Sensitive Ecosystems Inventory: Coldstream – Vernon, 2007

Volume 1: Methods, Ecological Descriptions, Results, Conservation Analysis, and Management Recommendations

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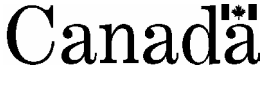

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Allison Haney and ***Mike Sarell***[7] compiled wildlife species lists for this report.

This project has adapted material from the reports for the Bella Vista – Goose Lake Range Sensitive Ecosystems Inventory[8] (SEI), Vernon Commonage SEI[9], Lake Country SEI[10] and Central Okanagan SEI[11].

Patrick Allen provided accommodation for the field crew.

We would like to thank the many landowners that gave us permission to access their lands for field sampling.

Allison Haney reviewed the draft version of this report.

[1] The mission of the Real Estate Foundation is to support sustainable real estate and land use practices for the benefit of British Columbians.
[2] Iverson & MacKenzie Biological Consulting Ltd.
[3] Polar Geoscience Ltd.
[4] Makonis Consulting Ltd.
[5] Ophiuchus Consulting
[6] Baseline Geomatics Inc.
[7] Ophiuchus Consulting
[8] Iverson 2003
[9] Iverson 2005
[10] Iverson 2006
[11] Iverson and Cadrin 2003

Abstract

The Okanagan Basin of British Columbia has very high biodiversity, including many vulnerable, rare and endangered species and plant communities. A high diversity of ecosystems occurs in close proximity, providing habitat for many species. The region has been subject to extensive agricultural conversion, intense human settlement pressure, extensive spread of invasive alien plants, uncontrolled motorized recreation, selective logging of old trees, and forest ingrowth and encroachment of trees onto grasslands associated with fire exclusion.

The Coldstream - Vernon area is the last remaining area of the north Okanagan Valley to complete a Sensitive Ecosystems Inventory (SEI). The study area includes all of the District of Coldstream, portions of the City of Vernon and all of Kalamalka Lake Park, Kalamalka Lake Protected Area, and Cougar Canyon Ecological Reserve. The area is a vital portion of the north – south corridor in the Okanagan Valley and is facing further rural and urban development pressures.

The Coldstream - Vernon SEI was initiated in 2005 to provide inventory information on rare and fragile ecosystems that can be used for ecologically sustainable land use and development planning. We used Terrestrial Ecosystem Mapping (TEM) as a base to develop a Sensitive Ecosystems theme map. The inventory was compiled through aerial photograph interpretation and field sampling in the summer of 2007. Draft ecosystem mapping was completed in 2006 and was revised in the fall and winter of 2007 – 2008 following field sampling. The project area covers private land, provincial parks, protected areas and ecological reserves, and small areas of crown land. This technical report documents inventory methods and results, the conservation analysis, and provides management recommendations.

Thirty-five percent of the study area is comprised of sensitive ecosystems (SE); four percent of the area was included in the other important ecosystem (OIE) categories. Wetlands, old forests, and broadleaf woodlands were extremely rare in the study area; riparian and sparsely vegetated ecosystems were very uncommon. Although greater areas of intact grasslands and coniferous woodlands remained, much of the area was covered by altered ecosystems including extensive urban and rural human settlements, agricultural fields, and young forests or cut blocks.

Many of the sensitive ecosystems are at high risk from human settlement, including loss, fragmentation, agricultural conversion or further degradation by human use and invasion by non-native plants. Although many sensitive ecosystems are also protected within Kalamalka Lake Park, Kalamalka Lake Protected Area, and Cougar Canyon Ecological Reserve, these areas require management of ingrowth, encroachment and invasive plants to retain or regain all values associated with them. It is also important to maintain connectivity between these protected areas and adjacent private and crown lands. Within the entire study area, many forested areas have become thick with ingrowth and are at risk of loss to catastrophic wildfires. Many grasslands have invasive alien plants in them and some have trees encroaching onto them. Sensitive and other important ecosystems provide many social values including recreation opportunities and increased property values. With the study area supporting many remaining rare and fragile ecosystems, it is paramount to balance the retention and ecological sustainability of sensitive ecosystems with sustainable land development.

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Using the Report

This report presents information on sensitive ecosystems in the District of Coldstream, portions of the City of Vernon and Kalamalka Lake Park, Kalamalka Lake Protected Area and Cougar Canyon Ecological Reserve of the North Okanagan Valley, and provides guidance regarding their conservation and management.

Chapter 1: Introduction sets the context of the SEI project by describing the importance of both biodiversity and the study area.

Chapter 2: Ecosystems of concern outlines the importance of sensitive ecosystems, and the need for concern about them.

Chapter 3: Impacts of concern describes the types of impacts that threaten sensitive ecosystems.

Chapter 4: Methods and limitations explains how the mapping was completed and limitations of the mapping.

Chapter 5: Inventory results describes and shows a map of the status of sensitive ecosystems in the study area.

Chapter 6: Conservation analysis describes the methods used in the conservation analysis and the results of the analysis.

Chapter 7: Planning and management outlines conservation and land management planning options for the City of Vernon, Regional District of North Okanagan, and landowners.

The Okanagan Sensitive Ecosystems Inventory Conservation Manual[12] provides detailed information on conservation tools that are directly applicable to ecosystems in the North Okanagan.

Chapters 8 through ***16*** profile each of the seven sensitive ecosystems and two other important ecosystems. Each chapter describes the specific ecosystem, and its status and importance in the study area. Impacts and management recommendations specific to the ecosystem are also discussed.

Chapter 17: Future directions presents recommendations for using the SEI, updating SEI products, and extending the inventory's coverage.

There are two companion volumes to this one for people who need or are interested in more technical information on ecosystem mapping (Volume 2) and wildlife habitat mapping (Volume 3).

Volume 2[13] provides detailed information on ***terrestrial ecosystem mapping*** (TEM) methods and gives descriptions of each of the ecosystems that occur within the sensitive ecosystems or

[12] Iverson et al. 2008
[13] Iverson and Uunila 2008

other important ecosystems categories. Appendix B of Volume 1 provides tables that can be used to cross-reference between sensitive and other important ecosystems units and ecosystem mapping units in the ecosystem mapping report.

Volume 2 includes information on methods, results and recommendations for the ***terrain mapping,*** including terrain stability and erosion potential mapping. It is intended for use by professionals that require more detailed ecological and terrain information. It is recommended for use by people interested in developing other interpretive map themes from the ecosystem or terrain mapping.

Volume 3[14] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following ten species: Great Basin Spadefoot (*Spea intermontana*), Painted Turtle (*Chrysemis picta*), Western Rattlesnake (*Crotalus oreganus*), Gopher Snake (*Pituophis catenifer* ssp*. deserticola*), Western Screech-owl (*Megascops kennicottii* ssp*. macfarlanei*), Long-billed Curlew (*Numenius americanus*), Yellow-breasted Chat (*Icteria virens*), Grasshopper Sparrow (*Ammodramus savannarum*), Swainson's Hawk (*Buteo swainsoni*), and Badger (*Taxidea taxus jeffersonii*). All of these species are considered at risk in the province of B.C. and most are listed under the federal Species at Risk Act. These species provide a cross-section of threatened or endangered amphibians, reptiles, birds, and mammals that depend on a range of different ecosystems in the study area. There are many other threatened and endangered species that likely occur in the study area and are listed in Appendix C of Volume 1, and in each ecosystem chapter of Volume 1 in which they are most likely to occur.

Wildlife habitat mapping portrays the potential importance of each ecosystem to specific animal species through a species-habitat model. The model assigns ratings to different ecosystem units from the TEM based on the needs of the species for particular life requisites. These ratings are displayed on the wildlife habitat maps. Volume 3 is intended for professionals who require more detailed information on wildlife habitat values in the study area than Volume 1 provides.

[14] Haney and Sarell 2008

1 Introduction

The Okanagan Valley is an area of tremendous biological, ecological and geological diversity. However, many ecosystems have been lost, significantly modified, or fragmented; these ecosystems continue to be primarily threatened by urban and agricultural development. The valley provides a vital north – south corridor connecting the Great Basin to the south with other dry interior valleys of British Columbia. The Coldstream – Vernon area includes the Coldstream Creek Valley and slopes, important protected areas along the east side of Kalamalka Lake, and significant natural areas on the east and north side of the City of Vernon. These areas are important for maintaining connectivity in the valley and have a diverse assemblage of relatively intact ecosystems that support many species at risk and other important species.

The Ministry of Environment initiated this project to complete an inventory information base and conservation analysis to support sound land management decisions and promote effective stewardship of sensitive ecosystems in the North Okanagan. The project provides the District of Coldstream, City of Vernon and Regional District of North Okanagan with data that can be used in revising their Official Community Plans and provides information to input into Neighbourhood and Parks Plans. It also provides information for the Ministry of Environment to use in managing parks and protected areas. This product contributes to the tools and information required to develop and assess broad conservation and development options for the study area.

This report describes inventory methods and results, rare and fragile ecosystems of the Coldstream – Vernon area, highlights their values and importance, and offers practical advice on how to best avoid or minimize damage to them.

The Coldstream - Vernon SEI follows from the Vernon Commonage SEI[15], Bella Vista – Goose Lake Range SEI[16], Lake Country SEI[17], Central Okanagan SEI[18], and Vancouver Island SEI[19]. Many of the materials in this report have been adapted from the reports of those SEI projects.

1.1 Study Area

The study area (Figure 1) lies within the north Okanagan Valley of south-central British Columbia. It is bounded by the extent of the City of Vernon in the north, the Bella Vista – Goose Lake Range and Vernon Commonage in the west, District of Coldstream in the east, and the District of Lake Country in the south. The area covers 21 195 ha and includes private land, provincial parks, protected areas and ecological reserves, and small areas of provincial crown land.

[15] Iverson 2005
[16] Iverson 2003
[17] Iverson 2006
[18] Iverson and Cadrin 2003
[19] McPhee et al. 2000

The study area lies within the Okanagan Very Dry Hot Ponderosa Pine (PPxh1)[20], the Okanagan Very Dry Hot Interior Douglas-fir (IDFxh1), the Kettle Dry Mild Interior Douglas-fir Variant (IDFdm1), the Shuswap Moist Warm Interior Douglas-fir (IDFmw1), and the Okanagan Dry Mild Montane Spruce (MSdm1) biogeoclimatic variants[21] (Figure 1 below). It is part of the northern extension of the Columbia Basin that extends south to Oregon and lies within the Northern Okanagan Basin ***Ecosection***[22], a wide trench formed by parallel fault lines and further carved out by multiple glaciations, the Northern Okanagan Highland Ecosection (NOH), a cool, moist, transitional mountain area, dominated by a rolling upland, and Shuswap Basin Ecosection (SHB) in the higher elevations above the NOB north of Coldstream Creek.

The Okanagan Valley experiences some of the warmest and driest weather conditions in the province. The valley lies in the rain shadow of the Coast and Cascade Mountains; this results in low precipitation in both winter and summer. In summer, hot dry air moves in from the Great Basin to the south, and very hot temperatures are common; however, the presence of Okanagan Lake and Kalamalka Lake (large, glacial-relic lakes), moderates these temperatures somewhat by cooling the air in summer and warming it in winter. In the highlands on the east side of the valley, the climate is moister and cooler.

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[20] The BC Ministry of Forests ***Biogeoclimatic Ecosystem Classification*** (BEC) is a system of classifying vegetation based on climatic and topographic patterns. The BEC system was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest and range management. See Pojar et al. 1987 for further information.

[21] The BC Ministry of Forests ***Biogeoclimatic Ecosystem Classification*** (BEC) is a system of classifying vegetation based on climatic and topographic patterns. The BEC system was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest and range management. See Pojar et al. 1987 for further information.

[22] An ***Ecosection*** is a subdivision of an Ecoprovince and is an area with minor physiographic and macroclimatic or oceanographic differences.

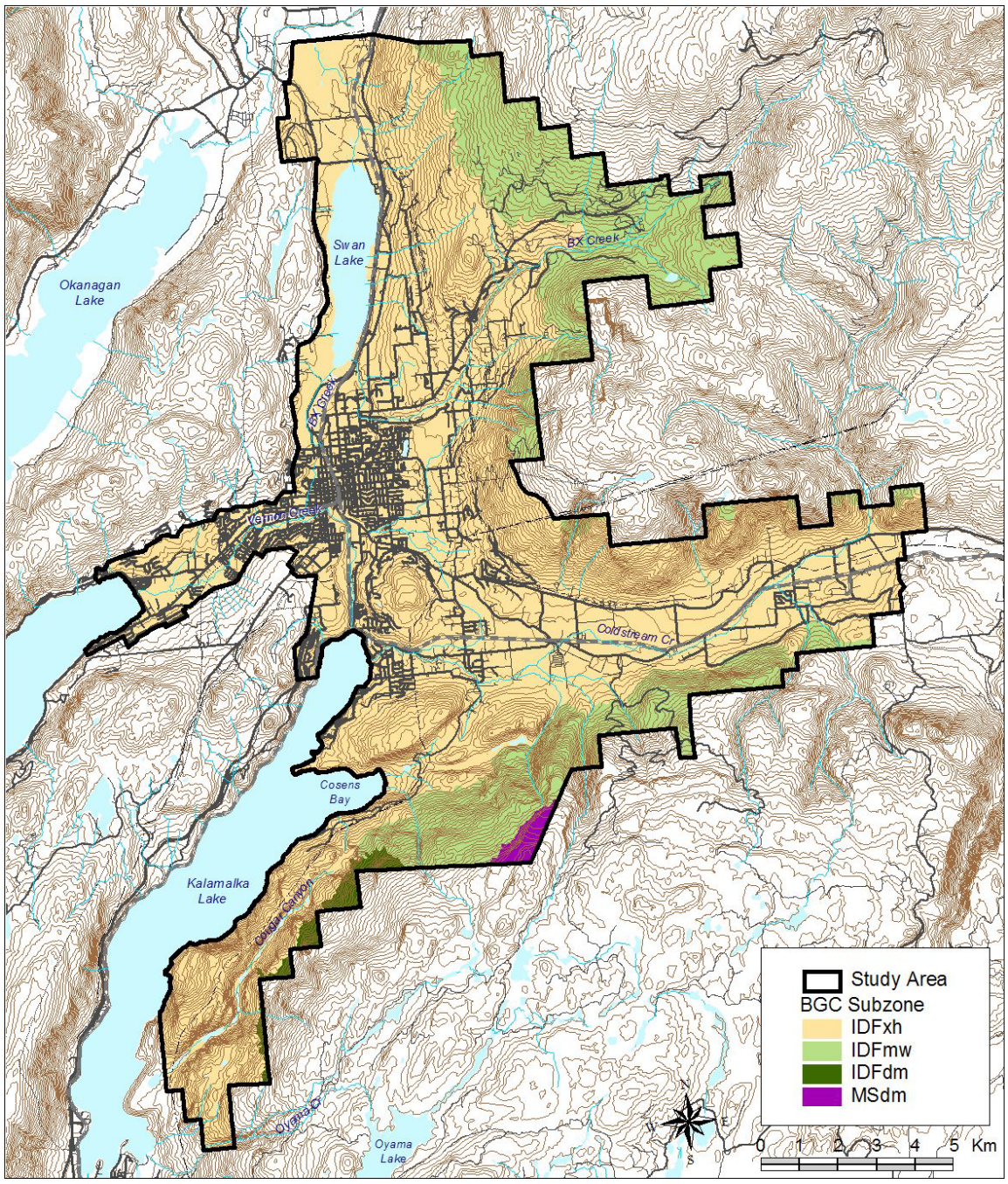

Figure 1. Map of the Coldstream – Vernon SEI study area. Study area boundary is shown in black. Biogeoclimatic subzones are also shown.

1.2 Ecological Importance of the Study Area

The Okanagan Valley is a region of nearly unparalleled biological diversity within British Columbia, Canada, and North America. The complex terrain of the area, combined with a semi-arid climate moderated by the influence of Okanagan Lake and other large lakes has resulted in a wide diversity of ecosystems and organisms in relatively close proximity to one another. The terrain and presence of glacial-relict lakes distinguish the Okanagan Valley from the broad Columbia Basin to

the south. Increasingly, scientists are finding that populations of species at the edge of their range, such as those in the Okanagan, are likely to persist longer than core populations during population declines. This phenomenon may allow these populations to adapt to future changes such as global warming[23].

The Okanagan Valley is a north to south corridor that connects the dry interior valleys of British Columbia to southern grassland ecosystems of the Columbia Basin in the U.S. The valley is a corridor for migrating birds and a point of entry for organisms entering into B.C.'s dry interior from the Columbia Basin.

The Coldstream - Vernon area has many natural features that provide the potential for long-term ecological integrity (or viability) of many endangered species and sensitive ecosystems. The area may be an important area for the northward migration of species during global warming. The area also provides many community values including aesthetics, hiking, and observing wildlife and nature.

Figure 2. Overview of Coldstream Creek portion of the study area.

[23] Scudder 1991

2 Ecosystems of Concern

2.1 What are Sensitive Ecosystems?

This sensitive ecosystems project recognises both ***sensitive ecosystems*** (SE) and ***other important ecosystems*** (OIE) in the study area. *Sensitive ecosystems* refer to seven ecosystem types (Table 1) that are ecologically fragile or are rare in the provincial landscape and are relatively unmodified by human influences[24] (Table 1). These sensitive ecosystems are generalised groupings of ecosystems that share many characteristics, particularly ecological sensitivities, ecological processes, rarity, and wildlife habitat values. These categories follow the provincial Standard for Mapping Ecosystems at Risk in British Columbia[25].

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 (Table 2).

Within developed landscapes, sensitive and other important ecosystems provide natural areas with intrinsic value and critical habitats for many species. They provide ecological functions that regulate the climate, clean freshwater, regulate and clean soils, maintain genetic diversity, maintain the water cycle, recycle nutrients, and pollinate crops. They are vital in creating healthy and attractive communities for people.

Table 1. Sensitive ecosystems mapped in the study area including the code, name and description.

Code	Sensitive Ecosystems	Ecosystem Description
WN	Wetlands	Non-forested ecosystems where the water table is at or near the surface; **marshes** (WN:ms), **swamps** (WN:sp), and **shallow open water** (WN:sw) ecosystems including ponds.
RI	Riparian	Ecosystems in gullies with intermittent or permanent creeks (**gully**, RI:gu); beaches (**beach**, RI:be), bench riparian ecosystems along floodplains (**bench,** RI:fp), and fringe ecosystems associated with pond and lake shorelines (**fringe**, RI:ff).
OF	Old Forest	Forest ecosystems dominated by large, old coniferous trees (**coniferous**; OF:co) or old broadleaf and coniferous trees (**mixed**; OF:mx); excludes old riparian forests; includes old Coniferous Woodlands and old Broadleaf Woodlands.
GR	Grasslands	Ecosystems dominated by bunchgrasses (**grassland**; GR:gr), invasive alien plants and bunchgrasses (**disturbed grassland**; GR:dg[26]) and **shrubland** (GR:sh) ecosystems that occur in a grassland matrix
BW	Broadleaf Woodlands	Ecosystems dominated by trembling aspen (BW:ac) occurring in depressions and moist areas in grasslands; old Broadleaf Woodlands are part of the Old Forest category.
WD	Coniferous	Open stands of Douglas-fir or ponderosa pine, often on shallow soils, with typically

[24] Ward et al. 1998
[25] Ministry of Environment Ecosystems Branch 2006
[26] Previous SEI projects in the North Okanagan included disturbed grasslands as an Other Important Ecosystem

Code	Sensitive Ecosystems	Ecosystem Description
	Woodlands	grassy understories; old Coniferous Woodlands are part of the Old Forest category.
SV	Sparsely Vegetated	Shrubby rock outcrops (**shrub**; SV:sh), grassy or unvegetated **rock outcrops** (SV:ro), **talus** (SV:ta) slopes, and **cliffs** (SV:cl)

Table 2. Other important ecosystems mapped in the study area including the code, name and description.

Code	Other Important Ecosystems	Ecosystem Description
FS	Seasonally Flooded Agricultural Fields	Cultivated fields that flood annually, providing important migrating habitat for birds and habitat for other wildlife. These sites were formerly riparian or wetland ecosystems and may have some potential for restoration of these ecosystems.
MF	Mature Forest	Forests dominated by mature trees; includes **broadleaf** (MF:bd) forests, **coniferous** (MF:co) forests, and **mixed** (MF:mx) deciduous and coniferous forests; excludes mature riparian forests and mature coniferous and broadleaf woodlands

2.2 Why are these ecosystems important?[27]

The ecological attributes and socio-economic values that are common to all SEI ecosystems are discussed below. Values and attributes unique to individual ecosystems are discussed in Chapters 8 – 16.

Ecological Attributes

Rarity is a primary feature of sensitive ecosystems. Rarity can be due to limited natural occurrence or the result of human activities since European settlement in the late 1800's. Most rare species or ecological communities in the study area are considered to be rare both because they are restricted in distribution or abundance, and because their extent and densities have been reduced and fragmented.

Rare ecological communities and vertebrate species are listed for each sensitive ecosystem (Chapters 8 – 16).

The Okanagan Valley provides habitat for many species that are nationally ranked by COSEWIC[28] as endangered (E), threatened (T) or of special concern (C), or are provincially ranked as red-listed

[27] Adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[28] **COSEWIC,** the Committee on the Status of Endangered Wildlife in Canada, determines the national status of wild Canadian species, subspecies and separate populations suspected of being at risk. Endangered (E) denotes a species facing imminent extirpation or extinction. Threatened (T) denotes a species likely to become endangered if limiting factors are not reversed. (SC) denotes a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

or blue-listed[29]. The Species at Risk Act[30] provides protection for species ranked as threatened or endangered that occur on Federal land. See Appendix C for a list of at-risk wildlife species with the potential to occur in the study area.

Some ***red-listed*** vertebrate animals in the study area include:

Badger (COSEWIC-E) (*Taxidea taxus* ssp. *jeffersonii*)
Swainson's Hawk (*Buteo swainsoni*)
Western Screech-owl (COSEWIC-E) (*Megascops kennicottii* ssp. *macfarlanei)*
Yellow-breasted Chat (COSEWIC-E) (*Icteria virens*)
Grasshopper Sparrow (*Ammodramus savannarum*)

Some ***blue-listed*** animals in the study area include:

Gopher Snake (COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Racer (COSEWIC-SC) (*Coluber constrictor*)
Western Rattlesnake (COSEWIC-T) (*Crotalus oreganus*)
Painted Turtle (COSEWIC-SC) (*Chrysemis picta*)
Great Basin Spadefoot (COSEWIC-T) (*Spea intermontana*)
Great Blue Heron (*Ardea herodias*)
Long-billed Curlew (COSEWIC-SC) (*Numenius americanus*)

Conservation Data Centre

web site: http://www.env.gov.bc.ca/cdc/

Check this web site for the current provincial conservation status of rare plants, animals, and ecological communities, since the status of these changes over time.

COSEWIC

web site: http://www.sararegistry.gc.ca/

Check this web site for the current national status of rare plants and animals.

- **Fragility** is a measure of an ecosystem's sensitivity to a range of disturbance factors that can cause decline or loss of ecosystem health or integrity. Disturbances include direct physical impacts, introduction of invasive species, and fragmentation. Many of the SEI ecosystem types are fragile because they are vulnerable to invasion by invasive plants, they have soils susceptible to erosion, and they depend on complex ecological processes that are easily disrupted.
- **High biodiversity** is a common feature of most SEI ecosystems, largely because of the proximity of the Okanagan Valley to grasslands and deserts to the south, and because of the close proximity of many different types of ecosystems in the landscape. This creates an ensemble of species at risk not found elsewhere in Canada.

[29] **Red-list**: The list of British Columbia's flora, fauna, and plant communities that are rare and endangered. **Blue-list**: The list of British Columbia's flora, fauna and plant communities that are at risk because of low or declining numbers.
[30] Government of Canada 2003.

- **Specialised habitats** occur throughout the SEI ecosystems. They support many species of plants and animals. Typically, these ecosystems are critical habitats for rare, threatened or endangered species or ecological communities. Some of these occur in only a few places in British Columbia or Canada, and their loss in the Okanagan would result in the loss of biodiversity and species at risk.

Socio-economic Values

- **Ecosystem Services** including air and water filtration and purification, nutrient cycling, and crop pollination. Clean water, water retention, and groundwater infiltration are important values provided by natural areas.
- **Natural areas** networks comprised of diverse ecosystems and species of the area will provide for human enjoyment and interaction with wildlife amidst development. The area provides an attractive and aesthetic backdrop for the City.
- **High scenic values** are provided by rock outcrops, grasslands, and cliffs that provide excellent views of the landscape. These areas are often targeted for recreational and residential development. The community's natural landscape attracts visitors and new residents, and contributes towards opportunities for nature-based tourism and the unique 'sense of place', and is a source of pride and pleasure for local residents.
- **Outdoor recreation** opportunities are provided by ecosystems in public parks, and on accessible crown land where low-impact activities will not damage the habitat. Wildlife viewing is very important to Canadians[31], and contributes to our quality of life. Bird watching is among the fastest growing leisure pursuits. Hunting, fishing, trapping and guide outfitting contribute to the economy and can occur where wildlife populations can sustain them.
- **Research and nature education** are important at all levels from early childhood through to university, plus continuing education programs. Many schools are now working with local groups (e.g., Streamkeepers and Wetlandkeepers); most focus on creating native plant communities and restoring wildlife habitat. The Allan Brooks Nature Centre provides opportunities for local and regional community ecosystem conservation efforts through displays, educational programs, hands-on workshops, and conservation-based volunteer activities.
- **Nature based tourism** is growing in economic importance, and can be very important in rural communities. Economic spin-offs can include benefits to local commercial services such as overnight accommodation, food concessions, and ventures such as guided nature trips and bird watching. Annual events such as the Meadowlark Festival in the South Okanagan make significant contributions to the local economy as they attract visitors from well beyond the host community.
- **Natural resource use** such as grazing and selection harvesting of forests have supported generations of Okanagan residents and continue to be important activities in the study area. The study area is also a source of many plants traditionally used by First Nations including food plants such as balsamroot and mariposa lily.
- **Increased property value** is provided by natural areas. The beauty of the natural landscape is often a large part of what attracts people to the North Okanagan. Studies show that

[31] Environment Canada 1999

undeveloped natural areas measurably increases the value of nearby property[32] by 5 to 32%[33] and thus, contributes far more in property taxes than it costs in services[34].

3 Impacts of Concern[35]

The study area has some of the few remaining areas in the North Okanagan with relatively intact natural ecosystems. Human settlement pressures represent the greatest threat to sensitive ecosystems in the study area. Large-scale landscape concerns, which affect all ecosystems, include landscape fragmentation, disruption of natural disturbance regimes, edge effects, and invasive species introductions.

3.1 Landscape fragmentation

Fragmentation of the landscape often affects the functioning of ecosystems by disrupting connections between different ecosystems (e.g., between uplands and wetlands, resulting in changing water movement and water table levels). Fragmented ecosystems also are more susceptible to a variety of impacts, such as invasion by non-native species and increased access and inappropriate activities by people and pets. In addition, disconnected islands of natural ecosystems often cannot provide the necessary habitat values for wildlife species, which may require a number of different ecosystems for breeding, wintering, and foraging. A network of corridors that connect habitats will help to maintain habitat access, gene dispersal, and the potential for distribution of wildlife species.

3.2 Disruption of Natural Disturbance Regimes

The exclusion and suppression of natural fire has changed grassland and forest ecosystems in the study area. Ecosystems and species of the Okanagan Valley have evolved with natural fire as a major factor in ecosystem and habitat distribution. Frequent ***surface fires***[36] maintained open forests with largely grassy and shrubby understories. Fire exclusion has resulted in dense forests ingrown with Douglas-fir and ponderosa pine, and encroachment of these trees onto grasslands. Fire exclusion has affected both ecosystem processes and wildlife habitat values.

Many streams have been partly or fully channelized and no longer have natural flooding regimes. Preventing natural flood events can reduce the size, diversity, site productivity, and complexity of wetland and riparian ecosystems, alter habitat values, and can intensify flood events downstream.

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[32] Meadows 1999
[33] U.S. National Parks Service 1990
[34] Fodor 1999
[35] Adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.
[36] Surface fires are fires that burn primarily through the understory or grass and herbaceous vegetation in an ecosystem and do not burn in the overstory trees. This is in contrast to the fires of 2003 which were able to burn through the forest canopy because forests are now more closed than they were historically.

3.3 Invasive Species

Both the deliberate and accidental introduction of invasive non-native plant species (see below) has significantly altered the species composition of some ecosystems in the study area. Many grasslands have been altered by invasive plants. Some invasive animal species such as European starlings have altered wildlife populations by displacing native cavity nesting birds.

Invasive plant species reduce diversity by displacing native plant species, and by reducing vegetation diversity and soil stabilization. Invasion of non-native plants usually results in a loss of forage for domestic livestock and wildlife. Recreation vehicles such as all terrain vehicles (ATVs), bicycles, animals, and people can all spread invasive plants. Many invasive plants have seeds that can survive in the soil for decades; consequently, invasive plant control must always be considered to be a long-term process.

For this SEI, we define **invasive plant species** as non-native plants which, in the area they occur, lack the natural enemies necessary to restrict their distribution.

Noxious weeds are aggressive invasive plants that are designated under the provincial ***Weed Control Act***.

Grasslands, old forests, coniferous woodlands, and sparsely vegetated ecosystems are vulnerable to invasion by cheatgrass (*Bromus tectorum*) and other alien annual bromes (*Bromus* spp.), diffuse knapweed (*Centaurea diffusa*), and sulphur cinquefoil (*Potentilla recta*). Riparian ecosystems and broadleaf woodlands are vulnerable to invasion by common hound's-tongue (*Cynoglossum officinale*) and common burdock (*Arctium minus*). Wetland ecosystems can be completely altered if purple loosestrife (*Lythrum salicaria*) becomes established (it was not observed in the study area but is known from around Kelowna).

Some invasive plant species:

Diffuse knapweed (*Centaurea diffusa*)
Sulphur cinquefoil (*Potentilla recta*)
Cheatgrass (*Bromus tectorum*) and other annual bromes (*Bromus* spp.)
Dalmatian toadflax (*Linaria genistifolia*)
Common hound's-tongue (*Cynoglossum officinale*)
Purple loosestrife (*Lythrum salicaria*)

3.4 Edge effects

Fragmentation of ecosystems combined with adjacent development contributes to the creation of 'edges' where there is an abrupt rather than natural, gradual change from one ecosystem type to another. This edge effect can alter the habitat value of the original ecosystem by creating changes in microclimate elements such as air temperature, light level, and humidity[37]. Direct biological effects result when specific species cannot tolerate human activity nearby, or they are exposed to

[37] Chen et al. 1995; Saunders et al. 1991

predation by other species including domestic pets. Increased invasion of alien species and competition for habitat are examples of indirect biological edge effects.

The study area is influenced by edge effects adjacent to rural developments and the urbanized portion of the City of Vernon. The agricultural fields in the study area provide a much softer edge than urban development. These agricultural areas still provide some habitat values, including places for wildlife to traverse to other habitats. Additional urban growth, roads, and other land development within the study area have the potential to increase edge effects.

3.5 Direct Impacts

Direct impacts to ecosystems are those which occur on site, and which have the most immediate and visible effect. Vegetation removal or damage, and soil removal or compaction, are examples of immediate and visible effects. Ditching, diking, draining and filling of wetlands and riparian areas are visible effects which also result in long-term indirect effects on water movement and water levels. Disturbances to wildlife species, particularly during the breeding season can directly impact their survival. Although it may seem like large rural lots have the potential to retain many natural values, many owners choose to remove native vegetation and natural features, and intensely graze domestic animals (e.g., horses). Degradation and fragmentation of these areas also leaves them more vulnerable to the introduction and spread of invasive alien plants. All of these possible changes reduce the ecological integrity and natural values of these areas.

3.6 Indirect Impacts

Activities that occur adjacent to or at some distance from the ecosystem result in indirect impacts. Hydrological[38] changes due to roads, buildings, irrigation[39], deforestation, removal of vegetation, invasive plant species, increased impervious road surfaces, soil compaction and agricultural practices can all result in reduced groundwater infiltration and summer soil moisture, increased annual runoff, disrupted drainage patterns, and reduced soil moisture holding capacity. These hydrological changes can change the water quality and function, structure, and wildlife habitat values of adjacent wetlands and riparian areas.

Water pollution from both point and non-point sources contributes to reduced water quality, potential outbreaks of water-borne disease, and impacts to wildlife populations through the loss of habitat and disruption of the food chain. The use of fertilizers and pesticides associated with agriculture and landscaping has also caused degradation of natural ecosystems and wildlife habitat[40].

The presence of humans and their pets, even on private property can cause disturbances to wildlife. Recreational activities involving all terrain vehicles (ATVs), dirt bikes, off-road vehicles, and mountain bikes create soil disturbances that allow rapid invasion and spread of invasive plants.

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[38] Water-related features and processes.

[39] The effluent spray irrigation program is the most extensive disruptive hydrological influence in the study area. In addition to the affects noted above, it also likely increases nutrient levels in water bodies, changes plant composition, promotes algal growth, and reduces oxygen levels.

[40] Cannings and Durance 1998

They can also disturb wildlife, and cause soil erosion and damage to plants. Similarly, domestic pets such as cats and dogs may predate or harass wildlife.

4 Methods and Limitations

This chapter describes the methods that were used to generate the sensitive ecosystems map. These methods largely follow those used in the Central Okanagan, Bella Vista, Vernon Commonage and Lake Country but have been altered slightly to meet the Standard for Mapping Ecosystems at Risk in British Columbia[41]. The provincially recognised Terrestrial Ecosystem Mapping[42] (TEM) approach was used to create a base map. Ecosystems were evaluated for rarity and ecological sensitivity, and a sensitive ecosystems theme map was developed.

4.1 Terrestrial Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) formed the foundation of the thematic sensitive ecosystems map that was created for this project. Polygons were drawn on 1:15,000 aerial photographs around areas of relatively uniform vegetation, topography and terrain features. Ecosystem, terrain, and conservation evaluations were recorded in a polygon database. The polygons were digitized and compiled in a geographic information system (GIS), and linked to the polygon database.

Details on methods, results, limitations and management recommendations for Terrestrial Ecosystem Mapping and terrain mapping can be found in **Volume 2**[43].

Details on methods, results, limitations and management recommendations for wildlife suitability mapping can be found in **Volume 3**[44].

4.2 Sensitive Ecosystems Mapping

TEM units were evaluated for rarity and ecological sensitivity and were assigned to sensitive ecosystems and other important ecosystems categories accordingly. Most TEM units were assigned to the same sensitive ecosystems as in other Okanagan SEIs (Central Okanagan[45], Bella Vista[46], Vernon Commonage[47], and Lake Country[48]). The exception includes the treatment of grasslands: units formerly assigned to **disturbed grasslands** (DG), an 'other important ecosystem' in previous projects, were assigned to the disturbed grasslands subclass of **grasslands** (GR:dg) and are now considered a sensitive ecosystem in the provincial Standard for Mapping Ecosystems at Risk in British Columbia[49]. Furthermore, disturbed grasslands were formerly restricted to

[41] Ministry of Environment Ecosystems Branch 2006
[42] Resources Inventory Committee 1998
[43] Iverson and Uunila 2008
[44] Haney and Sarell 2008
[45] Iverson and Cadrin 2003
[46] Iverson 2003
[47] Iverson 2005
[48] Iverson 2006
[49] Ministry of Environment Ecosystems Branch 2006

grasslands with 20-50% non-native plants and have now been defined as grasslands with approximately greater than 50% non-native plants.

Finally, cultivated fields that occurred in areas that were formerly riparian or wetland ecosystems and likely flood in most years were mapped as "Seasonally Flooded Agricultural Fields" (FS), an 'other important ecosystem'. Any TEM units not mapped in earlier map projects were evaluated for rarity and ecological sensitivity and assigned to an SEI unit accordingly.

The criteria used in the Central Okanagan, Bella Vista, Lake Country, and Vernon Commonage SEIs for ecological sensitivity included the presence of shallow soils, the susceptibility of the site to hydrological changes, erosion, and presence of invasive alien plants, and sensitivity associated with human disturbance. Rarity was based on rankings and proposed rankings by the Conservation Data Centre (CDC), the provincial distribution of those ecosystems (especially in an undisturbed state), and the threats to them.

If an ecosystem was determined to be ecologically fragile or rare, it was assigned to the applicable sensitive ecosystems category. In cases where a given ecosystem could be assigned to more than one Sensitive Ecosystems category, it was always assigned to the more sensitive category. For example, old riparian forests were assigned to the 'riparian' rather than the 'old forest' category and old coniferous woodlands were assigned to the 'old forest' category rather than the 'coniferous woodland' category.

Ecosystems were grouped into sensitive ecosystems categories using the Ecosystem-based Resource Mapping (ERM) Ratings Table Tool[50]. This tool allows SEI categories to be assigned to each ecosystem. Detailed conversion tables can be found in Appendix B.

Each polygon can have up to three ecosystem components mapped in it. The three components are ordered by area of occupancy from largest to smallest. The final Sensitive Ecosystems map shows the first component of the polygon in a colour specific to that Sensitive or Other Important Ecosystem type. The presence of a second or third component is indicated by cross-hatching but does not specifically indicate which Sensitive or Other Important Ecosystem is present.

Field Sampling and Conservation Evaluation of Sensitive Ecosystems

Prior to fieldwork, landowners within the study were contacted by letter and phone (and sometimes in person) to request permission to sample their lands. Numerous landowners agreed to have their lands sampled, although several large landowners did not grant access.

I developed a sampling plan using vegetation resources inventory (VRI) maps to identify areas of potential mature and old forests, and used aerial photographs to identify accessible sensitive ecosystems including grasslands, wetlands, ponds, aspen copses, riparian areas, rock outcrops, and talus slopes.

Three types of sample plots were used to identify and assess ecosystems: detailed ecological plots, ground inspections, and visual inspections[51]. Sample plots were subjectively located within polygons to best represent the ecosystem(s) in that polygon. Samples sites were distributed to maximize sampling of sensitive and other important ecosystems; other ecosystems were sampled along access routes to sensitive ecosystems. Sampling procedures for detailed ecological plots

[50] See http://www.env.gov.bc.ca/wildlife/whr/erm_system_flow.html for more information on the ERM tools.
[51] See Volume 2: Iverson and Uunila 2008

and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[52]. The *Standard for Terrestrial Ecosystem Mapping*[53] in British Columbia provides guidelines for visual inspection data collection. We also assessed the conservation values of each site (including, but not limited to, disturbance, known threats, adjacent land use, alien species, fragmentation, condition, ecological integrity, and landscape context).

Field sampling was completed in the summer of 2007, and a total of 301 sensitive ecosystems or other important ecosystems sites were field-verified (Table 3; additional plots were completed in modified landscapes). Figure 3 shows the location of all field samples, including those established in modified landscapes (a total of 414 plots). A team of three scientists including a plant ecologist, terrain specialist, and wildlife biologist conducted the sampling.

Table 3. Number of sites field sampled by ecosystem type.

Sensitive Ecosystems	Detailed Ecological plots	Ground Inspections	Visuals	Total Plots
Broadleaf Woodland	0	2	6	8
Grasslands	3	19	37	59
Old Forest	1	5	10	16
Riparian	1	15	42	58
Sparsely Vegetated	0	3	32	35
Coniferous Woodland	0	15	44	59
Wetland	1	1	31	33
TOTAL	**6**	**60**	**202**	**268**
Other Important Ecosystems				
Seasonally Flooded Fields	0	0	2	2
Mature Forest	0	6	25	31
TOTAL	**0**	**6**	**27**	**33**

[52] BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998
[53] Resources Inventory Committee 1998

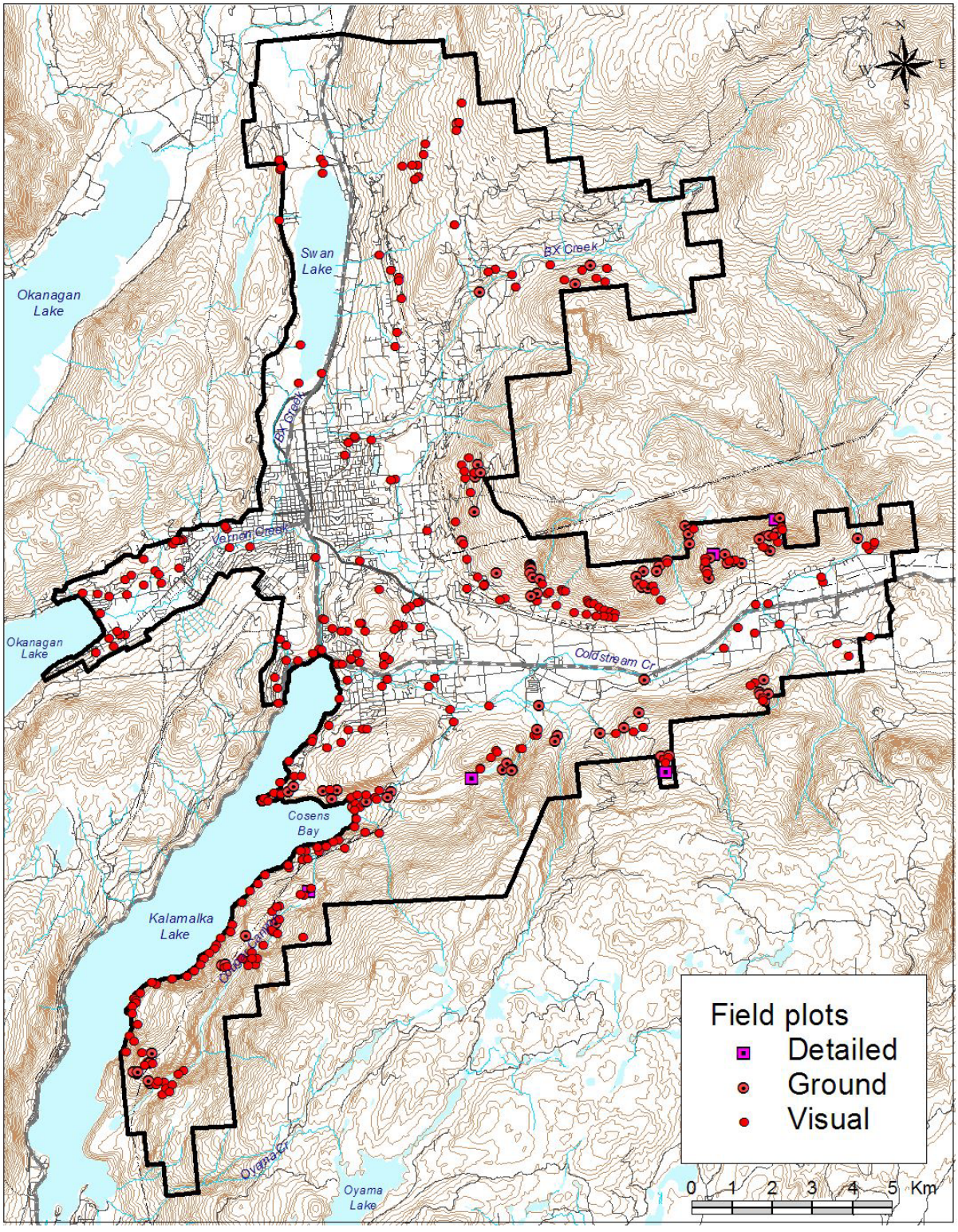

Figure 3. Location of field plots including detailed ecological plots, ground inspections and visual inspections. A total of 414 sites were sampled; 301 of these sites were located in sensitive ecosystems or other important ecosystems.

4.3 Mapping Limitations

The SEI information is intended to provide a broad planning base and to alert local and regional decision-makers, landowners, and development or planning consultants of the presence of important ecosystems and ecological features.

> The SEI mapping does not replace the need for on-site assessments of areas where land use changes are proposed or contemplated.

The accuracy of polygon boundaries is limited by the scale (1:15,000) and date (1994) of the aerial photographs on which the sites are delineated.

> It is recommended that digital data not be enlarged beyond the scale of the photos (1:15,000) as this may result in unacceptable distortion and faulty registration with other data sets.

On-going land uses may have changed some polygons after the date that the aerial photographs were taken or the field sampling was conducted. Wherever possible, polygons reflect conditions that were noted during field sampling and on orthophotos from 2006, rather than when the aerial photographs were taken.

One of the primary limitations of aerial photograph interpretations is the ability to see disturbances such as cover of invasive plants. I applied information from field sampling data to adjacent areas. Disturbance levels may have changed in some areas after the field sampling was completed.

Often small sensitive ecosystems are captured as a small component of a larger polygon that is dominated by one or two other ecosystems. Many polygons contain a complex of up to three ecosystems, and sensitive ecosystems may only occupy a portion of a given polygon. While polygon delineation is much more detailed than in many 1:15,000 ecosystem mapping projects, the landscape is complex, resulting in many complex polygons.

5 Inventory Results

This chapter provides a summary of the distribution and extent of sensitive ecosystems and other important ecosystems in the study area. Further details can be found in each of the ecosystem chapters.

5.1 SEI Summary Results

Seven types of sensitive ecosystems and two types of other important ecosystems were identified. Collectively the seven sensitive ecosystems (SE) covered 35.1% (7347 ha) and the two other important ecosystems (OIE) mapped covered 4.0% (842 ha) of the study area (Table 4), while modified landscapes covered the remaining 60.8% (12 717 ha) of the study area.

Ecosystems that have not been included as sensitive ecosystems or other important ecosystems still have many important values, especially to provide connectivity and buffers between and around SE and OIEs. Some ecosystems such as younger forests may be recruitment sites for future mature forests, old forests, and coniferous woodlands. Many non-sensitive ecosystems provide important wildlife habitat. Also, the vegetation and soils of these non-sensitive ecosystems help provide the safe capture, storage, and release of water that is critical to maintaining water quality, preventing soil erosion, and maintaining the hydrological function of wetland, riparian and other ecosystems.

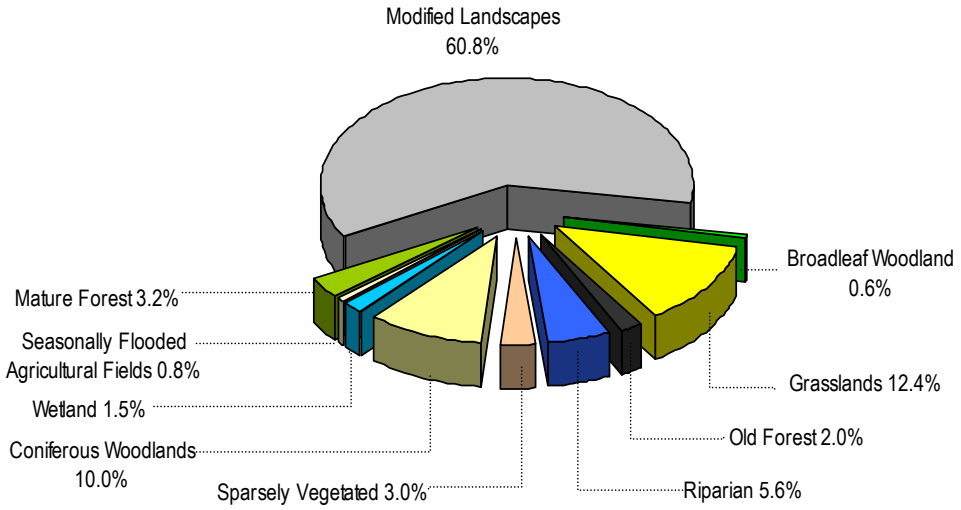

Figure 4. Relative proportion of sensitive ecosystems, other important ecosystems, and modified landscapes in the study area.

Table 4. Area of sensitive ecosystems and other important ecosystems in the study area.

	Area (ha)	Percent of Study Area[54]
Sensitive Ecosystems (SE)		
Broadleaf Woodland	129	0.6
Grassland[55]	2582	12.4
Old Forest	417	2.0
Riparian	1173	5.6
Sparsely Vegetated	631	3.0
Coniferous Woodland	2097	10.0
Wetland	318	1.5
Total SE	**7347**	**35.1**
Other Important Ecosystems (OIE)		
Seasonally Flooded Agricultural Fields	173	0.8
Mature Forest	668	3.2
Total OIE	**841**	**4.0**
TOTAL SE and OIE	**8188**	**39.1**

[54] This is a percentage of the study area excluding lakes (Swan Lake). Lakes are now considered an aquatic sensitive ecosystem, but results are presented as per the Okanagan Conservation Manual (Iverson et al. 2008) for consistency. The total study area including Swan Lake is 21 195 ha, without Swan Lake, the area is 20 906 ha.

[55] Other SEI projects in the North Okanagan mapped Disturbed Grasslands as a separate Other Important Ecosystem. Here they are mapped as part of the Grasslands category as per the recently published Standard for Mapping Ecosystems at Risk in British Columbia (Ministry of Environment Ecosystems Branch 2006).

6 Conservation Analysis

The first stage in developing a Local Ecosystems Plan (see Section 7) is the systematic prioritization of ecosystems for protection. This can provide a basis for a strategy for parks designation and acquisition, other forms of protection, and sensitive development. This can be accomplished using the base mapping used to develop the Sensitive Ecosystems Inventory. This conservation analysis is intended to provide the prioritization of ecosystems. It follows methods developed for the conservation analysis in 'Balanced Growth for the Bella Vista – Goose Lake Range'[56].

The primary goals of the conservation analysis are to identify areas within the study area that, if retained as intact ecosystems and properly managed, will:

- conserve representative high quality examples of all sensitive and important ecosystems;
- ensure the long-term existence of significant wildlife habitat and all native plant and wildlife species in the study area, especially rare and endangered species;
- maintain ecological linkages within the study area and to adjacent areas; and
- maintain all ecological functions and wildlife habitat needs within these areas.

To achieve these objectives, we used a broad scale planning approach based on GIS data from the Sensitive Ecosystems Inventory, Terrestrial Ecosystem Mapping[57], and Wildlife Habitat Mapping[58].

6.1 Conservation analysis methods[59]

Three stages were used to identify priority areas for conservation.

Stage 1: Cumulate Conservation Values

1. A rating scheme based on rarity, quality and condition of ecosystems, was developed to prioritize sensitive ecosystems mapped in the study area.
    a. The relative value of sensitive and other important ecosystems in the study area was ranked in order of importance from 0 (minimal importance) to 10 (highest importance), and the results shown below (Table 5).[60]

[56] Clarke et al. 2004
[57] Iverson and Uunila 2008
[58] Haney and Sarell 2008
[59] This section and these methods are adapted from Clarke et al. 2004
[60] Values are not intended to be absolute, instead only the relative ranking of ecosystems is important.

Table 5. Relative ecosystem values for sensitive and other important ecosystems.

SEI category	SEI sub-category	Relative SEI Value	Rationale (% of Coldstream – Vernon study area)
Broadleaf Woodland	Aspen Copse	7	Sensitive & very rare within the study area (0.6%)
Grassland	Grassland	9	Very Sensitive & provincially rare; moderately distributed in the study area (3.3%)
	Shrubland	9	Very Sensitive & provincially rare; very rare in the study area (1.1%)
	Disturbed Grassland	6	Disturbed but provide values for many grassland species including many rare and endangered species (7.8%)
Mature Forest	Coniferous	2	Moderately distributed, less sensitive (2.9%)
	Mixed	2	Very rare, but less sensitive (0.3%)
	Broadleaf	3	Very rare, but less sensitive (0.02%)
Not a Sensitive or Other Important Ecosystem		0	Not sensitive (61.4%)
Old Forest	Coniferous	10	Very sensitive, very important wildlife habitat, rare (1.9%)
	Mixed	10	Sensitive, important wildlife habitat, very rare (0.05%)
Riparian	Fluvial Fringe	10	Very sensitive, very important wildlife habitat, rare (2.1%)
	Floodplain	10	Very sensitive, very important wildlife habitat, rare (1.3%)
	Gully	10	Very sensitive, very important wildlife habitat, rare (2.2%)
	Beach	10	Very sensitive, important wildlife habitat, very rare (0.02%)
Seasonally Flooded Agricultural Fields		4	Rare, less sensitive, potential for restored riparian habitat (0.8%)
Sparsely Vegetated	Cliff	10	Sensitive, very important wildlife habitat, very rare (0.1%)
	Rock	8	Sensitive, very important wildlife habitat, rare (1.8%)
	Shrub	10	Sensitive, very important wildlife habitat, rare (0.6%)
	Talus	10	Sensitive, very important wildlife habitat, very rare (0.4%)
Woodland	Coniferous	6	Sensitive, very important wildlife habitat, common (9.9%)
Wetland	Marsh	10	Very sensitive, very important wildlife habitat, rare (0.7%)
	Swamp	10	Very sensitive, very rare (0.04%)
	Shallow Water	10	Very sensitive, very important wildlife habitat, rare (0.7%)

b. Each sensitive- or other important ecosystem was rated as to the ecological condition of the ecosystem in the original mapping (Cond_1, Cond_2, Cond_3)[61]. Values were assigned to these ratings from 0 (lowest value) to 1 (highest value) as shown below (Table 6).

Table 6. Values assigned to each quality and condition rating.

Condition Rating	Assigned Value (from 0 to 1)
Excellent	1
Good	0.8
Marginal	0.5
Poor	0.1

[61] Formerly referred to as Quality – Condition in previous SEI projects; use of the term and definition of "Condition" follows the Standard for Mapping Ecosystems at Risk in British Columbia (Ministry of Environment Ecosystems Branch 2006).

c. The SEI and condition values were multiplied together for each component (decile) of a polygon, to produce the combined ecosystem values. Condition may lower conservation values.

2. Wildlife habitat values were examined for the most important life requisites of the 10 selected species whose habitats were mapped (Table 7). All ecosystems, including sensitive and non-sensitive ecosystems were rated for current habitat suitability for various life requisites for each of these 10 species. We converted wildlife suitability ratings to values (High=10, Moderate=5, Low=1, Nil=0) for each component of a polygon (decile). We assigned the highest value of the 10 values for each component (decile) of each polygon.

Table 7. Species and life requisites used to assign wildlife values to polygons.

Species	Species Code	Life Requisite	Rating Code
Great Basin Spadefoot	A-SPIN	Breeding	RE
Painted Turtle	R-CHPI	General Living (foraging and wintering)	LIA
Western Rattlesnake	R-CROR	General Living (basking and denning)	LIA
Gopher Snake	R-PICA	Egg-laying	RE
Swainson's Hawk	B-SWHA	Nesting	RE
Long-billed Curlew	B-LBCU	Nesting	RE
Western Screech-owl	B-WSOW	Nesting	RE
Yellow-breasted chat	Y-YBCH	General Living (nesting and foraging)	LIG
Grasshopper Sparrow	B-GRSP	General Living (nesting and foraging)	LIG
Badger	M-TATA	General Living (denning and foraging)	LIA

3. For each polygon component, sensitive ecosystem and wildlife habitat values were combined into a single value giving a two to one weighting of ecosystems to wildlife (2 x ecosystem value + wildlife value). Wildlife ratings may raise conservation values (e.g. little or no ecosystem value due to condition, but may be important for at least one rare species), or lower them (e.g. due to slope, aspect or soil depth). Ecosystems were weighted more heavily as they also represent values for a much broader range of species whose habitat was not mapped [62]. The final value used for the polygon was the component (decile) with the highest value.

The resulting map of combined and weighted SEI / wildlife habitat ratings is shown as the 'Conservation Values Map' (Figure 6 below).

[62] There is no guidance in scientific literature to guide the appropriate weighting of ecosystem and wildlife habitat values. We found that there was considerable overlap between conservation priorities for ecosystems and wildlife, thus maps produced with different weighting would be very similar.

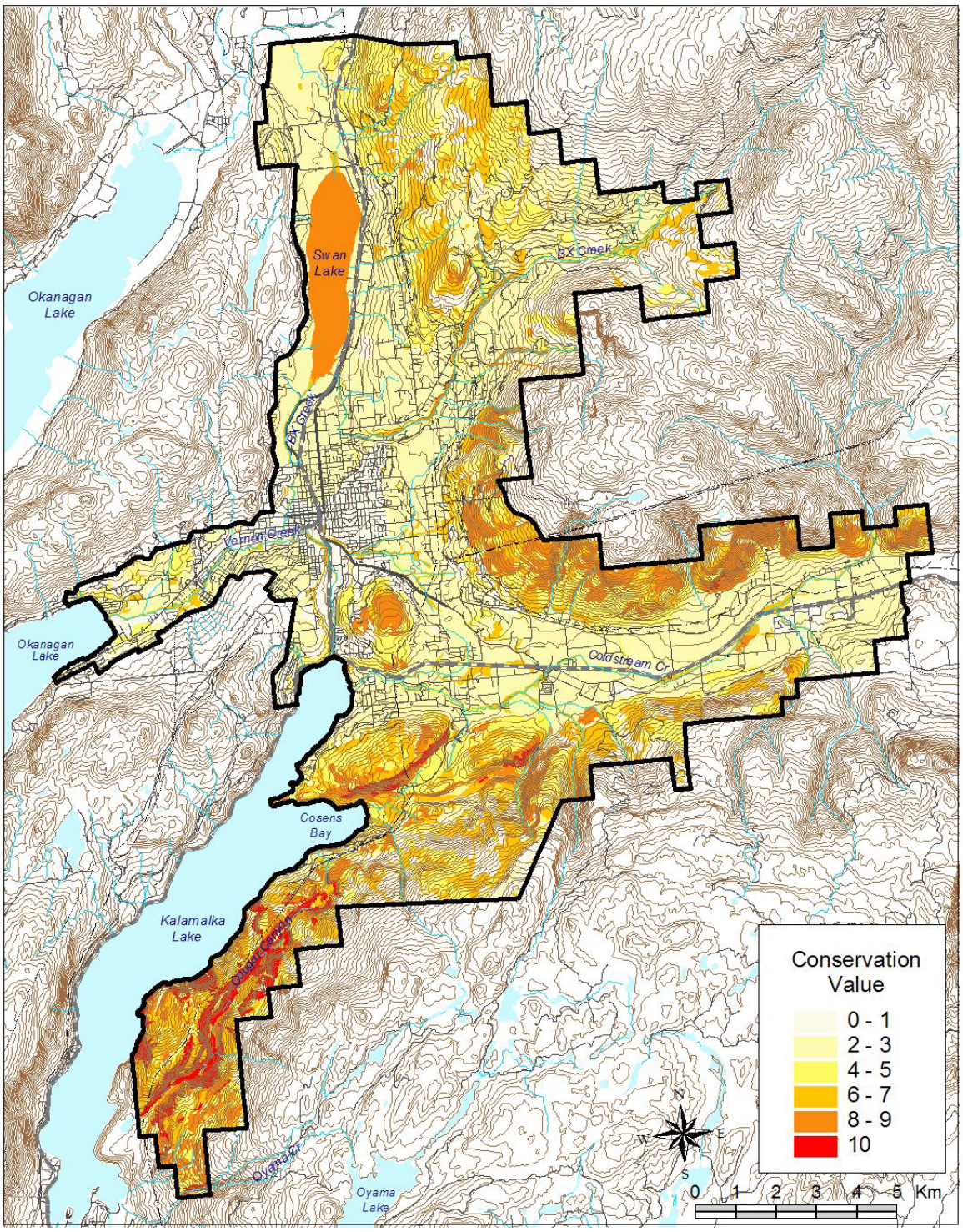

Figure 5. Conservation values map. Higher conservation values are shown in darker colours.

Our methods emphasize the highest conservation values within each polygon. Although the resulting map is biased towards higher conservation values (e.g. they appear to occupy a larger area than they actually do), we feel ***this method is important to avoid masking important conservation values*** that would result if the values within a polygon were averaged. The scale of the aerial photographs used in the project has inherent limitations in the size of polygons that can be delineated. Larger scale photographs would result in additional smaller polygons that would enable more small important conservation sites to be represented as individual polygons rather than as a component of a larger polygon. Where changes in land use are proposed, we recommend mapping ecosystems, wildlife habitat, and wildlife features at a larger scale (1:5000). The mapping should be refined, field-verified, and revised as necessary with clear documentation of the rationale for changes.

Stage 2: Identify Priority Conservation Areas

Using the conservation values map, conservation areas including core areas, buffers, wildlife corridors, and other important conservation areas were identified based on size, concentration and connectivity of high value areas (see Figure 6). The figure illustrates priorities for conservation, and could be used to develop a vision for a system of protected areas and resource lands connected across the landscape.

1. Core Conservation Areas

Areas with a large concentration of high and some moderate conservation values were identified as core conservation areas. These would be the areas of highest priority for conservation. Ideally, activities would be primarily directed towards maintaining ecological and wildlife habitat values in these areas. There may be small areas within the core areas that could be accessed and developed without compromising core values (e.g., by fragmentation); further larger scale mapping and wildlife inventory would be needed to identify these areas. Core areas are high priorities for acquisition by land trusts, conservation organizations, for Regional Parks, and should be zoned for environmental purposes.

2. Buffers

Core conservation areas need to be buffered from potential adverse effects of adjacent land uses. One hundred meter buffers around core areas were identified to conserve values in core conservation zones, and need to be managed for that purpose. The width and design of buffers also needs to be refined at larger scales to reflect the size of patches, ecosystem types, local landscape features and wildlife habitat values. Wetland and riparian buffers will likely need to be wider[63], but it is possible that buffers around some upland ecosystems may be narrower.

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[63] "It is generally acknowledged that terrestrial buffers or riparian strips (30 to 60 meters) wide will effectively protect water resources. However, terrestrial habitats surrounding wetlands are important to more than just the protection of water resources. They are also essential to the conservation and management of semi-aquatic species... Our data clearly indicates that buffers of 15-30 meters, used to protect wetland species in many states, are inadequate for amphibians and reptiles. We propose…three terrestrial zones of protection... an aquatic buffer 30-60 meters; a core habitat (which includes the aquatic buffer): 142 to 289 meters; and an additional terrestrial buffer of 50 meters"

3. Wildlife Corridors

Wildlife corridors provide animals with an opportunity to move freely between two or more habitat patches or habitat types in an otherwise fragmented landscape. This movement is essential to provide genetic links between populations and prevent inbreeding, and to compensate for temporary population declines in one of the habitat patches. The habitat needs of all priority species should be incorporated into the design of the corridor. Corridors must be suitably wide, with appropriate habitat features to provide security cover during movement. Corridors usually consist of linear habitats such as gully or streamside riparian areas; they are often composed of two or more ecosystem types to provide complexity to the corridor. Development and roads should avoid these zones, and mitigation will be required where roads and other developments transect the corridor. Wildlife corridors were identified to connect core areas to each other and to outside the study area, including connections to Okanagan Lake and Kalamalka Lake.

In some cases, corridors have already been fragmented by roads and connections need to be restored. In particular, it will be challenging to restore connections across Highway 97.

Corridors, where possible, include riparian draws with adjacent warm aspect grasslands, and ridges. These habitat features are those most commonly used for travel between habitats. Larger scale mapping and additional wildlife inventory might identify some small areas that could be developed without compromising connectivity and other corridor values. This would depend upon the type and configuration of development, and site-specific issues.

4. Other Important Conservation Areas

Areas with a concentration of moderate conservation values were identified as other important conservation areas. Activities would be directed towards maintaining ecological and wildlife habitat values. There would be areas within that could be accessed and developed without compromising some ecological values; further larger scale mapping and wildlife inventory would be needed to identify these areas.

Stage 3: Refine Conservation Priorities

The conservation area design identified in Stage 2 was compared to the SEI map and each wildlife habitat map to ensure all high priority values were included in the appropriate zone. This ensured that core areas included old forests and wetlands, and that there was diversity within each core area. The resulting Conservation Zones map is shown below in Figure 6.

"We propose…three terrestrial zones adjacent to core aquatic and wetland habitats (1) a first terrestrial zone immediately adjacent to the aquatic habitat, which is restricted from use and designed to buffer the core aquatic habitat and protect water resources (30 to 60 meters); (2) starting again from the wetland edge and overlapping with the first zone, a second terrestrial zone that encompasses the core terrestrial habitat defined by semi-aquatic focal-group use (e.g., amphibians 159 – 290m); and (3) a third zone, outside the second zone, that serves to buffer the core terrestrial habitat from edge effects from surrounding land use (e.g. 50 meters)"

From: Semlitsch, R. and J. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Cons. Biol. 17(5):1219-1228.

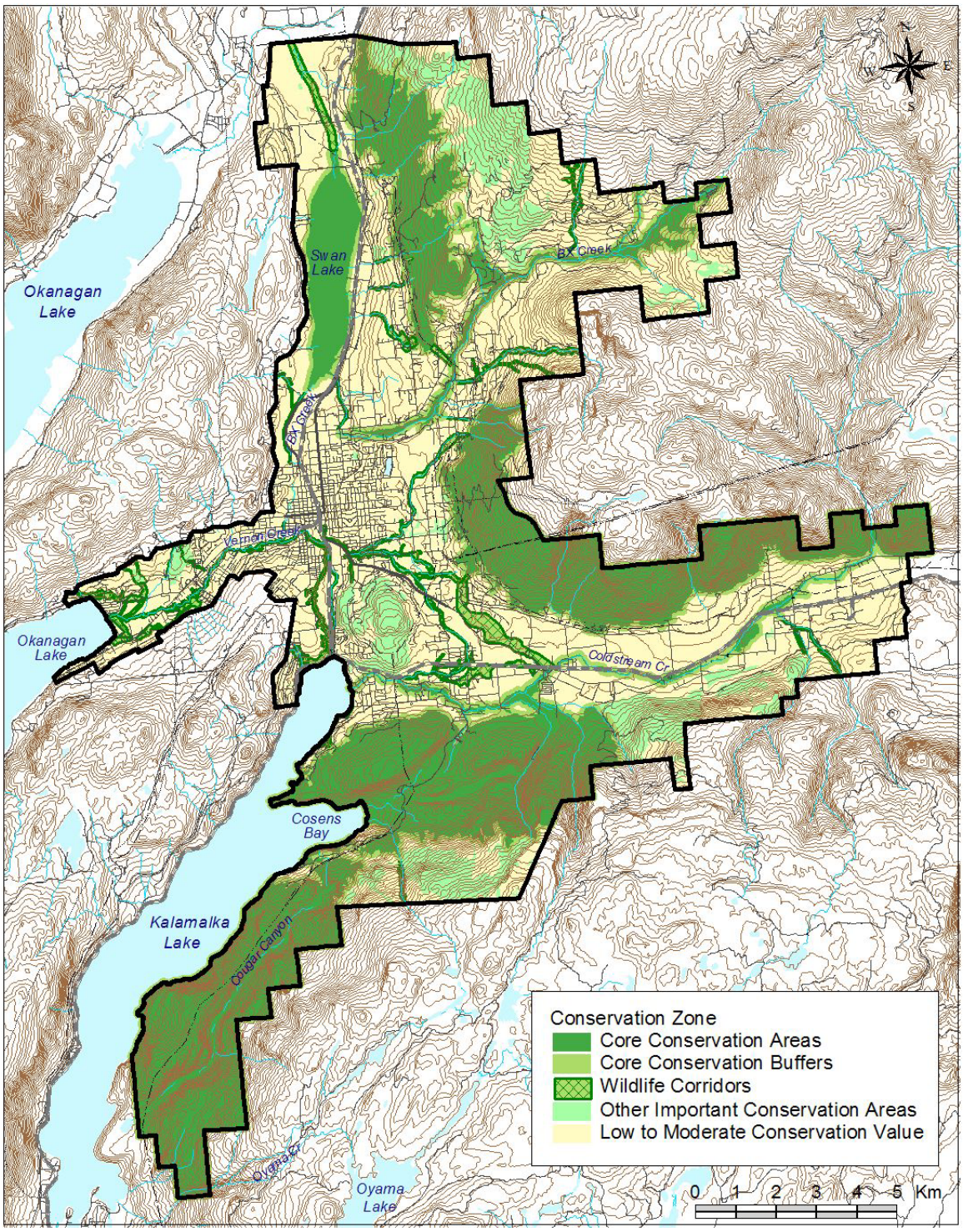

Figure 6. Conservation zones for the Coldstream – Vernon SEI study area.

6.2 Management of Conservation Zones

Management of Core Conservation Areas (CCA)

Where CCAs occur in areas of rural land use, some managed resource uses (e.g., grazing and selection harvesting of ingrown coniferous forests) may be compatible with conservation values. Landowner contact programs, stewardship agreements, and other forms of stewardship activities could help landowners understand and care for biodiversity values on their property.

CCAs that are situated on properties subject to urban development should be a priority for protection. Core areas are recommended as a focus for conservation/parkland acquisition and should receive more detailed analysis to determine appropriate park boundaries, and to determine other potential means of land acquisition and other conservation options such as conservation covenants. Development Permit Areas (DPAs) can provide for protection of some of the features in and adjacent to these areas. Golf courses are not compatible with the objectives of CCAs, but depending on site conditions, may be compatible with buffer areas or wildlife corridors.

Classification of parks and conservation features should be determined and applied consistently throughout the region. The approved park classification system should be used in the Neighbourhood Planning process to avoid confusion regarding the purpose of natural areas.

Park planning should use zoning to identify areas and apply management objectives for conservation and recreational values.

Management of Buffers

Buffer widths and designs should be refined to better reflect the specific ecosystem and wildlife habitat values in the CCA that they surround. Higher quality and more sensitive ecosystems, important wildlife habitats, and more natural areas are higher priorities for inclusions in buffers. Where wetlands occur near the edge of a CCA, they will require significantly wider buffers and buffers should be designed to provide Painted Turtles and Spadefoots sufficient unrestricted access to other habitats they require. Other more sensitive areas may also require wider buffers, but, conversely, less sensitive edges of the CCA may have narrower buffers. The City and Regional District should implement minimum setbacks from wetlands and watercourses.

Management of Corridors

Corridors for wildlife need to be established to provide secure movement opportunities between core conservation areas. Widths of 100 to several hundred metres are typically required. Recreational use is usually incompatible with maintaining effective corridors. The integrity of the ecosystem(s) within the corridor needs to be maintained, and often managed (and restored in some cases). Barriers may be required to keep domestic animals and unsuitable recreation activities out of the corridors, and keep potentially problem wildlife out of developed areas. Roads should avoid corridors but where this is not possible, underpasses or other techniques should be used to reduce traffic hazards to wildlife.

Management of Other Important Conservation Areas (OICA)

Some managed resource uses (e.g., grazing and selection harvesting of ingrown coniferous forests) are likely compatible with conservation values in OICA. OICAs that are situated on properties subject to urban or other development should be a priority for protection.

7 Planning and Management

7.1 Goals

The goals of the management guidelines differ between sensitive ecosystems and other important ecosystems:

- Sensitive ecosystem guidelines seek to conserve the seven sensitive ecosystems in a relatively natural state.
- Guidelines for other important ecosystems seek to maintain the resource values and minimise the loss of ecosystem functions.

7.2 City of Vernon, District of Coldstream and North Okanagan Regional District Planning

Develop a 'Local Ecosystems Plan'[64]

A systematic plan for prioritization and protection, and stewardship of local sensitive and other important ecosystems should be developed. The conservation analysis provides priorities for conservation. The local ecosystems plan should consider known gaps in the system of provincial and regional protected areas, and be integrated across the study area, and within the City of Vernon, Regional District of North Okanagan, and District of Lake Country to ensure landscape level connectivity.

Recognizing and protecting environmentally sensitive areas early in the community planning process provides the best chance of protecting environmental values.

- Design initial road and utility layouts at a landscape scale to minimize impacts to sensitive and other important ecosystems.
- Integrate ecosystem retention and conservation with other land use planning considerations (such as parks and recreation) that are consistent with the preservation of sensitive ecosystems.
- Develop and implement an invasive alien plant management strategy to minimize the spread and introduction of invasive plant species.
- Develop and implement a fire management plan that identifies forests that are a fire hazard and provides a strategy to reduce this hazard and return forests to historical stand densities.
- Develop a recreation use plan to avoid recreation in critical areas and designate appropriate types of recreation for other areas.

Aside from the ecosystems prioritized for protection in the ecosystem plan, other sensitive and other important ecosystems, and natural areas should be considered in all levels of planning and protection, and mitigation strategies should be developed in areas where development will occur.

[64] Refer to the Conservation Tools Section of Iverson and Cadrin 2003 for more detailed information.

SEI maps are intended to be used for broad-level planning, however, on-site visits are needed to assess the site and develop site-specific management recommendations.

On-site visits are needed to assess and develop site-specific management recommendations for neighbourhood plans and individual developments.

Develop a Conservation Strategy[65]

Aside from the large protected areas in the study area, most sensitive ecosystems in the Coldstream – Vernon area are on private property, so voluntary stewardship by landowners is essential in the long-term. Various tools and mechanisms are available for ecosystem protection depending on the ownership and the management policies and practices of the existing land managers. Once land status is determined, appropriate measures may be taken including:

- **Designation as Environmentally Sensitive Areas** (ESA) – The seven sensitive ecosystems should be a priority in the identification and designation of local government ESAs. In some cases, site boundaries should reflect the dynamic nature of the ecosystem (see **Retain Natural Vegetated Buffers around Sensitive Ecosystems** below). These ESAs should be identified in the Official Community Plan.
- **Acquisition of privately owned lands for conservation and protected status** – The most undisturbed of these remaining ecosystem fragments should be considered for purchase as conservation areas where only activities that do not impact the ecosystem would be permitted. Grassland, wetland, old forest, riparian and broadleaf woodland together with the highest quality coniferous woodland and sparsely vegetated sites should all be priorities for receiving protected status. ***Sites where different sensitive ecosystems occur adjacent or in close proximity to one another should also be given priority with regards to protection***.
- **Stewardship** – Private landowners with Sensitive Ecosystems who wish to retain ownership could become involved in voluntary stewardship initiatives such as registering conservation covenants on their property to protect ecosystem values. Protection of grasslands and managing invasive plants should all be priorities for stewardship programs.
- **Use other protection techniques** such as cluster development, Development Permit Areas, restrictive covenants, purchase of development rights, and incentives to leave sensitive sites intact.

Official Community Plan

The Official Community Plan (OCP) provides overall policy direction for the local government and establishes the basis for its regulations and development approvals. Below are specific recommendations for integrating this SEI into the City of Vernon's, District of Coldstream's and Regional District of North Okanagan's OCPs.

- Designate sensitive and other important ecosystems as ***Development Permit Areas***[66] (DPAs) in the OCP. DPA boundaries may go beyond ESA boundaries.

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[65] Significant portions of this section have been adapted from McPhee et al. 2000.

[66] Development Permits can be used by local governments to establish special requirements for developments including the protection, restoration or enhancement of natural ecosystems and biological

- Ensure that every effort shall be made to maintain or enhance the ecological integrity of these areas.
- Ensure that the vegetation, wildlife, and ecological functions of these areas are maintained or enhanced.
- Ensure that water balance and hydrologic functions are maintained and stormwater planning is integrated with other ecological planning.
- Limit landscaping to restoration of removed or altered native vegetation or habitat. Use native plants adapted to on-site conditions. Control invasive plant species.

- Designate sensitive and other important ecosystem DPAs as areas for which ***Development Approval Information*** is required.
- Use the local ecosystems plan to ***determine natural areas*** and develop conservation strategies for those areas. Create a natural areas designation for such areas.
- Ensure that only ***developments and other activities*** compatible with the preservation, protection, restoration, and enhancement of sensitive ecosystems occur in DPAs.
- Ensure ***neighbourhood plans are consistent with the local ecosystems plan*** and conservation strategies. At the development scale, maintain appropriate buffers, determined by qualified professionals, around sensitive ecosystem areas and provide connectivity between sensitive and other important ecosystems.
- Provide for ***greater incentives for density bonuses*** in developments in exchange for the retention of sensitive ecosystems:
  - Ecosystems identified for conservation in the local ecosystems plan should be the highest priority for retention.
  - Ecosystems must be retained in such a way that natural values are maintained or enhanced.
  - Provide buffers and connectivity to other natural ecosystems within and beyond the development (See Retain Natural Vegetated Buffers around Sensitive Ecosystems and Corridors between Sensitive Ecosystems page 33).
  - Do not limit the maximum density bonus to 20% in cases where density bonuses are granted in exchange for the secured conservation of sensitive ecosystems.
  - Retained natural ecosystems should be covenanted to ensure that future uses are compatible with the protection, restoration, and enhancement of sensitive ecosystems.
- ***Eliminate large lot zoning designations*** in favour of cluster development zones where the net number of housing units remains the same. ***Reduce minimum lot size to permit cluster development*** if more than 20% natural area is retained and is not disturbed. ***Consider the development of cluster housing as a zoning designation***.

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diversity. Development Permit guidelines can be specified in the OCP or in the zoning bylaw, as provided in Section 919.1(1)(a) of the Local Government Act (Iverson and Cadrin 2003).

- ***Plan and manage recreational access*** to minimize impacts to sensitive ecosystems, especially during wildlife breeding and nesting seasons. Uncontrolled motorized recreation is of particular concern.
- Add a goal into OCPs to ***acquire high priority sensitive ecosystems*** to add to protected natural areas.
- Add a goal into OCPs to ensure that ***trail and other recreation development*** is consistent with broader level conservation priorities and ecological integrity of sensitive ecosystems.

City of Vernon OCP

- Policy Section G[67] – ensure that subdivision plans along Kalamalka Lake have provisions for maintaining all foreshore vegetation and ecosystems and provide connectivity to upland ecosystems for wildlife.
- Policy Section K – Development Phasing. Revise this section to reflect conservation priorities and conservation plans once they are developed.
    - Avoid approval of any developments in the study area until conservation priorities have been established.
- Policy Section M – Special Areas. Re-designate areas to be consistent with the conservation analysis.

Additional Policies for Wetland and Riparian Ecosystems

- Protect water quality from pollutants, sediments, and changed nutrient loads
- Determine and consider the overall water balance affecting wetland and riparian ecology and protect from disturbance.
    - Maintain natural surface, groundwater and nutrient regimes.

Other Local Government Policies and Plans

Use a Regional Growth Strategy and Parks and Recreation Master Plan to establish community goals and policies for ecosystem protection and to establish urban containment boundaries. Revise other policies and zoning bylaws as direction is established for ecosystem protection.

7.3 Landowners

Plan Land Development Carefully

Landowners who wish to develop their land can use various tools outlined below to protect sensitive ecosystems. Landowners who do not wish to develop their land can use many of these same tools to provide long-term protection of the ecosystems on their property.

[67] Refers to Policy Sections in Vernon's OCP.

Tools for the Protection of Sensitive Ecosystems

- Have a qualified professional conduct an environmental impact assessment to provide wildlife inventory information and verify and map sensitive ecosystems at an appropriate scale for development planning. Work collaboratively with professional biologists in designing the development.
- Consider using cluster style developments to provide opportunities for development while retaining sensitive ecosystems. Work with city planners to obtain density bonuses in exchange for retention of sensitive ecosystems.
- Where golf courses are a desired component of a development, consider a links style golf course where retention of natural areas within the course is maximized.
- Where a development has been designed to ensure the long-term retention and function of sensitive ecosystems, consider an alternate niche marketing strategy to promote it as an 'ecosystem friendly' development.
- Consider conservation covenants on sensitive lands:
    - They can protect certain values while allowing other uses.
    - They are registered in the Land Title Office.
    - They can provide a tax advantage if they have reduced the property value through restrictions on its use. The covenanting organization can provide a charitable receipt for the difference in land value.
- Consider donating land:
    - Lands can be donated to a land trust, stewardship organization or government.
    - Owners may want to establish conservation covenants prior to donating to ensure the donated land is protected.
    - Land donations can provide tax benefits.
    - Owners may want to donate the portions of their land designated for retention of sensitive ecosystems.
    - Owners may want to consider providing for the donation of their land in their will.

Further Information:

Stewardship Options for Private Landowners in British Columbia[68]

Here Today, Here Tomorrow: Legal Tools for the Voluntary Protection of Private Land in British Columbia[69]

North Okanagan Parks and Natural Areas Trust (president: Jamie Kidston (250) 542-1582)

The Land Conservancy of British Columbia
www.conservancy.bc.ca (250) 479-8053

The Nature Trust of B.C.
info@naturetrust.bc.ca (250) 924-9771

The Canadian Ecological Gifts Program, Environment Canada
www.cws-scf.ec.gc.ca/ecogifts 1-800-668-6767

7.4 Park and Protected Area Management

This SEI can be used to facilitate the implementation and modification of management plans for Kalamalka Lake Park and Protected Area and Cougar Canyon Ecological Reserve. The SEI provides direction for restoring forested areas affected by ingrowth and grasslands affected by invasive plant species. Restoration activities can be prioritized to provide connectivity within the protected areas and to adjacent areas, and to expand areas with high conservation values. The conservation values map can also be used to direct management of human uses within the park to minimize the disruption of wildlife habitat and ecological values in these areas.

7.5 General Management Recommendations[70]

This section provides general recommendations to avoid negative impacts to sensitive ecosystems. These recommendations reflect the principles of biodiversity conservation, which apply to all sensitive ecosystems identified in the study area. For other important ecosystems (mature forests and seasonally flooded agricultural fields), broader conservation-oriented management practices are discussed.

Retain Natural Vegetated Buffers around Sensitive Ecosystems and Corridors between Sensitive Ecosystems

In order to achieve adequate protection, sensitive ecosystems must be buffered from potentially adverse effects of land use practices in adjacent areas. A natural vegetated buffer zone can absorb and avoid negative edge effects that result from animal and human access and disturbance. Buffers also play a role in maintaining microclimate conditions such as temperature and humidity, particularly for wetlands and riparian areas. A vegetated buffer is established by

[68] Ministry of Environment, Lands and Parks 1996
[69] Findlay and Hillyer 1994
[70] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

retaining or restoring natural ecosystems that surround sensitive or other important ecosystems. The size of the buffer zone varies by ecosystem type, and by constraints of the surrounding landscape. Fencing may be necessary along some buffers to delineate and protect the buffer from encroaching land uses and inappropriate activities. In planning for protection of a particular site, assessments and recommendations should be made by a qualified professional to ensure that conservation options are effective.

In addition to buffering core high priority areas, corridors are needed to connect conservation areas. As with buffers, corridors are vegetated zones established by retaining or restoring natural ecosystems to connect sensitive or other important ecosystems. They are usually longer and narrower than buffers and must be designed to provide sufficient width and natural vegetation cover for the species that use them.

Avoid Direct and Indirect Impacts

Minimizing negative impacts to sensitive ecosystems can be achieved through the following principles:

- ***Discourage settlement and other development within or adjacent to sensitive ecosystems*** unless only insignificant negative impacts can be demonstrated;
- ***Manage access to land and water***: Seasonal use-restrictions (e.g., during wildlife breeding seasons), fencing, designated trails, and signage can be used to help avoid the negative effects of access to sensitive areas. Designating trails and areas for limited used (e.g., restricting motorized recreation or mountain bikes) are another access management tool;
- ***Protect large old trees and snags***. Old trees and snags provide critical nesting habitat for many species of birds, bats, and other wildlife.
- ***Avoid use of insecticides in, or near, important foraging areas for wildlife***. Insecticide use near foraging habitat for animals that feed on insects (e.g., bats, Flammulated Owls and Lewis' Woodpeckers) should be avoided.
- ***Prevent disturbance of nesting or breeding areas*****:** Known and potential breeding sites, (especially for threatened or endangered species) should be protected from any activity that would disturb breeding wildlife;
- ***Control invasive species*****:** A broad invasive alien plant management plan may be necessary to control and limit the spread of plants such as diffuse knapweed (*Centaurea diffusa*), sulphur cinquefoil (*Potentilla recta*) and invasive annual grasses such as cheatgrass (*Bromus tectorum*). Reclaim disturbed sites using native vegetation species adapted to the site to reduce the potential for the introduction and spread of invasive plants. Managing human and livestock access, and treating existing invasive plant species will help maintain the ecological integrity of sensitive ecosystems. Invasive plant control can include hand-pulling, and native species can be planted to help prevent the establishment of more invasive plants. Herbicides and biological control agents are other possible treatments. The BC Ministry of Forests or BC Ministry of Agriculture and Lands can be consulted to determine the appropriate method and timing of treatment for invasive plant species; and
- ***Restore natural disturbance regimes*** wherever possible. Consider some planned thinning and prescribed burning to restore open forests, restore some encroached grassland habitat, and reduce wildfire hazard in interface areas. Consult a qualified professional to develop and

implement a restoration and prescribed burning plan. Consider restoring natural flooding regimes on creeks where possible.

Plan Land Development Carefully

Where it is not possible to limit settlement or other developments within or immediately adjacent to a sensitive ecosystem, activities should be carefully planned to minimize adverse effects to the ecosystem. An environmental impact assessment should be completed (see below) and inventories of wildlife, vegetation, including wildlife trees and the extent of tree root systems, terrain features such as cliffs and talus, adjacent water bodies, and other important microhabitats are necessary to determine and minimize the full impact of development on biodiversity at the site.

- **Require an environmental impact assessment conducted by a qualified professional**.
- **Plan, design, and implement land development activities to avoid adversely affecting or disturbing:**
  - native vegetation;
  - large old trees;
  - threatened or endangered species or ecological communities;
  - soils, and other terrain features such as bedrock;
  - wildlife nesting or denning sites;
  - standing dead trees (snags), and downed trees and logs; and
- **Restore native vegetation where it has been disturbed.** Seed or plant native species from nurseries, or plant native species that have been salvaged from other development sites. Ensure that any native plant material used is free of alien plant seeds.
- **Ensure adequate sediment and erosion control measures** are implemented.

8 Wetland

What are wetland ecosystems?[71]

Wetlands occur on sites where the water table is at, near, or above the soil surface for a sufficient period of time to influence soil and vegetation development[72]. Wetland ecosystems have plants that are adapted to growing on saturated soils with low oxygen levels.

Wetlands were divided into distinct classes according to their environmental and vegetation characteristics. These classes included marshes, swamps and shallow water ecosystems; they are described below.

Marsh ecosystems

Marsh wetland ecosystems occur at the edge of shallow open water, ponds, and lakes, on the edges of larger wetlands, and in depressions where the water table is above or near the soil surface. Rushes, cattails, reed canarygrass or occasionally sedges usually dominate marshes, and some floating aquatics such as duckweed are often present.

Swamp ecosystems

Swamp wetland ecosystems occurred in forested areas with extensive subsurface irrigation (water flow). These swamps were dominated by mountain alder and skunk cabbage. Some swamps also occurred at the edges of ponds and wetlands, forming a shrubby willow-dominated fringe around them.

[71] Adapted from Iverson and Cadrin 2003.
[72] MacKenzie and Moran 2004

Shallow water ecosystems

Shallow water ecosystems are either areas of open water that are intermittently or permanently flooded up to 2 m in depth at midsummer[73], or are ponds that are greater than 2m in depth, but are less than 50 ha in area. Vegetation is limited to submerged or floating aquatic plants with less than 10% cover of vegetation emerging above the water surface. Shallow water ecosystems often occur in association with marshes.

Vegetation

	Marsh	Shallow Water	Swamp	
Trees				
Western redcedar			**	*Thuja plicata*
Shrubs				
mountain alder			***	*Alnus incana*
willows			***	*Salix* spp.
Grasses, Sedges & Rushes				
rushes	***			*Schoenoplectus* spp.
baltic rush	**			*Juncus balticus*
sedges	*		**	*Carex* spp.
Forbs				
skunk cabbage			***	*Lysichiton americana*
cattail	**			*Typhus latifolia*
duckweed	**	**		*Lemna minor*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of wetland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

[73] Voller 1998

Rare*[74] *ecological communities of wetland ecosystems

Baltic rush – field sedge (B) (*Juncus balticus – Carex praegracilis*)
Common cattail marsh (B) (*Typha latifolia*)
Hard-stemmed bulrush deep marsh (B) (*Schoenoplectus acutus*)

Rare*[75] *vertebrates of wetlands

Peregrine Falcon (R, COSEWIC-SC) (*Falco peregrinus* ssp. *anatum*)
Western Grebe (R) (*Aechmophorus occidentalis*)
American Avocet (R) (*Recurvirostra americana*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Western Toad (COSEWIC-SC) (*Bufo boreus*)
Painted Turtle (B, COSEWIC-SC) (*Chrysemys picta*)
American Bittern (B) (*Botaurus lentiginosus*)
Great Blue Heron (B) (*Ardea herodias*)
Sandhill Crane (B) (*Grus canadensis*)
California Gull (B) (*Larus californicus*)
Western Small-footed Myotis (B) (*Myotis ciliolabrum*)
Fringed Myotis (B, COSEWIC-SC) (*Myotis thysanodes*)
Townsend's Big-eared Bat (B)(*Corynorhinus townsendii*)

- **Rarity**: Most wetland ecological communities have rare status (see above).
- **High biodiversity**: Ponds and marshes are focal points for wildlife because of their infrequent occurrence in this landscape. Wetlands provide wildlife and biodiversity values that are disproportionate to the area they occupy on the land base. Wetland vegetation provides food, shelter, breeding habitat, and cover for many species of amphibians, reptiles, mammals, birds, and insects. Wetland vegetation provides food for many aquatic organisms. Ponds are important watering sites for many species, and in the study area provides Painted Turtle and Spadefoot habitat. Wetlands are also sources of insects that provide food to many different species of birds and bats.
- **Fragility**: Wetlands are vulnerable to a range of human disturbances such as vegetation removal, dredging, diking, filling, and trampling by livestock. Small changes in hydrology such as reduced flows or lowered water tables, irrigation run-off, and urban run-off (including stormwater drainage) and other sources of nutrients including fertilizers and livestock manure can change and reduce the diversity of wetland communities. Such changes may occur away from the wetland, but can still influence it. Intensive recreational activities in and near wetlands can reduce plant cover, compact soil, and disturb nesting birds. Wetlands are vulnerable to overuse by livestock, but can still be extremely valuable and may recover quickly with improved livestock management.

[74] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) ecological communities as of May 2008 are noted.
[75] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of April 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

- **Maintenance of water quality**: Properly functioning wetlands store and filter water, and maintain water quality. They reduce the levels of sediment, nutrients, and toxic chemicals in outflow water.

- **Social values**: Wetlands provide water storage and filtration and opportunities for wildlife viewing, education, and aesthetic enjoyment. They are focal points in the arid landscape of the Okanagan. They can add to real estate values in adjacent areas and can provide a tourist attraction.

Status

Wetland ecosystems were rare in the study area; they occupied 318 ha or 1.5% of the study area land base. Many wetlands in the Okanagan Valley have been filled in, or their hydrology has been altered through changes in land use in the surrounding area. For example, in the area between Penticton and Osoyoos, 85-90% of large marshes have been lost[76]. Wetlands have been influenced by effluent irrigation run-off resulting in unnaturally high nutrient loads and different hydrology, and by domestic cattle grazing in the study area, together reducing plant cover and changing species on many sites. Such sites are still extremely valuable for wildlife and can recover quickly with effective range management. Future housing and other developments in the study area may alter, isolate, or cause losses of wetlands.

Marshes (153 ha) and shallow water (156 ha) were the most common wetland types in the study area; swamps were uncommon (9 ha).

Management Recommendations[77]

The ecological functions that wetlands provide, specifically water storage and maintenance of water quality, are provided free of charge. When these functions are removed through the loss or degradation of wetlands, it can be an exorbitant cost to replace them through technological means or by re-creating wetlands. The ecological functions and rarity of wetlands requires conservation of all remaining wetlands, including the maintenance of buffers to preserve the hydrologic regime, wetland functions, and connectivity to other ecosystems. Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether the wetland is on private or public lands.

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to wetlands.

Avoid Direct and Indirect Impacts

- **Roads** should not be built near wetlands as they can alter hydrology and lead to extensive mortality of wildlife species that use wetlands. Roads should never encircle wetlands and should be set back as far as possible (more than 50m; distance depends on local conditions; could provide opportunities for painted turtle nesting along with special fencing to prevent road mortality).

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[76] Voller 1998

[77] Many of the recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

- **Maintain wetland hydrology**. Draining or ditching in or around wetlands, the filling in of wetlands, irrigation run-off, and the discharge of stormwater into such sites should be avoided. Vegetation cover in adjacent areas should not be removed as this increases surface runoff and reduces the amount of groundwater infiltration, thus reducing available summer moisture. Additionally, areas of impervious ground surfacing (i.e., pavement) should be minimized. Hydrologists familiar with wetland function should be consulted to determine how to protect wetland hydrology.
- **Maintain water quality**. Wetlands store and filter water, and maintain water quality; therefore, the addition of urban storm drainage, agricultural runoff, and sediment from road building into wetlands should be prevented. Wetlands that have artificially high nutrient levels may experience algal blooms, and changes in vegetation composition (e.g. some marshes may convert from sedges or rushes to cattails).
- **Restrict recreational access**. Intensive recreational use of shoreline areas can reduce plant cover, compact soil, and disturb wildlife. Roots of trees and shrubs can be easily damaged by trampling and trail development in the moist soils of wetlands. Trails often become wide in wet, muddy areas, and sediments from trail damage may affect amphibians and insects. Motorized recreation, mountain biking, and horseback riding should be excluded from wetlands. In areas where trails to viewpoints in wetlands are desired, raised boardwalks should be used (avoid using rock or bark mulch on trails).
- **Manage livestock access**. Livestock use of many wetlands and ponds for water has significantly altered these sites. Overuse of wetlands by livestock can lead to soil compaction, damage and loss of vegetation cover and structure, and introductions of invasive plant species. Vegetation on many sites can quickly recover, however, when cattle use is reduced. Alternative watering sites, and fencing to allow a single access point to the water source can be used to maintain wetland functions and values while allowing some cattle use.
- **Prevent disturbance of nesting or breeding areas**. Recreational activities along wetland edges and canoeing in wetlands can impact amphibians, nesting waterfowl, and other birds, and thus, should be avoided during the breeding season (May through August). Disturbance of soils around wetlands, especially sandy soils that might be used by Painted Turtles for egg-laying or Spadefoots for burrowing, should also be avoided.
- **Restrain pets near wetlands during spring and summer**. Pets should be controlled to avoid disturbances to turtles, amphibians, waterfowl, and other birds during the breeding season (May through August).
- **Allow natural wetland processes to maintain wetland functions and values**. Beaver activity, flooding, seasonal drawdown, and groundwater recharge and discharge should be maintained. Inflow or outflow streams should not be diked or channelized.
- **Avoid use of pesticides and fertilizers in or near wetlands**. Follow the restrictions for each pesticide and ensure that winds do not cause sprays to drift and contaminate the water body. Roundup (glyphosate) is particularly toxic to amphibians[78].

[78] Relvea 2005

9 Riparian

What are riparian ecosystems?

Riparian simply refers to areas adjacent to water bodies such as lakes, rivers, streams, and ponds[79]. In this study, riparian ecosystems were defined as ecosystems that are adjacent to, and significantly influenced by a water body. That is, these sites are moister than and have a plant community that is distinct from the surrounding upland. Riparian ecosystems are typically linear in nature. Wetlands are riparian in nature but were described separately because of their distinct ecological nature.

Riparian ecosystem
vs.
Riparian zone

'Riparian ecosystems' vary in width and are delineated by site-specific vegetation, soil, and topographic features.

The term 'riparian zone' is often used to describe a fixed width management area surrounding streams and wetlands.

For this SEI, riparian ecosystems were classified into structural stages (Table 8) in order to identify different habitat values.

Table 8. Structural stages of riparian ecosystems

Code	Name	Definition
RI:1	Unvegetated or sparsely vegetated	Less than 10% cover of vegetation
RI:2	Herb	Herb dominated, shrub cover <20%, tree cover less than 10%
RI:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
RI:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, dense stands, generally 10-40 years old
RI:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
RI:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old; trees may be younger in broadleaf forests.
RI:7	Older forest	Trees are >10m tall and have 10% or greater cover, many tree ages, many trees are 250 years or older; trees may be younger in broadleaf forests.

For this study, riparian ecosystems were also divided into distinct classes (beach, fringe, bench and gully) according to their environmental and vegetation characteristics; these are described below.

[79] MacKenzie and Moran 2004; Voller 1998

Beach riparian

In the study area, beach riparian ecosystems occurred on the shoreline of Kalamalka Lake. They have little vegetation and are the area of sediments reworked recently by wave action. See: fringe riparian below for a picture of a beach ecosystem.

Gully riparian

Gully riparian ecosystems occur at the base and lower slopes of small valleys or ravines with significant moisture. These ecosystems have either permanent or intermittent surface water flow, or significant subsurface flow, but are usually not subject to flooding. They are rich and productive sites, providing habitat that is distinctly different from the surrounding landscape. They occurred in both grassland and forested landscapes. These ecosystems usually had a mixed coniferous and deciduous overstory with shrubby understories.

Fringe riparian ecosystems

Ponds, marshes, and Kalamalka Lake typically had fringe riparian ecosystems associated with their shorelines. This class also includes sites with significant seepage that are sensitive to soil and hydrological disturbances. These ecosystems usually had trembling aspen overstories with shrubby understories.

Photo shows a fringe ecosystem and beach on the edge of Kalamalka Lake.

Bench riparian ecosystems

Bench riparian ecosystems are flood or fluvial ecosystems that are associated with moving water such as creeks and rivers. They are influenced by flooding and subsurface irrigation. They usually occur as linear ecosystems on plains or terraces with sandy, gravely soils adjacent to creeks and rivers. The forest overstories were broadleaf, coniferous or mixed; understories were typically shrubby.

Vegetation

	Fringe	Gully	Bench	
Trees				
black cottonwood	*	*	***	*Populus balsamifera* ssp. *trichocarpa*
Douglas-fir	*	**	*	*Pseudotsuga menziesii*
western redcedar		**	*	*Thuja plicata*
trembling aspen	***	***	*	*Populus tremuloides*
paper birch				*Betula papyrifera*
Shrubs				
common snowberry	***	***	**	*Symphoricarpos albus*
red-osier dogwood	**	**	**	*Cornus stolonifera*
Douglas maple	**	**	**	*Acer glabrum*
water birch	**	**	**	*Betula occidentalis*
Nootka rose	**	**	*	*Rosa nutkana*
thimbleberry	**	**	**	*Rubus parviflorus*
Forbs				
Star-flowered false Solomon's seal	**	**	**	*Maianthemum stellatum*
mountain sweet-cicely	**	**	**	*Osmorhiza berteroi*
horsetail		*	*	*Equisetum* spp.
Mosses				
leafy mosses		*	**	*Mnium* or *Plagiomnium* spp.

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species. Beach ecosystems have little or no vegetation.

Why are they important?[80]

Ecological attributes and socio-economic values of riparian ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare[81] ecological communities of riparian ecosystems

Black cottonwood – Douglas-fir – common snowberry – red-osier dogwood (R) (*Populus balsamifera* ssp. *trichocarpa - Pseudotsuga menziesii - Symphoricarpos albus - Cornus stolonifera*)

Douglas-fir – western larch / pinegrass (R) (*Pseudotsuga menziesii – Larix occidentalis / Calamagrostis rubescens*)

Trembling aspen / common snowberry / Kentucky bluegrass (R) (*Populus tremuloides / Symphoricarpos albus / Poa pratensis*)

Douglas-fir / common snowberry – birch-leaved spirea (B) (*Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia*)

Douglas-fir / Douglas maple – red-osier dogwood (B) (*Pseudotsuga menziesii / Acer glabrum – Cornus stolonifera*)

Hybrid white spruce / black gooseberry (B) (Picea engelmanii x glauca / Ribes lacustre)

Western redcedar – Douglas-fir / red-osier dogwood (B) *Thuja plicata – Pseudotsuga menziesii / Cornus stolonifera*

Rare vertebrates of riparian ecosystems

Western Screech-Owl (R, COSEWIC-E) (*Megascops kennicottii* ssp. *macfarlanei*)
Lewis' Woodpecker (R, COSEWIC-SC) (*Melanerpes lewis*)
Yellow-breasted Chat (R, COSEWIC-E) (*Icteria virens*)
Brewer's Sparrow (R) (*Spizella breweri* ssp. *breweri*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Great Blue Heron (B) (*Ardea herodias*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: Their conservation status (B.C. Conservation Data Centre) lists most riparian ecological communities as at-risk (see above).
- **High biodiversity**: Riparian ecosystems support disproportionately high numbers of species relative to the area they occupy on the land base. They provide wildlife with water, cover, breeding habitat, and food. The wide diversity of plants, invertebrate organisms, and structural complexity of these ecosystems provide many habitat niches. Riparian vegetation provides food for many aquatic organisms. Gullies generally lack surface water flow but often have lush, productive vegetation that provides significant cover and food for wildlife and may be natural travel corridors.
- **Fragility**: Riparian ecosystems are strongly influenced by adjacent water bodies and, thus, they are sensitive to disturbance and changes in hydrology.

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[80] Adapted from Iverson and Cadrin 2003.
[81] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

- **Aquatic habitat protection and water quality**: Riparian vegetation supplies most of the organic matter and plays a large role in determining the composition of the aquatic invertebrate community. Riparian vegetation also provides a source of large organic debris (e.g., logs). Riparian areas are important for trapping sediments and maintaining water quality. The root systems of riparian vegetation stabilize stream banks, thus reducing erosion and sediment inputs to the water. Riparian vegetation plays a key role in controlling water temperatures by reducing incoming radiation.
- **Wildlife corridors**: Within the study area, gullies form natural wildlife corridors connecting lower and upper slopes of the study area and connect different types of ecosystems.
- **Social values**: Riparian areas provide water retention and filtration, prevent erosion, and provide natural areas, and opportunities for education, bird watching, wildlife viewing, and walking and hiking. They are cooler places to enjoy nature on hot summer days. Retention of riparian corridors can enhance and maintain property values and attract tourists by retaining the natural beauty that many people seek out.

Status

Riparian ecosystems are naturally uncommon in the study area and occupied only 5.6% (1173 ha) of the study area – predominantly gully (457 ha) and fringe (439 ha), with some bench (274 ha) and minor beach (4 ha) ecosystems.

Only 1% of riparian ecosystems in the study area were in the old forest structural stage. Another 41% was mature forest and 45% was young forest, indicating that many riparian ecosystems had been altered by human disturbance. Historically, riparian ecosystems would have been predominantly old and mature structural stages.

Conservation of all riparian ecosystems should be a priority. In all structural stages, it is important to retain all riparian vegetation to preserve stream bank and soil stability, water temperature and quality, and wildlife habitat values.

Management Recommendations[82,83]

Riparian ecosystems have attracted considerable attention in the last decade because of increased awareness of their value in stream and river protection. Most protection has focussed on fisheries or wildlife values, with less emphasis on the diversity and ecology of riparian plant communities.

Efforts should be made to maintain connections with adjacent upland ecosystems and to reduce fragmentation in order to preserve wildlife corridors. Where possible, vegetation and ecological functions of altered riparian ecosystems should be restored.

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to riparian ecosystems.

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[82] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[83] There are fish in all the major creeks, including Rainbow trout, and Kokanee are present in Vernon Creek and spawn in Coldstream Creek . Additional management recommendations for riparian ecosystems where fish may be present can be found in Iverson et al. 2008.

Avoid Direct and Indirect Impacts

- **Riparian vegetation should be maintained where it is present, and restored where it has been lost**. Vegetation maintains the cohesive nature of banks and provides inputs of organic matter into soils, which increases their capacity to adsorb and store water. Additionally, riparian vegetation moderates water temperatures, provides an important source of food for many aquatic organisms, and provides important wildlife cover for nesting and feeding.
- Where practical or necessary, **restrict livestock access** by using fencing. To allow safe wildlife access, fences should be top-railed, and bottom wires should be 45cm (18") above ground level (this height is for cattle, lower bottom wires are needed for sheep and other livestock).
- **Control pets**. Pets should be restrained and hunting dogs should be trained away from riparian areas during the spring and summer. Other disturbances to waterfowl during the nesting season should also be avoided.
- **Protect structural features***:* Maintain structures such as rocks and logs within streams as they provide important habitat and prevent erosion.
- **Avoid use of insecticides in or near water and important foraging areas for wildlife**. Insecticide use near foraging habitat for animals that feed on insects (e.g., Western Screech-Owl, Townsend's Big-eared Bat and amphibians) should be avoided.
- **Allow natural disturbances to occur**. Flooding, windthrow, and channel changes are recognised as important factors in the creation and maintenance of high diversity riparian habitats and provide important habitat attributes for fish. Leave sufficient buffers to allow these events and processes to occur wherever possible.

Plan Land Development Carefully

Where human settlement or other development is permitted adjacent to a riparian area, the following guidelines apply:

- **Design roads carefully**. Roads should be narrow and set back from the riparian ecosystem to ensure that both the riparian vegetation and bank stability are maintained. If roads must cross riparian ecosystems, bridges are recommended to minimize disturbance of soil and vegetation and to provide a wildlife corridor below. Where roads encroach upon riparian ecosystems, narrow the width of the road and avoid side-casting material into the riparian area.
- **Design trails carefully**. Trails should provide a direct route to a viewing area or crossing, and should avoid sensitive vegetation, seepage areas and wetlands, and stream banks or gully side walls with easily eroded soils.

10 Old Forest

What are old forest ecosystems?

Old forest ecosystems are forests that are dominated by large, old trees. Old forests historically would have dominated the forested patches in the study area. Throughout the study area, historical harvesting of large, old ponderosa pine and Douglas-fir has greatly reduced the area of old forest ecosystems. Old forests were mapped where polygons included old structural stage ecosystems except for old riparian forests, which were included in the riparian category.

Historically, most forests had frequent surface fires that killed most regeneration and allowed few new trees into the overstory. Overstories were generally multi-aged with a largely single-layered canopy, and understories were open and dominated by grasses and shrubs. Frequent fire also limited the occurrence of dead wood to scattered large snags and large, downed wood.

The exclusion of fires has caused formerly open, park-like forests to infill with waves of smaller trees (this is referred to as forest ingrowth; historically, most of these small trees would have been killed by periodic fires). Old forests still occur where large, old trees have not been selectively harvested. In most cases these stands have undergone some forest ingrowth and, thus, are not fully representative of the historical forests. Old trees, however, are structurally very important for wildlife, and old forest sites have the best potential for restoration to historical stand structure.

All old forests within the study area fell within the "coniferous" subcategory (OF:co).

Vegetation

Trees			
	ponderosa pine	**	*Pinus ponderosa*
	Douglas-fir	**	*Pseudotsuga menziesii*
Shrubs			
	common snowberry	**	*Symphoricarpos albus*
	tall Oregon-grape	**	*Mahonia aquifolium*
	saskatoon	**	*Amelanchier alnifolia*
Grasses			
	bluebunch wheatgrass	***	*Pseudoroegneria spicata*
	rough fescue	**	*Festuca campestris*
	pinegrass	**	*Calamagrostis rubescens*
Forbs			
	arrowleaf balsamroot	**	*Balsamorhiza sagittata*
	heart-leaved arnica	*	*Arnica cordifolia*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of old forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare[84] ecological communities of old forests

Douglas-fir / common snowberry – birch-leaved spirea (R) (*Pseudotsuga menziesii / Symphoricarpos albus – Spirea betulifolia)*

Douglas-fir – ponderosa pine / bluebunch wheatgrass (R) (*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata*)

Douglas-fir - ponderosa pine / bluebunch wheatgrass – pinegrass (B) (*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens*)

Douglas-fir / shrubby penstemon – pinegrass (B) (*Pseudotsuga menziesii / Penstemon fruticosus - Calamagrostis rubescens*)

Rare vertebrates of old forests

Swainson's Hawk (R) (*Buteo swainsoni*)
Lewis's Woodpecker (R, COSEWIC-SC) (*Melanerpes lewis*)
White-headed Woodpecker (R, COSEWIC-E) (*Picoides albolarvatus*)
Badger (R, COSEWIC-E) (*Taxidea taxus*)

Racer (B, COSEWIC-SC) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Great Blue Heron (B) (*Ardea herodias*)
Flammulated Owl (B, COSEWIC-SC) (*Otus flammeolus*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

Ferruginous Hawk (COSEWIC-SC) (*Buteo regalis*)

- **Rarity**: Most old forest ecological communities are rare (see above).
- **High biodiversity:** Old forests provide habitat for a wide variety of wildlife, plant, and invertebrate species. Old forest ecosystems have many unique and important structural attributes, many of them associated with old trees. Typically these forests have widely spaced trees with open understories, providing mule deer with good visibility from predators and ease of travel. The complex structure of old forests provides ample foraging, nesting and roosting opportunities for numerous wildlife species. Large old trees provide good snow interception, enabling animals such as mule deer to move easily through old forests in the winter.
- **Specialised habitats:** Many species depend on features found only in old forests. The large, old trees in these forests provide cavities for many bird and small mammal species. Additionally, these ecosystems usually have scattered large snags and large woody debris which provide critical habitats for many species, including some species at risk.

[84] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

- **Social values**: Old forests provide opportunities for education, and wildlife viewing. Large old trees provide attractive and aesthetic views that can raise real estate values in adjacent areas, and can draw tourists into the area.

Status

Historically, old forests likely dominated the majority of the forested portion of the landscape (about 43% of the study area) but now there are only small remnants. Most old forests had been lost to selection logging. The inventory showed that only 2.0% (417 ha) of the study area was old forests; these occurred primarily in protected areas and scattered in very small and fragmented patches, mostly in very rocky places not readily accessible for logging. There is a need to conserve all remaining old forests, and retain and restore stand structure in some mature forests for recruitment to old forests.

Management Recommendations

Loss of old forest ecosystems and forest ingrowth in remaining old forest areas has resulted in the loss of many habitat features (e.g., large old trees and grassy understory vegetation) and increased fire hazard.

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to old forest ecosystems.

Avoid Direct and Indirect Impacts

- **Restore and maintain ecological structures and functions**. Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion and logging. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of larger trees, plus thinning and removal of other trees to restore forest densities to the low tree densities of the late 1800's. Following thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals.

  Prescribed fire may be too dangerous to conduct on small, private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functioning of old forest ecosystems on their land by raking and removing fuels from beneath trees, and by cutting and removing small trees.

- **Prevent disturbance of nesting sites and breeding areas** (e.g., large trees with cavities).
- **Recruit new old forests.** Given that old forests are extremely limited within the study area, new old forests should be encouraged by proper management of mature forests (see Management Recommendations for mature forests on page 67).

11 Grasslands

What are grassland ecosystems?

Grasslands are ecosystems dominated by bunchgrasses with scattered forbs and a microbiotic crust. The grasslands of the North Okanagan represent a portion of the Pacific Northwest bunchgrass grasslands that are centred in south-east Washington, north-east Oregon and Idaho[85]. In British Columbia, grasslands cover less than 1% of the provincial land base but provide habitat for about 1/3 of the province's threatened and endangered species.

Areas where grasslands occurred are generally too hot and dry for forests to establish. Often, grasslands occurred on medium and finer textured soils where they are better able to capture the surface moisture than trees. Moisture is effectively funnelled by the conical shape of bunchgrasses and captured by extensive grass roots in the upper portions of the soil (generally the top 30cm), leaving little moisture available for tree seedlings. In comparison, trees are usually able to establish on moist sites, and on coarse soils (sandy, gravely) where moisture is available at depth. Grasslands are also favoured in areas where frequent, low-severity fires historically occurred and most young trees were killed by fire.

In the study area, grasslands were concentrated along the south-facing aspects of the Coldstream valley, in Kalamalka Lake Provincial Park and adjacent private lands to the east, and scattered as small pockets in amongst other ecosystems.

For this SEI, grassland ecosystems were divided into distinct classes (grasslands, disturbed grasslands and shrublands) according to their environmental and vegetation characteristics; these are described below.

Grassland ecosystems

Bunchgrasses, most commonly bluebunch wheatgrass, rough fescue, and Idaho fescue dominated healthy grassland ecosystems in the study area. Bunchgrasses are designed to funnel moisture to the center of the plant, and have extensive fine roots to capture moisture in the upper horizons of the soil. Grassland soils are topped by a thick, dark-coloured horizon enriched by organic matter from the decomposition of grass roots. Grasslands may have a component of invasive alien plants, but are dominated by native plants.

[85] Tisdale 1947

Disturbed grassland ecosystems[86]

Disturbed grasslands, once intact grasslands, have a mixture of native bunchgrasses and forbs and invasive alien plants. More than about 50% of the total plant cover was comprised of invasive plant species including cheatgrass (*Bromus tectorum*), diffuse knapweed (*Centaurea diffusa*), sulphur cinquefoil (*Potentilla recta*), and other alien species.

Shrubland ecosystems

Shrubs, most commonly snowberry and roses, dominated shrubland ecosystems in the study area. Shrublands occurred in grassland areas, but were moister than the surrounding grasslands as they occurred in depressions and moist pockets that tended to collect snow and some run-off. Soils were dark (organic rich), typically medium-textured, and very rich.

[86] In earlier projects (Bella Vista SEI, Central Okanagan SEI, Commonage SEI, and Lake Country SEI), disturbed grasslands were a separate category under "other important ecosystems". They were defined as having 20-50% invasive alien plants. Grasslands with >50% invasive alien plants were categorized as modified landscapes. Recognizing the provincial rarity of grasslands and the many values that grasslands with alien plants retain, particularly wildlife habitat values, the provincial Rare Ecosystem Mapping standards have provided this new definition of disturbed grasslands as a subcategory of grasslands and include grasslands with >50% invasive alien plants.

Vegetation

	Grassland	Disturbed Grasslands	Shrubland	
Shrubs				
common snowberry			***	*Symphoricarpos albus*
roses			***	*Rosa* spp.
Grasses				
bluebunch wheatgrass	**	**		*Pseudoroegneria spicata*
rough fescue	**			*Festuca campestris*
Idaho fescue	**			*Festuca idahoensis*
junegrass	*	**		*Koeleria macrantha*
Columbian needlegrass		**		*Achnatherum nelsonii*
Forbs				
arrowleaf balsamroot	**	*	*	*Balsamorhiza sagittata*
parsnip-flowered buckwheat	**	**		*Eriogonum heracleoides*
daisies or fleabanes	**	*	*	*Erigeron* spp.
silky lupine	**	**	*	*Lupinus sericeus*
lemonweed	**	**	*	*Lithospermum ruderale*
Mosses and Lichens				
sidewalk moss	**	*		*Tortula ruralis*
clad lichens	**	*		*Cladonia* spp.
Invasive Alien Plants				
cheatgrass or Japanese brome		**		*Bromus tectorum* or *B. japonicus*
diffuse knapweed		**		*Centaurea diffusa*
sulphur cinquefoil		**		*Potentilla recta*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of grassland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare*[87] *ecological communities of grasslands:

Bluebunch wheatgrass – balsamroot (R) (*Pseudoroegneria spicata - Balsamorhiza sagittata*)

Bluebunch wheatgrass – junegrass (R) (*Pseudoroegneria spicata – Junegrass)*

Idaho fescue – bluebunch wheatgrass (R) (*Festuca idahoensis - Pseudoroegneria spicata*)

Prairie rose – Idaho fescue (R) (*Rosa woodsii / Festuca idahoensis*)

[87] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

Rare vertebrates of grasslands

Swainson's Hawk (R) (*Buteo swainsoni*)
Lewis's Woodpecker (R, COSEWIC-SC) (*Melanerpes lewis*)
Prairie Falcon (R) (*Falco mexicanus*)
Burrowing Owl (R, COSEWIC-E) (*Athene cunicularia*)
Grasshopper Sparrow (R) (*Ammodramus savannarum*)
Lark Sparrow (R) (*Chondestes grammacus*)
Preble's Shrew (R) (*Sorex preblei*)
Merriam's Shrew (R) (*Sorex merriami*)
Badger (R, COSEWIC-E) (*Taxidea taxus*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Racer (B, COSEWIC-SC) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp*. deserticola*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Sharp-tailed Grouse[88] (B) (*Tympanuchus phasianellus* ssp*. columbianus*)
Long-billed Curlew (B, COSEWIC-SC) (*Numenius americanus*)
Short-eared Owl (B, COSEWIC-SC) (*Asio flammeus*)
Fringed Myotis (B) (*Myotis thysanodes*)
Great Basin Pocket Mouse (B) (*Perognathus parvus*)
Western Harvest Mouse (B, COSEWIC-SC) (*Reithrodontomys megalotis*)
Nuttall's Cottontail (B, COSEWIC-SC) (*Sylvilagus nuttallii* ssp*. nuttallii*)

- **Highly threatened**: Grasslands commonly occur on sites that are very amenable to development – both for agriculture and housing – and many grasslands have already been lost to agricultural or urban development. Overuse by domestic livestock and invasive plants also threaten remaining grasslands. Grasslands are recognised as one of British Columbia's most threatened ecosystems[89]. Only 8% of the grasslands in the province are protected[90].
- **Rarity**: All grassland native plant communities are listed by the B.C. Conservation Data Centre (see above).
- **High biodiversity**: Grasslands and shrublands support a unique assemblage of species that includes a high proportion of endangered species. Grasslands, in combination with other ecosystems, are used by many species.
- **Sensitivity to disturbance**: Grasslands are very sensitive to disturbances including off-road vehicle use and mountain biking, and recovery can take many decades. Disturbance to grassland soils can damage the fragile microbiotic crust, and can allow the introduction and spread of invasive alien plants, which can slow or limit recovery.
- **Social values**: Grasslands provide opportunities for education, wide open spaces for walking and hiking, wildlife viewing, and aesthetic enjoyment. Grasslands are particularly attractive in spring with their vibrant display of wildflowers. The open, natural spaces that grasslands provide can add to real estate values in adjacent areas, and can draw tourists into the area. Grasslands have many important traditional-use plants for First Nation peoples.

[88] Thought to be extirpated from the area.
[89] Canadian Parks and Wilderness Society 1996
[90] Grasslands Conservation Council of B.C. 2002

Status

Grassland ecosystems covered 12% (2582 hectares) of the study area. The majority of these were disturbed grasslands (1660 ha), with some grasslands (691 ha) and a smaller area of shrublands (230 ha).

All grassland ecosystems are a high priority for conservation considering that many have been lost to agricultural and urban settlement.

Management Recommendations[91]

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to grassland ecosystems.

Avoid Direct and Indirect Impacts

- **Manage access**. All motorized vehicles should be restricted to existing roads. Mountain bikes should be restricted to existing or carefully planned trails that are free of invasive plants, and not subject to erosion; otherwise, these trails should be closed until invasive plant problems have been controlled. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive alien species. Existing trails with erosion problems need to be rehabilitated and restored.
- **Protect large old trees and snags.** Scattered trees or snags are extremely important for wildlife in grassland areas. These trees can be isolated structures in grassland areas.
- **Manage livestock use**. Livestock grazing needs to be carefully managed to ensure that ecological values associated with grassland ecosystems are maintained. Bunchgrasses are damaged by season-long grazing. Careful monitoring should be implemented to ensure that grazing levels and timing meet management objectives for the site.
- **Remove encroaching trees**. Large old trees are important habitat features that should be protected where they occur in grassland areas, but young trees should be removed by cutting, or other mechanical means. Prescribed fire can also be used to remove encroachment, but it must be planned and conducted by a qualified professional and requires careful management of invasive plant species to prevent their spread.

Plan Land Development Carefully

Where development is allowed near grassland ecosystems, the following guidelines apply:

- **Maintain native grassland ecosystems and their wildflowers** by encouraging landowners and developers to maintain natural sites, and landscape with native species adapted to local conditions. Native plant gardening can help create wildlife habitat, and minimize the need to water or irrigate.

[91] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

12 Broadleaf Woodlands

What are broadleaf woodland ecosystems?

Broadleaf woodland ecosystems occurred on sites where conditions resulted in a broadleaf overstory in the climax stage of succession. Because these ecosystems are moister than surrounding areas, they have many similarities to riparian ecosystems, but are generally not found near standing or running water.

In the study area broadleaf woodland ecosystems included only aspen copse ecosystems. Aspen copse ecosystems occurred in broad, moist depressions and draws in grassland areas. They were typically small ecosystems with trembling aspen overstories and shrubby understories dominated by common snowberry and roses.

Vegetation

Trees		
trembling aspen	***	*Populus tremuloides*
Shrubs		
common snowberry	***	*Symphoricarpos albus*
Nootka rose	**	*Rosa nutkana*
saskatoon	*	*Amelanchier alnifolia*
tall Oregon-grape	*	*Mahonia aquifolium*
Grasses		
blue wildrye	*	*Elymus glaucus*
Forbs		
star-flowered false Solomon's-seal	*	*Maianthemum stellatum*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of broadleaf woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare[92] ecological communities of broadleaf woodlands

Trembling aspen / snowberry / Kentucky bluegrass (R) (*Populus tremuloides / Symphoricarpos albus / Poa pratensis*)

Rare vertebrates of broadleaf woodlands

Western Screech-Owl (R, COSEWIC-E) (*Megascops kennicottii* ssp. *macfarlanei*)
Lewis's Woodpecker (R, COSEWIC-SC) (*Melanerpes lewis*)
Yellow-breasted Chat (R, COSEWIC-E) (*Icteria virens*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: the only broadleaf woodland ecological community mapped in the study area is listed as rare by the B.C. Conservation Data Centre (see above).
- **High biodiversity**: Broadleaf woodland ecosystems have diverse plant communities that support a rich assemblage of species. Deciduous litter fall results in an organically enriched upper layer of soil.
- **Specialised habitats**: Aspen copse ecosystems are structurally diverse, and provide cover, food, and nesting habitat for many species. Aspen trees are very important for cavity nesting birds and animals. Many species that feed in adjacent grasslands require aspen trees for nesting and denning.
- **Social values**: Broadleaf woodland ecosystems provide opportunities for education, wildlife viewing, cover from the heat and sun, walking and hiking, and aesthetic enjoyment. They provide water filtration, soil stability and can add to real estate values in adjacent areas and draw tourists into the area.
- **Fragility**: These ecosystems are sensitive to soil disturbances because of their moist soils.

Status

Broadleaf woodland ecosystems were rare in the study area; they covered 0.6% of the study area (129 ha) and occurred scattered in grassland-dominated areas. All broadleaf woodland ecosystems are a high priority for conservation.

[92] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

13 Coniferous Woodlands

What are coniferous woodland ecosystems?

Coniferous woodland ecosystems in the study area had open coniferous tree canopies. They occurred on rocky knolls and shallow soils where limited moisture or shallow soil limited tree establishment. These ecosystems had scattered ponderosa pine and Douglas-fir trees, and saskatoon growing in rock fractures with patches of grasses and forbs in shallow soil pockets.

Coniferous woodland ecosystems were classified into five structural stages for this SEI. Structural stages are important to identify different habitat values and the quality of the site (Table 9). Generally, older structural stages are of higher conservation priority than younger structural stages. Younger sites are important for buffers, and they provide recruitment for older structural stages.

Table 9. Structural stages of coniferous woodland ecosystems.

Code	Name	Definition
WD:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
WD:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, dense stands, generally 10-40 years old
WD:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
WD:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old

Vegetation

Trees		
ponderosa pine	*	*Pinus ponderosa*
Douglas-fir	**	*Pseudotsuga menziesii*
Shrubs		
saskatoon	**	*Amelanchier alnifolia*
Grasses		
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
rough fescue	**	*Festuca campestris*
Forbs		
arrowleaf balsamroot	**	*Balsamorhiza sagittata*
selaginella	*	*Selaginella* spp.

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of coniferous woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare[93] ecological communities of coniferous woodlands

Douglas-fir – ponderosa pine / bluebunch wheatgrass (R) (*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata*)

Douglas-fir - ponderosa pine / bluebunch wheatgrass – pinegrass (B) (*Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens*)

Douglas-fir / shrubby penstemon – pinegrass (B) (*Pseudotsuga menziesii / Penstemon fruitcosus - Calamagrostis rubescens*)

Rare vertebrates of coniferous woodlands

Swainson's Hawk (R) (*Buteo swainsoni*)
Lewis' Woodpecker (R, COSEWIC-SC) (Melanerpes lewis)
Badger (R, COSEWIC-E) (*Taxidea taxus*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Racer (B, COSEWIC-SC) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Western Skink (B, COSEWIC-SC) (*Eumeces skiltonianus*)
Flammulated Owl (B, COSEWIC-SC) (*Otus flammeolus*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

Rubber Boa (COSEWIC-SC) (*Charina bottae*)
Ferruginous Hawk (COSEWIC-SC) (*Buteo regalis*)

- **Rarity**: Coniferous woodland ecological communities have rare status (see above).
- **High biodiversity**: Coniferous woodland ecosystems are diverse and support a rich assemblage of species. The open nature of these forests provides deer with good visibility from predators and provides habitat for many grassland species that do not tolerate closed forests. Coniferous woodland ecosystems on shallow soil sites with exposed bedrock often provide denning habitat for snakes.
- **Specialised habitats**: Scattered large, old trees and cracks and crevices in exposed bedrock provide a range of habitat niches.
- **Fragility**: Coniferous woodland ecosystems commonly have shallow soils that are very sensitive to disturbance.
- **Social values**: Coniferous woodland ecosystems provide opportunities for education, wildlife viewing, landscape viewpoints, walking and hiking, and aesthetic enjoyment. They can add to real estate values in adjacent areas and draw tourists into the area.

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[93] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

Status

The types of coniferous woodland ecosystems found in the study area have a limited distribution in the dry interior valleys of southern British Columbia. Historically, these ecosystems likely occurred on steep warm aspects and in areas with shallow soils in the study area. Most coniferous woodland ecosystems have been altered by disturbances such as logging, forest ingrowth, and invasive alien plants. Coniferous woodland ecosystems were relatively common in the study area (10% of study area; 2097 ha).

Old coniferous woodland ecosystems are included within the old forest category because of their extreme rarity.

Most coniferous woodland ecosystems were young forests (55%). Mature coniferous woodlands (37%) should have the highest priority for conservation.

Management Recommendations

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to coniferous woodland ecosystems.

Avoid Direct and Indirect Impacts

- **Prevent soil disturbances**. Coniferous woodlands often have shallow soils that are sensitive to disturbance. Soil disturbance can allow invasive plants to establish and spread and can make it difficult for native plants to re-establish.
- **Restore and maintain ecological structures and functions**. Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion and logging. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of larger trees, plus thinning and removal of other trees to restore forest densities to the low tree densities of the late 1800's. Following thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals.

  Prescribed fire may be too dangerous to conduct on small, private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functioning of coniferous woodland ecosystems on their land by raking and removing fuels from beneath trees, and by cutting and removing small trees.

14 Sparsely Vegetated

What are sparsely vegetated ecosystems?

Sparsely vegetated ecosystems in the study area occurred on sites where bedrock or talus limited vegetation establishment. Vegetation cover was discontinuous, and was interspersed with bedrock or blocks of rock.

Sparsely vegetated ecosystems were subdivided into four subtypes: cliff, rock, shrub, and talus ecosystems; these are described below.

Cliff (SV:cl)

Sparsely vegetated cliff ecosystems are steep, vertical bedrock. Cliffs have minimal vegetation restricted to cracks and crevices, narrow ledges and small soils pockets

Rock (SV:ro)

Rock outcrop ecosystems occurred on areas of exposed rock that had very little soil development and sparse vegetation cover. Vegetation cover typically consisted of patches of bunchgrasses, selaginella and scattered shrubs.

Shrub (SV:sh)

Shrub ecosystems occur on small rock outcrops with cracks and crevices. Soils are restricted to small pockets. Scattered shrubs and grasses grow in cracks and small soil pockets.

Talus (SV:ta)

Talus ecosystems occur on steep slopes covered with angular rock fragments. They usually occur below rock outcrops or cliffs. Vegetation includes scattered trees, shrubs, and cliff ferns.

Vegetation

	Cliff	Rock	Shrub	Talus	
Trees					
ponderosa pine				*	*Pinus ponderosa*
Douglas-fir				*	*Pseudotsuga menziesii*
Shrubs					
saskatoon	*	*	*	*	*Amelanchier alnifolia*
choke cherry	*		*	*	*Prunus virginiana*
mock orange	*			**	*Philadelphus lewisii*
Grasses					
bluebunch wheatgrass	*	*	*	*	*Pseudoroegneria spicata*
Forbs					
arrowleaf balsamroot		*	*		*Balsamorhiza sagittata*
selaginella		***			*Selaginella* spp.
cliff fern	*			*	*Woodsia* spp.
shrubby penstemon			*	*	*Penstemon fruticosus*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of sparsely vegetated ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Natural sparsely vegetated ecological communities recommended for the red- or blue- list

Antelope-brush – selaginella (*Purshia tridentata*)[94]

Choke cherry – bluebunch wheatgrass (*Prunus virginiana – Pseudoroegneria spicata*)

Saskatoon – mock orange (*Amelanchier alnifolia – Philadelphus lewisii*)

Selaginella – bluebunch wheatgrass (*Selaginella - Pseudoroegneria spicata*)

Rare[95] vertebrates of sparsely vegetated ecosystems

Peregrine Falcon (R, COSEWIC-SC) (*Falco peregrinus* ssp. *anatum*)
Prairie Falcon (R) (*Falco mexicanus*)

Racer (B, COSEWIC-SC) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Western Skink (B, COSEWIC-SC) (*Eumeces skiltonianus*)
Canyon Wren (B) (*Catherpes mexicanus*)
Fringed Myotis (B) (*Myotis thysanodes*)
Western Small-footed Myotis (B) (*Myotis ciliolabrum*)
Spotted Bat (B, COSEWIC-SC) (*Euderma maculatum*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: Most sparsely vegetated ecological communities have been recommended for rare status (see above).
- **Specialised habitats**: A variety of specialised habitats are found in sparsely vegetated ecosystems. A number of species, including many at-risk species are dependant on these habitats. Shrub, rock and cliff ecosystems with deep crevices, and some talus slopes provide roosting or hibernacula sites for a variety of snake and bat species. Isolated trees provide important roosting or nesting sites for Lewis' woodpeckers and raptors.
- **Fragility**: Sparsely vegetated sites are sensitive to disturbance. They can take very long periods of time to recover, or never if soil or rock is removed or eroded.
- **Social values**: Sparsely vegetated ecosystems often provide focal points in the landscape for scenic viewpoints, wildlife viewing, and aesthetic enjoyment. They can add to real estate values in adjacent areas, and can draw tourists into the area.

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[94] Although Antelope-brush does not occur in the North Okanagan, this plant community is still considered to occur here. Some plant communities have a broad range of vegetation species and plant community names do not always reflect the dominant species at a particular site.

[95] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

Status

Sparsely vegetated ecosystems covered 3% (631 ha) of the study area land base. In the study area, rock ecosystems were the most common ecosystem type (384 ha); shrub ecosystems were uncommon (132 ha) cliffs and talus sites were rare (30 ha and 85 ha).

Management Recommendations

General management recommendations for all sensitive ecosystems are found in Section 7.4 (page 33). Below are additional management recommendations specific to sparsely vegetated ecosystems.

Avoid Direct and Indirect Impacts

- **Manage access** to minimise vehicular, mountain bike, and livestock access on and near sparsely vegetated ecosystems. Vehicle traffic, including bicycles, erodes thin soils and causes mortality to wildlife species that rely on these ecosystems. Road access should be avoided and rock climbing should be carefully managed on cliffs. ***Do not develop trails*** on sparsely vegetated ecosystems. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive alien species.
- **Prevent disturbance of snake hibernacula**. If snake hibernacula are found, they should not be disturbed and should not be made known to the public unless they occur in an area where public use may disturb snakes. Use snake fences around higher density developments.
- **Prevent soil disturbances**. Sparsely vegetated have sensitive pockets of shallow soils, and they frequently occur on steep slopes. Soil disturbance can allow invasive plants to establish or spread and can make it difficult or impossible for native plants to re-establish. Disturbance of talus or bedrock may destabilize remaining rocks.

Plan Land Development Carefully

Where development is allowed in or near sparsely vegetated ecosystems, the following guidelines apply:

- **Protect endangered, threatened, or vulnerable species or ecological communities, and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance of rock debris;
  - do no permit rock climbing without determining which areas must be avoided to protect denning, nesting, and roosting habitats;
- **Avoid roads near hibernacula**. Determine locations of snake hibernacula prior to planning site layouts, including roads. Roads should not be located within 750m of a hibernaculum and barriers and underpasses or snake fences may be required to prevent snake mortality.

15 Mature Forest

What are mature forest ecosystems?

Mature forest ecosystems were mapped where polygons included structural stage 6 forests[96] (mature forest), except for mature riparian, broadleaf woodland, and coniferous woodland forests, which were included in the riparian, broadleaf woodland, and coniferous woodland categories respectively.

Historically, most forests had frequent surface fires that killed most small trees and allowed few trees into the overstory. Overstories were generally open, multi-aged, and had a largely single-layered canopy of mostly large, old trees. The understory of mature forests was open and dominated by grasses and shrubs. Frequent fire also limited the occurrence of dead wood; only scattered large snags and large, downed wood occurred.

The exclusion of fires has caused formerly open, park-like forests to infill with smaller trees (forest ingrowth). Mature forests occurred where there are mature trees and a few large old trees. These stands typically had a history of selection logging and had some forest ingrowth, but the mature and old trees they contained are structurally important for wildlife. Mature forest sites provide excellent buffers for old forests and have good potential for restoration to historical stand structure.

Mature forest ecosystems were divided into three subclasses based on the composition of the trees in the forest: broadleaf, coniferous, and mixed mature forest ecosystems.

Broadleaf mature forest ecosystems

Broadleaf mature forest ecosystems were dominated by broadleaf tree species in the overstory including trembling aspen and paper birch. These ecosystems occurred on moister sites than coniferous mature forest ecosystems and had shrubby understories. They differ from broadleaf woodland ecosystems in that they do not occur in grassland-dominated areas, have likely been selectively logged and will eventually become dominated by coniferous trees. They differ from riparian ecosystems in that they do not occur in a gully or adjacent to a creek, wetland, pond, or lake.

[96] Refer to Volume 2 (Iverson and Uunila 2005) for details on structural stage 6.

Coniferous mature forest ecosystems

Coniferous mature forests in the study area were dominated by ponderosa pine and Douglas-fir, with some western larch at higher elevations. These forests occurred on sites with a wide range of ecological conditions. Most sites had a Douglas-fir overstory, with scattered grasses, forbs, and shrubs in the understory.

Mixed mature forest ecosystems

In the study area, mixed mature forests had both Douglas-fir and broadleaf tree species, including trembling aspen and paper birch. These ecosystems occurred on moister sites than coniferous mature forest ecosystems and had shrubby understories with scattered grasses and forbs. They differ from riparian ecosystems in that they do not occur in a gully or adjacent to a creek, wetland, pond, or lake.

Vegetation

	Broadleaf	Coniferous	Mixed	
Trees				
ponderosa pine		**		*Pinus ponderosa*
Douglas-fir		**	**	*Pseudotsuga menziesii*
paper birch	**		**	*Betula papyrifera*
trembling aspen	**		**	*Populus tremuloides*
Shrubs				
common snowberry	***	**	***	*Symphoricarpos albus*
tall Oregon-grape	**	**	**	*Mahonia aquifolium*
Nootka rose	**	*	**	*Rosa nutkana*
Douglas maple	**		**	*Acer glabrum*
Grasses				
bluebunch wheatgrass		**		*Pseudoroegneria spicata*
rough fescue		**		*Festuca campestris*
pinegrass		**	**	*Calamagrostis rubescens*
blue wildrye	**		*	*Elymus glaucus*
Forbs				
arrowleaf balsamroot		*		*Balsamorhiza sagittata*
heart-leaved arnica		*	**	*Arnica cordifolia*
star-flowered false Solomon's seal	**		*	*Maianthemum stellatum*

This table broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of mature forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare[97] ecological communities of mature forests

Douglas-fir / common snowberry – birch-leaved spirea (R) (*Pseudotsuga menziesii / Symphoricarpos albus – Spirea betulifolia)*

Douglas-fir / pinegrass - kinnikinnick (B) (*Pseudotsuga menziesii / Calamagrostis rubescens – Arctostaphylos uva-ursi*)

Douglas-fir / pinegrass - twinflower (B) (*Pseudotsuga menziesii / Calamagrostis rubescens – Linnaea borealis*)

Douglas-fir - ponderosa pine / pinegrass (B) (*Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens*)

Rare vertebrates of mature forests

Swainson's Hawk (R) (*Buteo swainsoni*)

Racer (B, COSEWIC-SC) (*Coluber constrictor*)
Western Rattlesnake (B, COSEWIC-T) (*Crotalus oreganus*)
Great Blue Heron (B) (*Ardea herodias*)
Flammulated Owl (B, COSEWIC-SC) (*Otus flammeolus*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: About 1/3 of mature forest ecological communities have rare status (see above).
- **Future old forest ecosystems**: The extent of old forest ecosystems was extremely limited. With proper restoration, mature forests can, over time, become old forest ecosystems. However, removal of forest ingrowth is required to develop old forest ecosystems.
- **Biodiversity**: Mature forest ecosystems have many important structural attributes, including some remaining large, old trees. They provide habitat for many species, and, where they occur, broadleaf trees are important for many cavity-nesting species.
- **Landscape connectivity:** Mature forests provide buffers, and connectivity between other ecosystems.
- **Social values**: Mature forests provide opportunities for education, recreation, wildlife viewing, and aesthetic enjoyment. The natural areas that mature forests provide can add to real estate values in adjacent areas. Mature forests provide opportunities for selective logging.

Status

Mature forest ecosystems covered 3.2% (668 ha) of the study area. Most mature forest ecosystems in the study area were ingrown and required thinning to restore them to high quality sites that could become old forests.

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[97] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species and ecological communities as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

Coniferous mature forests were the most common type (610 ha); only 53 ha were mixed and 5 ha were broadleaf.

Management Recommendations[98]

Avoid Direct and Indirect Impacts

- **Restore and maintain ecological structures and functions**. Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion and logging. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of larger trees, plus thinning and removal of other trees to restore forest densities to the low tree densities of the late 1800's. Following thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals.

  Prescribed fire may be too dangerous to conduct on small, private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functioning of mature forest ecosystems on their land by raking and removing fuels from beneath trees, and by cutting and removing small trees.

[98] Management recommendations have been adapted from Iverson and Cadrin 2003.

16 Seasonally Flooded Agricultural Fields

What are seasonally flooded agricultural field ecosystems?

Seasonally flooded agricultural fields are lands that have been converted to agricultural use but have seasonally important wildlife habitat values. They are primarily located along low lying areas in the floodplain adjacent to Coldstream Creek and other large creeks. These sites may flood some springs or have patches of water, providing habitat for insects, amphibians, waterfowl and other birds. Vegetation is dominated by agronomic grass species.

Why are they important?

Ecological attributes and socio-economic values of seasonally flooded agricultural ecosystems are listed below.

- **Agricultural benefits**: Provide areas for growing crops.
- **Biodiversity**: Seasonally flooded agricultural fields provide important habitat for waterfowl, other bird species and other wildlife.
- **Linkages and travel corridors**: These sites provide opportunities for wildlife to travel between riparian and upland habitats.
- **Future riparian habitat**: These sites have the potential to recover riparian vegetation if agricultural use is discontinued.

Rare vertebrates[99] of Seasonally Flooded Agricultural Fields
Swainson's Hawk (R) *Buteo swainsoni*
Badger (R, COSEWIC-E) *Taxidea taxus*

Great Basin Spadefoot (B, COSEWIC-T) Spea intermontana
Western Toad (COSEWIC-SC) *Bufo boreas*
Gopher Snake, deserticola subspecies (B, COSEWIC-T) *Pituophis catenifer* ssp. *deserticola*
Racer (B, COSEWIC-SC) *Coluber constrictor*
Rubber Boa (COSEWIC-SC) *Charina bottae*
Western Rattlesnake (B, COSEWIC-T) *Crotalus oreganus*
Western Skink (B, COSEWIC-SC) *Eumeces skiltonianus*
Bobolink (B) *Dolichonyx oryzivorus*
Great Blue Heron, herodia subspecies (B) *Ardea herodias* ssp. *herodias*
Long-billed curlew (B, COSEWIC-SC) *Numenius americanus*
Short-eared Owl (B, COSEWIC-SC) *Asio flammeus*
Fringed Myotis (B) *Myotis thysanodes*
Townsend's Big-eared Bat (B) *Corynorhinus townsendii*
Western Harvest Mouse (B, COSEWIC-SC) *Reithrodontomys megalotis*
Western Small-footed Myotis (B) *Myotis ciliolabrum*

[99] Provincially endangered or threatened (R-red-listed) or special concern (B-blue-listed) vertebrate species as of May 2008 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of April 2008, are noted as endangered (E), threatened (T), or of special concern (SC).

Status

Seasonally flooded agricultural fields occupied 173 ha or 0.8% of the land base in the study area.

Management Recommendations

Avoid Direct and Indirect Impacts

- **Maintain or restore hydrological regime**: allow natural flooding to occur to improve wildlife habitat and to ensure continued health of adjacent riparian ecosystems. Where practical, plant native riparian shrubs and trees to restore riparian ecosystems.
- **Control invasive plant species**: Canada thistle and other unwanted introduced species can threaten both the wildlife and agronomic and native plant species.
- **Discourage human settlement or other land developments adjacent to seasonally flooded agricultural field ecosystems**. These sites are not suitable for development because they are prone to flooding; adjacent developments can disrupt connections to other ecosystems.
- **Prevent disturbance of nesting sites and breeding areas**. Many waterfowl are ground-nesters. Avoid haying during the nesting season if rare species are present.

17 Future Directions

The Coldstream - Vernon SEI provides an essential planning tool for the study area, and an important source of information for similar ecosystems that occur elsewhere in the North Okanagan. This project completes the SEI coverage of the majority of low-elevation ecosystems in the North Okanagan.

For the study area, this information should be used to develop a landscape level 'local ecosystems plan' and conservation strategy, which could tie into a broader 'ecosystem plan' for the North Okanagan including the protected areas on crown lands. Conservation priorities identified in the conservation analysis can provide the basis of a property acquisition strategy.

The SEI information can be used to modify Management Plans and direct restoration within Kalamalka Lake Park and Protected Area and Cougar Canyon Ecological Reserve.

As development proceeds within the study area, this inventory should be used as the basis for more detailed information gathering (at a larger scale) for development of neighbourhood area plans and Environmental Impact Assessments.

This SEI and the landscape level ecosystem plan for this area should be used to modify the District of Coldstream's, City of Vernon's and the Regional District of North Okanagan's Official Community Plans, and to provide input into a Growth Management Strategy. Sensitive and Other Important Ecosystems should be designated as Development Permit Areas within the Official Community Plans. The SEI map and conservation analysis can be used to guide zoning designations within the study area.

Existing mapping can provide a baseline to monitor changes in sensitive and other important ecosystems in the study area. As new housing, agricultural, and land developments, disturbances, and ecological succession occur in the study area, they will change components of the sensitive ecosystems map. The mapping should be updated every ten years to reflect and measure such changes.

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Appendix A: SEI Data

Spatial, non-spatial data and reports for the Terrestrial Ecosystem Mapping (TEM) component will be available for download at EcoCat http://www.env.gov.bc.ca/ecocat/ and can be found by searching by the project name "Coldstream – Vernon".

The following are available:

- project metadata
- non-spatial polygon attributes
- TEM report with expanded legend (Volume 2)[100]
- TEM and SEI map legends
- wildlife species accounts
- wildlife ratings tables
- wildlife report (Volume 3)[101]
- Arc/Info *.e00 Export Files includes two spatial coverages: ECI field sampling points and a ECP TEM polygon coverage

[100] Iverson and Uunila 2008
[101] Haney and Sarell 2008

Appendix B: Sensitive Ecosystems (SEI) Units[102] and related Terrestrial Ecosystem Mapping (TEM) units.

Sensitive Ecosystems

SEI Unit (Class, subclass)	SEI Code	TEM Unit Name	TEM Code[103]	Subzone / Site Series
Broadleaf Woodland, aspen copse	BW:ac	Trembling aspen – Snowberry – Kentucky bluegrass	AS (no "g" modifier)	IDFxh1 /98
Grasslands, disturbed	GR:dg	Kentucky bluegrass – Stiff needlegrass	BN	IDFxh1 /96
		Idaho fescue – Bluebunch wheatgrass	FW:$fc, FW:$kc, FW:$nc FW:$wk	IDFmw1 /00 IDFxh1 /91
		Bluebunch wheatgrass – Balsamroot	WB:$kc, WB:$nc, WB$wk	IDFxh1 /93
Grassland, grassland	GR:gr	Idaho fescue – Bluebunch wheatgrass	FW	IDFmw1 /00 IDFxh1 /91
		Bluebunch wheatgrass – Balsamroot	WB	IDFmw1 /00 IDFxh1 /93
		Bluebunch wheatgrass – Junegrass	WJ	IDFdm1 /02
Grassland, shrubland	GR:sh	Prairie Rose – Idaho fescue	RF	IDFmw1 /00 IDFxh1 /97
Old Forest, coniferous	OF:co	Douglas-fir / Western redcedar – Falsebox – Prince's pine	DF 7C	IDFmw1 /01
		Douglas-fir – Pinegrass – Feathermoss	DP 7C	IDFmw1 /04
		Douglas-fir / Ponderosa – Snowberry – Bluebunch wheatgrass	DS 7C	IDFmw1 /02
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 7C	IDFxh1 /07
		Douglas-fir / Ponderosa pine – Bluebunch wheatgrass - Pinegrass	DW 7C	IDFdm1 /03
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW 7C	IDFxh1 /03
		Douglas-fir – Ponderosa pine –Saskatoon – Mock orange	FO 7C	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Balsamroot	PB 7C	IDFxh1/02
		Antelope brush - Selaginella	SA 7C	IDFxh1 /00
		Douglas-fir – Penstemon - Pinegrass	PP 7C	IDFmw1 /03
		Saskatoon – Mock orange talus	SO 7C	IDFdm1 /00 IDFmw1 /00 IDFxh1 /00 MSdm1 /00
		Douglas-fir – Ponderosa pine – Snowbrush – Pinegrass	SP 7C	IDFxh1 /04
Old Forest, mixed	OF:mx	Saskatoon – Mock orange talus	SO 7M	IDFdm1 /00 IDFxh1 /00
Riparian, beach	RI:be	Beach	BE	IDFxh1 /00
Riparian, fringe	RI:ff	Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CD (no modifiers)	IDFxh1 /00
		Western redcedar – Devil's club – Foamflower	RD (no modifiers)	IDFmw1 /06

[102] See page 5 for SEI unit descriptions.

[103] All site modifiers, structural stages and stand composition modifiers are included unless otherwise noted. Structural stages are indicated by a number (e.g. '7'). Structural stage stand composition modifiers are indicated by a capital letter after the number (e.g., 'C' in '7C'). See Volume 2 (Iverson and Uunila 2008) for descriptions of site modifiers, structural stages, seral associations, and TEM units.

SEI Unit (Class, subclass)	SEI Code	TEM Unit Name	TEM Code[103]	Subzone / Site Series
		Western redcedar / Douglas-fir - Dogwood	RR, RRk, RRks, RRn, RRs, RRsw, RRw	IDFmw1 /05
		Western red cedar - Douglas-fir – False Solomon's Seal	RS (no modifiers)	IDFxh1 /00
		Hybrid white spruce / Douglas-fir – Dogwood – Gooseberry	SD (no modifiers)	IDFdm1 /06
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SD, SDn	IDFxh1 /08
		Hybrid white spruce – Gooseberry	SG (no modifiers)	MSdm1 /06
Riparian, fluvial plain	RI:fp	Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CDa, CDt	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DSt	IDFxh1 /07
		Western redcedar – Devil's club – Foamflower	RDa, RDt	IDFmw1 /06
		Western red cedar - Douglas-fir – False Solomon's Seal	RSa, RSt	IDFxh1 /00
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SDa, SDt	IDFxh1 /08
Riparian, gully	RI:gu	Trembling aspen – Snowberry – Kentucky bluegrass	ASg, ASgw	IDFxh1 /98
		Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CDg, CDgw	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DSg, DSgk, DSgs, DSgw	IDFxh1 /07
		Western redcedar – Devil's club – Foamflower	RDg, RDgw	IDFmw1 /06
		Western redcedar / Douglas-fir - Dogwood	RRg, RRgk, RRgw	IDFmw1 /05
		Hybrid white spruce / Douglas-fir – Dogwood – Gooseberry	SDg, SDgw	IDFdm1 /06
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SDg, SDgk, SDgw	IDFxh1 /08
		Hybrid white spruce – Trapper's tea - Horsetail	SHg	MSdm1 /07
		Douglas-fir / Western larch – Spruce - Pinegrass	SPg, SPgw	IDFdm1 /05
Sparsely Vegetated, cliff	SV:cl	Cliff	CL	IDFmw1 /00 IDFxh1 /00
Sparsely Vegetated, rock outcrop	SV:ro	Rock outcrop	RO	IDFmw1 /00 IDFxh1 /00
		Selaginella – Bluebunch wheatgrass rocky bluff	SB	IDFmw1 /00 IDFxh1 /00
Sparsely Vegetated, shrub	SV:sh	Choke cherry – Bluebunch wheatgrass rocky bluff	CW	IDFxh1 /00
		Antelope brush - Selaginella	SA (structural stage 3-6)	IDFxh1 /00
Sparsely Vegetated, talus	SV:ta	Saskatoon – Mock orange talus	SO (structural stage 3-6)	IDFdm1 /00 IDFmw1 /00 IDFxh1 /00
		Talus	TA	IDFdm1 /00 IDFmw1 /00 IDFxh1 /00 MSdm1 /00
Coniferous Woodland	WD:co	Douglas-fir – Penstemon - Pinegrass	DPv (structural stage 3-6)	MSdm1 /02
		Douglas-fir / Ponderosa – Snowberry – Bluebunch wheatgrass	DSkv, DSsw, DSv, DSvw, DSvz (structural stage 3-6)	IDFmw1 /02
		Douglas-fir / Ponderosa pine – Bluebunch wheatgrass - Pinegrass	DWjv, DWkv, DWs (structural stage 3-6)	IDFdm1 /03
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW (all modifiers, structural stage 3-6)	IDFxh1 /03
		Douglas-fir – Ponderosa pine –Saskatoon – Mock orange	FO (all modifiers, structural stage 4-6)	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Balsamroot	PB (all modifiers, structural stage 3-6)	IDFxh1 /02
		Lodgepole pine – Grouseberry - Cladonia	PGkv (structural stage 3-6)	MSdm1 /03
		Douglas-fir – Penstemon - Pinegrass	PP (all modifiers, structural stage 4-6)	IDFmw1 /03
Wetland, marsh	WN:ms	Bulrush marsh	BM	IDFmw1 /00 IDFxh1 /00

SEI Unit (Class, subclass)	SEI Code	TEM Unit Name	TEM Code[103]	Subzone / Site Series
		Baltic rush marsh-meadow	BR	IDFxh1 /00
		Reed Canarygrass Marsh	CG	IDFxh1 /00
		Cattail marsh	CT	IDFmw1/00 IDFxh1 /00
		Sedge marsh	SE	IDFmw1 /00
		Willow – Sedge	WS (structural stage 2)	IDFxh1 /09 MSdm1 /08
Wetland, swamp	WN:sp	Hybrid white spruce – Trapper's tea - Horsetail	SH (no modifiers)	MSdm1 /07
		Willow – Sedge	WS (structural stage 3)	IDFxh1 /09 MSdm1 /08
		Mountain alder – Skunk cabbage – Lady fern	Ws01	
Wetland, shallow open water	WN:sw	Shallow open water	OW	IDFmw1 /00 IDFxh1 /00
		Pond	PD	IDFxh1 /00

Other Important Ecosystems

SEI Unit	Code	TEM Unit	Code[104]	Subzone / Site Series
Seasonally Flooded Fields	FS	Cultivated Field	CFy	IDFxh1 /00 IDFmw1 /00
Mature Forest, broadleaf	MF:bd	Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6B	IDFxh1 /07
Mature Forest, coniferous	MF:co	Douglas-fir / Western redcedar – Falsebox – Prince's pine	DF 6C	IDFmw1 /01
		Douglas-fir – Pinegrass - Kinnikinnick	DP 6C	IDFdm1 /04
		Douglas-fir – Pinegrass – Feathermoss	DP 6C	IDFmw1 /04
		Douglas-fir – Ponderosa pine – Pinegrass	DP 6C	IDFxh1 /01
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6C	IDFxh1 /07
		Douglas-fir / Lodgepole pine – Pinegrass - Twinflower	DT 6C	IDFdm1 /01
		Douglas-fir – Ponderosa pine – Snowbrush – Pinegrass	SP 6C	IDFxh1 /04
Mature Forest, mixed	MF:mx	Douglas-fir / Western redcedar – Falsebox – Prince's pine	DF 6M	IDFmw1 /01
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6M	IDFxh1 /07

[104] All site modifiers are included unless otherwise noted.

Appendix C. Known and potential threatened and endangered vertebrate animals in the study area

Common Name	Scientific Name	Occurrence in Study Area	Prov. Status	Federal Status
Amphibians				
Great Basin Spadefoot	*Spea intermontana*	numerous locations, likely throughout	Blue	Threatened
Western Toad	*Bufo boreus*	unknown but likely	-	Special Concern
Reptiles				
Painted Turtle	*Chrysemis picta*	three locations, likely throughout	Blue	Special Concern
Western Skink	*Eumeces skiltonianus*	unknown but possible in south	Blue	Special Concern
Western Rattlesnake	*Crotalus oreganus*	southern portion	Blue	Threatened
Gopher Snake	*Pituophis catenifer*	adjacent records, likely throughout	Blue	Threatened
Racer	*Coluber constrictor*	unknown, likely throughout	Blue	Special Concern
Rubber Boa	*Charina bottae*	southern half	-	Special Concern
Birds				
Western Grebe	*Aechmophorus occidentalis*	historical colony on Swan Lake	Red	-
American White Pelican	*Pelecanus erythrorhynchos*	Swan & Okanagan Lks, possibly Kal.	Red	-
Great Blue Heron	*Ardea herodias herodias*	known rookery within city of Vernon	Blue	-
American Bittern	*Botaurus lentiginosus*	unknown but possible	Blue	-
Swainson's Hawk	*Buteo swainsoni*	two locations, likely throughout	Red	-
Ferruginous Hawk	*Buteo regalis*	unknown but possible	-	Threatened
Prairie Falcon	*Falco mexicanus*	unknown but likely	Red	-
Peregrine Falcon	*Falco peregrinus anatum*	unknown but likely	Red	Special Concern
Long-billed Curlew	*Numenius americanus*	north of Swan Lake	Blue	Special Concern
California Gull	*Larus californicus*	unknown but possible	Blue	-
Short-eared Owl	*Asio flammeus*	unknown but possible	Blue	Special Concern
Western Screech-owl	*Megascops kennicotti macfarlanei*	Coldstream & BX Creeks, historically elsewhere as well	Red	Endangered
Flammulated Owl	*Otus flammeolus*	unknown but likely	Blue	Special Concern
Common Nighthawk	*Chordeiles minor*	two locations, likely throughout	-	Threatened
Lewis' Woodpecker	*Melanerpes lewis*	unknown but likely throughout	Red	Special Concern
Williamson's Sapsucker	*Sphyrapicus thyroideus thyroideus*	unknown, possible at higher elevations	Red	Endangered
Canyon Wren	*Catherpes mexicanus*	Cosens Bay	Blue	-
Yellow-breasted Chat	*Icteria virens*	unknown but possible	Red	Endangered
Grasshopper Sparrow	*Ammodramus savannarum*	three locations, possibly throughout	Red	-
Lark Sparrow	*Chondestes grammacus*	one location, possibly elsewhere	Red	-
Mammals				
Merriam's Shrew	*Sorex merriami*	unknown but possible	Red	-
Preble's Shrew	*Sorex prebeii*	unknown but possible	Red	-
Townsend's Big-eared Bat	*Corynorhinus townsendii*	unknown but likely	Blue	-
Spotted Bat	*Euderma maculatum*	unknown but possible in south	Blue	Special Concern

Common Name	Scientific Name	Occurrence in Study Area	Prov. Status	Federal Status
Fringed Myotis	*Myotis thysanodes*	historical record at Okanagan Landing, possibly throughout	Blue	-
Western Small-footed Myotis	*Myostis ciliolabrum*	unknown but likely	Blue	-
Western Harvest Mouse	*Reinthrodontomys megalotis*	unknown but likely	Blue	Special Concern
Great Basin Pocket Mouse	*Perognathus parvus*	unknown but possible	Blue	-
Badger	*Taxidea taxus*	scattered records throughout	Red	Endangered