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CITY OF KELOWNA

**MEMORANDUM**

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**Date:** June 5, 2009  
**File No.:** 5280 – Environmental Management  
**To:** City Manager  
**From:** Community Sustainability Division  
**Subject:** Sensitive Ecosystems Inventory: Kelowna, 2007;  
Sensitive Habitat Inventory and Mapping – 2008 - Volume 3; and,  
Wetland Inventory, Classification, Evaluation and Mapping

Report Prepared by: Greg Sauer, Land Use Planner

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**RECOMMENDATION:**

THAT the following three reports be received for information:

- Sensitive Ecosystems Inventory (SEI): Kelowna, 2007;
- Sensitive Habitat Inventory and Mapping (SHIM) – 2008: Volume 3; and,
- Wetland Inventory, Classification, Evaluation and Mapping (WIM).

AND THAT City Council endorse the use of the following three reports to assist in the updating of the Official Community Plan (Kelowna 2030) and other land use management and policy initiatives as appropriate:

- Sensitive Ecosystems Inventory: Kelowna, 2007;
- Sensitive Habitat Inventory and Mapping – 2008: Volume 3; and,
- Wetland Inventory, Classification, Evaluation and Mapping;

AND FURTHER THAT staff be directed to follow the Communication Plan outlined in the June 5, 2009 memorandum.

**BACKGROUND:**

The natural environment in and around Kelowna is one of the most prolific in Canada and is a primary factor influencing both the settlement of Kelowna and population growth in the decades since. A significant increase in interest and awareness about the natural environment by the general public has been witnessed in recent years. While the impacts associated with increased population, including associated urban development patterns and the expansion of agriculture have not historically been well known, this is no longer true. In fact, mitigating the relatively large footprint associated with population growth and protecting sensitive ecosystems is now a top priority among most interested parties including the City of Kelowna.

Underlying this paradigm shift is an awareness that the natural environment provides for a wide array of ecosystem goods and services. Ecosystem services are the conditions and processes through which natural ecosystems sustain and fulfill human life. They provide goods of economic value to human beings, the ongoing maintenance of critical life-support systems and confer a wide range of



intangible cultural, spiritual, aesthetic and other non-market benefits. The importance of these services to current and future human welfare while exceedingly difficult to calculate in monetary terms, is substantial nonetheless.

The value of the natural environment to Kelowna residents has been confirmed over the years as part of a number of public consultation processes including the Kelowna Strategic Plan (2004), and perhaps most significantly and recently through the Official Community Plan update (2008-2009). To highlight resident's affinity for a healthy natural environment, when asked "What factors are important to you when choosing where to live?" results of an online survey conducted in early 2009 show that 65% of residents cited proximity to natural features such as lakes, streams, and open space. Of the 823 participants who completed the survey, only a "generally desirable neighbourhood" received higher support at 82%, while the "cost of housing" tied with "proximity to natural features" with 65% support.

From a land use perspective, while the importance of natural land and water-based features is clear from an ecological function perspective; our awareness of the location, condition, rarity and overall significance of natural features has been less clear, historically speaking. Without the appropriate tools and policies, Council and Staff have been ill-equipped to protect many environmentally sensitive and significant features to date. The result is that many environmentally sensitive and significant features have been lost, or severely compromised by past development. Further, without the implementation of the updated mapping, it is plausible that future development will impart similar negative impacts on sensitive ecosystems.

An awareness of the importance of a comprehensive understanding of sensitive ecosystems and environmentally significant areas led to a Council-endorsed approach to resolve this deficiency. The result was the issuance of three separate contracts intended to generate information for Council and Staff for decision-making purposes and also to develop valuable tools to assist in the identification and protection of important and sensitive ecological features. Three separate work programs were identified and included:

- Sensitive Ecosystems Inventory (SEI);
- Sensitive Habitat Inventory and Mapping (SHIM); and,
- Wetland Inventory, Classification, Evaluation and Mapping (WIM).

The Sensitive Ecosystems Inventory was awarded to Iverson & Mackenzie Biological Consulting Ltd and the project led by Kristi Iverson, a Registered Professional Biologist and plant ecologist specializing in ecosystem mapping and ecosystem classification. Kristi's qualifications include the review of ecosystem mapping from throughout the central and southern interior of British Columbia and the completion of all six sensitive ecosystems inventories in the Central and North Okanagan. The Sensitive Ecosystems Inventory methodology used by Iverson was developed by the B.C. Conservation Data Center (CDC), Environment Canada and, Canadian Wildlife Service (CWS) and first used in 1994.

The Sensitive Habitat Inventory and Mapping and Wetland Inventory, Classification, Evaluation and Mapping exercises were awarded to Ecoscape Environmental Consultants Ltd and led by Kyle Hawes, a Registered Professional Biologist specializing in freshwater fisheries and wetland / aquatic resources with experience across northern and western Canada. Like the SEI, the SHIM method has been used extensively in British Columbia and was initiated through the Fish Habitat Inventory and Information Program (FHIIIP) with cooperation between Fisheries and Oceans Canada, the BC Ministry of Water, Lands, and Air Protection along with a number of municipalities, and NGOs. The Wetland Inventory, Classification, Evaluation and Mapping initiative is the first of its kind and has been

adapted from, and designed to, conform to SHIM Data Deliverable Standards for publication in the SHIM Atlas.

A summary of each of these reports is provided in Attachment 1. Full consultant reports have been placed in the Council Reader file.

#### **INTERNAL CIRCULATION TO:**

Policy & Planning

#### **COMMUNICATIONS CONSIDERATIONS:**

It is critical that all stakeholders including City staff, consultants, non-government organizations and the public are aware and educated about these inventories and associated tools to assist in the identification and protection of important and sensitive ecological features. The mapping and inventory work will empower all stakeholders to assist the City to protect sensitive ecosystems in ways not previously available. The following are actions taken to date, and those anticipated to ensure wide distribution and dissemination of the work which will ensure project objectives are met:

- An overview of the Wetland Inventory, Classification, Evaluation and Mapping initiative was presented to the development industry through the local chapter of the Urban Development Institute. The information session was well received by representatives of this stakeholder group.
- The Sensitive Ecosystems Inventory consultant recently presented her work to a cross-section of consultants and non-government organization representatives, in addition to relevant City staff. This presentation and question/answer session was also well received by the 23 individuals in attendance.
- To date staff has made all of the consulting reports available for download by consultants and non-government organizations via a City of Kelowna file transfer protocol (FTP) site. The next step will be to make the mapping data (GIS shapefile data) from each of the studies available for download on the FTP site.
- Land Use Management staff will work with the Community & Media Relations Department to ensure that the value of these new tools is effectively communicated to the public. A first step includes a press release designed to notify the public of the inventory and mapping tools and further to direct them to additional resources. The primary resource will be the City website where an overview of the work will be provided and all of the consulting reports will be hosted for download by the public. Perhaps the most useful tool in communicating the value and volume of the inventory data is the Kelowna Internet Map Viewer. Efforts to make this data available to all residents and stakeholders through the Map Viewer are currently underway.
- Once the inventories have been fully integrated into the Kelowna map viewer, Land Use Management staff will host training sessions to ensure that all relevant City staff are confident and competent in the utilization of the inventory tools. This will ensure that the greatest value can be obtained from the inventories, and that staff can achieve higher efficiency and accuracy when dealing with stakeholders.

**EXISTING POLICY:**

Official Community Plan 2000 – 2020

There is current OCP policy direction with respect to managing the natural environment:

Environment Policy 7.3.10 **Initiate Watershed Restoration.** Initiate projects to increase watershed health and to demonstrate improved techniques that can be used for watershed restoration.

Environment Policy 7.10.6 **Natural Features Identification.** Continue to identify and assess Natural Environment areas with the objective of formulating protective strategies, encouraging restoration, and obtaining knowledge to facilitate appropriate land use and servicing decisions.

Environment Policy 7.10.12 **Retention of Natural Areas.** Encourage all development and infrastructure projects to conserve wetlands, wildlife corridors, trees or other indigenous vegetation. Encourage alternative development methods, such as considering increasing density, narrowing right-of-ways or cluster housing.

Considerations not applicable to this report:

- LEGAL/STATUTORY AUTHORITY:**
- FINANCIAL/BUDGETARY CONSIDERATIONS:**
- PERSONNEL IMPLICATIONS:**
- TECHNICAL REQUIREMENTS:**
- ALTERNATE RECOMMENDATION:**

Submitted by:

*for*   
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Todd Cashid  
Manager, Environment and Land Use

Approval for Inclusion



Shelley Gambacort  
Director, Land Use Management

- cc: Director, Design & Construction Services  
Director, Infrastructure Planning  
Director, Civic Operations  
Director, Development Services





## Attachment 1

Summary of Sensitive Ecosystems Inventory: Kelowna, 2007; Sensitive Habitat Inventory and Mapping – 2008 - Volume 3; and Wetland Inventory, Classification, Evaluation and Mapping

### **Sensitive Ecosystems Inventory (SEI): Kelowna, 2007**

Sensitive ecosystems are those which are ecologically fragile and/or are recognized as rare in the provincial landscape while rare ecosystems are considered to be provincially rare due to their limited distribution or because disturbance has significantly limited their distribution. Such landscapes are known to provide significant intrinsic and economic value to humans. For instance, sensitive ecosystems in Kelowna support a number of red and blue-listed species and are a critical component to the health, vitality, and economy of this community.

The Kelowna Sensitive Ecosystem Inventory was undertaken in 2007 in response to a need for scientific information pertaining to wildlife habitat and sensitive ecosystems inventory information which was needed to support sound land management decisions. The Kelowna Sensitive Ecosystem Inventory is one of six inventories undertaken to date as part of a regional effort in the Okanagan Valley. The contract was awarded to Iverson & Mackenzie Biological Consulting Ltd and the project led by Kristi Iverson. Kristi is a Registered Professional Biologist and plant ecologist specializing in ecosystem mapping and ecosystem classification. Kristi's qualifications include the review of ecosystem mapping from throughout the central and southern interior of British Columbia. Kristi has completed all six sensitive ecosystems inventories in the Central and North Okanagan and was selected to complete the City's Sensitive Ecosystems Inventory based on her extensive experience mapping ecosystems in the Okanagan Valley and the methodology developed in previous inventories.

The Sensitive Ecosystem Inventory was cooperatively funded by The Real Estate Foundation of BC, the BC Ministry of Environment, the City of Kelowna, and the Regional District of the Central Okanagan. The City of Kelowna's Policy & Planning Division allocated \$40,000 from its 2007 budget, while the total project budget was \$85,000.

The project study area covers approximately 21,500 ha including private land, regional parks, and crown land. Field work for the Kelowna Sensitive Ecosystem Inventory occurred in the fall of 2007 with mapping and other various components spanning the past few years. The deliverables for this project were twofold. Volume 1 is intended for people and organizations requiring information to help conserve and protect remaining sensitive and important ecosystems in Kelowna. In contrast, Volume 2 is intended for professionals that require more detailed ecological and terrain information including terrestrial ecosystem mapping (TEM) data.

The Sensitive Ecosystem Inventory project recognizes both sensitive ecosystems (SE) and other important ecosystems (OIE). Sensitive ecosystems refer to seven types that are ecologically fragile or rare in the provincial landscape, and are relatively unmodified by human influences. Sensitive ecosystems include: wetlands, riparian, old forest, grasslands, broadleaf woodlands, coniferous woodlands, and sparsely vegetated ecosystems. Each of these groups shares a number of characteristics, particularly ecological sensitivities, ecological processes, rarity, and wildlife habitat values. Other important ecosystems are partially modified ecosystems that provide many natural values including wildlife habitat, wildlife corridors, buffers between developed areas and sensitive ecosystems, and sources of potential recruitment for some sensitive ecosystems. There are two ecosystems in this category including seasonally flooded agricultural fields, and mature forests.

The study shows that 28 per cent of the study area (6,041 ha) is made up of sensitive ecosystems, while other important ecosystems comprised 0.5 per cent (102 ha) of the City's 21,500 ha. The

inventory further illustrates that of the seven ecosystem types, seasonally flooded fields, broadleaf woodland, mature forest, old forest, wetland, and sparsely vegetated ecosystems are all extremely rare in the study area. Riparian and grassland ecosystems are slightly less rare, but are still infrequent and unsubstantial in terms of overall extent.

On the basis of the inventory findings the City is now in a place to better support ecologically sustainable land use and development planning and to help promote effective stewardship practices. The inventory will inform a variety of plans and processes in a number of departments at the City of Kelowna. A primary intended use is the updating of the Official Community Plan, in addition to providing valuable input when producing or revising Neighbourhood and Parks Plans.

### **Sensitive Habitat Inventory and Mapping (SHIM)**

The two final projects, the Sensitive Habitat Inventory and Mapping (SHIM) and Wetland Inventory, Classification, Evaluation and Mapping (WIM) exercises were awarded to Ecoscape Environmental Consultants Ltd (Ecoscape) and led by Kyle Hawes. Kyle is a Registered Professional Biologist and Principal of Ecoscape. Specializing in freshwater fisheries and wetland / aquatic resources, Kyle has conducted numerous field studies within terrestrial and aquatic habitats throughout British Columbia, Ontario, the Northwest Territories, and Alberta. Kyle works closely with regional, provincial, and federal inventory specialists to develop and refine inventory protocols and data collection requirements and standards.

Ecoscape was engaged in the fall of 2005 to undertake a Sensitive Habitat Inventory and Mapping exercise of the creeks within the City. The Sensitive Habitat Inventory and Mapping project was cooperatively funded by the Okanagan Basin Water Board, and the City of Kelowna. The Okanagan Basin Water Board provided in excess of \$15,000 to the City's Sensitive Habitat Inventory and Mapping efforts while the remainder was funded from the City's Environment and Drainage budgets. The project budget for this phase was \$45,000.

Kelowna's Sensitive Habitat Inventory and Mapping is based on a standard developed for fish and aquatic habitat in urban and rural watersheds in British Columbia. These standards ensure reliable, high-quality, current, and spatially accurate data is collected. Using these standards Ecoscape objectively identified and assessed a number of criteria which included the overall length, channel width, degree of disturbance, presence and frequency of flows, grade, bank stability, substrate type, capacity to support fish, presence of fish migration barriers, riparian communities, and cover among others. The assessment resulted in an overall condition score between 0 and 100 per cent being determined for each watercourse.

The Sensitive Habitat Inventory and Mapping surveys began in 2005 with two creeks (Mill and Bellevue) resulting in the Volume 1 report being delivered in 2006. In 2006, a total of twelve creeks (Brandt, Cedar, Fascieux, Francis, Lebanon, Leon, Priest, Rembler, Scotty, Thompson, Whelan, and Wilson) including a couple of tributaries were evaluated and resulted in Volume 2 being delivered to the City in 2007. The third and final report, Volume 3, was received from Ecoscape in 2009. Volume 3 includes the assessment of a final fourteen creeks (Bauer, Bellevue - North Arm, Dewdney, Campbell, Gopher, Hachey, Hydraulic, Industry, KLO, Michaelbrook, Mission (top of ravine only), Rumohr, Thomson, and Vernon Creek East above Duck Lake) with fieldwork for this final phase occurring in 2008.

The Sensitive Habitat Inventory and Mapping objectives included inventorying and mapping the above-listed creeks along with their associated riparian habitats, and watercourse and important

fisheries habitat features. A further objective was to provide the basis for accurately mapped baseline data for integration into local mapping and planning initiatives; and, enhancing land use maps.

The Sensitive Habitat Inventory and Mapping evaluation resulted in streams being rated on their ability to support fish populations using an established fish passage protocol. This system resulted in streams being assessed as high, medium, or low in their potential to support spawning and rearing activities. A total of six creeks were assessed as having high value, while seven were rated as moderate and the remaining fifteen as having low habitat value. Although this assessment clearly articulates creeks of higher value in terms of fish habitat, it is important to remember the intrinsic value of all watercourses and their ability to support a rich diversity. This quality should not be diminished, and especially in a semi-arid environment such as Kelowna.

With the exception of Mission Creek which was not evaluated, the study determined that high aquatic habitat accounted for approximately 43km (35%) of the 123km of overall stream length in Kelowna. Moderate aquatic habitats accounted for 26km (21%), while low value aquatic habitats represent the remaining 54km (44%).

The aquatic habitat rating and condition score have been correlated in table format below. In terms of condition score, the ranges varied dramatically, from a low condition score of just 8% for a highly disturbed Brandt Creek, to a high condition score of 100% for Hydraulic Creek, which exhibits largely undisturbed and natural characteristics. Of further significance is that of Kelowna's high-value aquatic habitat, approximately 60% received low condition scores of less than 33%. Overall, however, streams of moderate value aquatic habitat have seen the greatest impacts with 88% of the combined length (26 km) receiving condition scores of less than 33%.

## Summary of Streams Assessed in Kelowna Using Sensitive Habitat Inventory and Mapping Methodology

Aquatic Habitat Rating	Stream Name	Survey Period	Stream Length (m)	Condition Score
High	Upper Vernon Creek	2008	2522	27%
	Mill Creek	2005	23300	30%
	Bellevue Creek	2005	6620	50%
	Priest Creek	2006	7100	72%
	KLO Creek	2008	2751	88%
	Hydraulic Creek	2008	721	100%
Moderate	Brandt Creek	2006	13600	8%
	Thompson Brook	2006	4800	11%
	Scotty Creek	2006	640	13%
	Wilson Creek	2006	2630	23%
	Francis Brook	2006	1400	25%
	Lebanon Creek	2006	2200	42%
	Dewdney Creek	2006	1077	67%
Low	Fascieux Creek	2006	6800	9%
	North Arm Bellevue Creek	2008	3802	13%
	Michaelbrook	2008	3369	17%
	Bauer Brook and Campbell - Industry Brook	2008	5442	19%
	Gopher Creek	2008	7706	28%
	Hachey Creek	2008	3571	36%
	Rumohr Creek	2008	7021	36%
	Rembler Creek	2006	5640	40%
	Cedar Creek	2006	1860	43%
	Leon Creek	2006	2700	43%
	Varty Creek	2008	1102	52%
	Whelan Creek	2006	810	63%
	Bertram	2008	1682	68%
	Casorso Creek	2006	1900	71%
	Bruce Creek	2008	173	83%

The Sensitive Habitat Inventory and Mapping project has resulted in a valuable tool in the understanding of sensitive habitats in Kelowna. On the basis of the Sensitive Habitat Inventory and Mapping findings, it is clear that there have been extensive impacts to many of the 28 creeks assessed, with some being rendered in a low functioning state.

The Sensitive Habitat Inventory and Mapping work will be a useful tool in a variety of applications. The data found in this table will be extremely valuable in ensuring that priority areas for protection and restoration can be identified. Sensitive Habitat Inventory and Mapping data will ensure more informed current planning decisions by providing detailed information not previously available. Examples include development applications requiring stormwater management and stormwater runoff consideration. Sensitive Habitat Inventory and Mapping will also help policy planners update the Official Community Plan, especially with respect to the determination of Natural Environment Development Permit Areas and in determining minimum setback distances. Sensitive Habitat Inventory and Mapping will also allow environment staff to more effectively monitor disturbances and changes in habitat, identify and map potential point sources of pollution, guide decisions and priorities with respect to habitat restoration and enhancement projects, identify sensitive habitats for fish and wildlife along watercourses, and highlight areas of potential channel instability or water quality issues requiring more detailed study.

Among the outputs of the Sensitive Habitat Inventory and Mapping is a highly interactive Geographic Information System tool that can be made available for use by municipalities, regional districts,



stewardship groups and interested members of the public. The Sensitive Habitat Inventory and Mapping reports and the Geographic Information System mapping tool will assist in the conservation, protection and reclamation of many key habitats. Sensitive Habitat Inventory and Mapping will be implemented into the City's Geographic Information System database and will be one tool in a new layer viewable in the Geographic Information System viewer (software available to limited staff) in addition to a new 'environment' layer on the Kelowna Map Viewer, which can be viewed by all city staff. While the extent of information will be different, the value will be similar: that is to provide the most up to date, accurate information available to appropriate individuals tasked with ensuring the ongoing health and functioning of natural flow regimes.

### **Wetland Inventory, Classification, Evaluation and Mapping (WIM) 2009**

In 2006, Ecoscape delivered an unsolicited wetland inventory proposal and presentation to the City of Kelowna Mayor and Council. This proposal was then used to obtain the funding necessary for initiation and completion of the project from the Okanagan Basin Water Board, Ducks Unlimited and various City of Kelowna departments. The primary objectives of this project were to identify, inventory, and map all wetlands and habitat features within the municipal limits of Kelowna for incorporation into existing development permit mapping. This initiative is the first of its kind and is now being recognized for its innovation. In fact, on May 28<sup>th</sup>, 2009, Kyle will present this new Global Positioning System-Geographic Information System approach for wetland inventories and mapping at the Columbia Mountains Institute "Conserving Wetlands" Conference in Revelstoke, British Columbia.

The Wetland Inventory, Classification, Evaluation and Mapping project was cooperatively funded by the Okanagan Basin Water Board, Ducks Unlimited, and the City of Kelowna. The City of Kelowna's Environment and Drainage budgets funded the project in the amount of \$25,000, while the total project budget was \$50,000.

A wetland is defined as land that is saturated long enough to promote wetland or aquatic processes indicated by poorly drained soils, wetland/aquatic vegetation species and various kinds of biological activity which are adapted to a wet environment. Wetlands have great significance when compared to other ecosystems. In fact, many wetlands have rates of net primary productivity that are among the highest of any ecosystem in the world. Of concern is that over 85 per cent of valley bottom and wetland riparian habitats have been lost in the Okanagan to date.

Of additional concern is that many of the remaining water-dependent communities are highly fragmented and in poor functioning condition. In terms of their overall importance, studies have shown that approximately 80 per cent of wildlife are either directly dependent upon wetland and riparian ecosystems, or use them more frequently than most other habitat types. Wetlands also provide a number of other functions including water retention and filtration, flood protection, and a number of recreational opportunities.

In 1998 an inventory was conducted that resulted in the identification of 81 wetlands and 57 potential, but unconfirmed wetlands (138 total potential and confirmed wetlands) locally. While many wetlands were identified and confirmed, a great number were not well known, their coordinates inaccurate, and their condition not well understood. As noted earlier, the lack of accurate, reliable data created a significant barrier to good planning and land use management. To overcome this barrier and to support informed decision-making, it was identified that a comprehensive update of the wetland inventory, including a habitat analysis using modern technologies such as Geographic Information System mapping would be necessary.



For this project, Ecoscapes developed a Global Positioning System-Geographic Information System-based application to carry out detailed wetland inventories, classifications, and evaluations. Using this new approach the objective was to identify, inventory and map all wetlands and closely associated communities and habitat features within the City; and, further to provide accurately mapped baseline data that could be integrated into City mapping and planning initiatives. Initiatives such as the Wetland Inventory, Classification, Evaluation and Mapping are primarily designed for use as flagging tools that can be used during a variety of land use development and planning exercises. The intent is that the Wetland Inventory, Classification, Evaluation and Mapping will provide a more comprehensive understanding of baseline data to assist in the monitoring of changes in habitats as a result of an array of disturbances, help guide management decisions and set priorities for habitat restoration and enhancement, identify particularly sensitive habitats for fish and wildlife, and describe the spatial extent of wetland and floodplain associations.

This work built upon a number of previous projects including the Sensitive Habitat Inventory and Mapping, the Foreshore Inventory and Mapping, the Sensitive Ecosystem Inventory, and the Wetland Habitat Management Strategy. The methodology was similar to that used to develop the City's Sensitive Habitat Inventory and Mapping (see above) and utilized high resolution digital imagery and contour maps prior to field work. This project also included an opportunity for public involvement which resulted in participants sharing local knowledge of the wetlands that they are familiar with.

The result of the Wetland Inventory, Classification, Evaluation and Mapping project is the confirmation of 278 wetlands and transitional sites (approximately double the original estimate). Despite the large increase in known wetlands, the inventory confirms that wetlands still occur relatively infrequently, covering 254 hectares or approximately one per cent of the total land area.

The field inventory determined that of the 254 hectares, approximately 75 per cent have been modified to some extent by human development such as agricultural practices and urbanization. In contrast, approximately 20 per cent are natural (not having been disturbed or modified) and approximately 5 per cent have been constructed. In addition to better understanding the degree of modification or disturbance, each wetland was assigned a generalized Functional Rating based on existing protocols that consider, for example, the interaction of vegetation, landform/soils, and hydrology, and also accounts for current and potential condition along with the minimum condition necessary to function. The result is that wetlands were categorized as being in Proper Functioning Condition, Functional-At-Risk, or Non-Functional Condition. The frequency and ability of fish to access wetlands was also evaluated as part of this inventory.

While the inventory resulted in a relatively low percentage of wetland area being categorized as being in non-functioning condition (5%), the results show that this value is at risk of increasing significantly if measures are not taken to protect and remediate a large percentage of wetlands. It is estimated that approximately 154 wetlands, accounting for 58 per cent of the total wetland area in the City are 'Functionally At Risk' of entering a 'Non-Functioning Condition'. Finally, approximately 64 wetlands representing about 37 per cent of the total wetland area coverage are in 'Proper Functioning Condition' despite some exhibiting some degree of modification.

<b>Functional Rating</b>	<b>Cumulative Wetland Area (ha)</b>	<b>Per cent of Total Wetland Area</b>
Non Functioning Condition	13.0	5%
Functional At Risk	146.1	58%
Proper Functioning Condition	92.6	37%

The inventory suggests that the primary factor leading to degraded ecological function of Kelowna's wetlands in the City is urban development. Activities such as encroachment, in-filling, draining,

habitat fragmentation (from upland habitats, and other functionally connected wetlands), contamination (e.g. stormwater), and hydrologic alteration have all led to the diminished functioning of wetlands. Agricultural practices such as livestock and range management are also significant factors influencing the decline of wetland function according to the inventory.

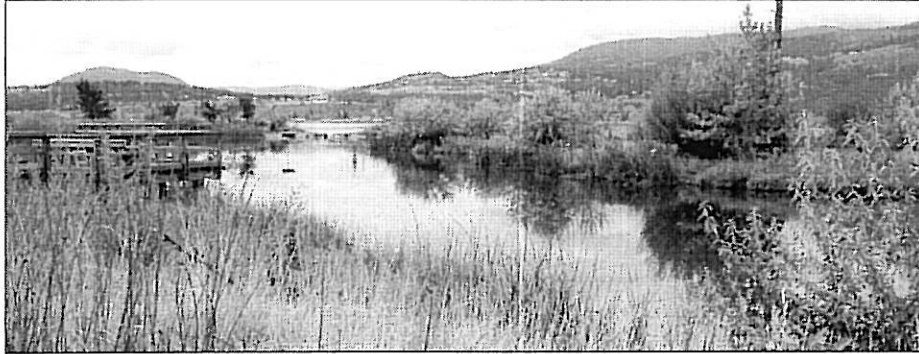
The inventory report and Geographic Information System data will generate extensive benefits in terms of both long range and current planning. In addition to highlighting their rarity, the City also obtained accurate spatial information and a qualitative and quantitative assessment for decision-making purposes. The Wetland Inventory, Classification, Evaluation and Mapping will yield immediate results in terms of processing development applications. This information will also permit land use managers and other stewards to direct development in ways that avoid alterations in surface and/or groundwater flow regimes that impact wetlands at the time of development application. Road cuts, stormwater systems, placement of fill material, compaction along slopes and through gullies and runoff from roads can all be considered based on their impact on wetlands.

In terms of policy planning, the City will also benefit from a more robust understanding of wetland resources. The inventory information can be used to facilitate the update of the City's Official Community Plan including development of adequate setback distances, and the determination of Natural Environmental Development Permit Areas.

In addition to the preventative measures, land use managers will also be in a better position to consider restoration efforts to reduce the area of wetlands either no longer properly functioning, or at risk of not properly functioning and take measures to return them to a functioning condition. The baseline inventory information can also assist in developing performance standards (i.e. quantifiable attributes) to determine when protection and restoration efforts have been successful. Finally, the inventory can be used to determine compensation ratios to ensure 'no net loss' when avoidance and mitigation are unsuccessful.



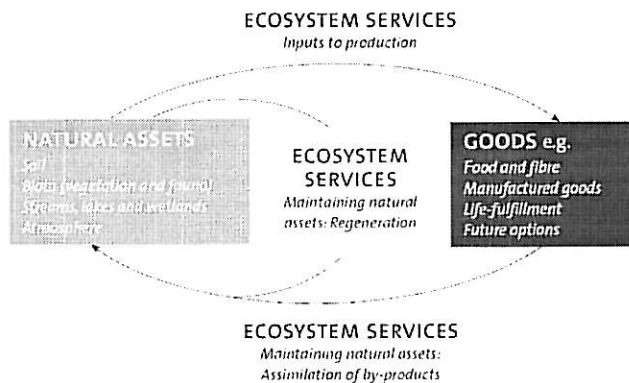
# Ecological Inventory and Mapping in the City of Kelowna



**Greg Sauer**  
Land Use Planner

Land Use Management Department  
City of Kelowna

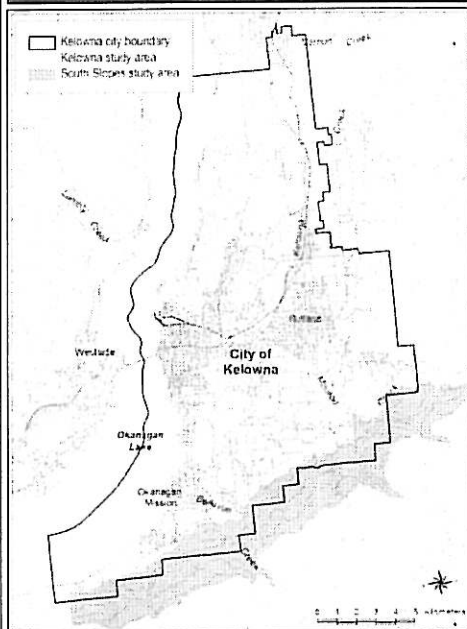
## Why Inventory and Map Ecosystems?



## Why Inventory and Map Ecosystems?



## Sensitive Ecosystem Inventory



**A standardized inventory of sensitive ecosystems that are relatively unmodified, and are ecologically fragile or are recognized as being rare in the provincial landscape.**

### **Sensitive Habitat Inventory and Mapping**



**The collection and mapping of reliable, high quality, current and spatially accurate information about local habitats and watercourses.**

### **Wetland Inventory, Classification, Evaluation and Mapping**



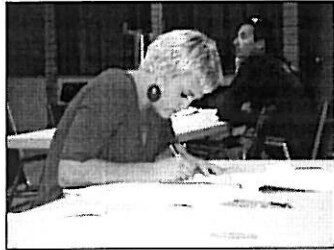
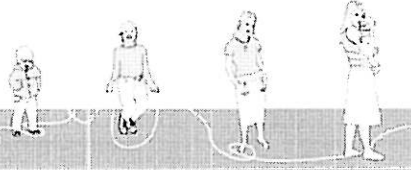
**The collection and mapping of current and spatially accurate habitat information about Kelowna wetlands.**



## Moving Forward

KELOWNA  
**2030**

greening our future



## Communications



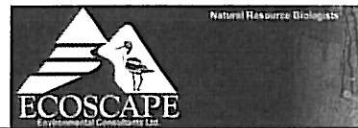
# WETLAND

## *Inventory and Mapping*

*Status and Condition of Kelowna Wetlands – A summary of an inventory on some of the rarest and yet most biologically significant and diverse communities in Kelowna using a new spatial GIS inventory approach.*



Presented by: **Kyle Hawes, R.P.Bio.**  
Natural Resource Biologist



## Project Partners



Ducks Unlimited Canada  
CANADA'S CONSERVATION COMPANY



Okanagan Basin  
WATER BOARD



## Wetlands

*What is a Wetland?*

A wetland is defined as land that is saturated long enough to promote wetland or aquatic processes indicated by slow to imperfectly drained soils, hydrophytic vegetation and biological activity, which are adapted to a wet environment.



## Wetlands

### Significant Habitat Areas and Imperiled

Over 84 percent of the Okanagan valley bottom wetland and riparian habitats lost in the Okanagan and Similkameen Valleys  
(Lea, 2008)

Percentage losses estimated to be higher in the Kelowna area than for the whole Okanagan valley

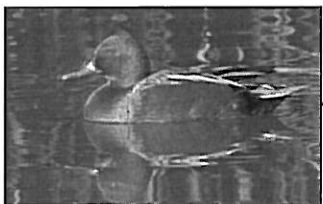


## **Wetlands**

### **Significant Habitat Areas and Imperiled**

Very high biodiversity value

Over 80 percent of wildlife are either directly dependent on wetland and riparian ecosystems, or use them more frequently than other habitats



## **Wetlands**

### **Significant Habitat Areas and Imperiled**

These ecologically significant areas continue to be lost to land use practices

Many of the remaining communities are highly fragmented and in poor functioning condition



## Wetlands

Those that remain should have high conservation priority premised simply on the fact that the hydrologic conditions support wetland development and that these disturbed/modified sites have a moderate to high capability for rehabilitation and enhancement.

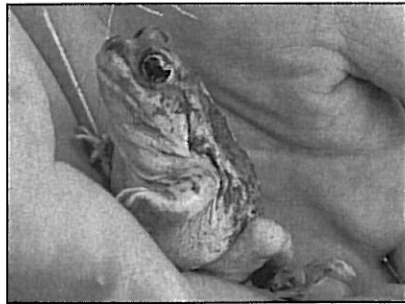


Photo by: Kyle Hawes

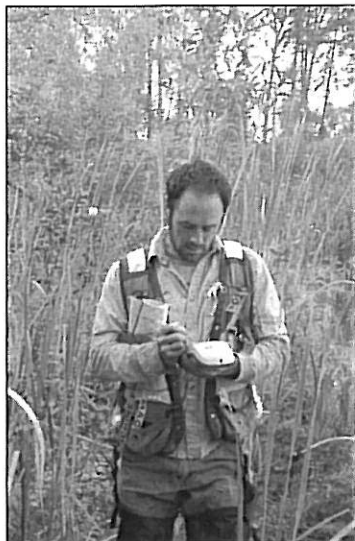
## The Issue

*If we don't know where they are, how can we protect them?*

Many watercourses and critical wetland and riparian communities not identified in current mapping and in some cases do not fall within Natural Environment Development Permit Areas

Some watercourse information spatially inaccurate (not in right location)

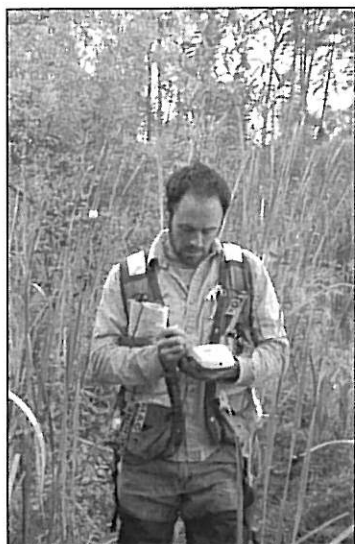




## Purpose and Application

Map and identify the spatial extent of wetland and floodplain associations not previously catalogued within the Kelowna city limit

Work within an interactive Geographical Information System (GIS) to provide useful map products for analysis and effective communication

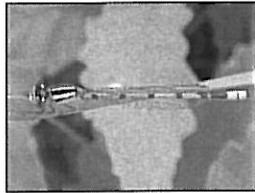


## Purpose and Application

Integrate property boundaries, land parcels, and road networks with locations of wetlands

Help guide management decisions and priorities with respect to wetland habitat restoration and enhancement projects

Provide baseline mapping data for future monitoring activities

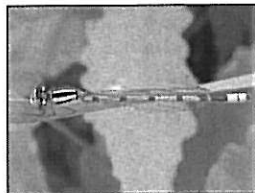
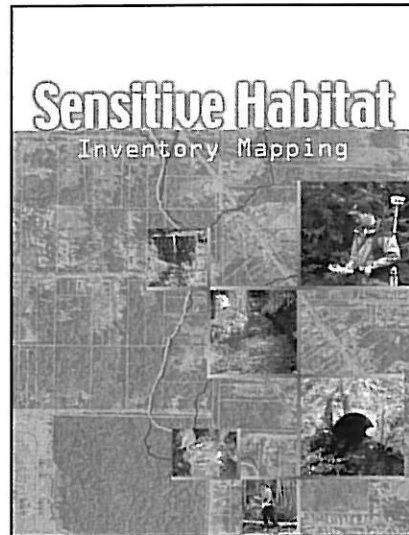


## Technical Approach

Collection Methods adapted Sensitive Habitat Inventory and Mapping (SHIM) Standards (Mason and Knight, 2001)

[http://www.shim.bc.ca/methods/SHIM\\_Methods.html](http://www.shim.bc.ca/methods/SHIM_Methods.html)

Data Dictionary revamped to include comprehensive wetland community classification elements



## Similar Projects

Sensitive Habitat Inventory and mapping (SHIM) has been completed by Ecoscape and others on watercourses throughout the Okanagan Valley.

> 120km of Streamline surveyed by Ecoscape in Kelowna.



# Community Outreach

SHIM and WIM Data provided to the Community Mapping Network: <http://cmnbc.ca>

**Sensitive Habitat Inventory and Mapping**

**Discharge Report**

View Discharge Information			
Discharge Type	Storm Drain	Culvert Material	Culverts
Storm	Left	Length	5.0
	1.0	Shape	2.0
	1.0	Temperature	1.0
Material	Concrete	Phone Number	6037214
Comments	High turbidity discharge with total disperse no precipitation treatment		



## Methods

### Wetland Classes

Methods adapt Canadian Wetland Classification System (Warner and Rubec, 1997) and the BC Wetland Classification System (MacKenzie and Moran, 2004).

Together these community variables are directly transferable to provincial TEM (Terrestrial Ecosystem Mapping) systems and standard best practices for mapping and identifying environmentally sensitive and important habitat areas



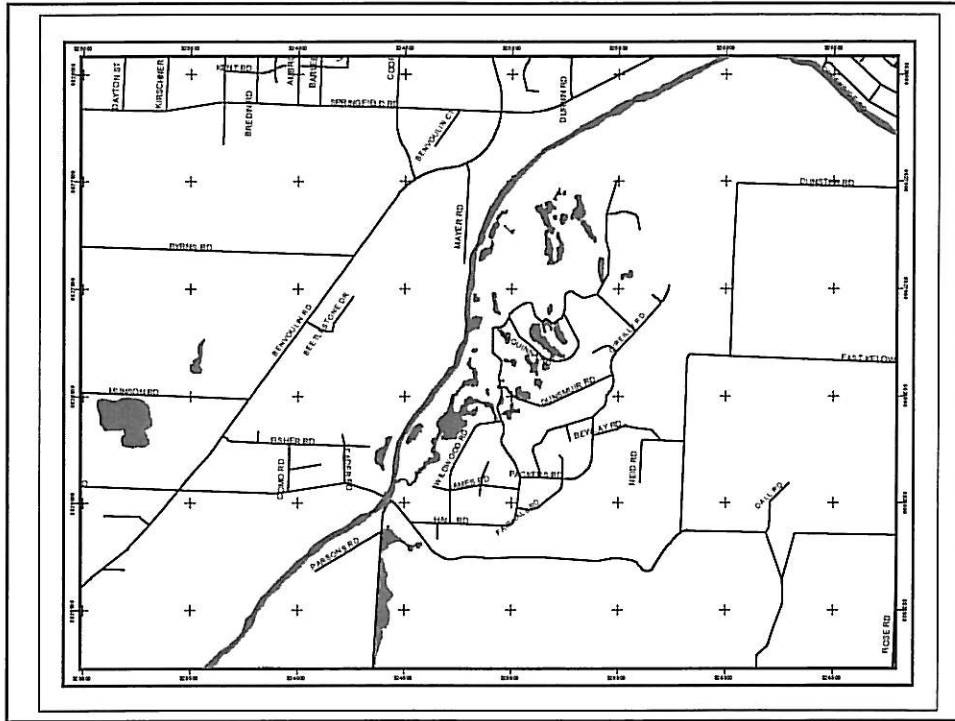


Photo by Kyle Hovens

## Wetland Communities

Natural Condition = 24%


Modified = 74%

Constructed = 2%

*\*Based on wetland area*








## Biodiversity

The importance of invertebrates in wetlands is sometimes overlooked.

Many insects are dependant on wetlands, and serve as a vital food source for other animals, both in their larval stages and as adults (e.g., caddisflies, mayflies and dragonflies spend their whole life cycles in and around wetlands.

Butterflies congregate around wet soil to drink and as part of their nuptial behavior. Pollinators such as bees require free water for drinking.

Mosquitoes and midges provide a vital food source both in their larval and adult (flying) stages to a variety of birds and bats



## Functional Rating

*Overview*

Over 50% of remaining wetlands are At Risk (Functionally) from development encroachment/infilling/draining, fragmentation (from upland habitats and other functionally connected wetlands), contamination, alteration of hydrology, invasive plants and animals etc.

Wetland Condition within Kelowna:  
Proper Functioning Condition: 40%  
Functioning Condition/At Risk: 56%  
Non-Functioning Condition: 4%



Photo by Kyle Hawes

## Wetland Dynamics

Appreciate the dynamic nature of wetlands and how they may change with fluctuations in climatic conditions. Many of these communities have poorly defined boundaries and, coupled with anthropogenic disturbance and hydrologic alteration, are transitional between wetland and upland associations.

Potholes and shallow lakes in semi-arid regions such as the Okanagan often experience dramatic water table fluctuations in response to climatic cycles

Favourable to many marsh species Banner and Mackenzie (2000).



## Dynamic Ecosystems

*Allow them to be...and establish functional objectives in urban wetlands*

In urban landscapes wetlands, although they may have their boundaries protected, still follow a natural succession - eventually filling in as organic material and sediments accumulate

Need to consider adaptive management in some existing urban wetland ecosystems to achieve long term functional objectives in some instances to account for these artificial static boundaries

# Acknowledgements

The following individuals are recognized for their review and editorial comments :

<b>Carmin Cadrin</b>	Vegetation Ecologist, Ecosystem Branch, Ministry of Environment
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<b>Drew Kaiser</b>	Biologist, Golder and Associates
<b>Jan Kirkby</b>	<i>Landscape Ecologist, Environment Canada Canadian Wildlife Service Pacific and Yukon Region</i>
<b>Heather Larrat</b>	Limnologist
<b>Brad Mason</b>	Senior Habitat Inventory Biologist Oceans & Watershed Planning & Restoration Habitat and Enhancement Branch Fisheries and Oceans Canada
<b>Ian Ramsay</b>	Biologist, IC Ramsay and Associates
<b>Harriet Rueggeberg</b>	Environmental/Land Use Planner B.Sc., M.Sc., MCIP, LANARC
<b>Jo-Anne Stacey</b>	Ecologist, BC Conservation Data Center, Ministry of Environment

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# City of Kelowna Sensitive Ecosystems Inventory



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## Presentation

1. Inventory Objectives
2. Methods
3. Results

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## Inventory Objectives

- Map ecosystems, terrain stability, and soil erosion in the City of Kelowna
  - update pre-existing mapping for the South Slopes
- Provide scientific information for urban and rural planning to support:
  - sustainable land management
  - conservation and land stewardship

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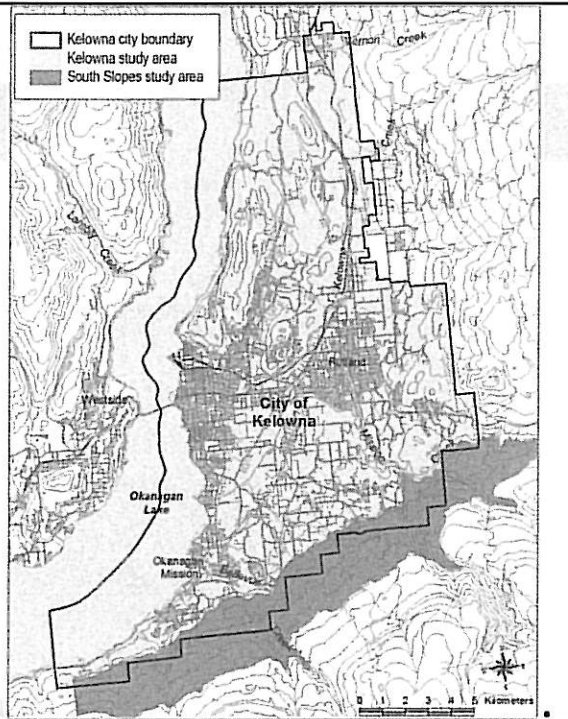
## Why are Sensitive Ecosystems Important?

- |  |   |
|--|---|
| • Ecological Values:   | • Social & Economic Values:                     |
| – Rarity <ul style="list-style-type: none"><li>• rare species, and plant communities</li></ul> | – Clean water and water retention               |
| – Fragility  | – Green space, scenery, recreation, eco-tourism |
| – High biodiversity  | – Education                                     |
| – Specialized habitats   | – Grazing and logging                           |
|  | – Increased property values                     |

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## Study Area



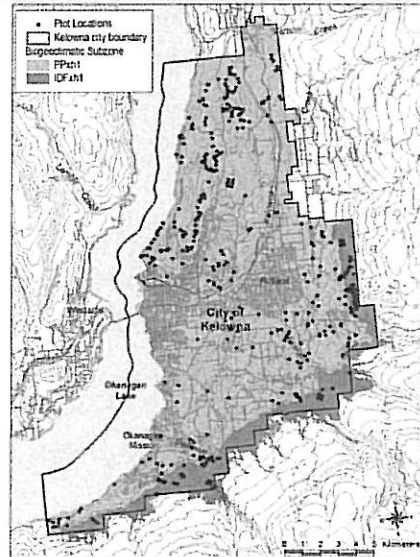
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## What is a Sensitive Ecosystems Inventory?

- Standardized approach used in:
    - Vancouver Island, Sunshine Coast, and North & South Okanagan
    - Now a provincial standard
  - Based on Terrestrial Ecosystem Mapping
    - Provincial standard
    - Bioterrain mapping base
    - Extensive field verification
  - Composite mapping of Sensitive Ecosystems
- •  
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## Terrestrial Ecosystem Mapping

- Verified by field data
  - 169 plots
  - Conservation assessment
  - Focus on sampling sensitive ecosystems
  - Verify terrain stability and soil erosion potential mapping
  - Completed only for lands with permission for access, except for roadside views

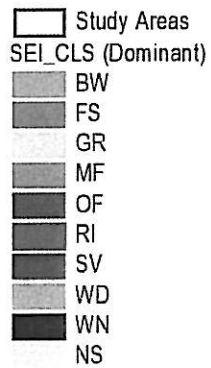


## Sensitive Ecosystems Mapping

- Each terrestrial ecosystem map (TEM) unit is evaluated for at-risk status and ecological sensitivities
- Grouped TEM units into Sensitive Ecosystems Units
- Apply to TEM polygons in GIS
- Create sensitive ecosystems map & database



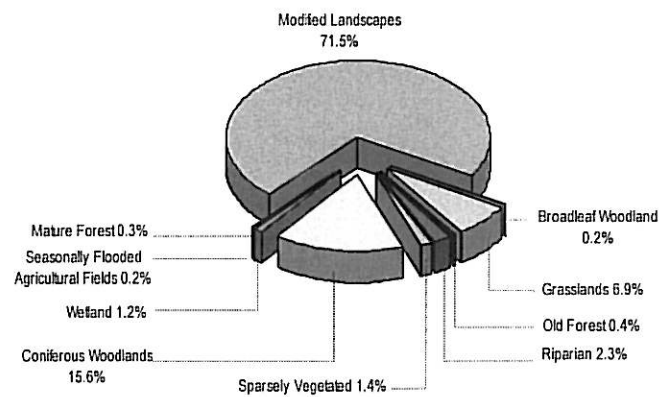
## SEI Map



## SEI Summary Results

28.0%  
Sensitive  
Ecosystems

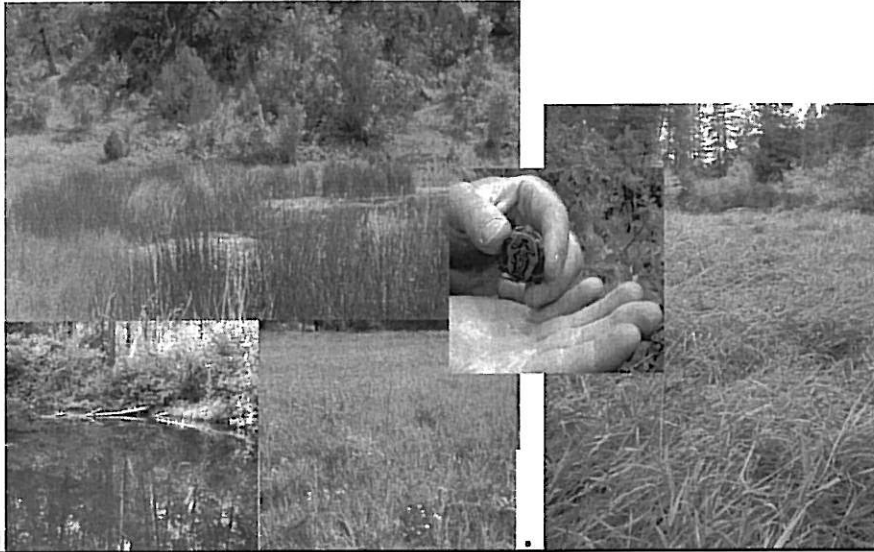
0.5%  
Other  
Important  
Ecosystems



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## Wetlands

1.2% of study area; 251 ha  
46.5% loss since 1800



⋮

## Riparian

2.3% of study area; 488 ha  
92.3% loss since 1800



⋮

# Old Forest

0.4% of study area; 86 ha  
1800 ~ 39% of study area



⋮

⋮

# Grasslands

7%; 1490 ha  
73%+ loss since 1800



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•

**Broadleaf Woodlands** 0.2%; 47 ha  
77.0% loss since 1800



•  
•  
•

**Coniferous Woodlands** 15.6%  
3354 ha



⋮

**Sparsely Vegetated** 1.4%; 291 ha  
29.8% loss since 1800

⋮

⋮

**Other Important Ecosystems**

**Mature Forest**  
0.3%  
71 ha

**Seasonally Flooded Agricultural Fields**  
0.2% 32 ha

⋮

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## What Can We Do?

- Develop a conservation strategy:
  - Prioritize sites
  - Network of ecosystems and linkages
  - Designate Sensitive Ecosystems as Environmentally Sensitive Areas (ESAs) and Development Permit Areas (DPAs)
  - Density bonus zones and cluster housing zones adjacent to ESAs
  - Strategic land acquisition, stewardship, covenants

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