3 26-April-2017 312°

Off Chanel 7/ S4 25-April-2017 144°

Aspen Planers/ S5 27-April-2017 150°

Naxwit/ S6 25-April-2017 360°

LSC Swamp/S7 36-April-2017 190°

Spray Creek Ranch/T1 26-April-2017 198°

Off Chanel 8/T2 25-April-2017 208°

5.4 Wetland Restoration

5.4.1 Cayoosh Elementary

With the help of approximately 180 Cayoosh Elementary students and staff (Figure 11), an area 504 m^2 (Map 8) around and within the existing wetland area was planted with 202 native plant species (Table 8). Weeds were removed throughout the wetland edges and replaced with native species. The most common weed on site was alfalfa *(Medicago sativa)* that has come to dominate an unmowed upland area surrounding the wetland. Areas within the wetland were infilled with smooth scouring rush *(Equisetum laeveticum)* in the place of exotic weeds and agronomic grasses. The surrounding area was planted with native shrub species to increase the riparian buffer around the wetland

The enhancement work on this wetland occurred during a Wetland Day outreach event at Cayoosh Elementary School. In addition to getting hands-on experience with wetland stewardship, the students also participated in a series of interactive games and activities including: "bugs in the water", a frog lifecycle interactive game, the ponds for frogs sack game, and an interactive wetland plant ID activity. All classes rotated through the event stations, taking part in the activities and finishing up by participating in the planting around the schoolyard wetland.

Figure 11 Cayoosh Elementary wetland stewardship day, 05 Oct 2016

Map 8 2016 planting area at Cayoosh Elementary. Note: orthophotography is pre wetland construction

Table 8 Planting composition in at the Cayoosh Elementary wetland site, October 2016.

COMMON NAME	SCIENTIFIC NAME	PLANTS	SIZE#
TREES - EVERGREEN			
Interior Douglas-fir	*Pseudotsuga menziesii var glauca*	1	1 gal
Ponderosa pine	*Pinus ponderosa*	3	1 gal
SHRUBS			
Black Hawthorn	*Cratageus douglasii*	5	1 gal
Choke cherry	*Prunus virginiana*	10	1 gal
Indian Hemp	*Ribes lacustre*	60	1 gal
Mock Orange	*Philadeiphus lewisii*	6	1 gal
Praire Rose	*Rosa arkansana*	65	6"
Red-osier dogwood	*Cornus stolonifera*	6	1 gal
Saskatoon	*Amelanchier alnifolia*	5	1 gal
Soopolallie	*Shepherdia Canadensis*	25	1 gal
FORBS/GRASSES			
Smooth Scouring Rush	*Equisetum laevigatum*	*16*	6"
OTHER		*202*	
Composted bark mulch	*4 yards*		4
Mycorrhizal Fungi (MykPro)	*1 bucket*		1

5.4.2 Off-channel 3 Connectivity Plantings

A total of 371 upland trees and shrubs were planted in the upland area between these wetlands. Our objective is to see an improvement in amphibian foraging habitat quality in this area, which is currently a degraded grassland site with a high cover of alfalfa, diffuse knapweed *(Centaurea diffusa)* and agronomic grasses. By planting trees and shrubs here, we are working towards a long-term goal of providing the canopy cover and shade necessary to allow for foraging by adult amphibians that are known to breed in the two adjacent wetlands.

Twenty-five UBC International Forestry Students (Figure 12) volunteered their time in the enhancement of this site during their annual educational trip to Lillooet. Splitrock Environmental also made a wetland presentation the evening before the planting event to the students and local community members. The presentation discussed the methods and results of the wetland inventory. The following morning the students toured other restoration sites within the Seton Corridor, ending with the enhancement planting at the wetland sites.

Figure 12 UBC students planting at S2 site, 01 Oct 2016

Map 9 The 2016 planting area between two amphibian breeding sites in the lower Seton River corridor.

Table 9 Planting composition in the upland area between wetland sites in the lower Seton River Corridor, October 2016

COMMON NAME	SCIENTIFIC NAME	PLANTS	SIZE#
TREES - EVERGREEN			
Interior Douglas-fir	*Pseudotsuga menziesii var glauca*	5	1 gal
Ponderosa pine	*Pinus ponderosa*	12	1 gal
SHRUBS			
Black Hawthorn	*Cratageus douglasii*	5	1 gal
Choke cherry	*Prunus virginiana*	15	1 gal
Indian Hemp	*Ribes lacustre*	83	1 gal
Mock Orange	*Philadeiphus lewisii*	6	1 gal
Praire Rose	*Rosa arkansana*	65	
Red-osier dogwood	*Cornus stolonifera*	15	1 gal
Saskatoon	*Amelanchier alnifolia*	15	1 gal
Snowberry	*Smyphoricarpos albus*	100	
Soopolallie	*Shepherdia Canadensis*	25	1 gal
FORBS/GRASSES			
Smooth Scouring Rush	*Equisetum laevigatum*	*25*	6"
OTHER		*371*	
Composted Bark Mulch	*4 yards*		4
Mycorrhizal Fungi (MykPro)	*1 bucket*		1

5.5 Land Management Planning

As noted above, during fieldwork all sites were assessed for ecological function and associated impacts. A Site-Specific Summary Report (Appendix 1) was prepared for each of the 48 wetlands surveyed. Included in these reports is a description of the hydrology, soils and vegetation types found at each location, along with site-specific stewardship recommendations written for specific community members, landowners and land managers. These reports provide initial assistance in guiding land management planning in the coming years, and provide recommendations that could be implemented by interested people to enhance and/or increase wetland and riparian habitats that benefit amphibians, birds and other wildlife.

Polygon maps were prepared also to visually show the extent of the wetlands in the study area (Maps 10 – 16). Wetlands over 400m^2 are shown as polygons on these maps indicating size of the wetland; and those under 400m^2 are shown as a small circle. The wetland data will eventually be uploaded to the SGS Truvian mapping system so that St'at'imc land managers have access to the information during their land-use planning and referral processes.

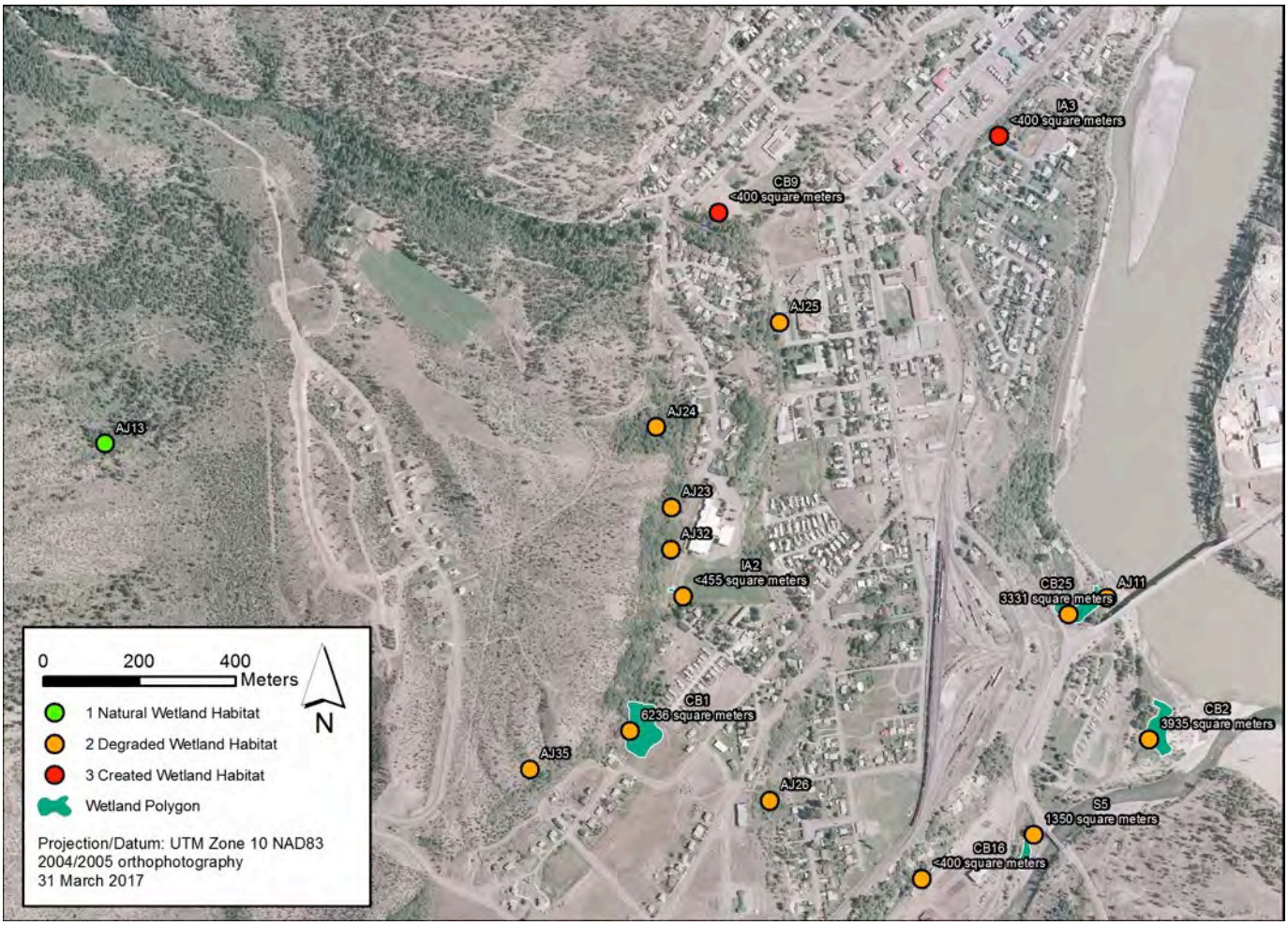
Methodology and results were presented to Sekw'el'was and T'it'q'et communities throughout the field season to ensure the partners to this project were aligned with the methodology being used and received the results in a timely manner. Splitrock Environmental also brought together representatives from Xwisten and Xalxlip for a meeting and presentation on the work completed with the goal of engaging them in increasing the footprint of the wetland survey. These communities, as well as Tsal'alh have now become partners in exploring opportunities to increase the wetland survey into their traditional territories. Splitrock was also invited to present the project to approximately 95 people at the T'it'q'et/P'egp'lg'lha Water Forum held in Lillooet in November 2016.

On the evening of 01 March 2017 results of our wetland survey were presented at an open house to 25 community members. A powerpoint presentation outlining the work completed and the results was shown and draft copies of the Site-Specific Summary Reports were passed along to participants and other interested people in the communities.

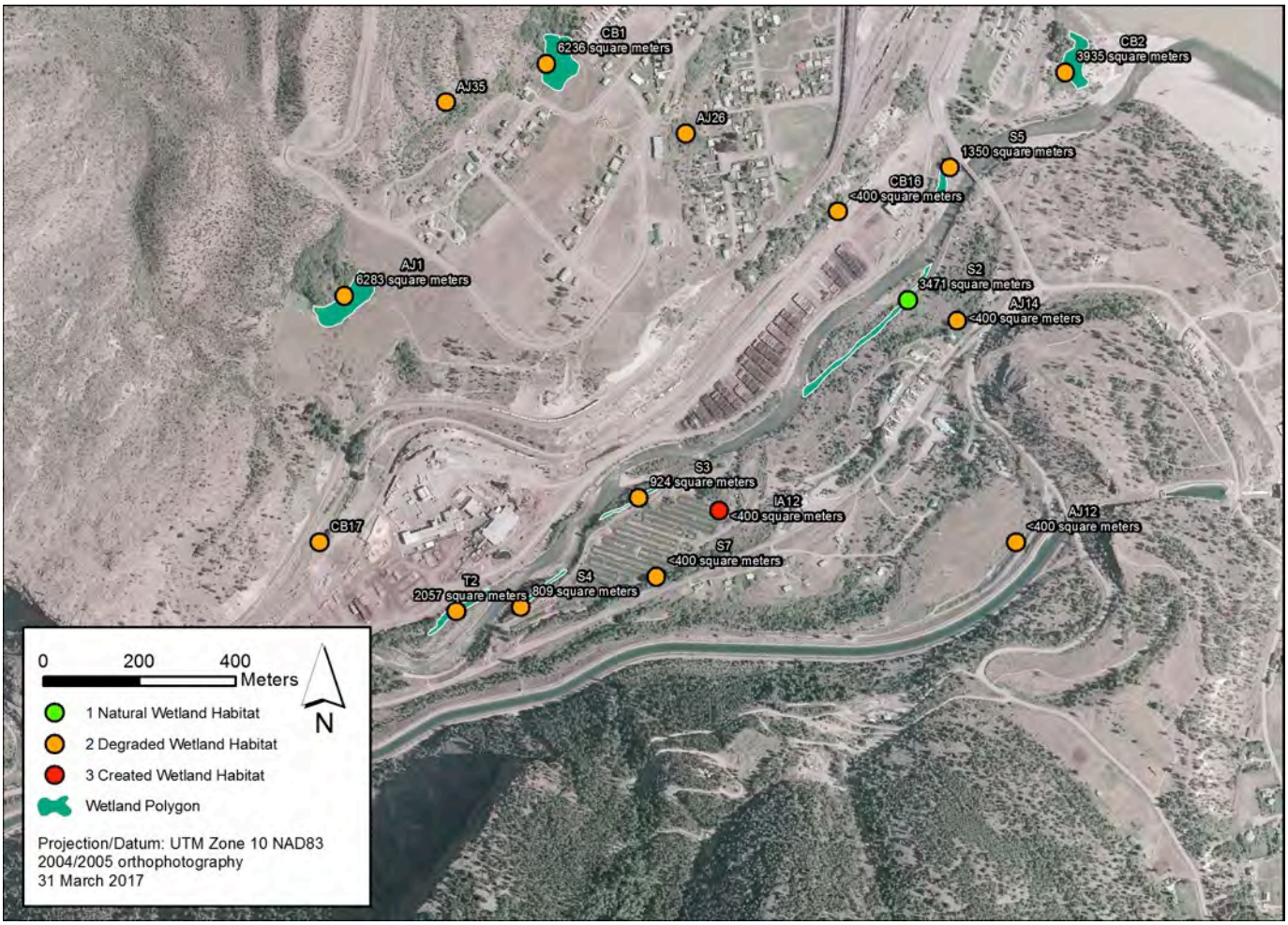
The recommendations made in the Site-Specific Summary Reports were a starting point for discussing stewardship activities. Table 7 under Recommendations below, highlight some of

the main stewardship recommendations that participants could implement either alone or with the assistance of our crews.

Through our outreach efforts, we have successfully engaged the five St'at'imc communities and St'at'imc Government Services (SGS) with the goal of working within Sta't'imc territory to gain a better understanding of the wetlands found on the landscape. As well local and regional governments, landowners, ranchers and NOGs have all been involved in the process and continue to support the work being planned for future years. The goal of this work is the protection, enhancement and/or restoration of the remaining wetlands and critical riparian areas associated with the wetlands that have been identified during this initial year, and to explore the opportunities for fish and wildlife in the remaining of the St'at'imc Territory over the coming years. This will include working with SGS to input the 2016-2017 wetland data collected into the Truvian mapping system that is being used by the communities to make land-use decisions and to respond to referrals from industry.



Map 10 Lillooet Townsite Area Wetland Locations 2016

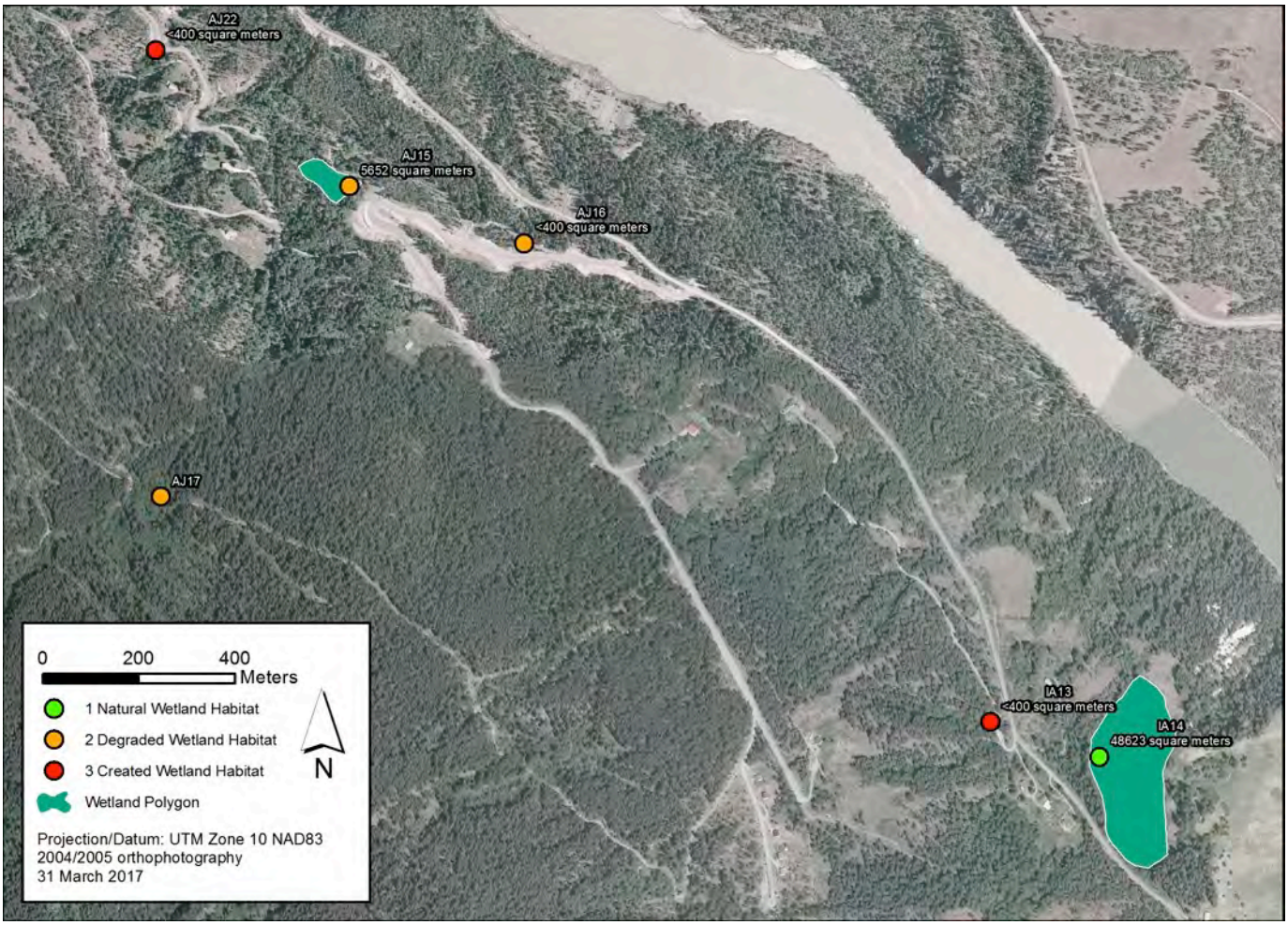


Map 11 Lower Seton Corridor Wetland Locations 2016

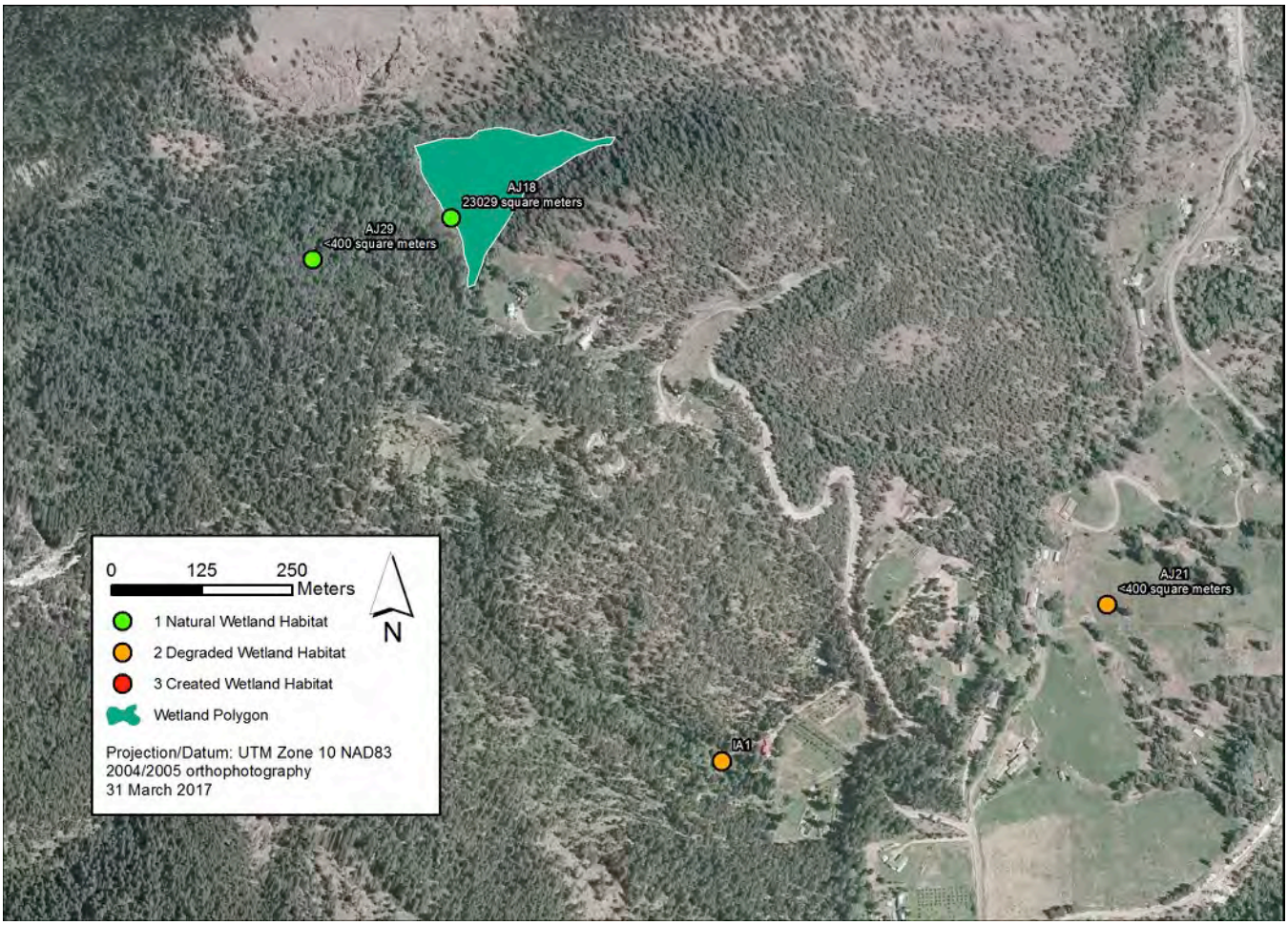
Map 12 Upper Seton Corridor Wetland Locations 2016

Map 13 Highway 99 Wetland Location

Map 14 Highway 99 Downton Wetland Location 2016



Map 15 Blue Hill Area Wetland Locations 2016



Map 16 Texas Creek Road Wetland Locations 2016

6.0 Discussion

The Lillooet wetland inventory was a challenging and rewarding project. The main result of this project has been an increased understanding of wetland occurrence and health in the study area, and increased community dialogue regarding wetland stewardship.

One of the first challenges encountered with this project was locating wetland sites within the survey area. A number of sites were already known from the existing literature, particularly the recent amphibian survey (Wind 2013). However these were generally concentrated within the Seton Corridor.

Review of orthophotography seemed to reveal a landscape with very few wetlands. At the scale of review of the orthophotography (1:1000 – 1:5000) there were simply very few sites within the study area that read visually as wetlands. Topographic and hydrologic layers supported this finding, especially in the two arms of the study area running along Seton Lake, and Cayoosh Creek. Both of these landscapes were composed primarily of steep rocky topography. Likewise, the TWI layer did not effectively help us to locate wetlands on the landscape. This was likely due to the scale of analysis used to create this layer; while the minimum polygon size in the TWI layer was 900 m^2, many of the wetlands within the study area were actually smaller than this size, and generally did not align with those areas predicted to be wet by the TWI layer. The TWI layer has performed well for other applications (Sue Senger personal communication), and perhaps its utility was only limited in this project due to the limited geographical extent of the study area, and the specialized demands of our particular application.

Though orthophotography interpretation did not reveal very many potential sites within the study area, we were successful in learning the location of many sites from communication with community members. These sites formed the majority our field visits. Examination of Map 5 indicates that most of our wetland sites occur within the most inhabited zone in the study area – the area around Lillooet. While it would be easy to attribute this concentration solely to the use of community knowledge to identify sites, there are other reasons also. Many of the wetlands in the Lillooet area are associated with backchannels in the Seton River riparian area, and others arise from several springs, which originate above town. Likewise, there are good reasons why other zones within the study area seem conspicuously lacking in wetland sites. For one thing, we were unable to survey the many wetlands and associated ecosystems on Jones' Farm.

Since this area represents 1459 acres of the valley bottom on Texas Creek road, it represents a large gap in the distribution of surveyed wetlands in this inventory. Likewise, the areas along Cayoosh Creek and Seton Lake are generally just too steep and rocky for the hydrologic and soil processes, which form wetlands. Given these conditions, it is not surprising that orthophotos review and ground searches did not reveal very many wetland sites in these areas.

Classification of wetlands in the study area to the site association level was not possible using the provincial guide (McKenzie and Moran 2004), and so we relied on the higher level classification level within this text which is based on the original Canadian Wetland Classification System (National Wetlands Working Group 1997). Difficulty applying the provincial classification system seemed to arise on nearly every site, when the plant community in front of us did not match well with those options outlined in tables in the book. While some of the indicator species described for a given site association were often present on the site we were trying to classify, the overall match of plant species composition and relative abundance was generally poor. Rather than attempt to classify every site to a site association when the fit was poor, we chose instead to use the higher level classes to describe general site conditions. While a specific classification for each wetland site would have contributed to our understanding of the quantity and quality of wetland features across our landscape, for these purposes it is also important that we have recorded a detailed description of the vegetation, soils, and hydrology of each site. As the provincial wetland classification develops, and becomes applicable to more parts of our province, we can use the data collected along with newer information to attempt to classify these sites again according to new developments. All of the wetland sites, which were surveyed, fell within one of three classes, either Low bench, Marsh, Swamp. Marshes were the most common class of wetland in the study area. This is to be expected within the dry climate characteristic of our study area. The fluctuating water levels typical of Marshes will be the usual condition in areas which receive early season moisture, but which tend to dry up as the growing season progresses. The unclassified wetlands typically occurred in conjunction with the Marshes, or occasionally on their own in the case of constructed ponds. Swamps were typically associated with springs and riparian areas receiving continuous wetness throughout the growing season. We did not encounter any wetlands dominated by organic soils, like bogs or fens. These wetland classes are typically found in depressions in cooler areas where accumulated water sits throughout the growing season causing slower rates of decomposition of plant matter. Though these peat lands did not occur

within our study area, we cannot draw conclusions regarding their rarity in the local landscape. These wetland types are here on the landscape, but they generally occur at higher elevations, above our study area limit of 800 meters above sea level.

In the same way that this study area boundary has skewed our results towards certain classes of wetlands, we also expect that the distribution of wetland categories, is also skewed towards those categories more associated with human activities and impacts. For example how do we interpret the fact that there are only eight category one wetlands within the study area? Are these features in fact rare across the landscape? And how rare? The biologically arbitrary study area boundary makes interpretation difficult. As something of a geographic outlier, the Top of Duffy wetland provides a good example of this. Though it was the only wetland with some characteristics of a fen in our study area, and one of the 8 category one wetlands, there are several more wetlands of this character visible from Highway 99 South, and based on local knowledge can be found in varying locations at higher elevations. So it seems that the distribution of wetland categories is skewed towards Category 2 not only because of the ongoing tendency for wetlands to be modified by human activity, but also because our study area is not a random sample of wetlands in the region. As the study area boundary was limited to valley bottoms within the immediate proximity to Lillooet, it is expected that our sample of sites is skewed towards those wetlands which have been affected by hydroelectric developments, agriculture, and human settlement. In the limited context provided by a strictly delimited study area, it is difficult to draw conclusions about the relative level of disturbance to the wetlands, and the range of wetland ecological functioning, in the entire St'at'imc region.

Some of the largest wetlands in the study area were classified as Category 1 - natural wetland habitat. It is encouraging that these individual features are extensive despite their relative scarcity. Phair Lake is one example of these large natural wetland features. This 2.3 hectare mid-elevation lake is mostly free from residential development (though there is one residence on the lake). The shores are fringed with cattails and bulrushes suitable for amphibian breeding, and the surrounding landscape is mature forest, which provides extensive foraging habitat for adult amphibians. Likewise, Wayne's swamp provides 2.3 hectares of relatively undisturbed habitat for ungulates, birds, and amphibians.

Due to issues regarding site access, we were unable to survey the largest, and likely most biologically important wetland complex within the study area – the Marsh at Jones' Farm (Figure

9). The wetland complex at Jones farm includes the only two wetlands within the study area which were previously detected from remote sensing data and included in the provincial Freshwater Atlas. A Marsh/Shallow open water complex at Jones' farm was also surveyed during the amphibian surveys conducted by Splitrock Environmental in 2013; at this time the presence of both Columbia Spotted Frogs and Western Toads was confirmed on site. No further breeding sites for either of these species was identified in the study area during our amphibian surveys in the summer of 2016.

Jones farm has long been a favourite site for local birders, and lists of avian species encountered on this site can be accessed on eBird (ebird.org). With total bird diversity of over 150 species, the area has been noted as:

"a rich assortment of terrestrial and aquatic habitats... no site in the Lillooet region rivals Jones' Farm in avian diversity and abundance. Greater than 150 species have been documented on the property. Several regionally endangered species have been recorded at the site including Western Screech-Owl and Yellow-breasted Chat. The ponds and associated wetlands host the only Yellow-headed Blackbird colony in the Lillooet area. It is also an important rest area for migratory waterfowl and shorebirds in the lower Fraser River Basin." (Ken Wright, Local Naturalist).

Despite the fact that we could not conduct on the ground survey work on Jones' farm in 2016, an aerial survey was flown in fall 2016 (Fig 9). Based on the past birding data, amphibian surveys, and the aerial survey, it is clear that this area is among the largest and highest functioning wetland complexes within the study area.

Wetland birding data has now been compiled from past research in the Lillooet area and a preliminary synthesis completed to inform the work moving forward (Appendix 2).

A significant aspect of this project involved the development of local capacity for ecological research and stewardship. One of the primary ways in which we worked to build capacity during this project was by training a team of summer students and environmental technicians on the full set of wetland and amphibian survey protocols. While some of these protocols were simple to execute, others presented an ongoing challenge. Among the easier protocols was the collection of vegetation occurrence, cover and structural data. The surveyors improved steadily in their recognition of common plant species, and in their capacity to apply the sometimes tricky

practice of visual cover estimates. The more challenging protocols for team members tended to be those which involved categorization of hydrologic, geographic, and soils parameters.

Longer form descriptive fields and qualitative categories posed another challenge for team members learning to apply the survey protocols. The original protocols presented during the wetland survey workshop included a few qualitative categorical fields such as landscape context, condition, ecological integrity, and restoration, each with the categories “excellent”, “good”, “fair” and “poor”. However, explicit definitions for each category were not included in the written protocols for these fields. Rather than collect this data due to the problem of standardization, we decided to change some of these questions to purely descriptive fields. Instead of choosing categories, the surveyors were instructed to make observations and notes on the landscape context, and site disturbance.

The crews were able to develop their terrestrial ecosystem survey skills throughout this project by working through the complete set of protocols many times with mentorship and guidance. By the end of the summer most of the fields on the data sheet were answered accurately with relative ease, and the technicians required much less supervision while completing surveys.

Local landowners and St’at’imc community members were also engaged in the survey process and many of these people now have a greater understanding of “their” wetland, and are interested in maintaining their function.

7.0 Recommendations

7.1 Site-Specific Recommendations

As noted above, a Site-Specific Summary Report for every wetland surveyed has been prepared, for the benefit of local St'at'imc communities, local landowners, other community members and land managers. These reports have been presented to the participants in the wetland survey and are attached in Appendix 1. A summary table (Table 10) is presented below highlighting some of the main recommendations made within the reports.

Table 10 Summary of site-specific recommendations.

Site	Classification	FWCP Ranking Category	Area (m2)	Recommendations
AJ1	Springs	2	NA	The shrub cover on this site should be preserved as it provides nesting habitat for songbirds and cover for small mammals. Also, burdock should be removed from this site.
AJ11	Marsh	2	<400	Restrict foot and vehicle access to this site by placing coarse woody debris to allow for the development of riparian shrubs.
AJ12	Springs	1	NA	Follow up work is required to determine the source of water and hydroperiod for this site. Removal of common tansy, an invasive species, will help prevent its spread throughout the Seton Corridor.
AJ13	Marsh	2	<400	Natural regeneration appears to be progressing well on this site. Removing burdock and promoting conservation are recommended.
AJ14	Unclassified	2	5652	To prevent disruption to existing amphibian breeding habitat, no substantial modifications are recommended for this site. Conservation and restoration actions for this site include: protecting this area from development and removing burdock.
AJ15	Marsh	2	<400	Conservation work includes protecting these areas from development, grazing, and timber harvest. Planting the east side of this site with a native shrub species mix will increase wildlife cover.
AJ16	Springs	2	NA	No management is recommended at this microsite.
AJ17	Swamp	1	23029	Burdock removal is recommended for this site.
AJ18	Marsh	2	6283	Limit timber harvest on the west slope above this site.
AJ20	Unclassified	3	960	Increase bird habitat by extending the shrub margin around the ponds. Species such as prairie rose, black hawthorn, chokecherry, Saskatoon, and wild red raspberry are suitable for this site.
AJ21	Marsh	2	<400	Exclude cattle from this site with temporary fences to allow a layer of native shrubs to regenerate.
AJ22	Unclassified	3	<400	Plant native shrubs to buffer this wetland from road runoff. Burdock removal is recommended for this site.

Site	Classification	FWCP Ranking Category	Area (m2)	Recommendations
AJ23	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ24	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ25	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ26	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ29	Swamp	1	<400	The areas surrounding this site should be protected from timber harvest.
AJ30	Unclassified	3	2585	Excavation and site contouring will extend the hydro-period and seasonal coverage of this site and provide breeding habitat for amphibians. Also, road deactivation through the placement of large rocks and coarse woody debris is recommended to prevent site disturbance.
AJ32	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ34	Springs	1	NA	A riparian buffer should be maintained around this feature.
AJ35	Springs	2	NA	A buffer around this spring should be protected from any future residential development or timber harvest.
AJ36	Marsh	1	10956	This site should be protected from any disturbance that would impair natural cycles of flooding and the unique plant communities. Any roadwork along highway 99 should strictly adhere to an environmental protection plan that outlines measures to prevent sediment, excavation, or filling of any part of this wetland.
CB1	Swamp	1	<400	This site should be reviewed by a herpetologist to determine its potential suitability as amphibian habitat. If this site is identified as suitable amphibian habitat, recommendations include excavating weedy areas proximal to the pond to replace exotic species cover with standing water.
CB12	Swamp	2	2238	This site should be resurveyed for amphibian larvae in the future. Also, burdock removal is recommended to prevent the spread of seeds on wildlife.
CB15	Marsh	2	<400	The forested area of this wetland could be increased by allowing regenerating shrubs to continue to mature in the pasture areas adjacent to this wetland.
CB16	Springs	2	NA	The marsh area could be expanded and a deeper and permanent pond dug.
CB17	Marsh	2	6236	A culvert draining this spring has altered the natural hydrology and precluded wetland development. We recommend allowing water to pool, which would promote the establishment of wetland plant communities.
CB2	Marsh	2	3331	Site disturbances including tree cutting and ATV use should be discouraged to preserve habitat and wildlife values.
CB25	Low Bench	2	3935	To increase inundation at this site, recommendations include excavating along the toe of the slope beside the road and using the existing water inflow to maintain a pond.

Site	Classification	FWCP Ranking Category	Area (m2)	Recommendations
CB9	Marsh	3	<400	There is a strong contrast between the wetland and surrounding recreational field, which may result in edge effects. Recommendations include promoting a more natural riparian buffer to improve the habitat values within this wetland.
IA1	Marsh	3	<400	The riparian area around these springs should be protected from residential development or timber cutting.
IA12	Unclassified	3	<400	No restoration is recommended for this site; however, this site is an ideal source of disturbance-adapted and early-successional species to apply for restoration in similar wetland features throughout the study area.
IA13	Swamp	1	48623	Because of its proximity to a road, this site is prone to disturbance from activities such as repairing an existing culvert. Because of the potential of this site to support breeding spadefoot toads, we recommend implementing conservation measures to protect it.
IA14	Springs	2	NA	Prevent timber harvest from site. Also, burdock plants should be removed.
IA2	Marsh	2	455	Minor restoration work is recommended to convert turf grasses into a shallow pond. Also, wetland enhancement will provide a living laboratory for the students of Lillooet Secondary School.
IA3	Marsh	3	<400	Garden plant species should be cut back after flowering to prevent spread. Also, burdock should be removed from the site.
IA40	Unclassified	3	1424	Replace and/or install cages around shrub species to prevent beaver damage. Invasive species such as knapweed should be removed.
IA7	Unclassified	3	<400	Burdock removal is recommended for this site.
IA8	Marsh	2	<400	Existing trees should be kept intact to provide woodland refuge for birds and amphibians.
S1	Marsh	3	1085	Because this site is known to support breeding long-toed salamanders and pacific tree frogs, it should be protected from dumping, filling, or any other deleterious activity. Also, planting native shrubs along the pond periphery could increase wildlife cover and foraging habitat.
S2	Low Bench	1	3471	Water use planning on the Lower Seton River should take into account the behaviour of this backchannel during flood events.
S3	Low Bench	2	924	Water use planning on the Lower Seton River should take into account the behaviour of this backchannel during flood events.
S4	Low Bench	2	809	Water use planning on the Lower Seton River should take into account the behaviour of this backchannel during flood events.
S5	Low Bench	2	1350	Soil excavation to the water table could be completed to create standing water suitable for amphibian breeding. Also, this site should be protected from disturbance when the bridge over the Seton River is moved.
S6	Swamp	2	<400	This site likely provides habitat connectivity for wildlife. We therefore recommend protecting this area from development.
S7	Swamp	2	<400	The grove of trees surrounding this site should be protected during work on highway 99 and the lower spawning channels. Also, burdock plants found at this site should be removed.

Site	Classification	FWCP Ranking Category	Area (m2)	Recommendations
T1	Springs	2	NA	This site should be investigated further for restoration and enhancement potential.
T2	Marsh	2	2057	This off-channel salmonid habitat should be protected from disturbance. Live stake cuttings of willow, dogwood, and poplar could be planted in the gravel slope to stabilize the bank, compete with invasive weeds, and provide shade and litter-fall for the pond below.

7.2 General Recommendations

The following recommendations are made based on reflections on the execution and results of the 2016 Púslumcw Wetland and Riparian Survey:

- Continue to engage with local stakeholders and land managers regarding the importance of wetlands in our region, and strategies to protect these valuable features across the landscape.
- Category 1 wetlands within our study area were often clearly associated with human activities which could impair their function and productivity. Some of the main threats identified were road development, residential development, and grazing. These Category 1 wetlands are a priority for conservation and restoration, and work will continue with agencies, communities and landowners to protect these wetlands through various avenues as identified over the coming years.
- The Category 2 wetlands are targeted for restoration and conservation. A decision making framework to prioritize sites for restoration will help determine how we proceed with the process of wetland restoration in the Lillooet area.
- Many of the Category 3 wetlands were those unclassified ponds occurring on private property. It is important to consider the wildlife value of these features in the arid landscape of the Lillooet area. Ongoing outreach with landowners can help shape these spaces into habitats with higher function and productivity.
- Hydrologic ramping may pose specific threats to the integrity and health of backchannel amphibian breeding habitat along the Seton River. The effects of altered flow regimes on wetland habitat in this system should be studied more, and further recommendations developed.

- Working with the nearby communities of Xaxlip, Xwisten, and Tsal'alh, we hope to build towards a regional understanding of wetland occurrence and health within St'at'imc territory. It is a priority to broaden the geographic scope of this study. In the future the partners recommend that headwater wetlands and other high elevation systems above 800 meters be assessed to better represent the unique functions of these features, and to compensate for losses that have occurred throughout the territory.
- Further survey effort should be applied to understanding the distribution and abundance of amphibian species in the wetlands at Jones' farm. There has been no work to survey this area since 2013 (Wind, 2014), and these surveys were limited to the large wetlands at the North end of the property. During our auditory sampling in the spring of 2017, we heard Pacific tree frogs calling throughout this large property, which indicates that there is more amphibian breeding habitat here than previously recorded. The undulating topography of this large tract of ranch land is one of the most likely areas of Great Basin Spadefoot Toad habitat within our study area. For these reasons, it is important this area be surveyed more intensively at such a time that access to the ranch is no longer restricted.
- Efforts should be made to provide permanent protection for the unique amphibian and avian habitat values noted in the Jones' Farm wetland complex. Partnerships have been established locally towards this goal. There are several parties including St'at'imc communities, local conservation groups, local businesses, and national conservation organizations who are beginning to work together to establish a vision for the conservation of the Jones' wetland complex. We have shared drafts of this report with the Nature Conservancy while they are working on the process of evaluating this region for conservation sites. We hope to work more with groups like the Nature Conservancy to protect important wetland habitats in the region.
- Complete a breeding bird survey at targeted wetland sites to increase knowledge of wildlife use of the regional wetlands, including species-at-risk. This work will build on the bird use lists compiled by members of the Lillooet Naturalist Society over the years. Focal species to include the Interior western screech-owl *(Otus kennicottii macfarlanei)* , yellow-breasted chat *(Icteria virens)* and Lewis's woodpecker *(Melanerpes lewis).*
- Moving forward, some of the survey protocols could be improved to suit our study area. We would like to implement a simple field protocol for the assessment of wetland and

riparian health. One such protocol is provided by Cows and Fish (Ambrose et al. 2009). If this protocol was modified and applied to our study area we could generate finer health scores for certain wetlands, and use these scores in processes to inform land management, and prioritization of restoration sites.

- Community based efforts to continue to build local environmental science capacity should be a feature of future wetland conservation and restoration activities within the Lillooet area. The technicians who worked on this project have improved their skills in the area of terrestrial ecosystem survey work. Efforts should be made to utilize the specialized environmental science training and experience possessed by these community members.
- Many of the Category 1 wetlands that we surveyed were not easily accessible, or on private property. When we had the chance to visit these little oases we were moved by the relative profusion and diversity of life which we encountered. Based on these experiences sharing some of these spaces with the next generation could be provided through on-site outreach highlighting the beauty, rarity, and importance of wetland habitat in our region.

8.0 Acknowledgements

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Appendices

I. Site-Specific Summary Reports

Site Name/Number	Marriage Rock/AJ1
Date	27 June 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	6283 m^2
pH	7.7
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Mule deer, butterflies and bees, songbirds.

Site Description: This small Marsh area is located at the toe of Marriage Mountain. The source of the water here are springs which originate above, as is evident by the grove of trembling aspen above the site. In the year of survey there was very little open water, and no amphibian larvae detected, however this site could provide amphibian breeding habitat in wet years. The areas surrounding the wettest parts of the site are dominated by shrubs, particularly prairie rose. The high proportion of exotic species cover is largely due to the abundance of Kentucky Bluegrass which is the dominant ground cover throughout much of the plot.

Native Plant Species (41% Herbaceous Cover): Spreading dogbane, *Carex* sp., common horsetail, field mint, balsam poplar, prairie rose, Canada goldenrod, pacific willow, common cattail**.**

Exotic Plant Species (36% Herbaceous Cover): Common burdock, Canada thistle, white sweet-clover, Kentucky bluegrass, garden parsnip.

Recommendations: The abundant shrub cover on this site should be preserved as it provides excellent nesting habitat for songbirds, and cover for small mammals. The aspen grove above site is also a great wildlife feature that provides dense cover for a variety of wildlife including deer, black bear, and coyote. Though overall exotic species cover is high, we would not recommend extensive remedial action to remove these species. The main exotic plant here is Kentucky Bluegrass, an introduced turf grass which dominates suitable sites with its extensive rhizomatous root system. Unfortunately there is no easy way to remove this species without causing extensive soil disturbance which would ultimately encourage the establishment of other, perhaps more problematic, exotic species. However, we do recommend the removal of the giant burdock. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar velcro-like “burs”. Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	**Bridge of 23 Camels/AJ11**
Date	4 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	8.6
Soil Texture	Sandy
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Deer, Bears, Fish.

Site Description: This small wet area occurs where the Station Hill springs reach below the high water mark on the west bank of the Fraser River, north of the bridge of 23 camels. No amphibians were detected in this wetland in 2016, and fluctuating water levels prevented the area from being surveyed in 2013. This wetland is along the south end of the Lion's trail, and sees a lot of foot traffic. There is also vehicle traffic from folks going to fish at an eddy further north on the shoreline. The site is dominated by plants adapted to flooding such as willows, red-osier dogwood, and long-leaved fleabane.

Native Plant Species (26% Herbaceous Cover): willow, long-leaved fleabane, scouring-rush, red-osier dogwood, pineapple weed,

Exotic Plant Species (6%): Quackgrass, Kentucky bluegrass

Recommendations: Because this wetland is below the high-water mark it will be repeatedly scoured during high flows in the future. This will limit the development of wetland soil, and a more productive plant community. Rocks and coarse woody debris could be placed around the margin of this wetland to restrict foot and vehicle access, which would allow for the development of a more robust shrub layer.

Site Name/Number	**Texas Creek Rd. Canal/AJ12**
Date	4 July 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400m^2
Soil Texture	Clayey
Moisture Regime	Moist
Wildlife	Deer tracks.

Site Description: This wet area occurs at the toe of the slope of the Lower Seton canal embankment. It is not clear if the water here occurs from springs, or just from upslope runoff. The area has been known to flood seasonally, and could host breeding amphibians in wet years. However, there was no standing water here during the summer of 2016. This small wetland is dissected by a fence which delimits two parcels of land. The portion to the south where the survey plot was located is within the BC Hydro right of way for the Seton Canal, and the north side of the fence line is a pasture on Sekw'el'was reserve land. The fence line between these parcels has remained un-cleared and this is where the tall shrubs and balsam

poplar occur. This site had the only occurrence of common tansy within our 2016 wetland inventory study area.

Native Plant Species (67% Herbaceous Cover): common horsetail, red-osier dogwood, balsam poplar, prickly rose, Pacific willow, toad rush, balsam poplar, Canada goldenrod, poison ivy, common snowberry, black hawthorn, rush sp.

Exotic Plant Species (5% Herbaceous Cover): Curled dock, catnip, Dalmatian toadflax, alfalfa, common tansy

Recommendations: Efforts should be made to determine the source of the water on this site. Is it simply runoff pooling in a low area? Is there a spring? Or, perhaps the water occurs from a leak in the canal? If the permanence and flow rate of the water on this site can be established, then this site could be a candidate for enhancement activities. If there is sufficient water, then a pool could be excavated north of the fence in the pasture to provide breeding habitat for amphibians, and foraging opportunities for songbirds and reptiles. This site should be revisited throughout the next few years to make observations of flooding extent and hydroperiod.

Because common tansy is relatively rare within the Seton corridor this small occurrence should be removed to prevent further proliferation. Fastidious digging of rhizomes would be required to eliminate this patch of tansy, or at the very least seed production should be prevented by cutting it yearly.

Site Name/Number	Springs above T'it'q'et/AJ13
Date	5 July 2016
Classification	Springs
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Slope	32 %
Aspect	West
Soil Texture	Silt
Soil Moisture Regime	Very Moist
Soil Nutrient Regime	Rich
Wildlife	Black bear, songbirds

Site Description: The site occurs on a steep west facing slope which has been recently burned during a 2009 wildfire. The source of water here is a small spring. According to the landowner, this area used to be a sort of riparian oasis on an otherwise dry forested hillside. However now the spring is just a small trickle which flows quickly off the landscape. The soils here were not hydric, and none of the plants were obligate wetland species. The dominant shrub on site is mountain alder, and the dominant herb is fireweed. These early successional species are to be expected in the wake of large wildfire disturbance and each has a valuable function. The alder

stabilizes soil and protects scarce moisture acting as a nurse crop for the next cohort of Douglas fir which may eventually dominate the site, while the fireweed is a prolific wild nectar plant.

Native Plant Species (62% Herbaceous Cover): Fireweed, mountain alder, red-osier dogwood, red raspberry, thimbleberry, yarrow, snowbrush, black hawthorn, field mint, trembling aspen, pin cherry, and prairie rose.

Exotic Plant Species (6% Herbaceous Cover): Great mullein, common burdock, Kentucky bluegrass,

Recommendations: Natural regeneration appears to be progressing well on this site, and so we would recommend a conservation approach to protecting this area. No restoration actions are needed in our opinion. The burdock occurring on site does pose a hazard to bats and songbirds which can become fatally entangled in the Velcro-like fruits of this species. Without further soil disturbance this species is unlikely to become more abundant; however, it would be a good idea to treat the infestation that is already there. Burdock can be eradicated by yearly removal of flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a small rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall flowering individuals as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock flowers and you will see the species decrease on the landscape through time.

Site Name/Number	**James' Property/AJ14**
Date	5 July 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	7.7
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Songbirds. Raccoons.

Site Description: This small wetland occurs under forested cover just north of some residences on Highway 99 south from Lillooet. Ground cover is sparse below the well-developed tree and shrub layers. Evidently the flooding on this site varies from year to year. In 2013 long-toed salamander larvae were observed here during the amphibian survey, but in 2016 the flooded area was very small and only located after some amount of searching.

Native Plant Species (10% Herbaceous Cover): Douglas maple, prairie rose, balsam poplar, willow, red raspberry, common snowberry, poison ivy.

Exotic Plant Species (5% Herbaceous Cover): Wall lettuce, great burdock.

Recommendations: Since this site already effectively hosts amphibian larvae in some years, and has a mature forest structure, we would not recommend any substantial modifications. This area should be protected from further development, and the grove of trees surrounding it should be maintained to provide cover and foraging habitat for adult long-toed salamanders. The burdock on site should be treated if possible. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like "burs". Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	**Blue Hill Switchback/AJ15**
Date	6 July 2016
Classification	Unclassified
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	5652 m^2
pH	7
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Very Rich
Wildlife	Bear trail. Long-toed salamanders.

Site Description: A series of small ponds accessed by an old trail north from the first switchback on Blue-Hill Road. Well-developed shrub and tree layers surround the edges of the ponds except for the eastern fringe which is cleared and has some cover of white sweet clover. Long-toed salamander larvae were observed here.

Native Plant Species (28% Herbaceous Cover): Red-osier dogwood, common horsetail, balsam poplar, water birch, willow, meadow horsetail, mountain alder, fowl mannagrass, field mint, bluegrass, balsam poplar, celery-leaved buttercup, common snowberry, common cattail, American vetch.

Exotic Plant Species (1% Herbaceous Cover): White sweet clover

Recommendations: This site is in generally good health, and shows only minimal disturbance from human activity. These ponds should be protected from development, grazing, and timber harvest. The east side of the ponds could be planted with a mix of native shrub species to increase wildlife cover on the site, or it could be left open to allow for limited public access to the site. In any case, the site should be monitored for invasive species, dumping, cutting, or any changes which might threaten its integrity.

Site Name/Number	**Blue Hill/AJ16**
Date	7 July 16
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	7.2
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Medium

Site Description: An extremely small wet area below a lower section of Blue Hill Road. A few wetland species such as cattail and shore buttercup were present here. Total area with wetland plant species was likely less than 9 m^2. The source of water is a spring, or perhaps a trickle from a culvert above. No open water at the time of survey.

Native Plant Species (47% Herbaceous Cover): Common snowberry, common cattail, prairie rose, Kentucky bluegrass, trembling aspen, willow, white clematis, red raspberry, Canada goldenrod, paper birch, Douglas-fir, yarrow, shore buttercup

Exotic Plant Species (45% Herbaceous Cover): white sweet-clover, redtop, bull thistle

Recommendations: No particular management is recommended at this microsite. The depressional area around the wetland plant community was limited, but still it would be interesting to observe flooding here in a wet year to determine if this feature sometimes hosts breeding amphibians. This site is not likely an important watering hole for wildlife, due to the close proximity to AJ15 which has year round water in abundance.

Site Name/Number	**Above Blue Hill/AJ17**
Date	8 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	8.3
Soil Texture	Silty
Moisture Regime	Wet

Site Description: A flooded expanse of forest accessible from a gated road above Blue Hill road. The source of water on this site is from a spring above. The water runs in a channel down the logging road briefly before continuing downslope across the site. It appears as if the water has not been running down this course for very long, because the channel development along the road is minimal, there is no mottling or gleying in the soil, and the plant community does not include any obligate wetland species. However, the plant species composition was diverse, and unique with several species that are not common on the dry slopes in this part of the Fraser Valley.

Native Plant Species (12% Herbaceous Cover): Balsam poplar, mountain alder, red-osier dogwood, western snowberry, Douglas maple, water birch, devil's club, saskatoon, prairie rose, red raspberry, black elderberry, western red-cedar, baneberry, goats beard, meadow horsetail,

sweet-scented bedstraw, mountain sweet-cicely, bluegrass, Hooker's fairybells, black raspberry, black elderberry, Lindley's aster, stinging nettle

Exotic Plant Species (3% Herbaceous Cover): Great burdock, wall-lettuce, Kentucky bluegrass

Recommendations: This wet patch on an otherwise dry hillside is an important watering hole for wildlife, and should be protected from development, timber harvest, and other disturbance. Furthermore, the plant community is generally unique for the region, including medicinal species such as devil's club and black elderberry. The burdock on this site was mostly still in the first year rosette stage. The seeds for these plants were likely brought onto this site with burs attached to wildlife coming for a drink. Because this site is likely a hub of animal movement, a burdock patch here would effectively spread the seeds of this invasive species further and wider upon the landscape. For this reason, we suggest the removal of burdock from this site in 2017. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	**Phair Lake/AJ18**
Date	11 July 06
Classification	Swamp
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	23029 m^2
pH	7.5
Moisture Regime	Very Wet
Nutrient Regime	Rich
Wildlife	Garter snakes. Pacific tree frogs.

Site Description: A small lake with some significant Swamp areas along the western fringe. This site has a diverse assemblage of wetland species including slender rein orchid, devil's club and awl fruited sedge. Cover of exotic species was low, and neither of the exotic species occurring on this site pose a serious threat to native biodiversity, or ecosystem function. Pacific tree frogs were observed during the survey. Except for one residence east of the lake, the riparian fringe of this lake is largely intact. There is an inflow of water from springs which originate on the slope above the lake on the West side. Another wetland site (Bear Bath/AJ 29) occurs in the forest on this hillside along the same springs.

Native Plant Species (18% Herbaceous Cover): Scouring-rush, mountain alder, awl-fruited sedge, paper birch, devil's club, balsam poplar, red-osier dogwood, western snowberry, thimbleberry, sweet-scented bedstraw, slender rein orchid, reed canarygrass, purple-leaved

willowherb, prairie rose, pink wintergreen, mountain alder, meadow horsetail, fowl mannagrass, false Solomon's-seal, Douglas-fir, Douglas water-hemlock, common mare's-tail, baneberry, balsam poplar, American speedwell

Exotic Plant Species (1% Herbaceous Cover): Wall-lettuce, bull thistle.

Recommendations: The west slope above this site should be protected from timber harvest in order to protect the springs which occur there. These springs provide the water source for the Marshy areas on the west side of the lake.

Site Name/Number	**Maxwell Pond/AJ20**
Date	12 July 2016
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	960 m^2
pH	8.37
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Rich/Very Rich
Wildlife	Belted kingfisher, Great blue heron, and garter snakes. A bat box is installed east of the pond.

Site Description: A created pond in a rural farmyard. This pond is fed water through a hose from a nearby source. The pond is fringed with Marsh vegetation around the edges. The shrubby border of the Marsh is dominated by prairie rose, and red-osier dogwood, while the dominant plants in the Marsh areas are soft-stemmed bulrush and reed canary grass. In addition to these native species, the riparian area around this wetland has been planted with ornamental species including lilacs, chestnut, daylilies, and several species of willows. The extent of the riparian wetland margin has been limited by the driveway and by mowing. One invasive species of concern on site is burdock. No amphibian larvae were detected during the

survey, though an unidentified fish species was observed. Many fish species prey upon amphibian larvae and so these species do not usually coexist within one wetland.

Native Plant Species (38 % Herbaceous Cover): Prairie rose, soft-stemmed bulrush, red-osier dogwood, reed canary grass, woolly sedge, common cattail, maple, Douglas' water-hemlock, black hawthorn, common spike-rush, balsam poplar, red raspberry, Canada goldenrod, great burdock.

Exotic Plant Species (11% Herbaceous Cover): Alfalfa, common lilac, Kentucky bluegrass, willow, daylilies, and chestnut.

Recommendations: This wetland is currently functioning as a piece of foraging habitat for piscivorous (fish-eating) bird species, and songbirds which use the shrubby wetland margin for perching, nesting and foraging. The habitat value of this pond for birds could be increased by extending the area of the margin of shrubs around the ponds. Simply stopping mowing in some areas, and selectively weeding around naturally regenerating shrubs could facilitate this process. Alternatively, this process could be accelerated by planting native shrub species in desired areas around the margin. Species such as prairie rose, black hawthorn, chokecherry, Saskatoon, and wild red raspberry will provide forage and habitat for birds and children alike! While some would recommend the removal of all non-native species, we are of the opinion that the introduced ornamental species here are unlikely to invade or detract from ecological function, and are rather a worthy addition to the aesthetic and biological diversity of the site. When we visited this wetland, the landowner was concerned about the potential invasive capacity of one of the ornamental willows. If there are lingering concerns, or any new indication of weedy tendencies, then we recommend the removal of this plant and replacement with a suitable native such as pacific willow or Bebb's willow.

The burdock occurring on site does pose a hazard to bats and songbirds which can become fatally entangled in the Velcro-like fruits of this species. Without further soil disturbance this species is unlikely to become more abundant; however, it would be a good idea to treat the infestation that is already there. Burdock can be eradicated by yearly removal of flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a small rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall flowering individuals as the flower from June - August. These individuals are ready to die after flowering,

so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock flowers and you will see the species decrease on the landscape through time.

Site Name/Number	**Sussums Pond/AJ21**
Date	13 July 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	7.2
Soil Texture	Loamy
Moisture Regime	Very Moist
Nutrient Regime	Rich
Wildlife	Deer

Site Description: This small Marsh occurs in a pasture. It is surrounded by a rocky turf. The dominant wetland herbs are common spike-rush, and American speedwell, an introduced geranium called common stork's bill is also abundant around the water. No amphibian larvae were detected during the survey, but this feature in not currently used by amphibians for breeding, it likely could be given some habitat enhancements.

Native Plant Species (37% Herbaceous Cover): Douglas-fir, common spike-rush, American speedwell, common horsetail, black gooseberry,

Exotic Plant Species (21% Herbaceous Cover): Common stork's-bill, curled dock, Kentucky bluegrass, great mullein, Bicknell's geranium, Canada thistle, quackgrass, alfalfa, Loesel's tumble-mustard, pineapple weed.

Recommendations: Prior to grazing, this wetland likely provided habitat for songbirds, mammals, and reptiles, and breeding habitat for amphibians. However, the current use of this water by cattle prevents the establishment of the plant structure, and hydrologic conditions favoured by wildlife species. The restoration of valuable habitat in this pasture could be as simple as temporarily fencing this area for part of the year and allowing a layer of native shrubs to regenerate. There are many strategies to restore wildlife habitat within pastures while maintaining the use of water and forage for livestock.

Site Name/Number	**Cook's Pond/AJ22**
Date	6 July 16
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2

pH	8.2
Soil Texture	Sandy
Moisture Regime	Very Wet
Nutrient Regime	Rich
Wildlife	Hawks, bears and deer.

Site Description: Small pond just above Cook's road. Most of the shoreline is covered by a well-developed shrub layer, but the roadside is mowed and hosts an assemblage of introduced agronomic species. No amphibians were detected here perhaps due to a lack of thin-stemmed emergent plant species, which are microsites for amphibian eggs.

Native Plant Species (0% Herbaceous Cover): poison ivy, thimbleberry, red raspberry, choke cherry, trembling aspen, balsam poplar, red-osier dogwood, yarrow, Douglas maple

Exotic Plant Species (25% Herbaceous Cover): Alfalfa, great burdock, common timothy.

Recommendations: This site should be re-monitored for amphibians. It could be used by pacific tree frogs and long-toed salamanders for spring breeding. Most of the east bank above the pond is a mowed embankment along the road. Between this mowed area and the waterline there are no tall shrubs, only agronomic species such as timothy and white sweet clover. This area of the shoreline should be planted with native shrubs to buffer this small pond from dust and runoff from the road. The burdock on this site should could also be controlled if time permits. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like "burs". Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots, or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil

Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	**Lillooet Secondary School Spring/AJ23**
Date	14 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Wildlife	Crows, woodpecker, Steller's jays, chickadees, and other songbirds. Black bear.

Site Description: A spring which originates above Lillooet Secondary school. Aside from the common cattail growing where the water sits in the ditch, there are no obligate wetland plant species on this site, and the species composition differs very little from the surrounding forest. The residential development below this site has modified the natural flow pattern of this spring.

Native Plant Species: Common cattail, common snowberry, prairie rose, balsam poplar, tall Oregon-grape, red-osier dogwood,

Exotic Plant Species: Kentucky bluegrass, great burdock.

Recommendations: A buffer around this spring should be protected from any future residential development or timber harvest.

Site Name/Number	Lillooet Secondary School Spring/AJ24
Date	14 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	8.5
Wildlife	Songbirds. Black bears.

Site Description: A spring which originates above Lillooet Secondary school.

Native Plant Species: Western mountain-ash, tall Oregon-grape, white clematis, paper birch, Douglas maple.

Exotic Plant Species: Great burdock

Recommendations: A buffer around this spring should be protected from any future residential development or timber harvest.

Site Name/Number	**Hospital Wetland/AJ25**
Date	14 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	8.5
Wildlife	Bear, deer.

Site Description: A spring originating in the forest near the hospital. No obligate wetland plant species were observed on this site. This leads us to believe that the extent of surface water at this site is limited to the channel, which quickly drains downslope.

Native Plant Species: Poison ivy, Canada goldenrod, red raspberry, prairie rose, balsam poplar, common horsetail, red-osier dogwood, mountain alder, Douglas maple.

Exotic Plant Species: Catnip, alfalfa, great burdock.

Recommendations: A buffer around this spring should be protected from any future residential development or timber harvest.

Site Name/Number	**Leslie Place/AJ26**
Date	14 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Wildlife	Black bear, deer, chickadee, flicker, crows. Steller's Jay.

Site Description: A spring originating in just below Mountainview Road. No obligate wetland plant species were observed on this site. This leads us to believe that the extent of surface water at this site is limited to the channel, which quickly drains downslope.

Native Plant Species: Poison ivy, common snowberry, prairie rose, trembling aspen, balsam poplar, red-osier dogwood, saskatoon, mountain alder, Douglas maple.

Exotic Plant Species: Great burdock

Recommendations: A buffer around this spring should be protected from any future residential development.

Site Name/Number	**Bear Bath/AJ29**
Date	15 July 2016
Classification	Swamp
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	Less than 400 m^2
pH	7.6
Soil Texture	Silty
Moisture Regime	Wet
Wildlife	Well-worn trail right through site. Possible use as a bear bath.

Site Description: A spring-fed Swamp on the slope above Phair Lake (AJ18). The forest canopy here is dominated by mature Douglas Fir, and the understory is dominated by paper birch. Devil's club is abundant in the shrub layer, and scouring rush dominates the herb layer. A well-worn wildlife trail dissects the site. No amphibian larvae were observed in the pond in this Swamp. The rest of this slope is covered in mature timber.

Native Plant Species (99% Herbaceous Cover): American speedwell, western red-cedar, northern gooseberry, pink wintergreen, Douglas-fir, Engelmann spruce, devil's club, false Solomon's-seal, scouring-rush, purple-leaved willowherb, red-osier dogwood, paper birch, baneberry, Douglas maple

Exotic Plant Species (1% Herbaceous Cover): Wall-lettuce.

Recommendations: This site is likely an important watering hole for wildlife on an otherwise dry slope. A better understanding of wildlife usage at this site could be developed by using wildlife cameras to monitor the area. This whole slope above Phair lake should be preserved from timber cutting in order to protect the function of this wetland, and the visual quality of the landscape around this beautiful little lake.

Site Name/Number	**Downton Ponds/AJ30**
Date	18 July 2016
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	2585 m^2
pH	7.7
Soil Texture	Sandy
Moisture Regime	Very Wet
Nutrient Regime	Rich/Very Rich
Wildlife	Garter snake, long-toed salamander

Site Description: Located at the base of Downton Creek FSR, just off highway 99 south of Lillooet, the Downton Ponds are seasonally occurring accumulations of water in depressions in an abandoned gravel pit. There is a road that separates the two ponds, which are situated in the midst of a network of ad-hoc roads and trails used by summer and winter recreationalists namely hunters, campers, ATV users, and cross-country skiers. The source of water in the ponds appears to be groundwater seepage, and there was evidence in the plant species composition that the water levels fluctuate drastically from flooding in the spring to a drawdown in the fall. Though the site is dominated by introduced agronomic species, there is only low cover of aggressive invasive weeds and high cover of native trees and shrubs in the surrounding uplands. Overall plant cover on the wetted portions of this site is very low with a

high cover of bare ground. This could be a result of intermittent flooding, or a lack of organic matter in the soil, or both. During the survey of this site on July 18, 2016, long-toed salamander larvae were observed in both ponds. However during a revisit on August 20 the larvae had not yet matured and were confined to one small (4 m2) puddle in the north pond. This site occurs within a Spotted Owl Provincial Wildlife Habitat Area.

Native Plant Species (7% Herbaceous Cover): Willow, red raspberry, Douglas-fir, balsam poplar, jointed rush, scouring-rush, common horsetail, purple-leaved willowherb, green alder, crepis, bentgrass.

Exotic Plant Species (6% Herbaceous Cover): Canada bluegrass, white sweet-clover, black medic, oxeye daisy, redtop.

Recommendations: When the mineral tenure holder of this site is ready to begin reclamation, this site should be maintained as a wetland habitat rather than backfilled and converted to an upland ecosystem. Further excavation and site contouring could shape the depression in such a way as to extend the hydro-period and seasonal coverage of open water to increase the capacity of this wetland as breeding habitat for long-toed salamanders and other amphibians. The spoils from this excavation will be applied to peripheral areas of the site in order to provide adequate substrate for the planting and establishment of native trees and shrubs. The goal of planting native trees and shrubs in adjacent areas is to speed the recovery of degraded parts of this site to a mature forest structure suitable for Spotted Owls, and other wildlife. In order to ensure the integrity of these improvements, the road through the site should be deactivated through the placement of large rocks and coarse woody debris.

Site Name/Number	Lillooet Secondary School Spring/AJ32
Date	16 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Wildlife	Chickadee

Site Description: A spring which originates above Lillooet Secondary school. Aside from the common cattail and common spike-rush growing where the water sits in the ditch, there are no obligate wetland plant species on this site, and the species composition differs very little from the surrounding forest. The road below this site has modified the natural flow pattern of this spring.

Native Plant Species: Common cattail, Canada goldenrod, red raspberry, prairie rose, trembling aspen, balsam poplar, common spike-rush, red-osier dogwood, sedge, mountain alder, Douglas maple.

Exotic Plant Species: Quackgrass, great burdock.

Recommendations: A buffer around this spring should be protected from any future residential development or timber harvest.

Site Name/Number	Red Rock Spring/AJ34
Date	22 July 2016
Classification	Springs
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Wildlife	Game trails all around site.

Site Description: A small draw on the hillside, not far from the Red Rock hiking trail. We were directed here by a community member who remembers a pond in the area from years ago. We did not find the pond, or any associated springs at this location.

Native Plant Species: Common snowberry, Canada goldenrod, bluebunch wheatgrass, Douglas-fir, ponderosa pine, tall Oregon-grape, red-osier dogwood, saskatoon, Douglas maple.

Exotic Plant Species: Yellow salsify.

Recommendations: Perhaps there is localized flooding at this site in some years, and at the very least, the cool shade of the bottom of the draw could provide refuge for adult amphibians during the hottest days of summer. This small riparian feature should be protected if any timber harvest activity were too occur on this slope.

Site Name/Number	Spiritual Center Wetland/AJ35
Date	14 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	7.6
Wildlife	Bear, songbirds, deer.

Site Description: A spring originating near the spiritual center in T'it'q'et. No obligate wetland species were observed on the site.

Native Plant Species: Western snowberry, Red-osier dogwood, soopolallie, prairie rose, Douglas-fir, choke cherry, balsam poplar, white clematis, Douglas maple.

Recommendations: A buffer around this spring should be protected from any future residential development or timber harvest.

Site Name/Number	**Top of Duffy/AJ36**
Date	22 July 2016
Classification	Marsh
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	10956 m^2
pH	7.5
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Rich
Wildlife	Long-toed salamanders.

Site Description: A relatively large Marsh occurring in the floodplain of Cayoosh Creek just beyond the southern extent of our study area. The soil on this site comprises alternating layers of peat and mineral matter, indicating a cycle of flooding of Cayoosh Creek. Though the soil and vegetation characteristics of this site led to its classification as a Marsh, this wetland had some characteristics of a fen. For example, the higher representation of peat in the soil profile, and the higher than average cover of mosses and sedges. Long-toed salamander larvae were observed during the amphibian survey.

Native Plant Species (50% Herbaceous Cover): Western red-cedar, Bebb's willow, black gooseberry, fowl bluegrass, slender rein orchid, Engelmann spruce, Canadian butterweed, black twinberry, dagger-leaf rush, bitter fleabane, scouring-rush, common horsetail, purple-

leaved willowherb, fireweed, hairy wildrye, red-osier dogwood, *cerastium* sp., *carex* sp., beaked sedge, Sitka sedge, giant spearmoss, bluejoint reedgrass, water birch.

Exotic Plant Species (4% Herbaceous Cover): Kentucky bluegrass, common timothy, common dandelion, wall lettuce, bull thistle.

Recommendations: This site should be protected from any disturbance which would impair its natural cycle of flooding, and the unique plant community that it creates. Any future transmission lines, or other ROW's should avoid this part of the Cayoosh creek floodplain in order to leave this site intact. Any roadwork along highway 99 should strictly adhere to an environmental protection plan that outlines measures to prevent sedimentation, excavation, or filling of any part of this wetland.

Site Name/Number	**Bill Machel's Place/CB1**
Date	27 June 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	6236 m^2
pH	8.3
Soil Texture	Silty Clay Loam
Moisture Regime	Wet
Nutrient Regime	Very Rich

Site Description: A Marsh which originates from a spring above T'it'q'et. Large portions of this wetland area dominated by aggressive exotic species such as quackgrass, Kentucky bluegrass, alfalfa, and burdock. The east side of the site has a pond, which occurs near the springs under thick cover of trembling aspen, and red-osier dogwood.

Native Plant Species (64% Herbaceous Cover): Common cattail, Canada goldenrod, willow, choke cherry, trembling aspen, common horsetail, red-osier dogwood, Douglas' water-hemlock.

Exotic Plant Species (36% Herbaceous Cover): Yellow salsify, curled dock, Kentucky bluegrass, alfalfa, quackgrass, cheatgrass, great burdock, wheatgrass.

Recommendations: This site was not surveyed for amphibians in 2016. In 2017 this site should be re-surveyed for the presence of breeding amphibians. This site should be reviewed by a herpetologist to determine its potential suitability as amphibian habitat. If the water here is of sufficient temperature and permanence, this site could be enhanced for amphibians. A pond could be excavated in some of the weedier areas of the site in order to replace exotic species cover with standing water for the benefit of breeding amphibians.

Site Name/Number	**Gord's Pond/CB12**
Date	8 July 2016
Classification	Swamp
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	Less than 400 m^2
pH	7.7
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Very Rich
Wildlife	Moose, Black bear.

Site Description: A small Swampy area on a Low bench above Fraser River. Aside from an unknown sedge species observed on site, there were no obligate wetland plant species on this site. The source of water on this site is groundwater, and gleying in the soil indicates that flooding persists on this site for extended periods. No amphibian larvae were detected on this site.

Native Plant Species (72% Herbaceous Cover): Common snowberry, willow, prairie rose, Douglas-fir, balsam poplar, scouring-rush, common horsetail, slender wheatgrass, red-osier dogwood, white clematis, sedge, water birch, Douglas maple.

Exotic Plant Species (1% Herbaceous Cover): Kentucky bluegrass, wall-lettuce, great burdock.

Recommendations: This piece of low elevation moose habitat in the Fraser valley should be protected from timber cutting, and overuse by cattle. This site should be resurveyed for amphibian larvae in the future. The fact that none were detected could have been because of the relatively late date of the survey. In order to prevent the spread of burdock by passing wildlife, the burdock on this site could be treated. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar velcro-like “burs”. Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	Jorgeson Fork/CB15
Date	26 July 2016
Classification	Swamp
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	2238 m^2
pH	8.1
Soil Texture	Silty
Moisture Regime	Very Moist
Nutrient Regime	Rich
Wildlife	Songbirds

Site Description: A Swamp occurring between the fork of Jorgenson road. There was no standing water at the time of survey. The plant community here is of a distinctly riparian nature, with mature cottonwood and trembling aspen in the canopy, and a thick shrub layer dominated by prairie rose, and red-osier dogwood. The native hydrology of this site is altered by the presence of the road. Invasive species of concern on this site are Canada thistle, and great burdock. The area is surrounded by agronomic pasture grasses.

Native Plant Species (96% Herbaceous Cover): Poison ivy, common snowberry, red raspberry, prairie rose, trembling aspen, balsam poplar, scouring-rush, common horsetail, black hawthorn, red-osier dogwood, bluejoint reedgrass.

Exotic Plant Species (11% Herbaceous Cover): Curled dock, Canada thistle, great burdock, common plantain, pineapple weed.

Recommendations: The forested area of this wetland could be increased by allowing regenerating shrubs to continue to mature in the pasture areas adjacent to this wetland.

Site Name/Number	Aspen Planers North/CB16
Date	27 July 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	8.4
Soil Texture	Clayey
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Songbirds.

Site Description: A very small Marsh occurring in the Aspen Planers yard, at the base of the slope below T'it'q'et. Though there was some standing water, no amphibians were observed during the survey.

Native Plant Species (31% Herbaceous Cover): Saskatoon, red-osier dogwood, common horsetail, prairie rose, poison ivy, common cattail.

Exotic Plant Species (Distribution - Single occurrence): Cheatgrass.

Recommendations: Prior to its current industrial tenure, this whole northern bank floodplain of the Seton River below T'it'q'et was a complex of ox-bows and backchannels associated with the Seton River. In addition to the well-known fish and wildlife values associated with such riparian areas, this zone may have been a substantial source of amphibian breeding habitat. The small

spring from the slope above this site could provide water for a small project to restore amphibian habitat in the Seton corridor. If Aspen Planers is willing to reclaim some of the area in their yard, the area of this small Marsh could be expanded, and a deeper more permanent pond could be dug.

Site Name/Number	**Aspen Planers South/CB17**
Date	27 July 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	8.3
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Songbirds

Site Description: A small springs draining into the Aspen Planers yard from the slope up to T'it'q'et. There was no standing water, and the water that was present was draining along through a small channel. This water is quickly moved off the landscape through a culvert.

Native Plant Species (5% Herbaceous Cover): Big sagebrush, red-osier dogwood, wildrye, common horsetail, balsam poplar, balsam poplar, prairie rose, Canada goldenrod, poison ivy.

Exotic Plant Species (Distribution - Several sporadically occurring individuals): Alfalfa, yellow salsify.

Recommendations: The culvert draining this spring has altered the natural hydrology, and precludes the possibility of wetland development at the base of this slope. If water were allowed to collect in this area, we could see the development of a wetland plant community with its attendant wildlife habitat values, and ecosystem functions.

Site Name/Number	Cayoosh Campground/CB2
Date	27 June 2016
Classification	Low bench
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	2935 m^2
pH	No open water.
Soil Texture	Sandy
Moisture Regime	Moist

Site Description: A Fraser River Low bench wetland occurring in the Lillooet campground. The herbaceous layer is dominated by scouring rush, which is typical of floodplains and Swamps, and there is cover of agronomic grasses in drier parts of the site. Because this wetland occurs within the Fraser River floodplain, it is still subject to its native disturbance regime of periodic flooding. This flooding favors the composition of a certain plant community by regulating soil moisture and nutrient regimes.

Native Plant Species (56% Herbaceous Cover): Mountain alder, red-osier dogwood, scouring-rush, showy aster, balsam poplar, balsam poplar, prickly rose, narrow-leaf willow.

Exotic Plant Species (10% Herbaceous Cover): Russian olive, alfalfa, Kentucky bluegrass, smooth brome.

Recommendations: Because this wetland occurs within the Fraser River floodplain, it is unlikely that development will pose a threat. However, any other disturbance to the site, including tree cutting, and ATV use, should be discouraged in order to preserve the wildlife value of this remaining urban fragment of riparian forest.

Site Name/Number	Station Hill/CB25
Date	12 September 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	3331 m^2
pH	8.5
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Rich

Site Description: This small Marsh occurs where a spring pools on a private lot at the base of Station hill. There is one small Marsh dominated by common cattail, which is drained off the property and eastward into the Fraser River by a small slowly flowing channel dominated by yellowcress. The wetted area on this site is extensive, and the flow rate of the water is steady. No amphibians were observed in this wetland, but the survey was conducted late in the season.

Native Plant Species (81% Herbaceous Cover): Common horsetail, balsam poplar, Marsh yellowcress, Canada goldenrod, common cattail.

Exotic Plant Species (>1% Herbaceous Cover): Great burdock, smooth brome, bull thistle, quackgrass, alfalfa, Kentucky bluegrass, curled dock, white willow, European bittersweet.

Recommendations: The inflow into this site could be used to maintain a pond to provide amphibian breeding habitat. This habitat enhancement could be created by excavating an area along the toe of the slope beside the road.

Site Name/Number	**Cayoosh Elementary/CB9**
Date	29 June 2016
Classification	Marsh
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2
Moisture Regime	Moist

Site Description: A small Marsh created in the schoolyard at Cayoosh Elementary. A depression has been excavated and lined, and wetland grasses, shrubs and trees have been planted. The edges of the wetland transition sharply to a mowed turf. There was no standing water at the time of survey. The source of water at this wetland is likely from excess water from the irrigation system which may be periodically used to fill the pond. The development of shrubs and trees around this wetland has been good, and now there is a diversity of woody structure all around the wetland edge. Likewise the wettest areas of the depression are dominated by native wetland grasses and bulrushes.

Native Plant Species (9% Herbaceous Cover): Bluejoint reedgrass, red-osier dogwood, common horsetail, reed canarygrass, balsam poplar, prairie rose, willow, bulrush.

Exotic Plant Species (Distribution - A single patch): Alfalfa.

Recommendations: Continue to naturalize the area around this wetland. Currently the margin between wetland and field is sharp. A more natural riparian buffer would improve the habitat conditions within this wetland and increase the local usage by songbirds. A more natural buffer between the school field and the wetland could be achieved by planting several rows of ponderosa pines around the perimeter of the ponds. Not only will the trees improve the habitat value of the pond, but they will also increase the quality of this space for children.

The water source and storage capacity of this wetland needs to be better understood. If the supply of water could be managed in such a way as to provide flooding throughout the spring and early summer, then this small pond could be used by breeding amphibians. Of course the flooding of this pond could also pose a hazard to children who play in the area, and so the any ecological enhancements on the site must be balanced with the need for safety.

Site Name/Number	Armit Brook/IA1
Date	29 June 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	8
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Golden eagle nest above on hillside.

Site Description: A small spring fed ravine above Purvis road. The water flows through this site in a generally channelized manner without pooling appreciably in any location. The canopy here is dominated by green alder and water birch, with a minor component of wester red-cedar, and Douglas fir. No exotic plant species were detected within the plot at this location. Like many other sites in the area, the herbaceous layer is dominated by scouring rush.

Native Plant Species (23% Herbaceous Cover): Douglas maple, baneberry, green alder, water birch, red-osier dogwood, common horsetail, scouring-rush, wild lily-of-the-valley, Douglas-fir, black gooseberry, thimbleberry, common snowberry, western red-cedar.

Recommendations: The riparian area around these springs should be protected from any residential development or timber cutting. The riparian trees and shrubs around this water source provide not only bank stability, but also habitat for wildlife. The moist, cool microclimate provided by this feature provides excellent foraging habitat for amphibians, within an otherwise dry and hot hillside.

Site Name/Number	**Lower Spawning Channel Marsh/IA12**
Date	12 Oct 2016
Classification	Marsh
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2
pH	8.6
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Rich
Wildlife	Beaver, Heron, Bear, songbirds, peregrine falcons, river otter, salmonids.

Site Description: This shallow area within the lower Seton River spawning channels hosts a variety of wetland shrubs and emergent aquatic forbs. Though the spawning channels themselves would not be strictly classified as a wetland, the shallow edges of these features host a wetland plant community in some areas. This plot was meant to capture the composition and structure of this plant community.

Native Plant Species (19% Herbaceous Cover): Saskatoon, water birch, slender sedge, woolly sedge, beaked sedge, Douglas' water-hemlock, red-osier dogwood, common spike-rush, purple-leaved willowherb, common horsetail, scouring-rush, water smartweed, balsam poplar, prairie rose, narrow-leaf willow, soft-stemmed bulrush, Canada goldenrod, western snowberry.

Exotic Plant Species (3% Herbaceous Cover): Canada bluegrass, curled dock, white clover.

Recommendations: The spontaneous regeneration of wetland plant communities along channel margins was not the intention of the creation of these features. We do not recommend any particular management with regards to these wetland plant communities, but rather we wish to draw attention to this case of natural wetland regeneration. The species growing here are disturbance-adapted, and early-successional species that could be suitable for the restoration of similar wetland features within this area. We recommend further efforts to document the composition of these plant communities, insofar as they can be used to model local wetland restoration prescriptions.

Site Name/Number	**Wet Ditch/IA13**
Date	13 Oct 2016
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2
pH	7.6
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Songbirds

Site Description: A very small pond in a ditch. It occurs above a road where a culvert is damaged and does not fully drain a small depression. Herbaceous growth is supressed under fully grown shrub and tree layers. No amphibian larvae were detected at this site, which is almost certainly the result of the late time of survey

Native Plant Species (0% Herbaceous Cover): Douglas maple, mountain alder, paper birch, mock-orange, Douglas-fir, prairie rose, red raspberry, willow, western snowberry.

Exotic Plant Species (1% Herbaceous Cover): Great burdock.

Recommendations: It is difficult to make recommendations for such small features that could be easily erased by seemingly inconsequential road maintenance activities - such as repairing

the culvert. If this site does in fact support breeding amphibians, then we would recommend preserving this pond for their benefit.

Site Name/Number	**Wayne's Swamp/IA14**
Date	13 October 2016
Classification	Swamp
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	48623 m^2
pH	7.5
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Wildlife trail through site.

Site Description: A large hillside Swamp dominated by scouring rush, mountain alder and red-osier dogwood. The water source appears to be from a series of springs which keep the entire area quite moist. There was no standing water at the time of survey, and a there were a few small channels where water drainage was concentrated. The shrub layer here was thick and vigorous. There was little evidence of human use on site, but several trails betrayed the frequent presence of wildlife.

Native Plant Species (60% Herbaceous Cover): Mountain alder, lady fern, water birch, paper birch, red-osier dogwood, common horsetail, scouring-rush, devil's club, slender rein orchid, black gooseberry, prairie rose, thimbleberry, Sitka mountain-ash, western snowberry.

Exotic Plant Species (<1% Herbaceous Cover): Great burdock.

Recommendations: In the dry context of this region, this site is likely an important watering hole for wildlife. It is also an excellent piece of foraging habitat for amphibians. Given the wetness of the slope it would be foolish to cut any timber here, as doing so would likely compromise slope stability. Mature timber was noted around the site, and we recommend that this buffer of large firs be protected along with the entirety of these springs. This would be an interesting site to deploy wildlife cameras. Since this site is likely utilized by deer, bear, and other large furry mammals, we recommend the removal of the burdock to prevent the spread of this problematic invasive plant. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like "burs". Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots, or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	**Lillooet Secondary School Field/IA2**
Date	29 June 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	455 m^2
pH	7.3
Soil Texture	Clayey
Moisture Regime	Wet
Wildlife	Hibernaculum noted nearby by neighbour. Juvenile snake spotted.

Site Description: This site is located on a small contoured slope along the west margin of the Lillooet Secondary School football field. This wet area occurs as a result of continuous seepage from a spring originating on a forested area upslope. The mineral soil in the wetted area is rich in organic matter and supports a plant community with a reasonable diversity of native graminoids and forbs, though the dominant species are introduced turf grasses. Despite occurring within an urban context, this site is adjacent to forested areas upslope which connect to the Town Creek drainage. The potential for this site to support breeding amphibians is increased through this connection to upland foraging and dispersal habitat.

Native Plant Species (29% Herbaceous Cover): *Bromus* sp., *Carex* sp., common horsetail, *Juncus* sp., Canada goldenrod, common cattail.

Exotic Plant Species (69% Herbaceous Cover): Canada thistle, quackgrass, black medic, alfalfa, common plantain, Kentucky bluegrass, common dandelion, white clover, redtop.

Recommendations: We recommend an active approach to restoration and enhancement at this site. Some minor earthwork could turn the lower portion of the wet area, currently dominated by introduced turf grasses, into a shallow pond suitable for amphibian reproduction. By excavating and lining a small area in this part of the field, the runoff from the hill can be managed and directed towards productive wetland functions, rather than simply flooding a part of the turf of the sports field. The wet areas upslope and adjacent to the created pond should be naturalized through the reintroduction of native shrubs and trees. In addition to providing appropriately connected bird, reptile, and amphibian habitat, this wetland enhancement could create a living laboratory for the students of Lillooet Secondary School.

Site Name/Number	**Galliazzo Pond/IA3**
Date	30 June 2016
Classification	Marsh
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2
pH	7.6
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Very Rich
Wildlife	Garter snakes, bats, and many songbird/migratory bird species recorded by owner.

Site Description: A beautiful garden pond fed by a spring. In addition to native wetland plants such as red-osier dogwood, and cattail, this site is also stocked with several ornamental plant species. There is a small pond among the cattails, which is frequented by amphibians and garter snakes. The homeowner here has noted many bird species using this pond, including several migratory and non-resident species.

Native Plant Species (80% Herbaceous Cover): Douglas maple, water birch, Douglas' water-hemlock, red-osier dogwood, common horsetail, common duckweed, red raspberry, Canada goldenrod, common cattail.

Exotic Plant Species (17% Herbaceous Cover): Great burdock, quackgrass, Kentucky bluegrass, curled dock, European bittersweet, great mullein.

Recommendations: This is a fantastic little piece of wildlife habitat right in the heart of Lillooet. In general this site seems to be well loved by humans, birds, reptiles and amphibians alike. In order to protect the ecological integrity of this wetland plant community and the wildlife that use it, we have a few general suggestions:

1. To prevent the spread of any potentially aggressive garden species, we recommend that these plants should be annually cut back after flowering. Likewise, care should be taken not to excavate and spread the roots of any species which are known to propagate aggressively by rhizomes.

2. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like “burs”. Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots, or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	Campground Ponds/IA40
Date	12 September 2016
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	1424
pH	8.3
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Very Rich
Wildlife	Beaver lodge. The ponds were built as juvenile salmonid rearing habitat.

Site Description: This series of ponds is located west of the BC Hydro Campground off highway 99 south. They were originally created as off channel habitat for juvenile salmonids on Cayoosh Creek. The ponds are located just off a well-used utility road connecting the campgrounds and the Cayoosh Creek generating station. The cover of invasive weeds around the ponds is high, with several noxious species present including two knapweeds, and Dalmatian toadflax. For the purpose of characterizing the vegetation community on this site, we delineated the plot as those areas of vegetation immediately adjacent to the water. Even so,

the species composition on this site is dominated by upland species, with only a few obligate wetland species in low abundances. Many ponds gradate from open water to Marsh along the edges, but not so here. The transition to upland occurs abruptly. Riparian woods and cottonwoods are regenerating along the shore and appear to be healthy. However, the regeneration of these shrubs may be threatened by a resident beaver which has built its lodge in one of the ponds. It appears that at some point these regenerating shrubs were caged to protect them from beaver damage, but at the moment the cages are strewn about and not in place around the shrubs.

Native Plant Species: Northern wormwood, water birch, awned sedge, red-osier dogwood, silverberry, purple-leaved willowherb, common horsetail, dagger-leaf rush, reed canarygrass, mock-orange, balsam poplar, Douglas-fir, prairie rose, red raspberry, narrow-leaf willow, willow, soopolallie, Canada goldenrod, western snowberry.

Exotic Plant Species: Redtop, cheatgrass, diffuse knapweed, spotted knapweed, orchard-grass, quackgrass, Dalmatian toadflax, alfalfa, yellow sweet-clover, Kentucky bluegrass, great mullein.

Recommendations: The establishment of a riparian shrub layer would be enhanced if the regenerating shrubs were still protected by beaver damage. The cages are already on site, and just need to be replaced around the shrubs. Further invasive species management should occur here also. In particular the knapweeds should be removed as these species are known to strongly inhibit the growth of native species, particularly bunchgrasses. Future efforts to create off channel habitat should consider the option of creating more complex contours. Rather than digging ponds that slope quickly to a homogenous depth, future off channel habitat could be developed as a complex of permanent ponds and seasonally inundated shallow Marsh areas. This variety of structure would increase habitat diversity for both fish and wildlife species. Another potential benefit of this strategy would be decreased restoration costs. While there is an abundant seedbank of many nasty upland invasive plant species in our region, on the other hand there are many examples of passively restored Marshes which are relatively free from exotic plant invasion. By creating the hydrological conditions for passive restoration we may be able to save ourselves the cost of planting, weeding, and watering upland plant communities.

Site Name/Number	**Brigman Pond/IA7**
Date	6 July 2016
Classification	Unclassified
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	Less than 400 m^2
pH	8.4
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Hyper
Wildlife	Great blue heron.

Site Description: A small pond on a suburban parcel off Texas Creek road. The source of water here is spring water, and the temperature of the pond was low (11°C) at the time of survey. No amphibian larvae were observed during the survey. Vegetation cover around the pond was full and vigorous. Mature shrubs covered several areas around the shoreline, particularly where the spring water comes in. Exotic grasses such as Kentucky bluegrass and quackgrass formed the dominant groundcover around the pond.

Native Plant Species (41% Herbaceous Cover): Spreading dogbane, red-osier dogwood, common horsetail, scouring-rush, reed canarygrass, balsam poplar, trembling aspen, prairie rose, red raspberry, willow, willow, American vetch.

Exotic Plant Species (6% Herbaceous Cover): Great burdock, quackgrass, black medic, white sweet-clover, common parsnip, common timothy, Kentucky bluegrass, curled dock, night-flowering catchfly, perennial sow-thistle, yellow salsify, white clover.

Recommendations: Of all of the exotic species encountered on this site, burdock poses the greatest threat to wildlife. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like "burs". Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots, or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	Deverell Pond/IA8
Date	6 July 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
Soil Texture	Silty
Moisture Regime	Moist
Wildlife	Grey catbird

Site Description: A small ditch where spring-water pools above McEwen road. At present this wet area is completely obscured from view by several mature box-elder trees which have sprawled throughout the site. Other native woody species such as red-osier dogwood, paper birch, and chokecherry fill out the understory. The development of shrubby species is so profuse that barely any light reaches the ground where only two exotic herbaceous plant species grow at a low abundances. There was no standing water. A gray catbird was present, and sang its varied song throughout the survey.

Native Plant Species (0% Herbaceous Cover): Box-elder, paper birch, red-osier dogwood, choke cherry, prairie rose, poison ivy.

Exotic Plant Species (1% Herbaceous Cover): Lamb's-quarters, prickly lettuce.

Recommendations: The mature box elder, and shrubs on site proved excellent cover for songbirds, amphibians, and small mammals. These trees should be kept intact as a small piece of woodland refuge amidst a developed urban neighbourhood. However, if the owners ever were to remove the trees from this part of their property, this area could be contoured into a small pond which might be suitable for breeding amphibians.

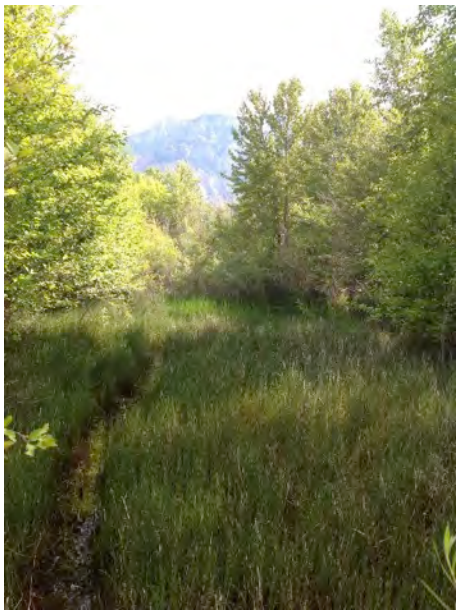
Site Name/Number	**Enterprise/S1A**
Date	16 Jun 2016
Classification	Marsh
Category	3 - Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.
Area	1085 m^2
pH	7.3
Soil Texture	Loamy
Moisture Regime	Very Wet
Nutrient Regime	Rich

Site Description: A large pond off Highway 99 south. Seemingly an excavation left behind from some past road-building or mining activity, this large pond now sits at the toe of a large embankment leading up to the highway. The fringes of this pond host a well-developed matt of cattails. No amphibian survey was conducted here in 2016, but both long-toed salamanders and pacific chorus frogs were recorded here during the 2013 amphibian survey.

Native Plant Species (70% Herbaceous Cover): Marsh bedstraw, common cattail.

Recommendations: Because this site is known to support breeding long-toed salamanders and pacific tree frogs, it should be protected from dumping, filling, or any other deleterious activity. The areas peripheral to the ponds were not surveyed in 2016, but they should be

looked at in future years. The fringes of this pond could be planted with native shrubs to increase cover for wildlife, and foraging habitat for adult amphibians.



Site Name/Number	**Off-Channel 3/S2**
Date	6 June 2016
Classification	Low bench
Category	1 - Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Area	3471 m^2
pH	7.7
Soil Texture	Silty
Moisture Regime	Very Wet
Nutrient Regime	Medium
Wildlife	Garter snake, pacific tree frog, long-toed salamander, beaver

Site Description: A flooded back-channel on the south side of the Seton River, across from the access road to Aspen Planers. Exotic plant species were absent from this site, and the dominant cover here was scouring rush, with a fringe of alders and willows along the shoreline. Both long-toed salamanders and pacific tree frogs were observed during the amphibian survey. A beaver trail transects the site. One the one side of the channel there is a smooth gradation to

upland on the island, and on the other side there is a steep rip-rap embankment to the upper bench outside of the floodplain. The rip rap embankment is covered by mature cottonwoods. The flooding on site results from the groundwater seepage, and occasional back-flooding from the Seton River.

Native Plant Species (61% Herbaceous Cover): Mountain alder, scouring-rush, balsam poplar, narrow-leaf willow, willow, soft-stemmed bulrush.

Recommendations: This piece of amphibian breeding habitat should be protected. The main threat to the viability of amphibian habitat here is from flooding on the Seton River. Increased releases from the Seton dam have the potential to fully connect this backchannel with the Seton River. Though this channel may sometimes receive back-flooding from the Seton River, the general separation from this larger system provides refuge for amphibian larvae, which are generally absent from fish-bearing waters. As BC Hydro works through the Water Use Planning process and determines the annual schedule of releases, due consideration should be paid to the backchannels along this system which provide important habitat for breeding amphibians.

Site Name/Number	Off-Channel 5/S3
Date	21 June 2016
Classification	Low bench
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	924 m^2
pH	8
Soil Texture	Silty Clay Loam
Moisture Regime	Very Wet
Nutrient Regime	Medium/Rich
Wildlife	Beaver

Site Description: A flooded back-channel on the south side of the Seton River, across from the access road to Aspen Planers. The flooding on site results from the groundwater seepage, and occasional back-flooding from the Seton River. The site occurs under cover of mature cottonwood, with a shrub layer dominated by mountain alder. Though dominated by scouring rush, this site had a more diverse herbaceous community with several sedges and grasses present as well. The standing water on this site is limited to the small puddle in the photo above, and so no amphibian survey was conducted here in 2016. Likewise, no amphibian survey took place here in 2013.

Native Plant Species (28% Herbaceous Cover): Mountain alder, saskatoon, woolly sedge, Douglas' water-hemlock, red-osier dogwood, Canada wildrye, common horsetail, scouring-rush, tall Oregon-grape, fowl bluegrass, balsam poplar, Douglas-fir, prickly rose, western red-cedar, common cattail.

Exotic Plant Species (16% Herbaceous Cover): Kentucky bluegrass, curled dock.

Recommendations: Water use planning on the Lower Seton River should take into account the behaviour of backchannels like this one during flood events. This area could function as amphibian breeding habitat during years of flooding, or could become off channel refuge for salmonids if it were permanently connected to the Seton River.

Site Name/Number	Off-Channel 7/S4
Date	21 June 2016
Classification	Low bench
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	809 m^2
pH	7.8
Soil Texture	Sandy
Moisture Regime	Wet
Nutrient Regime	Rich/Very Rich
Wildlife	Beaver

Site Description: A backchannel on the lower Seton River North of the lower spawning channels. The channel was mostly without standing water, and no amphibian survey was conducted. However, long-toed salamander larvae were observed here during the 2013 amphibian survey. The site has a canopy of cottonwood and mountain alder with high cover of mountain alder in the tall shrub layer as well. As is typical of Low bench wetlands in the area, the dominant herbaceous species is scouring rush; however, the cover of this species and other

herbaceous species was low throughout the site, with a higher cover of litter and bare ground instead. No exotic plant species were observed on site.

Native Plant Species (20% Herbaceous Cover): Douglas maple, mountain alder, mountain alder, saskatoon, swollen beaked sedge, red-osier dogwood, scouring-rush, tall Oregon-grape, balsam poplar, prickly rose, thimbleberry, Lindley's aster, western red-cedar.

Recommendations: Water use planning on the Lower Seton River should take into account the behaviour of backchannels like this one during flood events. This area could function as amphibian breeding habitat during years of flooding, or could become off channel refuge for salmonids if it were permanently connected to the Seton River.

Site Name/Number	**Aspen Planers/S5**
Date	21 June 2016
Classification	Low bench
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	1350 m^2
pH	8.2
Moisture Regime	Wet
Nutrient Regime	Very Rich

Site Description: An area of Seton river floodplain just off Highway 99 in the Aspen Planers yard that receives flooding during high water. At the time of survey in 2016 there was no open water, and so no amphibian survey was conducted. No amphibian larvae were detected here during the 2013 amphibian study. This small riparian wetland has likely been disturbed repeatedly during road building, and activities at the nearby mill. The plant community is generally herbaceous, and no shrubs or trees were included in the plot. There was significant cover of exotic weeds, including Canada thistle, an aggressive invasive species.

Native Plant Species (31% Herbaceous Cover): Bluejoint reedgrass, Douglas' water-hemlock, common horsetail, soft-stemmed bulrush, Canada goldenrod, common cattail.

Exotic Plant Species (12% Herbaceous Cover): Cheatgrass, Canada thistle, common watercress, European bittersweet.

Recommendations: This seasonally flooded area could be enhanced for the benefit of breeding amphibians. As the soil surface here is just above the water table, minimal excavation could be used to create ponds suitable for amphibian breeding. However, these ponds would exist within the context of the Seton River and its managed flood regime. So any habitat restoration here should not take place until a predictable flood regime is established on the Seton River. This site should be protected from further disturbance when the nearby bridge over the Seton River is moved. Any further soil disturbance could spread Canada thistle and allow it to become more fully established in the area.

Site Name/Number	Naxwit/S6
Date	24 June 2016
Classification	Swamp
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	7.4
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Wildlife trails, rubs, and bedding areas.

Site Description: A small Swamp near the Naxwit picnic site. This small wet area is sandwiched between highway 99 south and a Hydro transmission line ROW. Though covered by mature trees, the grove around this Swamp has hard edges on both sides, and is no more

than 30 meters at the widest point. The tree layer was dominated by balsam poplar and Douglas fir. Red-osier dogwood and mountain alder were both present in the tall shrub layer, along with black hawthorn. Like many of the Swamps we visited during this survey, the dominant herbaceous species was scouring rush. An amphibian survey was not conducted here in 2016, and no amphibian larvae were observed during the 2013 amphibian surveys.

Native Plant Species (20% Herbaceous Cover): Douglas maple, mountain alder, red-osier dogwood, black hawthorn, scouring-rush, tall Oregon-grape, balsam poplar, Douglas-fir, prickly rose.

Recommendations: Despite pressures to maintain the highway and hydro ROW's on either side of this site, this grove of trees has persisted around this small Swamp. These trees should be protected from cutting to maintain some connectivity for wildlife in this already fragmented landscape.

Site Name/Number	**Lower Spawning Channel Swamp/S7**
Date	24 June 2016
Classification	Swamp
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	Less than 400 m^2
pH	7.5
Soil Texture	Silt Loam
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Beaver, deer, songbirds. Wildlife trees.

Site Description: Another small Swamp in a fragmented grove of trees similar to S6. This site is sandwiched between the access road to the lower spawning channels and highway 99. Similar to S6, the tree layer is dominated by balsam poplar. There is a thick tall shrub layer dominated by red-osier dogwood, and the herbaceous layer is dominated by scouring rush. No amphibian survey was conducted here in 2016, and no amphibian larvae were detected here during the survey in 2013.

Native Plant Species (15% Herbaceous Cover): Douglas maple, red-osier dogwood, common horsetail, scouring-rush, balsam poplar.

Exotic Plant Species (15% Herbaceous Cover): Great burdock, alfalfa, Loesel's tumble-mustard, yellow salsify.

Recommendations: The small grove of trees surrounding this site should be protected from cutting during work on highway 99 and the lower spawning channels. The pools in this Swamp should be re-monitored for amphibian larvae. We also recommend the removal of the giant burdock. Burdock is a hazard to both songbirds and bats which can become fatally entrapped in the familiar Velcro-like “burs”. Without further soil disturbance this species is unlikely to become more abundant; however, it is a good idea to remove the plants that are already there. Burdock can be removed from a site by annually cutting flowering individuals for a period of a few years. Just like garden carrots, or beets, burdock is a biennial species which sprouts and grows into a rosette in the first year before producing seed and dying in the second year. Burdock reproduces only by seed. With this knowledge of burdock biology it is a simple matter to treat areas which are infested. Simply cut down the tall individual plants as they flower from June - August. These individuals are ready to die after flowering, so they will not re-sprout. There is no need to dig the first year rosettes, because their roots are almost impossible to fully extract from our rocky soils, and unlike the second year plants they will re-sprout if any root fragment is left. Even if the first year plants could be successfully removed, the disturbance caused by this process creates ideal conditions for the germination of residual burdock seed in the soil Remove the cut plants and dispose of them in a burn pile or at the waste station so that any seeds which may mature are not spread to other sites. Simply repeat this process each season as the burdock begins to flower, and you will see the species decrease on the landscape through time.

Site Name/Number	Spray Creek Ranch/T1
Date	16 June 2016
Classification	Springs
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
pH	7
Moisture Regime	Moist
Nutrient Regime	Very Rich

Site Description: A series of springs flooding and area of forest above a farmyard and an old orchard. Several of the springs have been diverted for irrigation and/or stock watering. The water pools here and there in small Swampy areas, but in general it moves downslope and off the landscape without significant storage happening at any one location. The survey of this site took place during the training exercise before the start of the 2016 wetland inventory field surveys. As such, these results are only cursory.

Native Plant Species: Douglas maple, mountain alder, mountain alder, lady fern, paper birch, common horsetail, scouring-rush, tall Oregon-grape, northern green rein orchid, balsam poplar, black gooseberry.

Exotic Plant Species: Wall lettuce

Recommendations: This site should be resurveyed in greater detail with more of an emphasis on understanding the opportunities that exist here for wetland enhancement and creation. The old orchard area which these springs flow through is cleared, and there is interest in creating a wetland on this site. Due to its ample hydrology and the enthusiasm of the ranchers managing this landscape, this site should be investigated further for restoration and enhancement potential.

Site Name/Number	**Off-Channel 8/T2**
Date	23 June 2016
Classification	Marsh
Category	2 - Formerly natural ecosystems that are no longer functioning effectively as wetland or riparian habitat; candidate for restoration.
Area	2057 m^2
pH	7.4
Soil Texture	Silty
Moisture Regime	Wet
Nutrient Regime	Very Rich
Wildlife	Deer, Beaver. Salmonids.

Site Description: A Marsh north of the Seton River, near the Aspen Planers yard. The site is flooded with backwater from the Seton River. There were no aquatic plants species which would have indicated that this wetland should be classified as Shallow open water. However, there were several obligate wetland plant species such as mare's tail, soft-stemmed bulrush, and common cattail. The extent of this wetland has likely been diminished by backfilling to create the bench above for the mill-site. As such, the North bank of the wetland is a steep gravel slope where many of the disturbance loving exotic plant species have established. No amphibian larvae were detected here in the 2016, or 2013 surveys, and juvenile salmonids were noted here during the 2016 survey.

Native Plant Species (20% Herbaceous Cover): Mountain alder, *Carex* sp., red-osier dogwood, common horsetail, scouring-rush, common mare's-tail, reed canarygrass, red raspberry, soft-stemmed bulrush, hemlock water-parsnip, Canada goldenrod, common cattail

Exotic Plant Species (3% Herbaceous Cover): Great burdock, cheatgrass, diffuse knapweed, alfalfa, curled dock, Loesel's tumble-mustard, great mullein.

Recommendations: This piece of off-channel salmonid habitat should be protected from further disturbance from the mill. Live stake cuttings of willow, dogwood, and poplar could be planted in the gravel slope to stabilize the bank, compete with the invasive weeds, and provide shade and litter-fall for the pond below.

APPENDIX 2

WETLAND BIRDS OF LILLOOET:

PATTERNS OF DIVERSITY AND OCCURRENCE

By Ken Wright

March 2017

Wetland habitats are vital to a wide array of terrestrial and aquatic organisms worldwide. The availability of water is especially important to many vertebrate taxa including amphibians, fish, reptiles, mammals and birds. The climate-induced increasing variability in hydrological cycles may impact wetlands in negative ways in the Lillooet region. Given the occurrence of several species at risk and overall biodiversity associated with our wetland features, it is important to help reduce anthropological impacts that alter or degrade our wetlands.

Splitrock Environmental has been contracted by the Fish and Wildlife Compensation Program and the National Wetland Conservation Fund to evaluate wetland habitats in the Lillooet region and identify existing constraints and restoration work that could enhance these wetland features.

This report provides a summary of the historical use (approximately 2000-2016) of wetland habitats in the Lillooet area during the breeding season. The bulk of this data is derived from eBird (www.ebird.org, Cornell Lab of Ornithology, Ithaca, New York) and has been primarily contributed by the author and Ian Routley of the Lillooet Naturalist Society (LNS).

METHODS

Candidate wetland species were chosen on the basis of habitat affinity and/or life history traits that link them to using either the aquatic or riparian habitats associated with wetlands in the Lillooet wetland study area (Anderson/North et al. 2016). Degree of dependence on wetlands is variable from species to species and was not factored into this preliminary analysis.
species selection criteria.

The primary source of data source is eBird records (www.ebird.ca) using the species map function. That data were collected largely by the author and Ian Routley of LNS over the last decade. Other contributors to that database include: Jeff O'Kelly, Christine Galliazo and other member of LNS. I also used data collected from the BC Breeding Bird Atlas and surveys conducted by Splitrock in the Seton corridor and Powerhouse Restoration site. While these data sets are useful, there is tremendous variability in the amount of data for each site (see Table 1). Additionally, the spatial precision of the data vary and it is not possible to tease apart specific habitat use for some species, especially ones that use forests and terrestrial habitats (Passerines, etc.). Notwithstanding this caveats, taken together these data provide a gauge on the diversity and relative abundance of wetland associated birds in the Lillooet landscape over the last 17 years.

RESULTS

Table 1. Avian diversity at selected wetlands in the Lillooet area.

Wetland ID	Species diversity	Rank	Primary Data Source
Jones Pond	102	1	eBird
Powerhouse	95	2	eBird, LNS/Splitrock
Lower spawning channel	86	3	eBird, Splitrock
Upper spawning channel	74	4	eBird, Splitrock
Cayoosh Campground	35	5	eBird
Lower Seton Corridor	25	6	eBird, Splitrock
AJ1 (T-bird)	23	7	eBird
IA14 (N of Jones Pond)	19	8	eBird
Lions Trail	18	9	eBird
S5 (Seton Bridge)	13	10	eBird
IA3 (VLA)	12	11	eBird
CB16 (Aspen Planers Mill)	10	12	eBird, BBA
Phair Lake*	8	13	eBird, Mike Kennedy obs
IA40 (Cayoosh spawn chan)	4	14	eBird
CB9 (Cayoosh School)	3	15	eBird
AJ30 (Downton Creek)	2	16	eBird
AJ36 (Cayoosh/Boulder Ck)	2	16	eBird
AJ23 (Lillooet Sec School)	1	17	eBird

Wetland ID	Species diversity	Rank	Primary Data Source
AJ13	0	18	no data

**total is pending revision*

Species diversity varied significantly among the twenty wetlands, ranging from 1 species at AJ23 to 102 species at Jones Pond, the richest wetland feature in the Lillooet region (Table 1, Figure 1).

*Use stacked bar graph with aquatic/riparian/riparian generalists
how many sp. occurred at 1 or 2 stations?
-compare bird guilds (waterfowl, shorebirds, warblers, sparrows, aerial insectivores, etc.)
As the eBird sampling were not tailored to a wetland sampling scheme, our level of sampling and inference on bird use at the various wetlands has considerable variation. It should also be mentioned that we have a lot of data on wetlands outside of the Splitrock study area, especially for the Fountain Valley and my analysis does not include those sites.

Table 2. Top 25 wetland-associated birds in the Lillooet area.

Rank	Species	Frequency of Occurrence (%)
1	Song Sparrow	0.70
2	Spotted Towhee	0.65
3	Evening Grosbeak	0.55
3	Black-capped Chickadee	0.55
4	American Crow	0.50
5	Cedar Waxwing	0.45
5	European Starling	0.45
5	Warbling Vireo	0.45
5	Canada Goose	0.45
6	Lazuli Bunting	0.40

Rank	Species	Frequency of Occurrence (%)
6	Yellow-rumped Warbler	0.40
6	Gray Catbird	0.40
6	Veery	0.40
6	Hairy Woodpecker	0.40
6	Bald Eagle	0.40
6	Great Blue Heron	0.40
6	Mallard	0.40
7	Yellow Warbler	0.35
7	Nashville Warbler	0.35
7	Violet-green Swallow	0.35
7	Osprey	0.35
7	Common Merganser	0.35
7	Barrow's Goldeneye	0.35
7	Green-winged Teal	0.35

In Table 2, I have presented the twenty-five most prevalent birds using frequency of occurrence or the percent of sites with known detections. Song Sparrow is the most common species in Lillooet wetlands. Spotted Towhee, Evening Grosbeak, Black-capped Chickadee and American Crow also occurred at 50% or more of sites. These species, aside from Evening Grosbeak are resident birds and tend to be more generalistic in habitat use. Evening Grosbeaks are large finches that have an irregular pattern of occurrence that is typical for finches (Newton xxxx). The top twenty-five species encompass a wide spectrum of foraging behaviours including granivorous sparrows (Spotted Towhee), specialized seed-eating finches (Evening Grosbeak), frugivores (Cedar Waxwing), arboreal insectivores (Hairy Woodpecker), herbivores (Canada Goose), foliage-gleaning insectivores (warblers, vireos), piscivores (Great Blue Heron, Osprey), aerial insectivores (Violet-green Swallow), insectivorous waterbirds (Barrow's Goldeneye) and opportunistic generalists (American Crow). This diversity of foraging niches, or guilds, helps us understand how birds respond to wetland features and provides an inferential ecological framework. The broad array of avian taxa using wetlands in the Lillooet area suggests that

wetland features are important components of the local environment and there are opportunities for restoration enhancement.

It is important to note that this is a preliminary and simplistic analysis of species occurrence with many violated assumptions. For instance I have not accounted for effort among sites, seasonal occurrence or differences in detectability. However, the high volume of data available does provide an informative perspective of birds associated with wetland features in the Lillooet landscape. This data is also useful for designing a more rigorous and assumption-based study. Splitrock will commence such a study using a two-pronged approach: breeding bird point counts and deployment of Autonomous Recording Units (ARU's) at target wetlands in June 2017.

Appendix 1. Status and habitat preference of wetland birds of Lillooet. Habitat codes: AGR - agricultural lands (primarily alfalfa fields), AQU - aquatic habitats (ponds, lakes, rivers, streams), RiG - riparian generalist (species uses riparian habitats as well as adjacent upland forests; not dependent on wetland features); RiP - riparian specialist (dependent on water features across the landscape)

Species	Status	Primary Habitat	Breeding status
Trumpeter Swan	migrant, occasional wintering	AQU	No
Snow Goose	rare migrant	AQU	No
Cackling Goose	rare migrant	AQU	No
Canvasback	rare migrant	AQU	No
Redhead	rare in summer	AQU	Probable
Greater Scaup	rare migrant	AQU	No
Long-tailed Duck	rare migrant	AQU	No
Surf Scoter	rare migrant	AQU	No
White-winged Scoter	rare migrant	AQU	No
Pied-billed Grebe	migrant, summer visitant	AQU	Yes
Western Grebe	rare migrant, occasional in winter	AQU	No
Virginia Rail	uncommon in summer	AQU	Probable
Sora	summer visitant	AQU	Yes
American Coot	common summer visitant	AQU	Yes

Species	Status	Primary Habitat	Breeding status
Sandhill Crane	rare migrant	RiG	No
Wandering Tattler	very rare migrant	AQU	No
Western Sandpiper	rare migrant	AQU	No
Short-billed Dowitcher	very rare migrant	AQU	No
Long-billed Dowitcher	uncommon migrant	AQU	No
Pectoral Sandpiper	rare migrant	AQU	No
Dunlin	very rare in winter	AQU	No
Wilson's Phalarope	rare in summer	AQU	Possible
Mew Gull	rare migrant	AQU	No
Bonaparte's Gull	rare migrant	AQU	No
Anna's Hummingbird	uncommon resident	RiG	Possible
Least Flycatcher	rare in summer	RiP	Possible
House Wren	rare in summer	RiG	Yes
Northern Waterthrush	very rare in summer	RiP	No
Yellow-breasted Chat	very rare in summer	RiP	No
Black-headed Grosbeak	rare in summer	RiG	Possible
Rusty Blackbird	rare autumn migrant	RiG	No
Greater White-fronted Goose	rare migrant	AQU	No
Gadwall	rare in summer	AQU	No
Harlequin Duck	fairly common in summer	AQU	Yes
Ruddy Duck	fairly common in summer	AQU	Yes
Common Loon	uncommon resident	AQU	Yes
Horned Grebe	uncommon in winter/migrant, rare in summer, formerly bred	AQU	Yes
Wilson's Snipe	migrant, uncommon in summer	AQU	Probable

Species	Status	Primary Habitat	Breeding status
Greater Yellowlegs	rare migrant	AQU	No
Solitary Sandpiper	rare migrant	AQU	No
Semipalmated Sandpiper	rare migant	AQU	No
Northern Saw-whet Owl		RiG	Yes
Western Screech-Owl	uncommon resident	RiG	Yes
Hammond's Flycatcher	common in summer	RiG	Yes
Cliff Swallow	rare migrant, uncommon in summer	RiG	Yes
Chestnut-backed Chickadee	rare in autumn & winter	RiG	No
American Redstart	very rare migrant	RiP	No
Yellow-headed Blackbird	uncommon migrant and summer	AQU	Yes
Cinnamon Teal	uncommon in summer	AQU	Probable
Northern Shoveler	rare migrant	AQU	No
Lesser Scaup	uncommon migrant/summer	AQU	Yes
Red-breasted Merganser	rare migrant	AQU	No
Killdeer	uncommon in summer	AQU	Yes
Least Sandpiper	uncommon migrant	AQU	No
Ring-billed Gull	rare migrant	AQU	No
Calliope Hummingbird	common in summer	AQU	Yes
Bank Swallow	rare migrant, uncommon in summer	RiG	Yes
Wood Duck	rare migrant & summer resident	AQU	Yes
American Wigeon		AQU	Yes
Northern Pintail		AQU	No

Species	Status	Primary Habitat	Breeding status
Blue-winged Teal	uncommon in summer	AQU	Probable
California Gull	common migrant	AQU	No
Herring Gull	uncommon migrant	AQU	No
Belted Kingfisher	uncommon resident	AQU	Yes
Downy Woodpecker	uncommon in winter, rare in summer	RiP	
Willow Flycatcher	rare in summer	RiP	Probable
Eastern Kingbird	uncommon in summer	RiP	Yes
Red-eyed Vireo	common in summer	RiP	Yes
Tree Swallow		RiG	Yes
Pacific Wren	uncommon in winter, rare in summer	RiG	Probable
Bullock's Oriole	fairly common in summer	RiP	Yes
Purple Finch	uncommon in summer, rare in winter	RiG	Possible
Common Goldeneye	uncommon in winter	AQU	No
Bufflehead	common in winter	AQU	No
Spotted Sandpiper	fairly common in summer	AQU/RiP	Yes
Glaucous-winged Gull	rare in autumn & winter (esp. during Pink runs)	AQU	No
Rufous Hummingbird	common in summer	RiG	Yes
Red-naped Sapsucker	uncommon in summer	RiP	Yes
Western Wood-Pewee	fairly common in summer	RiG	Probable
Dusky Flycatcher	common in summer	RIG	Yes
Say's Phoebe	fairly common in summer	RiG	Yes
Cassin's Vireo	fairly common in summer	RiG	Probable

Species	Status	Primary Habitat	Breeding status
Northern Rough-winged Swallow	common in summer	RiG	Yes
Barn Swallow	uncommon in summer (species appears to be declining locally)	RiG	Yes
American Dipper	uncommon resident	AQU	Yes
Ruby-crowned Kinglet	common migrant, uncommon in summer (higher elevations)	RiG	Probable
Swainson's Thrush		RiP	
Black-throated Gray Warbler	fairly common in summer (esp in Cayoosh drainage)	RiG	Probable
Common Yellowthroat	fairly common in summer	AQU	Probable
Brewer's Blackbird	common in summer, rare in winter	AGR	Yes
Ring-necked Duck	common migrant	AQU	No
Hooded Merganser	fairly common migrant	AQU	No
Vaux's Swift	fairly common in summer	RiP	Yes
Northern Shrike	uncommon in winter	RiG	No
Orange-crowned Warbler	uncommon migrant, summer resident (higher elevations	RiG	Probable
MacGillivray's Warbler	uncommon in summer	RiG	Probable
Wilson's Warbler	fairly common migrant, uncommon in summer (higher elevations	RiG	Probable
Western Tanager	common in summer	RIG	Yes
Savannah Sparrow	uncommon migrant, local summer resident on alfalfa fields	AGR	Probable
Red-winged Blackbird	common in summer, rare in winter	AQU	Yes

Species	Status	Primary Habitat	Breeding status
Brown-headed Cowbird			
Green-winged Teal	common migrant, rare in winter	AQU	No
Barrow's Goldeneye	common in winter, uncommon in summer	AQU	Yes
Osprey	fairly common in summer	AQU	Yes
Violet-green Swallow	common in summer	RiG	Yes
Nashville Warbler	common migrant, fairly common in summer	RiG	Yes
Yellow Warbler	common in summer	RiP	Yes
Mallard	common resident	AQU	Yes
Great Blue Heron	uncommon migrant and in winter	AQU	No
Bald Eagle	fairly common in winter, uncommon in summer	RiG	Yes
Hairy Woodpecker	fairly common resident	RiG	Yes
Veery	common in summer	RiP	Yes
Gray Catbird	common in summer	RiP	Yes
Yellow-rumped Warbler	common migrant, fairly common in summer	RiG	Yes
Lazuli Bunting	fairly common in summer	RiG	Yes
Canada Goose	common in summer, uncommon in winter	AQU	Yes
Warbling Vireo	common in summer	RiP	Yes
European Starling	fairly common resident	RiG	Yes
Cedar Waxwing	common in summer	RiP	Yes
American Crow	common resident	RiG	Yes
Black-capped Chickadee	fairly common resident	RiP	Yes
Evening Grosbeak	fairly common in summer, rare in winter	RiG	Probable

Species	Status	Primary Habitat	Breeding status
Spotted Towhee	common in summer, uncommon in winter	RiG	Yes
American Goldfinch	uncommon in summer, rare in winter	RiG	Possible
Song Sparrow	common resident	RiP	Yes