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## Executive Summary

The Slocan Wetlands Assessment and Monitoring Project (SWAMP) is a collaborative association of societies, quasi-government and government agencies, and individuals who support the integrated development of watershed level research. It was initiated by three societies following a workshop and bioblitz organized by the BC Wildlife Federation. It is governed by a Steering Committee of all members of the collaborating parties.

SWAMP undertook the assessment and mapping process the summer following its formation. Over the period from 2014 to 2018 SWAMP produced three wetland assessment and mapping reports as well as a report on Species at Risk. In 2018 detailed mapping of wetlands in the Bonanza Creek watershed was performed.

Prior to SWAMP's initiation, the Slocan River Streamkeepers Society (SRS) had commissioned two studies, an Aquatic Habitat Index (AHI) of the Slocan River and a Sensitive Environment Index (SEI) of the offsetting riparian areas. The Columbia Basin Watershed Network (CBWN) in cooperation with Selkirk College sponsors a summer mapping program with the result that the SEI and AHI have been merged into one map for SWAMP.

The Slocan Lake Research Center (Richard Johnson) (SLRC) also works with the Selkirk College Geomatics department by providing a list of projects that students might want to undertake as a term project. This resulted in aquifer mapping in the upper Slocan River Valley in 2015. This project, aquifer mapping, will be expanded and will continue. In 2017 a Selkirk student undertook an evaluation of remote sensing methods to identify potential wetlands in a watershed. Both of these projects were inspired by SWAMP.

SWAMP also spawned a series of projects that continue under a life of their own. Developing protocols to use Benthic Invertebrates to measure wetland health is an ongoing research project by Integrated Ecological Research (Darcie Quamme) under the SWAMP collaborative. Two wetland restoration projects are underway under the direction of the Slocan River Streamkeepers Society. In 2018 a group, deriving its nucleus from SWAMP members, initiated the Bonanza Biodiversity Corridor committee to study and protect that area at the northern end of the Slocan Watershed. The SWAMP 2018 Mapping supports that work.

Two Acoustic Recording Units (ARU's) have been acquired and are managed by SLRC. They record bird and frog vocalizations and have been deployed at various wetlands to document the "singers" each spring. This baseline data gathering will continue, especially in the wetland restorations mentioned above.

All reports referenced herein are available for download at the SWAMP website:  
<https://slocanswamp.org/>

## Recommendations

In the upcoming years SWAMP will probably be focused on projects other than simple assessments and mapping to add to the basic wetland layers that have already been mapped. Depending upon the capacity and initiatives of member groups, work will continue on projects that continue to build upon the baseline mapping that has been completed. As such, the project will continue as a living changing landscape as more layers and data are added over time.

### Recommendations:

1. The SWAMP website should continue. It can be managed by various parties with the Slocan Solutions Society having primary responsibility.
2. SWAMP data and assessment tools should continue as public documents. The reports and data should be made available on other repositories.
3. The SWAMP data and reports should be freely shared to support land use decisions that provide protection, enhancement, and acquisition of Slocan watershed wetlands.
4. Small and ephemeral wetlands should continue to be located and mapped. These can be refugia during climate change. Most of the wetlands, small to large, are hydrologically connected in the steeply sloped upper valley watersheds and along the winding Slocan River.
5. Ongoing assessments and stewardship of mapped wetlands should be done at regular intervals, for example every five years.
6. Benthic invertebrate studies should continue in order to get reliable baseline data, especially in the mountain, disturbed, challenged and newly created wetlands.

## Acknowledgements

The SWAMP project received funding from numerous sources which are identified in the acknowledgements and list of funders below. It also was supported by innumerable number of hours of planning, organization and implementation by volunteers, not just from the originating organizations but community members. The current environment of funding has shifted away from inventory mapping. As a consequence the original purpose of SWAMP, which was specifically assessment and mapping, has had difficulty in continuing beyond what has been accomplished so far and the executive has decided that this phase of the project will have to be considered completed. This report is a description of the results to date with respect to the actual mapping and assessment portion and the ongoing work, described in this report, will continue, each with its own life.

Numerous people have contributed volunteer time and resources to various workshops, bioblitzes, and public functions. Many belong to the founding societies and their work in supporting and conducting these studies have made SWAMP successful and are gratefully acknowledged here.

### Founding Societies:

Slocan Lake Stewardship Society; Slocan River Streamkeepers Society; and Slocan Solutions Society.

Our Steering Committee members often give of their own time even though they might be working for other organizations.

### Steering Committee:

Al Peatt, Amy Waterhouse, Ann Meidinger, Audrey Ehman, Claire Payton, Darcie Quamme, Doris Hausleitner, Emily Nilsen, Gregoire Lamoureux, Irene Manley, Jennifer Vogel, Jennifer Yeow, Kahylish Fraser, Marcy Mahr, Margaret Hartley, Martin Carver, Meeri Durand, Michael Zimmer, Neil W. Fletcher, Rhia Mackenzie, Richard Johnson, Rick Allen, Rick Desautel, Ryan Durand, Tammy Strauss, Tara Lynne Clapp, Terry Anderson, Tyson Ehlers, Verena Shaw. (Apologies to anyone that has been missed.)

The author would especially like to thank Margaret Hartley, Gregoire Lamoureux, Marcy Mahr and Darcie Quamme for their input in writing various sections of this report.

Richard H. Johnson, October 2018



Funding has been provided by:

BC Wildlife Federation; Columbia Basin Trust; Fish and Wildlife Compensation Program; Regional District of Central Kootenay; Royal BC Museum; Environment Canada – Wetland Conservation Trust Fund; Selkirk College; Loblaw Water Fund (World Wildlife Federation) through the Columbia Basin Watershed Network.



This project was undertaken with the financial support of the Government of Canada.  
Ce projet a été réalisé avec l'appui financier du gouvernement du Canada.



## 1.0 Introduction

### 1.1 SWAMP History

This report summarizes the work to date (October 2018) of the SWAMP project. A bibliography of reports produced during the last six years is included at the end of this report and is referenced herein.

The original project, Slocan Wetlands Assessment and Monitoring Project (SWAMP), was formed in 2013. It was formed as a collaboration rather than a society so that it could include government and quasi-government agencies. Parties joined the collaboration by agreeing to the “Terms of Reference”.

The following is an excerpt from the Terms of Reference:

**“Purpose:** *We are a coalition of individuals and organizations who love the Slocan Watershed; who acknowledge the importance of wetlands to the ecological and human health of this watershed; who are willing to learn and use recognized scientific methods for data collection; and who intend to share this knowledge with our communities to encourage stewardship of this critical habitat.*

**Vision:** *To see healthy, intact, thriving wetlands and riparian areas providing habitat to diverse species and supporting natural processes throughout the Slocan Watershed.*

**Mission:** *To map, assess, and monitor existing wetlands in the Slocan Watershed; to prioritize resources for this work; and to share our findings in order to inform the protection and restoration activities of associated groups and governments.”*

SWAMP planned to initially identify and map the wetlands in the Slocan River drainage. We recognized that the project was very large and that we would not be able to identify and visit every wetland so we made the decision to identify and detail a selection of wetlands that spanned the region, selecting them based upon wetland type (bog, fen, marsh, swamp and open water), elevation, private/public lands, and degree of damage. It was felt that, if a sufficient number of wetlands could be detailed, the classification of the remainder could be interpreted from their setting. We also expected, and continue to expect, that biolayers, such as amphibians, mammals, insects, and birds, will be added to these maps.

The initial mapping work was done in three phases over three years. Funding for mapping and assessment has become more difficult to secure so we have had to adjust our plans and work with the mapping that we did in those three years, adding data layers as we can from other studies. We have reached the stage now where we will be focusing on specific projects within the larger framework such as benthic invertebrate studies, wetland restoration and creation projects, biodiversity corridor studies, and bird and bat studies.

### ***1.2 Work to date***

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We set out to do basic mapping, including the identification, areal extent, vegetation, hydrological setting, wetland type, and numerous other criteria. Other spin-off projects developed from that and are described in this report in the sections “3.0 Ongoing Work” and “4.0 Parallel Projects”

The methodology used for wetland mapping was to identify wetlands from local knowledge, satellite images and air photos. Selected wetland complexes were outlined on these images and manual classification was performed to show the different types of vegetation/water from the images. Google Earth was used extensively. Another method that was used was to select “flat areas” from a digital elevation models (DEM). This technique was further described and refined by Wendy Castellanos, a student from Selkirk College, for a class project. A description of this technique is described later in this report.

This work was followed up by extensive, detailed field work by wetland specialists, resulting in the reports detailed herein and the 2018 map of the Bonanza corridor.

### ***1.3 Training workshops and community engagement***

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During the initial planning and creation of SWAMP the founders determined that training of wetland assessment technicians would be an objective, both to provide volunteer assistance in the project and as community education. Several of these were held in 2014 and the community response was more than satisfying.

One of the founding societies, the Slocan Lake Stewardship Society, holds several field days each summer for members of the community and summer visitors and has a display booth at the New Denver Friday Farmer’s Market. The Slocan River Streamkeepers actively visit schools, puts on wetland restoration participation events, holds River Paddle Day and continues to build community participation and education. SWAMP has booths at public events like the Hills Garlic Festival, Winlaw Rivers Day and Toadfest.

## ***2.0 Assessments and Mapping***

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The Slocan Wetlands Assessment and Monitoring Project was planned as having a finite life span. We have reached the stage in that span where the executive feels that formal mapping of wetlands is in hiatus. Work will continue as we find individual assessments and mapping projects but we do not foresee further effort right now for major baseline mapping projects.

This report documents the work we have done to date and references ongoing projects that SWAMP has spawned. These latter projects fulfil one of the objectives of adding layer upon layer to the original assessment and mapping.



## 2.2 SWAMP Phase 1 Report (Durand 2014)

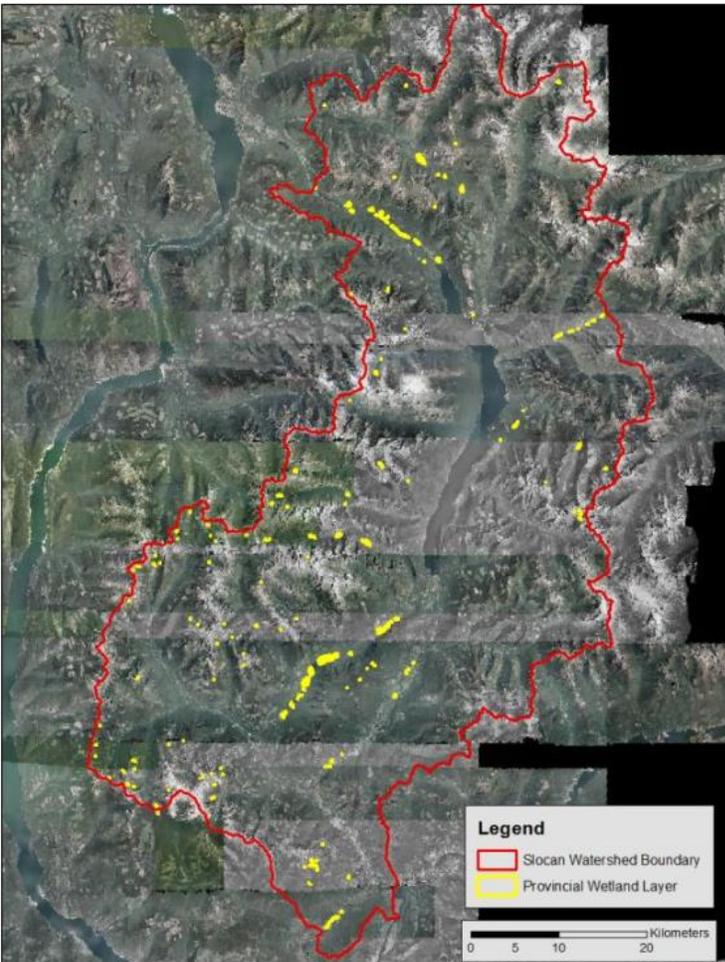


FIGURE 4.4-1 PROVINCIAL WETLAND LAYER SHOWING WETLANDS OCCURRING IN THE STUDY AREA.

The first work done by SWAMP was to determine the criteria, classification systems and method to be used in the assessment and mapping of the Slocan watershed wetlands. The report on this work (Durand 2014) details the different classification systems in use and references government mapping and classification systems used by others. It also references data sources and details the methodology that would be used in the field program the following year.

The reader is directed to the report for a detailed description of the wetland types and the field forms that were subsequently used in 2014.

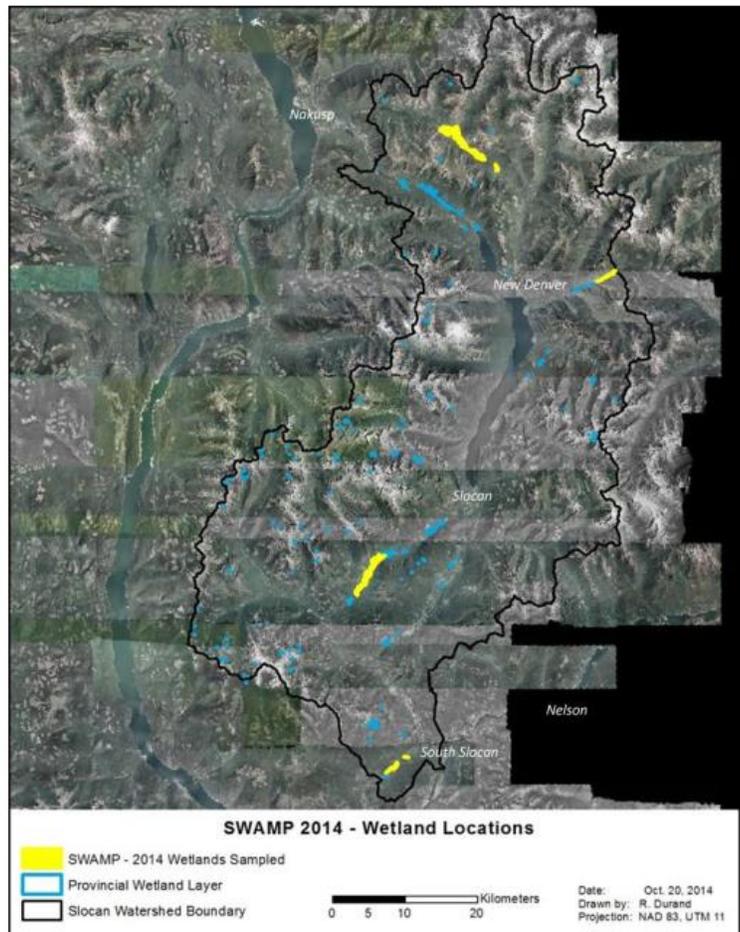
The map at left shows the extent of mapping that had previously been done in the study area as shown in the Provincial Wetland Layer.

### 2.3 SWAMP Phase 2 Report (Durand 2015)

The field work in 2014 focused on assessing and mapping four areas of the Slocan watershed. The map shown at the right shows the location of those four wetland complexes.

Detailed classifications of those complexes resulted in 50 ecosystem plots. In addition wildlife habitat assessments and ecosystem integrity were detailed. The report contains detailed tables.

Maps of the individual plots are included in that report (Durand 2015).



## 2.4 SWAMP Phase 3 Report (Durand 2016)

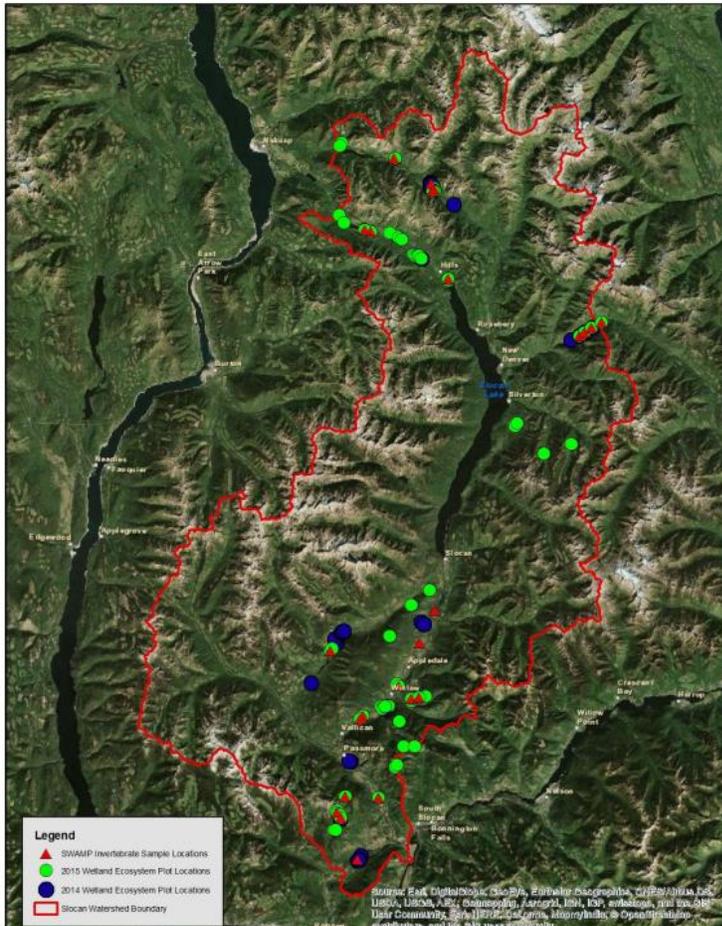


Figure 6. SWAMP wetland sample locations and invertebrate assessment locations (adapted from ESRI base maps).

The third season of wetland work focused on detailed assessments of additional wetlands and wetland characterization. This season also integrated with work by Darcie Quamme of Integrated Ecological Research on Benthic Invertebrates. More details on Darcie's work can be found later in this report.

One of the significant findings of this field work was the discovery of wetlands that did not fit neatly into the existing classification systems.

### 3.0 Related Work

A number of studies that have been performed were generated by ideas originating from work being performed by SWAMP. Four of these are detailed in the following pages.

#### 3.1 *Species at Risk - 2017*

In 2017 SWAMP commissioned a study of Species at Risk (SAR) in the Slocan Watershed, based upon the discovery of numerous species at risk during previous wetland assessments and mapping that SWAMP had done. Consequently, SWAMP secured funding for an assessment of the need for further field work on species at risk. The result was a report published in January 2018 on that study (Durand and Mackenzie, 2018).

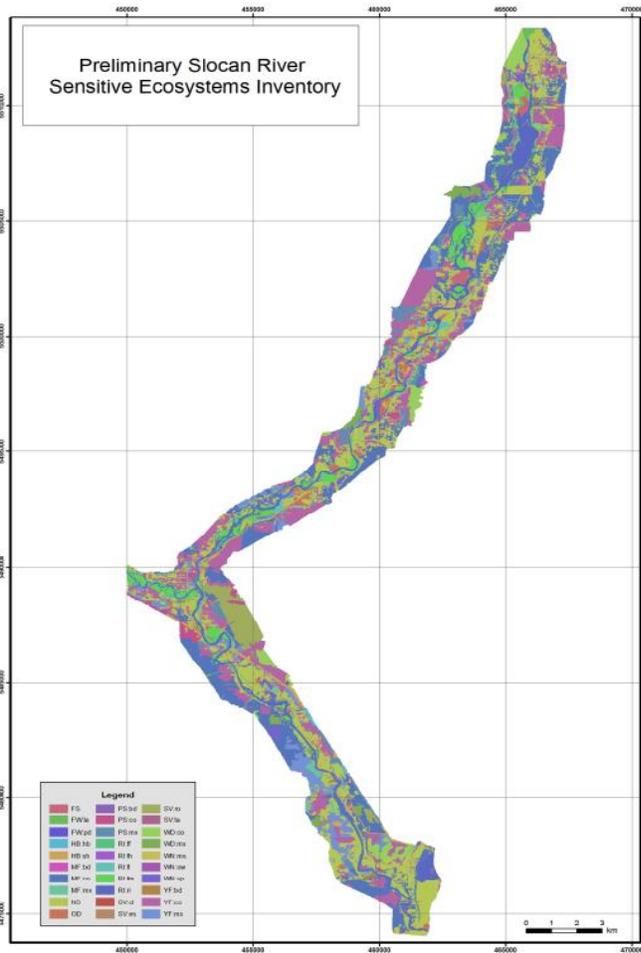
The following is an excerpt from the Executive Summary of that report:

“Through this project, which was largely a desktop exercise, we have confirmed 47 species-at-risk in the Slocan Watershed in 154 locations, and have identified an additional 11 species that have a high potential to occur. The species include vertebrates, invertebrates, reptiles, amphibians, vascular plants and non-vascular plants. This represents a considerable increase in the number of species-at-risk known to exist in the watershed, although several species on the list are well documented, but are not tracked, or do not show up on, CDC data.

The results of this project make it apparent that there is still much to be discovered regarding the species-at-risk that inhabit the Slocan Watershed. With every additional field check more species are found, and the range of existing species is expanded. We hope to secure funding to move beyond this desktop exercise and complete additional inventories. We recommend that a series of specific surveys be carried out in the watershed to complement previous studies. These studies would be completed by experts in their field and focus on under-inventoried areas, namely vascular and non-vascular plants, amphibians and invertebrates.”

SWAMP through its associated experts continues to find new species at risk and document their occurrence.

**3.2 SEI-AHI Consolidation**



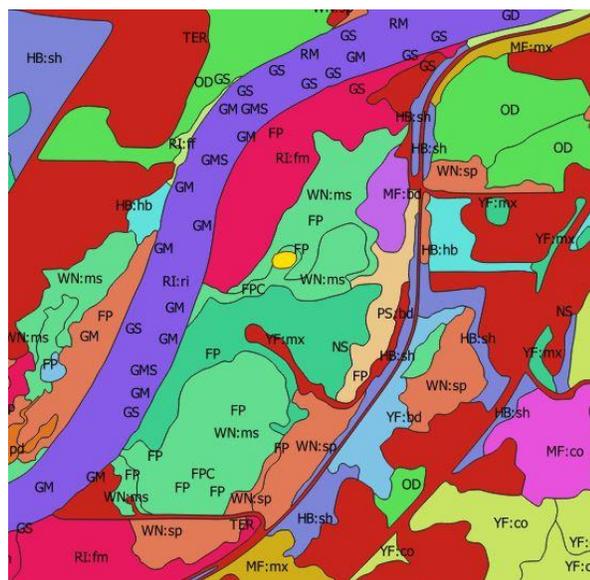
In 2013 Ryand Durand prepared Sensitive Ecosystem Inventory (SEI) maps of the Slocan River riparian area from orthophoto interpretation (Durand 2013). The map to the left is taken from that report and shows the extent of the mapping, viz. Slocan Lake to Kootenay River.

The Columbia Basin Watershed Network and Selkirk College run a joint mapping program each summer to assist their members by supplying mapping services through a summer student hired by Selkirk. In 2016, Jan Pindroch was employed in this role, to merge the above mentioned SEI data with Aquatic Habitat Index (AHI) maps of the Slocan River, prepared by Peter Corbett (Mirkwood Ecological Consultants) and Tom Bradley (Woodlot Forestry Services) to create a composite map.

The map to the right shows a small section of the composite map and illustrates the detail that is available from this work.

The yellow oval in the centre of the map is the location of the Goulden-Thurston restoration wetland described later in the Wetland Restoration section of this report.

The merged map data is available through Slocan River Streamkeepers and SWAMP.



### 3.3 Remote Sensing of Wetlands

In 2017 Wendy Castellanos, a student in the Advanced Diploma in GIS at Selkirk College, chose to evaluate methods for delimiting wetlands using GIS techniques for a class project.

Abstract (from Castellanos 2017):

*“The primary aim of this project proposal is to explore different methods for delimiting possible locations of wetlands in the Slocan River Watershed using Geographic Information Systems (GIS) techniques. The proposed GIS methodology consists of 3 different approaches (Difference Raster, Slope and Aspect method) using ArcMap and a Digital Elevation Model (DEM) obtained from the open source website: Geogratis. Additionally, a Python script and a Modelbuilder model were created to automate the detection of wetlands and flat areas in just 5 minutes using the Raster difference. Finally, the results from each methodology were represented in a web-map application using ArcGIS Online.”*

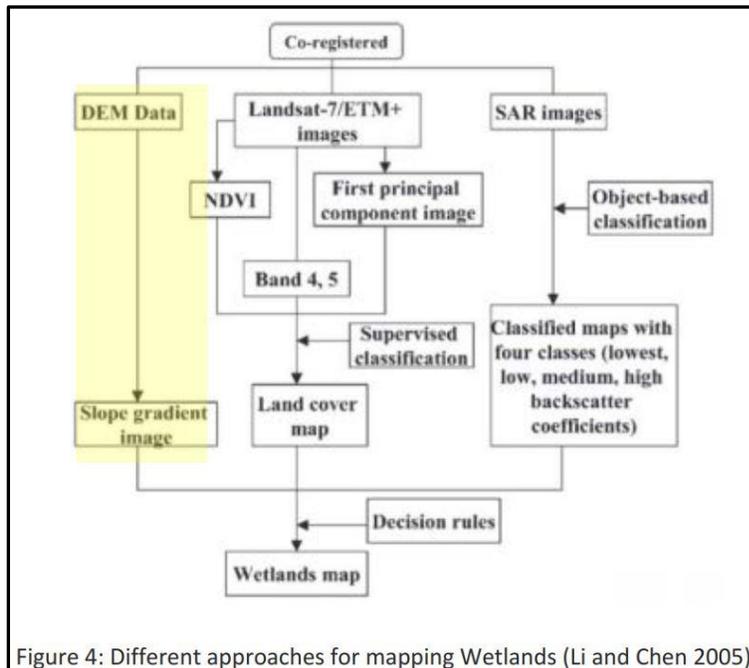


Figure 4: Different approaches for mapping Wetlands (Li and Chen 2005)

The diagram at left, taken from her paper (Castellanos, 2017) shows several methods of detecting possible wetlands.

One method of detection that is not well documented is using DEM subtraction where a raw DEM is subtracted from a “filled DEM”. In theory this method gives areas that are “undrained” and thus potentially a wetland.

The results of this study indicate that there are 345 flat areas in the Slocan watershed using a cutoff size of 3174 sq. m. (6 pixels).

Table 1 at right from Castellanos paper shows the result if a different slope cutoff is used.

The full report (Castellanos, 2017) is available for download from the SWAMP website.

	Original	Final
Slope 0 degree	2229	345
Slope 1 degree	9778	888
Slope 3 degrees	17086	1985

### 3.4 Aquifer Studies

Wetlands are controlled by the adjacent hydrology and are often connected to aquifers. The SWAMP protocols and field work address the hydrology of the wetland area based upon visual and airphoto/satellite image interpretation. The field forms have provision for recording pH, conductivity, water colour, hydrodynamic index and percent open water. The forms also include related information that can be used for interpreting the hydrological conditions of the wetland such as mineral soil drainage and other soil parameters, water source, hydro period and hydrological connectivity.

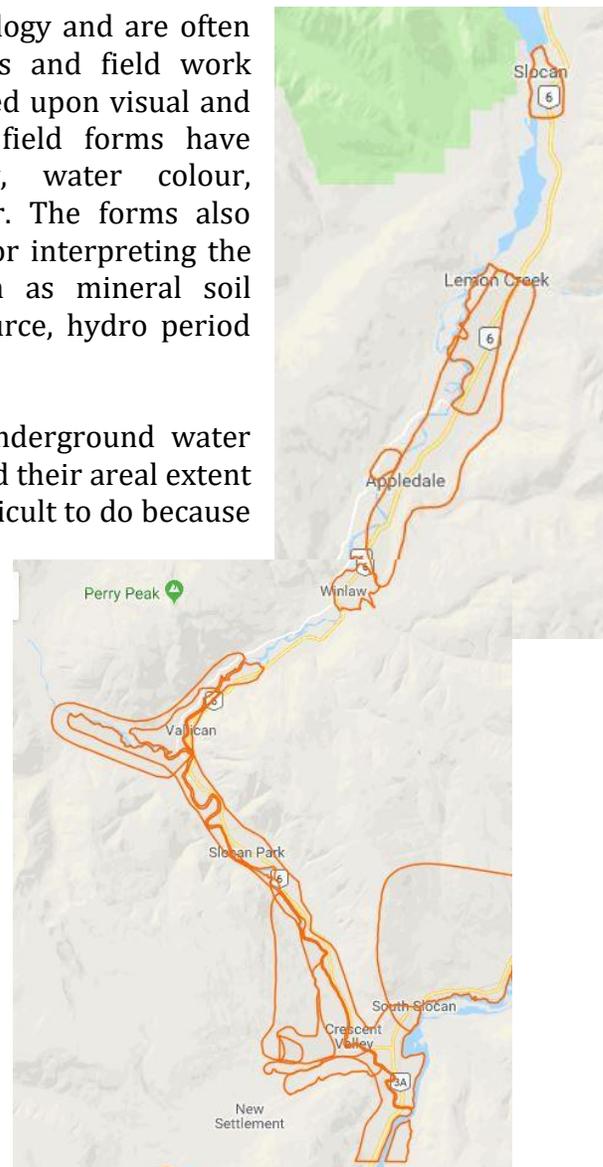
Many wetlands are connected to extensive underground water sources. These aquifers are often not defined and their areal extent has not been mapped. In a lot of cases this is difficult to do because of the lack of subsurface data. Some wetlands occur at the “toes” of scree slopes and are not the usual flat areas that can be detected by work with DEM

This is important in understanding the dynamics of the wetland and the possible changes that will occur under changed climatic conditions.

In 2016 the provincial government updated the aquifer data on aquifers in the Slocan Valley. (See map) Data on these aquifers can be downloaded from DataBC.

The Slocan Lake Research Centre (Richard Johnson) did some aquifer mapping of aquifers in the valley bottom in the area from Slocan Village to Winlaw as part of a student project (Christine Nichol) for a Selkirk College class in 2015. This work is ongoing as time and finances allow. Comparing the authors maps to the government aquifer descriptions show significant differences. More work needs to be done on all of the aquifers in the Slocan watershed.

Some of these aquifers relate and feed water to wetlands in the lower part of the valley. For instance, excavation work on the Crooked Horn site, about 1 kilometre south of Winlaw (described elsewhere in this document) revealed that two aquifers are supplying water to the wetland.



4.0 Parallel Projects

A number of studies were part of the SWAMP initiative or grew out of work that integrated into the assessment and mapping of SWAMP. The four outlined below are continuing in their own form as separate works.

4.1 Benthic Invertebrate Studies

Darcie Quamme ( Integrated Ecological Research) in working with SWAMP and the Slocan Solutions Society, developed quantitative biotic benchmarks to track wetland recovery that can be used to assess wetlands in the Columbia Basin. We wanted to answer the question “How are we doing?” in our approach to restoring wetlands

As a result we incorporated science-based benchmarks along with an adaptive management approach that can be used to make management decisions about restoration and conservation. We identified reference sites and use the Canadian Aquatic Biomonitoring Network methods for aquatic invertebrates in standing waters to compare to trends at restored wetland sites over time. Initial data showed that the number of invertebrate taxa are increasing over time but that this is a long-term process.

## The biodiversity of invertebrates in our local wetlands

Darcie Quamme<sup>1</sup>, Rhia MacKenzie<sup>2</sup>, Richard Johnson<sup>3</sup>, & Ryan Durand<sup>4</sup>

<sup>1</sup>Integrated Ecological Research, <sup>2</sup>Slocan River Streamkeepers, <sup>3</sup>Opus Petroleum Eng./Slocan Solutions, <sup>4</sup>Durand Ecological

**Project Goals:**

- Assess baseline biodiversity of wetland sites in the Slocan and Meadow Creek areas
- Prioritize wetlands for restoration & conservation
- Report findings to the local community

**Methods:**

Parameters monitored included:

- Invertebrates from emergent vegetation
- Water & sediment chemistry
- % Composition of emergent vegetation
- Habitat variables & stressors

**Conclusions:**

- Chemical stress varied from low to high at sites in the Slocan and Meadow Creek areas
- The composition of invertebrates differed by wetland type
- Reference sites were identified for comparison to impacted sites or restoration activities over time.

**What are macroinvertebrates?**

- Organisms without a backbone
- Visible to the naked eye
- Variable tolerances to stressors

*The suite of invertebrates indicates health*



**Indicators monitored**

Water, Sediment, Physical, GIS → Wetland Stress

Vegetation, Invertebrates → Biological health

**Site locations**

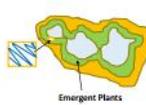


**Invertebrate collection:**

- 3 minute kick sample
- 5 x 5m quadrat



**Emergent Plants**



**1. Chemical Stress:** based on sediment chemistry: an indicator of human activity



**2. Biodiversity:** Invertebrates were identified to the genus level



**Methods can be used to identify impacts or track restoration goals**

**Encouraging wetland stewardship and restoration**

If you have a backyard wetland and want to be part of an innovative study please contact: Darcie Quamme, Integrated Ecological Research, [quamme@ecological.bc.ca](mailto:quamme@ecological.bc.ca), or Rhia MacKenzie, Slocan Streamkeepers Society, [zozist@gmail.com](mailto:zozist@gmail.com), full report at [slocanswamp.org](http://slocanswamp.org)










An important component of this project is private landowner engagement by participation in our invertebrate monitoring program and enhancement projects providing some first steps towards fostering stewardship and restoration of private wetlands. Data obtained during this study, will be used to inform new work on bat-insect trophic interactions and testing of bat enhancement methods centered within the Bonanza to Box Lake corridor.

In addition, the project helps to support increased information and knowledge on the ecological processes of wetlands in the Slokan Valley and North Kootenay Lake, leading to meaningful outcomes for the community, funders and supporters.

## Mosquito monitoring at Crooked Horn Farm

Darcie Quamme<sup>1,5</sup>, Rhia MacKenzie<sup>2,5</sup>, Gregoire Lamoureux<sup>2,5</sup>, Richard Johnson<sup>3,5</sup>, & Ryan Durand<sup>4,5</sup>

<sup>1</sup>Integrated Ecological Research, <sup>2</sup>Slokan River Streamkeeper Society, <sup>3</sup>Opus Petroleum Eng., <sup>4</sup>Ecologic Consulting, <sup>5</sup>Slokan Valley Wetland Assessment & Monitoring Program

### Project Goals:

- Assess the ratio of mosquito to natural enemies within the aquatic invertebrate population in local wetlands using Canadian Aquatic Biomonitoring Methods (CABIN)
- Verify CABIN results and increase search effort by quick dip sampling

### Methods:

Parameters monitored included:

- Mosquitoes from emergent vegetation
- Water & sediment chemistry
- % Composition of emergent vegetation
- Habitat variables & stressors

### Conclusions:

- Mosquitoes (n=51 kick net samples) comprised 0-6% of all invertebrates in emergent vegetation (2014-18) at all sites
- Mosquitoes comprised <2% of all invertebrates in 2016-18 at Crooked Horn Farm in pre and post-restoration monitoring (Kick-net, n=1 per year)
- Post-restoration monitoring in 2017 using 350mL dip sampler found zero larvae in 18 samples within the wetland & none in ditches (6 samples).
- Post-restoration monitoring in 2018 using 350mL dip sampler found two larvae in 24 samples within the wetland & none in ditches (6 samples).

### What are macroinvertebrates?

- Organisms without a backbone
- Visible to the naked eye
- Variable tolerances to stressors
- The suite of invertebrates indicates health
- Mosquitoes are one type of macroinvertebrate



### Indicators

Water, Sediment, Physical, GC

→

Wetland Stress

Ingestion, Invertebrates

→

Biological health

### Collection:

- Kick-net: 3 minute kick sample
- Standard area (25m<sup>2</sup>)
- Larval dip sampler (350 mL)









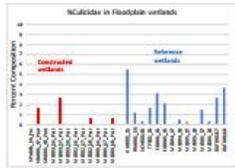

### Site locations



### Results:

Mosquitoes at all sites were in the genus *Anopheles*

**Methods will be used to track restoration goals**



**Further analyses to be carried out:**

- Calculation of predator : mosquito ratios
- Correlations with environmental variables such as degree days, and water level indices

### Encouraging wetland stewardship and restoration

**If you have a backyard wetland and want to be part of an innovative study please contact:** Darcie Quamme, Integrated Ecological Research, [quamme@ecological.bc.ca](mailto:quamme@ecological.bc.ca), or Rhia MacKenzie, Slokan River Streamkeepers, [zzoist@gmail.com](mailto:zzoist@gmail.com), full report at [slocanswamp.org](http://slocanswamp.org)









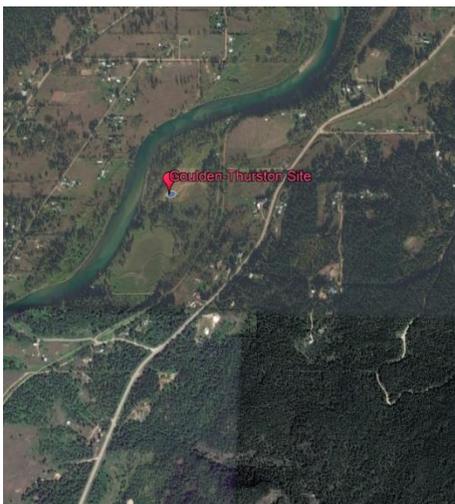


## 4.2 Wetland Restoration

One of the reasons for doing the SWAMP studies is to provide basic data for parties that are interested in doing further work on wetlands in the Slocan Valley. One of the active projects, that was generated by the SWAMP studies, is wetland restoration/enhancement being conducted by the Slocan River Streamkeepers Society (Gregoire Lamoureux). They are working on two sites, Crooked Horn Farms and Goulden-Thurston.



The Crooked Horn Farm site is located approximately one kilometre south of Winlaw, B.C. The site is a wetland that was drained by previous owners. The implementation of the project is completed. The Slocan River Streamkeepers, in partnership with the landowners, are doing some maintenance and further monitoring (with Darcie Quamme) of the project. Autonomous bird recorders have been deployed for two years now to record the changes in bird and amphibian life as the wetland develops. A diversity of native plants including sedges, rushes, trees and shrubs have been planted in and around the wetlands.



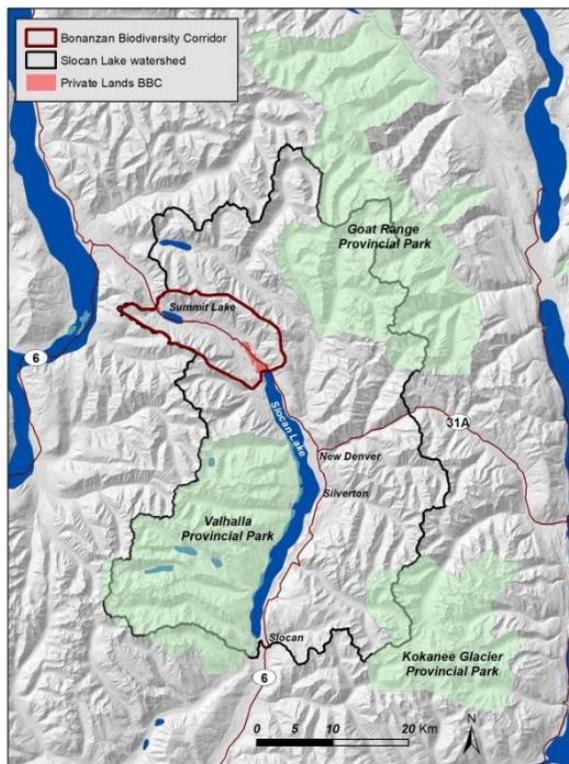
The Goulden -Thurston site (see map at left) is located 6 kilometres miles north of Winlaw. The site is located on the Slocan River flood plain and is covered with short vegetation, mainly Reed Canary grass. There are stands of Black Poplar between the site and the river. Slocan River Streamkeepers has been doing some riparian restoration along the river.

The plan is to excavate 4 shallow wetlands to create habitat for a diversity of species including amphibians, benthic invertebrates, birds, bats and other mammals. Some basking logs will be installed as well as nesting boxes for birds and bats. Some of the wetlands will be ephemeral. Native plants will be planted in and around the wetlands.

### 4.3 Bonanza Biodiversity Corridor

SWAMP's research formed the basis for highlighting the Bonanza Creek valley as a critical landscape for biological diversity, ecological process and connectivity. During the Slocan Lake Watershed Science and Conservation Action Planning Forum, held in February 2017, that area was named the "Bonanza Biodiversity Corridor" (BBC) because of its regional importance in linking Slocan and Summit Lakes, the Goat Range and Valhalla Provincial Parks and the Slocan Valley with Arrow Lakes. A working group was formed by 20+ local conservation organizations and research biologists under the leadership of the Slocan Lake Stewardship Society and the Kootenay Conservation Program.

The following is a map and quote from a report done by Marcy Mahr for the KCP. (Mahr 2018):



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

Bonanza Marsh is a wetland complex that is unique to this area because it is fed by several streams and probably underwater springs. Some of the water, probably from the springs, gives high sulfate and calcium values and this may account for the unique plant assemblage that have been recorded in the SWAMP studies. It is located on the north end of Slocan Lake and is at the southeast end of the BBC.

In 2018 the Valhalla Foundation for Ecology purchased 35 acres on the north side of Bonanza Marsh and named it the Snk'mip Marsh Sanctuary. They have done cleanup work and plan on preserving this wetland in its natural state.

#### ***4.4 Bird Song and Bat Call Recording***

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One of the original ideas for the SWAMP project was to add “biolayers” to the Slocan Watershed as time, expertise and funding became available. In the initial training and workshops put on by the BC Wildlife federation in 2013, with the support of the founding Societies, we ran a bioblitz of the Bonanza Marsh area and the Hunter Siding area. Dr. Cori Lausen (Wildlife Conservation Society Canada) did some mist netting and has been deploying automatic bat recorders in these areas. Although these studies were not instigated by SWAMP the data is continuing to be recorded and archived by Dr. Lausen.

In 2017 Slocan Lake Research Centre gained the use of two Wildlife Acoustic SM4 autonomous recording units (ARU's) similar to the bat recorders mentioned above. These recorders can be set to record wetland sounds at programmed intervals throughout the day and have a battery life that lasts several months depending upon how long the recording intervals are.

These two recorders were tested by deploying them in several wetlands in the Slocan Watershed during the 2017 spring nesting season to record and document bird songs. The first unit was deployed in Pass Creek, Crooked Horn Farm and Bonanza Marsh for approximately one week in each then cycling through again two weeks later. The second recorder arrived in June 2017 and was deployed at Terry Halleran's restored wetland in Meadow Creek for 20 days.

In 2018 the recorders were deployed again, one in the Crooked Horn Farm restoration wetland and the second in Bonanza Marsh. Unlike the previous year, when the recorders were moved approximately every week, these two sites were recorded from early May to mid-July, recording the first 10 minutes of every hour, every day. The recording parameters were set to match those used by the University of Alberta who have also agreed to act as an archiving repository for the sound files.

Because of the volume of the recordings (10 minutes times 24 hours = 4 hours per day in 2018) interpretation is ongoing. Raven Pro software is being used and other automatic identification software is being worked on. So, even though not all of the birds are yet identified, the sound file archives will be available for study by future researchers.

The Slocan Lake Research Centre of Opus Petroleum Engineering Ltd. is planning an expanded program in the coming years.

## 5.0 Glossary

The following is a list of terms and acronyms that are commonly used throughout this document:

AHI	Aquatic habitat Index.
ArcGIS	A Geographic Information System software package used for making and viewing digital maps.
ARU	Autonomous Recording Units. Programmable audio recorders used in studying bat, bird, frog, whale, insect and similar vocalizations.
BCWF	British Columbia Wildlife Federation
BEC	Biogeoclimatic Ecosystem Classification. A provincial system of defining ecosystem types at a variety of scales, from landscape level to site specific.
CBWN	Columbia Basin Watershed Network
Orthophoto	A series of digital air photos that have been geometrically corrected and combined into a seamless image.
RISC	Resources Information Standards Committee. Provincial program that creates standardized procedures and methodologies for data collection, analysis and presentation.
SAR	Species at risk. A designation and ranking system created by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species at Risk Act (SARA).
SEI	Sensitive Environment Index
SRS	Slocan River Streamkeepers Society
SLRC	Slocan Lake rResearch Centre
SWAMP	Slocan Wetlands Assessment and Monitoring Project
TRIM	Terrain Resource Inventory Mapping. Digital base mapping developed by the provincial government.

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