FINAL REPORT 2015 – 16

Seton River Corridor Conservation and Restoration Project

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Prepared for: Sekw'el'was and T'it'q'et Communities and
BC Hydro Fish and Wildlife Compensation Program

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EXECUTIVE SUMMARY

The Seton River Corridor is located within the traditional territories of the St'at'imc who have lived and worked in the region for thousands of years. The Seton River, which flows out of Seton Lake, is approximately 4.7 km long and joins the Fraser River just south of the town of Lillooet. The valley is bordered by steep mountain slopes in its upper reaches, widening as the river empties into the Fraser River. The Seton River and the land within the corridor have been directly impacted by the Bridge/Seton hydroelectric system, as well as transportation, forestry, urban development and recreational activities. These impacts are quite extensive; however, the area still has significant fish and wildlife values.

The intent of this project is to identify conservation, restoration and sustainable management areas within the Seton River Corridor, and develop wildlife corridors between high value habitats. The goal is to create a more diverse and healthy habitat for fish and wildlife, while taking into account all the human influences on the landscape.

This project was conceived as a direct result of the restoration work being carried out on the Powerhouse Foreshore Restoration Project. The ideas proposed were to create a functioning fish and wildlife corridor from Seton Lake to the Fraser River, while providing an opportunity for our community to learn the skills in ecological management of the land and to engage in watershed stewardship training and outreach activities.

Cayoose Creek Indian Band has been carrying out survey and habitat mapping of the Seton River Corridor since 2010. We have carried out the following work over the last five years with limited funds and through a lot of networking and by working in partnership with various organizations and individuals:

- 2010/11 ***Sekw'el'was* Seton Wildlife Corridor Restoration Feasibility Study** funded by Bridge Coastal Fish & Wildlife Program (BCRP) (partnership development, compilation of historical and current research, vegetation and soil surveys in lower corridor, Lower Spawning Channel in-stream mapping, temperature monitoring, aquatic invertebrate and periphyton accrual sampling; fish sampling, wildlife surveys, community capacity building and watershed education outreach.

- 2011/12 - ***Sekw'el'was* Seton River Corridor Habitat Enhancement & Restoration - Phase One** funded by Fraser Salmon and Watershed Program (FSWP) (removal of invasive plant species and increase stream-side vegetation around Lower Spawning Channel and in one test plot on the Seton River, continue stakeholder planning process, community capacity building and watershed education outreach).

- 2012/13 - ***Sekw'el'was*** **Seton River Corridor Conservation and Restoration Project** funded by FWCP, PSF, SGS, IAFBC (habitat and vegetation surveys in middle/upper Seton River Corridor, invasive species management, re-vegetation, fish stock and spawning gravel assessments, wildlife surveys, community capacity building and continuation of planning process).

- 2013/14 - **Seton River Corridor Conservation and Restoration Project - Phase 3** funded by FWCP, PSF, SGS, AFSAR (habitat and vegetation surveys in the upper Seton River corridor, wetland survey, invasive species management, re-vegetation, fish stock and spawning gravel cleaning research, wildlife surveys, community capacity building and continuation of planning process).

- 2014/15 – **Seton River Corridor Conservation and Restoration Project** funded by FWCP, PSF, SGS, AFSAR (fish stock assessment, gravel cleaning, interior western screech- owl monitoring and nest box installation, reptile monitoring and hibernacula installation, large mammal monitoring, restoration works, community capacity building, and continuation of planning process)

During 2015/16 the following work was completed:

1. Fish stock assessment of the two spawning channels (spawning use assessment, daytime electrofishing, temperature logging)
2. Cleaning of spawning gravels and related monitoring
3. Completion of habitat and vegetation mapping within the project footprint
4. Interior Western Screech-owl monitoring and nest box maintenance
5. Reptile monitoring, den searches and installation of hibernacula
6. Large mammal monitoring
7. Restoration works - invasive weed removal, habitat enhancement, and revegetation with native plants in three identified areas: Lower Spawning Channel, Upper Spawning Channel and Lower Corridor
8. Community capacity building and training
9. Watershed environmental education
10. Long-term ecological planning with partners and stakeholders

ACKNOWLEDGMENTS

This Project was funded by the **Fish and Wildlife Compensation Program** on behalf of its program partners BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and the public, who work together to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams.

The **Pacific Salmon Foundation (PSF) Community Salmon Program** funded the spawning gravel cleaning and ecological restoration portion of the project, without whose support this project would not have been possible. The PSF exists to support "salmon communities" in their efforts, to promote awareness of this keystone species and to guide the sustainable future of wild Pacific salmon and their habitat.

The federal government **Aboriginal Fund for Species-at-Risk (AFSAR)** program provided funds towards Interior western screech-owl and Great Basin gopher snake survey and enhancement works.

Sekw'el'was and St'at'imc Government Services provided funds towards the spawning channel enhancement and monitoring work.

Lillooet Naturalist Society provided funds and support at events for outreach work.

The information provided in this report has been compiled by Splitrock Environmental - Heather Richardson and Kim North - on behalf of Sekw'el'was and T'it'q'et. Information has been included from various contractor reports, and from research and fieldwork carried out by Daniel Espinoza (Instream Fisheries Research Inc), Odin Scholz, Robin Strong, Kim North, and environmental crew technicians from Splitrock Environmental:

Splitrock Environmental – Odin Scholz, Restoration Biologist
Lower Spawning Channel Gravel Cleaning Work and Monitoring Protocols (February 2016)

Instream Fisheries Research Inc – Daniel Espinoza, Project Biologist
Seton River Corridor –Fish Monitoring Work 2015 (March 2016)

Splitrock Environmental – Heather Richardson, Environmental Scientist
Habitat Assessment and Mapping (November 2015)

Splitrock Environmental - Kim North, Project Manager
Restoration and Revegetation Works 2015-16 (April 2016)

Splitrock Environmental – Robin Strong, AFSAR Project Manager
Monitoring Report: Restoration Trials of Riparian habitat for Western Screech-owl (August 2015)

Sekw'el'was, T'it'q'et, P'egp'ig'lha Council - Chief Michelle Edwards, Chief Shelley Leech, Perry Redan, Robin Frank, Shannon Squire
Management Planning Documents (March – April 2016)

Splitrock Environmental – Kim North, Heather Richardson
Management Planning Documents (February – April 2016)

We would like to thank the partners of this project – the Sekw'el'was and T'it'q'et communities, and contractors for their support throughout the season, both for mentoring local environmental crew technicians and providing their expertise to this project.

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Chapter 1. Introduction

1.1 Proponent Information

Splitrock Environmental is carrying out this work on behalf of the Sek'wel'was and T'it'q'et communities who are the beneficiaries of large traditional sustenance gathering areas that are, and should be, managed in a holistic relationship with the flora and fauna communities. We are located in the southern-interior of BC in close proximity to Lillooet within St'at'imc territory.

Splitrock Environmental has undertaken survey and restoration work within the corridor and along the Fraser River in collaboration with the Lillooet Naturalist Society and Sekw'el'was over the past several years, with the T'it'q'et community involved over the last two years.

1.2 Hydroelectric Impact

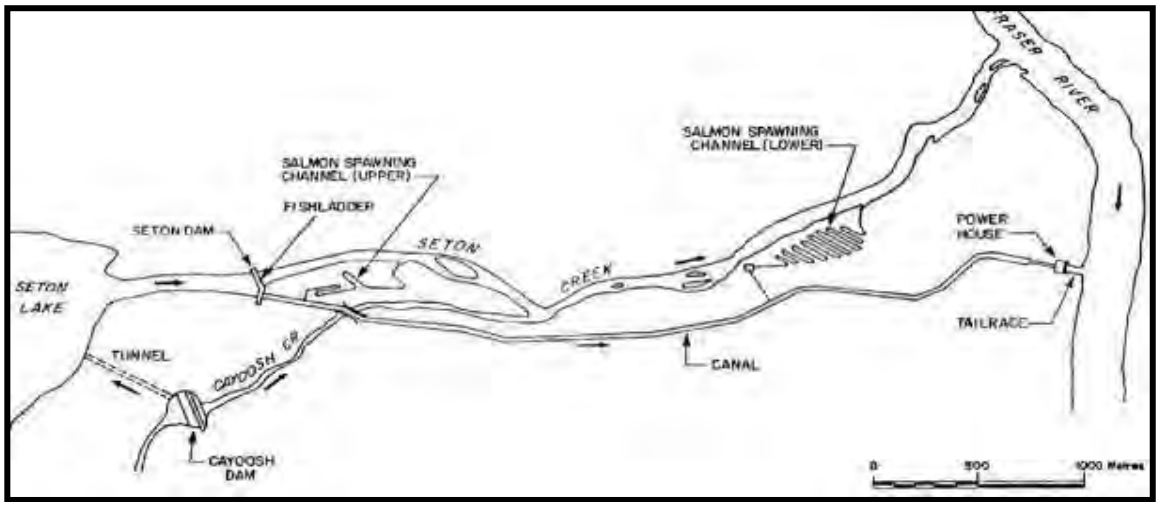
In the late 1950s the Seton watershed was subject to major alterations from hydroelectric development. The Seton Corridor relates directly to the historical loss of habitat due to construction of the BC Hydro Bridge River hydroelectric facilities. The Seton hydroelectric development is just one component of the larger Bridge River system.

The Bridge/Seton development resulted in creation of Carpenter Lake Reservoir behind Terzaghi Dam, which diverts water, through the mountain, from the Bridge River watershed into Seton Lake. The Seton portion of the project, in service since 1956, consists of Seton Dam just below the outlet of Seton Lake, where the majority of water is diverted into a 3.7km long concrete lined power canal. Water then flows through the powerhouse out into the Fraser River (Map 1).

Some of the footprint impacts indicated in the BCRP Strategic Plan 2000 include:

- Diversion of colder, nutrient poor Bridge River water to Seton Lake has changed the temperature regime and nutrient productivity of Seton Lake/River.
- Dredging to construct the approach channel to Seton Dam removed riparian habitat, upland forested hillsides and caused the loss of significant spawning habitat for pink salmon - spawning channels were built to compensate this loss.
- Construction of the project facilities reshaped the channel and banks, removed aggregates, and removed riparian vegetation over an extensive distance below the dam.
- Diversion of water from Bridge River and Cayoosh Creek has effects on wetted channel area, seasonal temperatures and stream productivity.
- Olfactory cues for sockeye returning to Gates and Portage creeks have been changed based on proportion of Cayoosh water mixed in tailrace discharge.
- Fish migration impeded by powerhouse penstock, spawning channels and Seton Dam.
- Dam traps gravel bedload and high flows erode original spawning gravels below the dam, decreasing spawning habitat.
- Dam traps woody debris normally recruited downstream.
- Lower water levels reduce fish access to former off channel habitat.
- Dam and canal construction have caused wildlife barriers which restrict movement within the corridor - thereby reducing available habitat and fragmenting populations.
- Loss of significant wetlands at the confluence of the Seton and Fraser Rivers.
- Visual impacts and invasive weed dispersal along hydroelectric powerlines.

The development that has taken place along the Seton River Corridor is extensive. Historical photograph (Figure 1) shows an aboriginal fish camp (Oleman family) at Skimka (today's Seton Beach) "in the days when salmon were thick" (*BC Archives*). Today, no fish are dried here.



Map 1 Seton Hydro Project Facilities (map source: BCRP, Strategic Plan Vol 2)

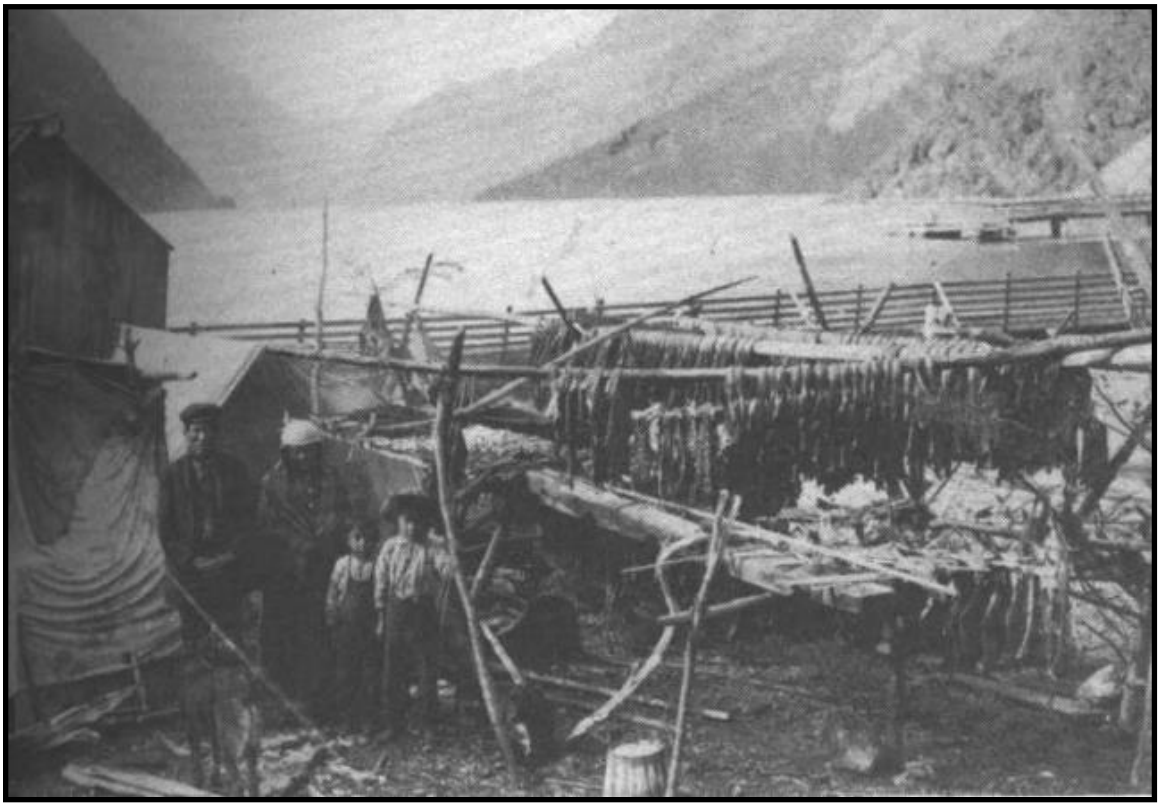


Figure 1 Oleman family fish camp and drying racks at Skimka

1.3 Statement of Need

Arial photograph (Figure 2*)* of the corridor clearly displays the scale of the operations that took place in the valley during the 1950s, and that continue to impact the area for both fish, wildlife and people. During initial construction of the hydroelectric operations the flow of the Seton River was dramatically altered.

> *"The original habitats in Seton River were very different than those that occur today. An area of low marshy habitat existed near the Fraser confluence ... Photographs of Seton River circa 1910-14 indicate a more significant riparian zone and forested slopes than at present" (BCRP, Strategic Plan - Volume 2).*

Other impacts that further fragment the corridor include forestry, rail and road transportation systems, independent power projects, hydroelectric transmission lines, urban development, and recreational infrastructures.

The fragmentation that exists today impacts the free flow of both fish and wildlife as evidenced by the large amount of research carried out over the years. Even with these impacts there is potential to enhance and conserve the remaining habitat, and to increase habitat through restoration work, and to work with operators in the corridor to modify operations where possible to mitigate past and ongoing impacts.

Sekw'el'was and T'it'qet are committed to implementing the values associated with the Nxekmenlhkalha lti tmicwa (*St'at'imc Preliminary Draft Land Use Plan, 2004*). These values also align with stated BCRP and agency priorities. The highest priorities noted in the Bridge/Seton River Watersheds - Summary of Agency Fish and Wildlife Priorities for the Seton River were:

- Assessment of species composition and use of original Seton pink channels to provide insight into future works.
- Restoration work/habitat complexing in the lower Seton Channel to include instream works and riparian planting.
- Assessment of mainstem spawning and off-channel options.
- Migration corridor conservation through buffers and habitat enhancement
- Restoration of damaged sites in riparian habitats

The Lillooet Tribal Council has worked over the last several years on developing an inventory of species-at-risk within our territory. The Black Cottonwood/Common Snowberry - Red-osier Dogwood (*Populus balsamifera ssp trichocarpa/Symphoricarpos albus - Cornus stolonifera*) and Douglas Fir - Ponderosa Pine/Bluebunch Wheatgrass (*Pseudotsuga menziesii - Inus ponderosa/Pseudoroegneria spicata)* plant communities are provincially red-listed and noted as having limited distribution (BC Conservation Data Centre). Both plant communities are found within the study area in varying degrees of health. We feel it is important to conserve existing healthy stands of these plant communities and restore areas that have the potential to provide enhanced wildlife values. Species-at-risk known to use the study area, and would benefit from possible enhancement of these habitats, include the Interior Western screech-owl (*Otus kennicottii macfarlanei*), Yellow-bellied racer (*Coluber constrictor),* Great Basin gopher snake (*Pituophis catenifer deserticola),* Townsend's Big-eared bat *(Corynorhinus townsendii)* and Spotted bat *(Euderma maculatum).*

We believe that by working together with the various agencies, local organizations and contractors, we will be able to define key fish and wildlife habitats, explore the obstacles and strengths within the landscape, and develop a cohesive Plan that will support both flora and fauna, and our communities. Work during 2015-16 saw the completion of the habitat mapping portion of the project and builds on the data gathering needed to develop a strong Land Management Plan, and culminated in discussions around possible management strategies.

Figure 2 Aerial photograph showing the narrow valley and some of the impacts 29 Mar 2011

Chapter 2. Goals and Objectives

The Sekw'el'was Seton Wildlife Corridor Restoration Feasibility Study, and the ongoing vegetation, spawning gravel, fish and wildlife surveys carried out between 2010-16 were implemented as a result of the restoration work taking place at the Powerhouse Restoration site and the increasing awareness of loss of intact wildlife corridors and habitat, both in-stream and upland. The questions were: 1) By enhancing and creating wildlife habitat at the Powerhouse site, were we creating a wildlife sink? 2) Can we provide corridors that wildlife can use to traverse the area between Seton Lake and the Fraser River in a safe way for both wildlife and people? 3) Can we increase both spawning and rearing habitat in the corridor, including the rivers and the three existing spawning channels?

The Goals of Sekw'el'was Seton River Corridor Conservation and Restoration Project are to:

- determine the health of the river, spawning channels and upland corridor; and
- gather data that will provide information to the partners and stakeholders on possible:
  - Category 1: Conservation areas
  - Category 2: Restoration areas
  - Category 3: Sustainable Management areas
  - Category 4: Wildlife Corridors that provide movement across the landscape.

The Objectives during the 2015-16 season were to:

- continue networking with interested stakeholders and engage partners in development of a long-term ecological plan for the corridor
- continue air and water temperature monitoring at Lower Spawning Channel
- clean identified sites of spawning gravels at Lower Spawning Channel
- complete fish stock assessment at the Lower and Upper Spawning Channels
- continue screech-owl monitoring
- continue reptile monitoring, including cover board monitoring, den search survey
- undertake large mammal survey using wildlife cameras
- remove invasive weeds and replant with native plant species in designated areas
- provide training and capacity building in ecological survey methods and restoration techniques
- provide watershed educational and volunteer stewardship opportunities

Splitrock Environmental has met the goals and objectives set out in our grant applications FWCP 16.W.SON.01, PSF CSP15S030 and 2015AFSAR2498. The work carried out during 2015-16 assisted in gathering the remaining habitat and wildlife data required and allowed increased restoration works and the development of possible management strategies to discuss during 2016-17. The ultimate goal is to conserve and/or restore a functioning habitat network that maintains ecological processes and provides for the movement of native species between key ecosystem spaces, while still taking into account the human impacts and requirements.

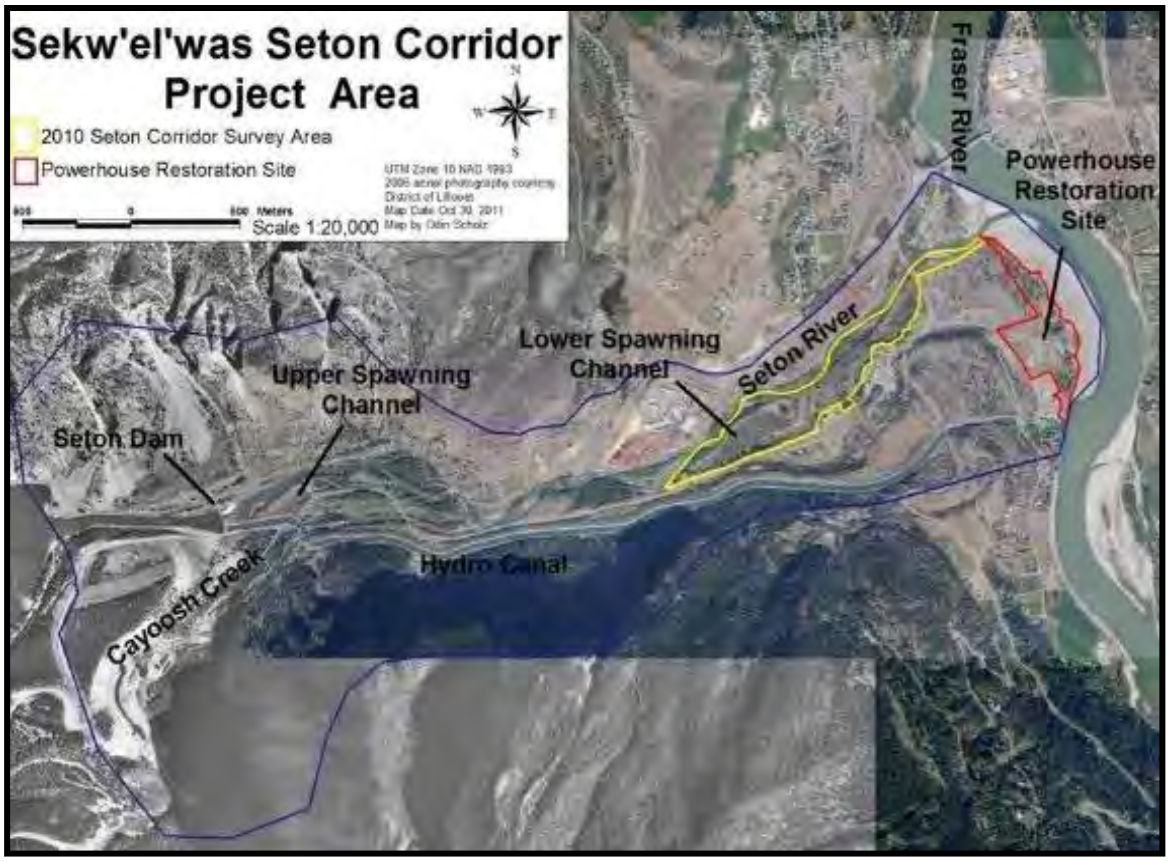
Chapter 3. Study Area

3.1 Site Location

The project site is located within the traditional territories of the St'at'imc, just southwest of the town of Lillooet. The Seton River basin is located in the rainshadow of the southern coastal mountains about 235 kilometres northeast of Vancouver. The Seton watershed begins in the headwaters of Gates Creek, which flows into Anderson Lake, through Seton Portage, spilling into Seton Lake. The Seton River flows east out of Seton Lake and runs approximately 4.7 kilometres where it drains into the Fraser River. Much of the flow coming from Seton Lake is diverted via the Seton Canal to the Seton Powerhouse on the Fraser River.

The area includes 3 spawning channels - Upper Seton River Spawning Channel (USpCh) and Lower Seton River Spawning Channel (LSpCh) and a smaller spawning channel on Cayoose Creek on the edge of the Cayoose Creek Power hydroelectric complex.

The boundaries created for the corridor plan includes the entire stretch of the Seton River corridor from Seton Lake to the Fraser River, and incorporates the Seton and Cayoose Rivers, three spawning channels, the Seton Canal, Powerhouse site, the upland habitats and cliffs on both sides of the rivers (Map 2 - blue boundary). This map also shows the Powerhouse and Mariposa Flat sites *(red boundary)*, and the Lower Seton Corridor *(yellow boundary).*



Map 2 Sekw'el'was Seton Corridor Project Area (Seton Lake to Fraser River)

3.2 Habitat Description

The site (574 385E - 5613 765N 575 732E - 5614 786N) ranges in altitude from 200m to 210m above sea level. The town of Lillooet falls into the Ponderosa Pine (PP) biogeoclimatic zone. The PP zone occurs in the dry valley bottoms along major river valleys of the southern interior and is the driest forested zone in British Columbia with very hot summers and annual rainfall between 280-500mm. The Lillooet area falls into the Ponderosa Pine very dry hot sub zone (PPxh2) of the biogeoclimatic zone classification.

Due to the influences of the Seton River, the spawning channels, and the steep rock faces within the corridor, there are a variety of micro-climates (Figure 3). The Seton Corridor area of interest extends from Seton Lake in the West to the confluence with the Fraser River to the East. The narrow stretch of land has multiple stakeholders and land uses including a railway, major highway, a fenced power canal and a major Hydro power-line. An independent power production facility exists on Cayoose Creek and a diversion canal from one of the two dams in the corridor directs water to the BC Hydro power generation facility on Powerhouse Road. The Corridor also has a major industrial site in the Aspen Planers plywood mill. There are residential developments and a gas station to the East on the Sekw'el'was band lands, two campgrounds (one on the North West end and one near the South East), as well as two recreation sites (one at Seton Lake and the Naxwit picnic area just below Seton Dam). A native plant nursery is now established at the Lower Spawning Channel also. Even with the high concentration of human land use in the area the corridor plays a significant role in the ecology of the region.

Figure 3 Seton River looking upriver from the lower corridor

Chapter 4. Spawning Channel Surveys

4.1 Introduction

The Seton River spawning channels provide important in-stream and terrestrial habitats. Prior to 2003 the spawning channels were only watered every 2nd year for approximately 6 months during the pink spawning and outmigration season. Instream features were limited to runs and the berms were mowed regularly so few trees and shrubs grew. In 2003 St'at'imc and DFO, with funding from BCRP and other inkind contributions, worked together to recomplex the system with the goal of increasing coho spawning habitat and other wildlife values. No monitoring or maintenance was carried out after recomplexing and therefore there had been limited knowledge on the outcome of the recomplexed work. Due to this oversight, in 2010 Cayoose and Splitrock Environmental developed maintenance protocols and began the process of gathering data to assess the current conditions and develop management strategies to ensure the spawning channels were providing habitat. The research taken place over the last several years shows that the two spawning channels do provide critical spawning and rearing habitat to a variety of species, including coho and chinook, but that there are ongoing issues that will need to be addressed.

A spawning channel committee was struck in March 2014 to guide the management and monitoring of the spawning channels. Representatives on the committee are from St'at'imc Government Services (Sue Senger), Skew'el'was (Bonnie Adolph and Fred James), DFO (Sean Bennett), BC Hydro (Dorian Turner), Jeff Sneep (local fish biologist), Daniel Espinoza (Instream Fisheries Inc) and Splitrock Environmental (Kim North, Odin Scholz). The committee met again on 13 November 2015 to discuss works completed and strategies moving forward. The meeting consisted of a powerpoint presentation, brainstorming session and field walk (Appendix 1: Spawning Channel Committee Minutes).

The objective of the 2015-16 spawning/rearing channel surveys was to complete the following works:

- Water temperature monitoring
- Adult spawner surveys
- Juvenile growth sampling
- Gravel cleaning
- Gravel cleaning monitoring (photopoints and acquatic invertebrate sampling)
- Beaver control
- Weed removal
- Bio-engineering and Revegetation

Splitrock Environmental Sekw'el'was technicians carried out the temperature monitoring, spawner counts, gravel cleaning and monitoring program, and assisted InStream Fisheries Research Inc in gathering data on juvenile growth rates in the Seton River and the two spawning channels. By combining efforts and resources the data collected will inform both the FWCP/PSF works and the BRGMON-9 Water Use Plan project.

4.2 Methods

4.2.1 Water Temperature

In 2012, three Onset Hobo Tidbit data loggers were installed in the Lower Spawning Channel. Two loggers are in-stream and one records air temperature. The data logger at the upper end of the spawning channel is located approximately 25 m downstream of the siphon outlet. The lower end data logger is located approximately 100 m upstream from the Seton confluence. Both in-stream loggers are set at approximately 0.5 m depth. Data loggers are programmed to record temperature every half hour.

In July 2015, two Onset Hobo Tidbit V2 loggers were installed at the Upper Spawning Channel by BC Hydro (Dorian Turner 2015). The data logger at the upper end of the spawning channel is located approximately 5 m downstream of the siphon outlet. The lower end data logger is approximately 30 m upstream from the Seton confluence. Data loggers are programmed to record temperature every one hour.

Data from the temperature loggers are downloaded throughout the year into an excel spreadsheet.

4.2.2 Adult Spawner Remuneration (Daniel Espinoza, Instream Fisheries)

Visual stream bank counts were undertaken for spawning Steelhead, Rainbow, Chinook and Coho salmon weekly throughout the whole extent of the Seton River (Figure 4). The Spawning Channels were also surveyed in attempts to identify their use by adult Salmonids. Methods replicated those utilized in BRGMON3 surveys (Burnett et al. 2016) and data collected is an index of abundance rather than total counts. Briefly, two observers walked in a downstream direction on the riverbank looking for visible signs of fish. Fish were classified by species and location and recorded in field notebooks. Viewing conditions, cloud cover and lateral water visibility were also recorded. Surveys commenced on 04 March for the enumeration of Steelhead and were completed on 15 June, when the Steelhead migration and spawning had completed. Chinook and Pink migration overlapped and surveys for both species commenced on 04 August and were completed on 30 September. Coho surveys began on 06 October and were completed on 15 December.

Figure 4 Spawner Counts Upper Spawning Channel 15 Sept 2015

Model Used to Estimate Escapement from Visual Count and Telemetry Data

An Area-Under-the-Curve (AUC) method was proposed to estimate escapement for Pink salmon in the spawning channels based on repeat visual counts from stream walks, combined with estimates of observer efficient (o.e.) and survey life from PIT telemetry.

In previous years AUC analysis was proposed as described in Hilborn et al. 1999, but due to the lack of fish observed, estimates were not produced. In the methods described in Hilborn et al. 1999, abundance is modelled as a quasi-Poisson distribution with arrival timing characterized by a beta distribution. We found that a normal distribution adequately described arrival timing of salmon in the Lower Bridge River (Burnett et al. 2016) and resulted in a simpler AUC model compared to the beta distribution version of the model. Consequently, abundance of Pink salmon in the Seton River in 2015 was modelled using a quasi-Poisson distribution with normally distributed arrival timing (described in Millar et al. 2012). Both methods were evaluated using maximum likelihood (ML), and differ only in the distribution of arrival timing. Abundance estimates were thus insensitive to this change in analysis, and consequently, we used the methods described below for Millar et al. (2012).

With abundance modelled as a quasi-Poisson distribution with normally distributed arrival timing (Millar et al. 2012), the number of observed spawners at time t (C_t) is

(1) $$C_t = a\ exp\left[-\frac{(t-m_s)^2}{2\tau_s^2}\right]$$

where *a* is the maximum height of the spawner curve, m_s is the time of peak spawners, and τ_s^2 is the standard deviation of the arrival timing curve.

Because the normal density function integrates to unity, the exponent term in Equation 1 becomes $\sqrt{2\pi\tau_s}$ and Equation 1 can be simplified to

(2) $$C_t = a\sqrt{2\pi\tau_s}$$

A final estimate of abundance ($\hat{E}$) is obtained by applying observer efficiency (*v)* and survey life (*l*) to the estimated number of observed spawners

(3) $$\hat{E} = \frac{\hat{C}_t}{l * v}$$

$\hat{E}$ in Equation 3 is estimated using ML, where $\hat{a}$ and $\hat{\tau}$ are the ML estimates of *a* and τ_s in Equation 2 ($\hat{C}_t = \hat{a}\sqrt{2\pi\hat{\tau}_s}$).

The AUC estimation in Equation 1 can be re-expressed as a linear model, allowing the estimation to be performed as a simple log-linear equation with an over-dispersion correction factor. Correction for over-dispersion accounts for instances where the variance of the

observations exceeds the expected value. The log-linear model is computationally simple and can be completed using standard generalized linear modelling software.

Observer efficiency was calculated as the number of externally tagged fish observed in each visual enumeration stream walk divided by the total number of fish calculated as being present through fixed PIT telemetry station records. Residence time in the spawning channels was estimated as the time period in which a live fish moved into the counting/spawning zone, spawned then proceeded to leave the channel where they would be recorded by the PIT antenna.

Passive Integrated Transponder Tagging

An intensive Passive Integrated Transponder (PIT) tagging operation has been taking place in the Seton River since the initiation of the BRGMON-9 project. Each adult or juvenile salmonid of a suitable size captured (juveniles > 70 mm and all adults), either through angling or electrofishing was implanted with a 12 mm or a 32 mm PIT tag. This mark recapture technique will allow for the tracking of movement and growth rate of individual fish in the Seton River system.

Movement of fish was assessed through the installation of four fixed PIT antenna arrays in the Seton River System. One of the PIT antennas is located in the fishway of Seton Dam. Another antenna is located at the outflow of the lower spawning channel. These two stations are powered by mains power and therefore are able to operate all year round. The third antenna was installed in Cayoosh Creek, approximately 650 m upstream of the confluence with the Seton River. It was powered by a 12v deep cycle (110amp hour) lead acid battery. The Cayoosh Creek station was operated from April through to December when the migration and spawning of Coho had finished. The fourth antenna, located near the outflow of the upper spawning channel, was installed in May of 2015. This antenna was powered by mains power and was also able to operate year round.

Fixed station data will be used to corroborate fish location, identify movement of each fish into each region, and collect basic data on fish migration and spawning behaviour in the Seton River. The data collected on adult Pink salmon will also be used to assess fish abundance through proportional distribution analysis.

This method for evaluating abundance, using data collected at the Seton fishway and proportional distribution, will account for fish that move through the visual survey area and are likely to be counted by that method but do not spawn in the Seton River. This is a short-coming of the AUC method described above because Coho, Chinook and Pink Salmon spawn in other areas of the Seton-Anderson Watershed; such as the lower and upper Seton River spawning channels, Cayoosh Creek, and upstream of the Seton Dam in Portage and Gates Creeks (H. O'Donaghey pers. comm.). The Seton fishway resistivity counter (BRGMON-14 funded) will provide an accurate estimate of the number of salmon that move above the dam and data collected by PIT tag arrays at key locations throughout the watershed will be used to calculate the relative proportion of fish that leave the mainstem and spawn elsewhere.

To achieve sufficient sample sizes 500 Pinks will be tagged with 32mm PIT tags and external Peterson disc tags. Data from PIT tags will used to determine the distribution of spawners throughout the entire Seton-Anderson watershed.

The abundance of Pink spawning below the dam will be calculated as follows:

$$E_{lower} = E_{ft} / P_{dam}$$

where E_{lower} is the number of salmon sp. spawning below the dam,
E_{ft} is the number of spawners through the fishway, and
P_{dam} is the proportion of PIT tagged fish that moved through the fishway.

To generate Seton River spawner abundance we must remove fish that spawn in the spawing channels and Cayoosh Creek. The Seton River salmon spawner abundance will be calculated as follows:

$$E_m = E_{lower} - E_{lower} \cdot P_{channels}$$

where E_m is the number of salmon spawning in the mainstem Seton River, and $P_{channels}$ is the proportion of PIT tagged fish that enter and spawn in the lower and upper spawning channels as well as Cayoosh Creek.

Estimates of salmon abundance for the two spawning channels and Cayoosh Creek can also be derived from these data.

This approach assumes that no tags leave the river to the Fraser prior to spawning; radio tag data will confirm this assumption as the lower river is too large for efficient operation of a PIT antenna. We will compare the estimates of spawner abundance from both methods.

4.2.3 Juvenile Growth Sampling (Daniel Espinoza, Instream Fisheries)

Fish growth and distribution was assessed through monthly open site electrofishing surveys using a Smith-Root LR-24 backpack electrofisher. Fish were captured by one-pass electrofishing at various sites within the river and spawning channels. Crews consisted of two or three members, with one person (crew leader) equipped with the backpack electrofisher and one or two dip netters to collect and sample fish. Fish collected from the surveys were placed in buckets of fresh water and held for sampling at the end of each site. Once the pass was completed, the fish were scanned for PIT tags and sampled.

In order to reduce handling stress, fish that were marked and/or sampled were anaesthetized with a diluted solution of clove oil, dissolved 1:10 in ethanol. Once a month (or every sampling session), a minimum of 30 fish per species were sampled for fork length (mm), weight (g) and scales. Length and scale data were analyzed from a stratified sample to a maximum of 5 fish per 5 mm group (Ward and Slaney 1988). Scales from each fish were collected from the area above the lateral line and immediately below the dorsal fin. Scale samples were placed in coin envelopes marked with appropriate data for cross-reference. After a period of air-drying, scales were processed in two ways. They were either pressed on to plastic and the imprints analyzed using a microfiche reader following the methods of Mackay et al. (1990) or they were directly placed on glass slides and read under a microscope. Age was determined by the methods outlined in Ward and Slaney (1988), in which two persons independently determined age without knowledge of the size, time and location of capture of the sampled fish. Samples were discarded when a consensus between both persons could not be reached. The age data was then used to create an age-length relationship that in turn was used to create a length-age key

and assign ages to the entire sample of fish. The age-length key was constructed by methods described in Isermann and Knight (2005) and the FSA package in R (Ogle, 2013).

The majority of sites selected for monitoring were in the main stem of the Seton River as per the BRGMON-9 TOR. However, Instream Fisheries Research, with the help of Splitrock Environmental, sampled the two spawning channels (lower and upper) as both parties thought it important to compare species presence and growth rate between the two habitat types.

Data from the two spawning channels was combined to compare against the main stem fish. Electrofishing within the spawning channels also provided the opportunity to PIT tag juvenile fish and assess any movement out of the spawning channels, through the installed PIT antenna at the outflow of the lower spawning channel (mains power provide by Splitrock Environmental). PIT tag data is not reported here, but can be assessed through BRGMON-9 reports.

In total 13 sites were surveyed: 3 in upper corridor (Map 3), 6 in middle corridor (Map 4) and 4 in lower corridor (Map 5). These sites were selected according to their appearance to hold fish as the main purpose of these surveys was to sample as many fish as possible. The spawning channels were sampled throughout their entire lengths.

Map 3 Location of Juvenile Growth Sampling Sites - upper Seton River

Map 4 Location of Juvenile Growth Sampling Sites - Mid Seton River

Map 5 Location of Juvenile Growth Sampling Sites - Lower Seton River

4.2.4 Spawning Gravel Cleaning

Site Selection

Fourteen sites (Map 6) were chosen as target areas for spawning gravel cleaning using the 'Sand Wand" technology, based on the joint DFO and Splitrock Environmental Sekw'el'was gravel permeability study conducted throughout the Lower and Upper Spawning Channels in 2012 (Hillaby, 2013). The targeted sites were identified and distributed throughout most of the length of the Lower Spawning Channel crossing sites that had a variety of treatment history including channel complexing, addition of LWD, gravel scarification and augmenting (Tisdale G. 2004).

Berm 1

- Sites 1, 2, 3 and 4: are runs that were complexed in 2003 with the addition of Large Woody Debris and large boulders and gravels. These berms and gravels have been impact by beaver mining and damming activities over recent years.
- Site 5: is the site of a deeper pool.

Berm 9

- Sites 6 and 7: are in run habitat area where the area was left undisturbed during the 2003 complexing.
- Sites 8, 9 and 10: located approximately mid-channel length were complexed and gravels scarified in 2003.

Berm 18

- Sites 11 and 12: are in run habitat that had gravels cleaned and augmented in 2003 as well as the channel complexed.
- Sites 13 and 14: the gravel was scarified and channel complexed in 2003.

During the cleaning process, instream microsites were identified in the indicated site locations and treatment focussed on cleaning the most productive spawning gravel sites.

Productive spawning gravel sites were identified and marked out in the field within the areas targeted for treatment based on the 2013 Hillaby report. Flagged areas were selected based on:

1. Sites where water flow over the gravels was consistent and strong.
2. Avoidance of settling sites where fines consistently settle and collect such as inside bends, downstream of large woody debris deep pools and directly downstream of large boulders.

Control areas were also flagged in the field to represent similar sites to the treated areas. Control sites will be monitored with the same intensity as treated sites through time for comparative effects.

Map 6 Proposed Gravel Treatment Sites Lower Spawning Channel

Gravel Cleaning Treatments

Cleaning was done using 'Sand Wand' technology (Streamside Environmental, Ohio, USA). This is a recently developed tool for removing fine sediment using a water pumping system

The 'Sand Wand' uses a combination of water jet and suction to mobilise and transport fine sediments beneath an enclosed hood (Figure 5). Crew manually moved the equipment across the streambed using a rocking motion moving parallel to flow (Figure 6). The arrangement of 3-inch pumps relative to the hood depends on the topography of the stream. Slurry was discharged to land in areas where restoration works were planned.

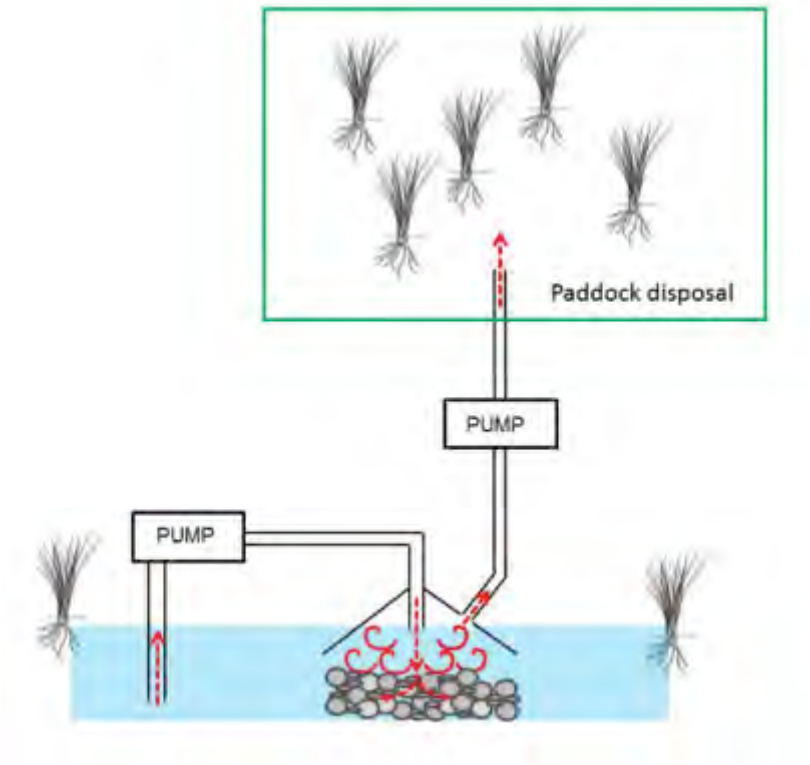


Figure 5 Schematic showing the arrangement of pumps using the SandWand system

Figure 6 SandWand head (left) and equipment in operation Aug 2015

Photomonitoring, aquatic invertebrate monitoring and adult spawner count protocols were established to monitor the outcome of the gravel cleaning process.

Photo monitoring

Photo monitoring was set up using 1X1m plot frames to photograph surface gravels in treated vs control plots (Figure 7).

Procedure:

1. Plot frames should be allowed to fill with water so they sink before closing the frame.
2. Place frames on surface of the gravels, anchor frame in place using larger rocks. Try to work from the downstream site to avoid creating disturbance that will affect water clarity.
3. Take photo of plot frame from above water surface to include entire frame in picture (Figure 7).
4. Use blue canon cameras and wait for the GPS satellite picture to stop flashing indicating satellite reception.
5. Take underwater pictures of the plot frame from the downstream end. Also take close up pictures of gravels showing algae cover.
6. Estimate thickness of algae by removing 5 rocks >5cm diameter and estimate algae cover on the upper surface and use a ruler to measure algae thickness.
7. Mark Plot location:
    i) Using permanent paint, make marks on either bank to indicate the downstream locations of the plot frames in the channel
    ii) Run a measuring tape between marks and centre the plot frames in the middle of the wetted width on the upstream side of the tape.
    iii) Mark plot locations with GPS

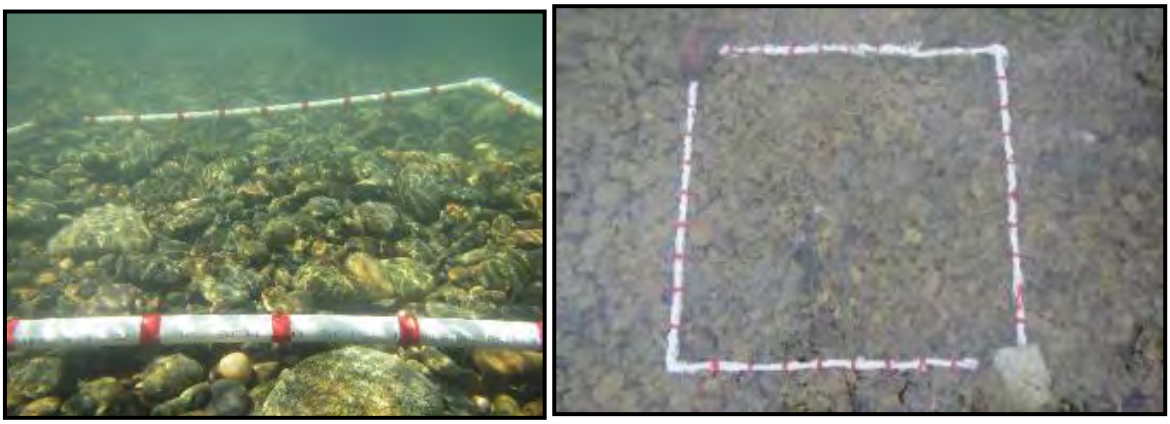


Figure 7 Photo monitoring grids Aug 2015

Aquatic Invertebrate Sampling

Procedures were adapted from *Streamkeepers Module 4*. Monitoring results will be sent to Streamkeepers database at the end of the project. Downstream locations were sampled first and crew technicians worked their way up the stream. Sampling procedures as follows:

1. Approach the first sampling area from downstream. Do not disturb the sampling area by walking in it or upstream of it.
2. Place the D-net on the downstream edge of the sample area, so the opening faces into the flow. Push the frame a little way into the stream substrate (Figure 8).
3. Measure the sampling area. The D-net is 30 cm wide (1 foot), so you can use it to measure the four sides of a 30 cm by 30 cm sampling square. Use large boulders to mark the corners of the square.
4. Pick up and Brush all stones and debris *5 cm or larger* within the sampling area. Pick up a stone, hold it under water in front of the net and rub it gently with a brush or your hands. The loosened invertebrates will be swept into the net. Place the cleaned rocks outside the sampling area.
5. Using your hands and starting at the upstream end, gently agitate the streambed to a depth of 2 to 5 cm to loosen any remaining invertebrates (Figure 9).
6. Take the net to stream bank and turn it inside out in a bucket, half full of cool stream water. Transfer the invertebrates and debris into the bucket by carefully rinsing or shaking the net, then scraping it with a plastic spoon. Gently pick off organisms that cling to the net. Handle them carefully to avoid injuring them and keep them in the shade. Make sure the entire sample is in the bucket. Check larger pieces of debris in the bucket for bugs, then discard the debris.
7. Take *two more samples* and combine them with the first one. Analyse and report the results for *the three combined samples*. Invertebrates are not distributed evenly in streams, so, even at one station, you can expect to find some samples with very few invertebrates and others with many.
8. IDENTIFY AND COUNT THE INVERTEBRATES Sort the sample: Pour some invertebrates from the bucket into a shallow white tray of water. Fill the compartments of two ice cube trays with stream water. Handle the invertebrates gently with tweezers, spoons, or eye droppers. Many will be active. Sort them into separate compartments of the ice cube trays based on obvious differences in appearance. Continue sorting until there are no invertebrates left in the bucket.
9. Identify the invertebrates: Use the Invertebrate Field Identification Chart to identify the organisms. There are thousands of species and most are difficult to identify. Taxon (plural taxa) is a general term referring to identifiable groups like species, genera, families, orders, or classes. Two different looking organisms usually are different taxa, although sometimes they are two life stages (e.g., larva, pupa) of the same species. Within each broad taxonomic group, distinguish as many kinds of organisms as possible, based on appearance. For example, there may be a few obvious types of caddisflies in a sample. You do not need to name them, just recognize them as different. Use a hand lens (10X magnification) or magnifying glass to examine small organisms.
10. Count the invertebrates: Record the numbers counted (Column B) and the number of identifiable taxa (Column C) for each broad taxonomic group on the Invertebrate Survey

Field Data Sheet (Figure 10). Record the total number and calculate the density (number per m2) in Part A of the Interpretation Sheet. Record the most abundant or predominant taxon in Part B. Return the organisms to the area of the stream you sampled. Occasionally, you may want to preserve a sample for future analysis or teaching, but we usually do not recommend it. To prepare a sample, remove as much water as possible and add concentrated isopropyl or ethyl alcohol to make a 70% solution of alcohol in water. Transfer the sample to a labeled bottle. You can use a tray marked with a grid on it if you find high Streamkeepers Module 4 Stream Invertebrate Survey page 13 The Stewardship Series numbers of one type of organism in the sample. First, remove all the different looking invertebrates, then spread the remaining ones on the gridded tray. Examine a few grid squares and count the average number of individuals per square. Multiply the average number per square by the total number of squares on the tray to get the total number.

Figure 8 Collecting invertebrates in D net (underwater view) Aug 2015

Figure 9 Collecting invertebrates Aug 2015

Figure 10 Counting and sorting invertebrates for indicator tests Aug 2015

4.2.5 Beaver Control

Beavers have been observed using the spawning channels over the last several years. The re-complexing works in 2003 and the resulting year-round watering of the spawning channels creates the ideal situation for beavers to breed: gently flowing water and restored vegetation are ideal for beaver (Sean Bennett, DFO, Pers. Com. 2014).

Control methods were necessary as some of the berms were being impacted by beaver digging into the banks and by higher water flow going over the berms creating erosion issues. Also, beavers were cutting down existing vegetation and revegetation cuttings, slowing down the restoration efforts. Control methods include:

- removal of smaller dams by hand-pulling apart structures
- protection of riparian vegetation through caging of trees/shrubs
- protection of riparian vegetation through painting lower portions of the stems with a linseed oil and sand mixture
- removal of beavers through trapping.

4.3 Results

4.3.1 Water Temperature

Water temperatures from the two monitoring stations at the Lower Spawning Channel (upstream and downstream ends) were again recorded in 2015, building on the data collected since 2010. The data collected in 2015 is depicted in Figure 11 and 12 (note: the large spikes in temperature readings as shown in the graphs are attributed to the day temperature loggers were being downloaded).

The warmer temperatures in the summer can be a stress to fish species, and the water temperatures in the channels are more prone to temperature fluctuations due to the shallow depths found and lack of tall riparian trees and shrubs along the canals in certain reaches (Sean Bennett DFO 2014). A summary of temperatures suitable for specific fish species is referenced according to the Ministry of Environment's "Ambient Water Quality Guidelines for Temperature" (Table 1).

Lower Spawning Channel: Temperature readings were logged every half hour at the Lower Spawning Channel at both the upstream and downstream stations.

There were 11 days when water temperature exceeded 21°C, the temperature maximum before salmon become stressed. The highest temperatures were recorded at the downstream monitoring site in July and August. Water temperatures rose above 21°C on the following days:

- 11, 12 July 2015
- 20 July 2015
- 01, 03, 04, 06 August
- 11, 12, 13 August 2015
- 20 August 2015

The highest recorded temperature occurred on 12 July 2015 with a downstream water temperature of 23.04°C, a difference of 2.199°C between the upstream and downstream logger locations.

Upper Spawning Channel: The temperature loggers at the Upper Spawning Channel were not installed until 28-29 July 2015, after the hottest day of the year was recorded (20 July). Temperature readings were logged every hour for the rest of the year.

There were no days where water temperature exceeded 21°C at the Upper Spawning Channel during the month of August. The highest water temperature of 20.198°C was recorded at the upstream logger on 20 August 2015. The difference in upstream and downstream temperatures varies very little throughout the year, recorded as 0.167°C difference on 20 August 2015. The Upper Spawning Channel has good riparian cover in most of the system, except at the upstream section where there is a lack of riparian trees and shrubs. This area is currently undergoing restoration treatments to increase riparian cover.

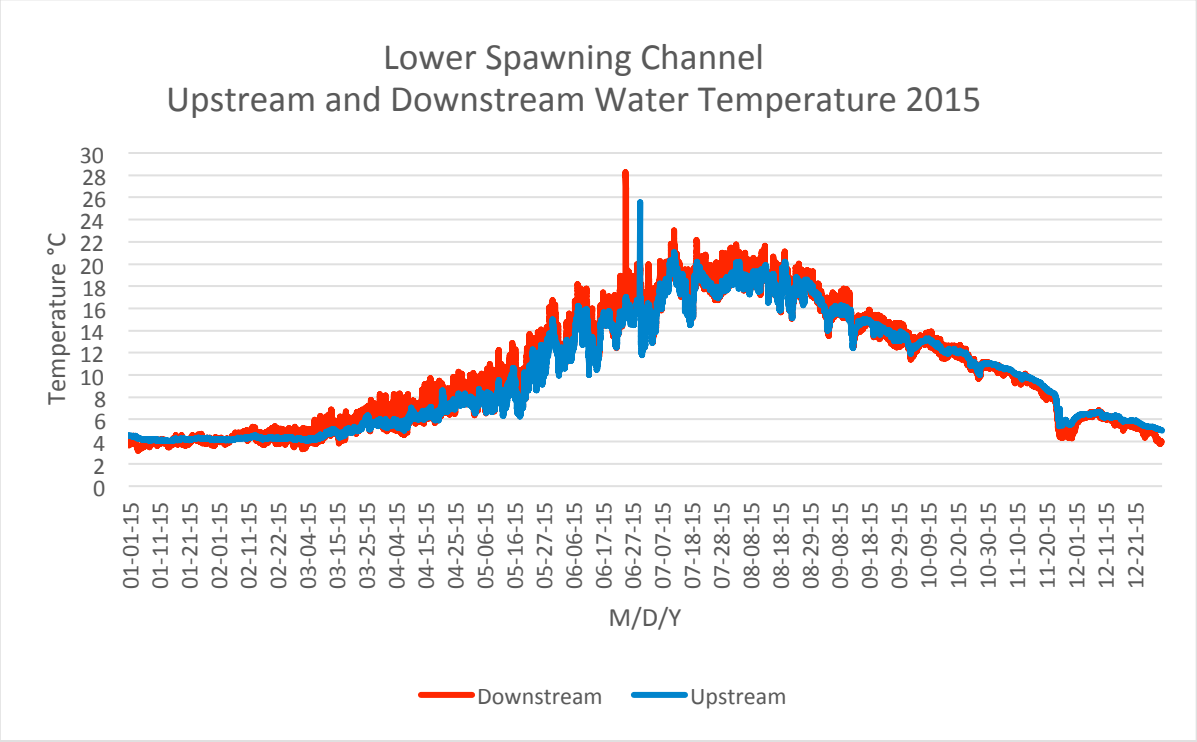


Figure 11 Water Temperature Lower Spawning Channel 2015

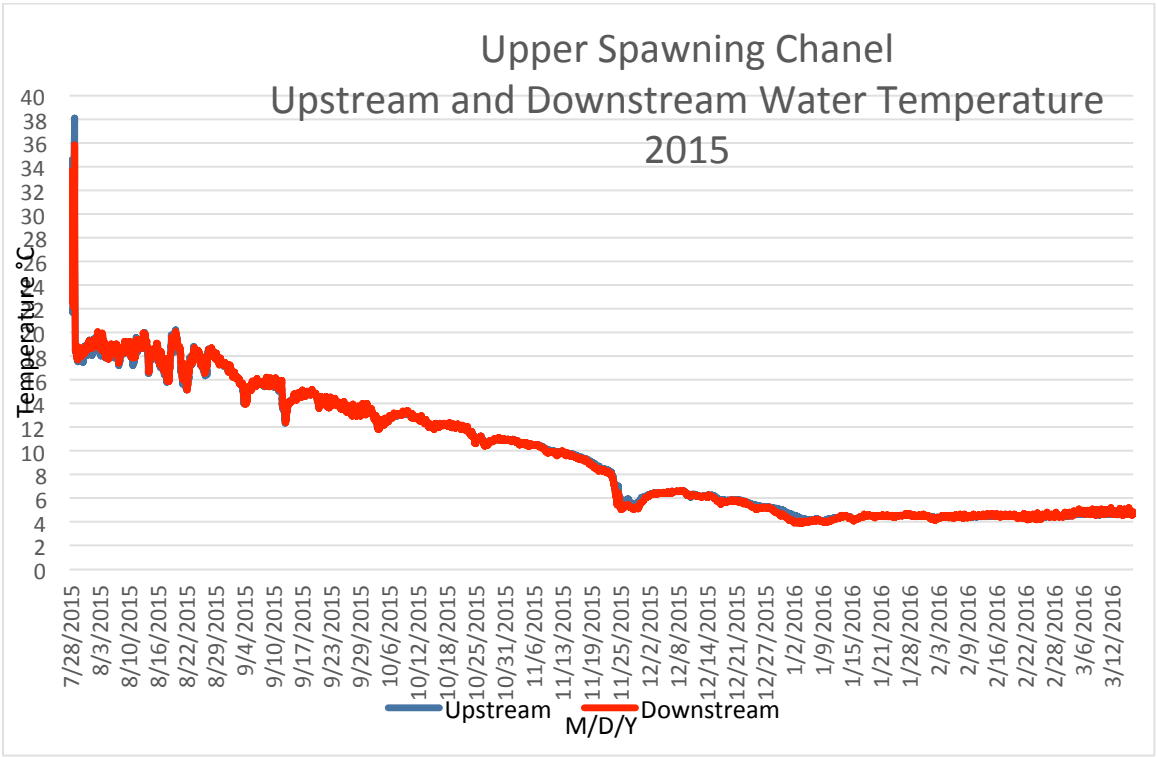


Figure 12 Water Temperature Upper Spawning Channel 2015

Table 1 Optimum Temperature Ranges of Specific Life History Stages of Salmonids and Other Coldwater Species for Guideline Application

Species	Incubation	Rearing	Migration	Spawning
Salmon				
Chinook	5.0-14.0	10.0-15.5	3.3-19.0	5.6-13.9
Chum	4.0-13.0	12.0-14.0	8.3-15.6	7.2-12.8
Coho	4.0-13.0	9.0-16.0	7.2-15.6	4.4-12.8
Pink	4.0-13.0	9.3-15.5	7.2-15.6	7.2-12.8
Sockeye	4.0-13.0	10.0-15.0	7.2-15.6	10.6-12.8
Trout				
Brown	1.0-10.0	6.0-17.6	—	7.2-12.8
Cutthroat	9.0-12.0	7.0-16.0	—	9.0-12.0
Rainbow	10.0-12.0	16.0-18.0	—	10.0-15.5
Char				
Arctic Char	1.5-5.0	5.0-16.0	—	4.0
Brook Trout	1.5-9.0	12.0-18.0	—	7.1-12.8
Bull Trout	2.0-6.0	6.0-14.0	—	5.0-9.0
Dolly Varden	—	8.0-16.0	—	—
Lake Trout	5.0	6.0-17.0	—	10.0
Grayling				
Arctic Grayling	7.0-11.0	10.0-12.0	—	4.0-9.0
Whitefish				
Lake Whitefish	4.0-6.0	12.0-16.0	—	greater than 8.0
Mountain Whitefish	less than 6.0	9.0-12.0	—	less than 6.0
Other Species				
Burbot	4.0-7.0	15.6-18.3	—	0.6-1.7
White Sturgeon	14.0-17.0	—	—	14.0

Source: http://www.env.gov.bc.ca/wat/sq/BCguidelines/temptech/temperature.html

4.3.2 Adult Spawner Remuneration (Instream Fisheries)

Attempts to enumerate all species of adult salmonids spawning in the Seton River system using radio-telemetry, visual counts and PIT tagging continued in 2015.

Steelhead:
Eighteen steelhead adults were PIT tagged at the confluence of the Seton and Fraser river. Five fish remained in the Seton river while the rest were observed in the Bridge River (BRGMON-03). Two of the fish that moved into the Seton River were observed (through PIT telemetry) moving into the lower spawning channel, where they most likely spawned (residence time of 10 days). One of those steelhead was observed moving through the fishway and past Seton Dam. The other two likely spawned in the Seton River or moved back out into the Fraser to continue their migration.

Visual counts were conducted from 04 March to 15 June, at which point spawning was assessed to be complete. Two Steelhead adults were observed in the Seton River Corridor: one on 04 May downstream of Seton Dam and one on 15 June in the Lower Spawning Channel. Water visibility was adequate (0.4 to 3.0 m) throughout the survey.

Coho:
Forty-eight Coho were captured as part of BRGMON-03 at the Bridge River, Fraser confluence. Of these 48 fish, five individuals were detected on the PIT readers in the Seton River corridor. One fish entered the lower spawning channel, two entered the upper spawning channel and the remaining two fish moved through the fishway and past Seton Dam.

Visual counts were conducted from 06 October to 15 December, at which point spawning was assessed to be complete. All of the Coho that were observed were in the Lower (18 individuals total) and Upper (4 individuals total) Spawning Channels, with a peak live fish count of 14 fish in the Lower Spawning Channel on 14 November. Water visibility was adequate (0.5 to 1.0 m) throughout the survey. There were no adult Coho observed in the main stem Seton River.

Chinook:
No Chinook were captured. Visual counts coincided with Pink salmon surveys and began on 04 August and ceased on 13 October, at which time spawning was assessed to be complete. Throughout this period there were no adult Chinook observed.

Pinks:
Attempts were made to enumerate adult pink salmon through a mark-recapture and proportional distribution methods, but tagging efforts produced few marked fish. The low sample size of fish to be distributed throughout the corridor was low and thus a confident/reliable estimate could not be produced. Valuable residence time data was collected through these methods and that value, along with the mean observer efficiency from existing literature was used to create an Area Under the Curve (AUC) estimate. Estimates indicate that the majority of pink spawning is occurring in the lower and upper spawning channels with estimates of 6,117 (95% CI, 0 and 47,540) and 12,433 (95% CI, 7551 and 17,315) individuals respectively. Only 2,541 (95% CI, 1,122 and 3,960 pinks were estimated in the main stem Seton River.

Visual counts were conducted from 04 August to 13 October. Pink salmon occurred in high abundance with a total of 6,562 live individuals observed in the spawning channels and the mainstem of Seton River. Peak live count was 4,347 fish on 21 September, and decreased to

zero fish on 13 October. Much of the pink spawning observed on streamwalks in the Seton River Corridor was located in the Lower (2888 individuals total) and Upper (2577 individuals total) Spawning Channels. Within the Seton River, the highest abundance of pink salmon were observed between Seton Dam and the BRGMON-13 inclined plane trap site on 14 September. Water visibility was adequate (0.5 to 1.5 m) throughout the survey.

DETAILS:

Steelhead

Tag Application and Bio-sampling

In 2015, fish capture attempts commenced at the end of March and continued until the end of May when migration was believed to have ended. Attempts to capture fish were made at the Fraser confluence and at various locations of the Seton River. Eighteen steelhead trout (3 males and 15 females) were captured by angling at the Seton – Fraser and Bridge – Fraser confluences and radio tagged from February 27 to April 19, 2015 as part of a collaborative effort with BRGMON-3. Mean fork lengths of radio-tagged males and females were 874 mm (range: 835 to 935 mm) and 759 mm (range: 630 to 820 mm), respectively (Table 2).

Table 2 Seton River Steelhead and Coho catch data, 2015

Capture Date	Capture Location	Species	Sex	Length (mm)	Catch A/R	PIT Tag ID	Radio Frequency	Radio Code	Angler & Crew
20/03/15	Seton Con.	SHA	F	740	A	230000010008	150.500	32	ES
24/03/15	Seton Con.	SHA	F	800	A	183225159	150.680	67	ES
03/04/15	Seton Con.	SHA	F	724	A	230000010018	150.500	50	RJ
08/04/15	Seton Con.	SHA	F	630	A	183225150	150.500	41	ES
14/04/15	Seton Con.	SHA	F	760	A	183225279	150.500	46	ES
15/10/15	Bridge Con.	COA	F	540	A	183225362	SP		
15/10/15	Bridge Con.	COA	F	495	A	183227082	RJ		
16/10/15	Bridge Con.	COA	M	650	A	183225801	ES		
17/10/15	Bridge Con.	COA	F	530	A	183225445	SP		
03/11/15	Bridge Pool	COA	M	610	A	230000010015	SP		

Fixed and Mobile Tracking

Tags were detected by the series of fixed telemetry stations and by mobile tracking by vehicle and on foot. Five of the 18 steelhead trout (Codes #32, 41, 46, 50, 67) tagged at the Seton – Fraser confluence (1.42 km downstream of LSC entrance) were detected on a radio receiver located at the LSC in the Seton River. Migration rates for these five steelhead trout can be computed by dividing the travel distance (1.42 km) by travel time. Mean rate was 0.3 km/day and ranged from 0.1 to 0.7 km/day (Table 3).

Table 3 Seton River Steelhead fixed telemetry records at Lower Spawning Channel, 2015

Code	Sex	Days to migrate to LSC	Migration rate (km day^{-1})
32	F	15.5	0.1
41	F	2.0	0.7
46	F	5.2	0.3
50	F	7.9	0.2
67	F	10.9	0.1

Four of the five tags (Codes # 41, 46, 50, 67) that entered the Seton River were detected during mobile tracking surveys (Table 4). The remaining 13 fish tagged at the Seton–Fraser confluence did not enter the Seton River and continued upstream to the Bridge River (BRGMON 03, Burnett et al. 2016).

Table 4 Seton River Steelhead mobile tracking data, 2015

Date	Time	Section	Frequency	Code
04/13/15	10:40 AM	CC-HW	150.500	41
04/23/15	-	LSC	150.500	46
04/27/15	2:00 PM	HW-LSC	150.500	46
04/30/15	2:30 PM	LSC	150.680	46
05/07/15	8:50 AM	LSC	150.500	46
05/11/15	9:36 AM	LSC	150.500	46
05/14/15	9:30 AM	LSC	150.500	46
05/22/15	9:00 AM	INT-BRIDGE	150.500	46
05/29/15	8:45 AM	LSC	150.500	46
04/13/15	10:40 AM	INT-BRIDGE	150.500	50
04/17/15	9:00 AM	INT-BRIDGE	150.500	50
04/23/15	-	LSC	150.500	50
04/17/15	9:00 AM	HW-LSC	150.680	67
04/27/15	2:00 PM	S.DAM-IPT	150.680	67

Adult Steelhead in 2015 were also tagged with PIT tags in order to track their movements into various locations in the Seton River corridor. Of the five individuals detected on the radio receiver at the LSC, two (Codes #32, 46) were detected entering and exiting the channel by PIT telemetry. Mobile radio tracking data corroborates PIT telemetry data. These fish entered the LSC on 14 April 1and 20 April and they remained there for approximately 10 days. The fish exited the system on 24 April and 30 April respectively. These fish likely spawned in the LSC. One of the five individuals (Code #67) was detected by a PIT reader passing the Seton Dam fishway. Code #67 entered and exited the fishway on 29 April at 06:56 and 29 April at 07:32,

respectively – this constitutes a passage time of 36 min. Mobile radio tracking data indicate that Code #67 was downstream of the Seton Dam on 27 April at 14:00.

Coho Salmon

Tag Application and Bio-sampling

Efforts to capture Coho salmon adults in the Seton River were reduced in 2015 after the efforts in 2014 did not produce good results. Efforts to capture adult Coho for BRGMON03 were quite successful and forty-eight Coho salmon (20 males and 28 females) were captured by angling and PIT tagged in the Bridge River from 15 October to 10 November 2015. Mean fork lengths of PIT-tagged males and females were 599 mm (range: 460 to 715 mm) and 541 mm (range: 410 to 680 mm), respectively. The significance of these catches are discussed below.

Fixed tracking – PIT tags

Of the 48 Coho salmon captured and tagged at the Bridge – Fraser confluence, 14 individuals moved to upstream reaches of the Bridge River. Of the 34 fish that did not enter the Bridge River, five individuals were detected on PIT readers in the Seton River (Table 5). Code #10015 entered the lower spawning channel on 09 November at 20:54 and exited on 25 November at 07:02 – this fish likely spawned in the channel, and had a residence time of 15.4 days. Two fish (Codes #183225801 and 183225445) passed Seton Dam on 18 October at 11:46 and 20 October at 00:56, respectively. Passage times for these two individuals were 41 and 37 min. Code #183227082 was detected at the entrance of the Seton Dam fishway on 11 November at 05:22 and later entered the upper spawning channel on 11 November at 16:25. Code #183225362 entered the upper spawning channel on 28 October at 23:12, this fish did not leave the spawning channel and was assumed to have spawned there.

Table 5 Seton River Coho PIT telemetry data – 2015

Code	Location	Date and time of entry	Date and time of exit
10015	LSC	2015-11-09 20:54	2015-11-25 07:02
183225801	Seton Dam	2015-10-18 11:05	2015-10-18 11:46
183225445	Seton Dam	2015-10-20 00:19	2015-10-20 00:56
183227082	Seton Dam	2015-11-11 05:22	-
	USC	2015-11-11 16:25	2015-11-12 05:49
183225362	USC	2015-10-28 23:12	Fish (or carcass) did not leave channel

Chinook

Efforts to catch and PIT tag adult Chinook Salmon were unsuccessful and thus the results focus on visual counts completed.

Pinks

Efforts to catch and PIT and Petersen disk tag adult Pink Salmon were successful, but not to the extent that was expected. It was proposed to tag 500 individuals, but after a few attempts at catching the fish the scope of the tagging was reduced. It would require a lot of time and effort to

tag that many fish. Instead two days of tangle netting were set aside each week from 4 – 25 September 2015.

From 10 to 24 September tagging efforts resulted in the capture and tagging of 54 individuals (51 males and 3 females). These fish were captured in tangle nets at a location downstream of the lower spawning channel. Mean fork length of PIT-tagged males and females was 532 mm (range: 460 to 660 mm) and 487 mm (range: 480 to 500 mm), respectively (Table 6). Eight of the 54 PIT-tagged pink salmon were detected on PIT readers throughout the Seton River corridor (Table 7). Of these eight fish, six (11%) were detected entering and exiting the Lower Spawning Channel (LSC) and were assumed to have spawned within the LSC (Table 8). On average these fish had a residence time of 5.3 days. One fish (1.9%) likely spawned in Cayoosh Creek – this individual entered and exited the creek on 18 September at 10:51 and 24 September at 06:37, respectively. Residence time in Cayoosh Creek for this individual was 5.8 days. One fish (1.9%) (Code #18018) was detected by a PIT reader passing the Seton Dam fishway. Code #18018 entered and exited the fishway on 27 September at 00:02 and 27 September at 00:43, respectively – this constitutes a passage time of 41 min.

Table 6 Seton River Pink Salmon tagging data – 2015

Fish No.	Date	Location	Capture Method	Species	Sex	Length (mm)	Disk	PIT Tag ID
1	10-Sep-15	LSC	Tangle Net	PK	M	490	Blue	900_230000018002
2	10-Sep-15	LSC	Tangle Net	PK	M	495	Blue	900_230000018001
3	16-Sep-15	LSC	Tangle Net	PK	M	520	O	900_230000018092
4	16-Sep-15	LSC	Tangle Net	PK	M	520	O	900_230000018101
5	16-Sep-15	LSC	Tangle Net	PK	F	480	P	900_230000018104
6	16-Sep-15	LSC	Tangle Net	PK	M	500	O	900_230000018112
7	16-Sep-15	LSC	Tangle Net	PK	M	520	O	900_230000018105
8	16-Sep-15	LSC	Tangle Net	PK	M	560	O	900_230000018137
9	16-Sep-15	LSC	Tangle Net	PK	M	550	O	900_230000018165
10	16-Sep-15	LSC	Tangle Net	PK	M	550	O	900_230000018133
11	16-Sep-15	LSC	Tangle Net	PK	M	550	O	900_230000018140
12	16-Sep-15	LSC	Tangle Net	PK	M	610	O	900_230000018118
13	16-Sep-15	LSC	Tangle Net	PK	M	565	O	900_230000018149
14	16-Sep-15	LSC	Tangle Net	PK	M	500	O	900_230000018163
15	16-Sep-15	LSC	Tangle Net	PK	M	585	O	900_230000018166
16	16-Sep-15	LSC	Tangle Net	PK	M	535	O	900_230000018166
17	16-Sep-15	LSC	Tangle Net	PK	M	535	O	900_230000018161
18	16-Sep-15	LSC	Tangle Net	PK	M	487	O	900_230000018147
19	16-Sep-15	LSC	Tangle Net	PK	M	525	O	900_230000018186
20	16-Sep-15	LSC	Tangle Net	PK	M	530	O	900_230000018148
21	16-Sep-15	LSC	Tangle Net	PK	F	480	P	900_2300000181807
22	16-Sep-15	LSC	Tangle Net	PK	M	610	O	900_230000018011
23	16-Sep-15	LSC	Tangle Net	PK	M	615	O	900_230000018164
24	16-Sep-15	LSC	Tangle Net	PK	M	510	O	900_230000018117
25	17-Sep-15	LSC	Tangle Net	PK	M	520	O	900_230000018030
26	17-Sep-15	LSC	Tangle Net	PK	M	490	O	900_230000018008

27	17-Sep-15	LSC	Tangle Net	PK	M	480	O	900_230000018098
28	17-Sep-15	LSC	Tangle Net	PK	M	580	O	900_230000018062
29	17-Sep-15	LSC	Tangle Net	PK	M	460	O	900_230000018058
30	17-Sep-15	LSC	Tangle Net	PK	M	550	O	900_230000018034
31	17-Sep-15	LSC	Tangle Net	PK	M	530	O	900_230000018097
32	17-Sep-15	LSC	Tangle Net	PK	M	480	O	900_230000018070
33	17-Sep-15	LSC	Tangle Net	PK	M	460	P	900_230000018056
34	17-Sep-15	LSC	Tangle Net	PK	F	500	P	900_230000018048
35	17-Sep-15	LSC	Tangle Net	PK	M	520	P	900_230000018079
36	17-Sep-15	LSC	Tangle Net	PK	M	480	P	900_230000018023
37	17-Sep-15	LSC	Tangle Net	PK	M	510	P	900_230000018022
38	17-Sep-15	LSC	Tangle Net	PK	M	510	P	900_230000018010
39	17-Sep-15	LSC	Tangle Net	PK	M	580	P	900_230000018018
40	24-Sep-15	LSC	Tangle Net	PK	M	495	O	900_230000018145
41	24-Sep-15	LSC	Tangle Net	PK	M	578	O	900_230000018155
42	24-Sep-15	LSC	Tangle Net	PK	M	511	O	900_230000018025
43	24-Sep-15	LSC	Tangle Net	PK	M	508	O	900_230000018029
44	24-Sep-15	LSC	Tangle Net	PK	M	559	O	900_230000018009
45	24-Sep-15	LSC	Tangle Net	PK	M	539	O	900_230000018157
46	24-Sep-15	LSC	Tangle Net	PK	M	488	O	900_230000018035
47	24-Sep-15	LSC	Tangle Net	PK	M	589	O	900_230000018028
48	24-Sep-15	LSC	Tangle Net	PK	M	589	O	900_230000018014
49	24-Sep-15	LSC	Tangle Net	PK	M	509	O	900_230000018006
50	24-Sep-15	LSC	Tangle Net	PK	M	525	O	900_230000018027
51	30-Sep-15	LSC	Tangle Net	PK	M	479	O	900_230000018033
52	30-Sep-15	LSC	Tangle Net	PK	M	557	O	900_230000018007
53	30-Sep-15	LSC	Tangle Net	PK	M	660	O	900_230000018067
54	30-Sep-15	LSC	Tangle Net	PK	M	520	O	900_230000018066

Table 7 Seton River Pink Salmon PIT telemetry data (Lower Spawning Channel), 2015

Code	Date and time of entry	Date and time of exit	Residence time (days)
18161	2015-09-16 09:57	2015-09-23 15:36	7.2
18034	2015-09-17 00:32	2015-09-21 00:49	4.0
18062	2015-09-17 00:30	2015-09-17 00:48	-
18092	2015-09-17 06:36	2015-09-23 00:45	5.8
18098	2015-09-18 16:48	2015-09-23 01:00	4.3
18035	2015-09-27 00:00	Fish (or carcass) did not leave channel	-
		Mean	5.3
		Minimum	4.0
		Maximum	7.2

Due to the limited number of PIT tags available to be distributed to the various spawning locations, using the proportional distribution method produced really inflated and unrealistic numbers. For example, only 1.9 % of the tags (1fish) migrated past the dam. Using this proportion and knowing that 87,032 Pinks migrated past the dam (Casselman et al. 2015) the resulting estimate would be over 4 million fish downstream of the dam. This method was abandoned for 2015, but shows lots of promise in future years. Instead an AUC estimate using the visual count data was used.

Seton Main stem

Pink visual surveys on the Seton River main stem did not begin until mid-September and thus a portion of the run was not counted. Observer efficiency and residence time could not be calculated and thus the mean value of 0.66 (Perrin and Irvine 1990 and Bue et al. 1998) was used. The residence time of 5.3 days observed in the PIT tagged individuals from the lower spawning channel was also used. The estimate provided from this analysis should be considered a minimum number as the first two weeks of the migration were missed. The spawner abundance estimate created for the lower Seton River main stem in 2015 was 2,541 individuals with 95% confidence intervals of 1,122 and 3,960 (Table 8 Seton River Pink Salmon AUC estimates with confidence intervals, 2015.).

Spawning channels

Visual count, PIT, and Peterson disk tag data was used to estimate the total number of spawners in each of the spawning channels. The visual count data provided us with weekly totals of fish observed. The PIT data allowed us to calculate residence time (5.3 days in LSC) at each of the locations and the visual Peterson disk tags allowed us to calculate observer efficiency (33% in LSC). All this data fed into an AUC model to generate a spawner abundance estimate. Due to the limited number (6 fish) of visual tags that entered the LSC we felt that the observer efficiency was biased low and thus would inflate the total estimate. Instead of using the 33 % value, a value of 66% was used. This value is an average taken from results reported in Perrin and Irvine, 1990 and Bue et al. 1998. None of the Pink Salmon tagged entered the upper spawning channel so the residence time and observer efficiencies calculated for the lower spawning channel were used. Spawner abundance for the lower spawning channel was estimated at 6,117 with lower and upper confidence intervals of 0 and 47,540 respectively. Abundance for the upper spawning channel was estimated at 12,433 spawners with 95% confidence intervals from 7,551 to 17,315 (Table 8 Seton River Pink Salmon AUC estimates with confidence intervals, 2015.).

Table 8 Seton River Pink Salmon AUC estimates with confidence intervals, 2015.

Site	Observer Efficiency (OE)	SE - OE	Survey Life (SL)	SE - SL	Escapement	Escapement SE	Lower 95 CI	Upper 95 CI
LSC	0.664	0.031	5.3	0.74	6117	21134	0	47540
Mainstem	0.664	0.031	5.3	0.74	2541	724	1122	3960
USC	0.664	0.031	5.3	0.74	12433	2491	7551	17315

4.3.3 Juvenile Growth Sampling (Daniel Espinoza, Instream Fisheries)

Juvenile fish growth surveys commenced on 23 April 2015 and continued on a monthly basis through to 20 October 2015. Both the main stem Seton River and the two spawning channel sites were sampled in all months from April to October. In total seven surveys were completed.

Twelve species of fish were observed, including six species of salmonids and six species of non-salmonids (Table 9). Of these species, only Rainbow trout, Coho and Chinook were caught in sufficient numbers to show the presence of discrete age classes. Smaller fish, most likely young of the year, had a higher and more consistent capture rate than large fish and thus provided a larger sample size for analysis.

Four distinct age classes of Rainbow Trout were observed (0+, 1, 2, and 3+), while two age classes were identified for Coho and Chinook: age one (1) fish in the spring, and young-of-the-year (0) throughout the rest of the year. The presence of young of the year Chinook in higher abundances was interesting as only one adult was observed in 2014. For detailed information on results see Appendix 2: Juvenile Growth Sampling Results – Seton River and Spawning Channels 2015.

Table 9 Total number of fish caught – Juvenile growth sampling surveys 2015

Species		Site	N
SALMONIDS			
Rainbow Trout	*Oncorhynchus mykiss*	Seton River	541
Rainbow Trout	*O. mykiss*	Spawning channel	118
Bull Trout	*Salvelinus confluentus*	Spawning channel	1
Coho	*0. Kisutch*	Seton River	288
Coho	*0. Kisutch*	Spawning channel	158
Chinook	*0. tshawytscha*	Seton River	177
Chinook	*0. tshawytscha*	Spawning channel	19
Sockeye	*O. nerka*	Seton River	23
Sockeye	*O. nerka*	Spawning channel	1
Mountain Whitefish	*Prosopium williamsoni*	Seton River	7
NON-SALMONIDS			
Bridgelip Sucker	*Catostomus columbianus*	Seton River	23
Bridgelip Sucker	*Catostomus columbianus*	Spawning channel	24
Prickly Sculpin	*Cottus asper*	Seton River	28
Prickly Sculpin	*Cottus asper*	Spawning channel	38
Coast-range sculpin	*Cottus aleuticus*	Seton River	169
Coast-range sculpin	*Cottus aleuticus*	Spawning channel	43
sculpin	*Cottus sp*	Seton River	17
sculpin	*Cottus sp*	Spawning channel	7
Longnose Dace	*Rhinichthys cataractae*	Seton River	282
Longnose Dace	*Rhinichthys cataractae*	Spawning channel	203
Redside Shinner	*Richardsonius balteatus*	Seton River	8
Redside Shinner	*Richardsonius balteatus*	Spawning channel	5
Peamouth Chub	*Mylocheilus caurinus*	Seton River	1

4.3.4 Spawning Gravel Cleaning

Gravel Cleaning Treatments

As noted above, fourteen sites were chosen as target areas for spawning gravel cleaning using the 'Sand Wand" technology, based on the joint DFO and Splitrock Environmental Sekw'el'was gravel permeability study conducted throughout the Lower and Upper Spawning Channels in 2012 (Hillaby, 2013).

Cleaning took place in August 2015 using 'Sand Wand' technology (Figure 13). Since the gravel cleaning process was faster than expected, 1512m^2 was cleaned as compared to the proposed amount of 840m^2. This represents an increase in cleaned areas of 672m^2 (Map 7). Silts removed from the system were deposited in areas were restoration works were planned.

Crew technicians, using garden rakes (Figure 14), cleaned an additional area of 69m2 based on recommendations from Sean Bennett, DFO (Map 7). The aim behind this idea is to compare a simple raking method to cleaning gravels compared to 'Sand Wand' treated areas.

Four control sites, for a total of 305m2, were no cleaning took place, were also established as part of the ongoing monitoring program (Map 7).

Figure 13 Cleaning gravels using SandWand technology Aug 2015

Figure 14 Cleaning gravels using rakes Aug 2015

Figure 15 Cleaned gravels after completing area Aug 2015

Map 7 Gravel and Control Site Locations Lower Spawning Channel 2015

Gravel Cleaning Monitoring

Photo monitoring, aquatic invertebrate monitoring, and adult spawner count protocols were set up and followed by crew technicians. Baseline data was collected in 2015 after cleaning had take place. This monitoring will continue in 2016 to assess the outcome of the cleaning work. One oversight was to undertake a baseline before the cleaning work commenced.

Photo Monitoring

Below are a selection of photo monitoring results where visibility conditions were suitable (Figure 16, 17, 18, 19).

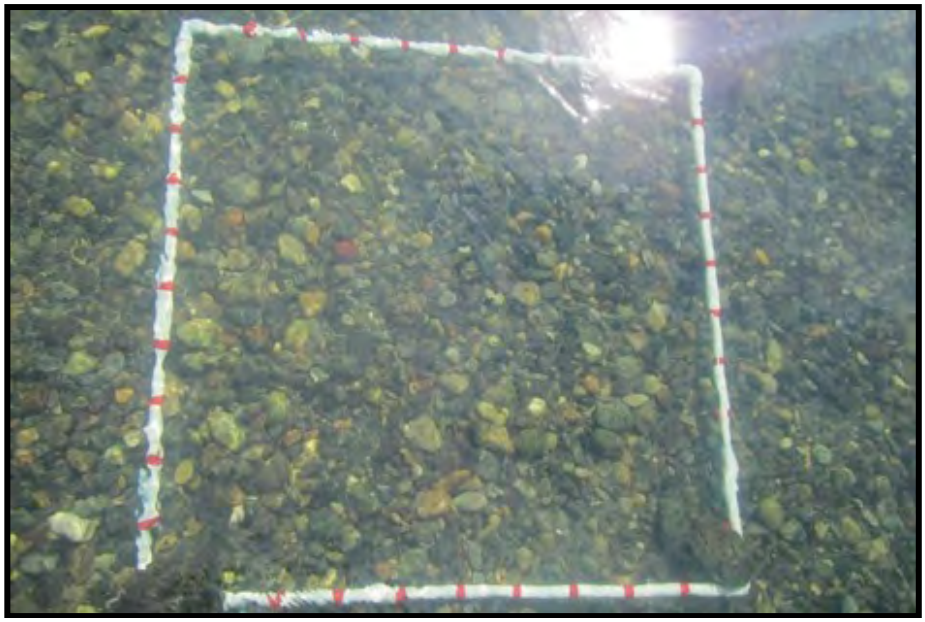


Figure 16 Poly P Photo Point 9

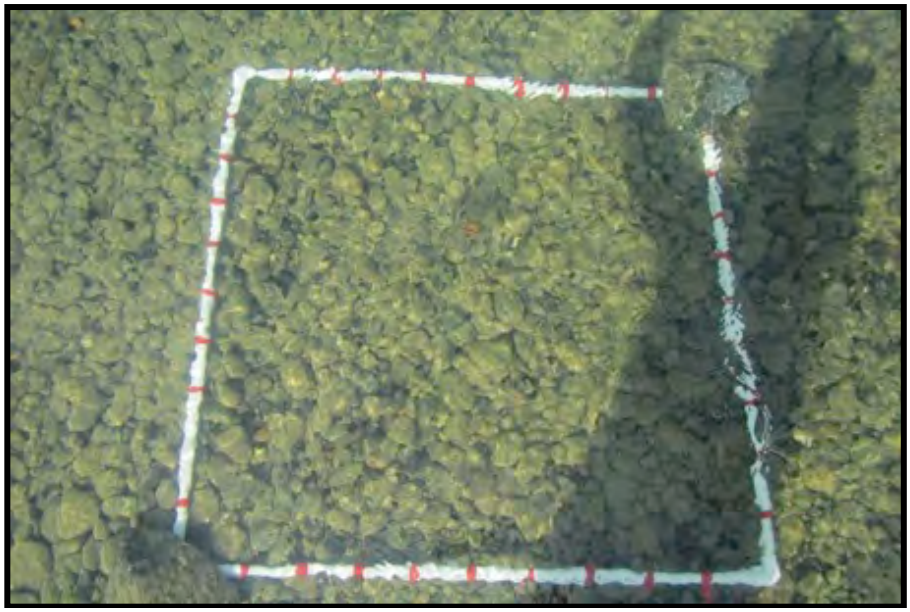


Figure 17 Control 4 Photo Point 6

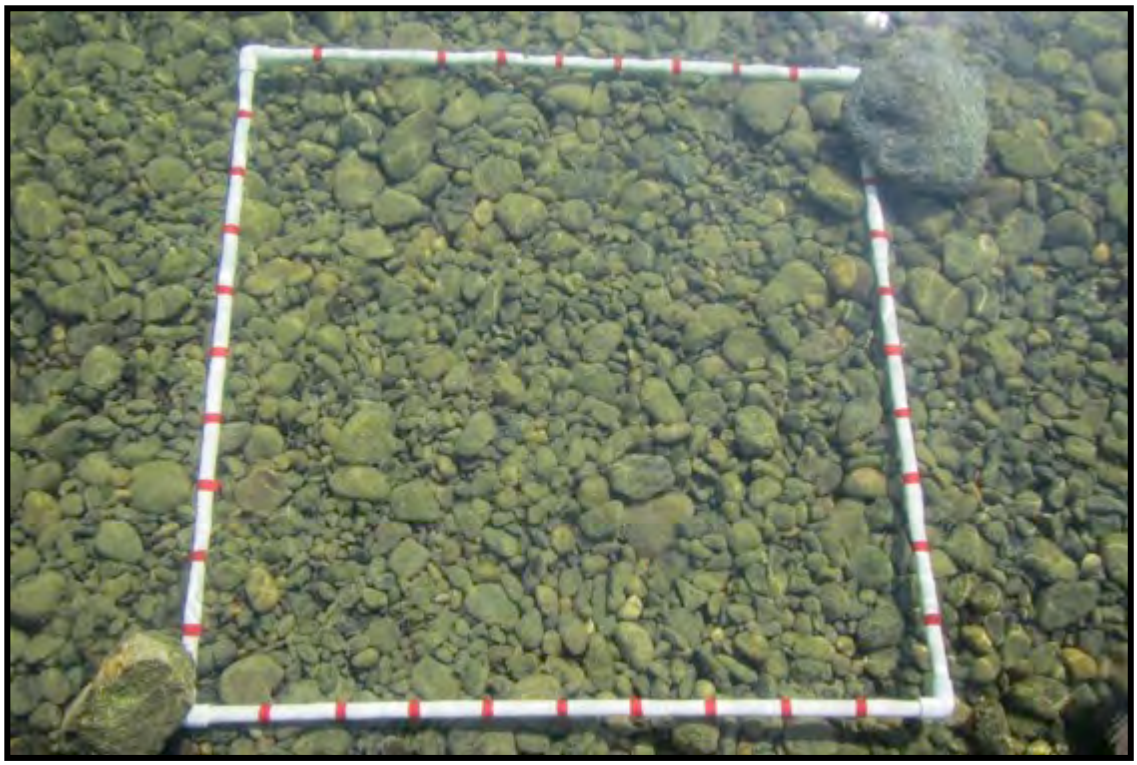


Figure 18 Poly 7 Photo Point 3

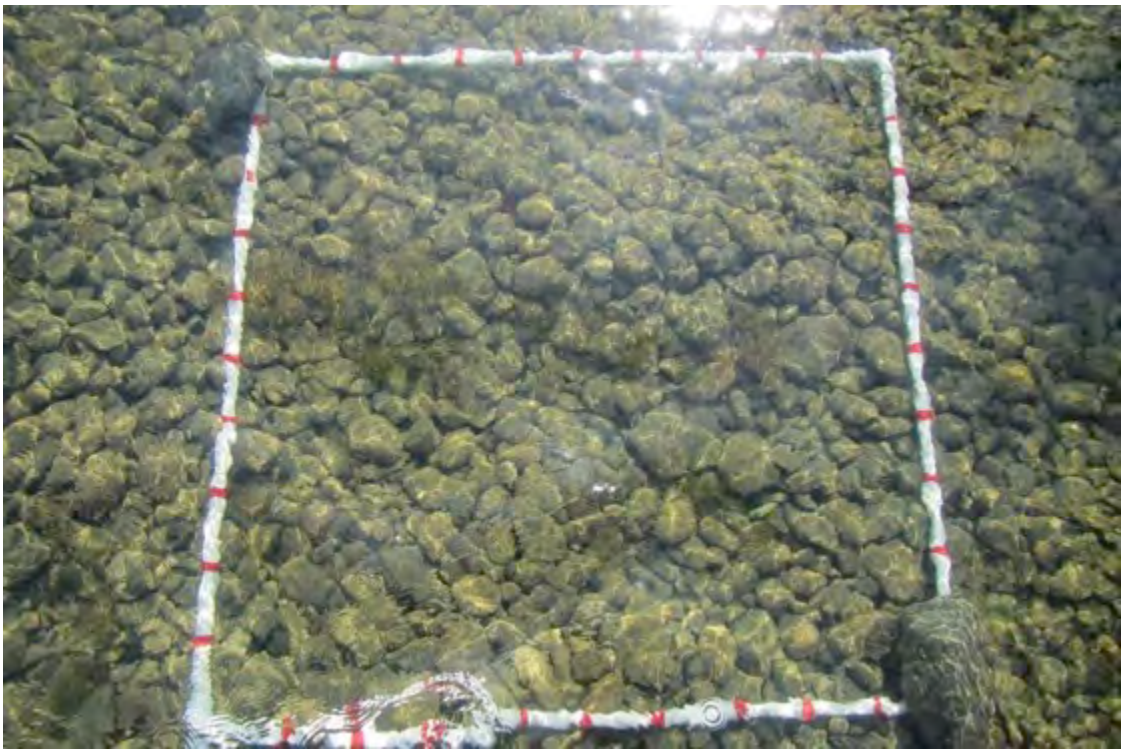


Figure 19 Control 3 Photo Point 5

Invertebrate Sampling

After gravel cleaning treatments took place, the invertebrate sampling monitoring plan commenced in order to assess water quality (Figure 20). Table 10 shows the results of the baseline survey which occurred shortly after the cleaning treatments. Note that some of the invertebrate sampling results reflect poor water quality in the cleaned areas. This result is likely because the cleaned areas were recently flushed of sediments and many invertebrates were probably carried with them. Future monitoring will determine if invertebrate levels return or increase past control levels.

Table 10 Invertebrate Sampling Gravel Cleaning Monitoring Lower Spawning Channel 2015

Date	Reach	Location	Total # of organisms	Inverteb Density	Dominant Taxon	Pollution Tolerant Index	EPT to Total Ratio	Dominant Taxon Ratio
31-Aug-15	9	Poly F	32	118.5185	caddisfly larva	82	1.06	0.37
28-Aug-15	2	Poly B	23	85.18519	mayfly nymph	57	0.74	0.35
28-Aug-15	3	CO3	60	222.2222	mayfly nymph	134	0.57	0.37
26-Aug-15	10	CO 4	61	225.9259	mayfly nymph	148	0.64	0.44
26-Aug-15	10*	Poly J	13	48.14815	aquatic worm	23	0.38	0.38
25-Aug-15	9 *	CO 3	51	188.8889	mayfly nymph	125	0.63	0.43
26-Aug-15	7 *	Poly F	54	200	aquatic worm	110	0.44	0.35

** These reaches were not complexed*

Figure 20 Crews sorting aquatic invertebrates 28 Aug 2015

4.3.5 Beaver Control

During 2015-16, beaver control was not as much of an issue as in 2014-15. Crews monitored the cuttings planted over the past several years on an ongoing basis and little damage was observed throughout the season. The protection of cuttings using a linseed oil/sand mixture was observed to be effective.

No new beaver lodges were constructed, but increased presence of beaver activity cutting existing vegetation was observed in November and December 2015. One beaver was removed in December and no further damage was observed until March 2016 (Figure 21, 22).

Spawning Channel Committee members continue to recommend beaver control as the only option in the man-made system, to ensure bank structure is not comprised and vegetation is protected.

Figure 21 Beaver dam being removed 19 Oct 2015

Figure 22 Beaver dam removed 19 Oct 2015

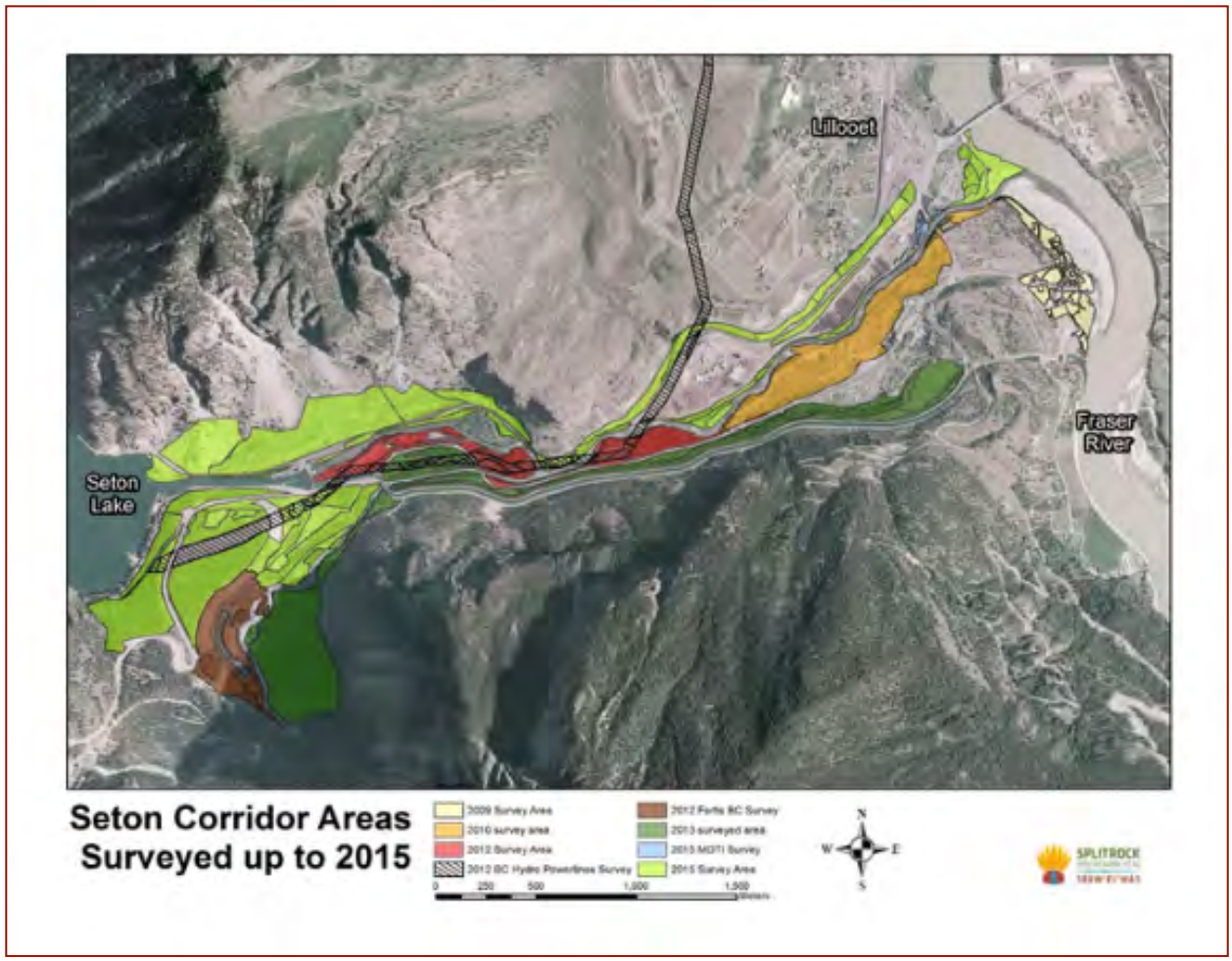
Chapter 5. Habitat Mapping

5.1 Introduction

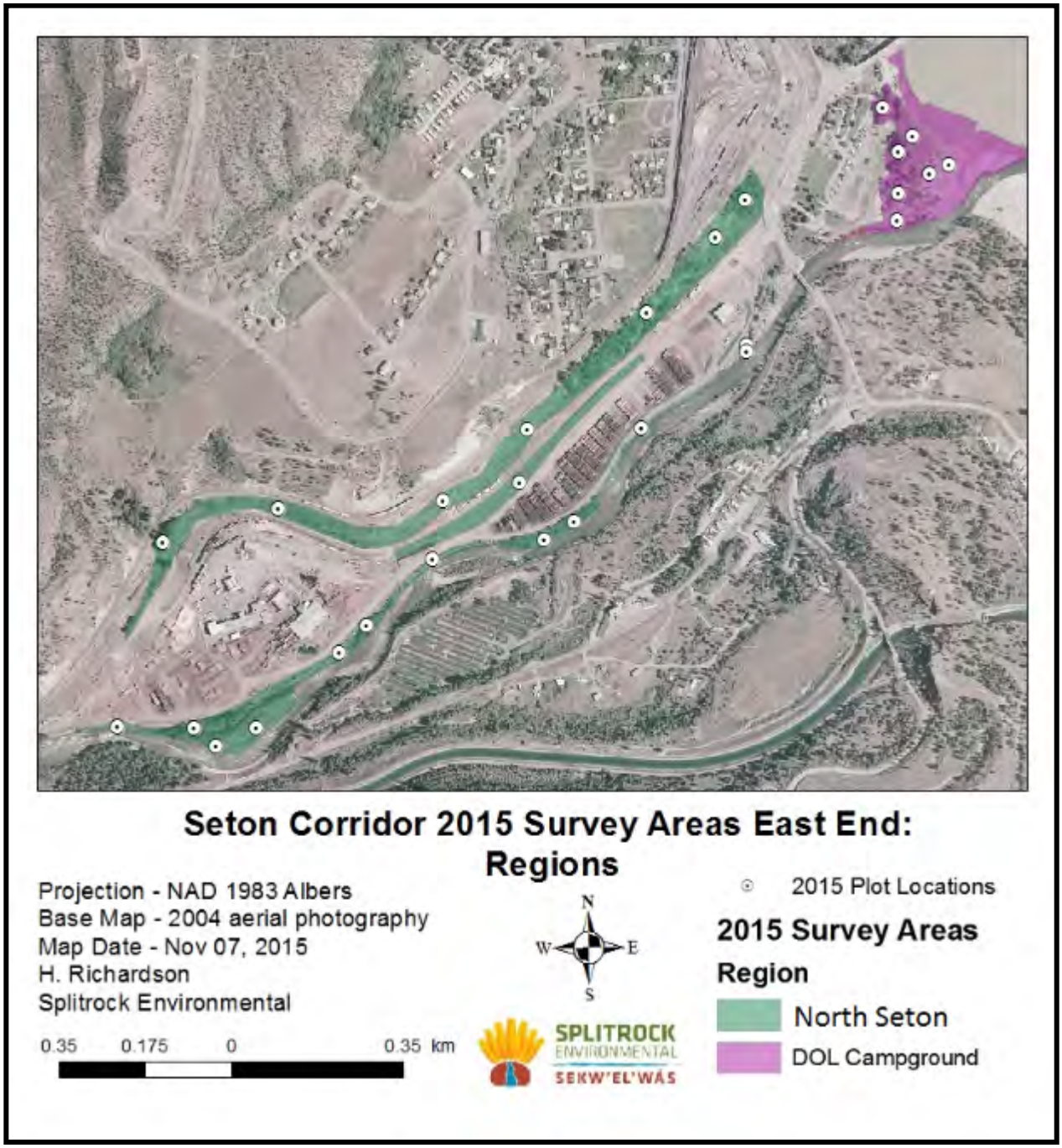
107 hectares of the Seton River Corridor were surveyed during the 2015-16 FWCP project. These areas were targeted in order to continue our survey work from the previous years and prioritize the most ecologically important regions.

The vegetation work that has been completed over the last several years (Map 8) provides an excellent understanding of the habitat and vegetation stands within the corridor. We remain on track for completion of the survey work next year when all the years' results will be compiled

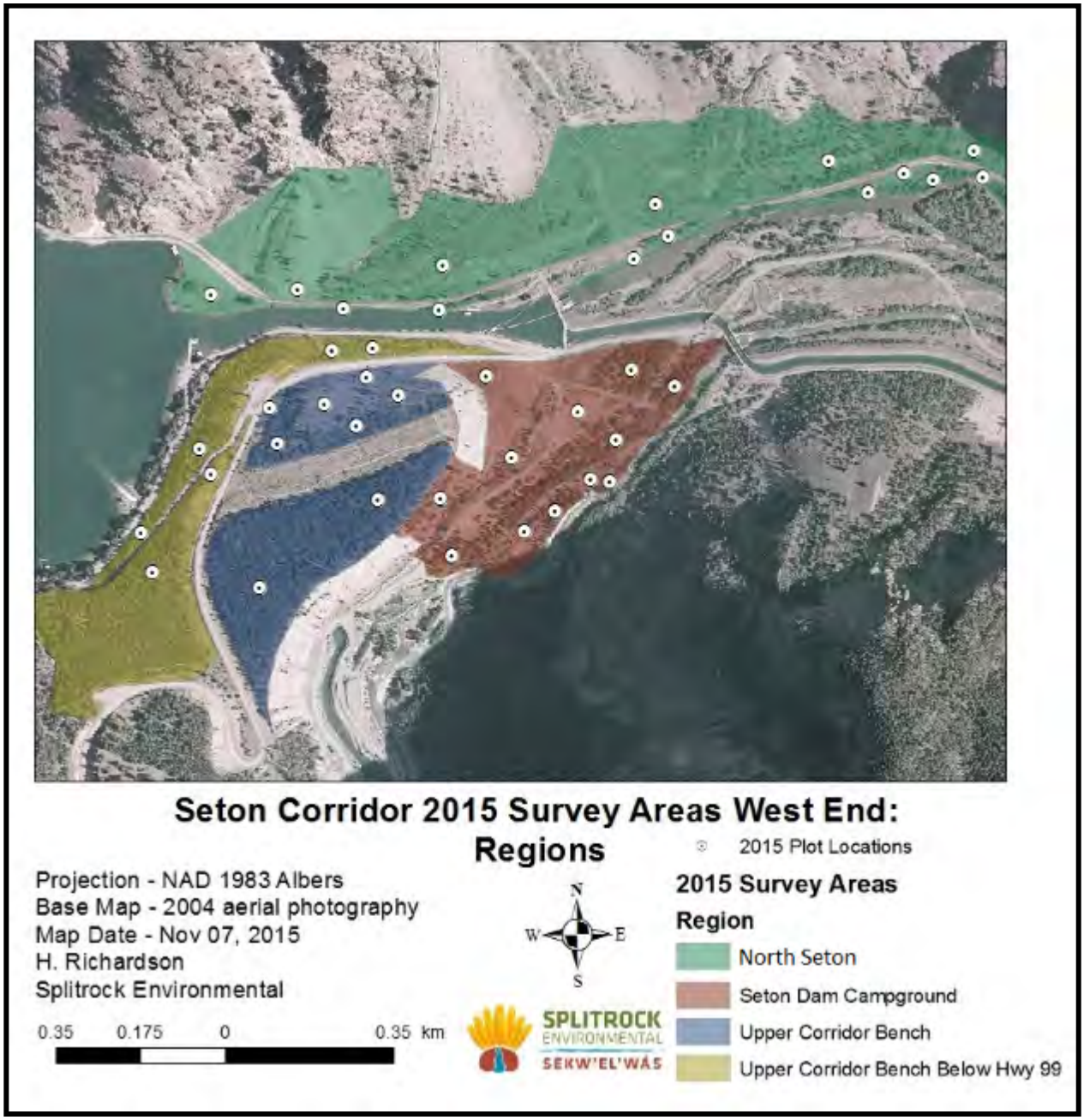
Field lead, Heather Richardson, and environmental technicians completed the surveys between 14 – 25 September 2015. The areas surveyed in 2015 included the area north of Seton River including the Aspen Planers property, the upper corridor bench, the upper corridor slopes below Highway 99, the Seton Dam campground, and the District of Lillooet campground (Map 9, 10).



Map 8 Seton Corridor Areas Surveyed 2009 – 2015



Map 9 Seton Corridor 2015 Survey Areas - East End



Map 10 Seton Corridor 2015 Survey Areas - West End

5.2 Methods

Habitat polygons were delineated using 2006 ortho-photography. The resulting polygons that make up this region were then ground inventoried and surveyed using sections of the BC Governments "Field Manual for Describing Terrestrial Ecosystems, LMH-25". Due to the range of ecosystem types in the corridor, inventory sampling plots varied in size from 400m² to 25m². Larger plots were used in forest stands in order to capture the diversity present whereas smaller plots could more easily represent a grassland area. Visual plots were used when areas were too dangerous to access or if walking on the site would cause too much disturbance.

Polygons were classified by structural and successional stage, and biogeoclimatic unit. Site characteristics, including vegetative cover by layer, slope and aspect, soil texture and substrate cover and site disturbance were all recorded (Figure 23). In forested polygons tree mensuration was conducted to assess the age and successional status of the stands (Figures 24).

As well as conducting inventories and surveys at each plot, signs of wildlife use were recorded with an additional focus on identifying the locations of major wildlife trails.

Maps of the polygons to be surveyed were carried into the field and polygon adjustments were made on site and later modified on the Arc View software. Polygon data was collected using plots and visual inspection depending on the size of the polygon and the habitat type. Data was compiled to represent vegetation cover for each plot.

Environmental crew technicians carried out the survey work using the following equipment:

- GPS, measuring tape (30 to 50 m), compass, clinometer
- field reference sheets (compiled from Describing Terrestrial Ecosystems, Riparian Restoration Survey Book, Site Identification and Interpretation for the Kamloops Forest District)
- Maps, Plants of the Southern Interior, bird, and insect identification books
- planting shovel, small tarp or sheet of plastic for soil pits, small water bottle for soil texture tests, soil screens 2mm and 1⁄4 inch
- camera, ducks back notebook with blank paper, small ruler
- hand lens for plant and grass ID, plastic bags for plant collections
- 1mx1m plot frame for grass/herbaceous sampling, increment bore, diameter tape, plot cords and flagging tape.

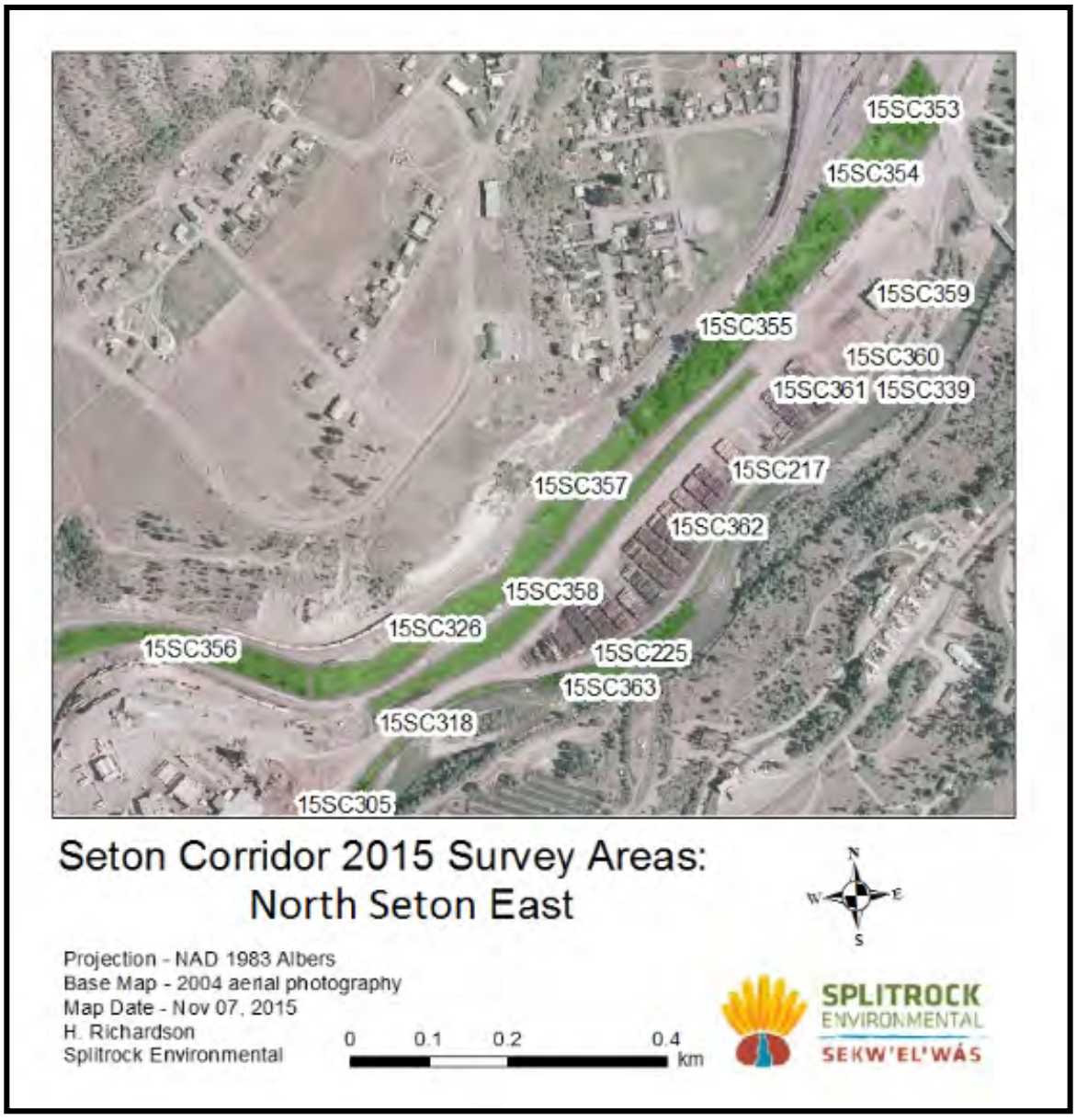
Figure 23 Habitat Survey 25 Sept 2015

Figure 24 Extracting core from tree to determine age Sept 2015

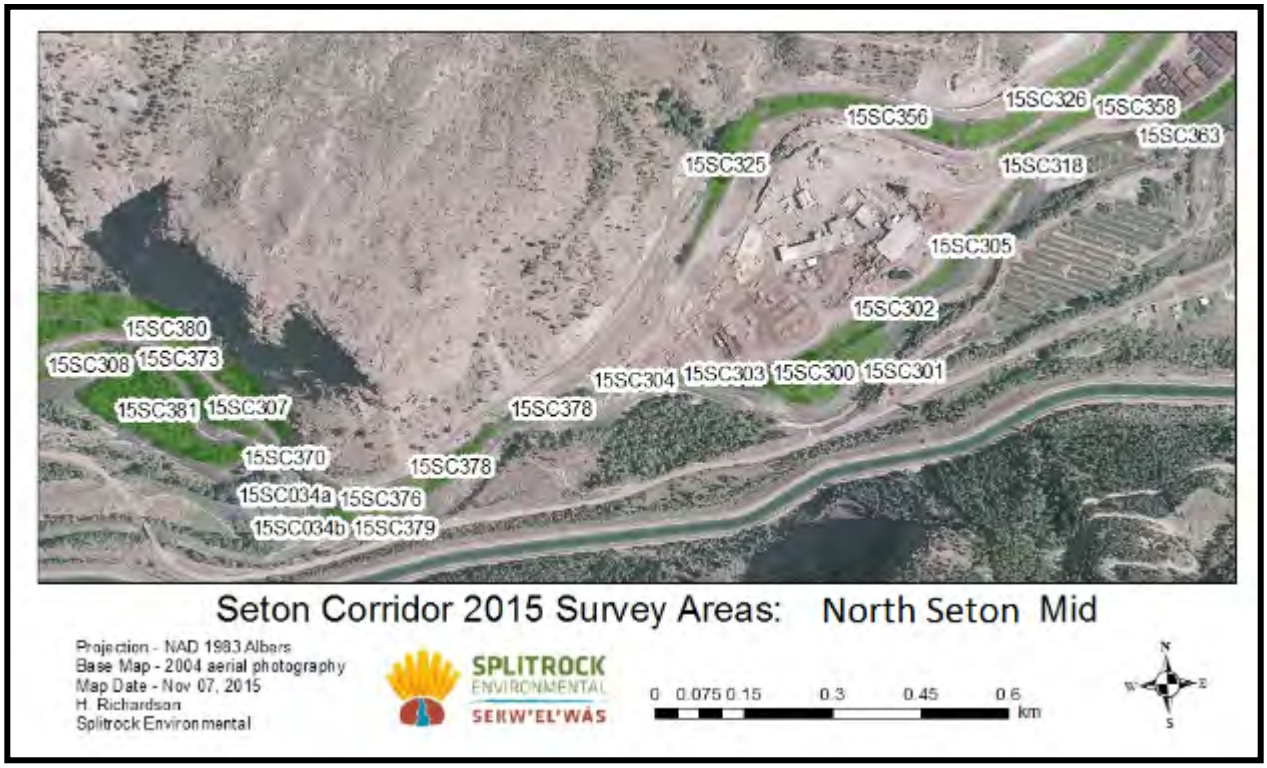
5.3 Results

5.3.1 North Seton River

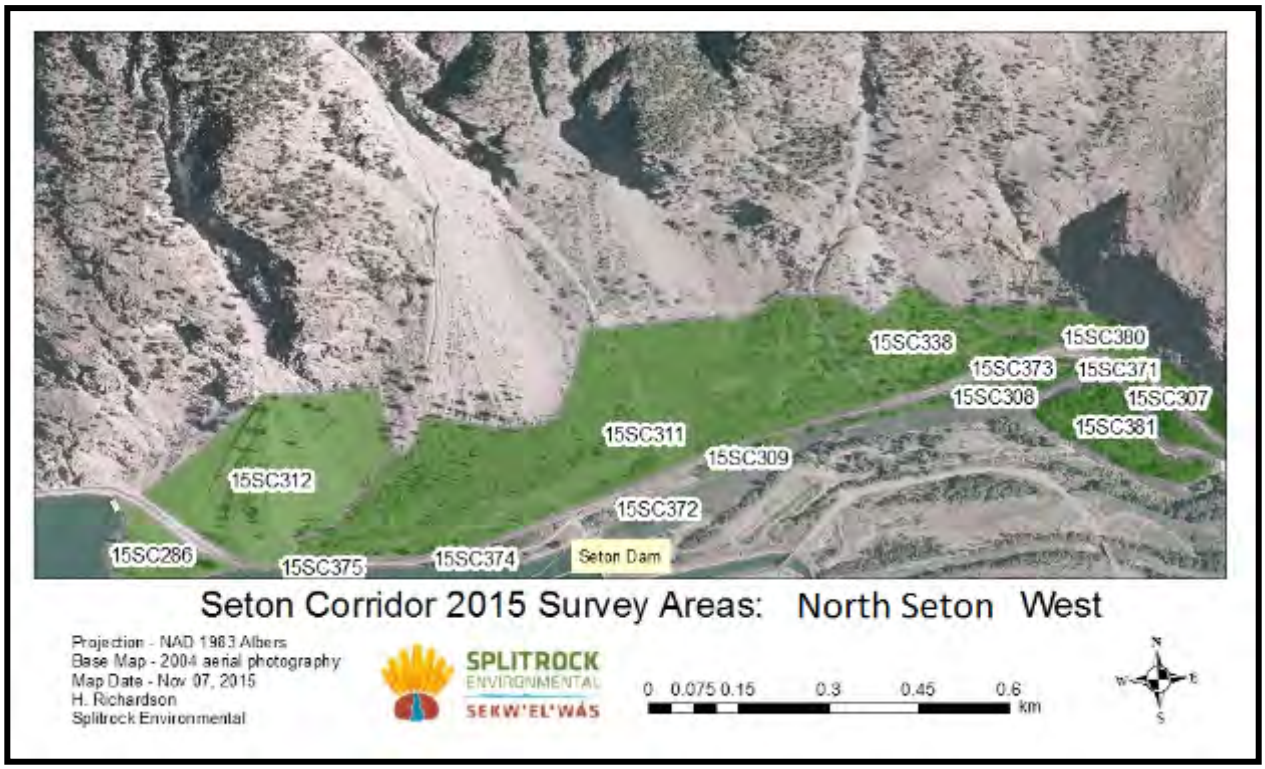
Land on the North shore of Seton River was surveyed during September 2015. Lands included property managed by Aspen Planers and CN Rail, as well as lands around Marriage Rock and the slopes above CN Rail out to Seton Lake (Map 11, 12, 13).



Map 11 Seton Corridor 2015 Survey Areas - North-east



Map 12 Seton Corridor 2015 Survey Areas - North Mid Corridor



Map 13 Seton Corridor 2015 Survey Areas - North-west

Aspen Planer's land is leased from Cayoosh Creek Indian bank and T'it'qet Indian band.

On the eastern end of the property where most of the industrial activity occurs, the land falls into the Ponderosa Pine BEC zone because the aspect and slope allows more sunlight to reach these areas. At this end, surveying was conducted on 53 ha of land along the riparian areas, on the slopes below the railway, along wetland ditches, and across a few grassland slopes within the work yard. Due to time restraints, polygons 15SC324, 15SC368, 15SC367, 15SC323, 15SC366, 15SC365, 15SC322, 15SC371, 15SC370, 15SC369, 15SC324, and 15SC368 were not sampled.

The western side of the property falls into the Interior Douglas-fir BEC zone. Here, survey work took place on the steep slopes above and below the railway.

Due to the steep slope of the north riparian areas of the Seton River and the disturbance from the construction and maintenance of an Aspen Planers road and CN railway within close proximity, much of the riparian zones are at bare or pioneer stages: Polygons 15SC217, 15SC339, 15SC318 (Figure 25), 15SC375, 15SC310, 15SC372, 15SC309, 15SC304 (Figure 26), 15SC302, 15SC370, and 15SC379. These areas consist of riprap or talus slope with limited cover of big sagebrush (*Artemisia tridentate*), rabbitbrush (*Chrysothamnus nauseosus*), penstemon (*Penstemon procerus),* silverleaf phacelia (*Phacelia hastate),* alfalfa (*Medicago sativa*), and tall tumble mustard (*Sisymbrium altissium*).

Figure 25 Polygon 318 Plot 74 - talus slope

Figure 26 Polygon 304 Plot 53 - sparse riparian area

Though most of the riparian areas are narrow, steep, and poorly vegetated, Polygons 15SC305, 15SC300, 15SC304, 15SC307 (Figure 27), 15SC308, and 15SC301 represent relatively healthy riparian areas. Several wildlife trails were recorded through these areas.

Notably, Polygon 307 is a mature, densely vegetated, mixed forest comprised of old Douglas-fir *(Pseudotsuga menziesii)* (>70 years old), black cottonwood (*Populus balsamifera*), Douglas maple (*Acer glabrum*), Saskatoon berry (*Amelanchier alnifolia*), Oregon grape (*Mahonia aquifolium*), prickly rose (*Rosa acicularis),* and paper birch (*Betula papyrifera*). Several trees were observed to have bear scratches and wildlife trails ran through the polygon.

The other riparian polygons have similar species including black cottonwood, mock orange (*Philadelphus lewisii),* Saskatoon, Douglas maple, prickly rose, and Oregon grape; however, these areas were less densely vegetated than Polygon 307.

Figure 27 Polygon 307 Plot 81 - mature mixed forest riparian area

Polygons 15SC326 (Figure 28), 15SC307, 15SC356, and 15SC312 are dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*), big sagebrush, tall tumble mustard, and cheatgrass (*Bromus tectorum*). Though these areas have minimal vegetation cover, they are often grasslands of pioneer successional status because of the dry and unstable terrain.

Polygons 15SC380, 15SC338, and 15SC311 are open forests and tall shrublands populated with Douglas-fir, Saskatoon, mock orange, smooth sumac (*Rhus glabra*), big sagebrush, and rabbitbrush.

Polygons 15SC355, 15SC325, and 15SC353 are areas of thick mixed forest near the entrance to Aspen Planers and Highway 99. Since several streams run through these polygons, the thick understory includes shrubs such as red-osier dogwood (*Cornus stolonifera)* and clematis *(Clematis ligusticifolia).* Polygons 15SC357 and 15SC354 have been harvested and have dried streambeds running through them.

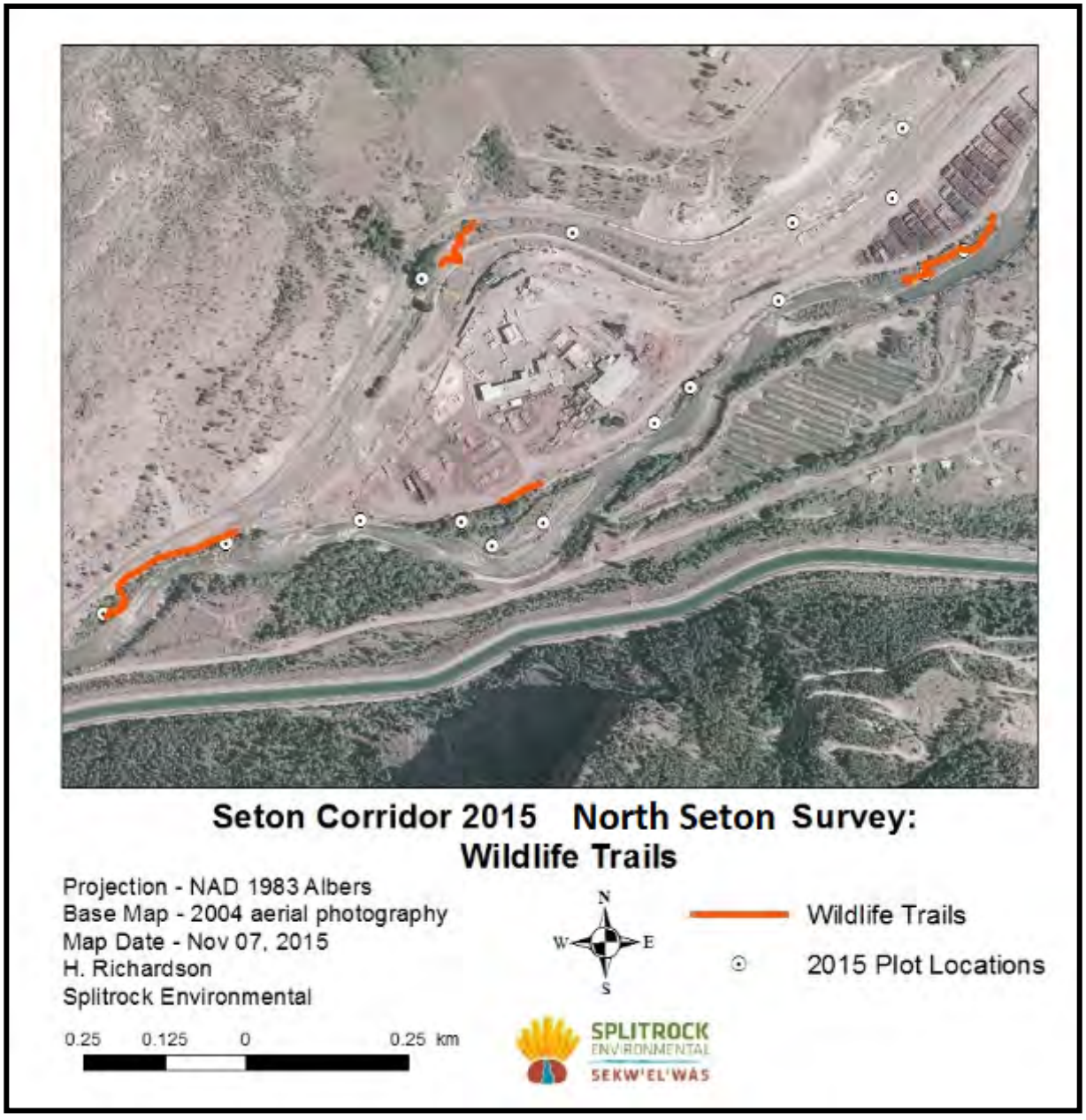
The thinly vegetated disturbed flats within Aspen Planers - Polygons 15SC305, 15SC376 (Figure 29), 15SC373, 15SC302, 15SC310, 15SC375, and 15SC286 - are of pioneer successional status.

Figure 28 Polygon 326 Plot 40 - grassland slope

Figure 29 Polygon 376 - thinly vegetated disturbed flat

Wildlife Trails

Wildlife trails encountered during the survey work along riparian areas and below the railway line were recorded and mapped (Map 14).



Map 14 Seton Corridor 2015 Wildlife Trials - north

Wetlands/Wetted Areas

Polygons 15SC361, 15SC360, and 15SC359 are small wetland patches in the parking lot area near the entrance to Aspen Planers. These polygons correspond to W03, W02, and W01 in Table 11. To the Northeast is a larger piece of wetland (W04, W10, W11, and W14) that was not surveyed this year; however work has occurred at this site in previous years. At the base of Polygon 15SC353, a stream running down the slope meets a wetland (W15, W16, W17) and flows underground to the large wetland approximately 100 m away (Map 15).

Table 11: Locations and descriptions of wetlands on North Seton River 2015

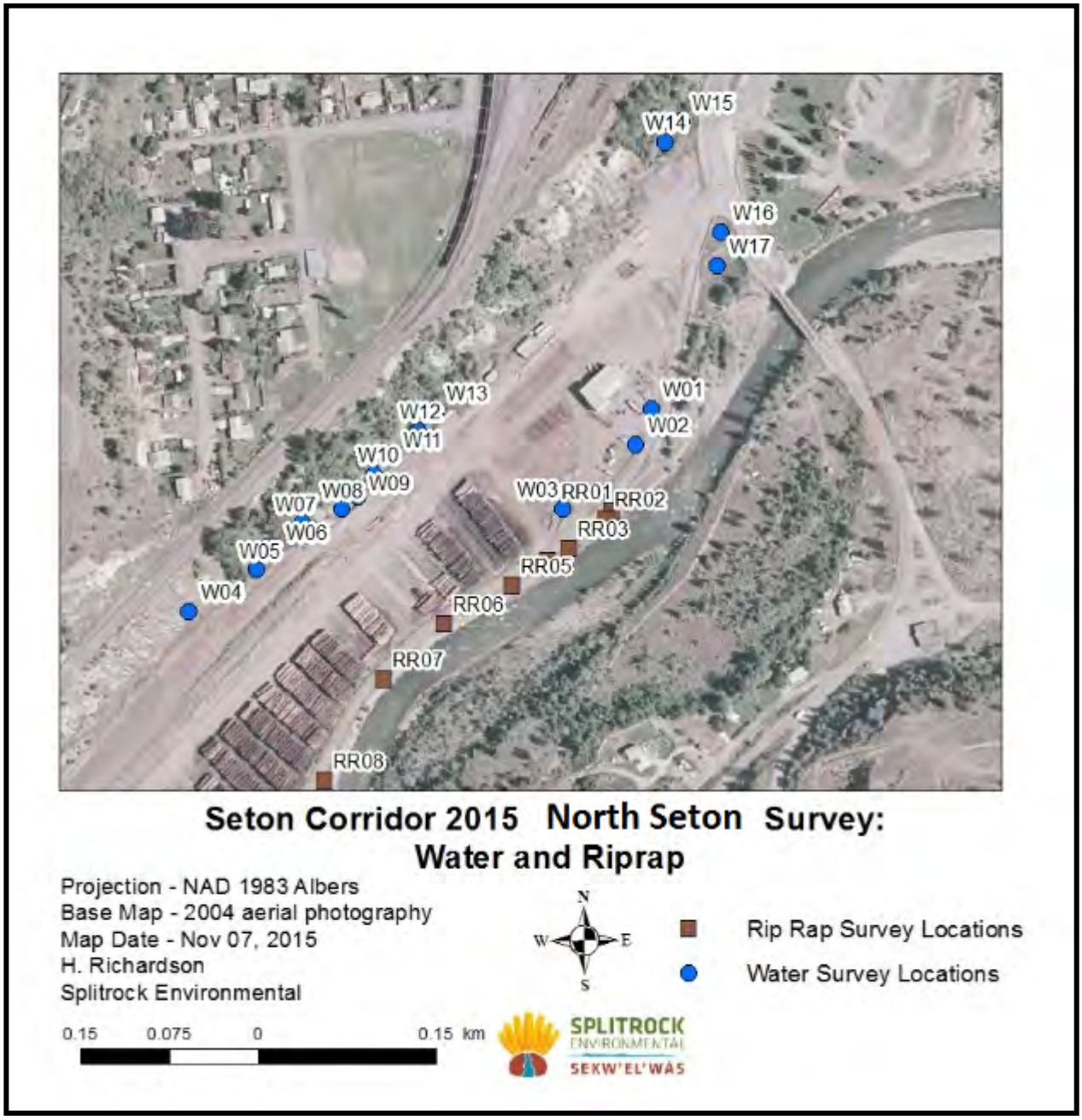
ID	Description	Latitude	Longitude
W01	Small ditch near eastern buildings	50.67832	-121.935
W02	Small ditch near eastern buildings	50.67806	-121.935
W03	Small ditch near eastern buildings	50.67757	-121.936
W04	Culvert; drainage pipe on upper slopes	50.67683	-121.94
W10	Steam entrance into wetland	50.67786	-121.938
W11	Base of stream flowing into upper tier of large wetland near highway	50.67802	-121.938
W14	Wetland	50.68035	-121.934
W15	Large creek running into culvert	50.6805	-121.934
W16	Where culvert drains into large wetland	50.67966	-121.934
W17	Wetland and natural spring	50.67941	-121.934

Riprap

Riprap along the Seton River was surveyed to identify how intact it is and how easily it could be planted with riparian shrub cuttings (Map 15,Table 12 Locations and descriptions of riprap areas along North bank of Seton River 2015).

Table 12 Locations and descriptions of riprap areas along North bank of Seton River 2015)

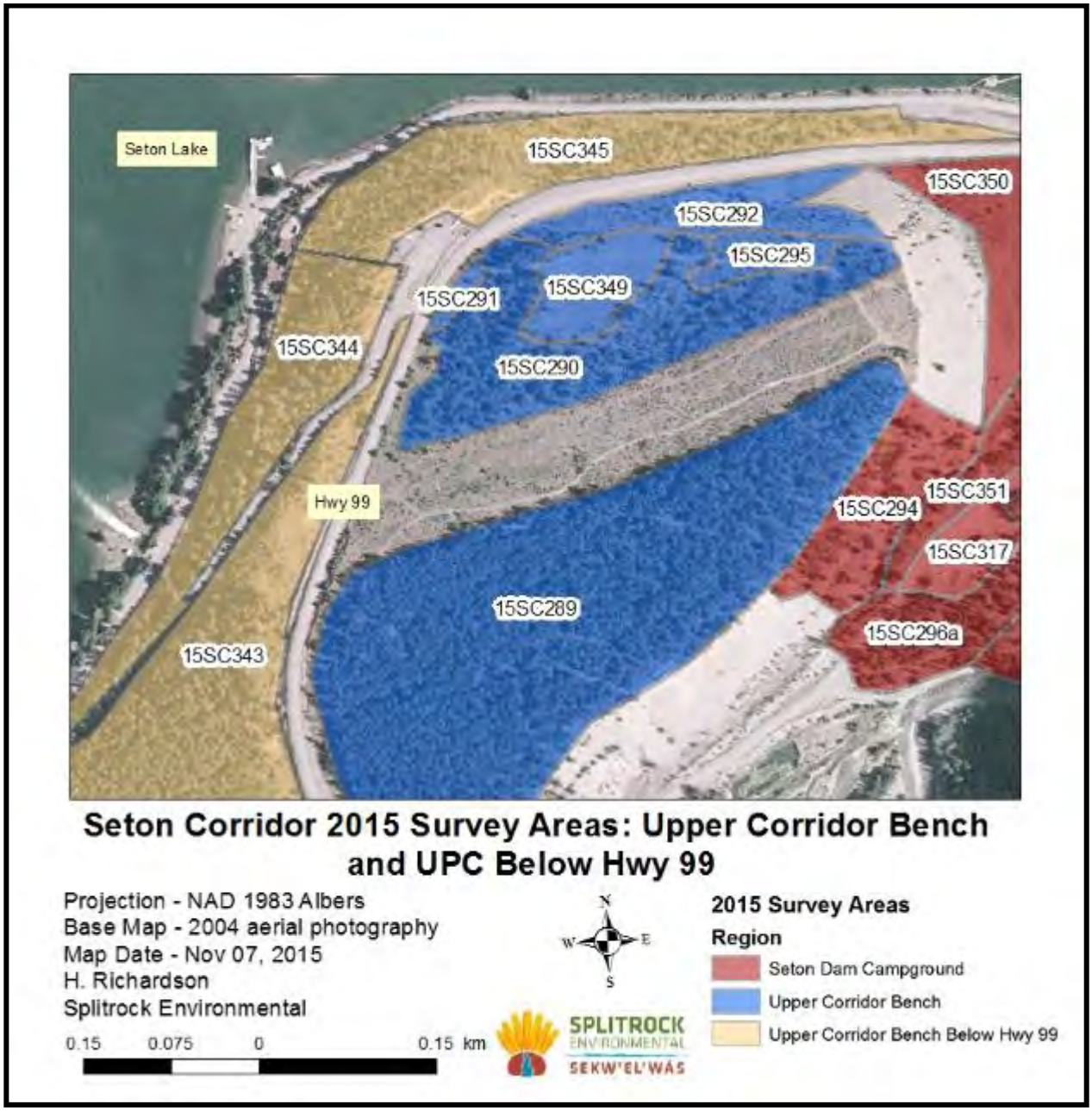
ID	Description	Latitude	Longitude
RR01	good place for planting	50.67754	-121.935
RR02	good place for planting	50.6775	-121.935
RR03	good place for planting	50.67727	-121.936
RR04	lesser priority and would need to add soil	50.67718	-121.936
RR05	main priority here for the next 30m west	50.67699	-121.936
RR06	main priority here for the next 100m west; tarps for 30m; needs soil	50.67672	-121.937
RR07	little vegetation here and could use planting but may be hard to plant; very steep slope; tiny riparian area beside road	50.67629	-121.938
RR08	little vegetation here and could use planting but lots of cement riprap notably in tact	50.67553	-121.939



Map 15 Seton Corridor 2015 Wetland/Wetted Areas and Riprap Locations

5.3.2 Upper Corridor Bench (Seton Flat)

The upper corridor bench (UCB) is an area of Interior Douglas-fir forest with a highly used trail system and powerlines running through it (Map 16). These areas are known as Seton Flat (on east side of Highway 99) and Seton Bluff (on north-west side of Highway 99 above Seton Lake).



Map 16 Seton Corridor 2015 Survey Areas - Seton Flat and Seton Bluff

The upper corridor bench (Seton Flat) is an area of Interior Douglas-fir forest with a highly used trail system and transmission lines running through it (Map 16). In 2015, 15 ha of land was surveyed on the flats.

Polygon 15SC289 has good canopy cover of mature Douglas-fir and Ponderosa pine but an undeveloped understory. The area is relatively healthy and there are evidence of wildlife trails. The area is also heavily used as a recreation area and there is evidence of campfires. Compared to the other surveyed sites, this polygon is particularly cool and wet and there was a large percent cover of ferns. Another interesting note is that the soopolallie shrubs appeared stressed and will be monitored in the future, building on the 2013 soopolallie survey undertaken to monitor berry production and plant health in regards to climate changes that may be observable.

Polygon 290 has been heavily disturbed in the past but is now in the young successional status, with a good percent cover of native species. This site has one of the largest remaining needle and thread grass *(Hesperostipa comata)* stands in the region. It has been observed at this site that some years there is no evidence of the grass, and in others there is a resurgence across the site.

The remaining polygons in this region – 15SC290, 15SC291(Figure 30), 15SC292, 15SC295 (Figure 31), 15SC395, and are sparsely vegetated and have high proportions of invasive species. Polygon 292 is on a steep slope overlooking highway 99, is difficult to access, and remains a low priority focus. Polygon 291 is a heavily used entranceway to the trails on Seton Flat and will need to be managed in the future. Polygon 15SC295 is a storage and working area for BC Hydro. Lastly, Polygon 15SC349 (Figure 32) is a large open flat that is a high priority for weed management. This site has one of the largest remaining needle-and-thread grass *(Hesperostipa comata)* stands in the region. It has been observed at this site that some years there is no evidence of the grass, and in others there is a resurgence across the site.

Figure 30 Polygon 15SC291 Plot 7 - high traffic entrance to Seton Flat

Figure 31 Polygon 15SC295 Plot 5 - highly disturbed site Seton Flat

Figure 32 Polygon 15SC349 Plot 14 - disturbed flat with high grassland valu

5.3.3 Upper Corridor below Highway 99 (Seton Bluff)

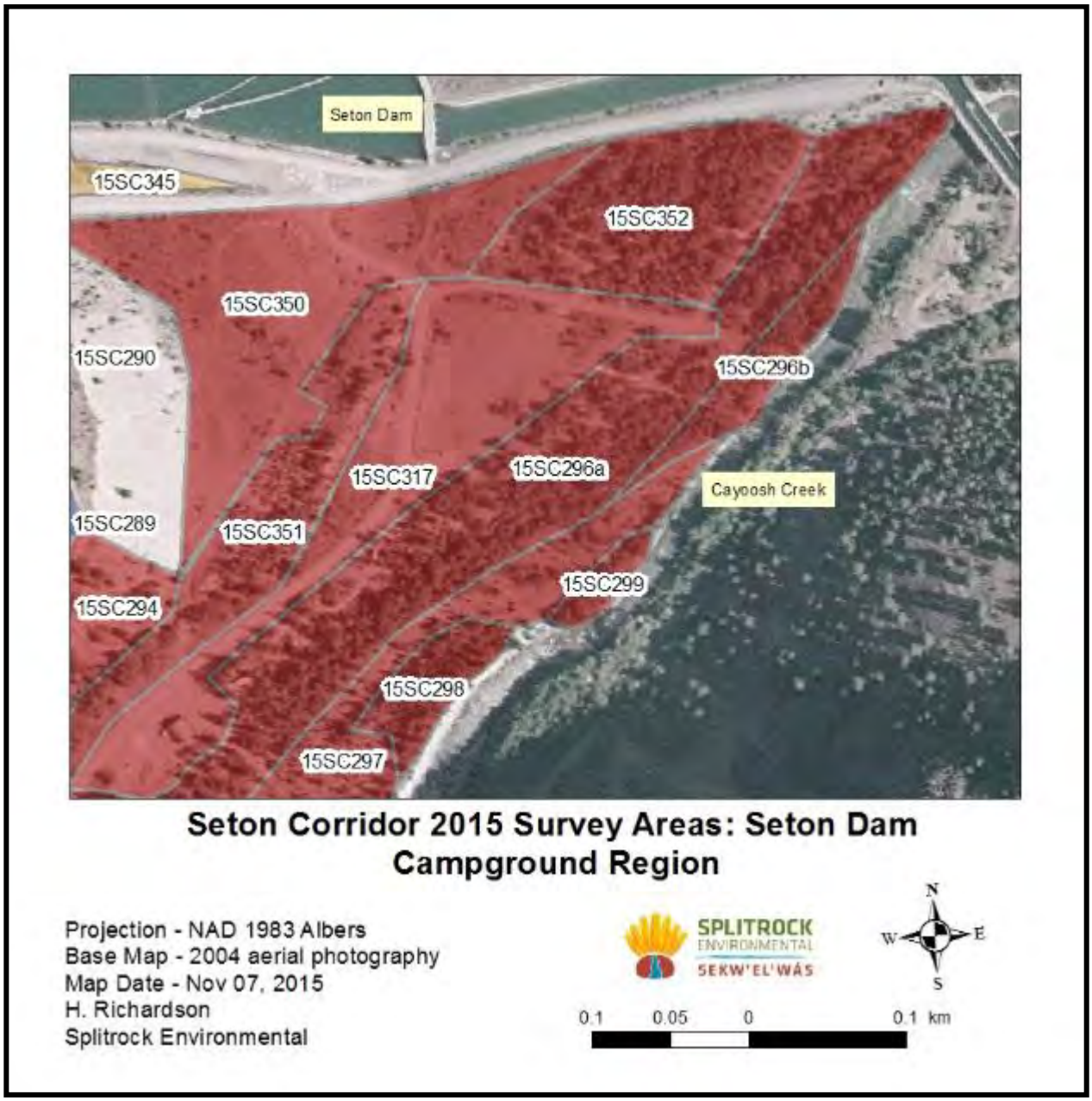
This region is also an Interior Douglas-fir forest with trail systems that are less frequently used than in the Seton Flat region (Map 16). A total of 15 ha of land in the UCB below Hwy 99 was surveyed in 2015.

In general, the understory is significantly more developed than in the Seton Flat sites. Polygon 15SC345 is a moderately steep north facing slope with evidence of past tree harvesting. This polygon has many wildlife trails and a large amount of diversity including significant cover of licorice fern (*Polypodium glycyrrhiza).* Polygons 15SC344 and 15SC343 (Figure 33) are mature forests with plenty of viable habitat. At plot 12, there is a depression that may indicate former existence of a pit house.

Figure 33 Polygon 15SC343 Plot 11 - Mature conifer forest

5.3.4 Seton Dam Campground

The BC Hydro Seton Dam (SD) campground is a recreational area between Highway 99 and the Cayoosh Creek (Map 17). 17 ha of land was surveyed in this region during 2015.



Map 17 Seton Corridor 2015 Survey Areas - Seton Dam Campground Region

Polygon 15SC317 is a non-vegetated parking lot for RVs and Polygon 15SC352 contains many campsites. Polygons 15SC350 (Figure 34) and 15SC351 have been highly disturbed by the construction and maintenance of the powerlines. Polygon 15SC350, in particular, has a large proportion of invasive species and is a priority for restoration. Though polygon 15SC351 (Figure 35) has good coverage of Douglas-fir, there are very few other species present and many rocky mounds. Polygon 15SC294 is an open forest with several old Douglas-fir and Ponderosa pine trees. There are few herbs present here because of the steep and unstable south-facing slope. After surveying, polygon 15SC296 was divided between its upper and lower tiers. The lower tier is a transitional area before the riparian zone that contains many red-osier dogwood shrubs, Saskatoon, and black cottonwood trees. Polygon 15SC297 is a mature open Douglas-fir forest that has an extremely rocky terrain that limits the understory. Polygons 15SC298 (Figure 36) and 15SC299 are mixed-forest riparian areas along the Cayoosh Creek that are dominated by Douglas-fir, Douglas maple, red-osier dogwood and black cottonwood.

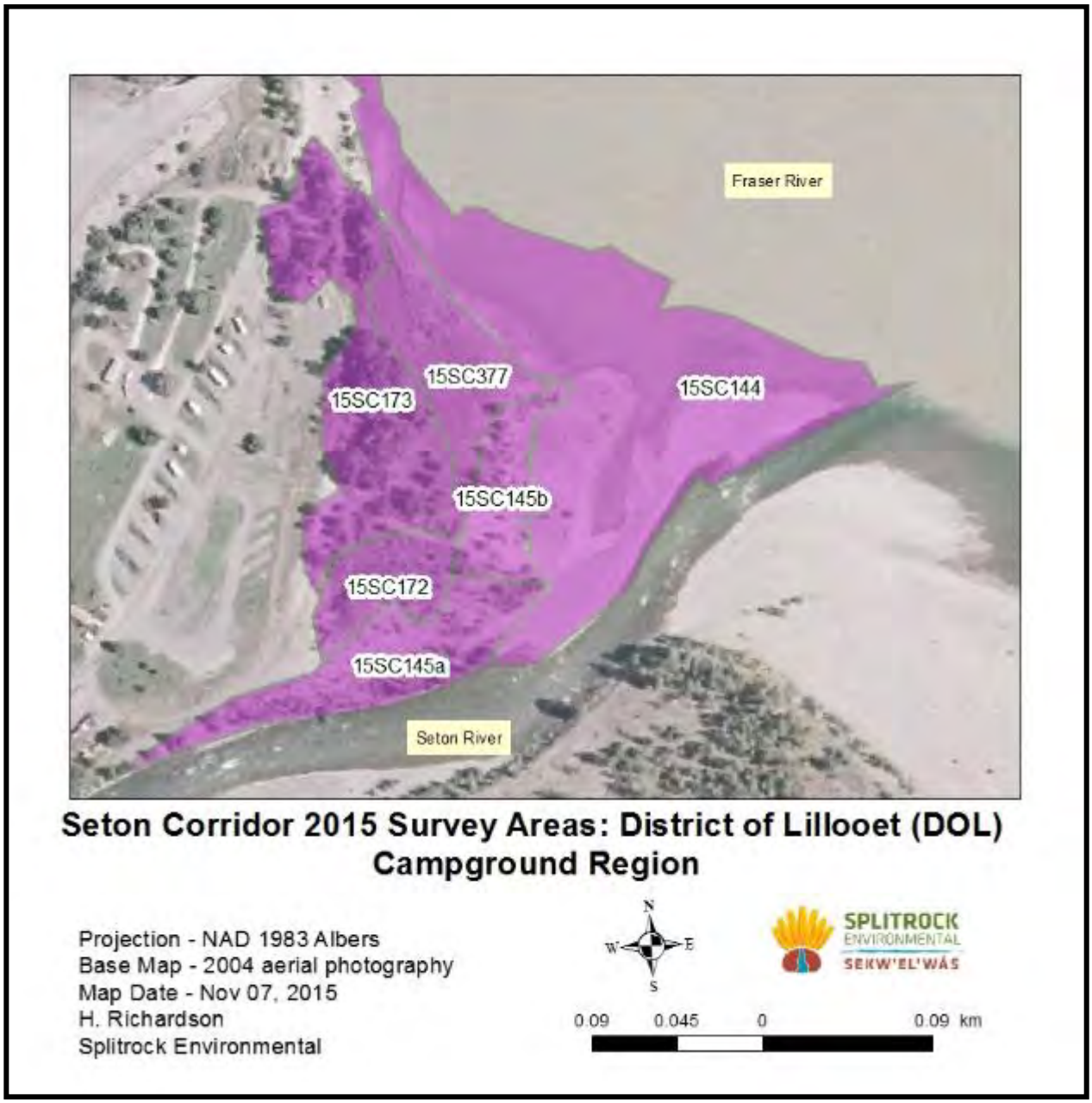
Figure 34 Polygon 15SC350 Plot 26 - disturbed flat at entrance to campground

Figure 35 Polygon 15SC351 Plot 23 - mixed forest near camping areas

Figure 36 Polygon 15SC298 Plot 19 - forested area near Cayoosh Creek

5.3.5 District of Lillooet Campground

The District of Lillooet (DOL) campground is located at the confluence of the Seton River and the Fraser River (Map 18). During 2015, 5.5 ha of land were surveyed in this region.



Map 18 Seton corridor 2015 Survey Areas - DOL Campground Region

Polygons 15SC144 (Figure 37), 15SC145, and 15SC377 are floodplains that have sandy terrain and are sparsely vegetated with scouring rush (*Equisestum hyemale),* willow (*Salix sp.),* and herbs such as brown-eyed Susan (*Gaillardia aristata*), and golden aster (*Heterotheca villosa*). Polygons 172 (Figure 38) and 173 are more densely vegetated with black cottonwoods, willow trees, and scouring rush; however, it also is heavily populated with smooth brome.

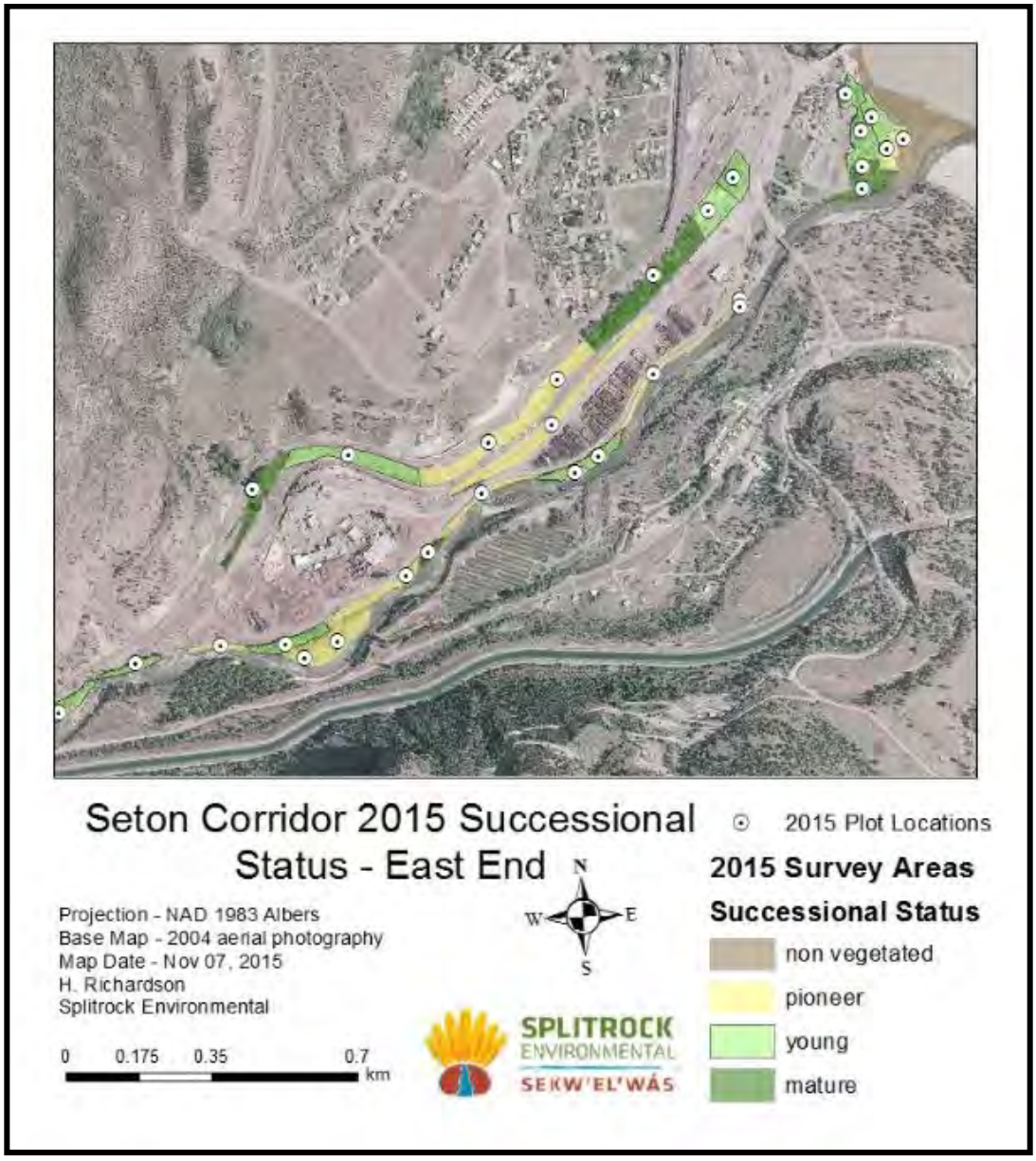
Figure 37 Polygon 15SC144 Plot 33 - floodplain

Figure 38 Polygon 15SC172 Plot 29 - riparian

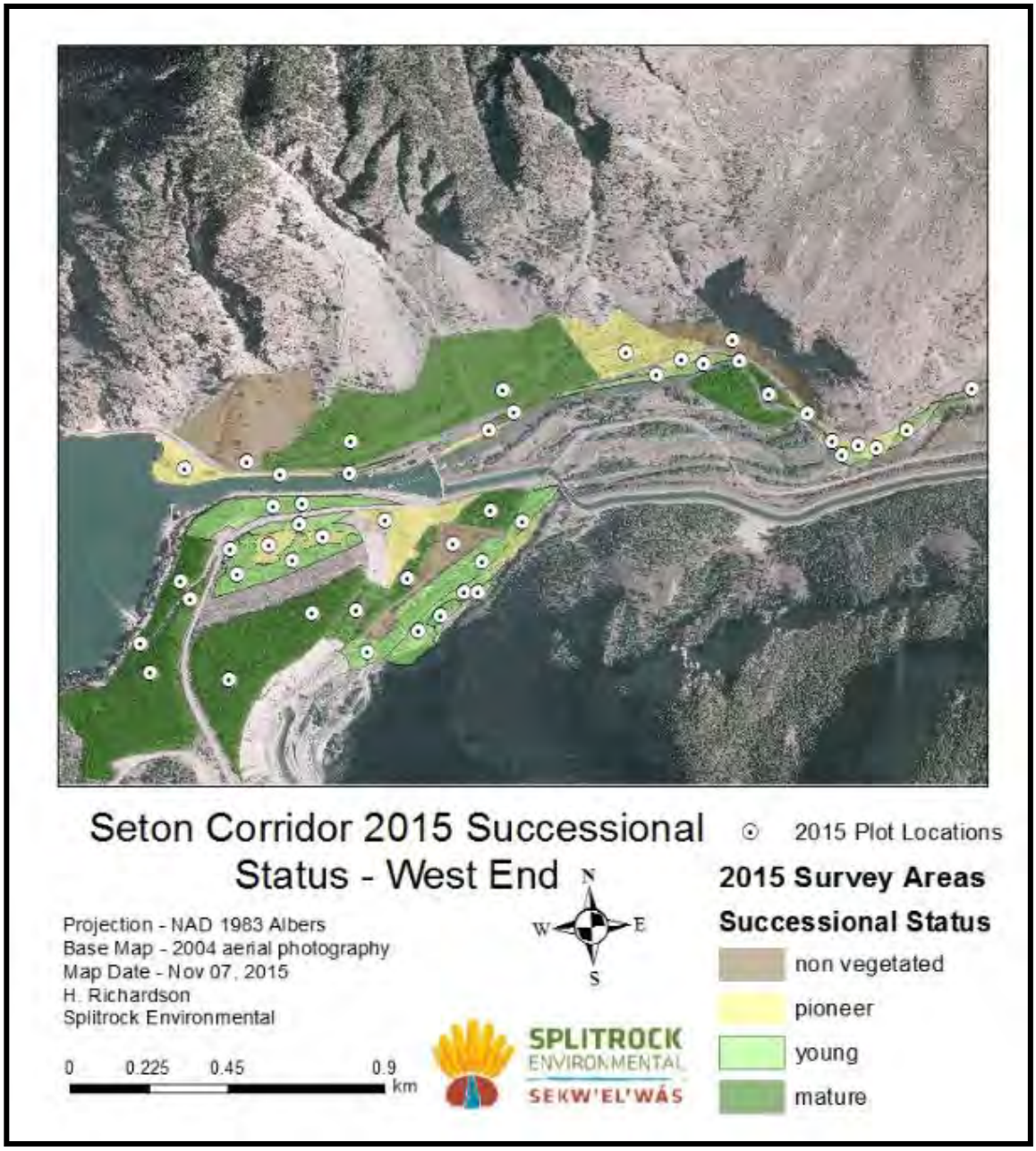
5.3.6 Identification of High Priority Areas

Successional State

By recording the species present and aging trees, we categorized each plot as non-vegetated, pioneer, young, or mature (Map 19, 20). Non-vegetated status areas may represent disturbed areas that require restoration or areas that remain bare as a function of the unstable steep slopes and dry terrain on which they reside. Pioneer status areas have begun the process of succession and may require monitoring or assistive restoration measures to remove competing invasive species and or to speed up natural successional processes. We defined areas of young successional status as newly established ecosystems with pioneer species while areas of mature successional status represent older (>60years) forest stands.



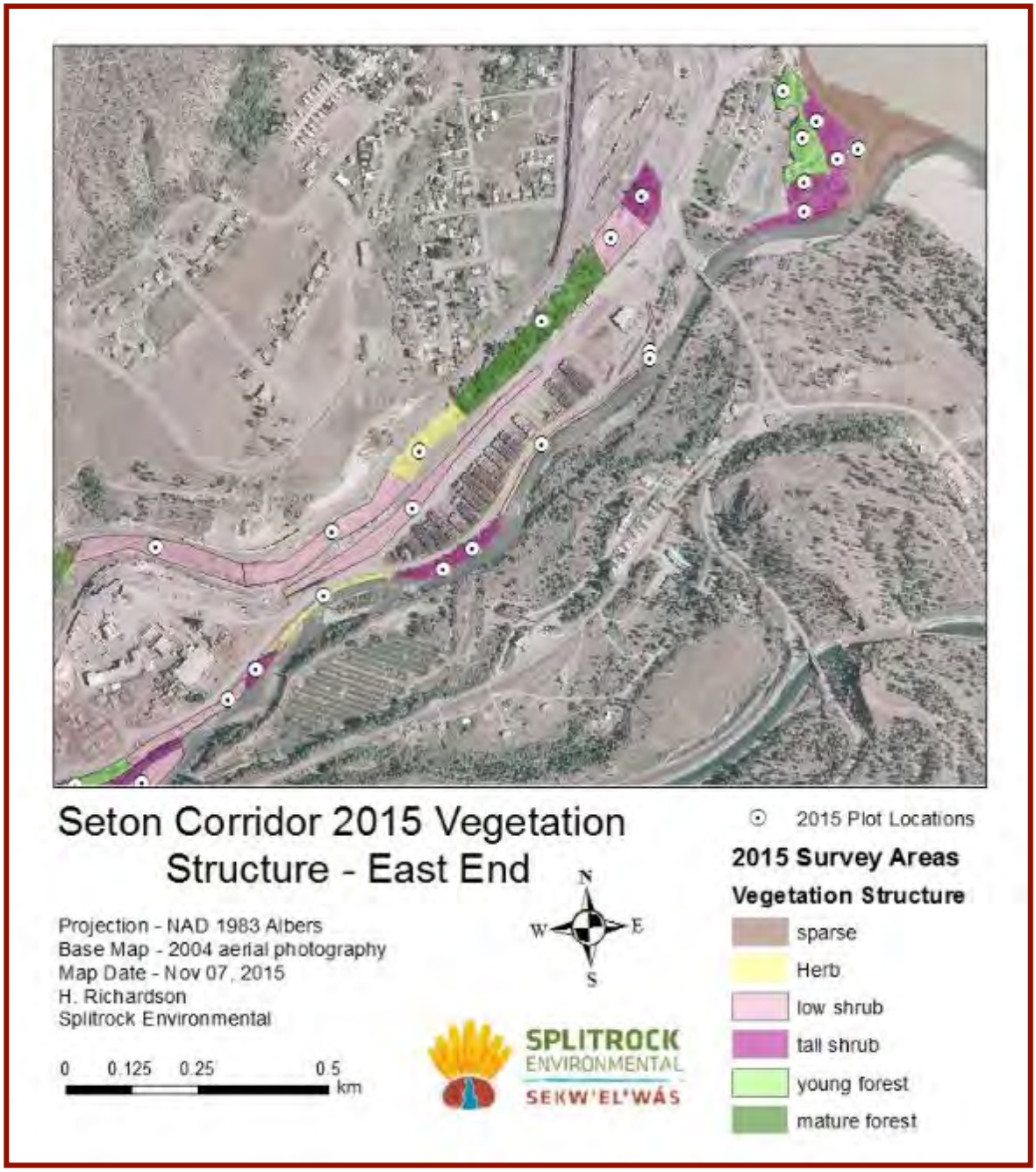
Map 19 Seton Corridor 2015 Successional Status - east



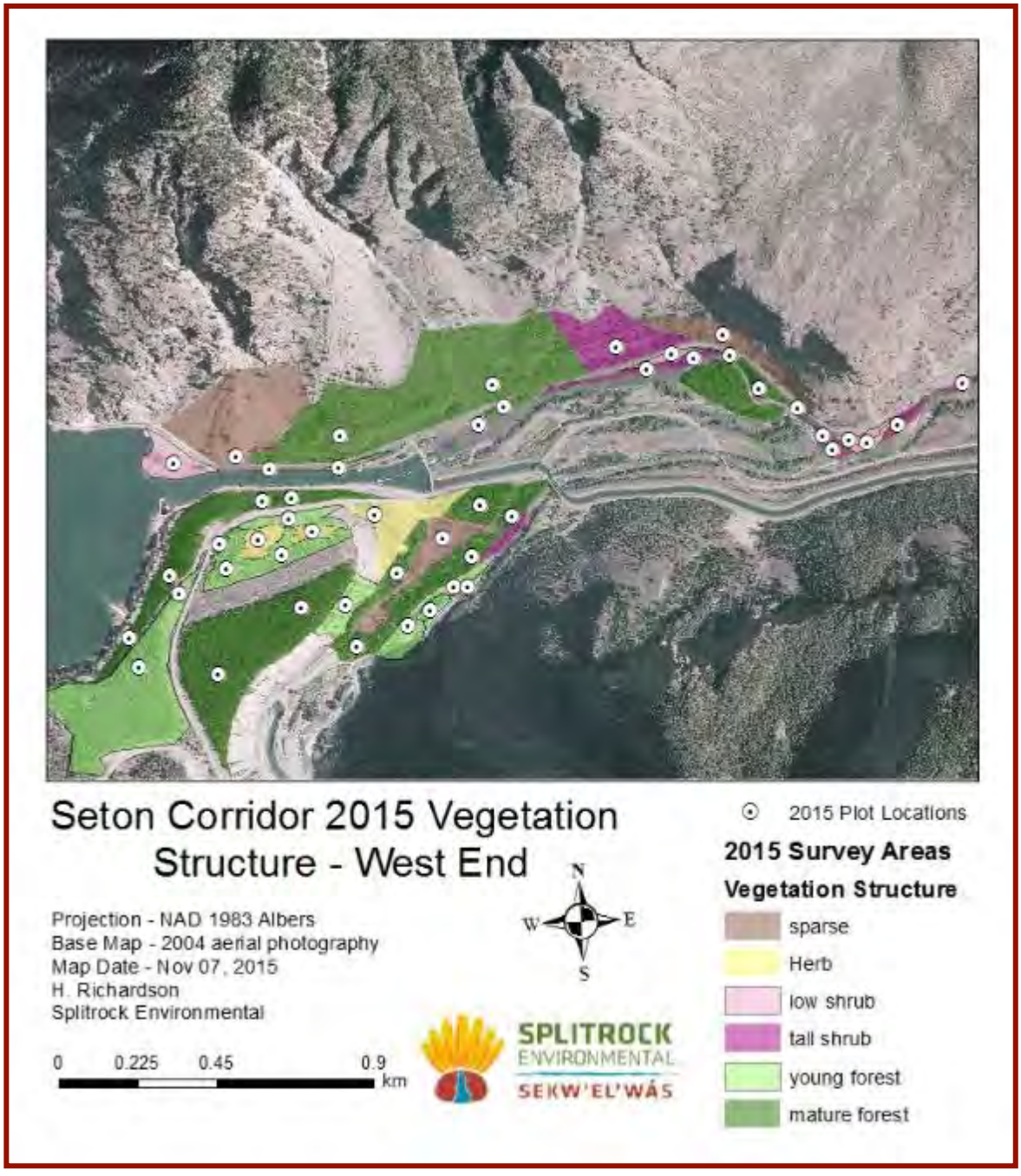
Map 20 Seton Corridor 2015 Successional Status - west

Vegetation Structure

Polygons were classified by vegetation structure: sparse, herb, low shrub, tall shrub, young forest, and mature forest (Map 21, 22).



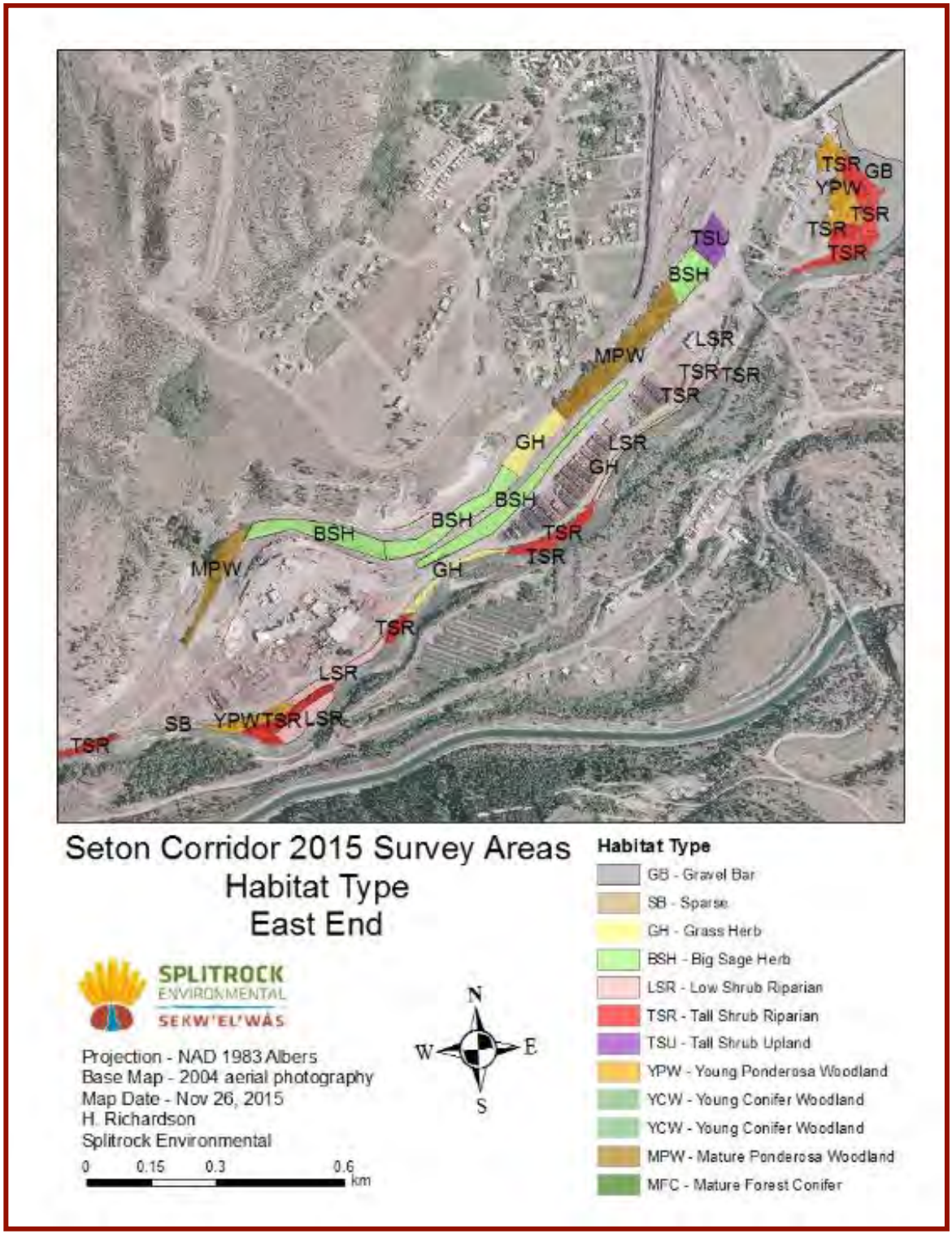
Map 21 Seton Corridor 2015 Vegetation Structure - east



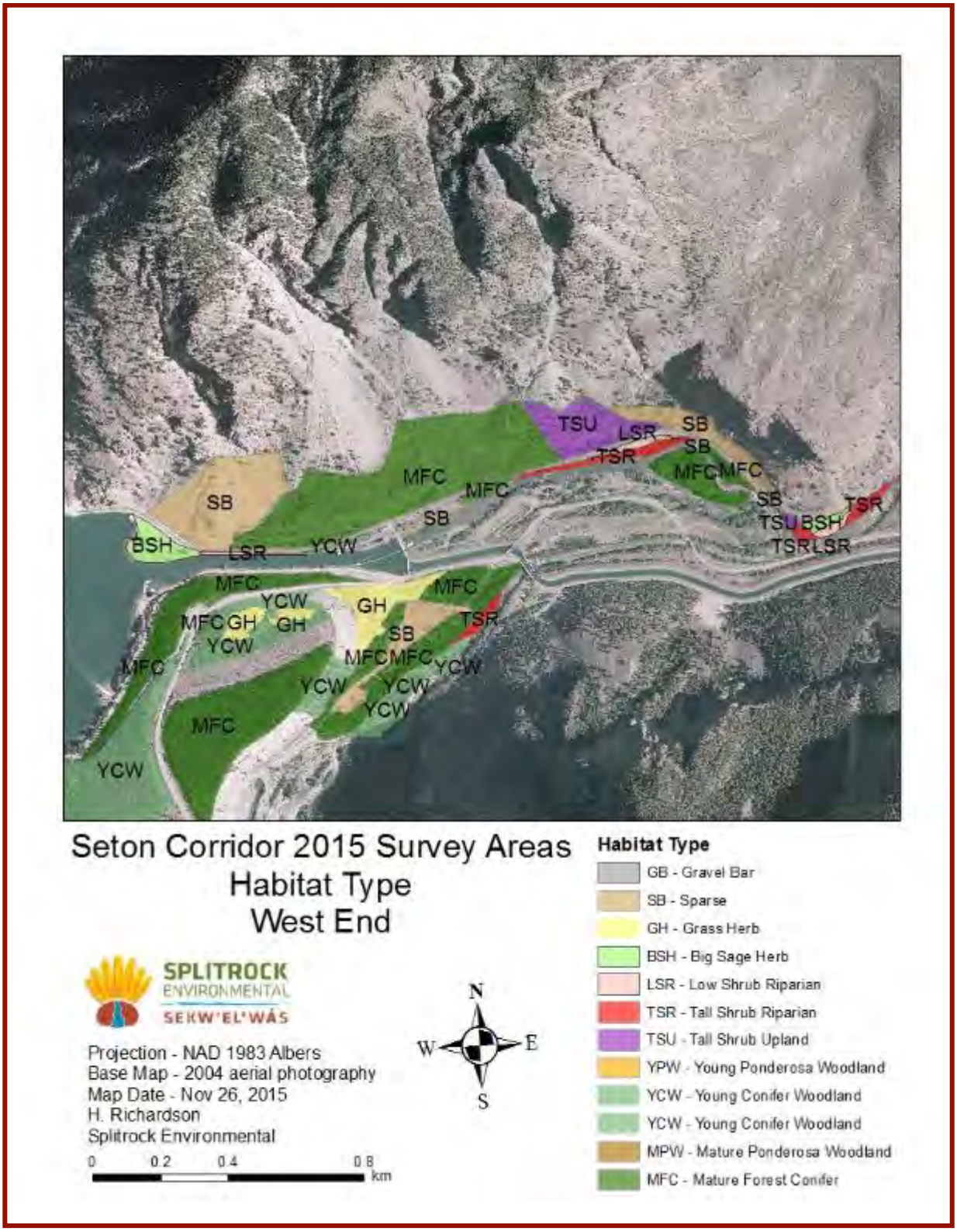
Map 22 Seton Corridor 2015 Vegetation Structure - west

Habitat Type

Polygons were also classified by habitat type (Map 23, 24). Categorization follows past year surveys - gravel bar, sparse, grass herb, Big sage herb, low shrub riparian, tall shrub riparian, tall shrub upland, young ponderosa woodland, young conifer woodland.



Map 23 Seton Corridor 2015 Habitat Type - east



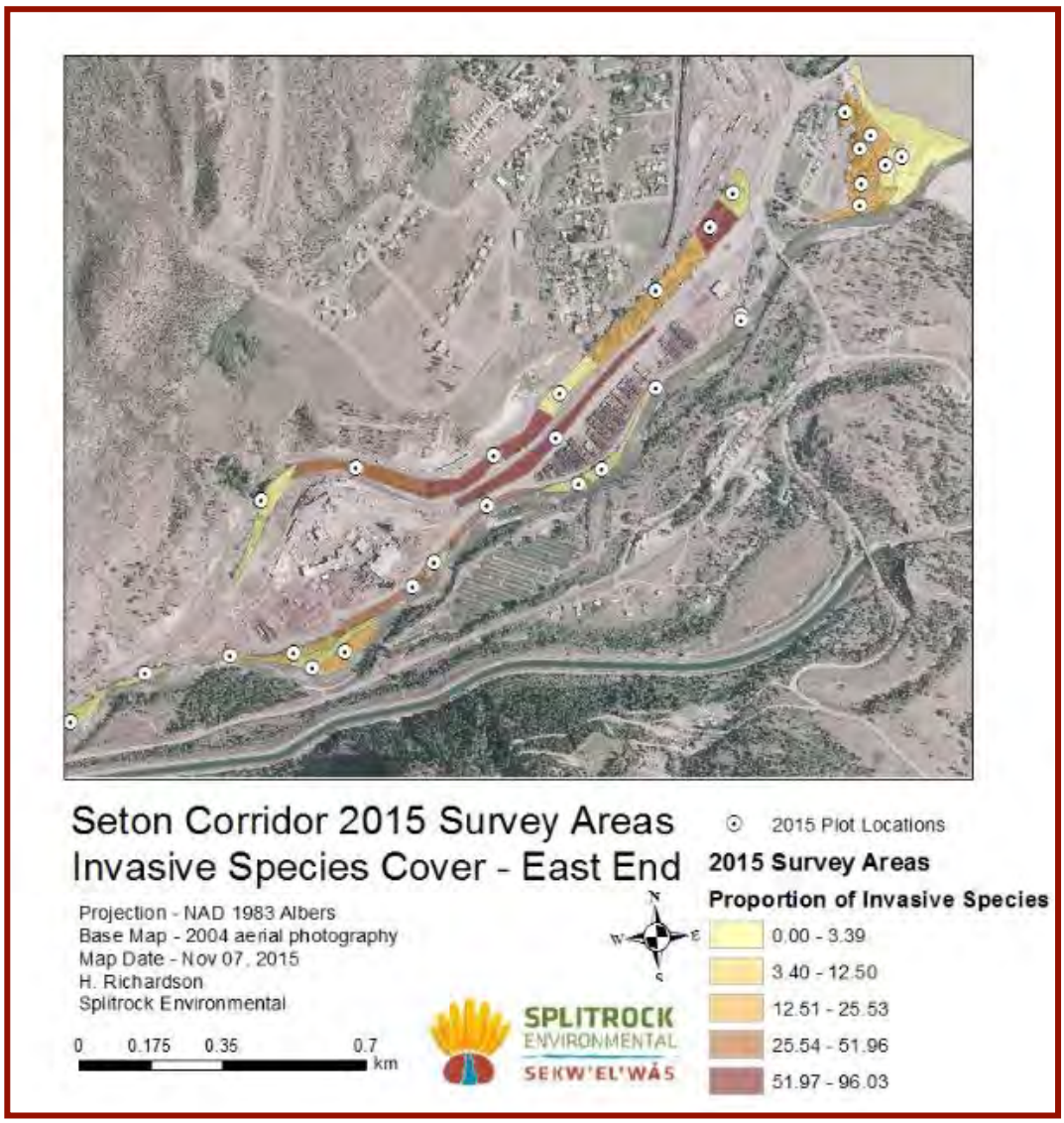
Map 24 Seton Corridor 2015 Habitat Type - west

Invasive Species

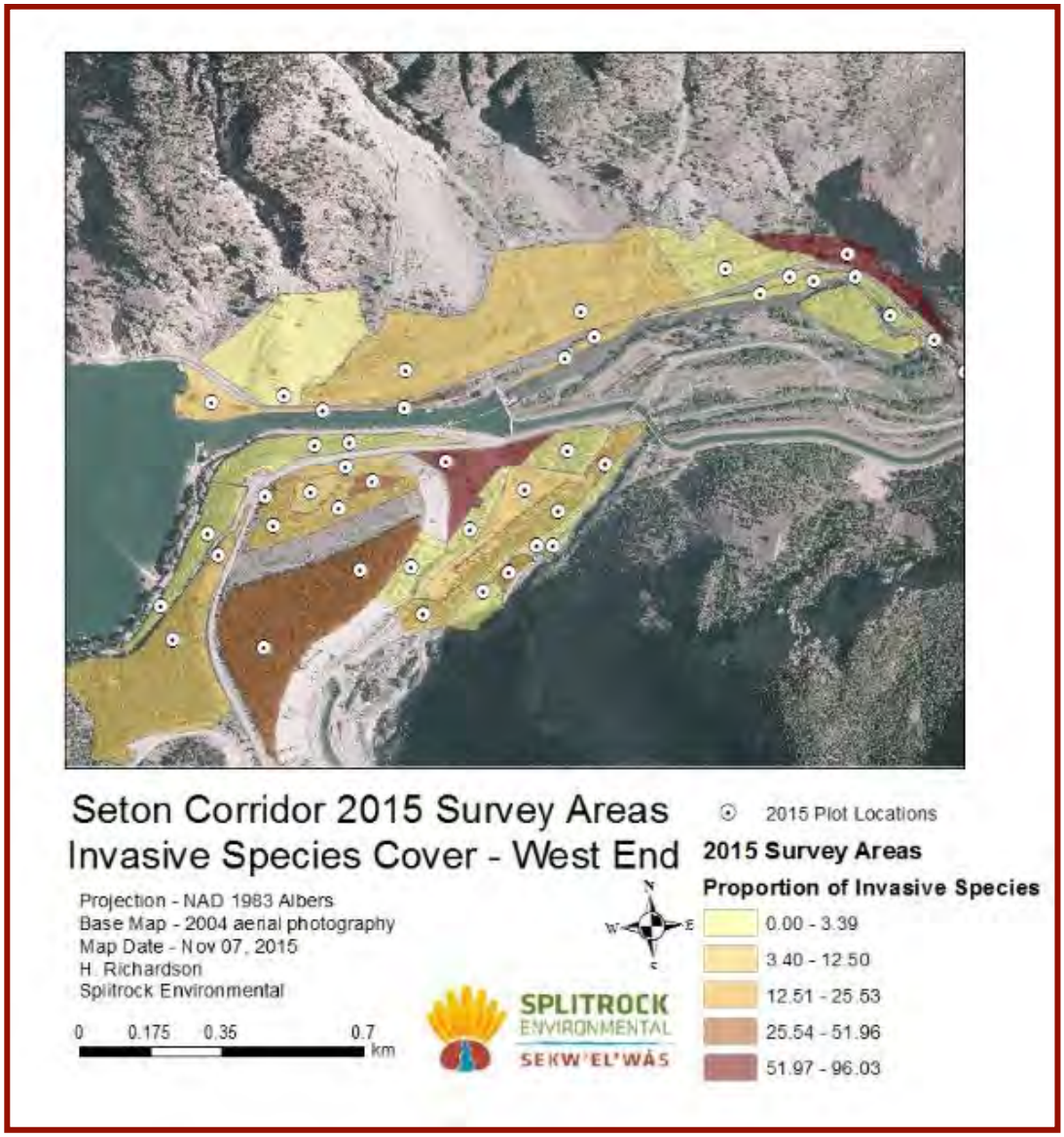
The percent cover of invasive species in each plot was determined by dividing by the total percent cover of shrubs and herbs then multiplying by 100% (Map 25, 26). This value was applied across the entire polygon (Table 13). Since old trees can persist in areas have been disturbed, it is helpful to evaluate ecological health by presence of invasive species.

Table 13 Proportion of invasive species per region

Region	Average proportion of invasive species (%)
Aspen Planers	20
Upper Corridor Bench – Seton Flat	32
Upper Corridor Below Highway	5
Seton Dam Campground	13
District of Lillooet Campground	13



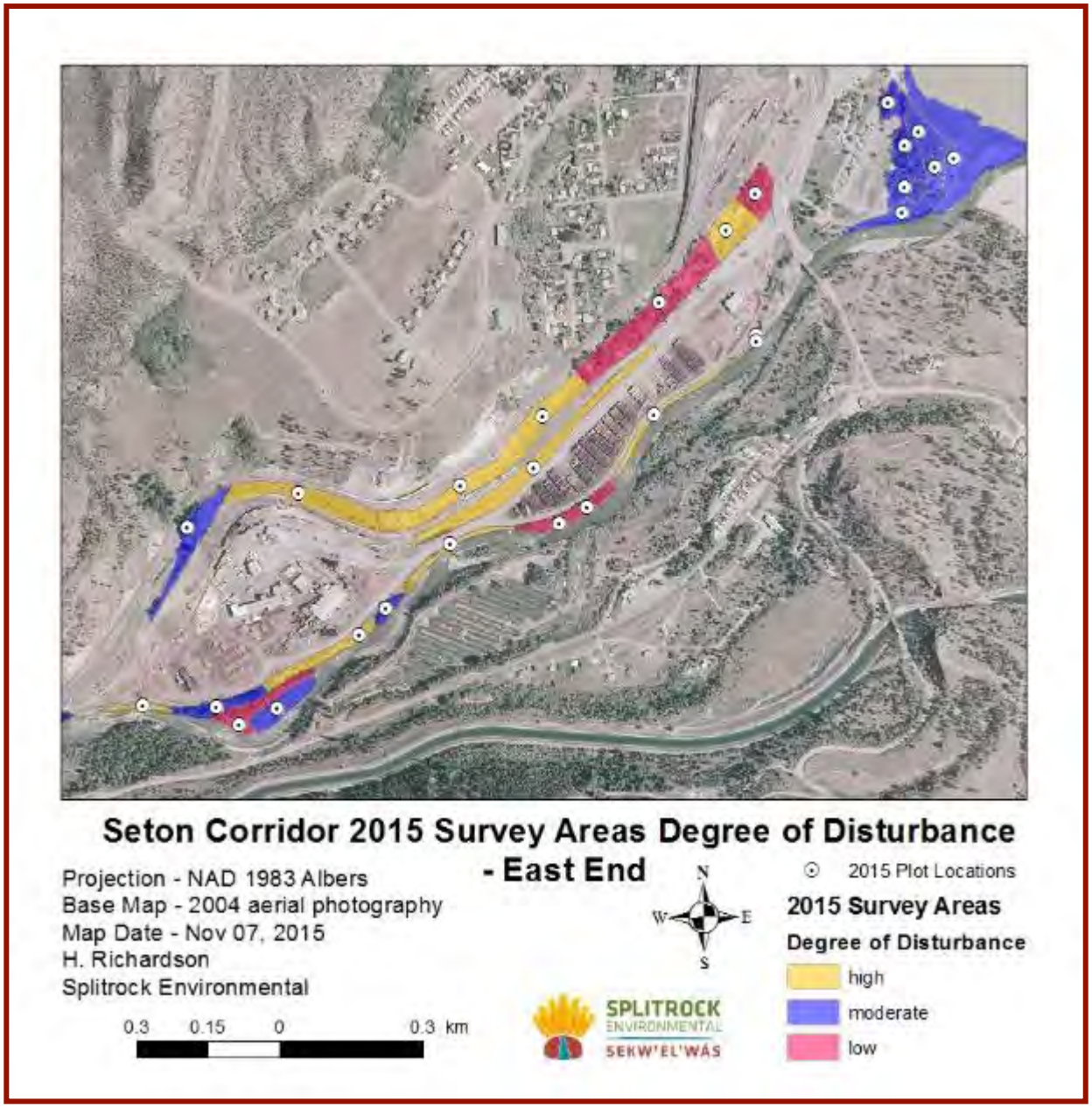
Map 25 Seton Corridor 2015 Invasive Species Cover - east



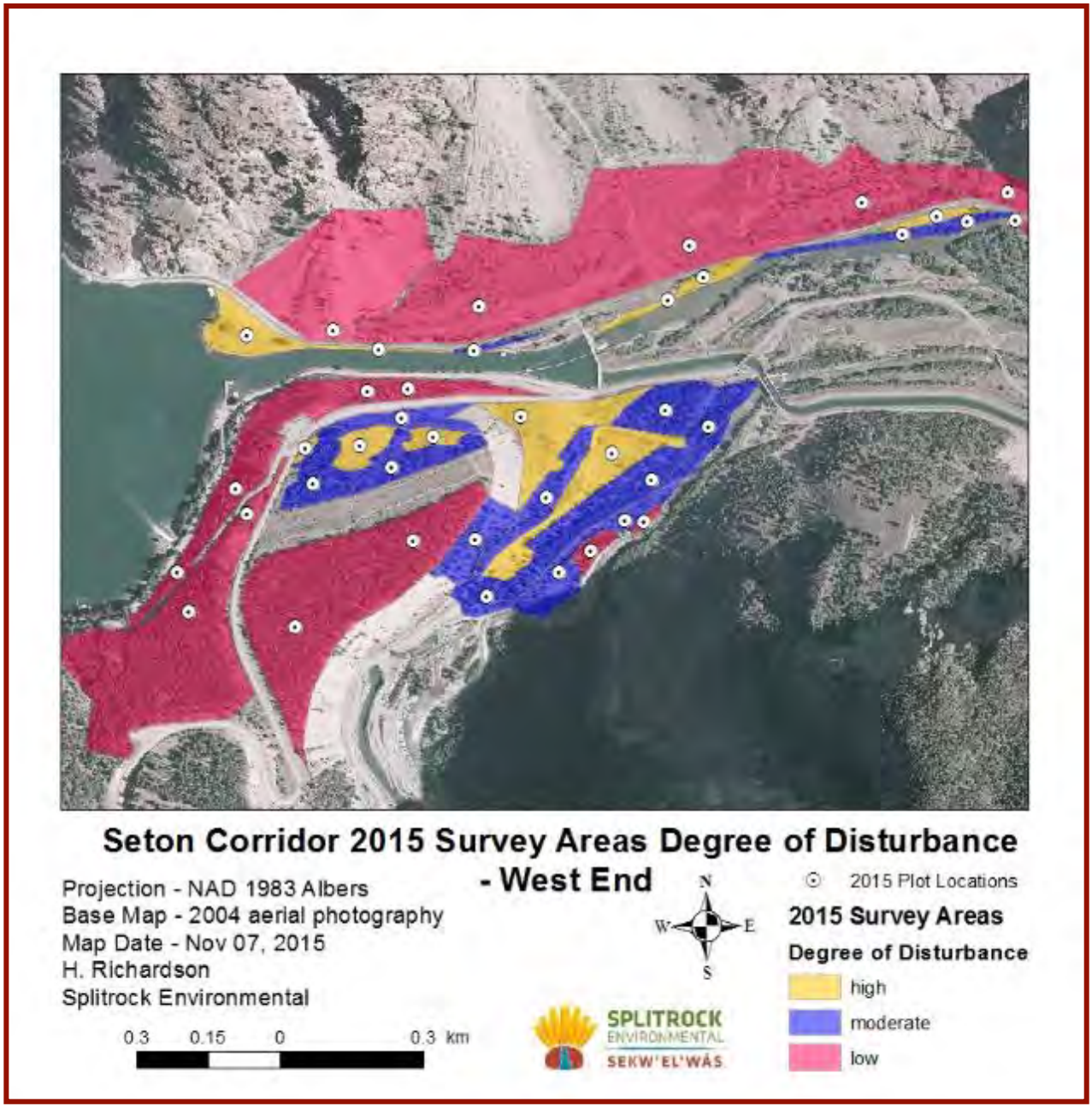
Map 26 Seton Corridor 2015 Invasive Species Cover - west

Degree of Disturbance

Polygons were ranked by degree of disturbance and this ranking also assists in determining ecological health of the system. The sites were ranked by degree of disturbance - high, moderate and low (Map 27, 28).



Map 27 Seton Corridor 2015 Degree of Disturbance - east



Map 28 Seton Corridor 2015 Degree of Disturbance - west

Chapter 6. Interior Western Screech-owl Monitoring

6.1 Introduction

The Interior Western screech-owl *(Otus kennicottii macfarlanei)* is the primary species to be targeted within the riparian zone in regards to the restoration work being undertaken.

Habitat loss is the primary threat to the Interior Western Screech-owl, which is a red-listed species. It occupies riparian woodlands at low elevations and approximately half that habitat has been lost in the last 50 years and most of the remaining habitat is degraded to some extent (Cannings, et al. 1999).

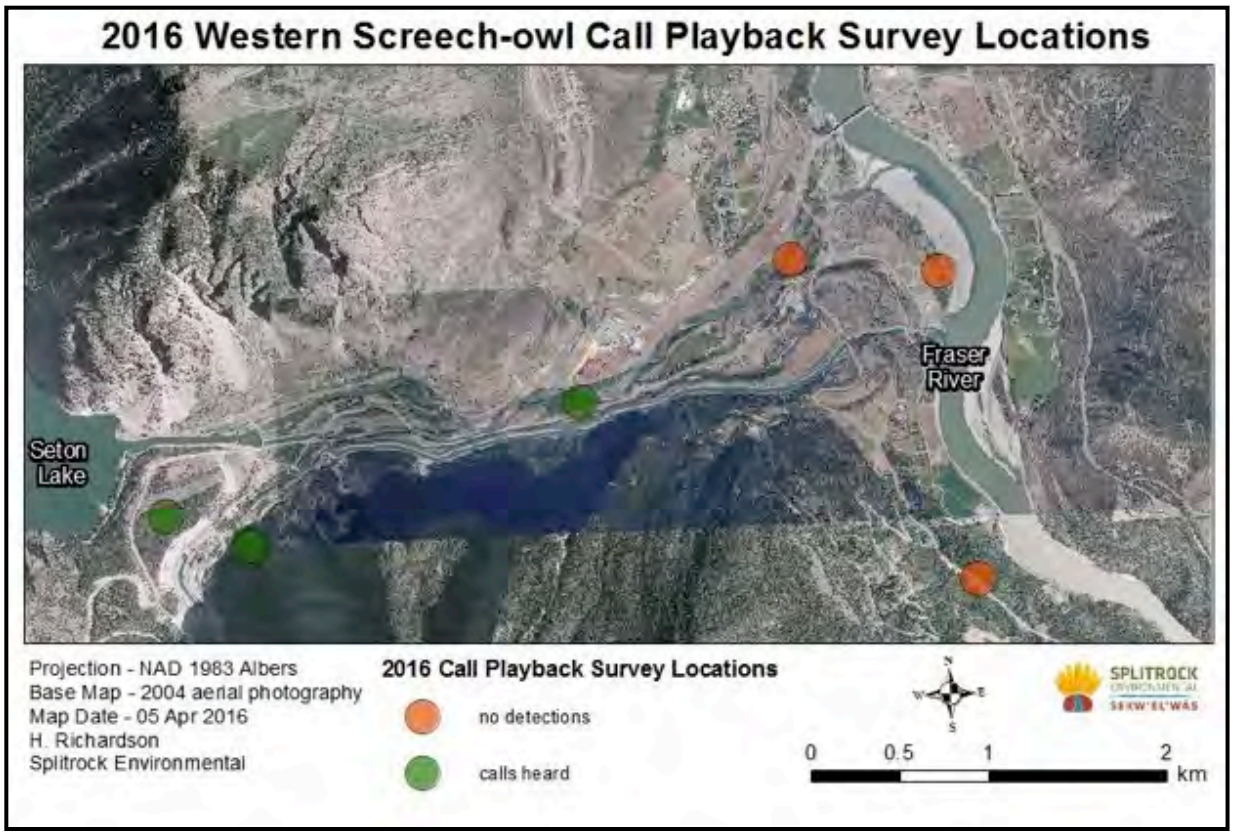
The owl has been detected using the Seton River Corridor over the last several years. The first detection was recorded by Jared Hobbs at the Fraser River Powerhouse restoration site. This detection lead to the establishment of a Wildlife Habitat Area (WHA) in 2010 for the screech-owl on crown land along a thin stretch of riparian habitat at the Fraser River.

In 2006, a nesting pair were documented near Cayoose Creek by Jared Hobbs and local naturalist Ian Routley. Splitrock and Lillooet Naturalist Society have carried out call playback surveys annually since then. In 2013 the pair moved nest sites to a ponderosa pine tree near Seton Lake in an area called Seton Flat. Call playback surveys done in March 2014 confirmed that the pair was occupying the nest tree again. Past surveys have indicated the possibility that there are two Screech-owl territories, but Jared Hobbs advised that we could not necessarily infer this due to the timing of the calls *(Jared Hobbs email and conversation 2014).* During March 2016, we again carried out call playback surveys to monitor the persistence of known pair and conclude if there are multiple Screech-owl territories in the corridor.

6.2 Methods

6.2.1 Call Playback Monitoring

Five monitoring stations were surveyed (Map 29) and encompassed the highest priority/ probability areas within the corridor from the Fraser River to the Seton Lake area. Three teams of surveyors undertook the surveys, each team doing two surveys per night. Start time was half an hour after sunset, rounded to the nearest five minutes. Using this method, three stations were surveyed simultaneously, allowing for detection of multiple owls at the same time.



Map 29 Western Screech-owl Call Playback Survey Locations 2016

Call playback surveys followed provincially standardized methodologies for call playback surveys outlined in Resource Inventory Standards Committee (RISC) (Hausleitner, 2006). Surveys were conducted in March 2016 on clear, calm nights. Upon arrival at the site, the surveyor waited until the survey start time previously arranged with all surveyors. The survey followed the following format:

- Listen passively for 15 minutes
- Broadcast for one minute
- Listen for four minutes
- Broadcast for one minute
- Listen for four minutes
- Broadcast for one minute
- Listen for four minutes
- Move to second survey site and repeat protocol.

Passive listening for 15 minutes is a requirement of the Lillooet Naturalist Society to minimize disturbance to owls. If a Western Screech-owl was detected, call playback was ceased. For each owl detection, the species code, call time, call duration, distance and direction were recorded. Other additional information included date, survey station, sunset time, temperature, cloud cover, wind and precipitation.

6.2.2 Nest box monitoring and maintenance

No new nest boxes were installed in 2015-16, however the existing boxes were monitored and maintained (Map 30).

Map 30 Seton Corridor Screech-owl Box Locations 2015

6.3 Results

6.3.1 Call Playback Monitoring

During the 2015-16 field year, occupancy surveys for breeding Western Screech-Owls were conducted on 17 March, 28 March and 07 April 2016. Surveys were conducted at six different stations by three teams, who were designated two stations each per night. In an effort to reduce disturbance to the owls, we adopted a 30-minute sampling period. The first 15 minutes were silent with no call playback, followed by 15-minutes of call playback as per the Provincial Inventory Standards (BC Resource Inventory Standards Committee, 2006). If an owl was detected in the first 15 minutes, we did not use call playback since site occupancy was confirmed passively.

The Western screech-owl was detected at three stations: Cayoosh Waterfall Riparian, Seton Flat, and Mid-Corridor Riparian sites. Table 14 displays the findings from the 2016 call playback surveys. In addition, we documented a Great Horned Owl at the Cayoosh Waterfall Riparian and Seton Bluff areas.

Table 14 Western Screech-owl Call Playback Survey Results 2016

Date	Location	Survey Start Time	Call Time	Owl Species	No. of Owls
17-Mar-16	Cayoosh Waterfall Riparian	19:43	19:44-19:47	WSOW	2
17-Mar-16	Cayoosh Waterfall Riparian	19:43	19:49	WSOW	1
17-Mar-16	Cayoosh Waterfall Riparian	19:43	20:09	WSOW	2
28-Mar-16	Cayoosh Waterfall Riparian	20:05	20:03-20:07	WSOW	1
28-Mar-16	Seton Flat	20:05	20:04	WSOW	1
28-Mar-16	Mid Corridor Upland	20:05	20:21-20:28	WSOW	2
28-Mar-16	Mid Corridor Upland	20:05	20:34	WSOW	1
07-Apr-16	Seton Flat	20:20	20:18-20:23	WSOW	1
07-Apr-16	Seton Flat	20:20	20:31	WSOW	1
07-Apr-16	Seton Flat	20:20	20:33	WSOW	1
07-Apr-16	Seton Flat	20:20	20:38	WSOW	1
07-Apr-16	Seton Flat	20:20	20:42	WSOW	1
07-Apr-16	Seton Flat	20:20	20:43	WSOW	1
07-Apr-16	Cayoosh Waterfall Riparian	20:20	20:23	WSOW	1
07-Apr-16	Cayoosh Waterfall Riparian	20:20	20:46	WSOW	1

Last year, calls were heard almost simultaneously from the Cayoosh Waterfall Riparian and the Mid Corridor Riparian sites on 31 March 2015. Similarly, on 28 March 2016 Western Screech-Owls were heard concurrently at Seton Flat and the Cayoosh Waterfall Riparian sites (Table 14). However, we also detected a pair of owls at the Mid Corridor Riparian site (responded to call playback), suggesting an increase in the level occupancy in the Seton Corridor. Table 15 summarizes occupancy across all sites. Owls were also detected simultaneously at Cayoosh Waterfall Riparian and Seton Flat on 7 April 2016. Taken together, the simultaneous and temporally-confined period in which owls were detected implies a minimum of two active territories and possibly three in the western portion of the Seton Corridor. Furthermore, it should be noted that owls at Cayoosh Waterfall Riparian and Seton Flat were calling spontaneously and no call playback was used, thus negating any broadcasting-induced movement bias.

An owl was also observed visually on the evening of 4 June 2015 at Seton Flat (Figure 39). Citizen scientists made this report after they spotted an owl while hiking. The observed owl was a juvenile looking out of the nest cavity. On the same night, another owl was observed at the Mid Corridor. On another night, 22 September 2015, it was reported that a WSOW was calling for several minutes.

Table 15 Western Screech-owl occupancy in the Seton River Corridor, Spring 2016

Date	SB[1]	CWR	MCR	PWH	LSC	TCR
17-Mar	0	1	0	0	0	0
28-Mar	1	1	1	0	0	0
7-Apr	1	1	0	0	0	0
Occurrence Frequency	0.66	1.00	0.33	0.00	0.00	0.00

[1]Site codes - SB = Seton Bluff, CWR = Cayoosh Waterfall Riparian, MCR = Mid Corridor Riparian, PWH = Powerhouse Restoration Site, LSC = Lower Seton Corridor, TCR = Texas Creek Road (see map).

Figure 39 Interior western screech-owl juvenile 04 June 2015

Ongoing discussions with Jared Hobbs, Ken Wright, and Ian Routley have taken place throughout the survey work and during analysis. Call-playback surveys cannot definitely assess the absence of owls because an owl may not respond to call playback, even after repeated surveys. The three surveys we conducted this year give us a 90% level confidence that we have detected owls at the sampling sites in the Seton Corridor (Jared Hobbs pers. Comm. 2014). While there is a possibility of more owls using this area, we feel it is unlikely because we sampled the highest quality habitat and our spatial coverage was high in this relatively small study area. Mean home range estimates from studies in the Shuswap River were 64.5 ha (*n*=10; Davis and Weir 2010). The Seton Corridor has roughly 298 ha of suitable habitat (using all low-elevation riparian and adjacent upland forest; calculated in Google Earth Pro), suggesting that the Seton River Corridor could support up to four territories. Given the heavy level of fragmentation (roads, power canal and hydroelectric corridor, and railway), a lower carrying capacity would be expected. Nonetheless, riparian habitat in the corridor is providing apparent high-quality habitat supporting a multitude of different types of prey for this generalist nocturnal predator.

It is recommended to continue annual owl surveys to document site persistence, movement of nest sites and to detect number of nesting pairs. Surveys should be undertaken in March (pre-breeding advertising period) and/or September (brood period) when spontaneous calling is most prevalent, maximizing detection probability. It is also recommended to conduct nest searches in the Mid Corridor Riparian area to confirm suspected nesting.

The recovery strategy for the Western screech-owl indicates that conservation of screech-owl territories is an urgent recovery activity. One Wildlife Habitat Area (WHA) for the screech-owl has now protected the riparian area at the Powerhouse Restoration site along the Fraser River between the confluence of Seton River and the tailrace. This was a direct result of the work being funded. Further WHAs may be established if crown land is available, but much of the land in the Seton corridor is either controlled by BC Hydro or the St'at'imc communities of Sekw'el'was and T'it'q'et and as such are not eligible for WHA designation. The importance of working with the partners and stakeholders is therefore critical if screech-owl habitat is to be conserved and/or enhanced within the corridor.

6.3.2 Nest box monitoring and maintenance

Seventeen nest boxes were visited on 4 March 2016 for monitoring and cleaning (Table 16). Three boxes were screwed shut and crew did not access them. At three other boxes, downy feathers and scat were observed, indicating use of these boxes. These boxes were located at the Seton Flat, Lower Spawning Channel, and Powerhouse sites.

Table 16 Western Screech-owl Nest Box Monitoring

Box ID	Latitude	Longitude	Location	Observations
Powerhouse1	50°40.583"N	121°55.394"W	Powerhouse	
Powerhouse2	50°40.446"N	121°55.363"W	Powerhouse	
Powerhouse3	50°40.680"N	121°55.500"W	Powerhouse	
Powerhouse4	50°40.730"N	121°55.549"W	Powerhouse	evidence that squirrel was nesting here
Powerhouse5	50°40.693"N	121°55.463"W	Powerhouse	
Mariposa6	50°40.470"N	121°55.680"W	Mariposa	downy feather and scat observed
SetonCorridor1	50°39'55.94"N	121°59'8.14"W	Seton Flat	screwed shut, no access
SetonCorridor2	50°39'57.31"N	121°59'5.97"W	Seton Flat	screwed shut, no access
SetonCorridor3	50°39'56.22"N	121°59'3.41"W	Seton Flat	screwed shut, no access
SetonCorridor4	50°39'54.66"N	121°59'6.37"W	Seton Flat	downy grey feather observed
SetonCorridor5	50°40'13.11"N	121°57'13.28"W	Mid Corridor	
SetonCorridor6	50°40'11.52"N	121°57'12.66"W	Mid Corridor	
SetonCorridor7	50°40'10.89"N	121°57'13.89"W	Mid Corridor	
SetonCorridor8	50°39'46.90"N	121°58'50.22"W	Cayoosh Ck	
SetonCorridor9	50°39'51.72"N	121°58'39.87"W	Cayoosh Ck	
SetonCorridor10	50°39'59.38"N	121°58'29.62"W	Cayoosh Ck	
SetonCorridor11	50°40'23.41"N	121°56'34.26"W	L Spawning Channel	downy grey feather observed

Chapter 7. Reptile Monitoring

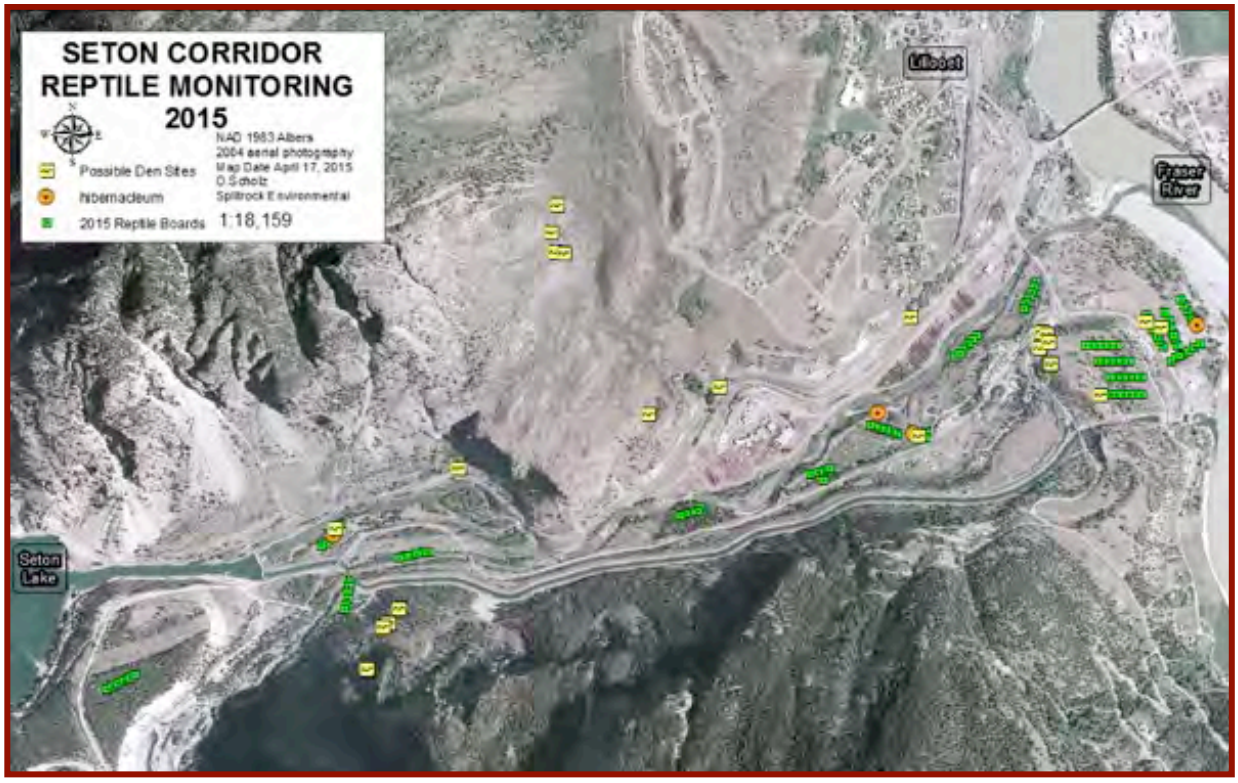
7.1 Introduction

Five reptile species have been confirmed using the Seton River Corridor

- western terrestrial garter snake (*Thamnophis elegans vagrans)*,
- Great Basin gopher snake (*Pituophis catenifer deserticola)(listed federally as threatened and provincially blue (vulnerable)*,
- western yellow-bellied racer (*Coluber constrictor mormon)(listed provincially blue or vulnerable)*,
- rubber boa (*Charina bottae*) (listed federally special concern)
- northern alligator lizard (*Elgaria coerulea principis*).

Each of these species has been observed either through cover board observations or incidental reports in the Seton Corridor. In addition, range maps indicate that common garter snake (*Thamnophis sirtalis*), is a possible resident of the area as is the rare sharp tailed snake (*Contia tenuis) (Listed federally endangered and provincial red)* (Jared Hobbs personal communication 2015).

To survey for presence and persistence across the years, reptile cover boards were monitored by crews and citizen scientists, and den searches were conducted by crews (Map 31). Citizen science was also employed through the Report-a-Snake program in order to record any other observations from the general public.



Map 31 Seton Corridor Reptile Monitoring Locations 2015-16

7.2 Methods

7.2.1 Reptile Cover Board Monitoring

Reptile cover boards and incidental observations have been used to monitor and record reptile species presence in the Seton Corridor since 2009. The number and location of cover boards has increased and shifted over the years to expand survey areas and to match available resources (Map 32). Cover board survey grids were set up by Splitrock crews and monitoring was carried out through the seasons with a combination of Splitrock crews and volunteer citizen scientists. In total 12 sites have been established in the Seton Corridor with between 6 and 24 cover boards at each site.

Note that the Upper Spawning Channel control site (orange text on map) was not monitored in 2015. For site descriptions of each set of reptile boards, see the Seton Corridor Conservation and Restoration Project Report 2014 -15 (North and Scholz, 2015).

Map 32 Seton Corridor Reptile Cover Board Locations 2015

Cover board surveys were originally designed by herpetologist E. Wind in 2008 for monitoring reptile presence at the Powerhouse site. Cover board monitoring has been expanded to assess reptile species present at various locations through the Seton Corridor. The cover boards measure approximately 50cm X .80cm and are constructed of exterior grade plywood painted black on one side. Boards were distributed in two to four rowed grids spaced approximately 20 m apart at each of the survey site locations. GPS positions were recorded for each board and GIS mapped in Arc Map 10 software. Each of the boards was labeled with a unique code for identification and reference. Cover boards were monitored starting in April and continued through to November. The goal was to monitor the boards weekly as resources allowed.

On a monitoring day surveyors filled out a field survey form for each of the sampling locations. Data forms included information for each survey date including date, recorder, weather information including cloud cover, air temperature, wind, precipitation. Each cover board is equipped with a string to allow each tilting of the board to inspect for species presence. Cover board id was entered onto the sheet and a zero was entered onto the form if there was no species present upon inspection. If there was a positive sighting the observer would identify to species as best as possible, take a photograph, record the number of individuals, estimate individual live stage and length and enter any other notes deemed relevant. Boards would slowly be lowered back to the ground. No physical contact was made with the reptiles. Collected data was entered into and Excel document for analysis. Positive observations were summarized into this report.

7.2.2 Hibernacula Surveys

Reptile den searches were carried out during 2015 to identify important denning sites used by snakes, with a particular emphasis on the blue-listed Great Basin gopher snake *(Pituophis catenifer deserticola).* The Great Basin gopher snake is at risk in BC because its hibernacula are often found on rocky slopes that are susceptible to extraction of rock for road building and landscaping. Other sources of mortality are cars and trains, as they like to bask on asphalt and between train tracks (www.bcreptiles.ca).

The aim of the den search was to help identify important habitats used by gopher snakes in the Seton River corridor, including priority sites for habitat restoration and sites for potential WHAs. While surveying for the gopher snake it was considered likely that other reptile species would be encountered, thereby providing additional information to assist in management strategies.

Through consultations with Purnima Govindarajulu (RPBI) with the Ministry of Environment and Lita Gomez, Resources Manager for St'at'imc Government Services, it was decided that presence/not detected surveys via den searches would be the most effective way of detecting gopher snakes in the corridor. Gopher snakes are a notoriously difficult species to find, and repeated surveys are often necessary to ascertain presence in a particular location (Ovaska, Sopuck, & Sarell, 2004). They are secretive creatures that move long distances over large home ranges, and spend time underground in rodent holes or talus slopes, becoming invisible to observers. Gopher snakes will spend some time basking in front of their den site before entering it for winter hibernation. If a surveyor spots a gopher snake during the autumn in a location with

den site attributes, it is probable that the snake is basking outside of its den (Jared Hobbs 2014).

Initial research work included researching historic surveys and reports done in the Lillooet area. The Conservation Data Centre database was reviewed and contacts made with the following people to look into sightings and known hibernacula of gopher snakes in the corridor:

- Dr. Karl Larsen, Thompson Rivers University
- John Surgenor, Wildlife Biologist, Ministry of Forests, Lands and Natural Resource Operations
- Orvill Dyer, Ecosystem Biologist, Ministry of Forests, Lands and Natural Resource Operations
- Ian Routley, Lillooet Naturalist Society

A reconnaissance of the Seton River Corridor was completed during summer 2014, under the guidance of Lita Gomez, to identify potential hibernacula sites (Map 33) The attributes that were needed to establish possible denning habitat sites included the following features:

- east, south or west facing slopes with good exposure to winter sun
- areas with rocky outcroppings, cliffs, or talus slopes
- areas within a 1km radius of the Seton River

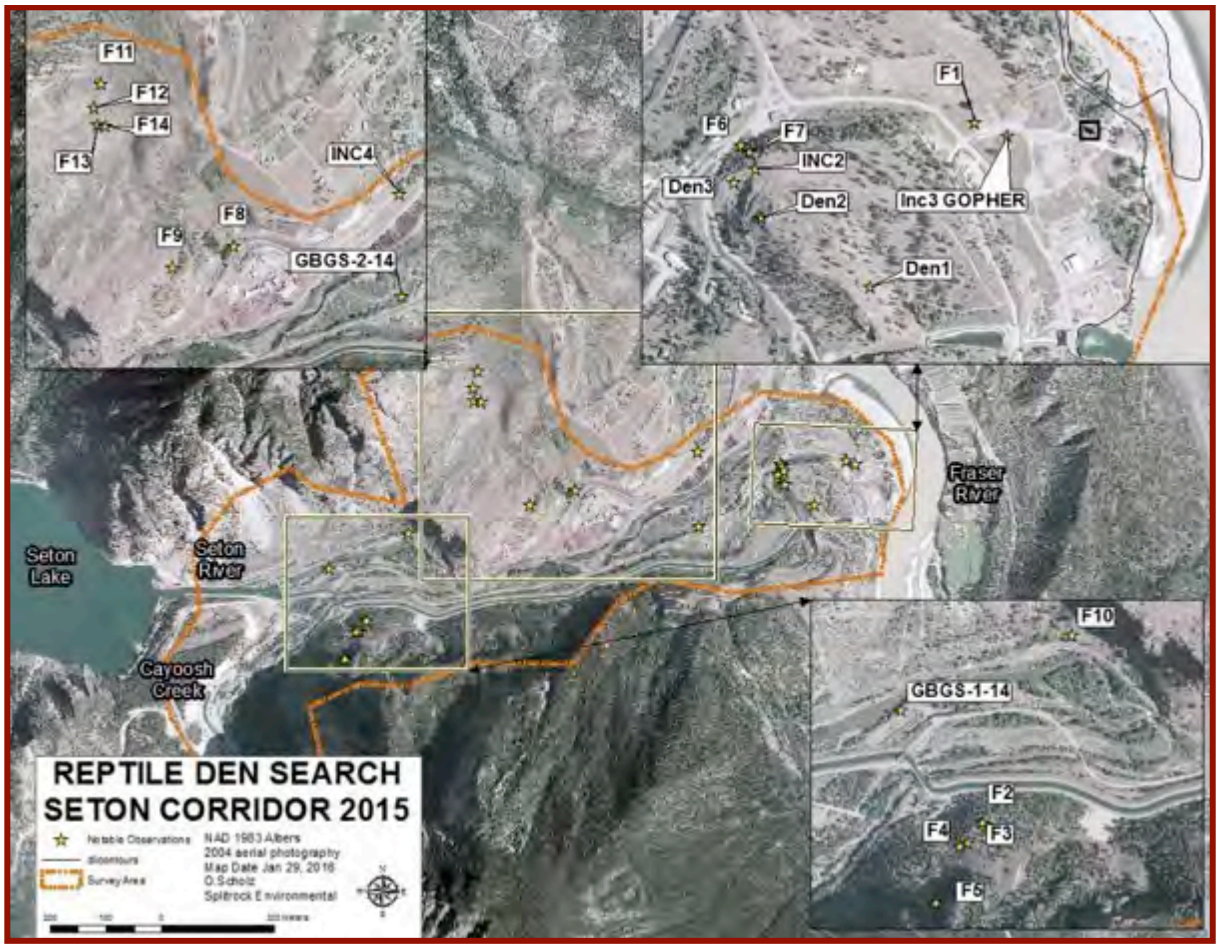
Jared Hobbs was engaged to facilitate a den survey workshop on 02 September 2015 (Figure 40) before the fall survey period. Crew technicians and other interested naturalists were provided with reptile ID and survey strategies to successfully carry out the work.

Crew technicians conducted den searches at the identified locations during autumn 2015 and again in early spring 2016 (Map 33). Den searches were conducted when nighttime low temperatures dropped below 9°C, as per Sewchuk (1996). Daytime conditions needed to be warm (between 15 - 30°C), clear, and wind-free, when snakes are most visible to observers (Bertram, Larsen & Surgenor, 2001).

On each survey day, two field technicians surveyed a section of the corridor that had been identified as potential denning habitat in the site reconnaissance. Upon arrival at the site, surveyors recorded survey location, date, survey start time, temperature, wind speed, cloud cover, and precipitation. A GPS track was started to record movements throughout the day.

The surveyors visited any feature that looked like a potential den site, including rocky outcroppings, the base of cliffs, and large boulders partially buried in talus slopes. Each feature was searched for snakes, photographed, and recorded in a GPS. Data collected included time of visit, mass, aspect, slope position, slope percent, and fracturing on a Feature Survey Form. Features were revisited as time allowed.

Snake sightings and sheds were recorded. Data collected included the species, number, life stage, behaviour, and current weather conditions. Materials used during the search included clinometer, datasheets, clipboard, pencils, compass, thermometer, GPS, extra batteries, camera, watch, radio, first aid kit and bear spray.



Map 33 Seton Corridor Den Search Location 2015

Figure 40 Jared Hobbs leading field portion of reptile ID/Survey Workshop 02 Sept 2015

7.2.3 Report-a-Gopher-Snake Program

To augment the den and cover board surveys, a Report-a-Snake program was initiated during 2014 and was continued in 2015. A request was made to the public to report any snake sightings in the Seton River Corridor, in particular the gopher snake. Report-a-Snake posters were developed with instructions on snake identification and how to report sightings to Splitrock Environmental (Figure 41). The posters were posted at key locations within the community.

Requests were also posted online and through email correspondence to targeted people. All data, photographs and information gathered from the public was entered into excel spreadsheets for analysis, mapping and reporting.

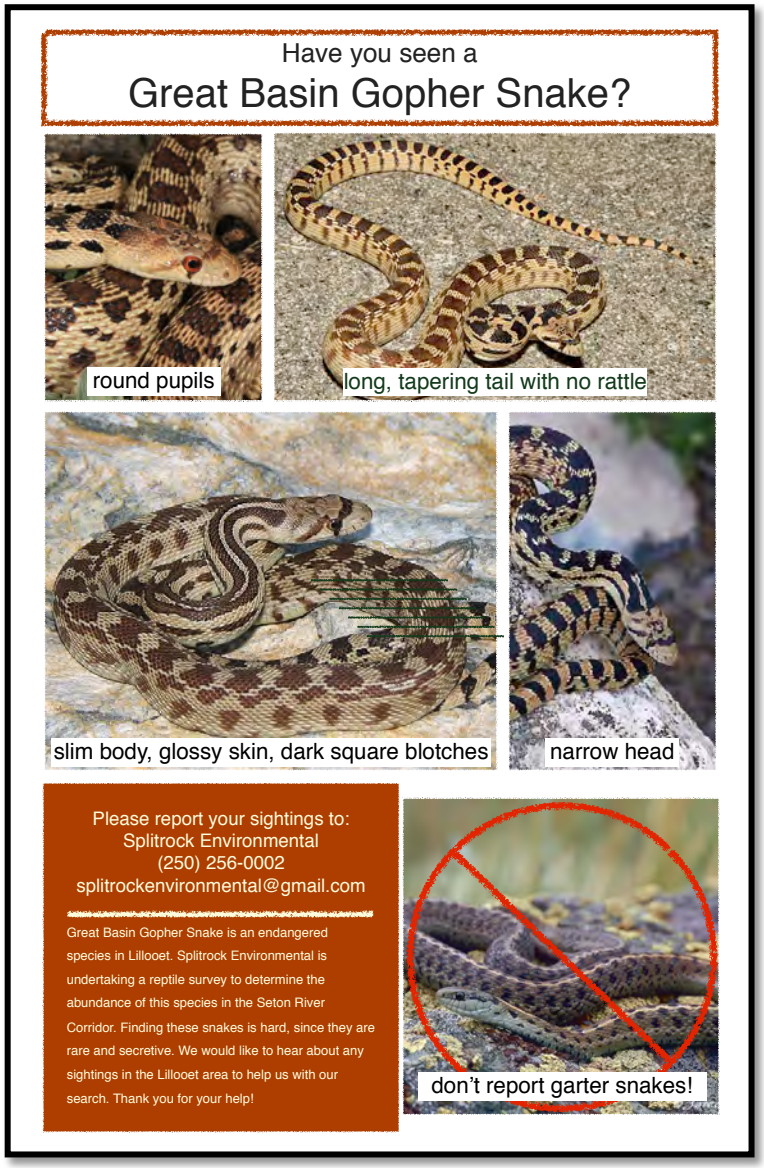


Figure 41 Report-a-Snake Poster

7.3 Results

7.3.1 Reptile Cover Board Monitoring

Throughout 107 site visits in 2015, 35 reptile individuals were observed while monitoring of cover boards in the Seton River Corridor (Tables 17, 18). In 2015, 17 western terrestrial garters (WEGA), 18 yellow-bellied racers (RACE), and 1 Great Basin gopher snake (GOSN) were observed (Tables 17, 18; Figure 43, 44). The most observations occurred at the Powerhouse and Lower Spawning Channel sites, though there were also a few observations at the LSC Road Restoration, Lower Seton Riparian, and Mariposa sites (Tables 17, 18).

Compared to the 2014 records, there were fewer site visit days and fewer observations made at the Powerhouse site while there were more site visit days and more observations made at the Lower Spawning Channel in 2015 (Table 19). Notably, there were 4 WEGA observations at the LSC Road Restoration site, which was installed in 2014, and that had no observations in 2014 (Table 19).

In 2014, there were few observations in both July and August; however, in 2015 there was a decrease in observations during July, but not August (Figure 42). Last year it was hypothesized that the limitation is likely the hot temperatures seen during July and August. In July and August of 2014, the mean temperatures reached 24.5°C and 23.7°C, respectively (Environment Canada, 2014). In 2015, the mean temperature during August was slightly cooler, at 22.5°C (Environment Canada, 2015; Table 20). It is possible that the slightly cooler temperatures impacted the use of the cover boards by snakes. It is also possible that the greater number of observations in August 2015 was a function of the amount of time since the boards were installed.

Table 17 Summary of reptile cover board monitoring 2015

Site	Site visit days	# WEGA observed	# GOSN observed	# RACE observed	Total No. individuals
Powerhouse	23	2	1	12	15
Mariposa	12	1			1
Orchard	6				0
Lower Seton Riparian	6	1			1
Lower Spawning Channel	12	9		6	15
Mid Seton Corridor	8				0
Upper Spawning Channel	16				0
Upper Spawning Control	0				0
Picks Falls	8				0
Upper Corridor Terrace	11				0
LSC Road Restoration	5	4			4
TOTAL	107	17	1	18	35

* WEGA: western terrestrial garter snake, GOSN: Gopher snake, RACE: yellow bellied racer

Table 18 All reptile observations during 2015 cover board monitoring

Site	Board	Date of observation	Species	No. individuals	Photos
Powerhouse	4-1	May 3 2015	RACE	2	y
Powerhouse	3-6	May 3 2015	GOSN	1	y
Powerhouse	1-5	May 16 2015	RACE	2	y
Powerhouse	4-4	May 16 2015	RACE	2	y
Powerhouse	1-4	June 7 2015	RACE	1	y
Powerhouse	2-5	June 7 2015	RACE	1	n
Powerhouse	4-2	June 7 2015	WEGA	1	y
Powerhouse	4-2	June 21 2015	WEGA	1	y
Powerhouse	4-2	Aug 29 2015	RACE	1	n
Powerhouse	m3	Sept 13 2015	RACE	1	n
Powerhouse	4-1	Sept 27 2015	RACE	1	y
Powerhouse	m4	Sept 27 2015	RACE	1	y
Mariposa	r2-1	Sept 24 2015	WEGA	1	y
Lower Spawning Channel	65	June 1, 2015	RACE	4	y
Lower Spawning Channel	63	July 27 2015	RACE	1	y
Lower Spawning Channel	63	Aug 14 2015	WEGA	1	n
Lower Spawning Channel	65	Aug 17 2015	WEGA	1	y
Lower Spawning Channel	66	Aug 17 2015	WEGA	1	y
Lower Spawning Channel	53	Aug 27 2015	RACE	1	y
Lower Spawning Channel	59	Aug 27 2015	WEGA	1	n
Lower Spawning Channel	60	Sept 15 2015	WEGA	1	n
Lower Spawning Channel	63	Sept 15 2015	WEGA	1	n
Lower Spawning Channel	70	Sept 15 2015	WEGA	1	n
Lower Spawning Channel	63	Sept 22 2015	WEGA	2	y
LSC Road Restoration	mini golf	Aug 31 2015	WEGA/RACE	2	y
LSC Road Restoration	57	Aug 31 2015	WEGA	3	y
Lower Seton Riparian	4	Sept 15 2015	WEGA	1	n

* WEGA: western terrestrial garter snake, GOSN: Gopher snake, RACE: yellow bellied racer.

Table 19 Reptile Observation Summary 2009 - 2015

Site	Year of Install-ation	2015 Site Visits	2015 No. Obs	2014 Site Visits	2014 No. Obs	2013 Site Visits	2013 No. Obs	2012 Site Visits	2012 No. Obs	2011 Site Visits	2011 No. Obs	2010 Site Visits	2010 No. Obs	2009 Site Visits	2009 No. Obs
Powerhouse	2008	22	15	29	24	16	3	33	22	31	7	23	9	>10	0
Mariposa	2012	6	1	19	0	10	6	27	0						
Orchard	2012	6	0	0	0	12	0	17	0						
Lower Seton Riparian	2012	6	1	0	0	12	1	17	1						
Lower Spawning Channel	2012	12	16	1	4	12	35	17	61						
Mid Seton Corridor	2013	4	0	18	0	4	0								
Upper Spawning Channel	2013	11	0	18	0	5	0								
Upper Spawning Control	2014	0	0	0	0										
Picks Falls	2014	6	0	19	0										
Upper Corridor Terrace	2014	7	0	18	0										
LSC Road Restoration	2014	5	4	0	0										
TOTAL		**86**	**37**	**122**	**28**	**71**	**45**	**111**	**84**	**31**	**7**	**23**	**9**	**>10**	**0**

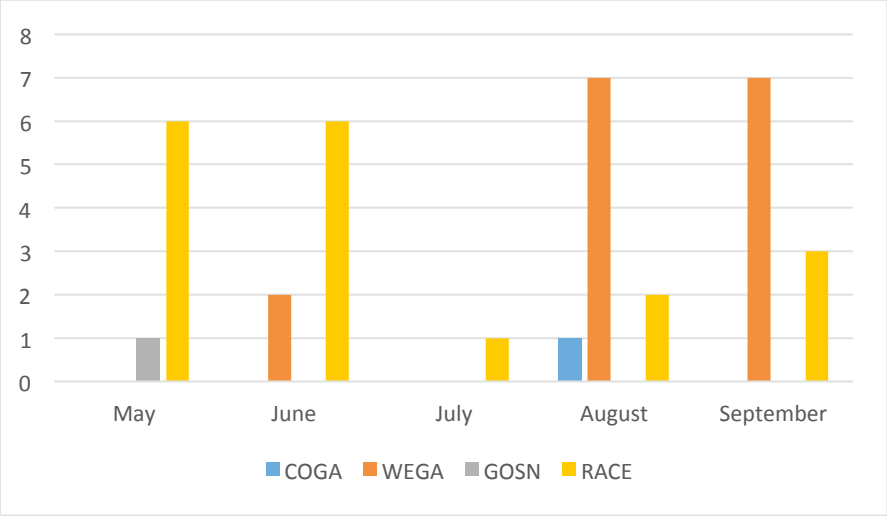


Figure 42 Reptile cover board observations by month 2015

WEGA: western terrestrial garter snake, GOSN: Gopher snake, RACE: yellow bellied racer, COGA: common garter snake

Table 20 Monthly weather values during 2015 reptile monitoring season (MOE)

Month	average daily mean temperature (°C)	average daily max temperature (°C)
April	10.5	17.1
May	17.6	25.1
June	22.5	30.5
July	25.2	32.9
August	22.5	30.1
September	15	21.1
October	11.1	16.2

Figure 43 Great Basin gopher snake under coverboard 3-6 at PH 03 May 2015

Figure 44 Baby racer under coverboard M3 at PH 13 Sept 2015

7.3.2 Hibernacula Surveys

A total of 13 hibernacula searches were completed during 2015-16 (Table 21, 22, Figures 45, 46). The den searches did not result in detections of Great Basin gopher snake at possible denning sites, but did result in nine incidental detections of the western yellow-bellied racer (Figure 48) and one detection of the common garter snake (Note: this is most likely a misidentification). Sheds were also observed and recorded during den searches (Figure 47).

Even though the den searches did not confirm gopher snakes denning in the corridor, the cover board data and two general sightings of gopher snakes in the corridor confirm their presence, and denning habitat, therefore, is assumed to be available.

Another season of den searches is recommended, targeting monitoring to early spring and fall when reptiles are leaving and retuning to hibernacula sites. It is important to confirm denning features so they can be protected in the future. It may be useful to look at placing PIT tags on several snakes in the corridor to accurately identify dens if the searches are not successful in the future.

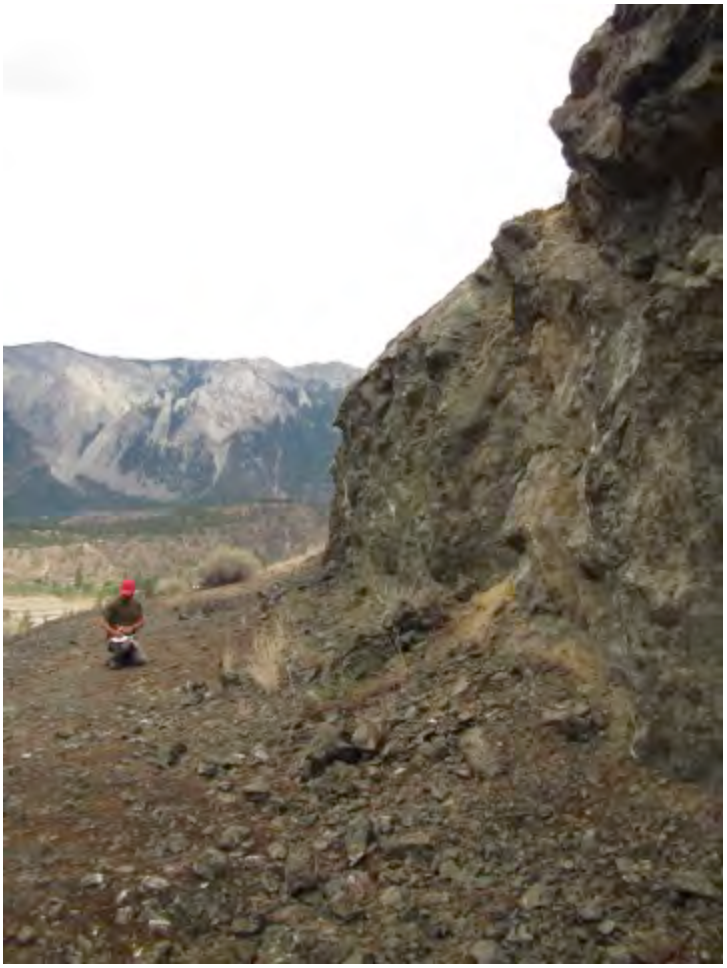


Figure 45 Reptile den survey Mariposa Flat 01 Sept 2015

Figure 46 Reptile den survey Marriage Rock area 01 Oct 2015

Table 21 Potential Reptile Den Sites in the Seton River Corridor

Feature ID	Easting	Northing	Mass	Apect (°)	Slope %	Fracturing*
F1	575860	5614380	2	102		0
DEN1	575663	5614094	2	n/a		5
DEN2	575474	5614226	3	n/a		1
F2	572801	5613356	2	335	100	5
F3	572758	5613295	3	320	55	3
F4	572235	5613284	2	304	60	2
F5	572662	5613114	3	11	4	4
F6	575443	5614358	2	4	0	4
F7	575460	5614358	2	0	0	3
F8	574132	5614191	3	168	0	5
F9	573842	5614093	3	97	60	5
F10	573067	5613912	1	205	85	3
F11	573508	5614953	3	115	84	5
F12	573479	5614843	3	122	78	3
F13	573491	5614762	3	108	75	3
F14	573529	5614759	2	84	102	3

* 0: no fracture, 1: friable rock, shallow fractures, 2-4: anything in between, 5: deep fissures, separate volcanic events or large rock flake

Table 22 Reptiles Found During Den Searches 2015

Date	Label	Easting	Northing	Time	Species*	Life Stage	Behaviour
Sept 12 2014	Inc1	575860	5614380	8:45 AM	RACE		
Sept 5 2014	Inc2	575467	5614315	11:21	RACE		
Sept 22 2014	Inc2	575880	5614345	11:30 AM	RACE		
Sept 22 2014	Inc3	575919	5614351	11:40 AM	RACE		
Sept 22 2014	Den3	575430	5614291	1:55 PM	RACE		
Sept 29 2014	Inc4	574912	5614438	1:40 PM	RACE	J	Basking
Sept 30 2014	Inc5	574228	5614148	1:10 PM	RACE	J	
Sept 22 2014	Inc1	575860	5614380	11:20	RACE		
Sept 21 2015		573359	5614430	1:00 PM	RACE		
Sept 21 2015	MisID?	573359	5614430	1:00 PM	COGA		

* WEGA: western terrestrial garter snake, GOSN: Gopher snake, RACE: yellow bellied racer, COGA: common garter snake

Figure 47 Shed observation Mariposa Flat 01 Sept 2015

Figure 48 Racer incidental observation Mariposa Flat 01 Sept 2015

7.3.3 Report-a-Gopher-Snake-Program

In 2014, several reports were made to the Report-a-Snake program; however, this year, despite the same amount of advertising as last year, only one report was made. A gopher snake was observed on 26 June 2015 (Figure 49) while the reporter was hiking near West Pavilion Road (not in the Seton Corridor). Confirmation was made by photograph. Another local Facebook report showed a dead baby racer that had been killed by a cat (Figure 50). Education on reptiles and cats was posted to our website and Facebook page after this incident.

Learning from this year, the Report-a Gopher-Snake program will be expanded next year. We will increase advertising using posters and social media. Additionally, we will requests reports of all snakes, not just gopher snakes in order not to exclude those who may not feel confident in their snake identification skills. Photographs will again be required to confirm species.

Figure 49 Great Basin gopher snake report BBrett West Pavilion 26 June 2015

Figure 50 Baby racer killed by cat reported Lillooet 25 Sept 2015

Chapter 8. Large Mammal Monitoring

8.1 Introduction

Wildlife cameras have been installed to monitor wildlife over the length of the corridor with the goal of identifying species using the corridor and what areas are of most value, including identification of existing wildlife trails. One wildlife motion detector camera was installed on a tree during the summer of 2012, six installed during 2013 and another two during 2014 (Map 34).

8.2 Methods

The cameras are distributed across the corridor and locations were chosen based on evidence of strong habitat structure, identified wildlife trails and likelihood of animals tripping the cameras. Locations were restricted to sites that would reduce the risk of vandalism or theft. Complete site descriptions for each camera can be found in Seton River Corridor Conservation and Restoration Project Report 2014-15.

Map 34 Seton Corridor Large Mammal Monitoring 2015-16

Bushnell trophy cam HD 8 megapixel cameras were used for capturing images. Image capture was programmed to take 10 second videos when the motion sensor was triggered. Cameras operate both in daylight and at night via led lights. 32 gigabyte memory cards were used inside each camera for data storage.

Cameras were locked with a padlock to secure the batteries and data card and then locked to trees using metal cable. Batteries were changed approximately every three months and data card was downloaded that day and returned to the camera with fresh batteries.

Image captures were downloaded to a computer and the images systematically viewed by a crew technician, analyzed and observation described. A data observation form was designed for positive image captures which included: Date, File, Time, Location, Species, Name, Number of individuals, life stage, Sex, Observation, Direction of travel, Activity.

Several of the observations 'Activity, life stage' categories used codes as described in Describing Terrestrial Ecosystems in the Field Wildlife Habitat Assessment. Observations were summarized into Microsoft excel tables, and reported information focused on species, location, direction of movement and observed activities. People that were captured in images were recorded as 'human' and treated as a species using the site.

8.3 Results

During the 2015 -16 season, 8 of the 9 wildlife cameras were used to monitor large mammal movement in the corridor. Wildlife Camera 2 was stolen and due to lack of resources not replaced, therefore, there is no recorded data for this location.

Similar patterns were observed as last year. During 2015-16 the following observations were made (Table 23, 24):

- 300 mule deer observations at Wildcam 7 and several mule deer observations at Wildcams 1, 4, 5, 6, and 9.
- One beaver was observed on Wildcam 3 at the lower spawning channel.
- One cougar was observed on Wildcam 6.
- Many coyotes were observed at Wildcam 6, 7, and 9 and a few were observed at Wildcam 5 and 8.
- The most black bears were observed at Wildcam 7, at Mariposa Flats.
- Interestingly, an elk was observed on Wildcam 7. Though elk have been known to roam south of town, it is interesting to have observed one so close to town.
- Humans were observed at all Wildcam locations but were most prevalent at Wildcam 9 where there is a trail system along the canal.

Table 23 Wildlife Camera Data 2015 - large mammal observations by species & camera ID

	No. of Large Mammal Observations											
Camera ID	**Mule deer**	**Human**	**Dog**	**Coyote**	**Black bear**	**Mt Sheep**	**Raccoon**	**Beaver**	**Cougar**	**Elk**	**Unknown**	**Total**
1	65	22										87
3		1	1		1			1				4
4	59	6	1								4	70
5	46	20	17	2	3						3	91
6	98	84	21	18	5	9			1		1	237
7	300	64	1	20	21	2	3			1	4	416
8		4	1	2								7
9	8	371	106	8		6						499
Total	576	573	148	50	30	17	3	1	1	1	12	1412

Table 24 wildlife Camera Data 2015 - Large mammal observations by species & month

	No. of Large Mammal Observations											
Month	**Mule deer**	**Human**	**Dog**	**Coyote**	**Black bear**	**Mt Sheep**	**Raccoon**	**Beaver**	**Cougar**	**Elk**	**Unknown**	**Total**
Jan	1	51	13	5	1	2						73
Feb	8	103	35	2				1				149
March	42	63	27	3	3						3	141
April	119	123	22	1						1	4	270
May	139	66	12	3							1	221
June	44	50	11	4	1	10					1	121
July	51	32	8	10	2	5			1		1	110
August	42	45	20	6	9							122
Sept	37	28		4	10							79
October	74	9		12	4		3					102
Nov	19	2										21
Dec		1									2	3
Total	576	573	148	50	30	17	3	1	1	1	12	1412

Chapter 9. Restoration Works

9.1 Introduction

Restoration works for 2015-16 built on the restoration works of the past several years, and included invasive species management, installation of habitat features and revegetation efforts.

Due to unexpected high flows in the Seton River, no planting occurred along the riprap of the Seton River as planned. However, past works along the Seton River (pocket planting, live stakes and willow fences) were monitored to determine it any adaptive management strategies should be undertaken. Instead of bioengineering work along the Seton River, cuttings were stocked around the berms at the lower spawning channels.

The following locations were targeted for restoration during 2015-16:

- Lower Corridor – riparian management/orchard area and old road/demo garden (Map 35 – shaded yellow)
- Lower Spawning Channel – berms (Map 35)
- Lower Spawning Channel – old road bed and gravel berm area (Map 35)
- Upper Spawning Channel (Map 36)

Map 35 Seton Corridor Planting Location 2015-16 - east

Map 36 Seton Corridor Planting Locations 2015-16 - west

9.2 Methods

9.2.1 Invasive Weed Management

Invasive weed removal is a large part of the restoration work needed in the corridor. Many invasive weed species are present in both highly impacted areas and in areas of functioning habitat.

Invasive species at restoration sites are removed by hand-pulling or digging with shovels to ensure native species planted have space to grow and seed. In areas where invasive species are present in other areas, targeted species are removed by hand and other species controlled by weed-wacking and mowing to decrease the risk of reseeding.

During invasive weed removal, all seed bearing plant materials and other identified species were bagged/tarped and transported from the sites to the local landfill. Some of the plant materials were left piled on site to act as habitat features and some were used to mulch any native species found. All other plant materials were transported to compost piles located beside the BC Hydro Transmission yards and used with other materials for preparing soil compost mixes to be used at the nursery in the future or to be used as mulching materials.

Lower Corridor
The area of focus for weed removal in the lower corridor was again the 2013-14 restoration sites (riparian management area and orchard area), with alfalfa *(medicago sativa)*, cheat grass *(bromus tectorum)* and bulbous bluegrass *(poa bulbosa)* being the main targeted species. The larger alfalfa was removed in the past but young plants have colonized the restoration sites from the seedbank. They were removed by hand-pulling and digging. In non-restoration areas surrounding the area the seedheads were removed by mowing down. Cheatgrass and bulbous bluegrass was hoed out of key areas. Hay was also added again to depress weeds and create a mulch layer so watering of the sandy sites was not as critical.

Other areas of focus were the deactivated roads at the entrance to the Lower Spawning Channel. During 2014 these old roadbeds were deactivated, habitat features added and revegetated and during 2015 monitored and weeded as necessary. Hand pulling and hoeing were the main methods of removal.

Lower Spawning Channel – Berms
Removal of invasive species continued along the berms at the Lower Spawning Channel, with a focus on similar species as was removed and/or controlled in 2012-2014. Giant burdock *(Arctium lappa)* and diffuse knapweed *(Centaurea diffusa)* have decreased significantly at the Lower Spawning Channel, but still persist due to the seedbank established over the years. Again these two species were hand-pulled and dug out to remove root systems. The spawning channels were also mowed and weed-wacked on a regular rotating weekly basis to control seeding by other species.

Lower Spawning Channel – Old Road and Gravel Berm Area
An excavator removed invasive plant species off and alongside an old road that was not required. This work was carried out on 26 May 2015 while preparing the ground for revegetation and building the hibernacula. The excavator pulled alfalfa out by the roots and turned remaining weeds into the soil and treated a 2,010sqm area. The site was then left fallow until just before planting in October 2015. Crews then swept through the site removing remaining weeds in the areas to be planted. The weeds were targeted before they went to seed and were piled on site to act as habitat features.

Upper Spawning Channel
Removal of invasive plant species at the Upper Spawning Channel took place on 2014-15 restoration site. Again crews hand-pulled and dug out targeted weeds around the native species, then weed-wacked and mowed the surrounding areas to decrease seed bank. The major species at the Upper Spawning Channel are diffuse knapweed *(Centaurea diffusa),* Alfalfa *(Medicago sativa),* mustard *(Erysimum spp.),* mullein *(Verbascum thapsus)* and wild four o-clock/umbrellawort *(Mirabilis nyctaginea).*

9.2.2 Site Complexing and Installation of Habitat Features

During the 2015-16 it was again necessary to use an excavator in the new restoration sites to turn soils, creates mounds and planting spaces. CWC was added to the sites and another hibernacula constructed.

Lower Corridor
No further complexing was required at this site.

Lower Spawning Channel - Berms
An increase in instream/bankside habitat was achieved by the placement of CWD from fallen cottonwood tree that had fallen across the access road at the site and other dead prunings.

Lower Spawning Channel – Old Roadbed and Gravel Berm
An attempt was made to use the rough-and-loose method of site manipulation, but due to the rocky nature of the site it was not possible in all areas. Where it was possible, the excavator loosened the surface, created holes and mounds, thereby creating micro-habitats. Where it was not possible, the excavator just scrapped the soil to an approximate depth of 0.5m. Piles of boulders/rocks were moved and placed in piles to create habitat features.

A second hibernacula was constructed at the Lower Spawning Channel. It was placed beside a south-facing slope and constructed by digging a hole approximately 2m deep and then filling with some of the boulders set aside from the road deactivation work. A few larger boulders were brought to the site and placed in the hole. The hibernacula was then capped with a layer of soil and cwd.

Upper Spawning Channel
No further complexing was required at this site.

9.2.3 Revegetation

Lower Corridor
Infill planting took place in the Lower Corridor, at both the riparian management/orchard area and on the old 2014 deactived roadbed (reptile road). Crew technicians dug holes twice the size of the potted plants, loosened soil in the hole, and watered. The soil was then loosened around the potted plant as required and additional soils and mycorrhizal fungi were added to the hole. Plants were then placed in the hole and covered with soil, packing around the plant as more soil was added. A slight depression was left where water can pool and the soil mulched with straw. Crew technicians and students carried out the work on the old roadbeds.

Lower Spawning Channel - Berms
The Lower Spawning Channel was targeted for increasing the riparian area around the berms as opposed to planting along the Seton River due to uncertainty of hydro flows in the Seton River.

Potted plants were used on the man-made berms in between the reaches of the spawning channel. As this ground is very compact and rocky, crews had to dig holes three times the size of the potted plants and fill with composted soils. The planting technique noted above was employed.

Along the edges of the berms close to the water's edge, cuttings were planted using live stakes. Live stakes approximately 1.5m tall were harvested from under the transmission lines in the upper corridor and soaked for two days. Using specially designed metal poles fabricated for the job, holes were drilled into the rocky edges of the river and channel by crew technicians, the cutting placed in the hole, and holes then closed back up with pole, boots and by hand.

Lower Spawning Channel – Old Roadbed and Gravel Berm
Potted plants and grassland plugs were used to revegetate the old roadbed and gravel berm area. The technique noted above for potted plants was employed for the trees, shrubs and forbs. The grassland plugs were planted with silviculture spades by opening up the ground a crack, placing the plug into the ground, and pushing soil back around the plant with the spade, by boots and by hand. Students from the local schools planted during the annual fall stewardship days.

Upper Spawning Channel
Potted plants and grassland plugs were used to infill the 2014-15 planted areas, to increase density and replace some of the fir trees that had died over the winter. The same techniques noted above were employed when planting out the potted plants and plugs. Students from local schools again assisted with the planting.

9.3 Results

9.3.1 Invasive Weed Management

Lower Corridor - Riparian Management/Orchard Area and Reptile Road/Demo Garden
During early spring 2015 (28 April to 01 May) crew technicians trained 6 labourers during a weed blitz to identify and remove invasive species at the riparian management/orchard area. This site had been planted in 2013-14 and the existing seedbank was overwhelming the native species.

A total of 174 person-hours were spent over these 4 days to remove bulbous bluegrass, quack grass, dandelion, alfalfa, mustard. One crew technician weed-wacked the surrounding areas that have invasive species to ensure they did not seed back into the restoration areas and other intact grassland forested areas close by. A total of 12 one-tonne truckloads of weeds were taken to the compost piles and 6 piles of plants that did not have the potential to seed were left on site as habitat features. Throughout the summer, the site was monitored for weeds on a weekly basis at the same time the site was watered. Weeds were hand-pulled as needed and the area was also weed-wacked once a month during June, July, August and September to keep invasive plants from seeding.

The old roadbed (reptile road and demonstration garden) was also weeded during a weed blitz by crew technicians and labourers (08 May). A total 18 person-hours were spent removing knapweed, cheatgrass and bulbous bluegrass on the reptile road and nursery staff weeded the demonstration garden as needed throughout the growing season.

Lower Spawning Channel – Berms
A weed blitz around the spawning channel berms targetted giant burdock *(Arctium lappa)* and diffuse knapweed *(Centaurea diffusa)* to ensure no further seed heads would establish. This work was completed in early spring (07-08 May) and involved walking each of the berms looking for the target species and pulling when encountering a plant or group of plants. In mid summer (02-03 July) a second sweep was completed. A total of 76 person-hours were required to do this work. As noted above, there has been a large decrease in these species, especial giant burdock, and it is hoped that this work will decrease over the years.

The spawning channels were also weed-wacked and mowed on a regular basis to keep down the white clover and alfalfa in particular. One crew technician monitored the weed growth and completed the task. On average 3-days are required to circle the spawning channel and hit all the berms once a month. The crew technician avoids native species, in particular the shrubs and trees encountered, and these plants are growing up over the weeds.

Lower Spawning Channel – Old Roadbed and Gravel Berm
Removal of invasive plant species on the old roadbed was completed by excavator during preparation for revegetation. Similar invasive plant species as noted above were found in this area as well. The excavator pulled alfalfa out by the roots, decompacted the road and turned remaining weeds into the soil as it worked its way down the site. Crews then went into the site two-weeks later and removed any remaining weeds in the areas to be planted.

Upper Spawning Channel
The weed blitz crew continued their weeding efforts in the spring (05-06 May) at the upper spawning channel. By this time the labourer crew were intimately familiar with the invasive species; however, as this was a newly restored area (2014-15) they had to be careful not to damage the smaller native species and confuse the invasive grasses with the native species.

Again crews hand-pulled and dug out targeted weeds around the native species, then weed-wacked and mowed the surrounding areas to decrease seed bank. A total of 91 person-hours was required to remove 7 one-tonne truck loads of weeds from the site during the May weedblitz.

Throughout the summer (19 May to 28 July) another 68 person-hours were spent weekly at the site removing weeds, weed-wacking/mowing and watering in the 2014-15 trees and shrubs. During August and September this work continued weekly at a lower level of effort, but crew technicians did not record effort on data sheets.

The major species removed at the Upper Spawning Channel were diffuse knapweed *(Centaurea diffusa),* alfalfa, cheatgrass, mustard *(Erysimum spp.),* mullein *(Verbascum thapsus)* and wild four o'clock/umbrellawort *(Mirabilis nyctaginea).* This last species is difficult to remove; as the Upper Spawning Channel site is the only area that it has been observed within the corridor it will be important to continue to monitor and remove before seeding occurs.

9.3.2 Site Complexing and Installation of Habitat Features

Lower Corridor - Riparian Management/Orchard Area and Reptile Road/Demo Garden
No further complexing was required at this site. During weed removal, as noted above, crews left removed plants that had no chance of seeding in piles around the riparian management area with the goal of creating habitat features.

Lower Spawning Channel - Berms
During a windstorm in August 2015 a large cottonwood tree fell over the access road through the Lower Spawning Channel. The tree was cut and pushed part-way into the water to create both in-stream and riparian habitat (Figure 51).

Lower Spawning Channel – Old Roadbed and Gravel Berm
An excavator was employed on 27 May 2015 to decompact an old road and dig large holes in the gravel berm and slope (Figure 52). During that time a lot of small boulders, rocks and cobbles were unearthed while soil was being manipulated to create a rough-and-loose texture for future planting. The machine operator created small piles of rocks and cobbles throughout the restoration site and kept some of the material aside for the hibernacula construction. The excavator returned to the site on 14-15 September and 05 October to fill the large holes made in the gravel berm with purchased top soils and to fill the hibernacula with boulders and rocks.

The hibernacula was constructed using the technique recommended by the Toronto Zoo, noted above. This is the third hibernacula constructed in the Seton River Corridor over the last two years and it will be interesting to monitor for use to see if a man-made feature can provide denning habitat.

Upper Spawning Channel

No further complexing was completed at this site. Again weed piles were left site on some occasions to create wildlife habitat features.

Figure 51 Large tree placed in Lower Spawning Channel 29 Aug 2015

Figure 52 Excavator preparing old road and gravel berm site Lower Spawning Channel

9.3.3 Revegetation

Lower Corridor - Riparian Management/Orchard Area and Reptile Road/Demo Garden
Infill planting took place in the Lower Corridor at the riparian management/orchard area on 26 October 2015. This work was undertaken to increase density on the 2013-14 restoration site and replace dead shrubs that had not survived the very hot dry summer of 2015. A total of 580 plants were stocked into a 295sqm area (Map 35, Table 25).

The old road (reptile road and demonstration garden sites) were also targeted for planting to increase density. A total of 675 plants were stocked into a 675sqm area (Map 35, Table 25).

Lower Spawning Channel - Berms
In mid-March 2016, black cottonwood cuttings were collect in the Seton Corridor, in an area under BC Hydro transmission lines. Splitrock has an agreement in place with BC Hydro to harvest in this area, benefitting both our revegetation efforts and BC Hydro's vegetation management program. Between 22-24 and 28-29 March 2016, seven crew technicians successfully planted 2,255 cuttings long every second berm at the Lower Spawning Channel (Map 35, Table 25, Figure 53), with the goal of increasing shade to reduce deil water temperatures and temperature fluctuations that put fish at risk. An additional 692 potted plants were planted on the berms above the water level to supplement the cuttings and along the hillside near the bird blind (Map 35, Table 25, Figure 54). The estimated area planted along every second berm and around the spawning channel is 8,100sqm.

Figure 53 Cuttings along Lower Spawning Channel berms 30 March 2016

Figure 54 Planting around berms and bird blind Lower Spawning Channel 01 April 2016

Lower Spawning Channel – Old Roadbed and Gravel Berm

During April, May and October 2015, potted native species were planted at the Lower Spawning Channel. This work was possible due to leveraging of additional funds from AFSRA for the benefit of the listed gopher snake and western screech-owl. Planting took place after an old road at the Lower Spawning Channel was deactivated and planting pockets dug into an old gravel berm left over from the recomplexing of the channels. Crew and volunteers attending the Walking with the Smolts and Fall Stewardship events planted a total of 547 riparian species and 1,726 grassland species over a 2,010sqm area (Map 35, Table 25, Figure 55).

Figure 55 Planting Old Road/Gravel Berm Area Lower Spawning Channel 07 Oct 2015

Upper Spawning Channel

At the upper spawning channel planting occurred on 23 and 27 October 2015 by crew technicians and volunteers from the local schools and community during the annual fall stewardship days. A total of 729 plants were stocked into 2,277sqm area to increase density and to replace several dead fir trees (Map 36, Table 26, Figure 56, 57).

Sage seedlings were also thinned out while still small so that they do not overcrowd the native species in the future, in an attempt to decrease sage levels as has been observed at the Powerhouse site.

Figure 56 Increase in density/remove sage Upper Spawning Channel 07 Oct 2015

Figure 57 Restoration site showing lack of trees/shrubs 22 Oct 2016

Table 25 Restoration Works Summary 2015-16

Location	Site Description	Area (sqm)	Riparian Cuttings	Riparian Plants	Upland Plants	Total
Lower Spawning Channel	Old Road Gravel Berm Area	2,010		547	1,726	**2,273**
	Bird Blind Area	743		23	370	**393**
	Berm 1	438	388	34		**422**
	Berm 3	1,088	717	29		**746**
	Berm 5	913	459	21		**480**
	Berm 7	848	415	14		**429**
	Berm 9	985	276	36		**312**
	Berm 11	402		24		**24**
	Berm 13	888		10		**10**
	Berm 15	725		22		**22**
	Berm 17	378		13		**13**
	Berm 19	535		34		**34**
	Top of Lower Spawning (west)	105		7		**7**
	Nettle Pockets	52		55		**55**
Lower Seton Corridor	Reptile Road & Demo Garden	675			675	**675**
	Orchard	295			580	**580**
Upper Spawning Channel	Upper Spawning Channel	2,277		271	458	**729**
TOTAL		**13,357**	**2,255**	**1,140**	**3,809**	**7,204**

Table 26 below details the species breakdown for each day of planting by location.

Table 26 Revegetation Species Breakdown by Area Planted 2015-16

2015-16 RESTORATION PLANTING SUMMARY		SETON CORRIDOR ONLY											
		INVOICE 01	INVOICE 02	INVOICE 03		INVOICE 04	INVOICE 05	INVOICE 06	INVOICE 10	INVOICE 8		INVOICE 9	
		LOWER SPAWNING CHANNEL					LCOR	USCHANNEL	LOWER SPAWNING CHANNEL				
	Date Planted	**25-27 April 25 May 2015**	**29-May-16**	**07-Oct-15**	**15-Oct-15**	**16-Oct-15**	**26-Oct-15**	**23 & 27 Oct 2015**	**22-29 Mar 2016**	**30-Mar-16**	**31-Mar-16**	**01-Apr-16**	
	Location Planted	Demo Garden	Riparian Section of Gravel Pit Area	Grassland Section of Gravel Pit Area	Old road area behind cobble pile	Top Road Bird Blind to Riparian	**ORCHARD PLANT**	**UPPER SPAWNING CHANNEL**	Berms 1, 3, 5, 7, 9 Cuttings	Berms 1, 3, 5, 7, 9 Potted	Berms 11, 13, 15, 17 & West end Potted	Bird Blind Area Potted	**Seton Corridor TOTALS**
	Who Planted	Volunteers Earth Day Walk Smolts	Volunteers Walk Smolts	Volunteers Stewards	Crew	Crew	Nursery Crew	Crew	Crew	Crew	Crew	Crew	
COMMON NAME	**SCIENTIFIC NAME**												
CUTTINGS													
Black Cottonwood	*Populus balsamifera ssp. Trichocarpa*								2,255				**2,255**
TREES - EVERGREEN													
Interior Douglas-fir	*Pseudotsuga menziesii var glauca*	32	47	20	50	23		56		37	40		305
Ponderosa Pine	*Pinus ponderosa*			10	34	11		32		31	22	6	146
Rocky mountain juniper	*Juniperus scopulorum*					5		3					8
TREES - DECIDUOUS													
Black Cottonwood	*Populus balsamifera ssp. Trichocarpa*		167	30	35			150					382
Mountain Alder	*Alnus incana ssp. Tenuifolia*							15		43	42		100
Paper Birch	*Betula papyrifera*							15			10		25
		32	**214**	**60**	**119**	**39**		**271**		**111**	**114**	**6**	**966**
SHRUBS													
Black Hawthorn	*Cratageus douglasii*			10	15	5		10					40
Choke cherry	*Prunus virginiana*		35	5	5	5				9		6	65
Gooseberry	*Ribes lacustre*										5		5
Hemp Dogbane	*Apocynum cannabinum*		36					20					56
Kinnikinnick	*Arctostaphylos Uva-ursi*											3	3
Mock Orange	*Philadelphus lewisii*	3											3
Oregon grape	*Berberis nervosa*						12						12
Pacific willow	*Salix lucida ssp. Lasiandra*			10	10								20
Red-osier dogwood	*Cornus stolonifera*		100	10	10								120
Saskatoon	*Amelanchier alnifolia*		36	35	60	33	113	50		6		11	344
Shrubby penstemon	*Penstemon fruticosus*	9						18				18	45
Soopolallie	*Shepherdia Canadensis*		56	20	20	5	69	40		8	11	10	239
Stinging Nettle	*Urtica dioica*										35		35
		12	**263**	**90**	**120**	**48**	**194**	**138**		**23**	**51**	**48**	**987**
HERBS													
Arnica	*Arnica cordifolia*	7											7
Birch-leaved spirea	*Spiraea betulifolia*	7											7
Brown-eyed Susan	*Gailardia aristata*	50		43	44							12	149
Canada Goldenrod	*Solidago Canadensis*			5	5								10
Graceful Cinquefoil	*Potentilla gracilis*	5											5
Cutleaf Anemone	*Anenome multifida*	24											24
Golden Aster	*Heterotheca villosa*	10										12	22
Hoebell's rockcress	*Arabis holboellii*											5	5
Common red paintbrush	*Castilleja miniata*	3											3
Lemonweed	*Lithosperma ruderale*	5											5
Artic Lupin	*Lupine arcticus*	15											15
Pearly Everlasting	*Anaphalis margaritacea*	9											9
Round-leaved Alumroot	*Heuchera cylindrica*	8											8
Slender Hawksbeard	*Crepis atrabarba*	5											5
Showy Aster	*Aster conspicuus*			20	20								40
Showy Daisy (purple)	*Erigeron speciosus var. speciosus*	4											4
Spikelike goldenrod	*Solidago spathulata*	7											7
Trailing Daisy	*Erigeron flagellaris*	6										6	12
Tufted prairie aster	*Symphyotrichum ericoides*	13		20	20								53
Yarrow	*Achillea millefolium*	2		30	30							17	79
Yellow Mountain-avens	*Dryas drummondii*	20											20
		200		**118**	**119**	**0**	**0**	**0**		**0**	**0**	**52**	**489**
NATIVE GRASSES													
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	149	70	500	500	12	340	320				28	1919
Giant Wildrye	*Leymus cinereus*			50	50	5							105
Indian Ricegrass	*Stipa hymenoides*	26											26
Junegrass	*Koeleria macrantha*	170					29					50	249
Needle and Thread Grass	*Hesperostipa comata*	18					7					52	77
Sand Dropseed	*Sporobolus cryptandrus*	27											27
Sandberg's Bluegrass	*Poa secunda*	25											25
Stiff Needlegrass	*Achanatherum lemmonii*	16					10					53	79
		431	**70**	**550**	**550**	**17**	**386**	**320**		**0**	**0**	**183**	**2507**
													7,204
	TOTAL PLANTS	**675**	**547**	**818**	**908**	**104**	**580**	**729**	**2,255**	**134**	**165**	**289**	**7,204**

RIPARIAN SPECEIS		547			23		271	2,255	134	165		3,395
UPLAND SPECIES	675		818	908	81	580	458				289	3,809
	675	**547**	**818**	**908**	**104**	**580**	**729**	**2,255**	**134**	**165**	**289**	**7,204**

Chapter 10. Restoration Monitoring

10.1 Introduction

During 2010, monitoring of restoration sites was completed using established photopoint locations. Data has been collected, downloaded, but all data has not been fully analyzed due to lack of resources.

However, the riparian bio-engineering work carried out on the Seton River was extensively surveyed to gauge the success of the approach with the aim of developing adaptive management strategies in 2016.

10.2 Methods

10.2.1 Riprap Monitoring along Seton River

During the 2015–16 season, no restoration took place in riprap areas along the Seton River. Since BC Hydro announced they would potentially be increasing flows up to 90cms+, we opted to plant all our cuttings along the Lower Spawning Channel instead of the Seton River.

Though no planting occurred on the Seton River riprap this year, we did monitor and maintain the restoration works from last year.

In March 2015 Splitrock Environmental undertook bioengineering to restore riparian ecosystems along the Seton River. The restoration work was monitored in August 2015.

There were two goals of the restoration project:

- Increase riparian nesting and foraging habitat for Western Screech-owl by establishing cottonwood forests on degraded streambanks of the Seton River, and
- Develop successful methods for re-vegetating rip-rapped streambanks and eroding streambanks.

A three-year monitoring plan was developed to examine the success of establishing cottonwood forests and reducing erosion. Monitoring work will provide information about the most successful techniques for re-vegetating riprapped areas, and can guide adaptive management for future projects.

We undertook re-vegetation trials on four sites totalling 1,114m2, including three riprapped areas and one eroding streambank (Map 37). Re-vegetation techniques included:

- Pocket planting: filling spaces in the riprap with soil, and planting live cuttings into the soil. Five soil types were used to fill pockets to determine if soil type influences the survival and growth of cuttings.
- Wattle fencing: fences are built across an eroding slope using live stakes, and the fences are backfilled with soil to create terraces.
- Live staking
- Seeding with native plant seeds
- Planting seedlings into eroding banks and on wattle fence terraces.

More information about the restoration methods can be found in the 2014-2015 FWCP Final Report (North & Scholz, 2015), and in “Natural Processes: Restoration of Drastically Disturbed Sites” by David Polster (2011).

Map 37 Seton River Riprap Restoration Locations 2015

Monitoring was undertaken on August 27, 2015. The following activities were completed:

- Visited each riprap pocket and counted the number of living stakes, noting the soil type for each pocket.
- Observed the wattle fences, noting the vigour of growth, success of wattle fence in preventing slope erosion, and difference in success rates among the six wattle fences due to elevation, length of the fence, or any other factors.
- Counted the number and species of surviving stakes and native plant seedlings on the eroding banks.
- Took photographs at each of the photo points, according to methods described in Photopoint Monitoring Handbook (Hall, 2002).

10.3 Results

10.3.1 Riprap Monitoring along Seton River

Pocket Planting

Overall we were pleased with the success of the pocket planting method. 468 cuttings were planted and 186 survived, giving a survival rate of 39.7%. The survival rates of the cuttings varied according to soil type and sites. In general, Soil Type 1 (plain soil) saw the highest survival rates, with 56% of cuttings surviving. The lowest survival rate of 7% was found in Soil Type 5, which is a mix of soil, worm castings and organic fertilizer. See Table 27 to Table 33 below.

It is unclear if soil type is the main factor influencing survival rates. The sample size (n) is too small to see patterns in the results. Survival rates were vastly different between sites, possibly due to factors other than soil type. Factors that may influence the survival rates include watering regime, slope position of pockets (ex: pockets on lower slope would be submerged for longer periods during freshet), soil moisture, shade from surrounding vegetation, and hereditary factors of the cuttings.

Table 27 Soil type mix descriptions

Soil Type	Description
1 (yellow flagging)	gravelly soil
2 (red flagging)	3 shovels gravelly soil 1 shovel worm castings ¾ cup Gaia Green 4-4-4 fertilizer
3 (blue flagging)	3 shovels gravelly soil 1 shovel bark compost
4 (pink flagging)	gravel with water retention pouch
5 (pink flagging)	20 shovels gravelly soil 4 shovels worm castings 1 cup Gaia Green 4-4-4 fertilizer

Table 28 Soil type 1 Survival Rates

Site #	Planted #	Surviving	Survival Rate
1	31	18	58.06
3	27	17	62.96
4	56	27	48.21
Average survival rate:			56.41

Table 29 Soil Type 2 Survival Rates

Site #	Planted #	Surviving	Survival Rate
1	49	10	20.41
3	40	26	65
4	18	4	22.22
Average survival rate:			35.88

Table 30 Soil Type 3 Survival Rates

Site #	Planted #	Surviving	Survival Rate
1	43	7	16.28
3	18	13	72.22
4	56	16	28.57
Average survival rate:			39.02

Table 31 Soil Type 4 Survival Rates

Site #	Planted #	Surviving	Survival Rate
1	89	45	50.56
3	0	-	-
4	0	-	-
Average survival rate:			50.56

Table 32 Soil Type 5 Survival Ratees

Site #	Planted #	Surviving	Survival Rate
1	0	-	-
3	0	-	-
4	41	3	7.32
Average survival rate:			7.32

Table 33 Cutting Survival Rates (%) by soil type and site

Site #	Soil Type					Average
	1	2	3	4	5	
1	58.06	20.41	16.28	50.67	-	36.36
3	62.96	65.00	72.22	-	-	66.73
4	48.21	22.22	28.57	-	7.32	26.58
Average	56.41	35.88	39.02	50.67	7.32	

Wattle Fences

Five of six wattle fences sprouted and grew (Table 34, Figure 58), and we expect these fences to gain structural strength as the cuttings grow. One wattle fence sprouted and then died. The most vigorous wattle fence, Fence #2, was located on the lower slope near the high water mark. Wattle fences above the high water mark sprouted in spring but partly died back in the hot summer months when soil moisture was scarce. Wattle fences below the high water mark sprouted in spring, were submerged for a period of time, and survived the dry summer months. The dead wattle fence is providing erosion control, but will lose structural integrity as the cuttings rot or are washed away. It will be interesting to resurvey in spring 2016 to see if this fence will re-sprout. See Table 34 below for summary of results.

Table 34 Wattle Fence Summary Table 2015

Fence #	Vigour	Slope position	Length (m)	Height of shoots	Notes
1	good	mid-upper	2.6	.6	All vertical stakes sprouted. A few lower cross pieces sprouted. Successfully controlled erosion. Some summer desiccation.
2	excellent	middle	10.2	1.62	Near high water level. All vertical stakes sprouted. Many cross pieces sprouted, including cuttings in all layers. No summer desiccation. Successfully controlled erosion.
3	good	lower	6	.8	Some vertical stakes sprouted. No horizontal cross pieces sprouted. Some summer desiccation. Some browsing by ungulates.
4	fair	middle	2.37	.68	Some vertical stakes sprouted. Lowest cross pieces sprouted. Not as successful at stopping erosion - not as well built as other fences.
5	fair	lower-mid	3.9	.82	Some vertical stakes sprouted. Cross pieces from all layers sprouted. Some summer desiccation. Fairly moist growing site near natural seepage.
6	dead	upper	2.5	0	Sprouted and then died. Location above high water mark. Succeeding at controlling erosion.

Figure 58 Wattle fence 1 06 Seton River 06 Oct 2015

Live Stakes and Seedlings

Live stakes were planted throughout the eroding slope, and saw a survival rate of 31% (Table 35). The surviving stakes were all on the lower slope, mostly near a natural seepage. Seedlings were planted on the eroding gravel slopes and on terraces created by wattle fences.

The survival rate of seedlings was much higher on the terraces, likely because seedlings were protected from rolling rocks and constantly moving soils (Table 36, 37)). Douglas-fir was very successful on both the eroding slopes and the terraces, with a survival rate of 90%. We did not find any seedlings that germinated from the seed mix that was scattered throughout the site.

Table 35 Survival Rate of Single Live Stakes 2015

Planted #	Surviving	Survival Rate
45	14	31.11

Table 36 Survival Rate of Native Plant Seedlings on Terraces 2015

Species #	Planted #	Surviving	Survival Rate
Bluebunch wheatgrass	14	6	42.86
Ponderosa pine	5	3	60
Douglas-fir	5	5	100
Saskatoon	3	2	66.67
Chokecherry	2	1	50
Soopolallie	1	0	0

Table 37 Survival Rate of Native Plant Seedlings on Eroding Slopes 2015

Species #	Planted #	Surviving	Survival Rate
Bluebunch wheatgrass	14	1	7.14
Ponderosa pine	5	1	20
Douglas-fir	5	4	80
Saskatoon	3	1	33.33
Chokecherry	2	1	50
Soopolallie	1	0	0

Photo Point Monitoring

Eight photo points were established to track changes in the vegetation. Four photo points were set up in March 2015, and four more were set up in September 2015. Figures 59 to 83 show the results of the photo point monitoring.

Figure 59 Photo Point Monitoring - Site 1 PP 1; 30 March 2015

Figure 60 Photo Point Monitoring - Site 1 PP 1; 27 August 2015

Figure 61 Photo Point Monitoring - Site 1 PP 1, zoomed; 30 March 2015

Figure 62 Photo Point Monitoring - Site 1 PP 1, zoomed; 27 August 2015

Figure 63 Photo Point Monitoring - Site 1 PP 7; 15 September 2015

Figure 64 Photo Point Monitoring - Site 1 PP 7, zoomed, 16 September 2015

Figure 65 Photo Point Monitoring - Site 2 PP 1; 30 March 2015

Figure 66 Photo Point Monitoring - Site 2 PP 1; 16 September 2015

Figure 67 Photo Point Monitoring - Site 2 PP 1, zoomed, 30 March 2015

Figure 68 Photo Point Monitoring - Site 2 PP 1, zoomed, 16 September 2015

Figure 69 Photo Point Monitoring - Site 2 PP 8; 16 September 2015

Figure 70 Photo Point Monitoring - Site 2 PP 8, zoomed; 16 September 2015

Figure 71 Photo Point Monitoring - Site 3 PP 1; 30 March 2015

Figure 72 Photo Point Monitoring - Site 3 PP 1; 16 September 2015

Figure 73 Photo Point Monitoring - Site 3 PP 1, zoomed; 30 March 2015

Figure 74 Photo Point Monitoring - Site 3 PP 1, zoomed; 16 September 2015

Figure 75 Photo Point Monitoring - Site 3 PP 6; 16 September 2015

Figure 76 Photo Point Monitoring - Site 3 PP 6, zoomed; 16 September 2015

The following photos were taken in September of 2015 in the new location.

Figure 77 Photo Point Monitoring - Site 4 PP 1; 15 September 2015

Figure 78 Photo Point Monitoring - Site 4 PP 1, zoomed; 16 September 2015

Figure 79 Photo Point Monitoring - Site 4 PP 2; 30 March 2015

Note: The location of this photo point has been changed, since the existing vegetation blocked the view of the stream bank when the leaves emerged in spring. The following photos were taken in September of 2015 in the new location.

Figure 80 Photo Point Monitoring - Site 4 PP 2; 16 September 2015

Figure 81 Photo Point Monitoring - Site 4 PP 2, zoomed; 16 September 2015

Figure 82 Photo Point Monitoring - Site 4 PP 5; 16 September 2015

Figure 83 Photo Point Monitoring - Site 4 PP 5, zoomed, 16 September 2015

It is recommended that the monitoring plan again be carried out in August 2016 and 2017 to look at the results over the long-term and monitor how well the cuttings are rooting and to see if they still require ongoing watering through the drip-irrigation system installed (Figure 84). The use of drip-irrigation system increased the successful establishment of pocket planted areas, stakes and willow fences. It will be interesting to see if cuttings survive in future years, once the roots outgrow the soil pockets, and if cuttings/fences that looked dead in 2015 will re-sprout. When re-vegetating eroding gravel slopes using native plant seedlings, focus on planting Douglas-fir, as this species showed the highest survival rate of all native plants used in 2015, and plant seedlings on wattle fence terraces rather than on eroding slopes.

Figure 84 Evaluating effectiveness of willow fences in relation to erosion issues 06 Oct 2015

Chapter 11. Community Capacity Building

Community capacity building in fisheries, land management, restoration and horticulture fields has been identified as an important component of the Seton River Corridor project. Based on agency priorities noted during the BC Hydro WUP process, it was noted that the lack of skilled workers impacts on the ability to carry out restoration and survey work. Therefore, over the last several years the focus of the Sekw'el'was community has been to increase knowledge, both cultural and scientific, so that St'at'imc communities have trained and passionate workers now and into the future.

Training in survey protocols and techniques were again provided to crew technicians, community members, summer students and volunteers during the work and activities presented above. Through leverage of funds crews were deployed to work on a range of activities under the guidance of professionals in their field, thereby providing opportunities to learn a variety of skills in a real setting.

Before each activity, contractors, project manager and/or restoration specialist provided an overview of the work to be undertaken, including the rationale for doing the work, and the protocols needed to successfully gather data that is relevant. Hands-on training opportunities were offered in equipment use and survey protocols.

Many of the crew who have worked on these projects for the last seven years remain committed to the project and continue to grow in their skill set. These crew technicians now act as mentors to the summer students and new crew, and are now taking on more of the data entry and analysis. However, as these are young workers it is important to always include new youth in the process so that when current employees move onto other education and/or jobs, there is a bank of people who have some knowledge and interest in the work.

Specific targeted training in 2015-16 was provided by experts in their field and included the following activities (Figures 85 – 89):

- Native and invasive plant species identification (Splitrock Nursery)
- Ethnobotanical uses of plants (local elders)
- Reptile ID and den search protocols (Jared Hobbs)
- Using an I-pad in the field to collect data (Odin Scholz)
- Gravel Cleaning Technology (Streamside Environmental)
- Owl ID, calls and monitoring (Ken Wright, LNS)
- Aquatic Invertebrate Sampling (Jeff Sneep)
- Fish ID and smolt outmigration monitoring protocols (Jeff Sneep)
- Seed stratification (Splitrock Nursery)
- Careers in the environmental field (Splitrock Technicians to high schools)

Figure 85 Streamside Environmental lead explaining gravel cleaning protocols 12 Aug 2015

Figure 86 Fish ID and outmigration survey techniques 05 Mar 2016

Figure 87 Reptile skin ID and survey protocols 02 Sept 2015

Figure 88 Seed cleaning and stratification training 01 Dec 2015

Figure 89 Summer students (high school) learn skills on-the-job 05 Aug 2015

Chapter 12. Watershed Education Outreach

Environmental education programs continue to be included in all the stewardship activities undertaken as part of the Seton River corridor project. The goal of engaging the community in stewardship work and other environmental activities is to build a strong community that has both the knowledge and an appreciation of the natural world. It is believed that these conditions lead to increased stewardship of the land.

Environmental education programs are advertised in the community and through networks with the local St'at'imc communities, local NGO groups, interested public and schools (both local and regional).

Crew technicians are trained in environmental education and share their passion for the work they are doing and the knowledge they have gained with the wider community. Before activities begin, brainstorming sessions take place to decide on what programs to deliver, lesson plans are then developed and schedules set. Crew technicians and other volunteers from the community deliver the programs at large events like the annual Walking with the Smolts Celebration and the Salmon in the Canyon Festival, and during other planned activities.

Other important environmental education occurs at the partner and stakeholder meetings so that participants are aware of the fish, wildlife, plant communities, issues and culmative impacts so that informed decisions can be made in regard to land management.

Some of the outreach events and/or activities that took place during 2015-16 (Table 37, Figures 90 - 96) provided both outdoor interactive and classroom activities:

Table 38 Outreach Activities 2015-16

Date	Event	No. of Participants	No. of Volunteers
25 April 2015	Earth Day/ Nursery Open House	10	3
14 May 2015	Career Fair Site Visit – District high schools	80	0
29 May 2015	Walking with the Smolts – activities & planting	1000	500
18 June 2015	Aboriginal Day Cayoose – parade and games	120	0
5 July 2015	Elders from Cariboo Tour	15	0
23 July 2015	Radio Lillooet broadcasts	4	2
27 July 2015	Summer Camp activities with Xaxli'p	17	2
15 Aug – 15 Sept	4 days Ethnobotany Workshops	10	0
19 August	Summer Camp activities with T'it'q'et	14	2
15 September 2015	Salmon in Canyon Festival – demos, booths, games	215	84
27 September 2015	Shoreline Cleanup	12	12
2/7 October 2015	Fall Stewardship Day – Elementary – activities/plant	250	250
3 October 2015	Fall Stewardship Day – University of BC tour/plant	30	30
6 October 2015	Embark Evaluation of Bioengineering	2	2
23 October 2015	Teacher Education Event - ethnobotany	30	0
13 November 2015	Spawning Channel Committee Meeting	8	8
8 March 2016	Seton Corridor Planning – Partner Meeting	8	0
15 March 2016	Seton Corridor Planning – Stakeholder Meeting	35	0
16 March 2016	Ethnobotany Day	50	0
18 March 2016	Field walk with T'it'q'et Chief and Council	10	0
24 March 2016	Young Naturalist program	25	2

Figure 90 Walking with the Smolts Community Concert 29 May 2015

Figure 91 Fall Stewardship Activity (pools, riffles, glides) 02 Oct 2015

Figure 92 Summer camp (Aquatic Invertebrates) 27 July 2015

Figure 93 Ethnobotany Course lead by local elder 30 Aug 2015

Figure 94 Salmon in the Canyon Festival 13 Sept 2015

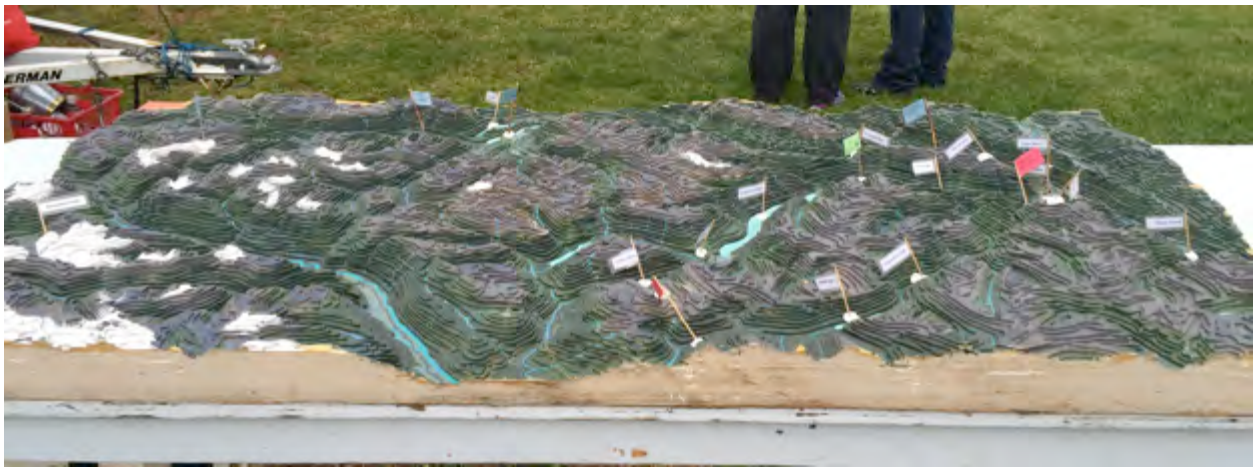


Figure 95 Watershed Model Salmon in Canyon 13 Sept 2015

Figure 96 Salmon Obstacle Mini-Golf Course 13 Sept 2015

Chapter 13. Discussion

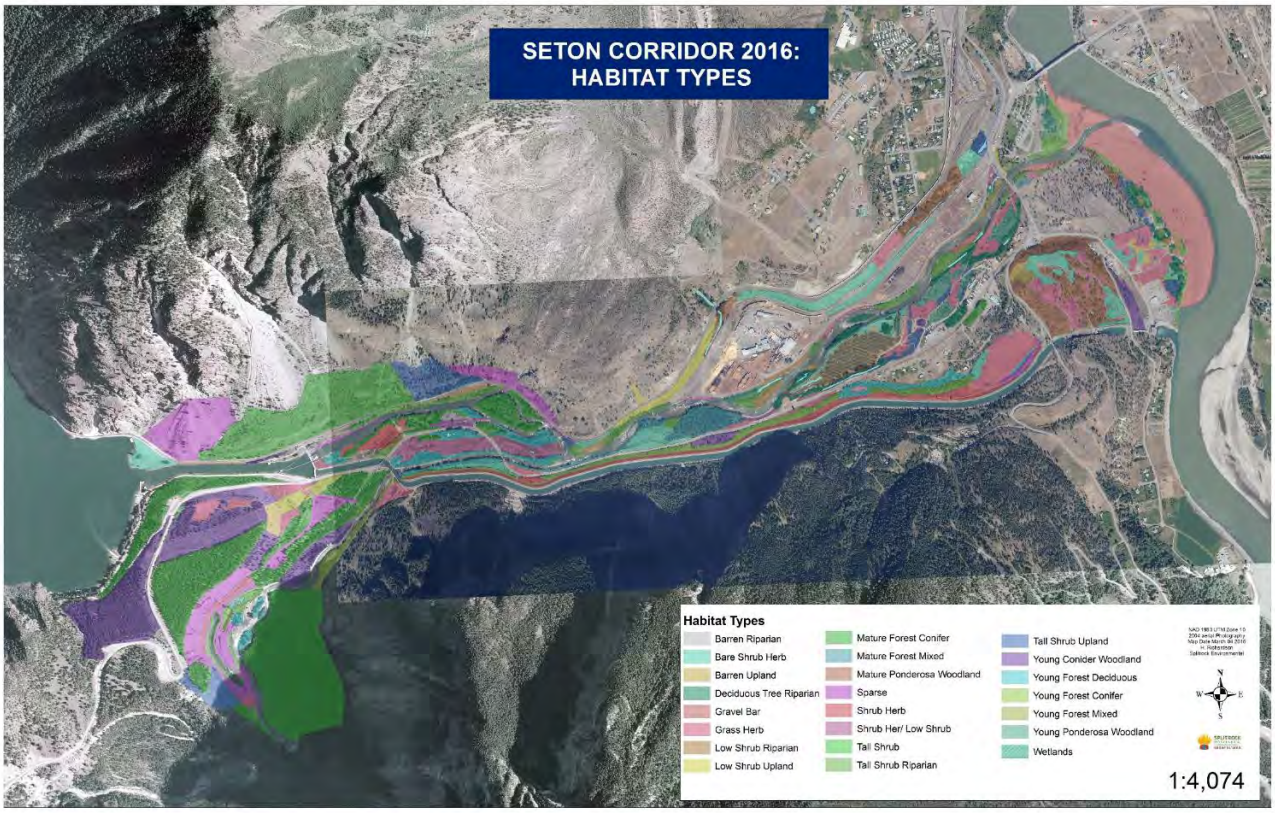
Sekw'el'was and T'it'q'et have partnered on this project and their commitment to ecological health for the corridor is strong. Over the last several years they have provided input into the project, have guided discussion at the table, and provided in-kind and financial supports. The partners have invited the various stakeholders (government, industry and NGOs) to become involved in the project, so that their expertize and interests can inform the process of developing strategies to conserve, restore and/or sustainably manage lands within the Seton River Corridor for the benefit of fish and wildlife.

Seton River Corridor is an intensively used area and multiple stakeholders have ownership, interests and/or operations within the corridor as discussed throughout this report and reports from 2010 until present. The Seton River Corridor is also an important valley providing fish and wildlife habitat in varying stages of ecological integrity, and is an important location for wildlife movement across the broader landscape. In the past little research had been undertaken in the Lillooet region as a whole; however, over the last few years increased survey work has begun in part due to the FWCP, AFSAR and PSF opportunities, and the BC Hydro/St'at'imc Agreement and resulting approval of the Bridge-Seton Water Use Plan. All this activity provides the opportunity of working together to create a unified vision for the protection and enhancement of our watersheds.

The work we have carried out over the last seven to nine years helped us move towards the goal of categorizing the land base and designating protections. The focus is on conservation of existing high value lands, restoration of areas that would contribute to ecosystem health, and lands where existing operations could be adapted to increase habitat features. There were gaps in the data that needed to be filled before any final designation could be applied and management plans developed.

During 2015-16, the final stage of the habitat mapping was completed. A total of 329ha has now been categorized by habitat type, including barren areas, gravel bars, forested, riparian and grassland areas. (Map 38). With this information and the wildlife surveys completed to-date (screech-owl, breeding birds, aerial insectivores, reptiles, amphibians, fish, large mammals and wildlife trails) Splitrock was able to look at the entire corridor in regards to its benefits to fish and wildlife and identify where potential areas could be managed to benefit species-at-risk and other wildlife species using the system. Over 40 fish/wildlife species have been identified using the corridor, including red-listed and blue-listed species.

Also during 2015-16, spawning gravel cleaning took place for the first time and is now being monitored, wildlife surveys continued and ecological restoration building on past work has increased functioning habitat. As well, capacity building and environmental education provided the opportunity for adults, families and youth to become involved in stewardship work.



Map 38 Seton Corridor Habitat Types 2016

Information on habitat and wildlife use gathered over the last nine years was pulled together and analyzed. From this work Splitrock Environmental staff developed draft habitat assessments and recommendations that were then presented to the partners. Representatives from the Sekw'el'was and T'it'q'et communities provided community considerations for each of the areas discussed, such as ecological importance, future development projects and areas of cultural importance. These discussions occurred on 08 March and 14 March during the scheduled 2016 Seton Corridor Partner Meetings. The partners provided direction to Splitrock Environmental and the designations presented will be adapted to take into account partner discussions.

Discussions with the spawning channel committee also informed the designations and possible strategies were incorporated into the draft habitat assessments and recommendations.

These habitat assessment maps and recommendations were then taken to the stakeholders at our 5th Annual Seton Corridor Stakeholder Meeting held on 15 March 2016. Over 30 participants again took part in this meeting and provided insight based on their expertise (Figure 97). A powerpoint presentation outlining the process of developing the habitat assessments was presented (Appendix 3: 2015 Stakeholder Presentation), and the resulting day long discussions provided important feedback and ideas to the process.

Figure 97 Seton River Corridor Stakeholder Meeting T'it'q'et 15 March 2016

Conservation, Restoration and Sustainable Use categories were determined based on land tenure and use, existing successional state, vegetation community composition, structural stage, ecological function, distrubance history and disturbance regime. High ecological importance and priority was placed on wetlands, riparian zones and intact forested grasslands. Areas identified as ecologically significant such as mature riparian ecosystems were recommended for conservation while highly disturbed riparian ecosystems were recommended for restoration. Areas indicated for restoration will need to have specific prescriptions designed for each site in the future.

The following categories were developed and presented:

Category 1 – Conservation: A conservation designation given to polygons where the ecology was assessed as relatively intact and the human land use values were considered low. These areas serve as important habitat zones for wildlife, being mostly in the important riparian zones along water bodies, but also including some fairly intact forest-grassland ecological communities. Conservation polygons had predominantly native vegetation with low amounts of Invasive species. The ecological functions of these polygons were rated high and could be deemed relatively high priorities to protect from disturbance or development. A conservation designation would not preclude the polygons from restoration treatment that may benefit the ecology of the site in future.

Category 2 – Restoration: A second category of management designation was given to polygons that were observed to benefit from some form of ecological restoration, and again had low human land use values. These sites were noted as needing active management to improve ecological function. Restoration polygons often showed lower ecological diversity structure and function often due to past or ongoing disturbance including the presence of invasive plant species. Restoration polygons were identified primarily along the highly disturbed roadsides, especially small roads that cut through grasslands and forested areas. These areas showed a high concentration of invasive species and recent disturbance and riparian areas that currently had minimal vegetation structure and cover and where riprap areas decreased the chances of natural recruitment. Only areas with no future development plans were targeted for this designation.

Ecological restoration could take the form of preventing ongoing disturbances such as vehicle access, invasive species removal, native plant re-vegetation and seeding, installation and addition of habitat structural features such as logs and boulders, soil remediation including amendments and mulches, and removal of both garbage and old fencing.

Category 3 - Sustainable Management: A third category of management designation was given to polygons whose land use priority was for socio-economic values including recreation and industrial use, with ecological values being at least secondary.

Because of the limited land base in the constricted Seton Corridor any piece of available land that could be enhanced or managed for ecological values would be considered a valuable addition to the ecology of the corridor. Discussions around sustainable management polygons encouraged land managers to look at adopting management strategies where possible to promote ecological diversity, structure and function. Examples of such management could include:

- Maintain pockets and stands of native vegetation.
- Prevent and remove invasive weed species.
- Reduce fragmentation by limiting use of fencing.
- Protect dead standing trees as important wildlife habitat.
- Promote the use of native plant species.
- Maintain healthy riparian vegetation cover along waterways

Summary maps showing the overall draft habitat assessments that were presented to the partners and stakeholders to visually show the extent of potential areas for discussion and their ecological values (Maps 00, 00, 00). The participants at the partner and stakeholder meetings provided input into the areas of focus shown (Attachment 4: Seton River Corridor Conservation, Restoration and Sustainable Management Planning Process Summary).

Category 4 – Wildlife Corridor: Wildlife trails have been mapped over the last several years during ground surveys and some confirmed with use of wildlife camera tracking. During the upcoming year this data will be used to assess how wildlife are moving between areas of high ecological value and how the management plan can facilitate safe movement. This will be difficult due to the narrow corridor and the transportation and canal infrastructures that fragment the landscape.

In summary, the following habitat assessments were discussed and recorded:

Conservation Habitat Assessment

Map 39 Seton Corridor Habitat Assessment 2016 - Conservation

Habitat Assessments highlighted seven main areas as priority conservation zones due to their high ecological value. The intact riparian areas and side-channels were also highlighted for conservation and occur along the length of the Seton River, as well as areas along the bank above Aspen Planer. The areas that have some of the larger intact areas left in the corridor occur in all three locations (Map 39, Table 39).

Table 39 Draft Habitat Assessment Conservation Areas by Location within Corridor

Upper Corridor	Middle Corridor	Lower Corridor
Seton Flat	Midway Point	Powerhouse Fraser River
Picks Falls		Mariposa Flat
Seton Cliffs		
Gravesite Island		
	Areas at bottom of slope above Aspen Planers	
Intact riparian areas and side channels along the length of the Seton and Fraser Rivers		

The T'it'q'et community noted that economic land use planning is currently taking place for both the Seton Flat and Pick's Fall sites (shaded red Table 37). The community is interested in scheduling Splitrock to take elders/planners on a site tour to present the wildlife habitat values.

The partners and stakeholders agree that the other areas recommended for conservation should be designated as conservation (shaded green Table 37).

For the complete management planning process working document, see Attachment 4.

Restoration Habitat Assessment

Map 40 Seton Corridor Habitat Assessment 2016 - Restoration

Habitat assessments identified the sparsely vegetated disturbed flats on the north side of Seton River as regions suitable for restoration Areas include an old mill/lodge site on the edge of Seton Lake and areas alongside the tracks. CN Rail was not present at the stakeholder meeting and the communities again reiterated the importance of CN being involved in the process.

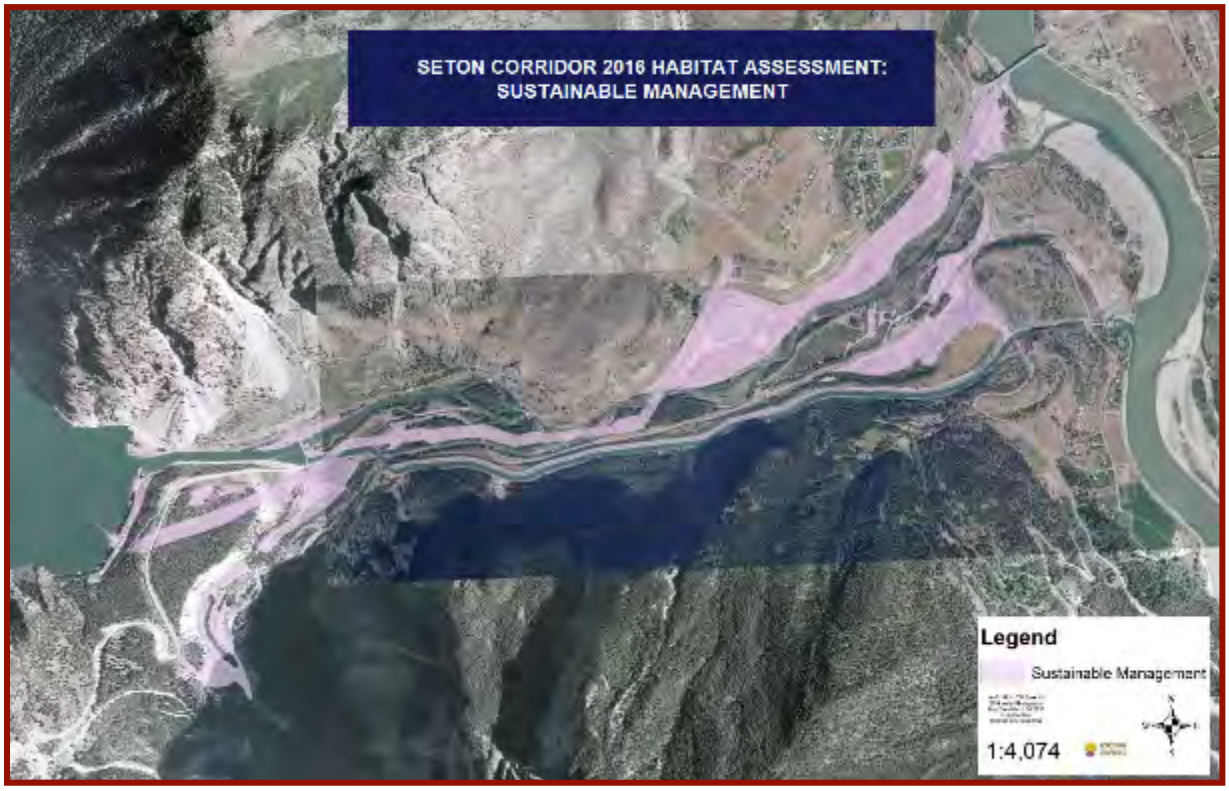
The entrance to Seton Lake Campground, the slopes above the campground, sites along Highway 99, the three spawning channels, upland bench at Powerhouse site, Cayoose Flat, and riprap areas along Seton River and in-stream works were all identified for restoration activities. (Map 40, Table 40).

Table 40 Draft Habitat Assessment Restoration Areas by Location in Corridor

Upper Corridor	Middle Corridor	Lower Corridor
Entrance Seton Lake Campground	Lower Spawning Channel	Upland Powerhouse site
Slopes above Campground		Cayoose Flat
Cayoosh Creek Spawning Channel		Upland Fraser-Seton
Areas along Highway 99 and CN Rail		
Riprap areas along the length of the Seton and Fraser Rivers		
In-stream Seton River		

After consulting with the partners, it was noted that land use planning is also underway in the areas around Seton Lake Campground and Cayoose Flat (shaded red Table 39). A field tour will be scheduled for land planners. Restoration will not be planned for an area unless the area can be conserved afterwards. For the complete management planning process working document, see Attachment 4.

Sustainable Management Assessment



Map 41 Seton Corridor Habitat Assessment 2016 - Sustainable Management

Because of the steep topography of the Seton Corridor and the industrial and recreational activity, there is little available space for wildlife to move through the corridor. Therefore, it is important to develop relationships with the industrial stakeholders in order to develop best practice strategies. Key partners identified to pursue sustainable management strategies include Innergex, BC Hydro Transmission, Operations and Parks, Ministry of Transport and Interior Roads, CN Rail, Aspen Planers, Lightfoot Gas, Splitrock Nursery, District of Lillooet. Representatives of all the identified groups have agreed to work towards developing sustainable management strategies, excluding CN Rail who has only been represented at one meeting (Map 41, Table 41).

Table 41 Draft Habitat Assessment Sustainable Management Areas by Location in Corridor

Upper Corridor	Middle Corridor	Lower Corridor
Cayoosh Creek Powerplant	Aspen Planers Mill	Aspen Planers Mill
Seton Lake Campground	Lightfoot Gas	BC Hydro powerplant
Seton Lake Recreational Area	Splitrock Nursery	Cayoosh Creek Campground
BC Hydro leased land - housing		Sekw'el'was housing/band office
T'it'q'et rental cabins		
CN Rail		
BC Hydro Canal		
Transmission Lines throughout corridor		
Areas along Highway 99, Powerhouse, Roshard and Texas Creek Roads		
In-stream Seton River		

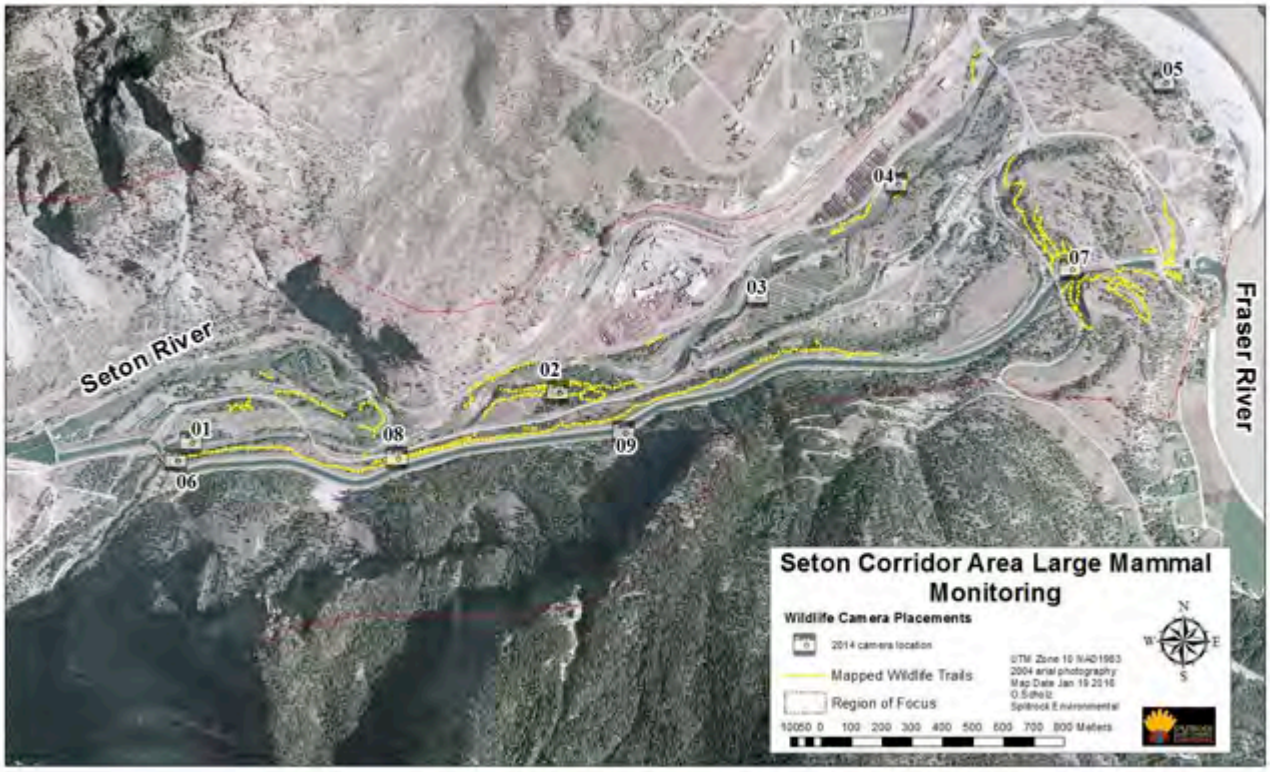
One existing successful partnership is between Splitrock Environmental and the vegetation management branch BC Hydro's transmission lines operations. By training hydro crews to leave shrubs in place when they will not grow tall enough to interfere with the lines, and by having Splitrock crews annually harvest cuttings from under the lines for restoration works, the lines are cleared of tall vegetation, the impact to shrubs, forbs and grasses is reduced, and vegetative stock for future restoration works are available. Though the natural landscape is changed, a diverse understory and healthy open woodland habitat is still possible.

Below are examples of proposed management strategies that will be explored over the coming year:

- Continue training BC Hydro crew and managing vegetation so that native shrub species are left in place under transmission lines
- Move the Aspen Planers access road away from the Seton River, expanding the riparian area. Connecting viable habitat along the north side of the lower Seton Corridor should be considered a priority activity.
- Work with Ministry of Transportation, Aspen Planers, and other agencies early in the planning process for installing any new riprap, so that riparian cuttings can be installed during the process. The installation of the new Station Bridge will be a good opportunity to develop those relationships and strategies.
- Communicate with the Ministry of Transportation so that the community takes more responsibility in managing the land adjacent to the highway so that invasive species are reduced along Highway 99 and native tree species are planted to create a buffer between highway and residential areas.
- Install wildlife signage more prominently along Highway 99
- Install culverts for reptile movement under Roshard Road
- Install wildlife bridge over canal
- Work with owners and operators of the recreational areas to decrease invasive species spread and increase native plant cover, and reduce erosion issues along river and slope trails.

For the complete management planning process working document, see Attachment 4.

Wildlife Trails



Map 42 Seton Corridor Identified Wildlife Trails 2010-2015

A number of wildlife travel routes have been identified within the corridor (Map 42) and will be assessed during 2016-17 to see how they connect with areas of high ecological value. This map does not show the wildlife trails observed at the Powerhouse site, but wildlife are moving from the canal area (Camera 07) over Mariposa Flat and down to the riparian areas along the Fraser River.

Wildlife may be crossing the Seton River at one of the narrowest points in the corridor (near Camera 02), and are definitely crossing through the landscape at both ends of the canal (near Camera 01, 06 and 07). Wildlife trails observed running east-west above the highway and below the canal may be shown to be important for the movement of wildlife away from the highway. Deer bedding/fawning areas and bear resting places have been identified and trails come and go from these areas.

It would be beneficial to monitor the movement of large mammals from the Texas Creek and Marriage Rock areas to identify key routes to and from these areas and to ensure once they reach the Seton River Corridor that they are not impeded in their travels or put at risk from public encounters.

Reptiles have been observed killed on Roshard and Powerhouse Roads and identifying hibernacula sites and travel routes will be important in identifying a possible wildlife culvert that will make it safer for them to move from their dens to their nesting/foraging grounds. A possible PIT tagging program may assist in this work.

Chapter 14. Recommendations

Sekw'el'was and T'it'q'et communities, Spawning Channel Committee and stakeholders all agreed that Splitrock Environmental should continue fish and wildlife monitoring and planned restoration works while also moving forward with engaging stakeholders in developing concrete strategies that could be implemented to increase fish and wildlife habitats, both in-stream and terrestrial. The strategies developed will form the Seton River Corridor Fish and Wildlife Management Plan.

The Seton River Corridor Fish and Wildlife Management Plan will be developed taking into account the intent of the Nxekmenlhkalha lti tmicwa (St'at'imc Preliminary Draft Land Use Plan). and will provide concrete actions that support the St'at'imc plan. The strategies and networking developed during the research and development of the Seton River Corridor plan provides a strong staging ground for future implementation plans and has built expertise in the communities to carry out similar work throughout St'at'imc Territory.

Based on successful funding from FWCP, AFSAR and PSF, and engagement of stakeholders, the following work is recommended for 2016-17 (Table 42):

Table 42 Seton River Corridor Recommendations for 2016-17

Task	**Location**
Spawner Remuneration	River and Seton spawning channels
Temperature Logging	Dam and Seton spawning channels
Juvenile Growth Sampling	River and Seton spawning channels
Initiate in-stream habitat mapping, aquatic invertebrate study and fish survey	Cayoose Creek spawning channel
Continue meeting with Spawning Channel Committee	Rivers and 3 spawning channels
Reptile surveys (cover boards, hibernacula search, movement obstacle identification	Corridor
Screech-owl monitoring	Corridor
Large mammal survey – wildlife cameras	Corridor
Invasive Weed Management	Past restoration sites
Revegetation Monitoring	Past restoration sites
Restoration Works	River, 3 spawning channels, lower corridor grasslands
Community Engagement – Partner meetings, Stakeholder networking, development of strategies leading to draft management plan	Corridor
Environmental Outreach (Walking with Smolts, Fall Stewardship Days, Eco-cultural tours)	Corridor
Data entry, analysis and reporting – combining information gathered to-date and partner/stakeholder inputs to develop draft management plan	Corridor

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LIST OF ATTACHMENTS

1. Spawning Channel Committee Meeting Minutes
2. Juvenile Growth Sampling Table and Figures
3. Seton Corridor Stakeholder Presentation Slides
4. Seton Corridor Management Planning Process Summary Table
5. Evidence of Acknowledgment of FWCP

APPENDIX 1

Seton River Corridor Spawning Channel Committee Meeting

13 November 2015 | 11:00pm – 1:00pm | Splitrock office

Meeting called by	Splitrock Environmental
Type of meeting	Spawning Channel Committee
Facilitator	Kim North
Note taker	Odin Scholz

Attendees: Sean Bennett (DFO); Sarah (DFO); Jeff Sneep (Fish Biologist) Kim North (Splitrock), Odin Scholz (Splitrock), Fred James (Sekw'el'was);

Regrets: Sue Senger (SGS), Bonnie Adolph (SER)

MET IN FIELD: John Barten & Assistant (FortisBC)

Minutes of Meeting 13 November 2015

☐ Welcome 11:15 am
Discussion to add Dorian Turner (BCHydro) to Spawning Channel Committee
ACTION: Kim to contact Dorian and request his involvement.

Brief overview of work carried out over the last several years
Presented information via powerpoint and discussion

☐ In-stream habitat mapping (upper & lower channels) – *Maps show the instream habitat*

Lower Spawning Channel (LSCh) Pools 33%; Run 59%; Riffles 8%.
Upper Spawning Channel (USCh) Pools 29%; Run 45%; Riffle 23%.

Discussion of instream habitat. It was noted that the optimum is to aim for 33% of each type of habitat type. Sean pointed out that the low gradient in the LSCh limits the rapids and riffles and that there is more of this habitat in the Upper Spawning Channel USCh. LSCh shift from pink salmon spawning to more rearing habitat since complexing in 2003.

Sean noted that the LSCh was just fine in terms of available habitat and instream structures, but that the USCh may benefit from more runs and riffles using Newberry weirs if we wanted more of that type of structure. The gradient in the USCh makes this more feasible.

ACTION: Look at possibility of adding Newberry weirs to USCh to increase runs and riffles

☐ Temperature monitoring (lower channel) *Example of temperature monitoring data*

Jeff gave an overview of the temperature monitoring at the LSCh. There is a temperature difference between day/night and between upper portion of the channel – v- lower portion, being warmer at the lower end in the summer months.

ACTION: Continue riparian planting initiated to mitigate this difference.
ACTION: Install temperature monitors at USCh (Splitrock has already purchased – just need to install)

☐ Spawner Surveys (upper & lower channels) – *Tables showing Pink salmon runs in LSCh 2011/13/15 and USCh 2013/15*

Spawner surveys are ongoing weekly at both Seton River channels. Historical antedoctal information (10-20,000 spawners) compared to current surveys shows a dramatic decrease in pinks using the channel. Fred noted that the salmon used to smell so bad you had to run across bridge over the river, but over the last several years that is not the case. Discussion around who would have the historical data identified Salmon Commission Office in Vancouver. *(Note: Odin found some data relating to the spawning channels and came across a number that the USCh and LSCh together were estimated to provide spawning habitat for 46,000 pink salmon. If this*

is the case we are currently at <10% potential with the 2015 run and even less from the 2013 run – comment by Jeff Sneep: that is a big number for the length of habitat. In terms of the trends, it is important to rememeber that this also has a lot to do with factors outside of the habitat provided by the spawning channels – eg marine survivial, etc. But this is also why it would be informative to do some fry outmigration monitoring so we can get a better handle on what egg-to-fry survival in the channels currently is. Instream also has a lot of experience with this kind of sampling).

Discussion on the historical role of the Hell's Gate slide on the Seton River pink and other salmon runs. Also noted that studies have shown a 77% pre-spawn mortality in some sockeye salmon, and that there is generally a 2-3 week delay in sockeye entering the Fraser River due to warm temperatures (*during years with low water levels and high temperatures (Jeff Sneep).*

ACTION: Gather further historical data/research together re: numbers in channels.
ACTION: Continue weekly spawner counts. Information is also being provided to Instream BRGMON-9

☐ Juvenile growth sampling (upper & lower channels)

Splitrock is working with Instream (BRGMON-9) to carry out surveys in the spawning channels re: juvenile growth sampling to complement. The information will be used for both the FWCP and BRGMON-9 reports as it was agreed that the spawning channels provide significant spawning/rearing habitat that is missing in the mainstem.

ACTION: Continue these surveys as they provide valuable data on use within the whole system.

☐ Aquatic invertebrate surveys (lower channel)

Acquatic invertebrate surveys were conducted initially in 2010 to gather data on the health of the LSCh and again in 2015 in relation to the gravel cleaning project. Both surveys indicate that the water quality is good.

☐ Gravel survey and subsequent cleaning and monitoring (lower channel) *Map LSCh Gravel Cleaning & Monitoring Polygons 2015*

Gravel permability tests were undertaken in 2012 and based on that information gravel cleaning using SandWand technology was completed in identified sections of the LSCh (August 2015). Currently Splitrock is monitoring the results of the project by photomonitoring and acquatic invertebrate studies. Discussion around the effectiveness and actual need to do the SandWand treatment. Sean notes that the gravels are clean. Horsefly spawning channels have issues with sediment, but it is believed the the Seton channels would not have many problems. Sean recommends the monitoring of sediment in the LSCh by digging holes in the gravels and assessing fines in the interstitial spaces. This is in lieu of the dissolved oxygen interstial gravel oxygen meter assessment project carried out under Judy Hillaby's direction.

ACTION: Monitor sediment in the LSCh by digging holes in the gravels and assessing fines in the interstitial spaces. (Jeff comment: Could this include underwater photo monitoring at each excavation site to document sediment compostion (incl. organics) and develop a time series across years for noting changes over time?)

☐ Weed removal (upper & lower channels)

Ongoing weed removal has decreased the burdock, knapweed and clover populations. Weed removal will need to be included in ongoing maintenance at the spawning channel to ensure invasive species don't reseed and spread.

ACTION: Continue weed removal activities, including hand removal of targeted species and mowing down of remainder to decrease seedbank.

☐ Revegetation (upper & lower channels) *Maps of Re-vegetated polygons LSCh (2010-2015) and USCh (2013-2015)*

Discussed revegetation efforts completed to date – 6.52 ha within the corridor. Work has taken place at both spawning channels as shown on the maps. Discussed the challenges of planting along the berms and

riprapped slopes of the channel and the lack of water recruitment. Channels were recomplexed using geotextiles and clay that would hamper water migration towards the berms. Sean suggested that we apply to PSF for funds to bring in tonnes of soil to improve planting success around the channels and create microsites with wood, etc; and that we look at installing an irrigation system in targeted section of the system.

Stewardship activities included local school children and other community members in the planting. Beaver damage to cuttings was an issue but painting live stakes with linseed oil/sand mixture has shown great success.

ACTION: Look at PSF grant for purchasing soil for planting and other avenues for irrigation infrastructure.

☐ Beaver control (upper & lower channels).

Beaver utilization of the channel is an ongoing issue as the banks are undermined by digging and by water spilling over berms, and vegetation is cut down. Ongoing removal of beaver dams and beavers through trapping continues. Nine dams were built over a two-week period this past month. Discussion around death/live trapping and/or shooting took place. It was agreed that a Sekw'el'was member placing traps was the best option. Sean and Fred thought there maybe some places that require beavers so live trapping could take place. Caging and painting linseed oil/sand mixture on existing trees and newly planted trees/shrubs should be continued.

ACTION: Trapping program initiated on regular basis
ACTION: Caging and linseed oil/sand treatment

☐ Wildlife monitoring (reptiles, WSO, songbirds, aerial insectivores, bats, mammals)
Various wildlife studies have taken place and will be presented at the upcoming Jan/Feb 2016 stakeholder meetings.

ACTION: Gather habitat and wildlife data together for presentation to partners and then stakeholders in Jan/Feb 2016

☐ Collaborating with InStream Fisheries – discussed above. Working with Instream has provided additional data to both organizations and research should assist in learning more about the movement of fish and fish species that are using the spawning channels and how they relate to the mainstem.

THE FUTURE?

☐ Do we continue to do the above activities – is it providing useful information?

It was agreed that all the above survey and works were creating excellent results and that the work should continue. Discussed the funding for spawning channel maintenance and monitoring – Chief Michelle had noted that the Seton River Spawning Channels were to receive $60,000 annually to do this work, but that half went to Gates Creek. Discussion with hydro may be necessary to increase funding as $30,000 is not sufficient to carry out all the work necessary and/or to increase infrastructure to make the work more efficient.

Discussion also centred around the DFO coho salmon counts and who is doing that and how we can assess to the data. Sean will look into finding the information and to set up a meeting in Kamloops for Splitrock to share the work being done with the fisheries scientists.

Creating an artificial freshet in the channels was again discussed. Sean suggested making temporary dams starting at the top end to create flooding. When these are released they would wash down and clean out channels one section at a time. Also discussed was the importance of plants/algae to acquatic invertebrates and fish, and how much of this freshet do we need.

ACTION: Grants have gone into FWCP – leverage funds from PSF and other agencies. Have Chief Michelle discuss spawning channel funds and possibility of increasing so we are not so reliant on grants.

ACTION: Sean to look into DFO coho salmon counts over the years.

ACTION: Sean to set up meeting in Kamloops so work can be shared.

Notes: During a meeting with Cayoose, Hydro and Antares a few days after this meeting regarding the closing of the canal and the effect on the spawning channels, it was asked if this might be an opportunity to create an artificial freshet. There may be an opportunity to 1) provide an additional .5cms of water flow to the channel within the April-June window, inspect and modify/upgrade siphon pipes and valves which could be set to deliver a freshet annually, and to investigate what minimum flows would be able to maintain wetted area of the spawning channel to enable a future initiation of a seasonal hydrograph. Spoke with Dorian Turner re: spawning channel committee and setting up meeting to discuss minimum flows we would like to target in spawning channels.

☐ Beaver control protocols (permits, methods, safety). No permits required as on reserve lands – get St'at'imc person (Fred) to do this work.

ACTION: Fred needs to do some trapping now – best time to control as it is when male beaver are establishing territory, getting ready for winter AND before beaver have young.

☐ Out-migration Survey

Sean and Jeff both agree that doing an out-migration survey would be beneficial. Equipment may still be around the Cayoosh band office shed (Fred). Set up of a two-way fence for trapping and counting fish. The work would need to be carried out for a 6-8 week period beginning in March/April.

ACTION: Look for out-migration survey equipment and/or get plans from Sean on how to build our own. Maybe look at Streamside equipment for this work?

☐ Cayoose Creek Spawning Channel

Discussed the history of the Cayoose Creek spawning channels – not much historical knowledge. Field walk planned to look at the condition of the channels and meet with John Barten (see info below).

☐ Gravel placement idea – Seton River

This is an idea that has been talked about over the years. It was noted that gravel seeding is done on a regular basis on regulated systems in the Okanagan in Penticton, and in the Salmon and Englishman Rivers on Vancouver Island. Gravel seeding could become an annual program as part of the general operations of the Bridge-Seton hydro system.

ACTION: Gravel seeding to be discussed at partner/stakeholder meetings. Do we need to gather background information?

☐ Seton River water levels and their impact on spawning channels.

There are ongoing discussions around the upcoming canal outgages and additional waters coming into the Seton River due to La Joie dam flow modifications.

☐ Need to develop a Spawning Channel Management Plan – what should be included?

Sean advised that what we have noted above here is a good basis for a management plan. Need to put together a draft plan and circulate to committee members.

ACTION: Splitrock to develop draft plan and circulate for comments

FIELD VISIT – Cayoosh Creek Spawning Channels

General observations were that the main channel looks good in terms of clean gravels. The channel could use complexing through the addition of boulders, weir, logs to diversify the habitat. Two pair of Coho (large) and half dozen white fish were observed in the off-channel ponds. Dead Coho head (with eggs) and fresh bear scat. Beaver lodge in main pond with fresh stash of winter branches and freshly chewed cottonwoods

around the berms.

John Barten joined the group and gave a history of the construction of the spawning channel. The channels were built by FortisBC to compensate for the loss of spawning habitat in the Cayoosh and planting of trees did occur at that time. John Barten also noted that fish monitoring took place for a number of years, but finished once their contract commitment expired. John will find the historical data and forward to Splitrock.

Part of the grant to FWCP Seton Corridor project is to do some fish species identification survey work at the channels in 2016 and survey work to determine opportunities to increase the function of the channels.

ACTION: Gather data from John Berten

FIELD VISIT – OFF-CHANNEL GRAVEL BAR ON NORTH SIDE OF RIVER (ASPEN)

During meeting it was discussed that surveying the side channels and gravel bars along the Seton River before revised flow targets were implemented would provide some useful data (flow targets to increase in April). Noted that there were a few places where increased flows may create some off-channel habitat in existing wetted areas that are currently not connected to the mainstem.

A site visit of the off-channel gravel bar on the north side of the Seton River within the Aspen yards was conducted. Sean was concerned after seeing the channel that it would be anoxic water and possibly contaminated by leachate from the wood piles stored on the banks above the ponds. The wetland looks healthy with emergent and aquatic vegetation but with low flow rates. Currently not connected to the mainstem with water coming from pipes that presumably run underground through the Aspen yards from wet seepages along the top edge of the mill stie. Sean suggested that water would need to be brought into the pools from the river to increase oxygen and flows to make them fish friendly.

ACTION: Survey the side channels now and again at high flow levels to see the difference in structure/use. (Jeff: Also monitoring of dissolved oxygen and temperature in this off-channel habitat was suggested at the meeting. Would need a DO meter and temperature logger for this. This channel is seasonally connected to the mainstem under higher flows. Consideration could be given to some minor excavation at the bottom and/or top ends of the channel in order to maintain a connection with the mainstem year-round).

APPENDIX 2

Juvenile Fish Growth Sampling Results
Seton River and Spawning Channels 2015

Juvenile fish growth surveys commenced on April 23, 2015 and continued on a monthly basis through to October 20, 2015. The main-stem Seton River and the spawning channels sites were sampled in all months from April to October. Fourteen sites were sampled on the Seton River main stem (Figure 1). These sites were selected according to their appearance to hold fish. The spawning channels were sampled throughout their entire lengths (Figure 1). Seven surveys were completed at each of these sites.

In total, 12 species of fish were observed (Table 1). Six species of salmonids (Rainbow trout, Bull trout, Coho, Chinook, sockeye and Mountain White fish), and six species of non-salmonids (Bridgelip Sucker, Prickly Sculpin, Coastrange Sculpin, Longnose Dace, Red-sided Shiner and Peamouth Chub). Of these species only Rainbow trout, Coho and Chinook were caught in sufficient numbers to show the presence of discrete size classes. Smaller fish, most likely young of the year, had a higher and more consistent capture rate than large fish and thus provided a larger sample size for analysis.

Rainbow Trout:

A total of 541 Rainbow trout were sampled in the Seton River main-stem throughout the sampling series and their length ranged from 27 to 205 mm (Table 2). Length distributions show multiple modes in the histograms indicating multiple age classes are present throughout the year (Figure 2). In April and May two modes are visible, one ranging from 55 to 120mm and the other representing fish larger than 125 mm. In June only the latter length class was observed. In July three distinct modes are apparent, one in the range from 20-60 mm, another in the 70 to 130 mm and a few fish greater than 135 mm. The length patterns observed in August are consistent

with the patterns observed in July (i.e. three modes), although the mode of the largest group of fish is not as clearly defined. The September survey data is sparse for larger fish and thus is hard to identify any modes from the larger size classes. However, the larger fish sampled appear to be split evenly into three size classes (100-130 mm, 130-170mm and >175 mm). There is a clear mode for young of the year that ranges from 40 to 100mm (Figure 2). In October only one distinct mode was clearly visible between 45 and 110 mm. There was only 2 other fish sampled that were above that size class.

In the spawning channels 118 rainbow trout were sampled. Their lengths ranged from 40 to 235 mm (Table 2). Like in the mainstem river, the spawning channel histograms from the monthly sampling surveys indicate a similar distribution of size classes (Figure 3). The histogram from the spawning channels in April shows three possible size classes. A size class ranging from 55 mm to 110 mm, another from 125 to 165 mm and a size class of fish with fork lengths greater than 170 mm. In May the three distinct modes are not as clearly visible, but the data shows a similar spread or range. A distinct peak is observed at 80 mm while the others are not as clearly defined another at around 160 mm and one larger fish greater than 200 mm. In June two modes are possible, but not clearly defined by the data as sample sizes were low. One of the modes can span from 80 to 110 mm and the other from 140 mm to 165 mm. In July a smaller size class is visible (40 mm to 60 mm), along with the two larger size classes that range from 100 to 130 mm, and one fish at 160. In August very few rainbow trout were sampled in the spawning channels, but data shows three distinct size ranges. One from 55 to 80 mm, another from 105 to 120 mm and another from 150 to 170 mm. In October when the spawning channels were once again sampled, few fish were captured. This resulted in weak representation of the size classes however the data indicate modes between 60 to 90 mm, one fish at 110 mm, 130 to 180 mm and 195 to 205 mm. This is consistent with the July and October size distributions.

As was observed in 2014, Rainbow Trout in the spawning channels were consistently larger than those sampled in the mainstem (t-test; p-value<0.05). This pattern was consistent for all the months where both areas were sampled (Table 3).

Scale/Age Analysis:

For the purpose of scale analysis all of the scales from the spawning channel fish and those of the main-stem river were pooled to increase sample sizes. Analysis from the scale data corroborate the different modes observed in the length frequency histograms of each month (Figure 2 and Figure 3). Data is presented for April through to October. In April, scale analysis showed three distinct age classes present. These ages represent fish that are one, two and three years old (Figure 4). All the Rainbow trout that have survived a winter were classified as age 1 +. In April these fish have not shown any scale growth to classify them as "+" fish but for graphical purposes they were classified as such. This was done for age 2 + and 3 + as well.

The length, age histogram for April shows an overlap of sizes between the age one and age two fish and age two and age three fish (Figure 4). The mean size at age for age one fish was 80 mm with a range from 55 to 120 mm, age two fish had a mean length of 120 mm (70 - 170 mm) and age three fish had an average length of 170 mm (160 – 195) (Figure 5). May age data showed the same age classes present (age 1, 2 and 3), but little overlap between age one and age two fish and no overlap between age 2 and age 3 fish. In June two distinct age classes were identified, age one and age two fish. These fish had a mean size at age of 96 and 128 mm respectively (Figure 4). In July, analysis showed three distinct age classes (0, 1 and 2) with a distinct new age class for young of the year Rainbow trout that had recently emerged from the gravel (Figure 4). Some of the fish were quite small and had not yet formed scales or developed annuli. Scales were not collected from fish smaller than 45mm. It was assumed that these fish were age zero or young of the year. The age zero fish had a mean fork length of 42 mm that ranged from 27 to 66 mm. The mean size for age one fish in July was 107.4 mm (73 – 160 mm), while age two fish had a mean fork length of 131 mm (130 – 132 mm) (Figure 6). There were no age three fish sampled in July.

In August, the same three age classes (0, 1 and 2) were observed. Mean size for age zero, one and two fish was 57, 111, and 137 mm respectively (Figure 4).

During the September sampling series, the dominant age class sampled was the age zero fish (Figure 4). Mean length for age zero fish was 69 mm with a range from 41 to 112 mm. Age one

and two fish were also sampled, their mean size at age was 132 and 205 mm respectively. In October, only two distinct age classes were sampled (Figure 4). They were age zero, and age one fish. Age zero fish had a mean length of 72 mm (45 - 84 mm) while age one fish had a mean fork length of 132 mm (86 – 170 mm) (Figure 7). An overlap between age zero and age one fish was not evident.

Growth Analysis:

Although scales were not collected in all months, one can follow the common modes to assess growth rates through time. Age data collected along with the length frequency histograms are used to assess growth rates of the different age classes in the Seton River main-stem. For young of the year fish both data are used.

Length, weight analysis showed a strong relationship between length and weight for Rainbow trout of all sizes within the Seton River (R2=0.953) (Figure 8).

Rainbow trout Age 0+

As expected, young of the year Rainbow were not observed until the July sampling survey. This was the case for sites in the main-stem river and spawning channels. During this survey fish had a mean fork length of 42 mm with a range from 27 to 66 mm. Average weight was 1.2 g with a range from 0.20 to 7.0 g. In August these fish had grown to a mean length of 57 mm (38 to 76 mm) and a mean weight of 2.5 g. Growth continued into September with a mean fork length of 67 mm (45 – 112 mm) and a mean weight of 4.5 g. From September to October the growth rate observed was not as high. Mean fork length increased by 5 mm to 72 mm (45 – 84 mm) and a mean weight of 5.1 g (Figure 9 and 10). In total young of the year grew an average of 30 mm (0.31 mm/day) from July to October.

Rainbow trout Age 1+

Age one fish were represented in all months of the year where samples were collected. In April, the mean fork length of these fish (as reported previously) was 78 mm (55-118 mm) and had a

mean weight of 5.7 g. By July these fish had grown by 30 mm to 108 mm and a mean weight of 19.9 g. From July to October growth was variable. From July to August fish did not show much growth. From August to September growth increased and fish grew by 22 mm to 133 mm. What was odd was the decrease in growth from September to October. Mean fork length decreased to 118 mm (mean weight = 30.1 g) (Figures 11 and 12). Not including the month of October, age one fish grew an average of 55 mm (0.36 mm/day and 0.17g /day) in five months, from April to September.

Rainbow trout Age 2+

Age two fish were represented in all months except in October. Sample sizes were small in all but survey 1 and 2 and thus a confident growth analysis cannot be provided. In the first two months of sampling where a large enough sample size was sampled, age two fish grew by 17 mm to 145 mm and a mean weight of 36.8 g (Figures 13 & 14). Age two fish grew an of 0.8 mm/day from April to May.

Rainbow trout Age 3+

Age three fish were only observed during the second sampling session. As they were only observed once throughout the year a growth pattern could not be assessed. This may be due to limitations of the sampling gear. Larger faster fish are more difficult to capture through open site electrofishing.

PIT Recaptures

Throughout the sampling year 206 Rainbow Trout that were PIT tagged. These fish were then available for recapture in future sampling surveys. In total 15 PIT tagged Rainbow Trout were recaptured, and could be retraced to original tag date (Figure 15). The amount of time passed between catches varied from 31 – 131 days. Based on the age analysis these fish were classified as age one and age two fish. Mean length and weight of age 1 recaptured fish was 110 mm (81–149 mm) and 18.9 g (7.0 – 42.4 g) (Table 4). On average these fish grew 0.3 mm/day and 0.16

g/day, this corresponds with the growth rates observed for the age one fish (0.36 mm/day and 0.17 g/day). Mean length and weight of age 2 recaptured fish was 157 mm (155– 159 mm) and 44.0 g (42.3– 45.6 g). On average these fish grew 0.6 mm/day and 0.27 g/day, this corresponds with the growth rates observed for the age two fish (0.8 mm/day).

Juvenile Coho

A total of 466 Coho were sampled in the Seton River main-stem (288) and spawning channels (158) throughout the sampling series (Table 1). Coho fork length ranged from 32 to 124 mm. Results from the length distributions, of both the main-stem river and spawning channels, show two modes in the histograms suggesting multiple age classes present during certain times of the year (Figure 16 and Figure 17). In April two distinct modes are visible, one single peak in the range from 30 to 50 mm range (young of the year) and the other with a range from 85 to 125 mm representing larger older fish. In May a similar distribution was observed, with two size classes clearly visible. In June only one size class of smaller fish was observed in the spawning channels. In the main-stem the same was observed but a single larger individual was also observed. In July fish length distribution was unimodal with a peak at 60 to 65 m. This is what is expected as the larger, older fish have most likely migrated downstream to the ocean. Length distributions in August are consistent with July length distributions with only a single size class apparent. This same trend was observed in the September and October with only one age class present in the 50 to 105 mm range.

In April, fork length of spawning channel fish were larger than those observed in the main-stem (p-value < 0.05 and t-stat > 2). There was no difference in the mean fork lengths between the mainstem coho and those of the spawning channels the rest of the year (p-value > 0.05, & t-stat < 2). This was consistent in all the months where both areas were sampled (Table 5).

Scale/Age Analysis:

Similar to the data of Rainbow trout, all of the scales from the spawning channel fish and those of the main-stem river were pooled to make a stronger sample size. Analysis from the scale data corroborate the modes observed in the length frequency histograms of each month.
Coho life history in the Seton River differs from Rainbow Trout in that they only spend their first year in fresh water then migrate to the ocean to rear for one and a half years. Therefore, age zero (young of the year) fish would be encountered throughout the year and age one fish encountered only in the early spring.

This was the case with the sampling completed in 2015 in the Seton River. In April two age classes were identified. Age zero fish and age one fish (Figure 37). Mean length for age zero fish was 35.3 mm (31 - 44 mm). Age one fish had a mean fork length of 91 mm (82 – 102 mm). In May age 0 Coho had a mean length of 38 mm (30-82 mm). Age 1 Coho were also larger in May with a mean length of 103 mm and a range spanning from 97 to 110 mm. One of the fish sampled in May was aged as a 2 year old. This is possible, but unlikely as the length of an age 2 fish is expected to be larger than 101 mm. The larger fish observed in the length frequency histograms in April and May are most likely Coho smolts getting ready to migrate to the ocean. Through June to September only age 0 Coho were observed. The histograms show the same unimodal distribution changing in length, suggesting that the fish sampled were the age zero fish rearing in the system (Figure 37).

Growth Analysis:

Age data collected along with the length frequency histograms were used to assess growth rates of age zero Coho in the Seton River.
Length, weight analysis showed a strong relationship between length and weight for Coho Salmon of all sizes within the Seton River (R^2=0.907) (Figure 38).
Age Zero fish were first encountered in April. They had a mean length of 35 mm with a range from 31 mm to 44 mm. By June they had grown by a length of 16 mm to a mean length of 51 mm (37 – 69 mm). From June to July the fish grew another 8.5 mm to a mean length of 60 mm

(45 – 80 mm) and a mean weight of 2.9 g (1.1 – 5.5 g). From July to August growth remained constant and mean fork length of age zero fish was 69 mm (51 – 84 mm) and mean weight was 4.0 g (0.5 – 7.6 g). From August to September growth slowed slightly and an increase of 7 mm in fork length was observed. Mean length and weight in August was 76 mm (55 – 93) and 5.4 g (1.2 – 8.6 g) respectively. September to October saw an increase in growth of 7 mm to a mean length of 83 mm (53 – 100 mm) and weight of 7.7 g (2.0 – 12.8 g) (Figure 39 and 40).

Juvenile Chinook

In 2015, Chinook juveniles were observed in all sampling surveys throughout the year. In total 196 Chinook were sampled. Nineteen fish were sampled in the spawning channels and 177 in the main-stem Seton River (Table 4).

Like Coho juveniles, one dominant size/age (age 0) class is consistent throughout the year (Figure 41). From April to June sample sizes were small (<10 fish) and distinct modes are not obvious. In April, three age zero (young of the year) and one age one Chinook were observed. This is expected and consistent with the stream type life history of Chinook. In May and June only age 0 fish were observed and fork length for those fish ranged from 30 to 65 mm. In July, the number of Chinook sampled increased considerably. All of the fish sampled in July were age zero fish and ranged in size (45 to 90 mm). Through July to October only age 0 Chinook (except for one age 1) were observed. The histograms show the same unimodal distribution shifting in length, suggesting that the fish sampled were the age zero fish rearing in the system (Figure 41).

Growth Analysis:

Age data collected along with the length frequency histograms were used to assess growth rates of age zero Chinook in the Seton River. Length, weight analysis showed a strong relationship between length and weight for Chinook Salmon of all sizes within the Seton River (R^2=0.915) (Figure 42).

Age zero fish were first encountered in April. They had a mean length of 43.5 mm with a range from 34 mm to 53 mm. In May a slight decrease in mean length for age zero fish was observed. Mean fork length was 40 mm (34 – 58mm). By June age zero fish had grown by a length of 12 mm to a mean length of 52 mm (40 – 65 mm). From June to July the second largest growth was observed. Fish grew 14 mm to a mean length of 66 mm (49 – 90 mm) and a mean weight of 3.6 g (1.6 – 8.0 g). From July to August growth decreased slightly and mean fork length of age zero fish was 77 mm (67 – 94 mm) and mean weight was 5.5 g (3.9 – 9.6 g). In September, mean length and weight appeared to decreased and was 72 mm (60 – 95) and 4.7 g (2.4 – 8.6 g) respectively. September to October saw the largest increase in growth of 17 mm to a mean length of 89 mm (58 – 104 mm) and weight of 9.2 g (2.2 – 14.8 g) (Figure 43 and 44).

TABLES

Table 1 Total number of fish caught during juvenile growth sampling surveys, 2015

Species	Site	N
Bridgelip Sucker	Seton River	23
Bridgelip Sucker	Spawning channel	24
Bull Trout	Spawning channel	1
Coast-range sculpin	Seton River	169
Coast-range sculpin	Spawning channel	43
Prickly Sculpin	Seton River	28
Prickly Sculpin	Spawning channel	38
Chinook	Seton River	177
Chinook	Spawning channel	19
Coho	Seton River	288
Coho	Spawning channel	158
Longnose Dace	Seton River	282
Longnose Dace	Spawning channel	203
Peamouth Chub	Seton River	1
Rainbow Trout	Seton River	541
Rainbow Trout	Spawning channel	118
Redside Shinner	Seton River	8
Redside Shinner	Spawning channel	5
sculpin	Seton River	17
sculpin	Spawning channel	7
Sockeye	Seton River	23
Sockeye	Spawning channel	1
Mountain Whitefish	Seton River	7

Table 2. Mean length of Rainbow trout sampled during juvenile growth sampling surveys at Seton River and Seton River spawning channels

Site	Month	N	Mean	sd	Min	Median	Max
Seton River	April	60	84.6	19.7	55	83	164
Spawning channel	April	38	112.4	35.8	72	96.5	194
Seton River	May	51	84.5	20.3	57	82	155
Spawning channel	May	17	128.9	47.1	81	103	235
Seton River	June	7	84.6	17.3	56	88	104
Spawning channel	June	15	118.2	21.2	72	116	155
Seton River	July	69	57.9	31.3	27	42	156
Spawning channel	July	18	81.4	38.6	40	60.5	160
Seton River	August	37	64.4	23.8	38	57	142
Spawning channel	August	10	98.5	37.6	58	91	165
Seton River	September	281	76.7	26	41	70	205
Seton River	October	36	79.1	17.8	45	79	145
Spawning channel	October	20	122.7	48.7	64	118.5	204

Table 3. Results of simple t-test comparing length of main-stem Seton River fish with spawning channel fish in 2015.

Species	Month	t-stat	df	p.value
Rainbow Trout	April	4.4011642	51.454085	5.45E-05
Rainbow Trout	May	3.7692706	18.009945	0.0014032
Rainbow Trout	June	3.944818	14.327754	0.001407
Rainbow Trout	July	2.3839098	23.131929	0.025716
Rainbow Trout	August	2.7282835	11.021472	0.0196074
Rainbow Trout	October	3.8613971	21.861266	0.0008529

Table 4. Growth of PIT-tagged juvenile Rainbow Trout, 2015.

PIT ID	Age	First FL (mm) measurement	Last FL (mm) measurement	Growth (mm)	Rate of growth (mm day^{-1})
650261	1	112	114	2	0.065
650274	1	85	130	45	0.536
650301	2	142	155	13	0.236
650323	1	84	81	-3	
650352	1	108	149	41	0.313
650945	1	103	113	10	0.156
650953	1	81	111	30	0.469
657013	1	82	123	41	0.313
657016	1	75	112	37	0.282
657556	1	90	117	27	0.415
657584	1	86	97	11	0.115
657614	1	95	93	-2	
657700	1	77	85	8	0.119
657713	2	125	159	34	0.944
657716	2	115	157	42	0.646

Table 5. Results of simple t-test comparing length of main-stem Seton River Coho with spawning channel Coho in 2015.

Species	Month	t-stat	df	p value
Coho	April	6.452	32.635	2.70E-07
Coho	May	1.745	89.957	8.44E-02
Coho	June	-0.166	53.788	8.69E-01
Coho	July	-1.628	41.354	1.11E-01
Coho	August	0.569	30.739	5.73E-01
Coho	October	1.918	23.879	6.72E-02

FIGURES

Figure 1. Location of juvenile growth sampling sites, Seton River, 2014.

Figure 1. Cont…

Figure 1. Cont…

Figure 2. Length frequency histograms of juvenile Rainbow trout sampled in Seton River 2015

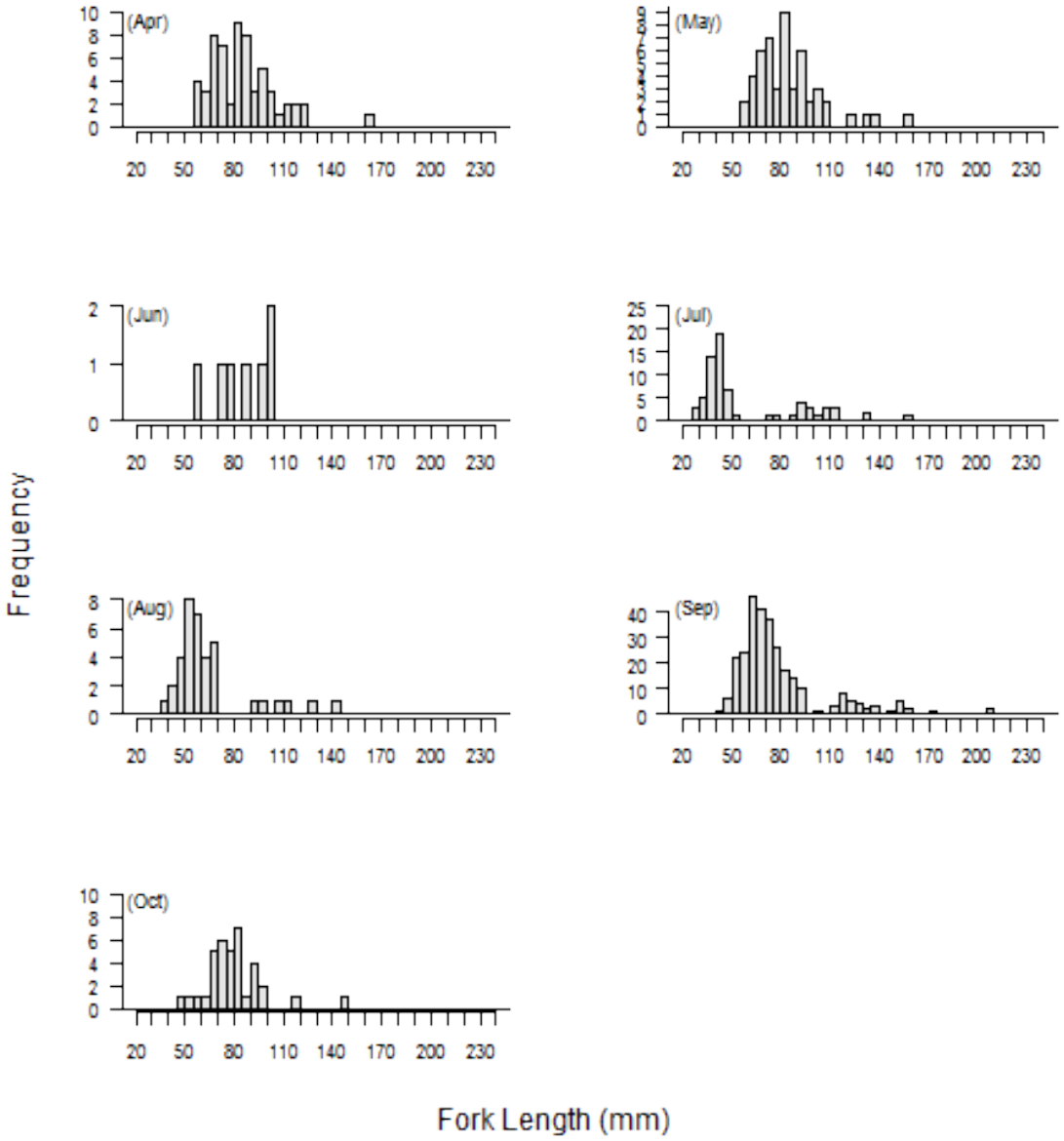


Figure 3. Length frequency histograms of juvenile Rainbow trout sampled in Seton River spawning channels in 2015

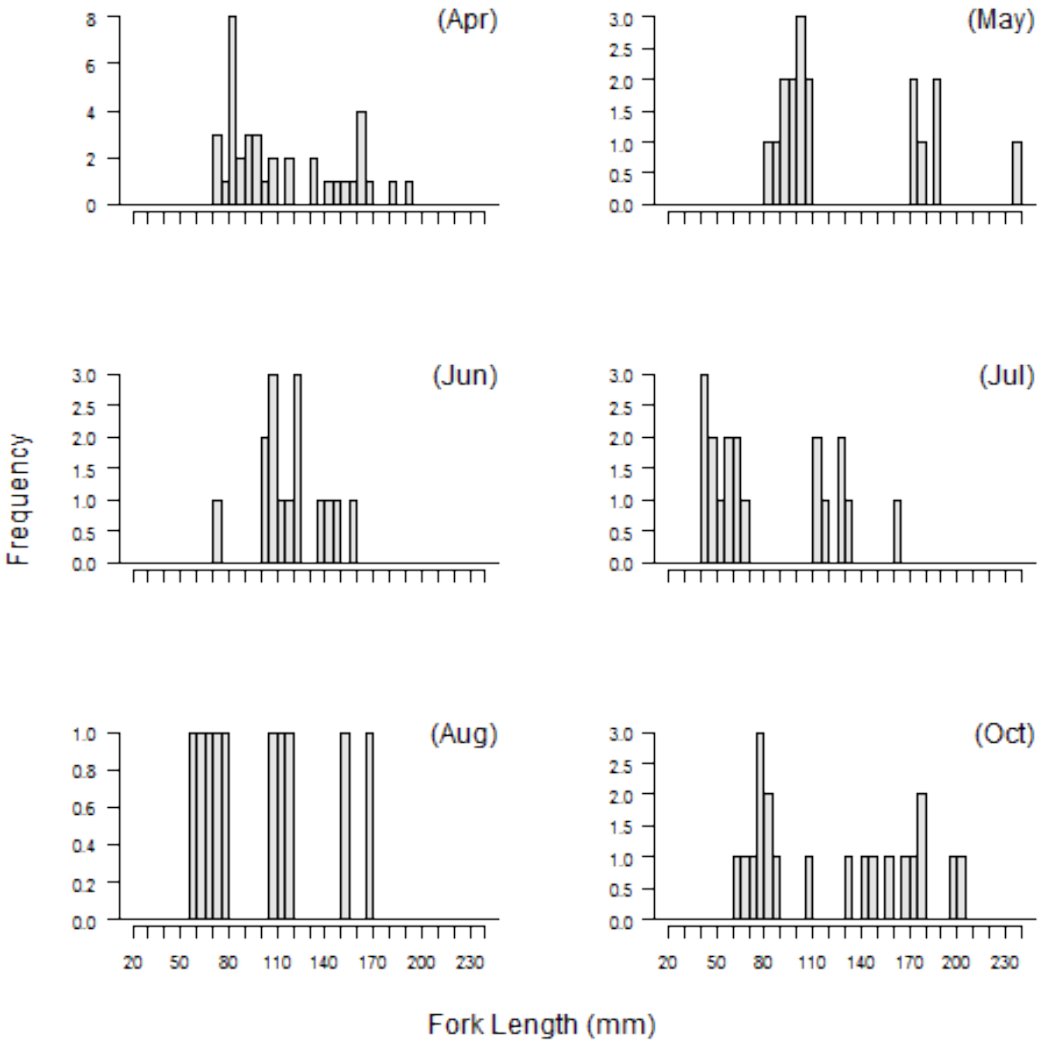


Figure 4. Length at age frequency distributions for Seton River Rainbow trout April to October 2015.

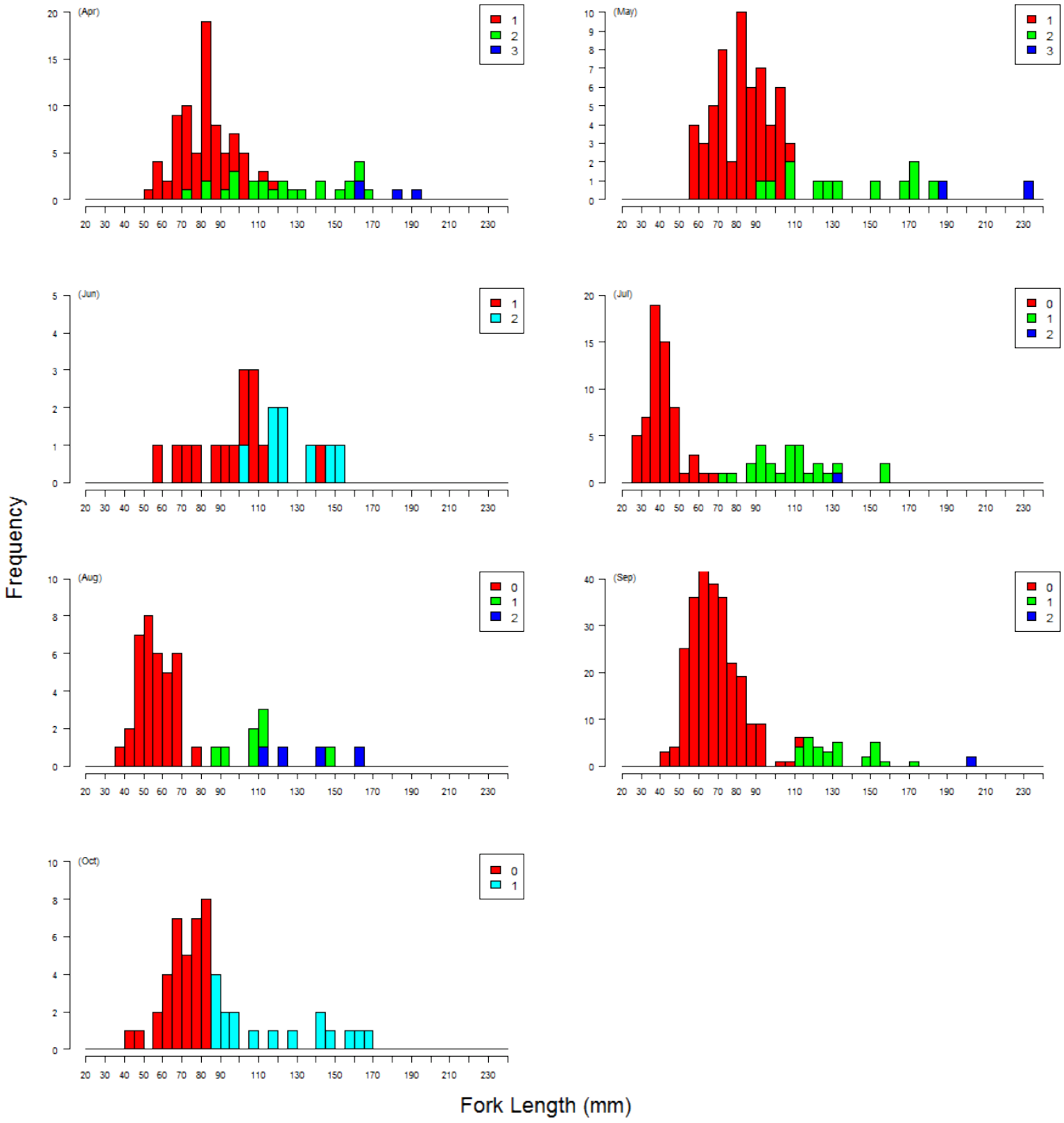


Figure 5. Length-at-age for Seton River Rainbow trout sampled in April 2015. Mean lengths-at-age connected by blue line.

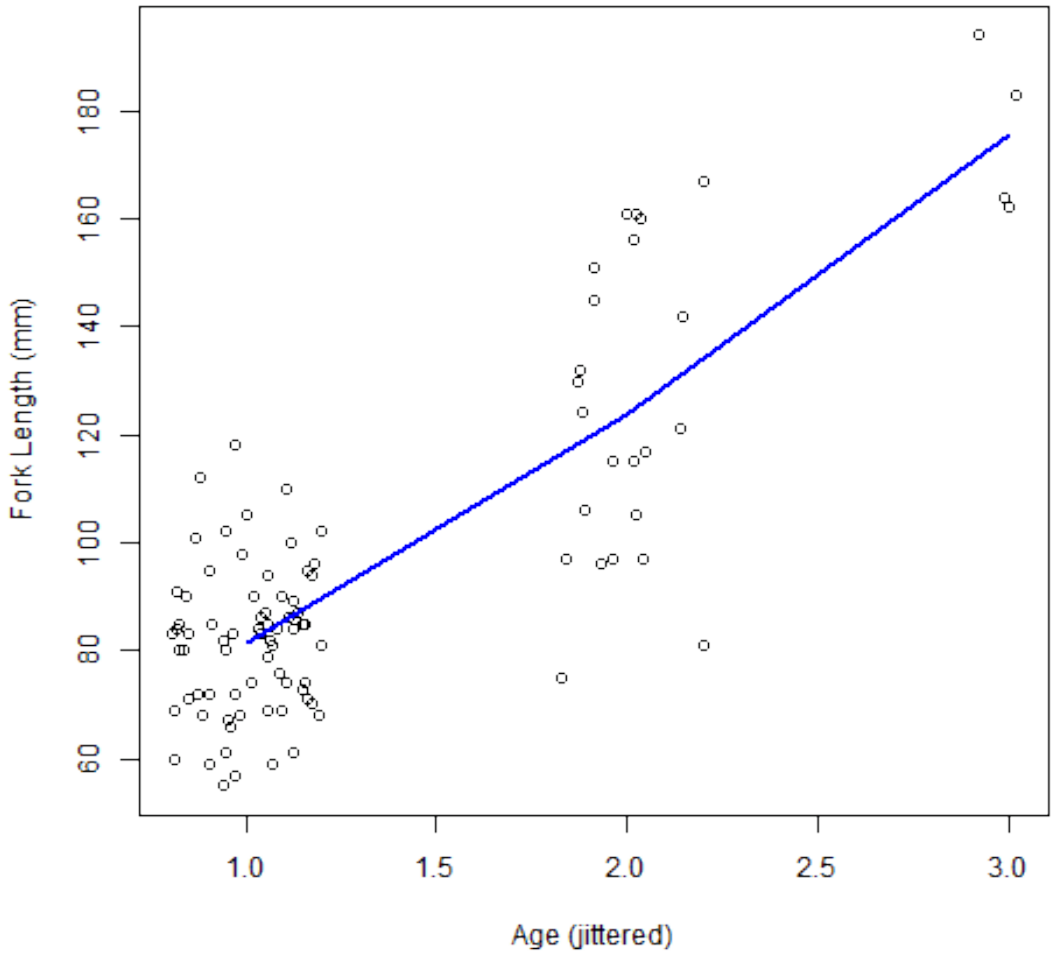


Figure 6. Length-at-age for Seton River Rainbow trout sampled in July 2015. Mean lengths-at-age connected by blue line.

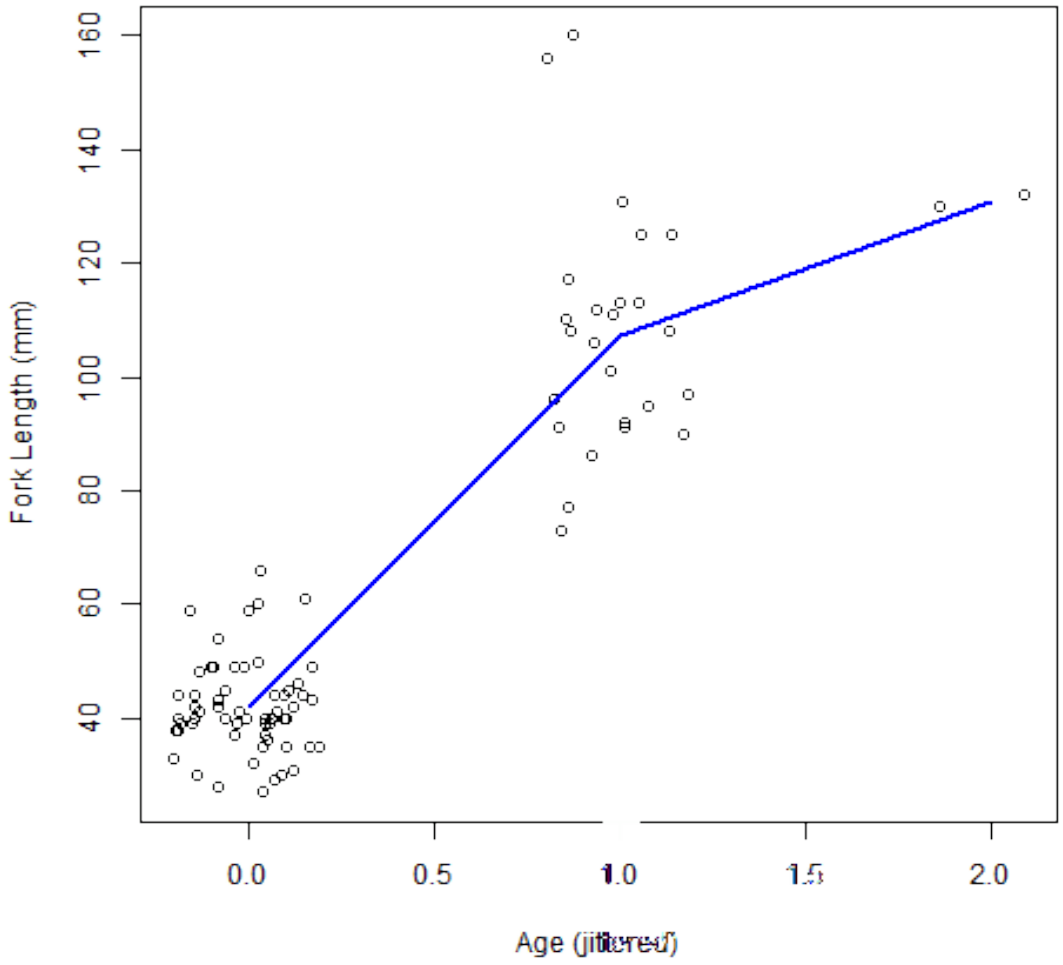


Figure 7. Length-at-age for Seton River Rainbow trout sampled in October 2015. Mean lengths-at-age connected by blue line.

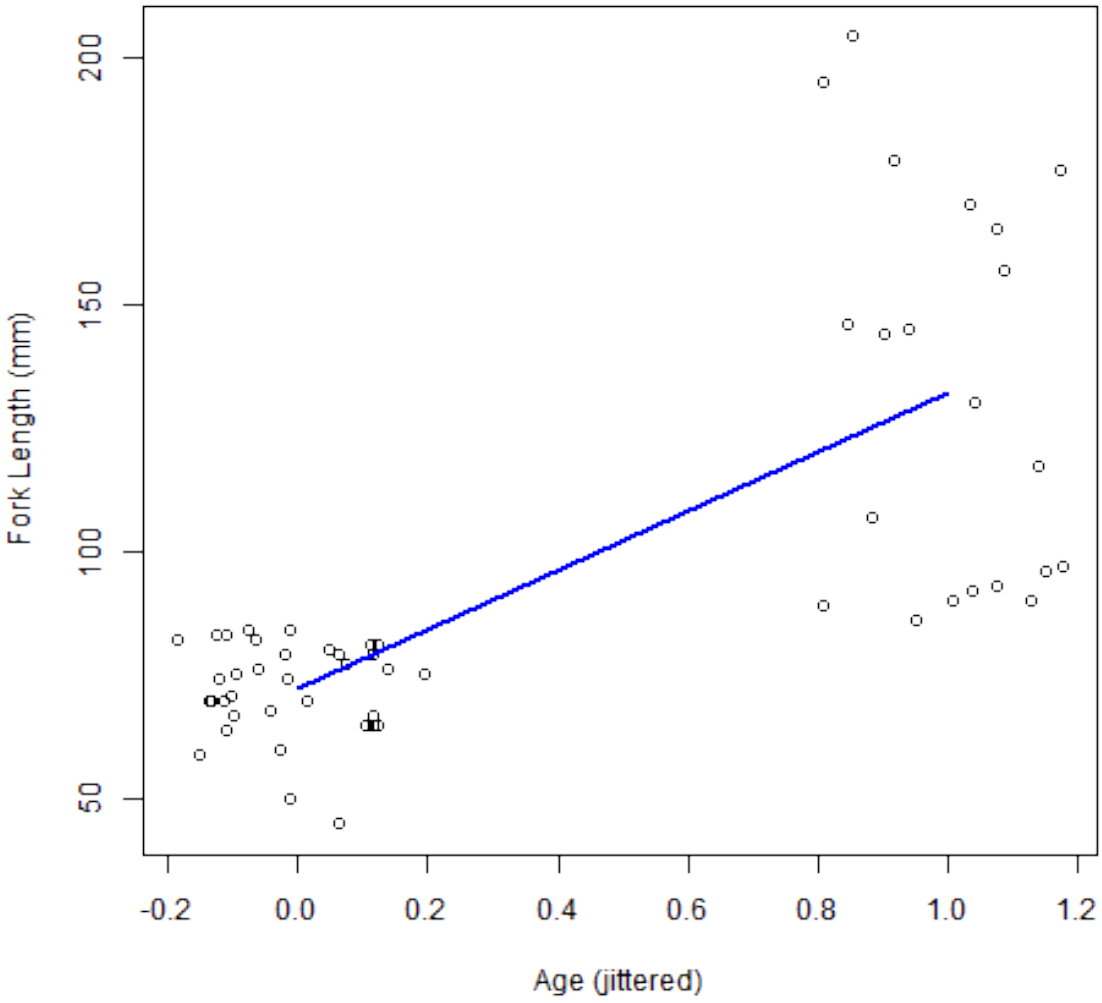


Figure 8. Weight, length relationship for Seton River Rainbow trout sampled in 2015

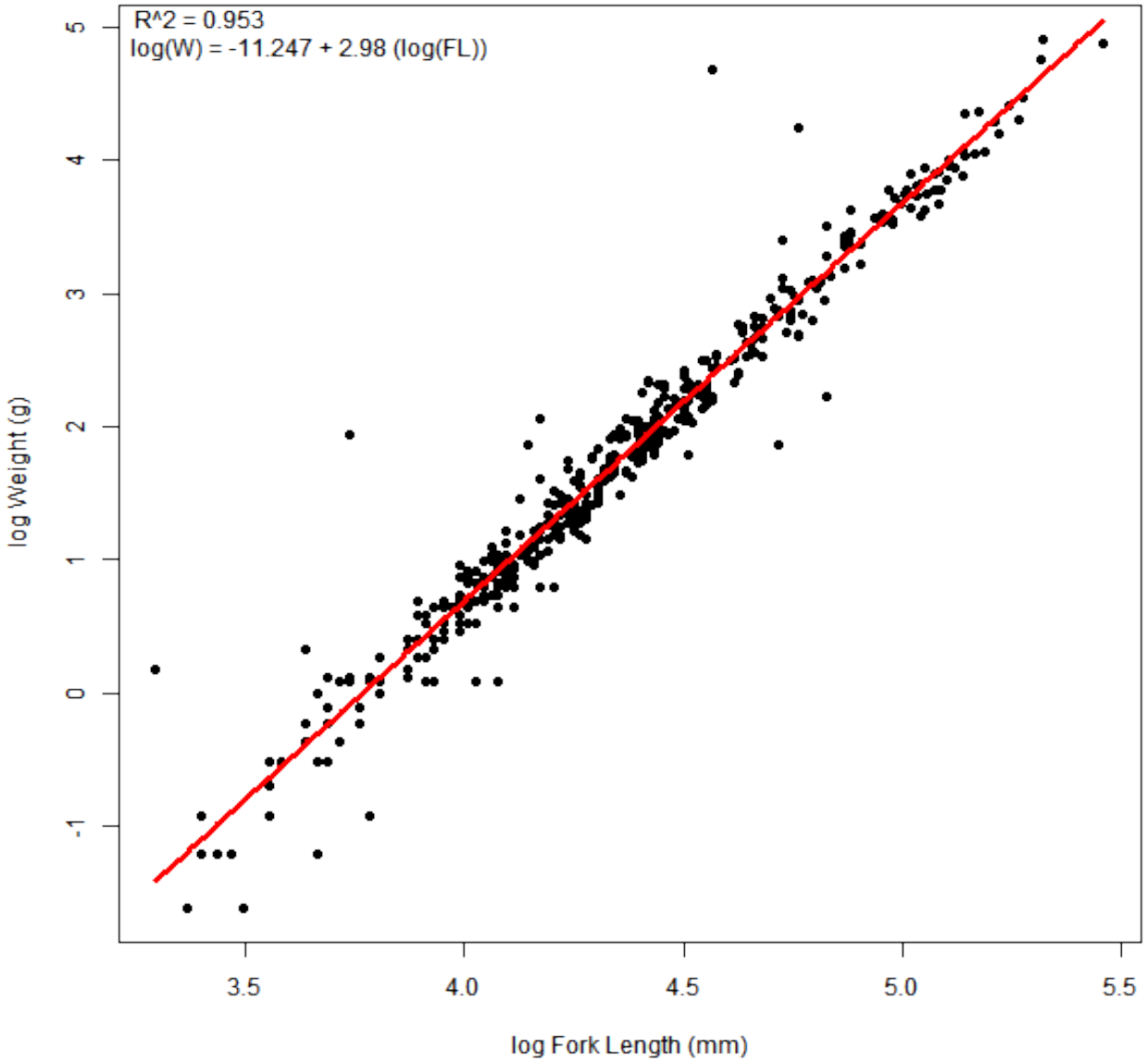


Figure 9. Length boxplot of Seton River age 0 Rainbow trout from July -October 2015

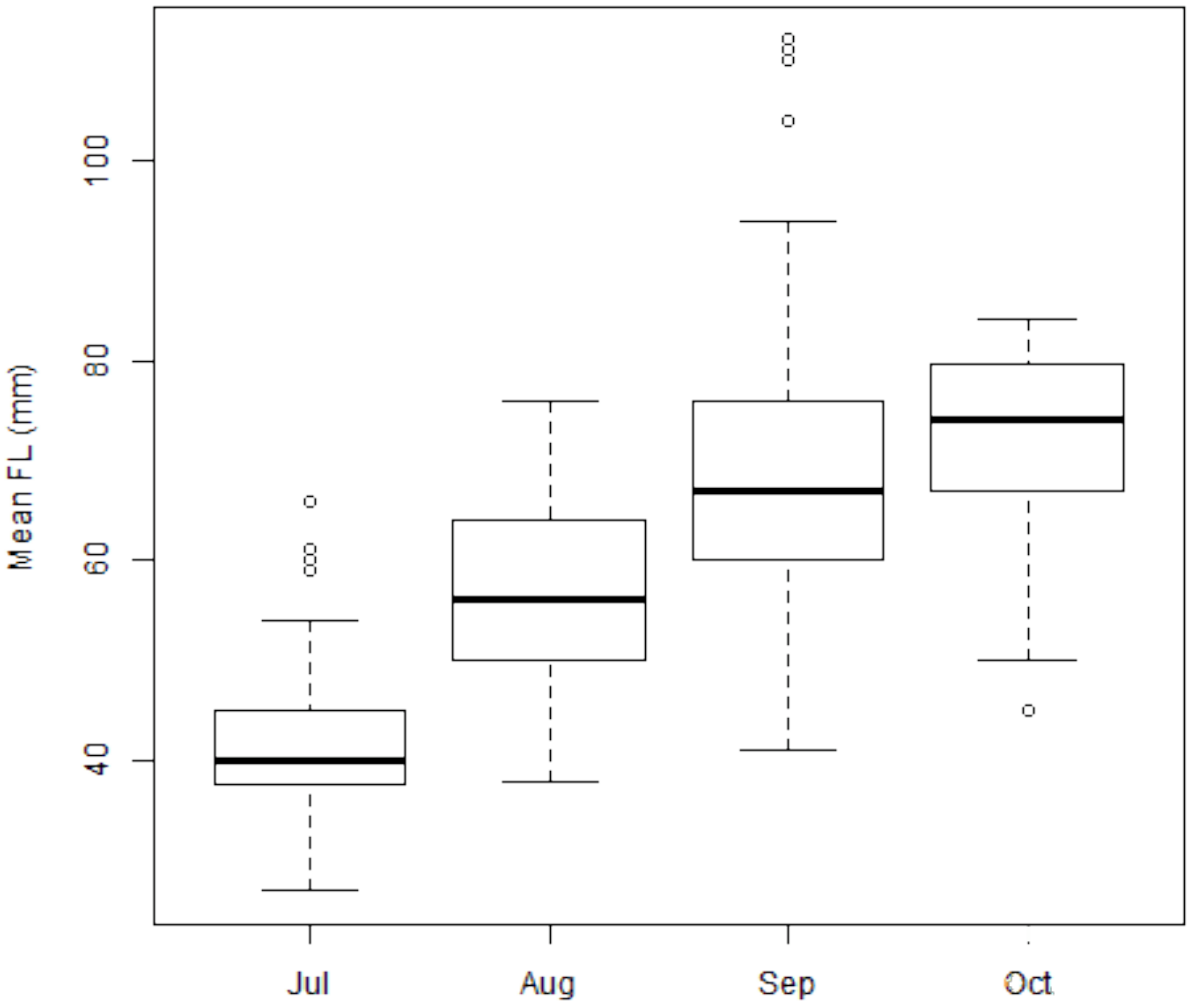


Figure 10. Weight boxplot of Seton River age 0 Rainbow trout from July - October 2015

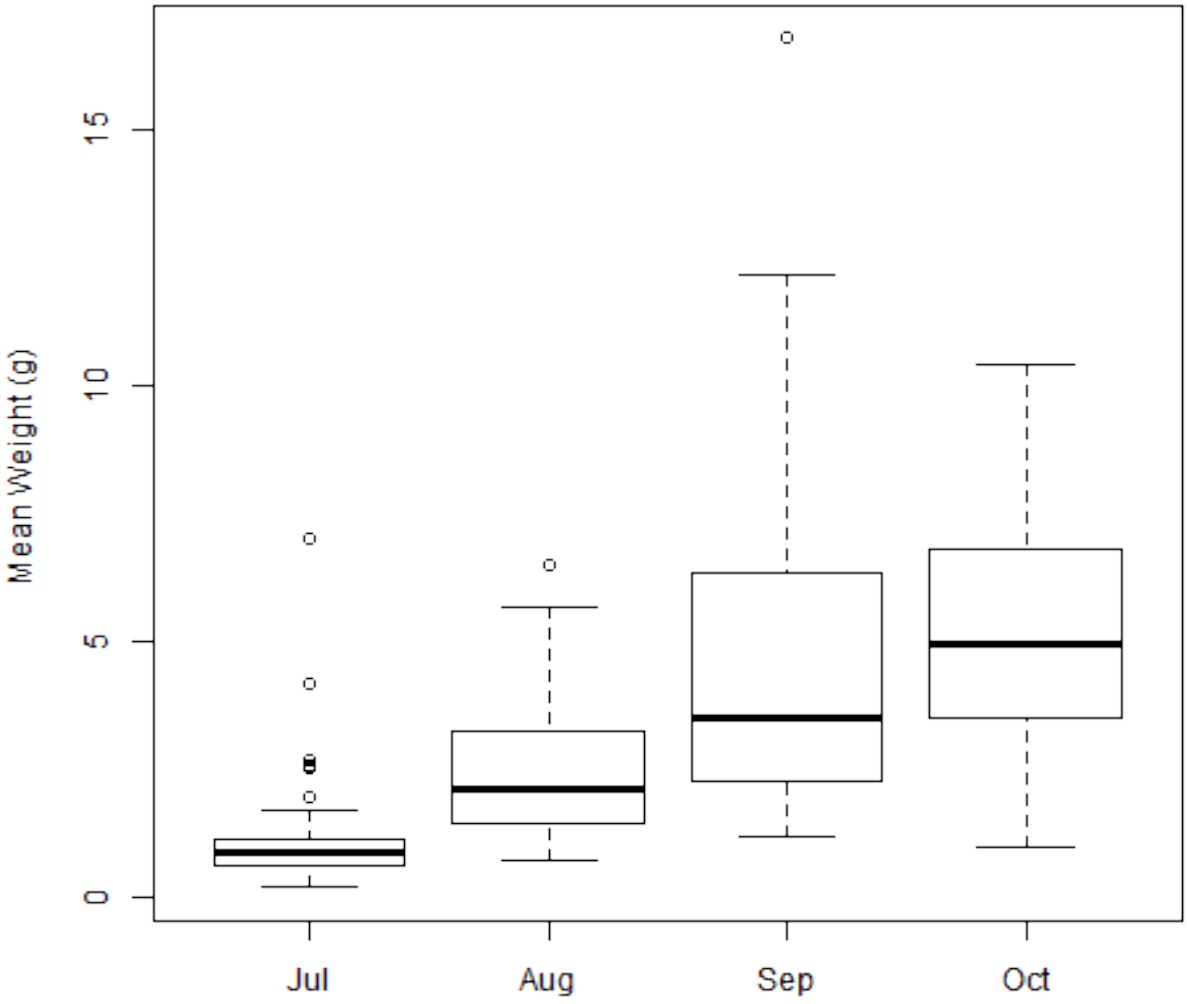


Figure 11. Length boxplot of Seton River age 1 Rainbow trout from April -October 2015

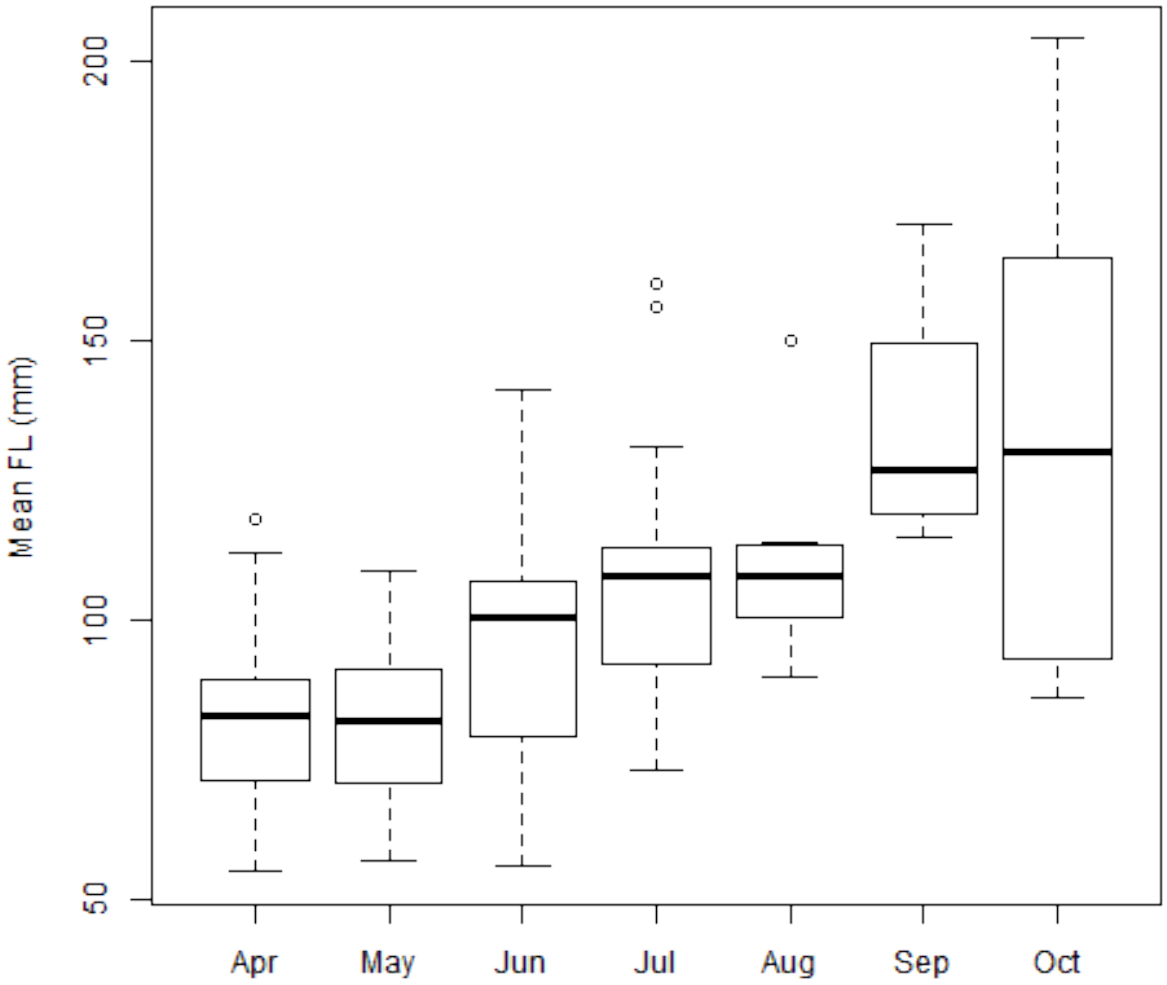


Figure 12. Weight boxplot of Seton River age 1 Rainbow trout from April -October 2015.

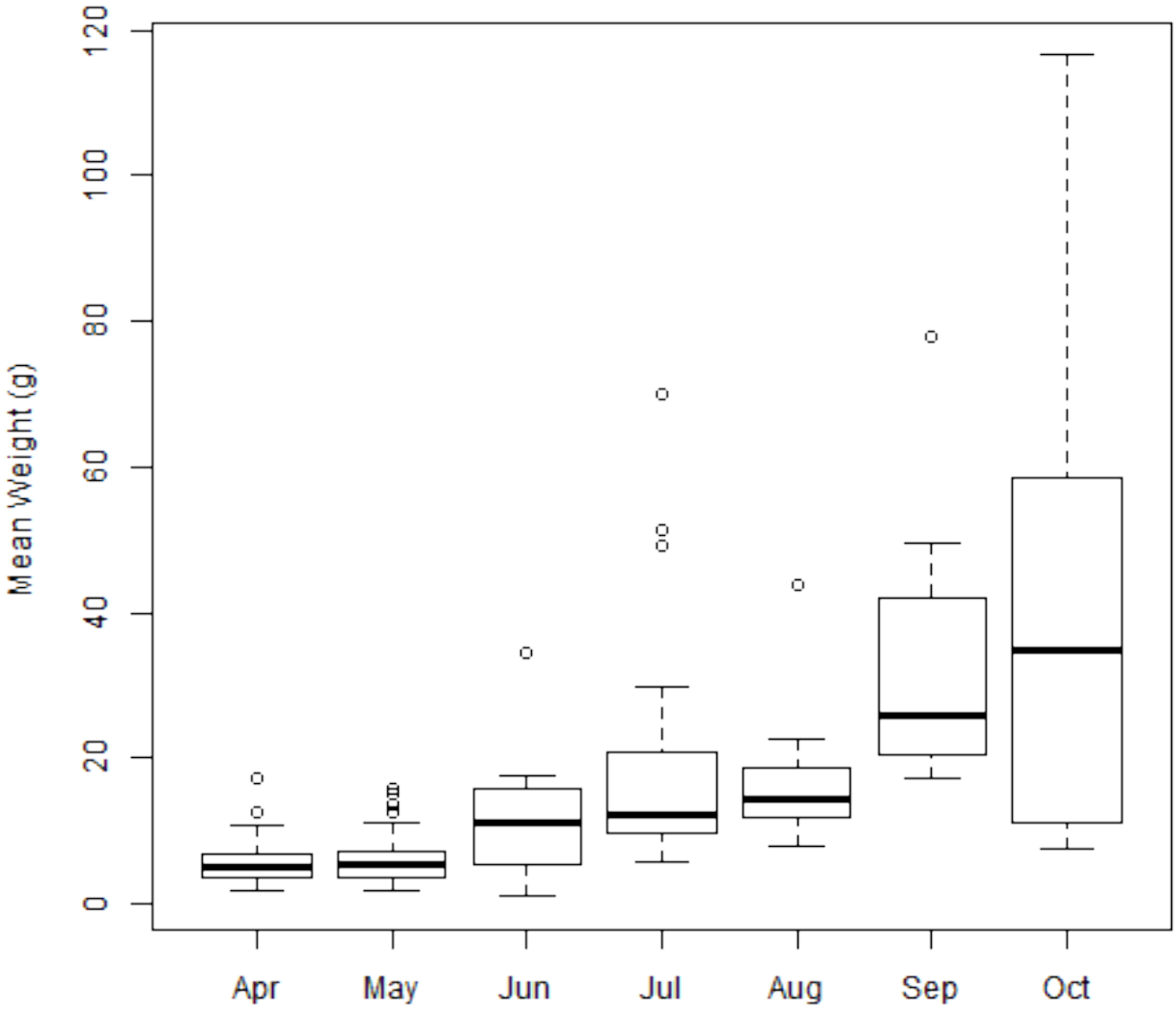


Figure 13. Length boxplot of Seton River age 2 Rainbow trout, 2015.

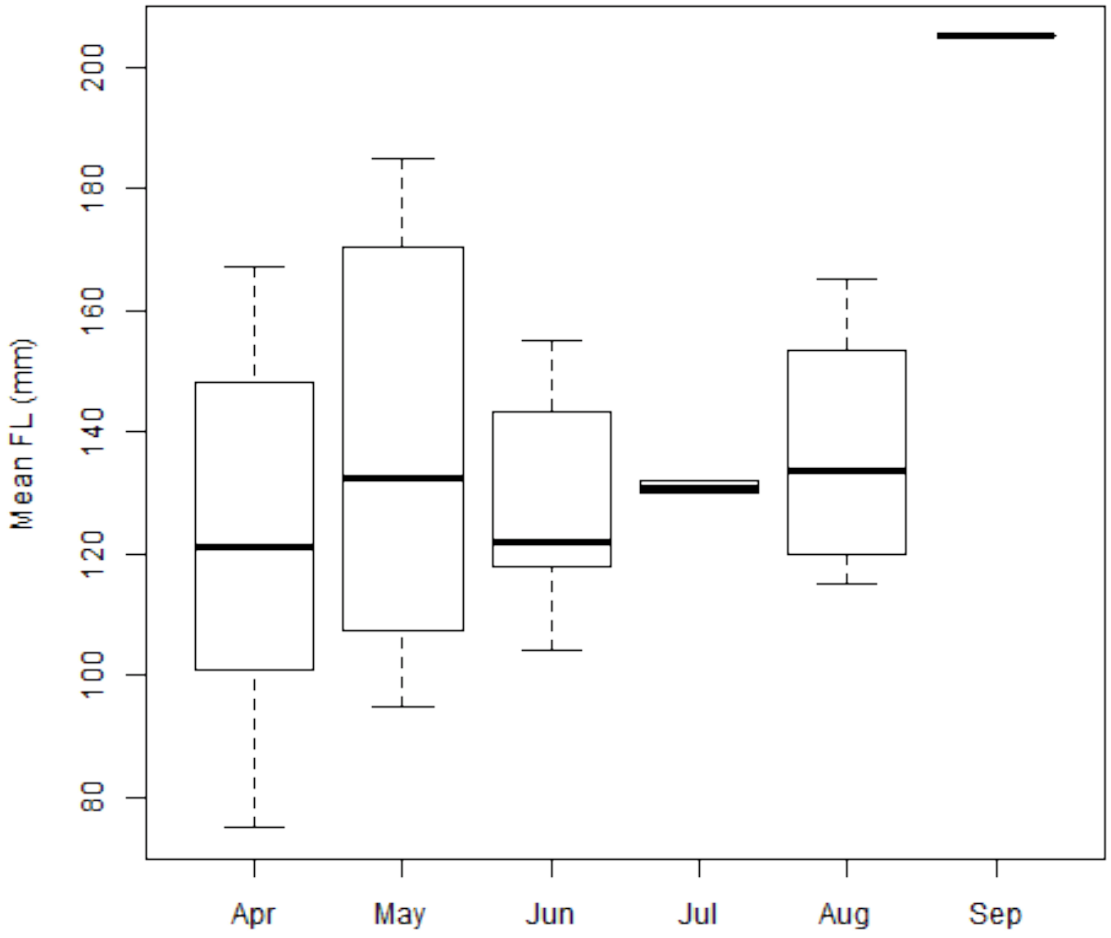


Figure 14. Weight boxplot of Seton River age 2 Rainbow trout, 2015.

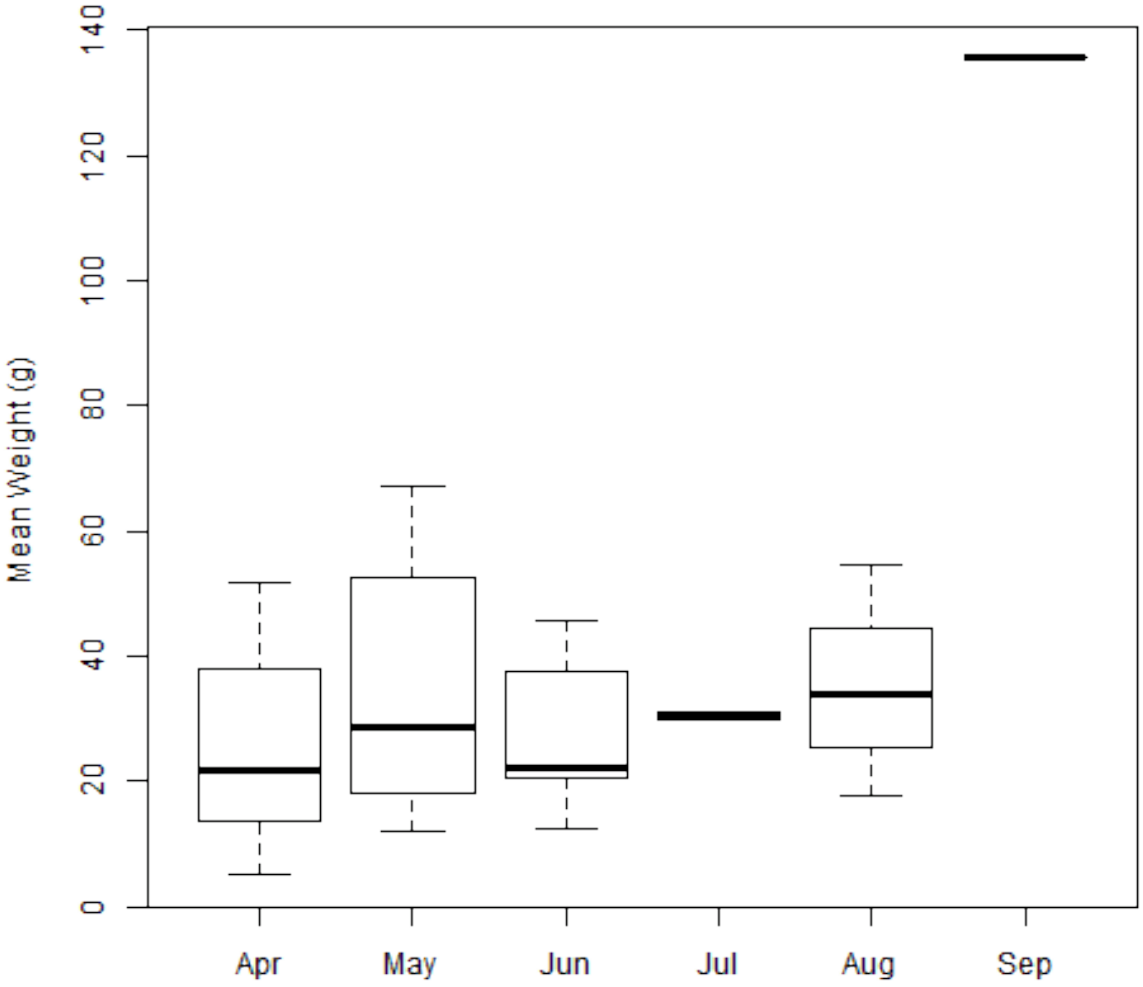


Figure 15. Growth of PIT-tagged juvenile rainbow trout from April to October 2015. Each panel represents the growth of an individual fish. LSC and USC are the Lower and Upper Spawning Channels, respectively.

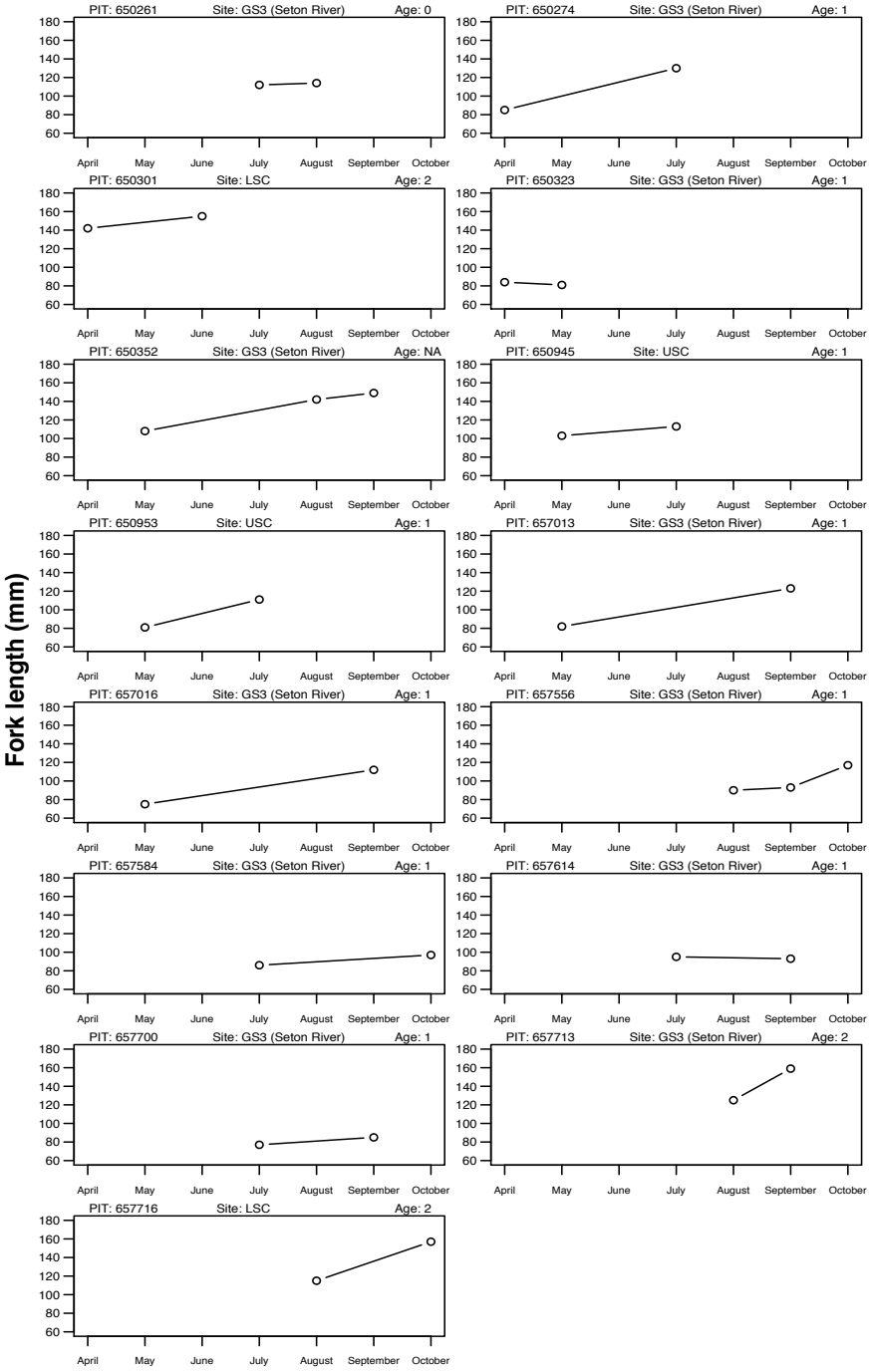


Figure 16. Length frequency histograms of juvenile Coho sampled in Seton River 2015

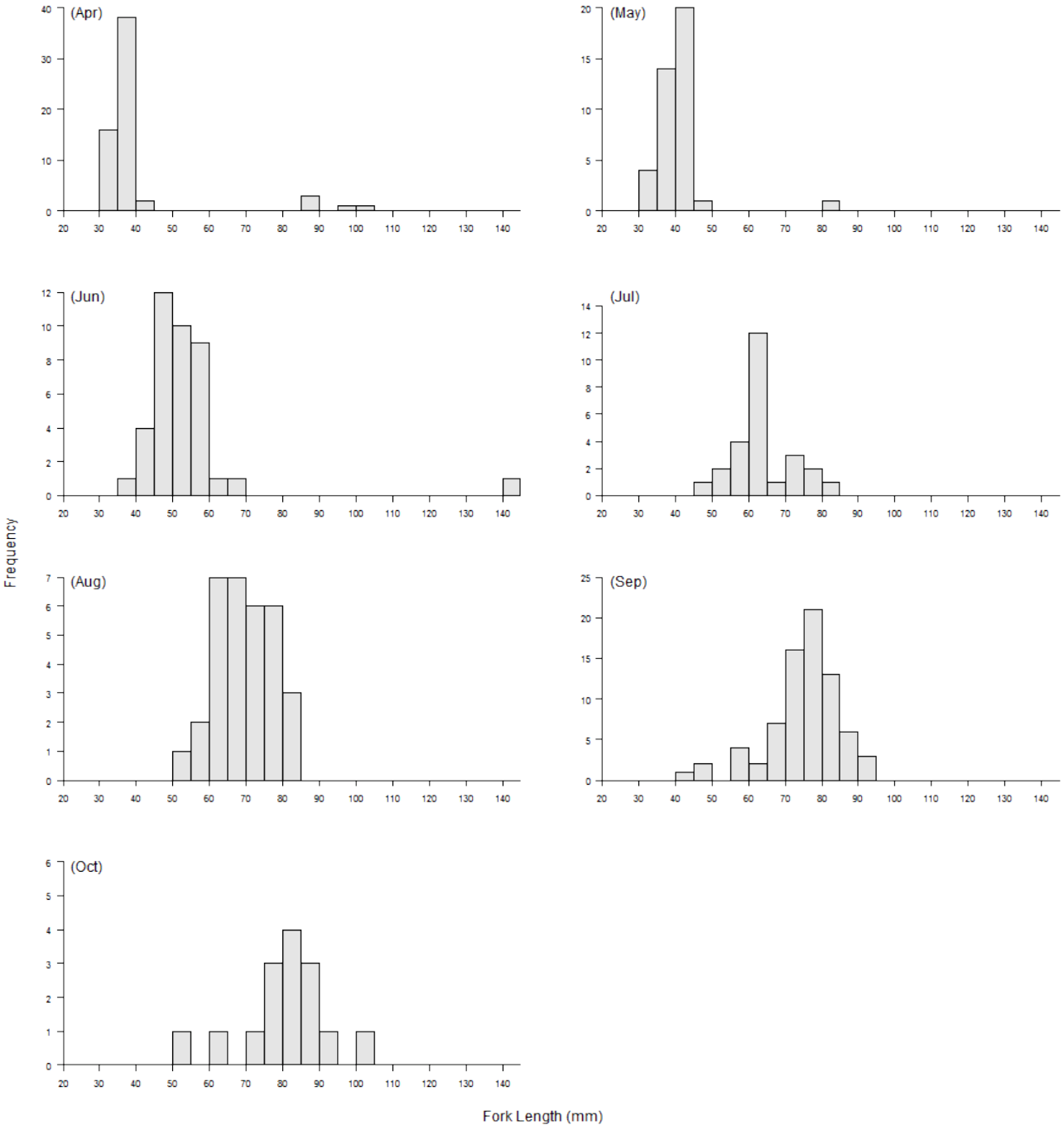


Figure 17. Length frequency histograms of juvenile Coho sampled in Seton River spawning channels 2015.

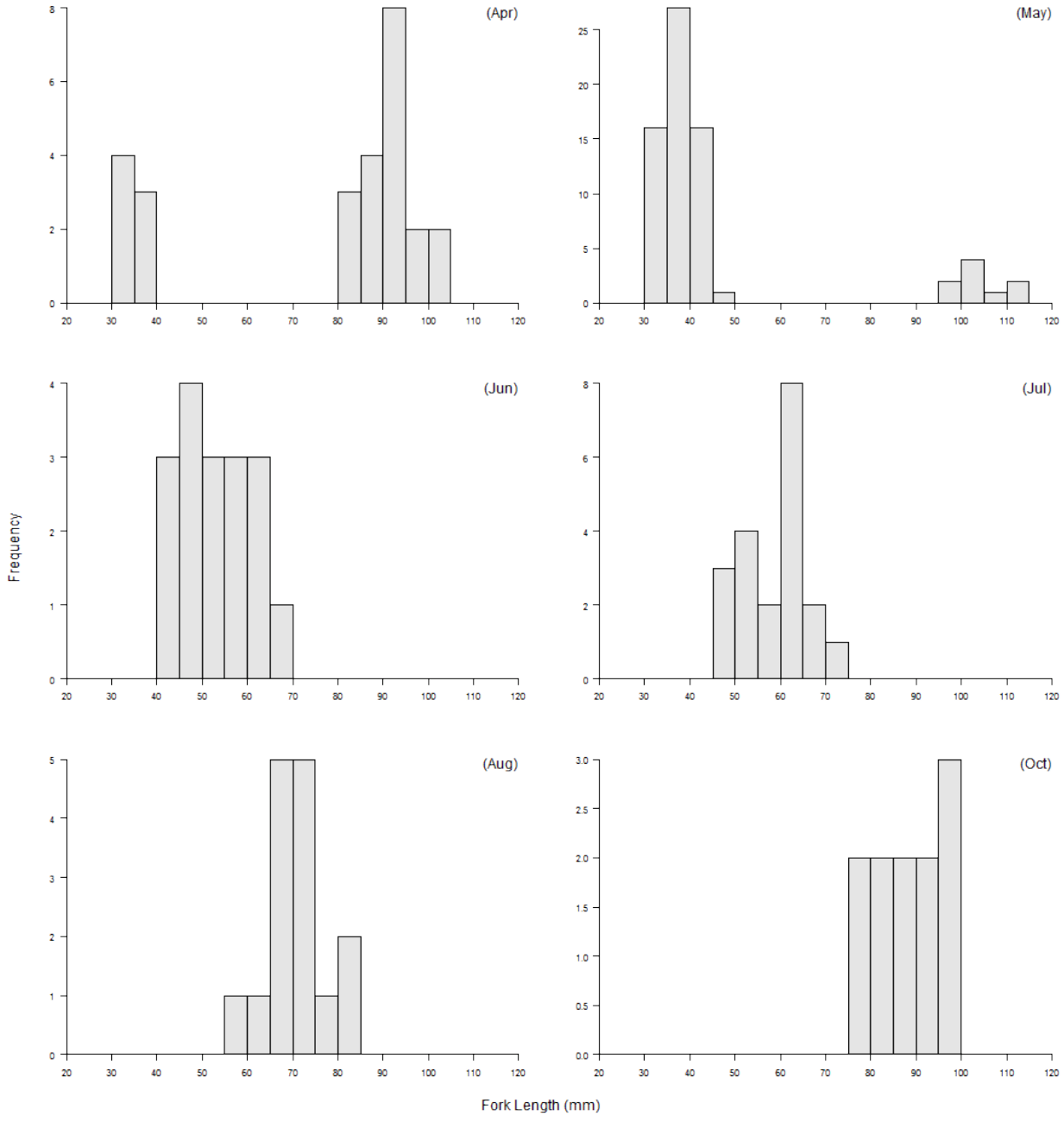


Figure 18. Length and age frequency for Seton River juvenile Coho in 2015,

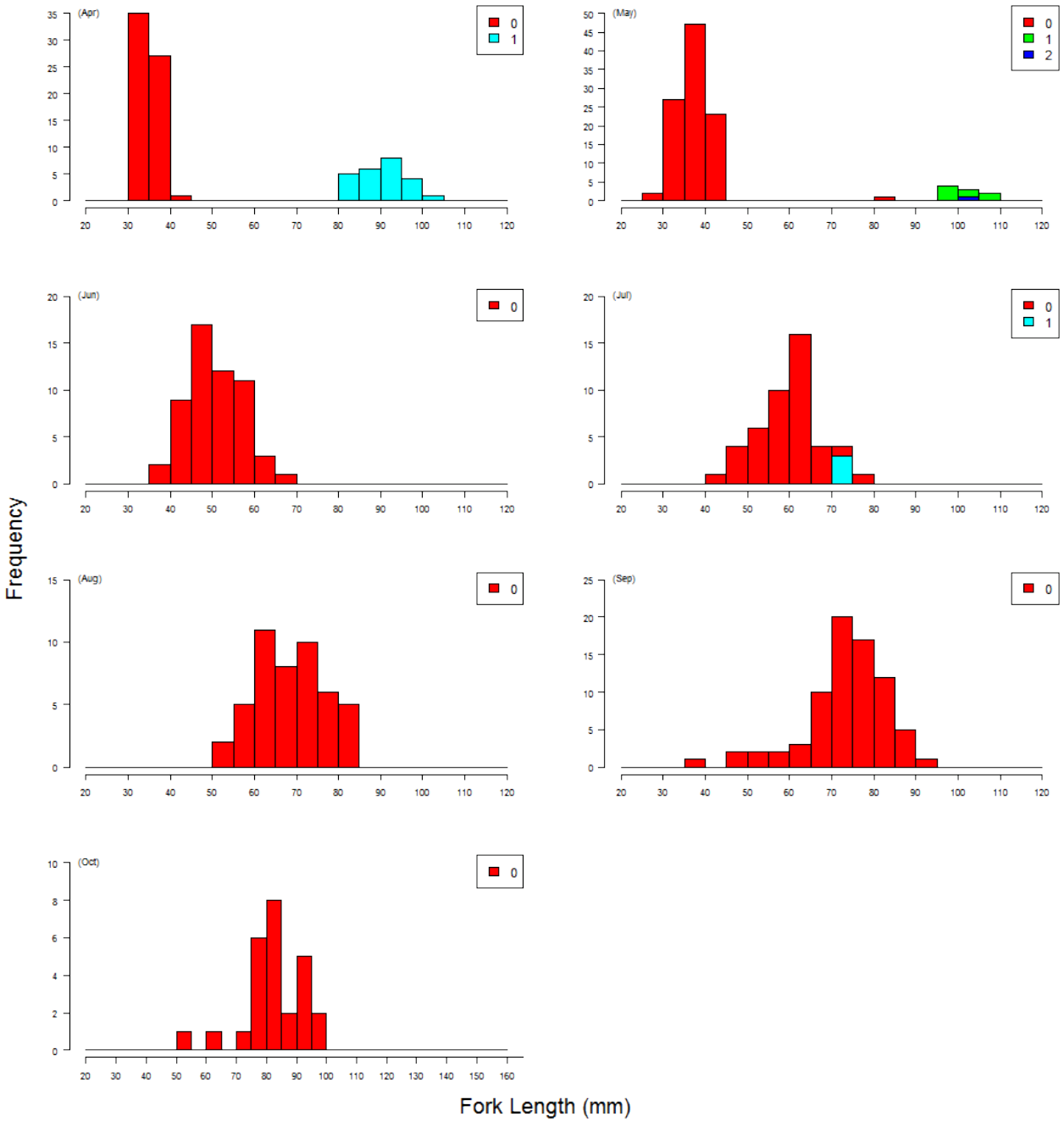


Figure 19. Weight, length relationship for Seton River juvenile Coho salmon sampled in 2015.

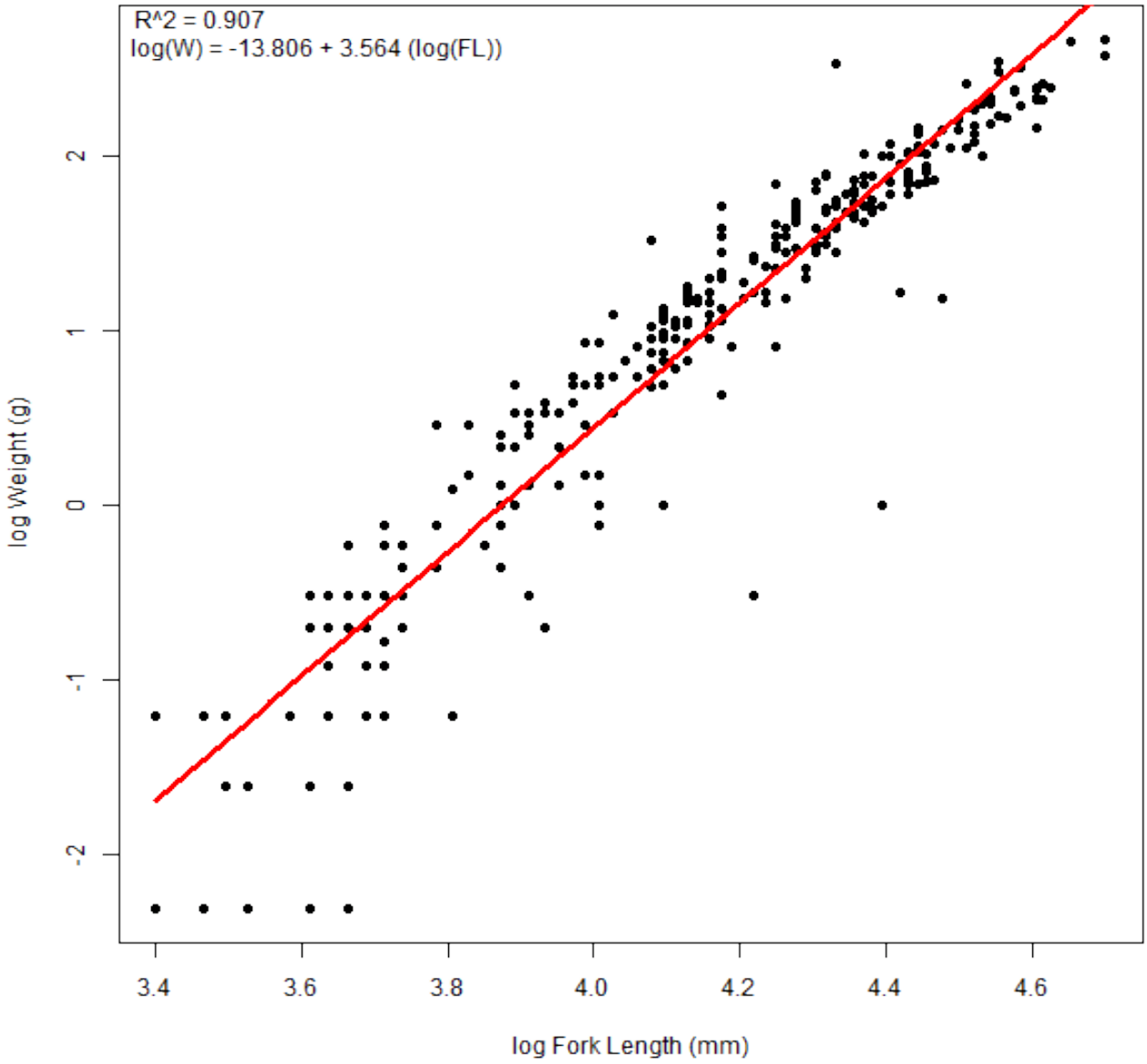


Figure 20. Length boxplot of Seton River age 0 Coho from April -October 2015.

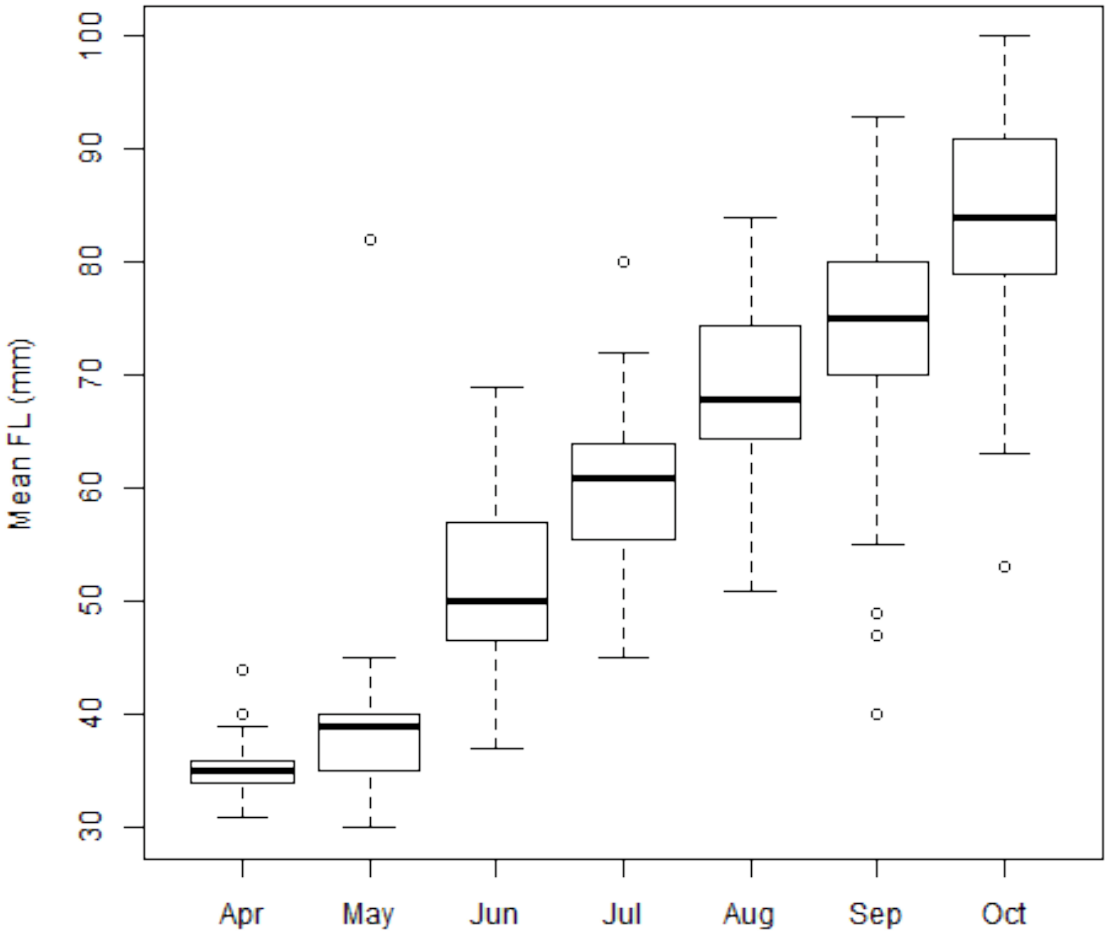


Figure 21. Weight boxplot of Seton River age 0 Coho from April -October 2015.

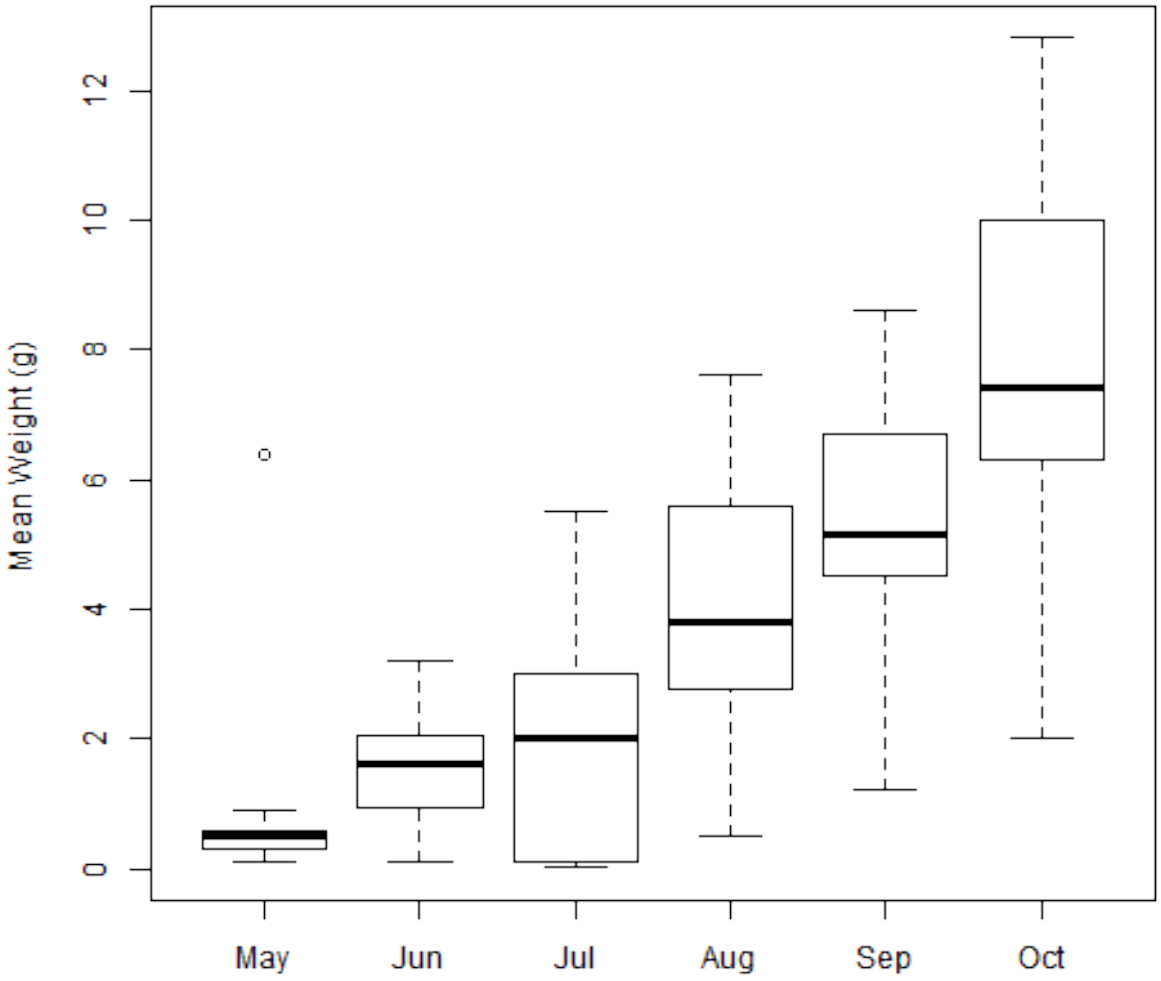


Figure 22. Length and age frequency for Seton juvenile Chinook in 2015.

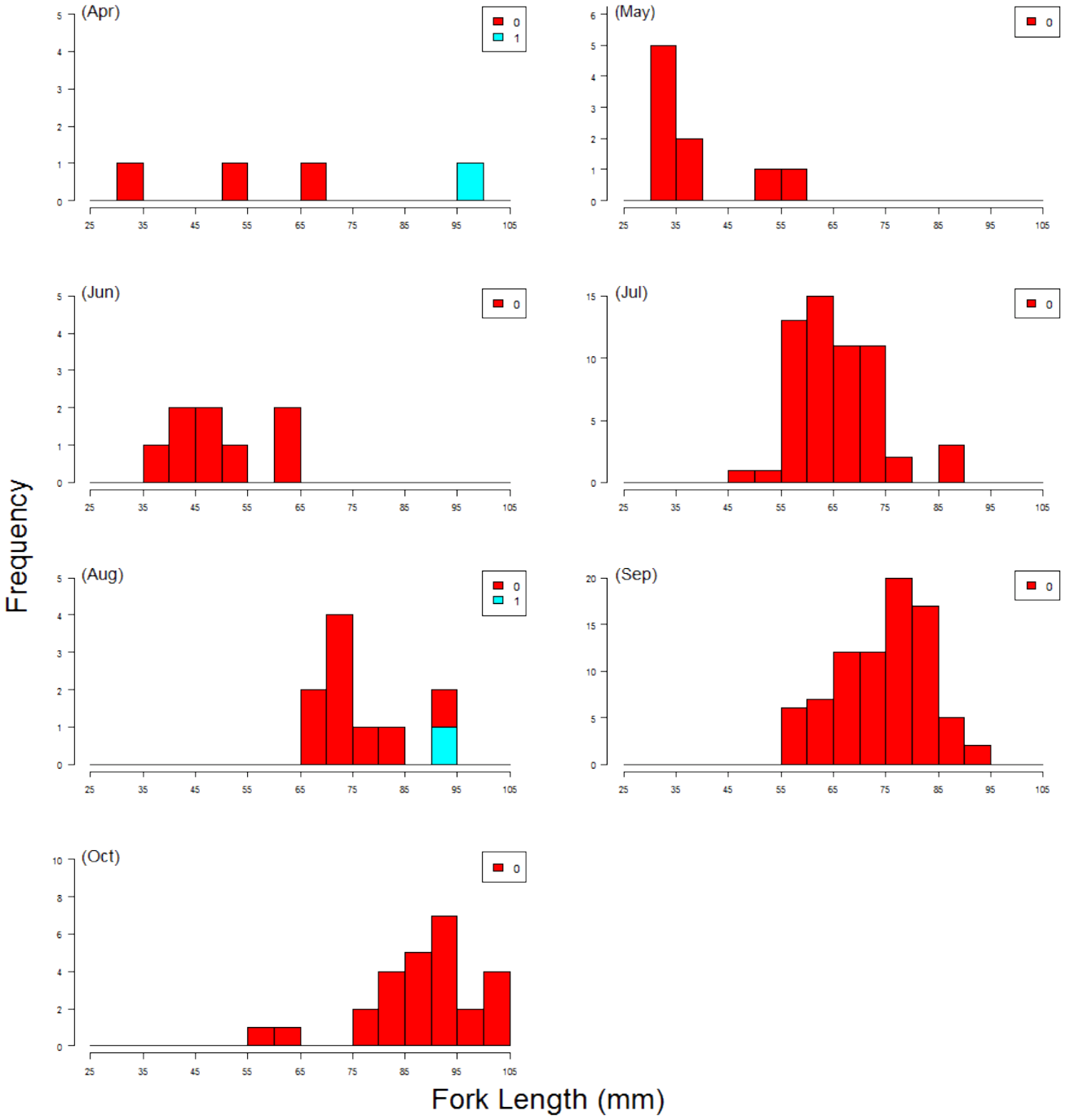


Figure 23. Weight, length relationship for Seton River juvenile Chinook salmon sampled in 2015.

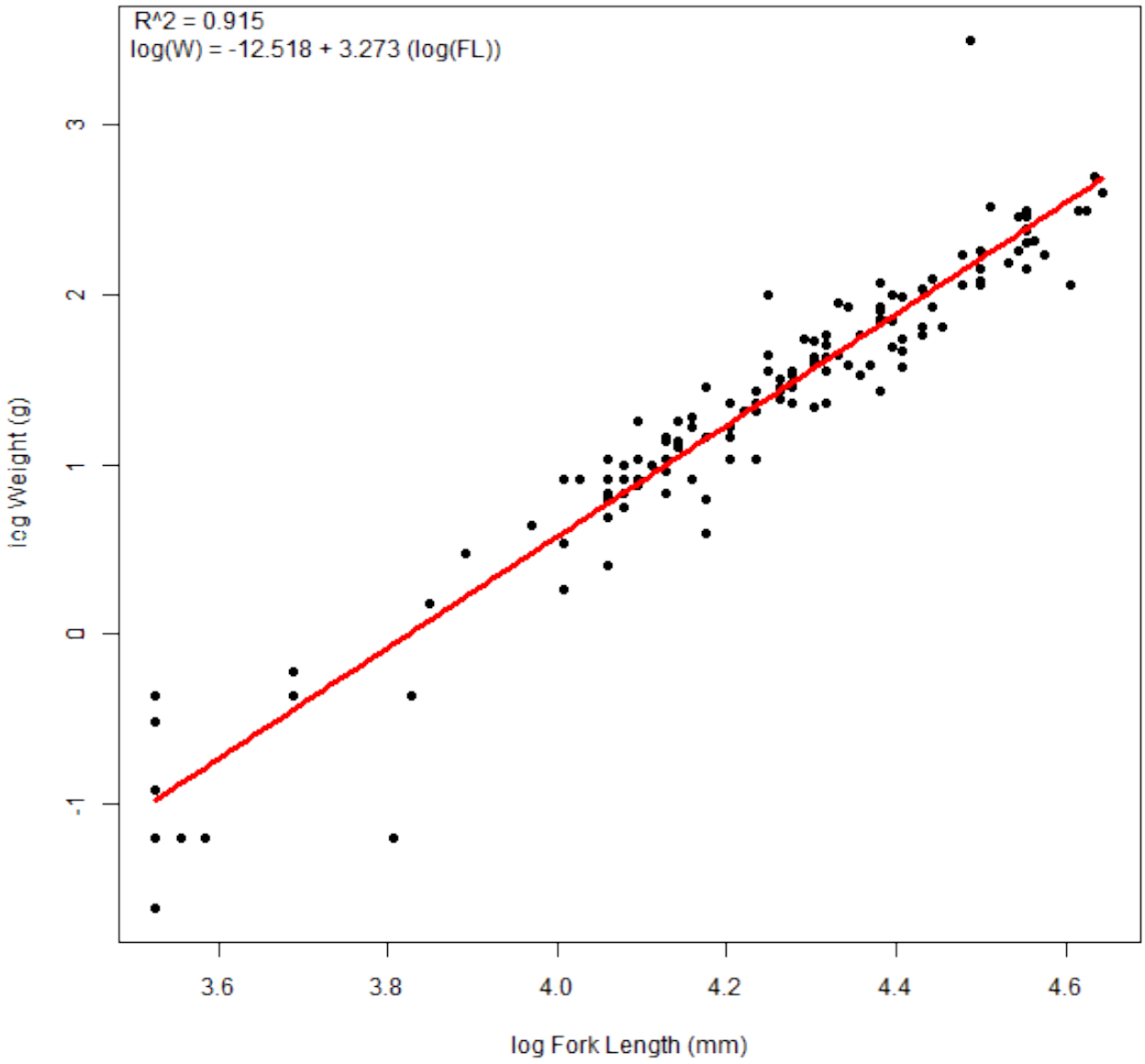


Figure 24. Length boxplot of Seton River age 0 Chinook from April -October 2015.

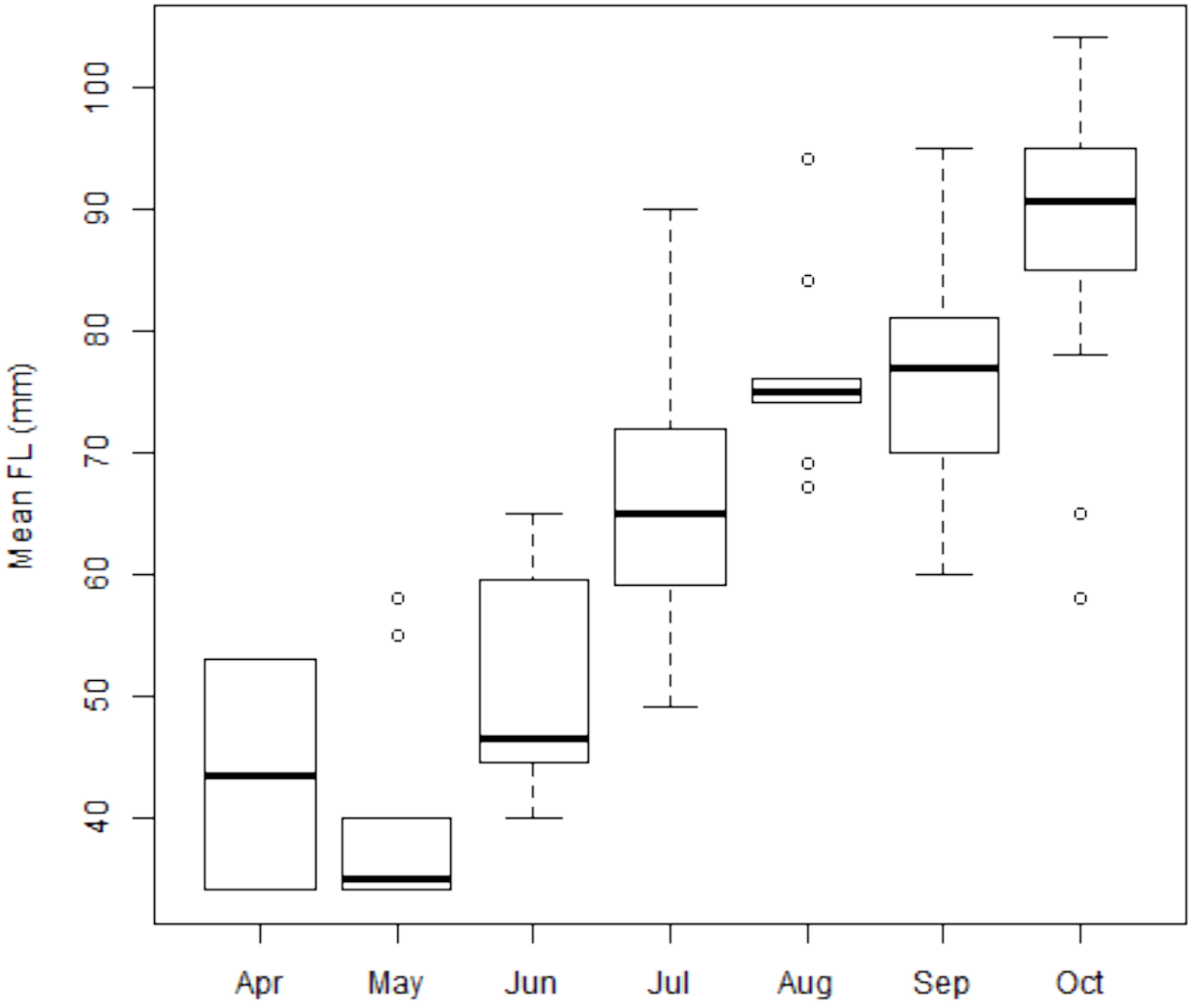
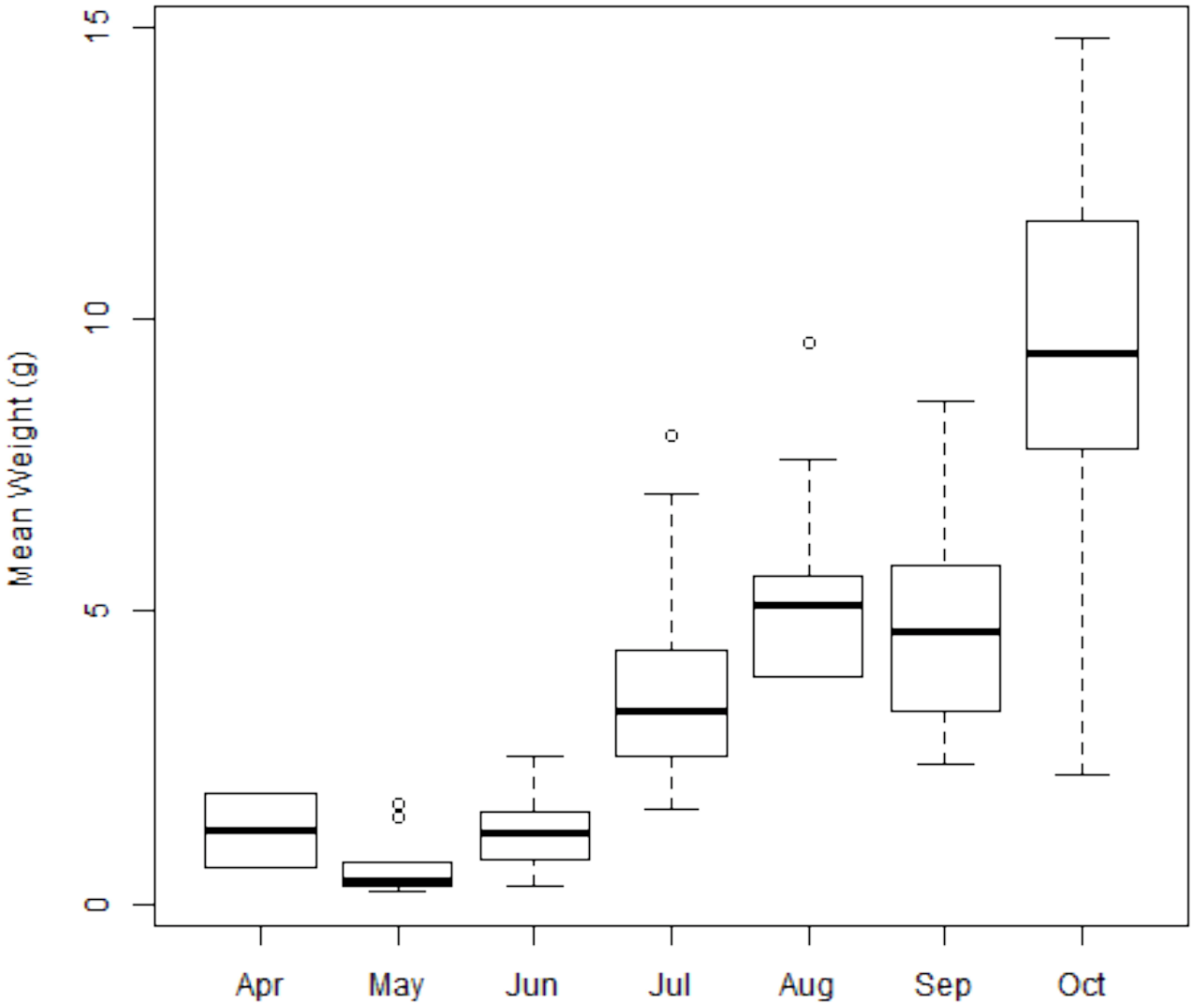


Figure 25. Weight boxplot of Seton River age 0 Chinook from April -October 2015.



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2016 Seton Corridor Stakeholder Meeting

15 March 2016

Splitrock Environmental
Sekw'el'was

Mission Statement

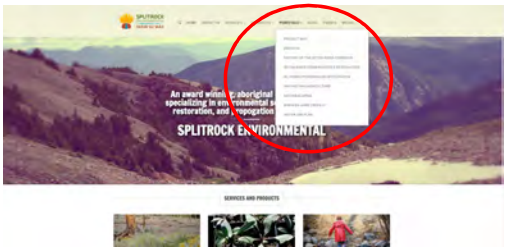
Working together to develop a unifying vision to support fish and wildlife values in the Seton River Corridor, while honouring cultural and operational values

Stakeholders Involved

- St'at'imc Government Services
- Lillooet Tribal Council
- Fisheries and Oceans Canada
- Ministry of Environment
- Ministry of Transportation
- SLRD
- District of Lillooet
- Pacific Salmon Foundation
- BC Hydro
- Innergex
- Interior Roads
- CN Rail
- Aspen Planers Ltd
- Lillooet Naturalist Society
- Lillooet Regional Invasive Species Society
- Local fisheries professionals
- St'at'imc community members and concerned citizens

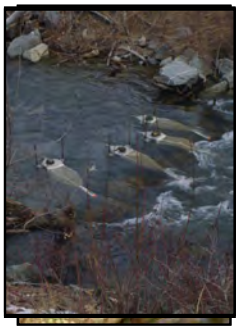
Rationale

Find resources on our website



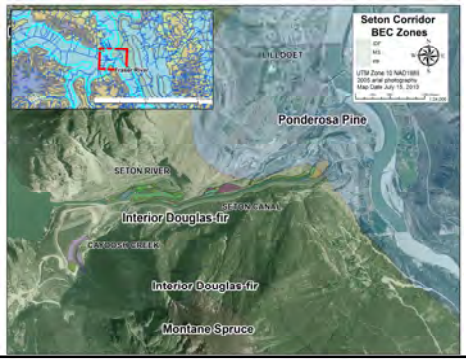
Highlights of Work Completed

- Over 7 outreach events per year with 800 community members involved
- Build community capacity and provided employment for approx. 12 community members per year
- Surveyed and mapped 329 ha of land within the Seton Corridor into habitat classifications
- Facilitated restoration projects at the Powerhouse, Upper Spawning Channel, Lower Spawning Channel, lower Seton Corridor, and along the Seton River
- Performed fish stock assessments, instream habitat surveys, and restoration
- Recorded and analysed wildlife observations in a database of over 40 species



Mapping

From landscape to stand scale



Grassland

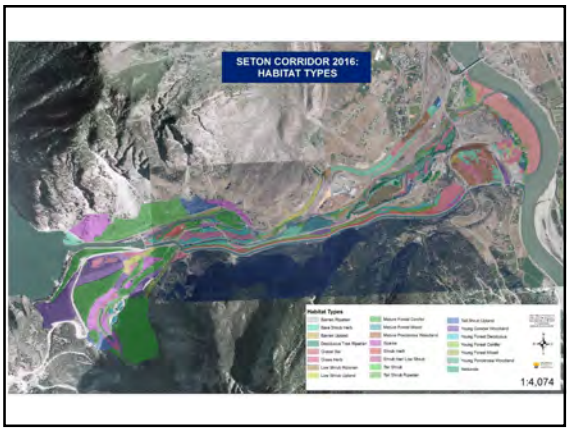
High quality habitat vs. impacted area

Forest

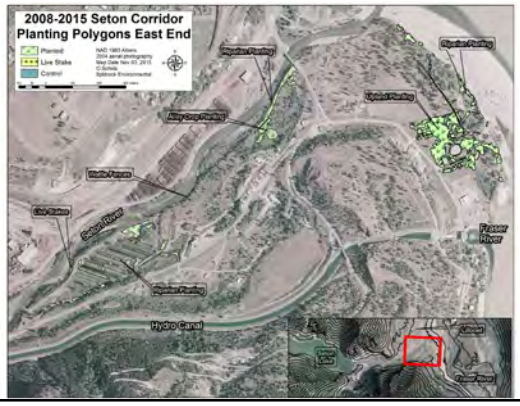
High quality habitat vs. impacted area

Riparian

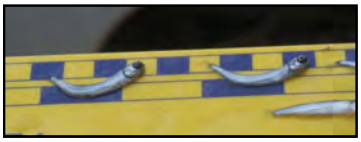
High quality habitat vs. impacted area

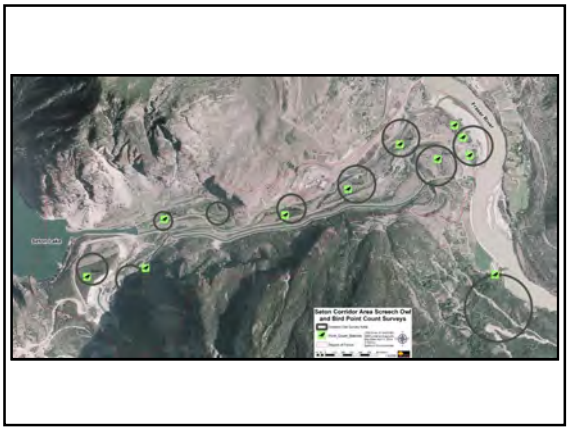


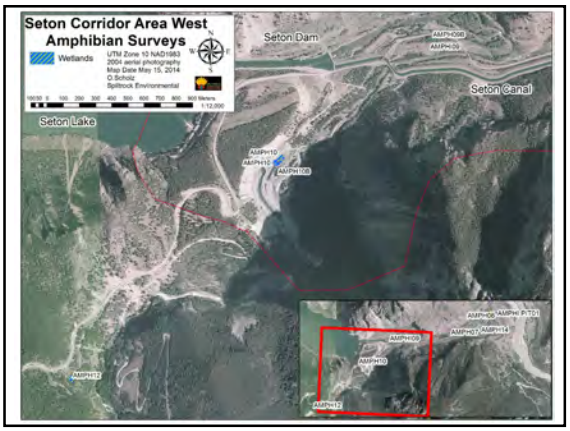
Restoration Works

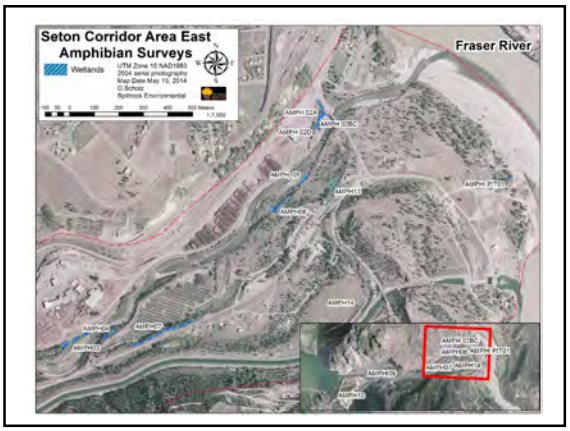


Fish Work







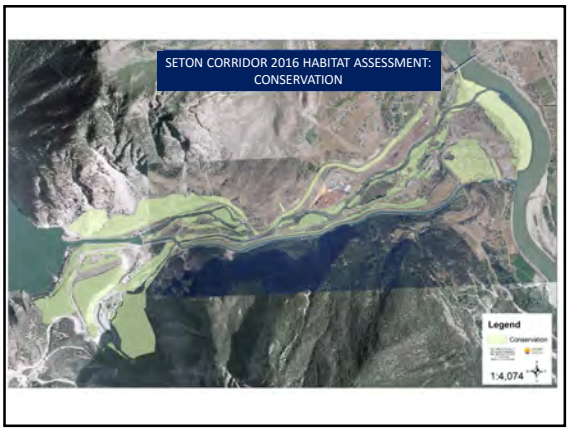


Based on the habitat assessments, the following categories were established

1. Conservation
2. Restoration
3. Sustainable Management

Together we will create a management plan

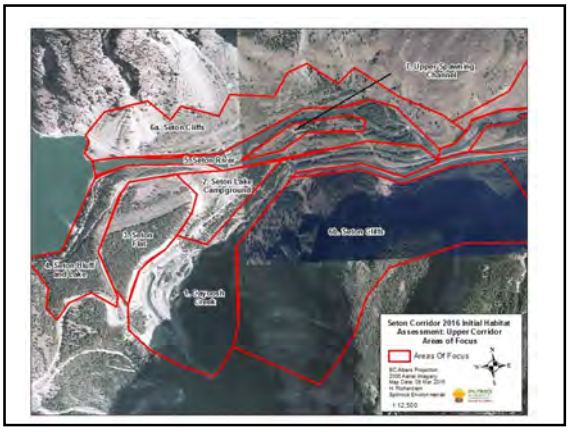
Habitat Assessment (Splitrock) → Community Considerations (Partners) → Other Considerations (Stakeholders)

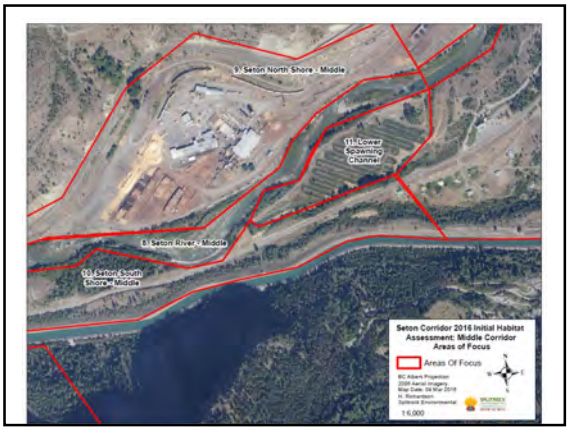


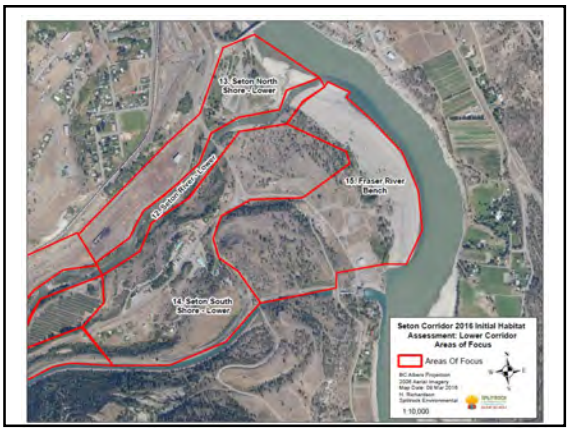
Digging a little deeper

Please refer to the maps on the following slides outlining the areas of focus and the revised handout where we have compiled everyone's comments.

- Upper corridor
- Middle corridor
- Lower corridor







Funding provided by:

FISH AND WILDLIFE COMPENSATION PROGRAM

PACIFIC SALMON FOUNDATION

ST'ÁT'IMC GOVERNMENT SERVICES

Environment Canada

Environnement Canada

APPENDIX 4

SETON RIVER CORRIDOR
CONSERVATION, RESTORATION AND SUSTAINABLE MANAGEMENT PLANNING PROCESS

Wildlife Photographs by Ian Routley (Great Basin Gopher Snake & Western Interior Screech-owl)

Working Document: Updated 30 April 2016
Prepared by: Splitrock Environmental on behalf of the Sekw'el'was and T'it'q'et communities

"Working together to develop a unifying vision to support fish and wildlife values in the Seton River Corridor, while honouring cultural and operational values" Stakeholder Meeting 2013

Sekw'el'was

ST'ÁT'IMC
TI'T'Q'ET · QWÍLWEN · SK'EMQÍN · SKWEXSÚT · ÁKUZCÁ7A · TXWÍN'EK · SPÉLTLEKW · P'EGP'IG'LHA

UPPER CORRIDOR

		MANAGEMENT PLANNING		
LOCATION and STAKEHOLDERS	**CURRENT CONDITIONS**	**HABITAT ASSESSMENT** *Based on habitat and wildlife surveys completed to-date (Splitrock)*	**COMMUNITY CONSIDERATIONS** *Based on local knowledge and ongoing planning by partner communities (Partners)*	**OTHER CONSIDERATIONS** *Other ideas, issues, and recommendations for each area. (Stakeholders)*
Area of Focus 1: Cayoosh Creek Area				
Cayoosh Creek DFO CCDC/Innergex BC Hydro MOT	WETLAND AMPH10; AMPH12 (Hwy99) Cayoose Spawning Channel Water flows greatly diminished due to IPP Water quality good Good Riparian cover along most of riverbank Crossed by canal bridge Crossed by one-lane Highway 99 bridge Recreation – campground users/fishing/trails *WILDLIFE:* *Coho, Pinks, Sockeye, Steelhead, Western Screech Owl, alligator lizard*	**RESTORATION** - Can water flows be increased into river? - Expand riparian areas. - Increase riffles in spawning channel, increase riparian cover & remove old wire - When new 2-lane bridge being installed take part in planning & environmental monitoring - Ensure trails to river are safe and do not lead to erosion on riverbank	**RESTORATION** - BRGMON-14 looking at dilution rates - Restoration work to increase riparian areas and in-stream habitat should go ahead - MOT to involve both Sekw'el'was/T'it'q'et in planning when new bridges go in - Use of story-board signage along river trail and look at trial infrastructure (upgrade trails and/or remove problems)	-siphons impact to fish migrating -BRGMON14 – maybe water flows can be increased to river and Cayoosh define what volume
North Shore *Independent Power Plant Site* CCDC/Innergex DFO BC Hydro	Excess gravels removed from holding ponds Transmission line crosses riparian area Invasive weed species throughout site Riparian area diminished *WILDLIFE:* *Deer trails observed, Bear*	**SUSTAINABLE MANAGEMENT** - Use of gravels for Seton River spawning - Move transmission line away from riparian? - A survey of the site was carried out for Fortis 2014 and has recommendations to remove invasive species and increase riparian cover.	**LAND USE PLANNING UNDERWAY** - Low ratio of gravels to fines; materials would have traditional gone into river. Annual seeding Cayoosh/Seton Rivers? - Need more research on gravel seeding. - There will be new capital infrastructure works at the IPP site. Work with Innergex in the planning phase, environmental monitoring and reclamation	Gravel Recruitment - see old report (Bonnie) -to retain gravel, we need armoring - large chains, logs, boulders, spawning platforms -this restoration is expensive – consider restoration of side channel instead - consider use of goats for invasive species management – acknowledge problem with wild and domesticated goats
South Shore *Picks Fall Area* CCDC/Innergex BC Hydro? Private Owner?	Cultural values Good quality forested habitat Invasive plant species at beginning of trail Recreational use high – hiking, dogs *WILDLIFE:* *Western screech-owl (nesting site)* *Falcon and Bats using cliff sides* *Mountain goats and Mountain sheep* *Flying squirrels* *Alligator lizards* *Cougar, bobcat, bear, mule deer*	**CONSERVATION** - One of the largest intact areas that provides habitat for red-listed species - Remove weeds at start of trail (LNS has started the process – need at least 5 years) - Discuss dog control and effect on wildlife. - Continue to monitor screech-owl and reptile use (citizen science project)	**LAND USE PLANNING UNDERWAY** - Access controlled by BC Hydro to north shore of Cayoose Creek - Walden North/site in economic planning stage with CCDC/Innergex - Private lands – mining rights? (2#code pre-1920; 4# code 1950+) - Recreational values high – T'it'q'et - Invasive weed management - Info booklet at trailhead; dog bags/bin - Continue wildlife monitoring	- High value Western screech-owl site. Work with T'it'q'et to see how some type of conservancy is possible – aboriginal land so cannot have a WHA, but may be able to put together an agreement.

Area of Focus 2: Seton Lake Campground				
Entrance BC Hydro Parks T'it'q'et BC Hydro Trans	Entrance off Highway 99 Impacted site Invasive species Transmission Line *WILDLIFE: As above use these areas also*	**RESTORATION** - Remove invasive species, - Microsite construction, soil additions - Revegetation, irrigation/maintenance - Don't plant tall trees under transmission line – use shrubs/grassland species	**LAND USE PLANNING UNDERWAY** - Entrance in planning stages for possible economic development (T'it'q'et CC).	- BC transmission Kamloops (Brett Merkley) – no new transmission line being planned except -60L21 – pit house relocation -60L20 – relocation to other side of Fraser to remove from Xaxlip lands
Campsite BC Hydro Parks Sekw'el'was	Good riparian cover along creek Good forest/shrub cover Invasive weed species Roads fragment site – snake mortality reported High Recreational use in season *WILDLIFE:* *Songbirds; Garter snakes; Racer; alligator lizards, Mule deer, black bear, cougar, ermine, western screech owl, woodpecker*	**SUSTAINABLE MANAGEMENT** - CONSERVE riparian areas - CONSERVE existing native trees/shrubs - Report reptile/wildlife mortality so planning can take place - Reptile signs to educate public (decrease road and human fear mortality) - Invasive weed control to stop spread - Bear safety – continue garbage management	**SUSTAINABLE MANAGEMENT** - Work with operators to CONSERVE existing native riparian and forest vegetation (training field trip/workshop with Splitrock/operators). - Keep as natural as possible as that is what people like about the area. - LRISS invasive weed signage moved to more prominent place - Welcome; Best Use; Storyboard signage; plan so does not impact natural feel of site.	- number of campers is increasing - educate - firewood is given out free so habitat in area is protected -cottonwood ecosystem - knapweed picked on rainy days to prevent seeds from spreading -open May long weekend to Thanksgiving -critical woodpecker site
Hillside BC Hydro Parks T'it'q'et	Steep Partially forested/dryland habitats Recreation trails lead up slope to Seton Flat	**CONSERVATION** - No development on slope - Ensure trail is not creating erosion	**LAND USE PLANNING UNDERWAY** - Currently under land use planning stage (T'it'q'et CC).	- little available land for development - some weed management will have to be started around the trail so they do not spread across the slope. - Gravelly area will have use by reptiles.
Area of Focus 3: Seton Flat/Bench				
Grassland areas T'it'q'et BC Hydro	Cultural Values Healthy grasslands in places – rare ecosystem in our area Invasive species encroaching BC Hydro landing station Possible business use *WILDLIFE: Reptiles, Spotted Bat*	**RESTORATION** - Protect remaining grassland sites - Invasive weed control - Confirm use of flats as landing sites for BC Hydro – Confirm T'it'q'et land use planning	**LAND USE PLANNING UNDERWAY** - Land returning to reserve lands T'it'q'et - Splitrock to provide briefing paper and field walk re: habitat assessment - BCHydro will continue use of landing site	- High value grasslands – the largest area in corridor where Needle & Thread grass thrives. - Need to manage dogs/walkers - Need to ensure gate is locked so vehicles do not access the site
Transmission Line BC Hydro	Transmission line runs through site Relatively intact native plant species under line, with some invasive species encroaching Road to access transmission lines Recreational trail on roadbed (hikers/dogs)	**SUSTAINABLE MANAGEMENT** - Limit cutting of shrubs under power lines - Manage invasive species - Add coarse woody debris to improve habitat. - Install signs and bags/bins to encourage users to clean up after dogs	**LAND USE PLANNING UNDERWAY** - Planning with BCHydro to limit cutting of shrubs and impacts to forbs to continue (Splitrock/Hydro) - Dog/Wildlife signage; bags/bins	- false acacia present - good site for native seed collection - surprisingly intact shrub, forb, grass layers - need to manage dogs/walkers

Forested Area T'it'q'et BC Hydro	Cultural Values Mature conifer forest Oldest and largest ponderosa pine and fir trees in the corridor - high value wildlife trees NEST SITE – screech-owl (red-listed) Screech-owl boxes installed Successional conifer forest Invasive species encroaching Recreational trail (hikers/dogs) *WILDLIFE:* *Western screech-owl (nesting site)* *Racers, Green tree frog* *Mule deer, black bear, cougar*	**CONSERVATION** - Protect cultural values - Develop a forest management plan - Create a WHA for the Western screech-owl - Protect wildlife trees and provide public education - Add coarse woody debris to improve habitat - Thinning, especially around ponderosa pine - Invasive species management - Continue to monitor screech-owl nest and boxes.	**LAND USE PLANNING UNDERWAY** - Land returning to reserve lands T'it'q'et - Splitrock to provide briefing paper and field walk re: habitat assessment - Tree removal is continuing - Chief Kevin Whitney & T'it'q'et CC to work with Hydro re: gate/road access - Continue to monitor screech-owl - Protect cultural values	- Nesting site of Western screech-owl so would be important to put under conservation - cannot be a WHA as it is on aboriginal land, but could develop covenant - high diversity of conifer dependent birds and pine seed harvesting site for Clarks nutcracker also - sign needed regarding tree removal and ecologically important area - diversion tunnel – status/ purpose, restoration?
Area of Focus 4: Seton Bluff and Seton Lake				
Bluff T'it'q'et BC Hydro – Parks	Cultural Values Forested area Parking area and lookout Possible business development area	**SUSTAINABLE MANAGEMENT** - Conserve forested sections - Manage garbage - Planning process for development to include ecological/green technologies	**LAND USE PLANNING UNDERWAY** - Conserve forested sections - Manage garbage - Planning process for development to include ecological/green technologies	- Signs needed regarding dog waste – how to enforce? – letters in newspaper? – dog bags?
Forested Hillside BC Hydro Parks	Cultural Values Fairly intact forested area with good understory Trail system winds down hillside	**CONSERVATION** - Trail system managed for erosion - Possible closure of trail to decrease fragmentation	**LAND USE PLANNING UNDERWAY** - Trail system managed for erosion - Possible closure of trail to decrease fragmentation	- Agree that hillside should be protected for both ascetics and wildlife. - Nice forested area with good understory makes it important site for birds.
Recreational Areas T'it'q'et BC Hydro Parks DOL	Recreational area used for swimming/boating Grassed area with logs along shoreline False acacia memorial trees Garbage bins and outhouses Cayoosh Creek hydro outlet Dock *WILDLIFE:* *Loons, Geese, Bears, Bats*	**SUSTAINABLE MANAGEMENT** - If false acacia memorial trees die replace with fir tree or other less invasive species. - Are logs providing suitable protection/recreation use? - Bear safety: continue garbage management - Appropriate geese impacts controls	**LAND USE PLANNING UNDERWAY** - T'it'q'et and BCHydro in discussions - DOL responsible for garbage and dock - WUP Erosion Study underway. T'it'q'et & Sekw'el'was to be involved in developing recommendations. - LRISS to train beach staff in invasive weed ID and management	- this is T'it'q'et reserve land - SLRD supports LRISS with invasive species management (policy and financial) and will continue to do so -extensive water bird use especially during migration
Residential/Cabins T'it'q'et Private Leasees BC Hydro	Invasive plant species Homeowner/tenant garbage Roads	**SUSTAINABLE MANAGEMENT** - Manage invasive species & increase native plants - Bear safety: garbage management - Report road kill so planning can take place	**LAND USE PLANNING UNDERWAY** - T'it'q'et own cabins and one strata lease - LRISS to train owners/renters/staff in invasive weed ID and management - Report wildlife kill to Splitrock (workshop)	- Japanese Knotweed is a problem here and LRISS is working with T'it'q'et to resolve it

SETON LAKE BC Hydro SER (WUP)	Bridge River inflows have changed Seton Lake Erosion issues along Seton Lake shore Boat Dock CN Rail close to water edge: impacts unknown Power boats *WILDLIFE* *Gates Creek salmon run endangered, Wanish diminished* *Sturgeon?*	**RESTORATION** - Current WUP Erosion Monitoring Project may result in recommendations to decrease erosion issues - Sturgeon Studies? - CN operations research or data - Signage at dock regarding invasive species on boats, noise and fluid management	**LAND USE PLANNING UNDERWAY** - Seton Lake not Seton Reservoir - WUP Erosion Study underway. T'it'q'et & Sekw'el'was to be involved in developing recommendations and implementing. - Sturgeon have been reported in lake (J.Diablo has video; canal outages 6-7ft dead sturgeon Fred). NEED RESEARCH - Gwenish culturally important; declined stocks NEED RESEARCH (UBC 2014) - CN blasting caps have been found in the Seton River (Jess) - CN boulders removed from tracks moved into lake edge?	- A 10 year Wanish study is underway - CN should be at the table. They have missed two meetings so far and need to be more engaged.
Area of Focus 5: Seton River				
Seton River (Gates Creek watershed) DFO BC Hydro SER/UBC	Good water quality Dam impacts passage of spawning fish Dam impacts recruitment of gravels into river Lack of spawning/rearing habitat Traditional fishing reduced/eliminated Cayoosh joins Seton River at narrowest point in the watershed *WILDLIFE* *Coho, pinks, steelhead, trout, harlequin ducks, dippers, and other waterbirds*	**SUSTAINABLE MANAGEMENT** - WUP exploring best options for spawner access over dam (UBC) - Gravel recruitment using fines from IPP or other source (over dam or directly into river) to increase spawning gravels. - Addition of LWD/boulders to increase fish habitat - Pocket planting in riprap along forebay and Seton Lake outflow.	**SUSTAINABLE MANAGEMENT** - BRGMON14 UBC - Study of "strays" – where from (Perry) - Gravel seeding into Seton from IPP gravels or other sources. RESEARCH - Will CWD/boulders installed in river increase fish habitat and capture seeded gravels? - Seton River was dredged to create forebay (movies are available on hydro construction (M.Michelle SGS) - Pocket planting in riprap along forebay and Seton Lake outflow.	- imperative to get CN on board with management planning - test strays – link to Seton Gates/ Seton MON13 - understand adult fish delay
Sacred Island	High cultural values Valuable conifer and riparian habitat A few invasive plant species *WILDLIFE* *Deer bedding (and possible fawning)*	**CONSERVATION** - Protect Island - Weed removal - burdock; knapweed	**CONSERVATION** This island has high cultural values; field trip to island did not reveal artifacts. - Deer bedding areas important to conserve - Removal of weeds so they do not spread. Currently they are just seen on island shores (burdock on north shore; knapweed on south shore John).	- good riparian cover good for Western screech-owl. The owl has not been observed here but the area provides critical habitat for foraging and possible nesting.

North Shore CN DFO BCHydro	Historic resort by lake Traditional fishing drying site? CN RAIL LINE Narrow Riparian band between CN line & river Riprap and eroding banks – little riparian veg DAM operations road access *WILDLIFE: Bighorn sheep, bears, coyotes*	**RESTORATION** - Restore flat bench beside lake where historic resort was located. Riparian & dryland restoration - Protect existing riparian areas along river - Increase riparian vegetation - cuttings - What are CN impacts, if any? What are solutions?	**RESTORATION** - BCHydro safety issues from infrastructure and falling rock (can only access across dam or along railway line) - If possible restore as no other uses possible. Access and safety issues. - CN blasting; wildlife crossing; spraying of weeds. WORK WITH CN to look at potential environmental concerns and solutions.	- again CN needs to be at table to discuss.
South Shore BC Hydro MOT	Riparian vegetation along river good Transmission lines cross large swath of land Highway 99 and two bridges Riprap to protect Highway 99 at confluence Canal impacts smolt outmigration Wildlife travel routes converge - bottleneck Vegetation along canal cut for safety reasons Access roads along both sides of canal Good forested hillsides above canal Gravel pit *WILDLIFE:* *KEY WILDLIFE CROSSING UNDER VIADUCT*	**SUSTAINABLE MANAGEMENT** - Conserve existing riparian areas - Increase riparian coverage where possible - Manage vegetation removal under Transmission Lines – planning with Hydro/Splitrock in place - Explore wildlife signage along highway - Plant trees/shrubs at highway pullout - weedy site - Pocket planting in riprap? - Hydro mitigating Gates Creek smolt passage impacts by closing powerhouse at night - EXPLORE wildlife bridge over canal and highway - Manage gravel pit to limit disturbance	**SUSTAINABLE MANAGEMENT** - Conserving and increasing riparian area throughout corridor good idea - Splitrock/Hydro to continue working to develop a plan for management under powerlines. Provide training to hydro crews in plant ID and what not to cut. - Splitrock currently using site for collection of cuttings for restoration projects in other regions of the corridor. - MOT re: pocket planting in riprap beside highway 99 - Canal Bridge has been seen as a liability issue in the past by hydro. - Key for gravel pit controlled by Sekw'el'was/Splitrock. Hydro/Sekw'el'was to be aware of use.	- fault line through this area- what cautionary actions are BC Hydro taking? – piezometer along canal - good riparian vegetation again good for screech-owl and other species. - Need to maintain a continuous riparian along the whole length of the Seton and Cayoosh Rivers.
Area of Focus 6: Seton Cliffs				
North cliffs Crown land	Talus slopes and south facing cliffs provide unique habitat. *WILDLIFE: Mountain goats, bighorn sheep, falcon, bats, reptiles, alligator lizard*	**CONSERVATION**	**CONSERVATION** - Unique habitat in corridor and used by variety of species.	- habitat for Canyon wren and rock wren – which are not listed birds but are rare in Lillooet - Too steep to search for reptile dens, but high probability that different species use these cliffs.
South cliffs Crown land	Rocky cliffs with more shaded aspect *WILDLIFE: Mountain goats, bats*	**CONSERVATION**	**CONSERVATION**	- SLRD/ DOL process will protect rural resources and current uses – this area is currently in category Zone 5 - obtain zoning maps from SLRD

Area of Focus 7: Upper Spawning Channel				
Naxwit Picnic Area BC Hydro - Parks Sekw'el'was	Recreation area, parking area Riparian vegetation good along river Forested area and maintained trees/shrubs *WILDLIFE: Snakes, Bear, Deer*	**SUSTAINABLE MANAGEMENT** - Conserve existing riparian vegetation and forest - Continue to manage public access and garbage - Build new bridge across top end of channels so forested land around Naxwit is not impacted	**SUSTAINABLE MANAGEMENT** - Conserve existing native vegetation and planted trees. - Monitor and remove invasive species; -LRISS to train operators on ID and removal techniques.	- nice park for visitors that also provides wildlife habitat - Naxwit means snake – mostly garter snakes in area, but racer has been observed at west end of area.
Upper Spawning Channels Spawning Channel Committee	Pools 29%; Run 45%; Riffle 23% (Optimum 33% of each type of habitat) Good riparian cover at bottom end of channels Invasive plant species and no riparian cover at top end of channels *WILDLIFE: Multiple species use the systems*	**RESTORATION and MAINTENANCE** - Increase riffle habitat by building Newberry weirs - Restoration at top end in progress – continue - Invasive species management - Begin outmigration and continue spawner surveys - Man-made system must be maintained/monitored	**RESTORATION and MAINTENANCE** - Tourists are fishing in channel – install No fishing signs - Canal outages (5, 6, 7 years) and alternative water source from Seton River - This is a man-made system and needs to be monitored yearly to ensure the channels are actually doing the job of increasing spawning/rearing habitats. More funds needed to complete this work.	- Coho in the Classroom program is having a hard time getting local coho eggs and is looking for help. That way the local eggs, can be released locally at the Walking with the Smolts event

MIDDLE CORRIDOR				
		MANAGEMENT PLANNING		
LOCATION and STAKEHOLDERS	**CURRENT CONDITIONS**	**HABITAT ASSESSMENT** *Based on habitat and wildlife surveys completed to-date*	**COMMUNITY CONSIDERATIONS** *Based on local knowledge and ongoing planning by partner communities*	**OTHER CONSIDERATIONS** *Other ideas, issues and recommendations (Stakeholders)*
Area of Focus 8: Seton River				
Seton River Aspen BC Hydro DFO	Narrowest section of corridor just past confluence Narrow fast sections of river Little spawning habitat Island in middle of river (by bottom end of lower spawning channel) *WILDLIFE: Salmon, Trout, Steelhead, Deer use island for fawning, riverine birds*	**RESTORATION** - Add LWD/Boulders to capture seeded gravels (if gravel recruitment project proceeds) - Monitor changes on river, riparian and riprap due to changing hydro flow regimes. - PROTECT island	**RESTORATION** - Old vehicles in river need to be removed - Link to MON-9 which has an instream habitat assessment component - Link to MON-14 re: fish passage - Link to Erosion Study (Erica Ellis, Fluvial Geomorphologist, Embark) - Follow up on recommendations from these studies. - Protect Island	- note: 200 year flood plain has record from 1864 - conditions for recreational use (kayaking)? Noted that fish are having a hard time in the river already so what impacts might be felt by recreational kayaking – limit for now - Level 1 habitat assessment of river (Caroline) -leaching problem from Aspen yard?
Side Channels BCHydro DFO	Good riparian cover 2 side channels on north side of river; water through Aspen feeds one of these. 2 side channels on south side of river *WILDLIFE: Deer, bear, birds, amphibians, reptiles, salmon fry*	**CONSERVATION** - Conserve and monitor side channels - Survey and monitor river inflow to test for potential off-channel spawning/rearing habitat - Possible opening up of side-channel to river in one location - Test water quality (Karen) and temperature - Obtain copies of last Aspen Environmental study to assist in developing ecological plan	**CONSERVATION** - Important to do a baseline survey of side channels and monitor changes at different water levels. This will provide the information needed to evaluate enhancement opportunities, if any. - Past report (Gene Tisdale) may provide protocol that could be repeated. - Compensatory program: SIDECHANNEL SURVEY - Aspen: Environmental reports	- note that Riparian Area Regulations are in effect here and the SLRD requires a development permit for any work undertaken within a 30 m buffer zone
Riparian/Riprap	Narrow riparian band along river in places 2 riprap sections on north side of river 3 riprap sections on south side of river	**RESTORATION** - Goal is to have canopy cover along the length of the river on both sides. Increase riparian cover in riprap areas using pocket planting, live stakes and willow fences - Ensure riprap will protect banks from erosion - Use Pit House erosion control project as a MODEL. – heavy riprap, bioengineering and instream habitat construction methodology.	**RESTORATION** - Need to have a comprehensive survey of the current riprap (location, condition, effect on river). - Need to be involved in planning/study of any new riprap proposed. - Link to Erosion Study (Erica Ellis) - Do not want the riprap to cover the whole river – need to have more bioengineering methods included.	- song birds depend on these areas - again focus on increasing riparian areas along the whole stretch of the rivers to decrease fragmentation and increase critical riparian habitat for a number of species.

Area of Focus 9: North Shore of Seton River				
Marriage Rock BCHydro	High cultural values Potential Reptile Denning sites Transmission lines CN rail line at bottom of cliff KEY WILDLIFE RIVER CROSSING AREA *WILDLIFE: Mountain Goats, deer, bear, Reptiles*	**CONSERVATION** - Protect the integrity of Marriage Rock - Invasive species management - Vegetation management to protect shrubs/forbs - Continue den searches to confirm hibernacula to ensure protection strategies work	**CONSERVATION** - Protect and manage Note: St'at'imc have always protected AND managed the land. Management consisted of fire, pruning, harvesting, seeding, etc.	- breeding areas for aerial insectivores which regulate insects
Aspen Planers - west end T'it'q'et Aspen Planers	WETLANDS AMPH03; Seepages along steep bank; small wetlands throughout Aspen site. Riparian and dryland habitat on bank above mill Aspen Planers sawmill yard; PCVs storage Water quality from mill to river (wood, oil, etc) Transmission line Riprap (noted above) **KEY WILDLIFE RIVER CROSSING AREA** *at top end: Observations of bear, deer, reptiles.*	**SUSTAINABLE MANAGEMENT** - Conservation of riparian between mill and railway line - wet seepage, small creek, standing water - Natural slopes will recruit back - wetter/drier areas - Determine underground movement of water - Obtain copies of last Aspen Environmental study and combine with Splitrock data to assist in developing ecological sustainable management plan in partnership with Aspen. - Manage vegetation under transmission line	**SUSTAINABLE MANAGEMENT** - Protect the existing riparian areas and wetlands at Aspen Planers - Have Karen (Sekw'el'was) take water sample from side channel wetland to ascertain if any toxins found. - Aspen should have an Environmental Management Plan – who is auditing the plan? Need copies of past audits. - INAC would require an Environmental Management Plan for the lease.	- Ken Wright suggests that bird surveys would be useful here
Area of Focus 10: South Shore of Seton River				
Halfway Point BCHydro	Cultural values (mushroom) The largest high value forested/riparian area in middle of corridor (1 of 3 larger areas in corridor Seton Flat, Halfway Point, Powerhouse) High value grassland habitat under and beside transmission lines Party site with garbage and vehicle impacts Invasive species encroaching **KEY WILDLIFE RIVER CROSSING AREA** (inferred from trails; cameras) *WILDLIFE: Deer bedding area, bears, coyote den, raccoon, Western screech-owl*	**CONSERVATION AND SUSTAINABLE MANAGEMENT** - Protect forest and riparian habitats - Protect grassland habitat - Protect wildlife crossing area - Garbage cleanup - Gate road access - Manage vegetation under transmission lines - Continue to monitor screech-owl & cameras	**CONSERVATION and SUSTAINABLE MANAGEMENT** - Protect and manage as noted - Old Bridge site/old dump?	- garbage and metal dumped (John) - lots of fish get stranded here when water levels go down (Bonnie) - this is the 2nd most important site for the Western screech-owl. Protection may be possible through WHA.

Highway 99 MOT Sekw'el'was	River close to Highway in 2 locations necessitating heavy riprap (noted above) Invasive weed species along highway Old fisheries building site is heavily infested with invasive plant species (Sekw'el'was) **KEY WILDLIFE CROSSING AREA** *WILDLIFE: Deer, bears*	**SUSTAINABLE MANAGEMENT** - Increase riparian cover through pocket planting in the heavy riprap (based on engineering design) - Invasive species management along Highway99 - Restoration or sustainable building at old fisheries building site	**LAND USE PLANNING UNDERWAY** - Goal is to increase riparian cover throughout corridor, including riprap - Decrease invasive weeds. Problem along roads and transmission lines. Not enough funds to remove. - Sekw'el'was old fisheries site under land use planning currently.	- recent request to MOT for wildlife signs MOT rep believes that the current 60km signage and straight view lines on highway should be sufficient to slow traffic; signs cost approx. $350 each and several signs have recently been vandalized, so costly. - Negotiate for signs (both wildlife and children playing signs) and double lines (no passing) when highway is repaved
Highway 99 to Hydro Canal MOT BCHydro	Transmission line running along bank of Highway 99 necessitates cutting of trees on a regular basis Invasive species along Highway 99 Narrow forested/grassland areas running above highway in fairly intact condition Sekw'el'was gravesite Sekw'el'was residential area at east end Canal continues through middle corridor and provides no wildlife access The two canal access roads continue along this section Canal vegetation management on canal slope removes trees/shrubs for safety reasons **KEY WILDLIFE CROSSING AREA** *WILDLIFE: Deer, bears*	**SUSTAINABLE MANAGEMENT** - CONSERVE forested area above highway - Restoration in places on flat above highway - Transmission Line vegetation management on Highway 99 hydro ROW. - Canal vegetation management on canal slope - Invasive species management throughout - Assist Sekw'el'was in native vegetation screen from highway if required. - As this area is a KEY WILDLIFE CROSSING AREA from Marriage Rock across to Halfway Point and up to the Canal, this may be the best place to look at a potential bridge over the canal and highway. Possible education showpiece, as well as benefit to wildlife (would need to be researched and planned in detail to ensure it meets wildlife needs and does not create a bottleneck, predator trap, etc. - Put up wildlife signs and reduce speed limit	**SUSTAINABLE MANAGEMENT** - Conserve and manage - Decrease invasive species – again no funds. - Native vegetation should be used to screen community from highway while also providing cover for travel by wildlife. - Community does not think a bridge going over the canal and highway is a good idea as it would be too large of a structure creating a visual eyesore, would cost too much and may lead to risks for wildlife re: predators. - A small bridge over the canal may be an option, but would have to ensure wildlife is not directed to highway. - Wildlife are learning to go around the canal. Just create more habitat. - Wildlife signs important on highway; MOT planning paving with shoulder for cycling/walking. Highway ROW would need to be widened. - MOT presented idea to community for discussion this past week. - Wildlife are killed most often on this stretch of highway. When new paving put in make the highway in that area non-passing (double lines).	- important to conserve the forested areas along the whole stretch of above the highway as this will help wildlife stay off the road. - bike path along one side of highway will allow better line-of-sight for drivers - discussion re: wildlife bridge. There are possibilities of making smaller crossings. Might be interesting to explore the ideas.

Area of Focus 11: Lower Spawning Channel				
Lower Spawning Channel Spawning Channel Committee Splitrock	WETLANDS AMPH 04, 07 Pools 33%; Run 59%; Riffles 8% Good water quality; Didymo in system Spawning Channels fed by canal that are dewatered every 5 to 6 years for safety reasons Re-complexed in 2003 with year round flow Riparian vegetation needed to mitigate temp fluctuations High wildlife use area Beaver active in system Nursery/Greenhouse Business Vehicle access needs to be restricted - gate *WILDLIFE:* *Beaver, salmon & other resident fish; deer, bear, bobcats, aerial insectivore, bats*	**RESTORATION** - This is an active restoration site - Increase riparian vegetation around channels - Increase aquatic vegetation in swamp area - Continue gravel cleaning monitoring to assess success and provide adaptive management strategies - Continue invasive species management - Continue Beaver control - Continue fish productivity monitoring - Continue to monitor screech-owl and bat boxes - This is a man-made system and will require annual maintenance and monitoring - Ensure Splitrock operations do not impact the spawning channels	**RESTORATION** - Man-made system. Will need to be maintained and monitored annually. - High wildlife values. - High recreational values (hiking, learning) - Splitrock using no chemicals in operations - Annual smolt outmigration and spawner renumeration should continue until BC Hydro's operational system is fixed (re: LaJoie dam; generating facilities). - Compensatory Studies due to impacts.	- some of the areas that were left uncomplexed for pinks should be complexed to increase riffle habitat for other species - consider DNA testing for species presence - investigate potential of research study related to beavers - complete gravel cleaning in the rest of the channel – is there a more efficient method than used in the past? - riparian vegetation will eventually decrease water temperature, but also provides critical habitat to screech-owl and other species.

LOWER CORRIDOR				
		MANAGEMENT PLANNING		
LOCATION and STAKEHOLDERS	**CURRENT CONDITIONS**	**HABITAT ASSESSMENT** *Based on habitat and wildlife surveys completed to-date.*	**COMMUNITY CONSIDERATIONS** *Based on local knowledge and ongoing planning by partner communities*	**OTHER CONSIDERATIONS** *Other ideas, issues and recommendations (Stakeholders)*
Area of Focus 12: Seton River				
Seton River DFO BC Hydro DOL	Cultural values Slower flow through this section of corridor Good water quality Lack of spawning habitat Enters Fraser River DOL water system (3 wells/intake)	**RESTORATION** - Add LWD/Boulders to capture seeded gravels (if gravel recruitment project proceeds) - Monitor water levels to ensure enough to allow salmon to move back and forward through mouth (re: DOL water intake)	**RESTORATION** - Water temperature throughout Seton River a problem. Need to increase riparian cover. - Intake only for emergency. 3 wells may require new Water Sustainability Act review - Should not affect the amount of water at the mouth as less water is taken than is released from the dam.	- again increase of riparian cover along entire stretch of rivers.
Side Channels DFO	2 side channels on south side of river - one forested area near old orchard area - one gravel bar below station bridge - flows into Fraser River and over gravel bars on both sides of the confluence	**CONSERVATION** - Conserve and monitor side channels - Survey and monitor river inflow to test for potential off-channel spawning/rearing habitat - Invasive weed management	**CONSERVATION** - same comments as middle corridor	- side-channels important for fish, but also other species. Set up monitoring program.
Riprap BCHydro Aspen	1 long narrow riprap bank on north bank below Aspen (some hard, some crumbling) 3 riprapped/eroding banks on south bank (just below spawning channel outlet, one above and one below Station Bridge)	**RESTORATION** - Increase riparian cover in riprap areas using pocket planting, live stakes and willow fences - Ensure methodology will protect banks and if not increase engineering efforts as required	**RESTORATION** - same comments as middle corridor	- requesting Environmental Management Plan and Audit from Aspen Planers
Area of Focus 13: North Shore				
Aspen Planers – east end Aspen Planers Cayause Flats T. Sekw'el'was	WETLANDS – Small, multiple, wet seepage Forested and dryland bank above mill Log sort/weigh station; buildings; office Assess road right up against river - dust Minimal riparian coverage along river Riprap in various state of repair After heavy rain water into side channel is a chocolate colour 2 side channels (noted above) Invasive plant species	**SUSTAINABLE MANAGEMENT** - Increase riparian area by moving access road back, decompacting/planting in old roadbed and existing riprap - Conserve forested area between yard and railway on steep slope - Restore dry slopes where streams seemed to run in the past to encourage flow - Invasive species management targeted areas	**SUSTAINABLE MANAGEMENT** - Need to ascertain how water is moving above, across and into wetlands and Seton River. Town Creek water also. - Slope where DOL water line runs needs reclamation. DOL most likely has an Environmental Plan and required to mitigate loss of habitat in other areas if not there.	- consider using salmon berry as an indicator for habitat quality/ fish abundance (as it was used traditionally as an indicator) -communicate with Lightfoot Gas regarding environmental plan

Station Bridge MOT Sekw'el'was	Station Bridge Replacement Wetland	**RESTORATION** - When station bridge is being replaced restore and enhance wetland area beside bridge approach. - Assist in planning and restoration after bridge is built to increase native plant species while decreasing invasive species	**RESTORATION** - Need to be part of proactive planning for bridge replacement. Sekw'el'was involved currently. - Bridge will create widening and changing of area. - Gate to Sekw'el'was lands will mostly likely not be needed.	- bridge to be replaced in 2017 - WETLAND is fed by Town Creek and backs up when Seton River is at high flows. - good riparian and shrub cover
Cayoosh Campground DOL Sekw'el'was	Cultural Values High value riparian vegetation (cottonwood; willow) along Seton and Fraser Rivers Recreational Campground Roads throughout Invasive plant species Access to Fraser River north along old road DOL Water Plant – Water License Good location for community events	**SUSTAINABLE MANAGEMENT** - CONSERVE riparian - don't cut down willows and cottonwood trees - Remove invasive Russian olive - Invasive weed management - Old soil piles and newly created bench vector for weeds - Block road access past/under bridge if possible to decrease impacts on riparian vegetation and garbage/partying sites - Improve public education via signage re: garbage and invasive species on boats	**SUSTAINABLE MANAEMENT** - Very important to conserve existing riparian and increase where possible - Is it possible to remove soil piles, replant with native species? - What is being used as a public boat launch at Bridge 23 Camels should be controlled - Sturgeon fishing – listed species – and tourism questionable for area	- meet with DOL works team to go over the issues. - Develop a management paper for operators and do some training on what is a weed and what is not.
Area of Focus 14: South Shore				
Forested Grassland Sekw'el'was Reserve Lands	Cultural Values WETLAND AMPH05, 06, 13 Rare ecosystem Ponderosa/fir/bluebunch Intact in sections, but impacted in others Invasive plant species in sections In flood plain – no permanent structures Transmission Line runs through Vehicle access needs to be restricted Impacted areas from Highway 99 to Fraser River (weed encroachment, transmission lines, horses) *WILDLIFE: Mule deer, bear, coyote, bobcat, reptiles, amphibians, ermine*	**CONSERVATION and RESTORATION** - PROTECT 3 identified s7istken (pithouse) sites - PROTECT the ponderosa pine, Interior Douglas-fir, bluebunch wheatgrass habitats: red-listed ecological community - PROTECT identified wetlands and enhance - Invasive species management - RESTORE areas of low habitat value (mostly grassland habitats) - MANAGE for recreational use and dog/wildlife interaction - Restrict vehicle access with gate to lower corridor - Continue bear safety and garbage management	**LAND USE PLANNING UNDERWAY** - Protect and manage as noted - Could take gate from Station Bridge area and use here - Sekw'el'was may build community gathering area, but no permanent structures. - Could be part of ethnobotanical tourism trail system.	- currently monitoring for screech-owls and reptiles to see if restoration works are having an impact. - gate the old orchard road to stop the motorbike going down.

Highway 99 MOT Lightfoot Gas Sekw'el'was Residential Areas	Highway 99 continues through middle of lower corridor Gas Station business with large customer base (sewerage system, gas spills) BC Rail ROE – housing trailers on site Apartment Buildings Old Shantyman Gas and Restaurant site Texas Creek and Powerhouse Road turn off highway	**SUSTAINABLE MANAGEMENT** - Invasive species management along Highway99 - Increase native plant coverage along highway - Monitor sewage system for enviro hazards - Build forested avenue between residential trailers and highway to provide shade and screening from highway - Bear Aware – garbage management - Restoration or sustainable renovation of old Shantyman building	**LAND USE PLANNING UNDERWAY** - Again weed management necessary. Explore contract with MOT. - Cutting machine used for vegetation management should be replaced by contracted labour from Sekw'el'was (similar to Xwisten). - Environmental Plan from Lightfoot - audits - BCRail ROE going back to band and new infrastructure will be built, with highway screening with native trees - Old Shantyman replaced or renovated; remediation work necessary?	- more money needed for invasive weed management. MOT not cutting sides of roads soon enough. Explore option of having community do the work instead (similar to Xwisten).
Highway 99 to Canal MOT BC Hydro	WETLAND AMPH14 Sekw'el'was and LTC Offices Sekw'el'was Residential lands Canal Flat Canal *WILDLIFE:* *Mule deer, bears, bats*	**SUSTAINABLE MANAGEMENT** - Increase native plant coverage through landscaping around offices - Canal Flat: discuss future of area – development or restoration - If restoration is chosen propose the use of agroforestry islands that will restore environmental and agricultural value by growing native crops for food, ethnobotanical products, and bulking seed bank.	**LAND USE PLANNING UNDERWAY** - Increase native plants where feasible - Canal Flat possible outdoor recreation area; ideas still be explored; could incorporate agroforestry islands	- there has been a strong decline of western meadowlarks in North America. They use this site and are an ecological indicator
Area of Focus 15: Fraser River Bench Lands				
Powerhouse Restoration Site MOE BC Hydro	WETLAND PIT01 High value habitat area Active restoration site Riparian area increasing with road closures Grassland area under active restoration Logs have shifted which has allowed ATVs to again impact riparian areas Invasive weeds throughout areas of site Signage needs to be installed still *WILDLIFE: Mule deer, bear, coyote, reptiles, small mammals, bats, Western screech-owl, Killdeer, Meadowlark, Osprey, Heron, Kingfisher*	**CONSERVATION and RESTORATION** - PROTECT existing riparian habitat and increase through live staking - Add large boulders to discourage ATV access - Thin sage and start seeding trials - Increase bunchgrass by planting plugs - increase forested and shrub habitat by planting larger stock - Invasive weed management ongoing - Decrease weed seeds along Powerhouse Road and property opposite Powerhouse site - Signage to be installed (Koochie sign with backdrop and signage structure) - Highly impacted site will need maintenance until grassland forested area outcompetes weeds	**CONSERVATION and RESTORATION** - Area has improved for both wildlife and the community through the restoration efforts. - Continue efforts. How will we manage funding as FWCP removes maintenance funds. - Weeds on hydro sites impacting on restoration site – Rhonda Kaiser re: noxious weed management. - Signage for Koochie (Abby Design)	- cultural values here also - 3rd main site for the Western screech-owl. Now a WHA as it was crown land in the riparian section. - manage vehicles; some have been observed going through areas where the logs have been unmoored - manage dogs?? - Great Basin gopher snake has been confirmed at this location in 2015. - As well large numbers of racers are breeding on the site. - High number of bats, including the Spotted bat.

Mariposa Flat BC Hydro Sekw'el'was	Cultural values High value habitat area Good grassland species throughout Largest area for Mariposa lilies Possible denning sites on rock faces above the flat areas Reference site for Powerhouse site Radio Tower Sekw'el'was water storage Hydro access roads and canal	**CONSERVATION and RESTORATION** - Survey this area and develop management prescriptions for restoration/conservation - Invasive species removal to decrease spread before impacts site too much. - Limit vehicle use across site - PROTECT potential reptile denning sites - DEVELOP road crossings (culverts and/or signage) for reptiles to travel from denning sites to nesting and foraging grounds at Powerhouse site. - Vegetation management along new hydro lines from Powerhouse site to Texas Creek Road needs to be contracted. This area is of high ecological values and the new lines will create a vector for invasive species.	**CONSERVATION and RESTORATION** - Protect cultural sites - Phill Doddridge (retired) had suggested culverts for snake movement. Look at possibility on Roshard Road – whose jurisdiction? - Radio tower could come down if not being used - Continue discussions around vegetation management under transmission lines, along hydro canal and highway/roads. - Continue to monitor wildlife camera where new hydro lines were installed to see if there has been a decrease in use of the area as a foraging and travel corridor.	- fire management - weedy areas along roads are a vector; can one of the roads be closed down.
Canal and Tailrace BC Hydro	Canal continues through lower corridor, goes under Texas Creek Road, underground, then into a pooled area before going through powerhouse and out to Fraser River tailrace Invasive weeds throughout Transmission lines Road construction **IMPORTANT WILDIFE CROSSING POINT** WILDLIFE: Mule deer, bear, coyote, reptiles Bighorn sheep, one Elk sighting	**SUSTAINABLE MANAGEMENT** - Ensure smolts mortality % through turbines meet standards? - Ongoing spawner delay at tailrace? - Invasive weed management - Develop wildlife movement corridor plan - Ensure communities are involved in planning of transmission lines and other hydro activities so mitigation strategies can be initiated before work begins.	**SUSTAINABLE MANAGEMENT** - BC Hydro is not meeting it's on guidelines for shut down powerhouse during smolt outmigration (only 50% of the time last year); however, no reprecussions. Why not? DFO? Communities? BRGMON-13 ongoing. - Spawner delay at tailrace BRGMON-14 ongoing. - Fuel reduction	- sharing info ARC ax

NOTE: Partners noted that it will be important to develop a Cumulative Impact Model as part of the Seton River Corridor Fish and Wildlife Management Plan and develop a referral processes that all stakeholders can easily use for all their projects in the corridor.

NOTE: SLRD regional growth strategy and DOL Initiative Plan available for download online or email Claire at SLRD


7. Upper Spawning Channel
6a. Seton Cliffs
5. Seton River
2. Seton Lake Campground
6b. Seton Cliffs
3. Seton Flat
4. Seton Bluff and Lake
1. Cayoosh Creek
Seton Corridor 2016 Initial Habitat Assessment: Upper Corridor Areas of Focus
Areas Of Focus
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BC Albers Projection
2006 Aerial Imagery
Map Date: 09 Mar 2016
H. Richardson
Splitrock Environmental
SPLITROCK
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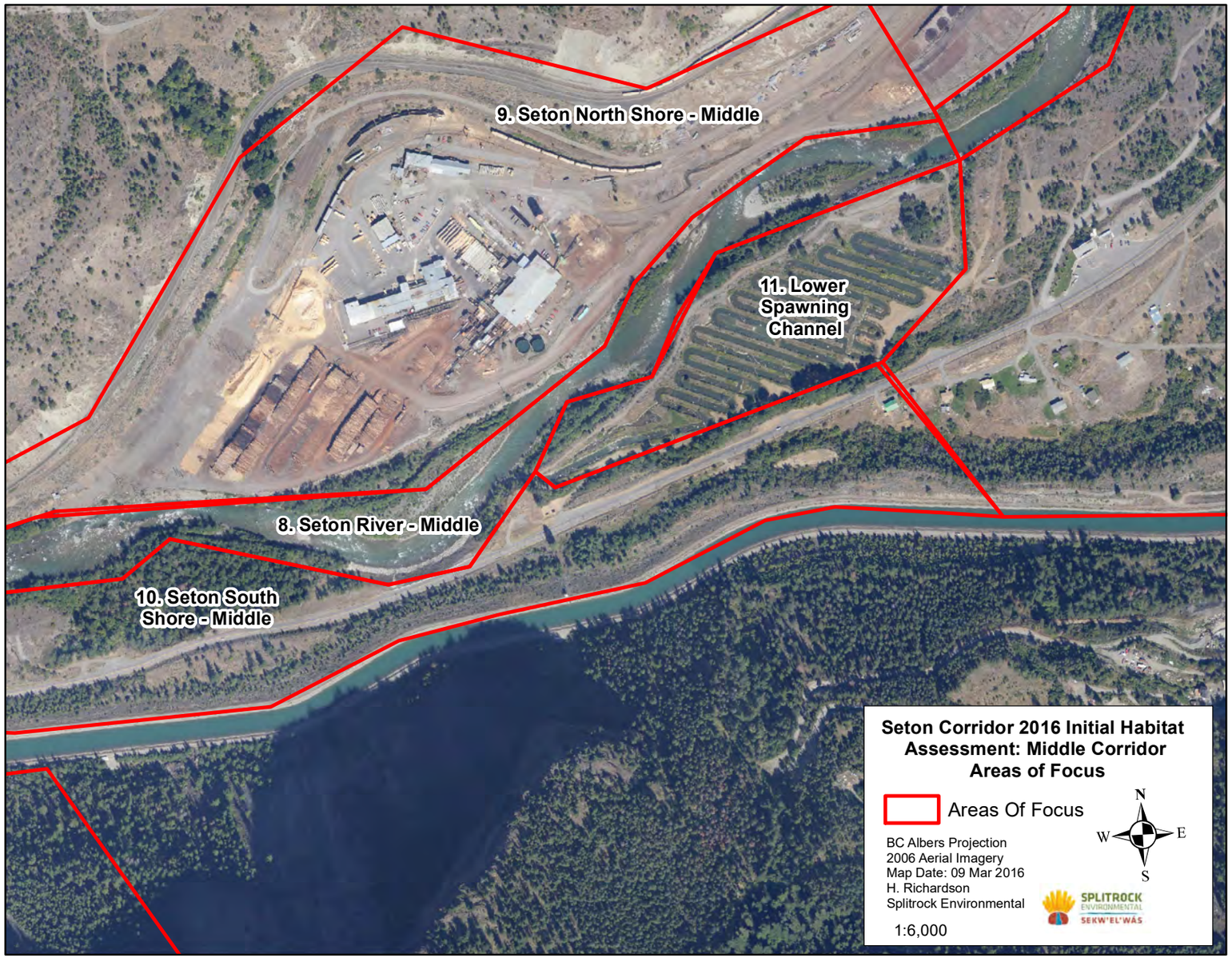
9. Seton North Shore - Middle
11. Lower Spawning Channel
8. Seton River - Middle
10. Seton South Shore - Middle
Seton Corridor 2016 Initial Habitat Assessment: Middle Corridor Areas of Focus
Areas Of Focus
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BC Albers Projection
2006 Aerial Imagery
Map Date: 09 Mar 2016
H. Richardson
Splitrock Environmental
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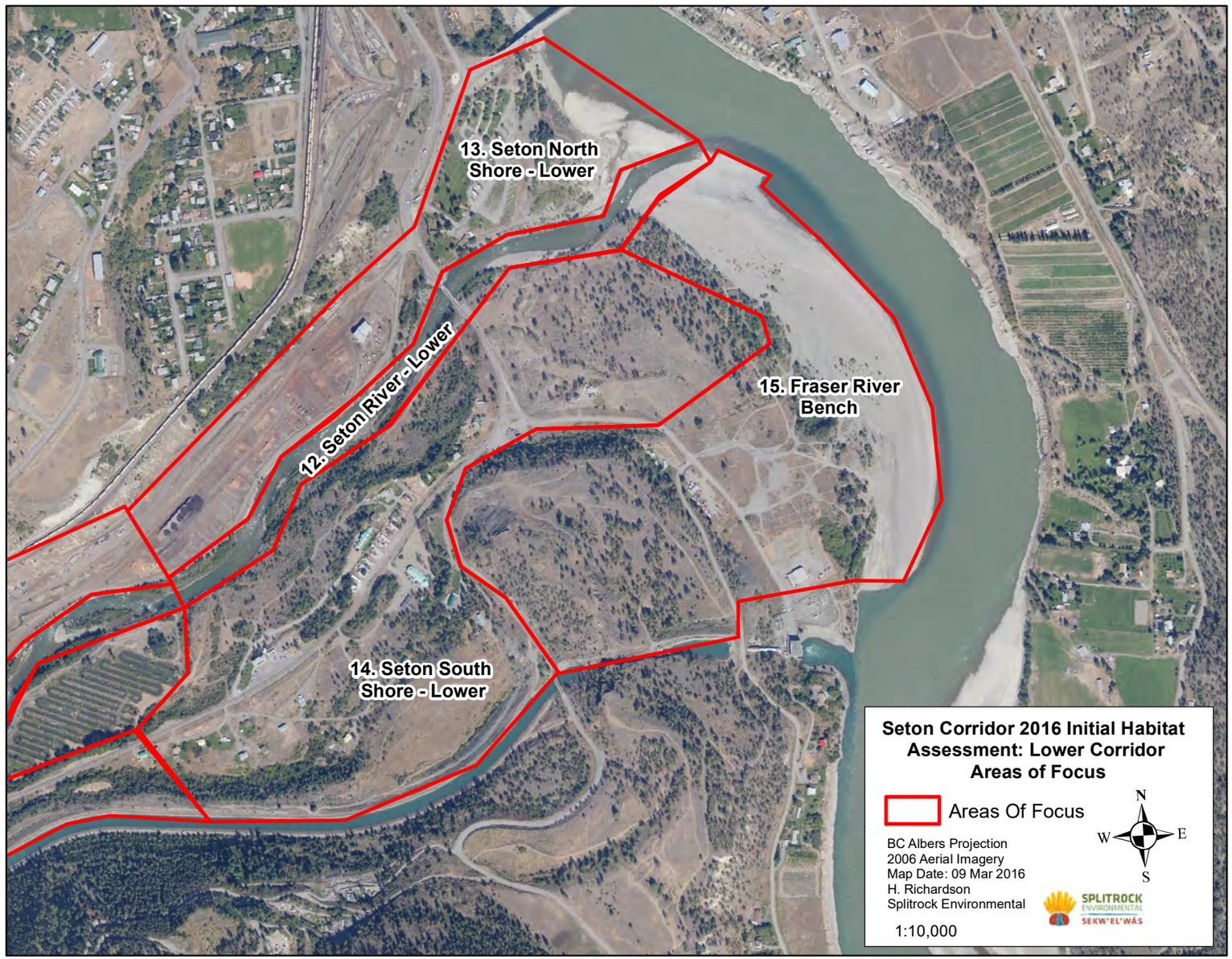
13. Seton North Shore - Lower
12. Seton River - Lower
15. Fraser River Bench
14. Seton South Shore - Lower
Seton Corridor 2016 Initial Habitat Assessment: Lower Corridor Areas of Focus
Areas Of Focus
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BC Albers Projection
2006 Aerial Imagery
Map Date: 09 Mar 2016
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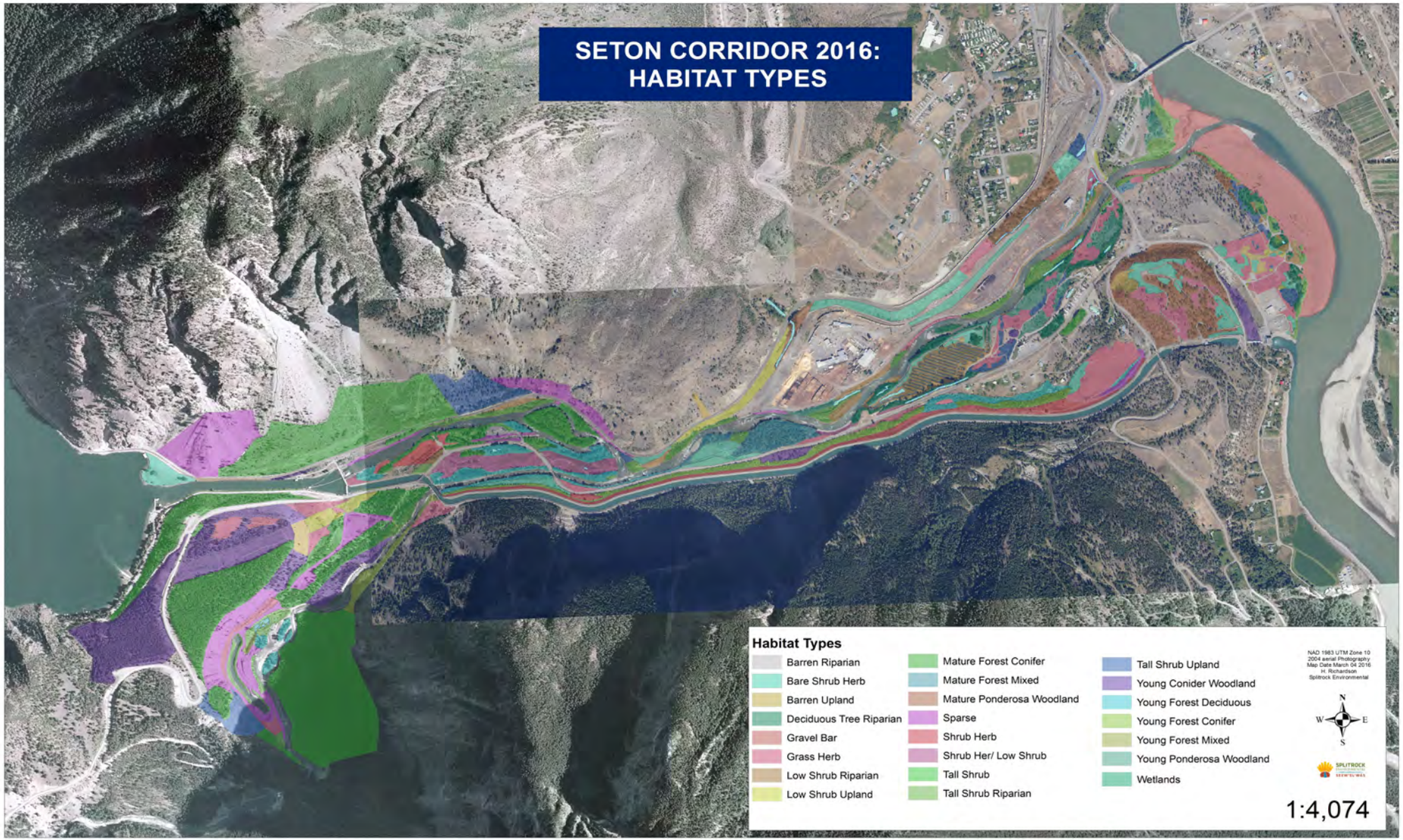
SETON CORRIDOR 2016:
HABITAT TYPES
Habitat Types
Barren Riparian
Bare Shrub Herb
Barren Upland
Deciduous Tree Riparian
Gravel Bar
Grass Herb
Low Shrub Riparian
Low Shrub Upland
Mature Forest Conifer
Mature Forest Mixed
Mature Ponderosa Woodland
Sparse
Shrub Herb
Shrub Her/ Low Shrub
Tall Shrub
Tall Shrub Riparian
Tall Shrub Upland
Young Conider Woodland
Young Forest Deciduous
Young Forest Conifer
Young Forest Mixed
Young Ponderosa Woodland
Wetlands
NAD 1983 UTM Zone 10
2004 aerial Photography
Map Date March 04 2016
H. Richardson
Splitrock Environmental
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Funding for habitat, wildlife and management planning work provided by:

Environment Canada Environnement Canada

FISH AND WILDLIFE COMPENSATION PROGRAM

ST'ÁT'IMC GOVERNMENT SERVICES

PACIFIC SALMON FOUNDATION

Note: See 2016 stakeholder meeting ppt for more details and maps of the project. Also final reporting documents online at www.splitrockenvironmental.ca (Portfolio)

Facilitated by:

SPLITROCK ENVIRONMENTAL
SEKW'EL'WÁS

Sekw'el'was and T'it'q'et communities thank all the NGOs, government and industry representatives for providing input into the Seton River Corridor Management Plan over the past several years:

St'at'imc Government Services
Lillooet Tribal Council
Fisheries and Oceans Canada
Ministry of Environment
Ministry of Transportation
Squamish Lillooet Regional District
District of Lillooet
Lillooet Naturalist Society
Lillooet Regional Invasive Species Society
Local Fisheries professionals
BC Hydro (Operations, Transmission, Parks)
Fortis BC
Interior Roads
CN Rail
Aspen Planers Ltd
St'at'imc community members and concerned Lillooet citizens

APPENDIX 5

Confirmation of FWCP Recognition

- Salmon in the Canyon Newspaper Article – FWCP was recognized during speeches, on signage at the event and at the restoration table.
- Fall Stewardship Days – Teacher Schedule
- Stakeholder Meeting Powerpoint Presentation – last 4 slides
- Seton River Corridor Conservation, Restoration and Sustainable Management Planning Process documents – last page

Salmon in the Canyon brings out the community

Advocates, volunteers, families and individuals joined together at Cayoosh Campgrounds in the late afternoon on Sunday, September 13 to celebrate wild salmon cycles as part of Rivershed Society of B.C.'s province-wide FraserFEST. One of a series of family-friendly events hosted in communities along the banks of the Fraser River, Salmon in the Canyon festival was co-ordinated by Split Rock Environmental and launched at the Cayoosh Creek Campgrounds.

Informational booths, activities and live music kicked off a day of honouring connections to wild salmon cycles and the importance of habitat preservation. The crowd was directed later in the day to travel a short distance and enjoy the highlight — a free salmon BBQ feast hosted by the Sekw'el'was (Cayoose Creek) community of the St'at'imc Nation..

Left: Drummers perform the Welcome Song to open the day of festivities.
Above: A stone tool with a cutting edge used for scraping and filleting fish was made available for inspection as part of a filleting demonstration.
Top Right: Sekw'el'was Chief Michelle Edwards praised youth for their work preserving fish habitat for future generations.
Bottom Right: Mayor Marg Lampman welcomes attendees.

Split Rock Environmental employee John Redan manning the business's ecological stewardship booth.

Cooler autumn weather didn't deter support for Lillooet's Salmon in the Canyon celebration.

Brynn and Sabrina Wenstob enjoy an environmental activity area.

Paul Frank, Lakeisha Jacob and Roger Lucas inspect a watershed map of the area.

Hunter Grossler tries his hand at a salmon tossing game.

Bannock was plentiful at the community dinner.

Volunteers Ellise Anderson, Marissa Pelland and Calista Ledoux prepare to serve the hungry crowd.

The casual, fun and delicious community dinner drew a full house. Attendees socialized and queued for an abundance of salmon, savoury dishes and salads.

FALL STEWARDSHIP DAYS – 2015
Focus: Habitat, Wildlife and Migration

Cayoosh Elementary & Homeschoolers
Dates: Friday 02 October 2015 Times: 9:30 am – 12:30pm

TIME	THINNING	SAGE	HABITAT	MIGRATION
9:30 am 15 min	INTRODUCTION		PHOTO JOURNALING	
9:45 to 10:00 15 min 5 min transition				
10:05 to 10:20 15 min 5 min transition				
10:25 to 10:40 15 min 5 min transition				
10:45 to 11:00 15 min 5 min transition				
11:20	WALK to Restoration Area and have RECESS			
11:30 – 12:30	Stewardship Acitivity: PLANTING GRASSLAND			
12:30 – 1:00	LUNCH and BUS PICKUP			

Government of Canada Gouvernement du Canada

Aboriginal Fund for Species at Risk

PACIFIC SALMON FOUNDATION

FISH AND WILDLIFE COMPENSATION PROGRAM

Funding provided by:

FISH AND WILDLIFE COMPENSATION PROGRAM

PACIFIC SALMON FOUNDATION

ST'ÁT'IMC GOVERNMENT SERVICES

Environment Canada | Environnement Canada

Funding for habitat, wildlife and management planning work provided by:

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FISH AND WILDLIFE COMPENSATION PROGRAM

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