Sensitive Ecosystems Inventory: Coldstream – Vernon, 2007

Volume 3: Wildlife Habitat Mapping

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This project has adapted material from previous Sensitive Ecosystems Inventory (SEI) projects, including Central Okanagan[7], Bella Vista – Goose Lake Range[8], Vernon Commonage[9], and Lake Country[10].

Patrick Allen provided accommodation for the field crew.

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Kristi Iverson 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] Sarell et al. 2003
[8] Sarell and Haney 2003
[9] Haney and Sarell 2005
[10] Haney and Sarell 2006

Abstract

The Okanagan Valley contains the northern-most extent of Great Basin shrub-steppe ecosystems. These are bisected by species-rich riparian and wetland habitats, and flanked by open forests and rugged slopes. The ensemble of wildlife that depends on habitats in the valley is diverse, containing species from the boreal forests to the north and the deserts to the south. Many of the southern-associated species are considered at risk in British Columbia and in Canada, due to their rarity and declining populations in landscapes that are sought for human development. Extensive land development is fragmenting and encroaching upon important wildlife habitats, which is considered the main cause of population declines for many species at risk. In the North Okanagan, many rare wildlife species are at the northern extent of their range in BC, and others are on the edge of an Okanagan population with just a tentative connection to a Thompson population. Individuals on the edge of a species or population range are believed to be crucial to the survival of the species under changing or stressful conditions, as they are more likely to be able to cope with variation and adapt to change[11].

This report is **Volume 3** of a Sensitive Ecosystems Inventory (SEI) project for the Coldstream – Vernon area. The report includes habitat summaries and species-habitat models for ten wildlife species considered at risk in British Columbia. **Volume 1**[12] describes Sensitive Ecosystems, and offers practical advice on how to best avoid or minimize damage to them. **Volume 2**[13] provides details on the Terrestrial Ecosystem Mapping and terrain mapping.

The results of this habitat mapping indicate that large areas of suitable habitat exist for species that use open forest and grassland (e.g., Gopher Snake, Badger), although marginal or unsuitable areas separate them and individuals are subject to mortality risk during travel. Habitat for species preferring certain grassland conditions, such as extensive gently sloping areas (e.g., Grasshopper Sparrow), especially with low-profile vegetation (e.g., Long-billed Curlew) is scarcer. Wetland habitats also are limited for wildlife reliant on these habitats (e.g., Great Basin Spadefoot, Painted Turtle), and surrounding upland habitats are often unsuitable or fragmented by roads, causing road mortality. Riparian habitats are typically rare in the Okanagan, but the study area hosts a relatively large amount of mature to old deciduous forest (e.g., Western Screech-owl habitat), and deciduous thickets with intact shrubby understory (e.g., Yellow-breasted Chat habitat). Overall, the mosaic of habitat types present in the study area creates high habitat suitability for a wide range of wildlife species, and high biodiversity values.

Wildlife suitability models can be used to depict potential habitat values for individual species, or in conjunction with Sensitive Ecosystems Inventory to identify potential environmental values of areas for conservation purposes (i.e., natural parks), or to guide development proposals. The wildlife suitability models have been incorporated into a Conservation Analysis that was developed to guide landscape-level planning.

Environmental assessments for development proposals, including on-site inventory, should be conducted to verify and revise the predictive suitability mapping. Revised environmental attributes, in a georeferenced format, should be submitted to the planning staff at the City of Vernon or the District of Coldstream to revise in-house mapping. This feedback would permit revisions to ecosystem and wildlife suitability mapping, updates of developed lands and areas retained as green space, and permit monitoring the efficacy of environmental planning and adaptive management.

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[11] Scudder 1991
[12] Iverson 2008
[13] Iverson and Uunila 2008

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1 Introduction

This report presents information on wildlife habitat mapping 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. It is the third volume in the Sensitive Ecosystems Inventory reports for Coldstream Vernon.

Volume 1[14] describes the study area, inventory methods and results, rare and fragile ecosystems of Coldstream Vernon, highlights their values and importance, and offers practical advice on how to best avoid or minimize damage to them. **Volume 2**[15] provides details on the Terrestrial Ecosystem Mapping and terrain mapping.

1.1 What is Wildlife Habitat Mapping?

Habitat mapping portrays the potential importance of the land and its features to specific wildlife species through a species-habitat model. The model is used to generate a habitat map by assigning ratings to different habitat types, based on the needs of the species for particular life requisites. The ratings indicate the value of a habitat compared to the best habitat in the province[16]. Suitability is the ability of the habitat in its current condition to support a species. Capability is the ability of the habitat to support a species under optimal natural conditions, irrespective of the current condition of the habitat.

The following key elements and concepts summarize the Provincial standards for developing wildlife habitat ratings in British Columbia[16]:

1. There are three rating schemes; each reflects a different level of information available about the habitat requirements of a species (Table 1).
2. Ratings reflect a percentage of the provincial benchmark habitat. The provincial benchmark habitat has the highest suitability value for a given species in the province, against which all other habitats for that species must be rated. The benchmark is an actual location.
3. All ratings are a value for a specified season and activity, or life requisite.
4. A habitat rating is provided for each species for every occurring ecosystem unit (i.e., every site series / structural stage / site modifier combination).

Table 1 below shows the different habitat rating schemes.

[14] Iverson 2008
[15] Iverson and Uunila 2008
[16] Resources Inventory Committee 1999 (now Resources Information Standards Committee)

Table 1: Habitat rating schemes for different knowledge levels of habitat requirements[17].

Percent of Provincial Benchmark[18]	6-class (Substantial Knowledge of Habitat Use)		4-class (Intermediate Knowledge of Habitat Use)		2-class (Limited Knowledge of Habitat Use)	
76 - 100 %	High	1	High	H	Habitat Useable	U
51 - 75 %	Moderately High	2	Moderate	M		
26 - 50 %	Moderate	3				
6 - 25 %	Low	4	Low	L		
1 - 5 %	Very Low	5			Likely No Value	X
0%	Nil	6	Nil	N		

Habitat ratings are assigned to each ecosystem unit (e.g., habitat type) and then the values are projected onto the landscape where they are mapped. Habitat inventories assess the presence of available and potential habitat; they do not determine species presence or abundance. Much of the accuracy in predicting these habitat values is contingent on our understanding of how wildlife uses their habitats.

1.2 How is Wildlife Habitat Mapping related to TEM and SEI?

Terrain and soil characteristics influence the vegetation of a site, within a given climate. Terrestrial Ecosystem Mapping (TEM) evaluates the specific ecological conditions (e.g. climate, terrain, vegetation community, and structural stage) for each polygon. All of these factors influence the wildlife assemblage and use within an area. TEM is used in a habitat model by assigning each ecosystem unit a wildlife habitat rating, indicating how useable (currently or potentially) the site is for a given wildlife species. These ratings are then applied to the TEM database and spatial data using GIS and portrayed as a habitat suitability or capability map of the study area.

In the field component of TEM, the terrain, vegetation, and wildlife aspects are assessed in the field and discussed with the other members of the field crew, contributing to a greater accuracy of interpreted habitat use for wildlife. Field sampling is used to extrapolate the occurrence of certain habitat features as well, such as snags and course woody debris, to the types of habitats they commonly occur in.

Sensitive Ecosystems Inventory (SEI) groups ecosystems into broad categories based on their ecological rarity and sensitivity, but also considers critical habitat needs for select wildlife species. Often, sensitive ecosystems contain important habitats for many wildlife species.

1.3 How is Wildlife Habitat Mapping Used?

The Okanagan Valley is one of the most diverse wildlife areas in Canada, and contains many of the Province's and Nation's rare and endangered species. The area also has attracted considerable human settlement and associated land developments. Previous land use planning was limited in its ability to assess, identify, and conserve important wildlife habitats. This often led to the permanent loss of critical wildlife habitats, increasing the need to conserve those that remain. TEM, SEI, and wildlife habitat mapping

[17] Resources Inventory Committee 1999 (now Resources Information Standards Committee)
[18] The best habitat in the province. For example, High suitability (1 or H) is 76-100% as good as the best habitat in the province.

can dramatically improve land use planning to ensure that critical habitats are not developed, or that appropriate mitigation activities are undertaken.

The effectiveness of wildlife habitat mapping is contingent on the information being portrayed in a manner that is easily interpreted by planners, developers, regulatory agencies, and the public. This can be a challenge considering the diverse array of wildlife species potentially present, and the variety of habitat types used. The values of ecosystems as habitat for wildlife have been considered in the SEI mapping, although some 'Not Sensitive' ecosystems may still provide important habitat. Wildlife values for select species were given further consideration in the 'Conservation Analysis' provided in Volume 1[19], which should be consulted for landscape-level planning. For land-use planning at a finer scale (e.g. neighbourhood plans), each species model should be inspected to direct detailed inventories to avoid or mitigate impacts to crucial habitats.

Wildlife habitat mapping can also be used as a tool in wildlife management and recovery, a guide for wildlife viewing, and as a gauge of the loss of critical wildlife habitats.

1.4 Objectives

The objective of the wildlife habitat mapping is to provide input to land-use planning in the study area by providing estimated habitat values for wildlife species of management concern. The habitat mapping enables planners and managers to examine some of the wildlife values in order to guide development. Potential impacts can be identified and mitigation plans developed. ***Wildlife habitat mapping does not replace the need for development proponents to field-verify the presence or absence of wildlife species and the significance of identified habitats.***

2 Methods and Limitations

2.1 Project Wildlife Species

A vast number of rare or endangered wildlife potentially occur in the study area (Appendix B). Ten of these wildlife species, all known to occur in the North Okanagan, were selected to demonstrate important wildlife habitats in the study area (Table 2). These species satisfy the following criteria[20] used to select wildlife species for habitat mapping:

- the level of knowledge of the species' use of habitat is adequate;
- the habitat required by selected species is also habitat required by other wildlife species;
- TEM is able to capture most of the habitat features required by the species;
- the species' habitat is present in the project area; and
- the species, or evidence of the species, is likely to be observed in the project area.

All of the selected species are considered at risk in the Province[21], and most of these species have been designated through Federal listing[22] as well.

[19] Iverson 2008
[20] Resources Inventory Committee 1999 (now Resources Information Standards Committee)
[21] Conservation Data Centre (CDC) 2007: http://srmwww.gov.bc.ca/cdc/
[22] Committee on the Status of Wildlife in Canada (COSEWIC) 2007: http://www.cosewic.gc.ca/

Table 2: Wildlife species modelled in this project, their status, and rating scheme used.

Common Name	Scientific Name	Species Code	Prov. Status[23]	COSEWIC Status[24]	Rating Scheme
Great Basin Spadefoot	*Spea intermontana*	A-SPIN	Blue	Threatened	4-class
Painted Turtle	*Chrysemis picta*	R-CHPI	Blue	Special Concern	4-class
Western Rattlesnake	*Crotalus oreganus*	R-CROR	Blue	Threatened	4-class
Gopher Snake	*Pituophis catenifer*	R-PICA	Blue	Threatened	4-class
Swainson's Hawk	*Buteo swainsoni*	B-SWHA	Red	-	4-class
Long-billed Curlew	*Numenius americanus*	B-LBCU	Blue	Special Concern	4-class
Western Screech-owl	*Megascops kennicottii macfarlanei*	B-WSOW	Red	Endangered	4-class
Yellow-breasted Chat	*Icteria virens*	B-YBCH	Red	Endangered	4-class
Grasshopper Sparrow	*Ammodramus savannarum*	B-GRSP	Red	-	4-class
Badger	*Taxidea taxus jeffersonii*	M-TATA	Red	Endangered	4-class

2.2 Species-Habitat Models

Wildlife habitat was modeled for the Coldstream – Vernon TEM according to the standards in the *BC Wildlife Habitat Ratings Standards - Version 2.0*[25].

There are two basic components to a species-habitat model: the species account and the ratings table. The model is applied to the ecosystem mapping to generate the spatial depiction of suitable habitat.

The species account summarizes the knowledge about a species and how it was modeled. The account describes the distribution of the species in the province and in the project area, provides an overview of its ecology, and includes a detailed description of the critical life requisites and habitat uses of the species. The ratings section outlines the rating scheme (2, 4, or 6-class), the life requisites and habitat uses that are modeled (map themes), and assumptions used to rate habitat characteristics. A section on map interpretation is also included, which describes how map themes were layered on the map, how the ratings were applied to the polygons, and provides information needed to correctly interpret each map.

Preliminary ratings tables, developed before field sampling, consist of an abbreviated table that provides habitat values for representative ecosystem units likely to occur in the project area. The tables were modified to present assumptions used for rating ecosystems, which were incorporated into each species account. These assumptions, after being field-verified and modified as necessary, guided development of the final ratings tables.

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[23] Red List: indigenous species or subspecies (taxa) considered *Extirpated*, *Endangered*, or *Threatened* in BC.
Blue List: indigenous taxa considered *Vulnerable* (Special Concern) in BC.

[24] Endangered = facing imminent extirpation in Canada or extinction.
Threatened = likely to become endangered in Canada if limiting factors are not reversed.
Special Concern = particularly sensitive to human activities or natural events.

[25] Resources Inventory Committee 1999 (now Resources Information Standards Committee)

2.3 Field Sampling

Field assessments occurred in conjunction with field sampling for ecosystem mapping. Survey intensity level 4 (visitation of 15 - 25% of polygons) was used[26]. Fieldwork was conducted by A. Haney and took place in June and July of 2007. During field sampling, habitat values were recorded on Wildlife Habitat Assessment (WHA) forms (FS 882HRE 98/5). An example of the form is presented in Appendix C. Data was entered into Venus 5.0 data capture software. Table 3 lists and briefly describes the life requisites and habitat-uses rated in the field.

Table 3: Life requisites and habitat-uses rated during fieldwork

Species	Life Requisite and Habitat Use	Rating Code
Great Basin Spadefoot	Security/thermal habitat for reproducing (breeding ponds). Security/thermal habitat and food for general living, all year (terrestrial sites).	RE LIA
Painted Turtle	Security/thermal habitat for reproducing (egg-laying sites). Security/thermal habitat and food for general living, all year (ponds).	RE LIA
Western Rattlesnake	Security/thermal habitat for general living all year (basking/denning sites). Food and security/thermal habitat for general living, summer.	LIA LIS
Gopher Snake	Food and security/thermal habitat for general living, growing season. Security/thermal habitat for reproducing (egg-laying sites).	LIG RE
Swainson's Hawk	Security habitat for reproducing. Food for general living, growing season.	RE LIG
Long-billed Curlew	Security habitat for reproducing. Food for general living, growing season.	RE LIG
Western Screech-owl	Security/thermal habitat for reproducing.	RE
Yellow-breasted Chat	Security/thermal habitat and food for general living, growing season.	LIG
Grasshopper Sparrow	Security/thermal habitat and food for general living, growing season.	LIG
Badger	Security/thermal habitat and food for general living, all year.	LIA

2.4 Wildlife Habitat Mapping

A final habitat ratings table was developed after field inspections were completed, and after a final list of ecosystem units was developed. Values were assigned using information from the species accounts, including assumptions, and from the wildlife report generated from field data in Venus 5.0.

We generated wildlife habitat maps by applying the ratings table values for each map theme (i.e., habitat use / life requisites for each species) to the TEM spatial and non-spatial data. An Ecosystem-based Resource Mapping (ERM) tool[27] was used to apply the ratings tables to the TEM map in ArcView GIS software.

[26] Resources Inventory Committee 1998 (now Resources Information Standards Committee)
[27] http://srmwww.gov.bc.ca/wildlife/whr/sta.html

Multiple map themes were displayed on the habitat-use map for some species, using a hierarchy of critical habitat requirements and life requisites. As habitat uses may overlap, we ensured that the most critical habitat uses overlaid less critical habitat uses. Each map was assigned a set of colours that identified the theme and values mapped.

Ratings were assigned to polygons with multiple ecosystem components (i.e., deciles) using one of the following four methods; based on which one best demonstrated the relative importance of that map theme:

- Highest-value – the highest rating within each polygon is displayed, regardless of the area it represents. The highest-value method exaggerates the amount of high value habitat because the whole polygon may be coloured high even if only a small part of it is actually high value.
- Averaged – the average rating within each polygon is displayed. Some parts of a polygon may be coloured as having some value, even if those parts have little or no habitat value. Similarly, some parts of a polygon may be rated as having low value, although the habitat in those parts has high value.
- Largest area – the rating for the ecosystem unit that covers the largest area of a polygon is displayed.
- Dot density – ratings for all of the ecosystems units are displayed, based on the percent area of the polygon they occupy. The dominant ecosystem unit provides the background colour, while dots of different colours or shades show the relative amount of other units occurring in the polygon.

2.5 Mapping Limitations

Limitations to Terrestrial Ecosystem Mapping are described in detail in Volume 1[28], including:

- Scale of the aerial photographs (1:15,000). It is recommended that digital data not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets.
- Date of the aerial photographs (1994) and field sampling (2007). On-going land uses may have changed some polygons after the date that the aerial photographs were taken or the field sampling was conducted.
- Ability to see disturbances such as cover of invasive plants on aerial photographs. Information from field sampling was applied to adjacent areas.
- Complex landscape, resulting in many complex polygons. Small ecosystems are often captured as a small component of a larger polygon that may contain up to three ecosystems.

For wildlife modelling purposes, additional limitations include:

- High variability of some ecosystem units (e.g., slope, soil depth, and, in a few units, vegetation composition). A given ecosystem unit may be described as having ‘moderate to steep slopes’, and some wildlife will use moderate slopes but are less likely to use steep slopes. Soil depth can also be highly variable; a shallow-soiled unit may have large pockets of deep soil suitable for burrowing.
- Condition of the habitat (e.g., fragmentation, forest ingrowth, presence and abundance of invasive plants) is not accounted for in TEM, except for seral association in grasslands and structural stage in forests. The general ecological condition of the ecosystem is available in SEI as a condition value, and, while not incorporated into wildlife models, it was included in the Conservation Analysis[29], where the sensitivity/rarity of the ecosystem, the condition of the ecosystem, and the wildlife values were all considered.

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[28] Iverson 2006

[29] Volume 1: Iverson 2006

3 Results

3.1 Species Accounts

Complete species accounts, including citations, are available as described in Appendix A. Each species account also includes the final habitat suitability map for the species. Brief summaries of some important habitat requirements for the project species are included in the Wildlife Habitat Maps section below.

3.2 Field Sampling

A total of 409 plots were visited and assessed during Terrestrial Ecosystem Mapping, with 5 full plots, 84 ground inspections, and 320 visual inspections completed in the field (Figure 1). However, 69 of the visual plots were assessed for terrain mapping purposes only, and very little, if any, investigation for evidence of wildlife use was conducted in some of the other visual plots as well.

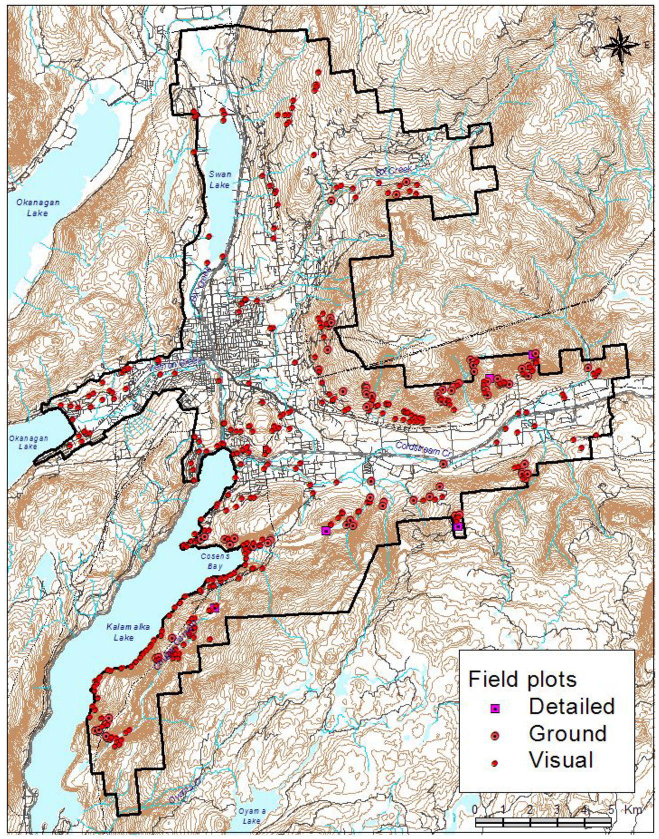

Figure 1: Locations of plots assessed during ecosystem mapping fieldwork.

3.3 Evidence of Use

For many of the project wildlife species, we did not observe evidence of use during fieldwork. This is not surprising, as most of them are rare, elusive, or nocturnal, and fieldwork was intended as a habitat inventory rather than a wildlife survey.

Few, if any, wildlife inventories appear to have been conducted in this area. Previous observation records for the project species were amalgamated from all known sources[30], and are summarized in Table 4, as well as records obtained during fieldwork for this study.

Table 4: Observations of project wildlife species or evidence of their use in the study area.

Species	Previous Observations in Study Area	Observations During SEI
Great Basin Spadefoot	Numerous records in Ok Landing area, Mud Lake, NORD office[31], and east of Swan Lake	None
Painted Turtle	One location, Cosens Bay	Two locations, Swan Lake and Cools Pond (L&A Rd)
Gopher Snake	A few anecdotal observations, and numerous records in adjacent areas to the west and south	None
Western Rattlesnake	Numerous known hibernacula in southern portion; records in adjacent areas to the west and south	None
Swainson's Hawk	Two locations, DND lands and a nest east of Middleton Mtn.; additional records in adjacent areas to the west	ID uncertain, but possible pair foraging over Coldstream valley bottom
Western Screech-owl	Coldstream and BX Creeks; historical records at Ok Landing and Lavington	None
Long-billed Curlew	One location, north of Swan Lake	None
Grasshopper Sparrow	Two locations, Middleton Mtn. (possibly lost to development) and Cosens Bay	One location, nest on south slopes of Vernon Hill
Yellow-breasted Chat	None, but a couple non-breeding records to the west	None
Badger	Scattered records throughout low elevation areas	One possible burrow, on slopes north of Coldstream Creek

The study area represents the northern extent of the BC distribution for some of these species. For many others, the area represents the edge of the Okanagan population range, and the location is important for maintaining occasional gene flow with Thompson/Nicola population(s). Individuals on the edge of a species or population range are believed to be crucial to the survival of the species under changing or stressful conditions, as they are more likely to be able to cope with variation and adapt to change[32].

Other listed species recorded from the study area include American White Pelican (BC Red list), Lark Sparrow (BC Red list), Common Nighthawk (COSEWIC Threatened), Rubber Boa (COSEWIC Special Concern), and a number of rare invertebrates.

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30 CDC 2007, Ministry of Environment 2007
31 wetland being drained at time of fieldwork
32 Scudder 1991

3.4 Final Ratings Table

The final ratings table lists all of the mapped ecosystem units, including every combination of site series, site modifier, structural stage, stand modifier and seral association. See the expanded legend in Volume 2[33] for a description of all ecosystem units. Each ecosystem unit was assigned a rating for each of the 17 habitat uses for the ten wildlife species. An example of the format of the ratings table is provided in Appendix D.

3.5 Wildlife Habitat Maps

By applying the habitat ratings to the TEM database and spatial data, seventeen map themes were created (Table 5), including a duplication of one map theme (Gopher Snake denning uses the ratings from Western Rattlesnake denning).

The Species Accounts (see Appendix A) provide descriptions of how the map themes were rated and presented, as well as full-page maps for each species. Smaller versions of each map are presented in the following sections with an interpretation of each model. We discuss the distribution of habitats and the accuracy of the model based on past sightings and wildlife observations during fieldwork.

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[33] Iverson and Uunila 2008.

Great Basin Spadefoot

The Great Basin Spadefoot requires wetlands for courting, egg-laying, and development of eggs and larvae. The development of young spadefoots from egg to tadpole to adult is relatively quick, so temporary water bodies that dry up in summer are commonly used. Temporary wetlands may actually be preferred due to the absence of fish or other aquatic predators.

Other than during spring breeding, adult spadefoots spend most of the year in nearby terrestrial habitats. These habitats must have deep, friable soils for spadefoots to bury themselves in to avoid desiccation during dry weather and freezing during winter.

Previous observation records exist throughout the study area, but no spadefoots were detected during fieldwork. However, high suitability breeding ponds (Figure 2) were frequently encountered, and appear fairly common in the study area, but occupy little of the land base due to their small size.

Figure 2: Small wetlands provide excellent breeding habitat for Great Basin Spadefoot.

The suitability model generated two map themes: aquatic breeding habitats and terrestrial living habitats (Figure 3). Breeding habitats overlay living habitats. Both themes are displayed using the highest-value method.

Spadefoots do not generally breed in large lakes, due to the presence of fish, so breeding was depicted as suitable only within 150 m of the shoreline of Swan Lake. Suitable breeding sites predicted by the model occur throughout the study area, and high value breeding ponds appear common and well distributed in low-lying areas.

Terrestrial habitats near breeding ponds are more valuable to spadefoots than those farther away, but very small, temporary wetlands may not have been identified at this scale of mapping, so living suitability is not dependant on proximity to identified breeding habitat.

Spadefoots are well adapted to arid conditions, with a hardened ‘spade’ on their hind foot for burrowing into soils, and skin secretion that prevents dehydration while buried.

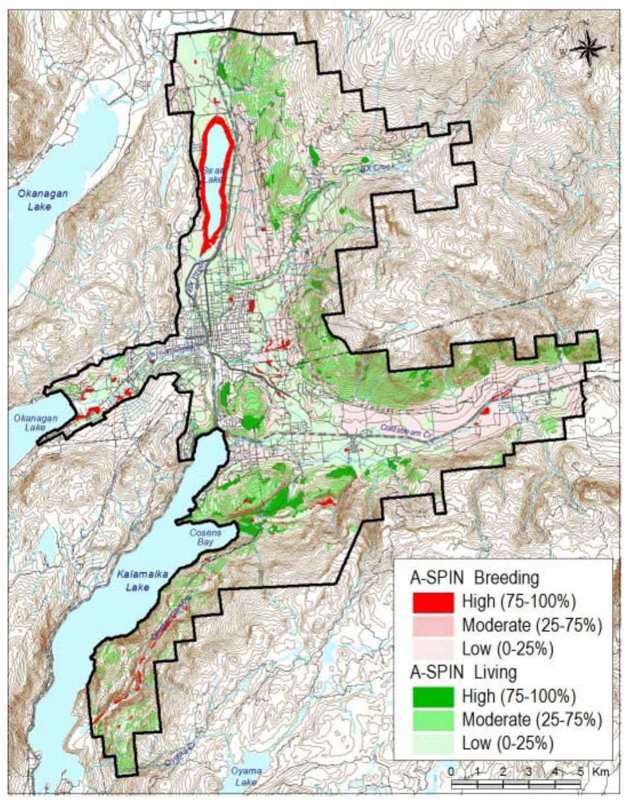

Figure 3: Distribution of suitable breeding and terrestrial habitats for Great Basin Spadefoot.

Painted Turtle

Turtles require wetlands throughout the year for foraging and over-wintering. Females leave the ponds to lay eggs in nearby terrestrial habitats with sandy, well-drained soils and sparse vegetation.

Turtles only leave their ponds when females lay eggs during the summer, and the occasional dispersal movement, particularly if their pond dries up during a dry spell.

Painted Turtles have been recorded from a few sites in the study area, including Cosens Bay in Kalamalka Lake, Swan Lake and one pond. Other suitable ponds (Figure 4) appear scarce in the study area, as they were encountered only a handful of times, mostly in the southern half of the study area.

Figure 4: Ponds provide living habitat for Painted Turtle.

The suitability model generates two map themes: aquatic living habitats and terrestrial nesting or egg-laying habitats (Figure 5). Both themes are displayed using the highest-value method. Nesting habitats are portrayed only if the polygon is within 250 m of suitable ponds. Living is depicted as suitable only within 150 m of the shoreline of large lakes.

The model predicts sparse suitable turtle ponds (living habitat), and the majority of those are artificial, including reservoirs and golf course ponds. Cougar Canyon in an exception, with abundant suitable aquatic habitat, but nearby nesting habitat (deep, well-drained soils) is rare. The shoreline of Swan Lake is another exception, but no suitable egg-laying sites are predicted. Micro-sites may be used around Swan Lake and other developed areas, such as small cutbanks, the edges of cultivated fields, or the shoulders of roadways. Suitable living and nesting habitats are predicted in close proximity in only two areas: Middleton Mtn. and east of Cosens Bay.

Mortality from roads along the lakeshores is potentially very high, especially along Swan Lake.

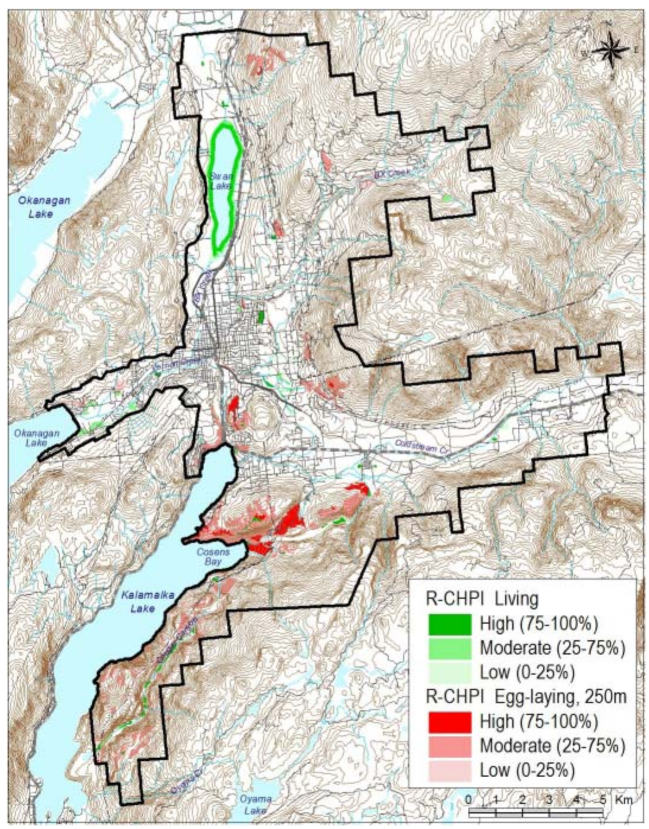

Figure 5: Distribution of suitable living and nesting habitats for Painted Turtle.

Western Rattlesnake

Western Rattlesnakes require sparsely vegetated ecosystems such as rock outcroppings for hibernating. Riparian areas, broadleaf woodlands, grasslands, or open forests are used for foraging. High-value denning and basking habitats on south-facing rocky hillsides (Figure 6) were observed at only six of the field plots.

Figure 6: Denning habitat for rattlesnakes.

High-value foraging habitats include riparian areas and broadleaf woodlands, which support dense prey populations and have more moderate summer temperatures (Figure 7).

Figure 7: Foraging habitat for rattlesnakes in the heat of summer.

Rattlesnakes are well known from the southern portion of the study area, with numerous den sites recorded. No observations have been made in the northern portion.

Suitability was modeled for two map themes for rattlesnakes; both were displayed by the highest-value method (Figure 8). The denning theme (top map layer) consists of security/thermal habitats potentially used all year, including denning during winter, basking in spring and fall, and throughout the summer for gravid females. Foraging includes habitats that provide security and thermal shelter as well as food.

The map depicts suitable denning and foraging habitat in close proximity throughout much of the study area. However, rattlesnakes are not known from the northern portion, or to the north of the study area. Allowing north-south movement corridors in this area may be critical to maintain a genetic link with the Thompson population, and possibly for range expansion to accommodate climate change.

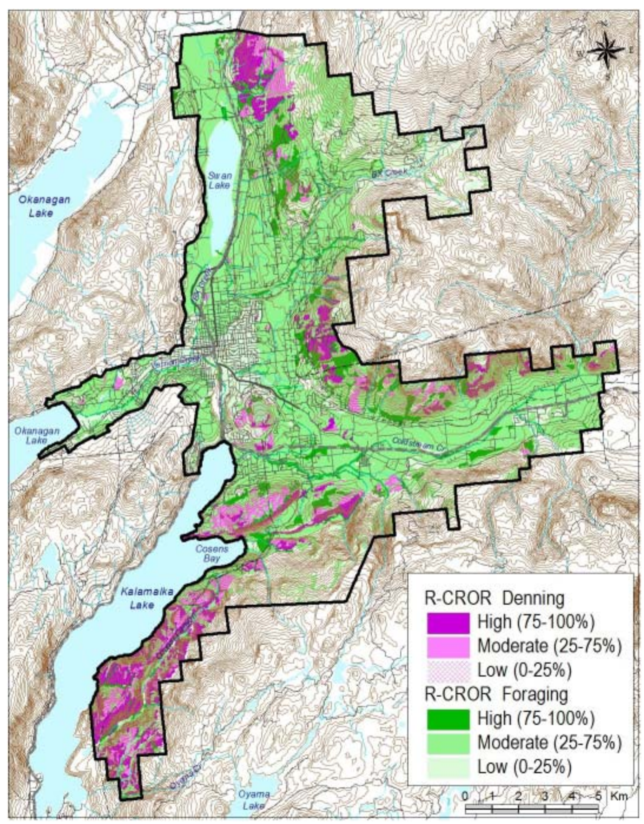

Figure 8: Distribution of suitable denning and foraging habitats for Western Rattlesnake.

Gopher Snake

Gopher Snakes den in either deep-soiled grasslands or sparsely vegetated ecosystems (rocky habitats). Deep-soiled denning sites were not modeled for this project, as they are very difficult to predict. Because of the similarities in rocky den sites to rattlesnake suitability, ratings were not assigned separately for Gopher Snake and rattlesnake ratings are used.

High value foraging habitat occurs in deep-soiled grasslands, broadleaf woodlands and riparian areas.

Unlike Western Rattlesnakes, Gopher Snakes lay eggs. Egg-laying habitat is frequently associated with warm-aspect grasslands with deep soils (Figure 9), which was encountered frequently in portions of the study area.

Although numerous observations of Gopher Snakes have been made just west of the study area, only a few have been recorded within it. The grassland slopes east of Swan Lake appear to be the northern extent of the Okanagan population.

Figure 9: Warm aspect slopes with sparse tree cover and deep soils are important for egg laying and foraging.

The Gopher Snake habitat-suitability model generated three map themes. Denning overlays egg-laying, which overlays general living (Figure 10). Denning was derived from the rattlesnake denning theme, and predicts only rocky den sites. Deep-soiled, warm aspect sites predict egg-laying habitat, which may also capture some earthen denning sites. The living theme depicts areas potentially rich in prey that also provide security and thermal cover.

Suitable habitat is predicted to occur throughout most of the study area, except the Cougar Canyon area where deep-soiled grasslands for egg-laying and foraging are scarce. As with rattlesnake, this area may be in a critical location on the edge of their range. Because of the low suitability of the Cougar Canyon area, maintaining habitat connectivity with Commonage, Bella Vista, and areas to the north is even more important. Road mortality may be a significant barrier to movement between suitable areas.

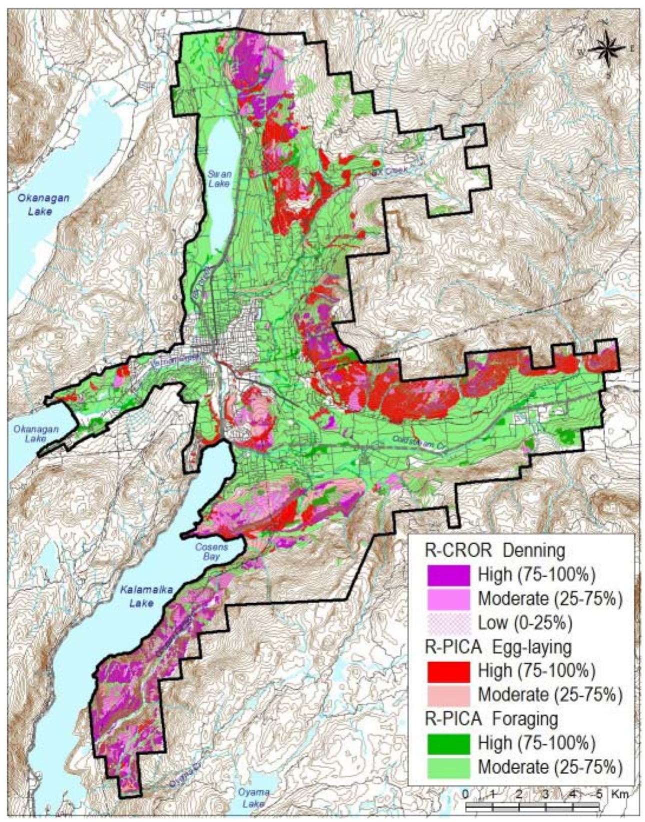

Figure 10: Distribution of suitable denning, egg-laying, and living habitats for Gopher Snake.

Swainson's Hawk

These hawks require expansive, open areas for foraging, and scattered large trees in or adjacent to grasslands for nesting (Figure 11).

Swainson's Hawks are known from the study area, including a possible observation of a foraging pair during fieldwork.

Over 30 plots were assessed as having high value nesting habitat, and 25 as high-suitability for foraging, indicating that abundant habitat exists.

Figure 11: Expansive grassland and other open habitats for foraging, and sporadic trees for nesting, are critical for Swainson's Hawks.

Both the nesting (top layer) and foraging theme generated by the model were displayed using the highest-value method (Figure 12).

Most of the nesting habitat depicted occurs in the southern portion of the study area. However, stands of trees in or near open foraging habitats are more valuable for nesting, and very small stands and isolated trees are also important.

Hawks are highly motile, hunting over a large area, and require a relatively large amount of suitable foraging habitat to support a nesting pair. Almost all of the best foraging areas are in the central and northern portions of the study area.

The colouration of Swainson's Hawks, as well as the more common Red-tailed Hawk, is highly variable. Swainson's can be distinguished from the Red-tailed by their longer, narrower, and more pointed wings.

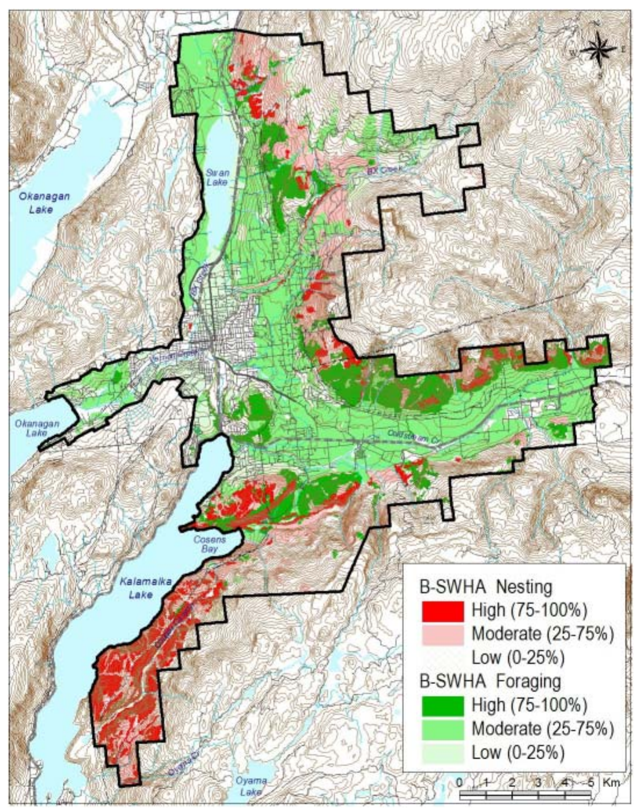

Figure 12: Distribution of suitable nesting and foraging habitats for Swainson's Hawk.

Long-Billed Curlew

Curlews require fairly large areas of level to gently sloping grassland with short vegetation and no trees for nesting. Foraging occurs in grasslands, meadows, pastures, and hayfields, and families of curlews will often move to lush cultivated fields once the young have fledged.

No sign of Long-billed Curlews was detected during fieldwork, and they have been previously recorded only once from the study area.

High suitability nesting habitat (Figure 13) was encountered at only two plots during fieldwork. Expanses of gently sloping grasslands are typically the first areas to succumb to development pressures.

Figure 13: Long-billed Curlews only nest on flat or gently sloping grasslands.

The suitability model for curlews generates two map themes: nesting and foraging (Figure 14). Curlews generally avoid nesting near treed areas, so polygons that contain more than 20% forested ecosystems are considered unsuitable for nesting, and have been manually selected from the database and rated nil.

High suitability habitat is predicted to occur in fairly restricted areas, mostly in the central portion of the study area. Suitable nesting habitat occurs north of Swan Lake as well, but other areas predicted as suitable in the northern portion are likely too small and isolated to be valuable. Despite the availability of grasslands in the study area, optimum nesting conditions are scarce due to slope or proximity to trees. Historically, much of the valley bottom would likely have been important habitat.

Curlews are very tolerant of cattle grazing, but are vulnerable to trampling of the eggs and young.

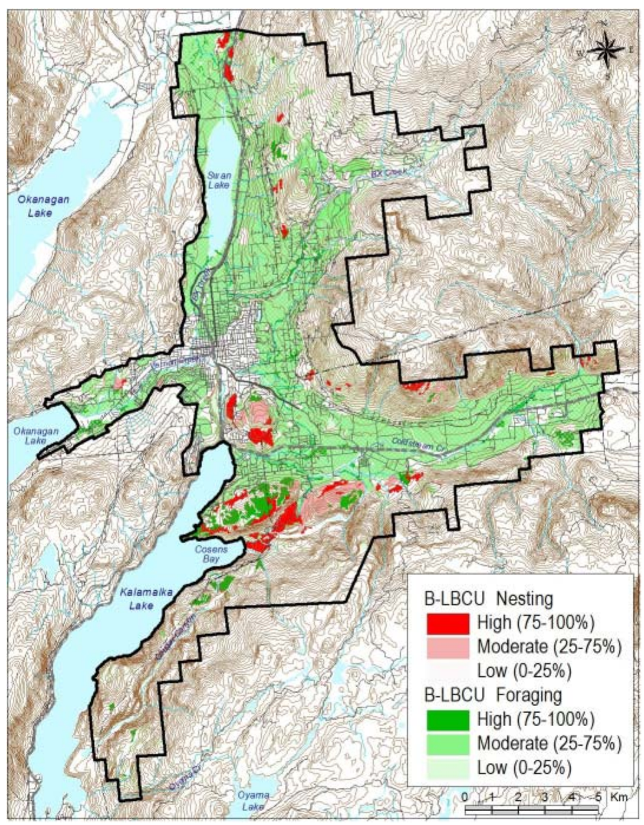

Figure 14: Distribution of suitable nesting and rearing habitats for Long-billed Curlew.

Western Screech-owl

Western Screech-owls are dependant on mature to old riparian forest and most often nest in cavities in large cottonwood trees. Nesting is known from the Okanagan valley floor as far north as Vernon, and also in the middle Shuswap (J. Hobbs, H. Davis pers. comms.).

We found no evidence of Western Screech-owls during fieldwork, but previous record exists for the study area along BX and Coldstream Creeks, with historic records from Okanagan Landing and the Lavington area.

Potential high-value nesting habitat was observed at ten plots, all dominated by large cottonwood (Figure 15) or birch.

Figure 15: Mature cottonwood stands provide optimum nesting habitat.

The suitability model for Western Screech-owl generates one map theme, nesting habitat, which is displayed using the highest-value method (Figure 16). In addition to hunting within nesting habitat, foraging may occur in adjacent areas, so a 150m buffer was created around nesting to highlight these areas.

A relatively large amount of high suitability habitat is predicted to occur throughout the study area, considering how scarce mature cottonwood stands have generally become in the Okanagan. Low and moderate suitability areas consisting of younger stands represent recruitment sites, which may eventually provide important habitat.

The call of the Western Screech-owl is easily identified, described as a ‘bouncing ping-pong ball’.

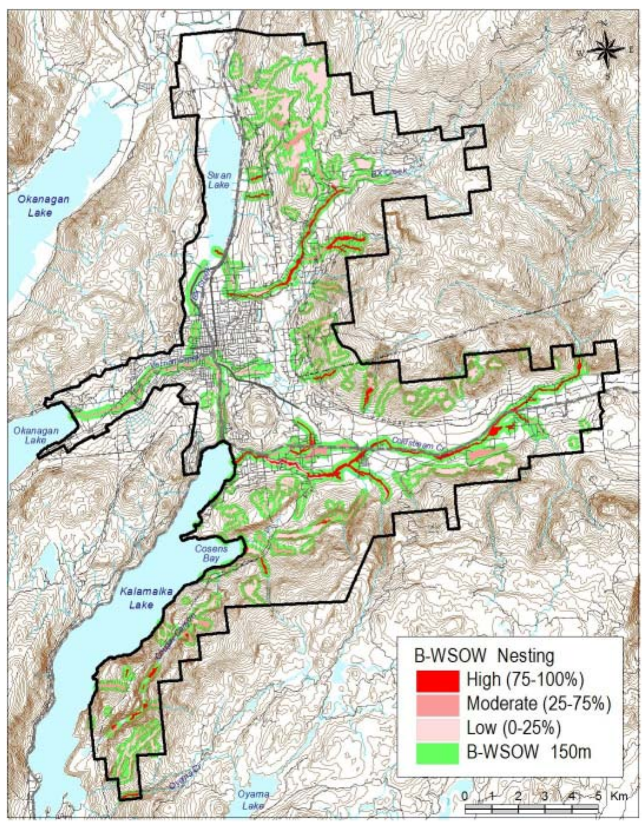

Figure 16: Distribution of suitable nesting habitat for Western Screech-owl.

Yellow-breasted Chat

These songbirds are dependant on riparian areas with a shrubby understory, preferably with dense wild rose and snowberry.

Yellow-breasted Chats were not observed during fieldwork, and no previous records are known from the study area. They have been detected to the west of the study area, but the majority of records are from the South Okanagan.

High suitability habitat for Yellow-breasted Chats (Figure 17) was recorded at nine plots during fieldwork.

Figure 17: Dense stands of rose and other deciduous shrubs provide potential nesting habitat.

All chat activity is generally confined to a nesting territory. Therefore, there is only one map theme (living), which includes nesting and foraging (Figure 18). This theme is displayed using the highest-value method, so suitable habitat may occupy only a portion of some of the polygons identified.

The model portrays a surprisingly large amount of suitable chat habitat. However, some of the remnant strips of riparian habitat along the main creeks are very narrow, and unlikely to provide adequate security cover for nesting in the current condition. Historically, suitable habitat on the valley floor was probably extensive.

Chats earned their name because of their noisy and highly diverse range of calls, including a typical 'chat-chat-chat-chat'. They are one of the very few songbirds that are vocal at night.

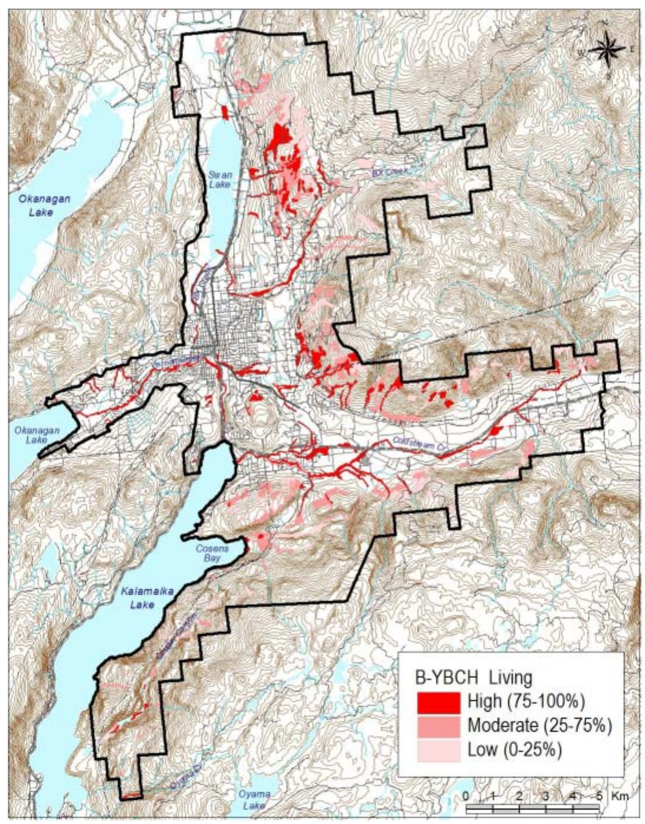

Figure 18: Distribution of suitable living (including nesting) habitat for Yellow-breasted Chat.

Grasshopper Sparrow

Grasshopper Sparrows generally occur in grasslands with little or no sagebrush or trees, and that are flat or on gentle warm aspects.

Grasshopper Sparrows have been recorded from three locations in the study area: Cosens Bay, Middleton Mtn., and the southern slopes of Vernon Hill.

High suitability living habitat was encountered at a dozen of the plots assessed, including at one nest site encountered (Figure 19).

Figure 19: Grasshopper Sparrows nest at the base of large bunchgrass clumps in open grasslands.

Nesting and foraging by Grasshopper Sparrows generally occurs in the same type of habitat. Therefore, the model generates only one map theme: living (Figure 20). The initial model displayed the theme using the dot-density method, as this bird prefers fairly large contiguous areas of suitable habitat. However, the highest-value method was used in the final Coldstream – Vernon model to more clearly identify the few areas of high-suitability habitat, including some small areas on Vernon Hill where a nest was found.

Larger areas of high-rated living habitats are concentrated in the central portion of the study area.

Grasshopper Sparrows nest on the ground, usually at the base of bunchgrasses, and use the overhanging vegetation to build a dome with a side entrance. They received their name from a portion of their call that resembles the buzz of a grasshopper.

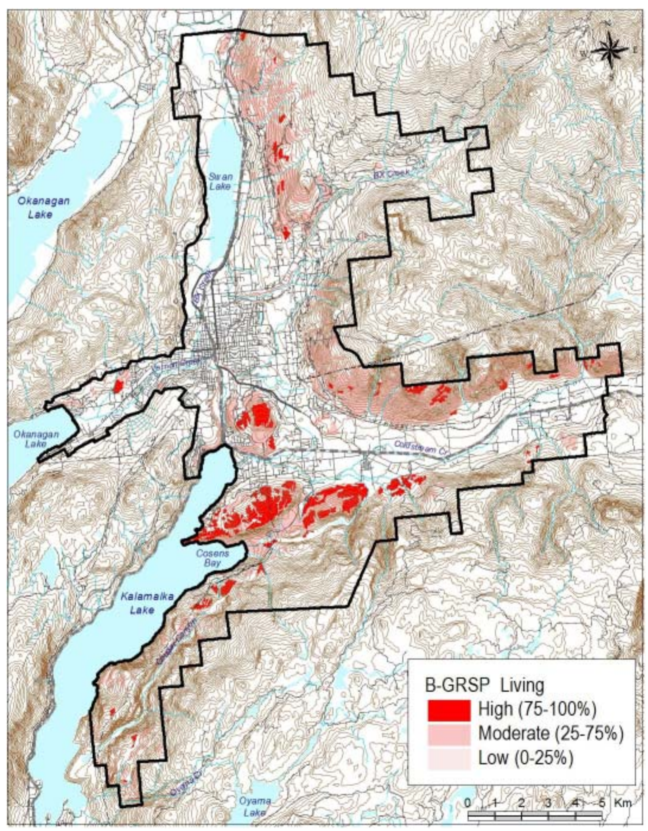

Figure 20: Distribution of suitable living habitat for Grasshopper Sparrow.

Badger

Badgers are usually residents of deep-soiled grasslands (Figure 21) although they will venture into a broad range of habitats. The north Okanagan has an abundance of deep-soiled grasslands that probably historically supported stable Badger populations.

Records of Badger observations occur sporadically throughout the study area.

Many plots were assessed as high-value habitat during fieldwork, including suitability for maternity dens.

Figure 21: Expansive, deep-soiled grasslands without road traffic are essential for Badger populations.

One map theme, living, is generated by the model, which includes foraging and denning (Figure 24). The dot density method is used to display habitat values, as this gives an indication of the proportion of the polygon suitable for use.

Suitable burrowing habitat may occur as small pockets within a polygon. The abundance of rodent prey could not be directly included in the habitat suitability model, but pocket gopher burrows often occurred in small pockets of deep soil throughout much of the study area. However, badgers commonly forage for more colonial prey (i.e., marmots and ground squirrels), displaying patchy use of habitats.

Badger populations have likely declined from habitat loss, persecution and traffic mortality. Fragmentation of habitats has also likely contributed to their decline.

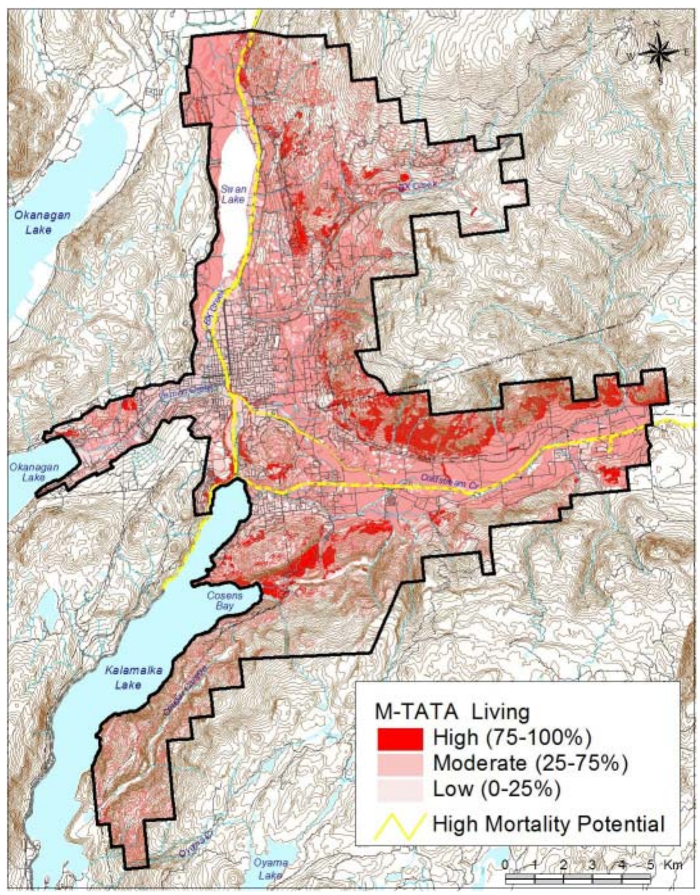

Figure 22: Distribution of suitable living habitat for Badger.

3.6 Habitat Values of Sensitive Ecosystems

Sensitive Ecosystem Inventory categories[34] are shown in Figure 23 by largest area, which portrays the dominant component of each polygon. Almost all polygons dominated by *sensitive ecosystems* have high suitability for at least one of the project wildlife species. *Other important ecosystems*, particularly disturbed grasslands, often have high value for many of the project wildlife species as well. It should be noted that because the SEI categories are displayed using largest area, many of the polygons contain sensitive ecosystems that are not shown.

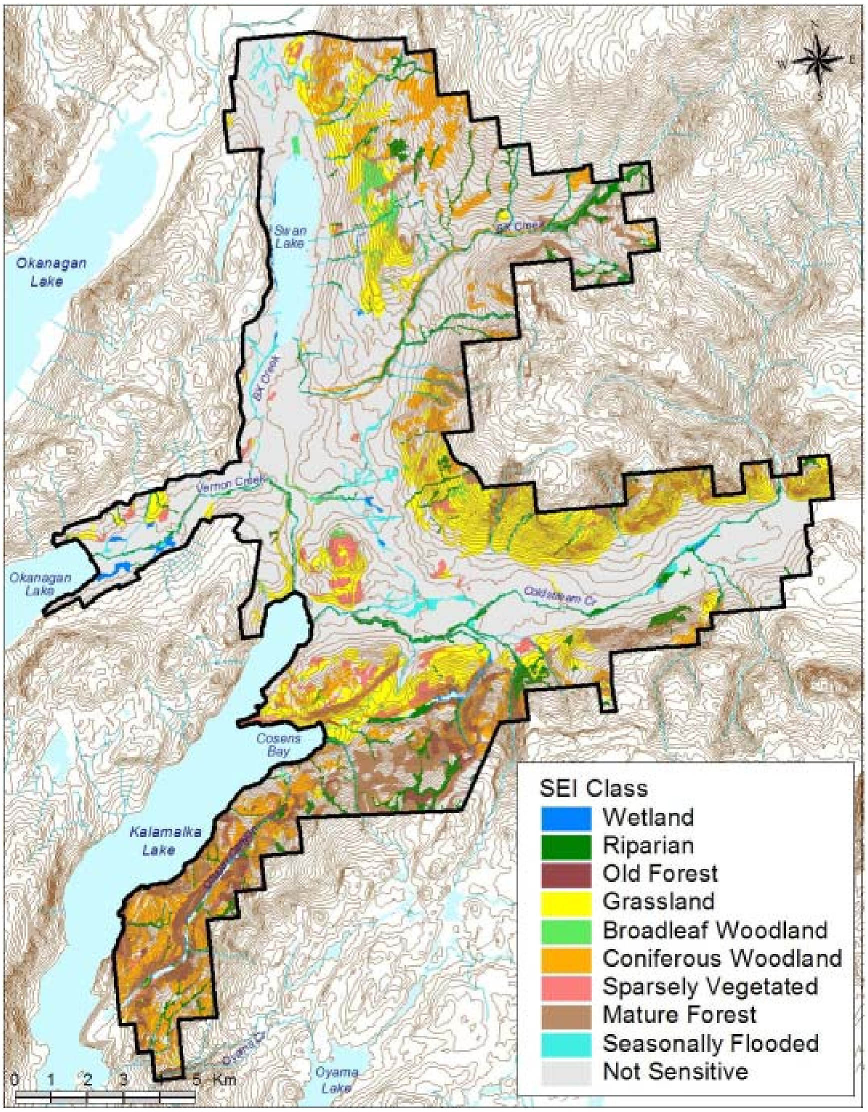

Figure 23: Sensitive ecosystem mapping, displayed using largest area method.

Many polygons without sensitive or other important ecosystems may still provide important wildlife habitat for species at risk, including rural and agricultural areas.

[34] Iverson 2006

3.7 Composite Wildlife Habitat Map

Ten life requisites were chosen to represent the most limiting habitat requirements of the project wildlife species (Table 5). This does not imply that the species or life requisites omitted are not as important. Rather, their needs may be met if habitats for the remainder of the map themes are conserved.

Table 5: Map themes used in composite wildlife habitat map.

Species	Species Code	Map Theme	Rating Code
Great Basin Spadefoot	A-SPIN	Breeding	RE
Painted Turtle	R-CHPI	General Living	LIA
Western Rattlesnake	R-CROR	Basking / 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	B-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

A composite wildlife habitat map of high- and moderate-value habitats for the ten critical map themes is presented in Figure 24. This map is displayed using the highest-value method. While this method is excellent for highlighting polygons containing important areas, it portrays an exaggerated amount of valuable area, as entire polygons are shown by the highest value that they contain.

The composite wildlife map portrays abundant high-suitability habitat, indicating that many of the polygons in the study area contain valuable habitat for at least one of the project species. The map should be used to view important habitats on a landscape level. For areas of interest, refer to individual wildlife habitat models and investigate them in the field to assess values. Habitats may be important to wildlife other than the project species as well, and all listed species should be considered prior to any development or planning decisions.

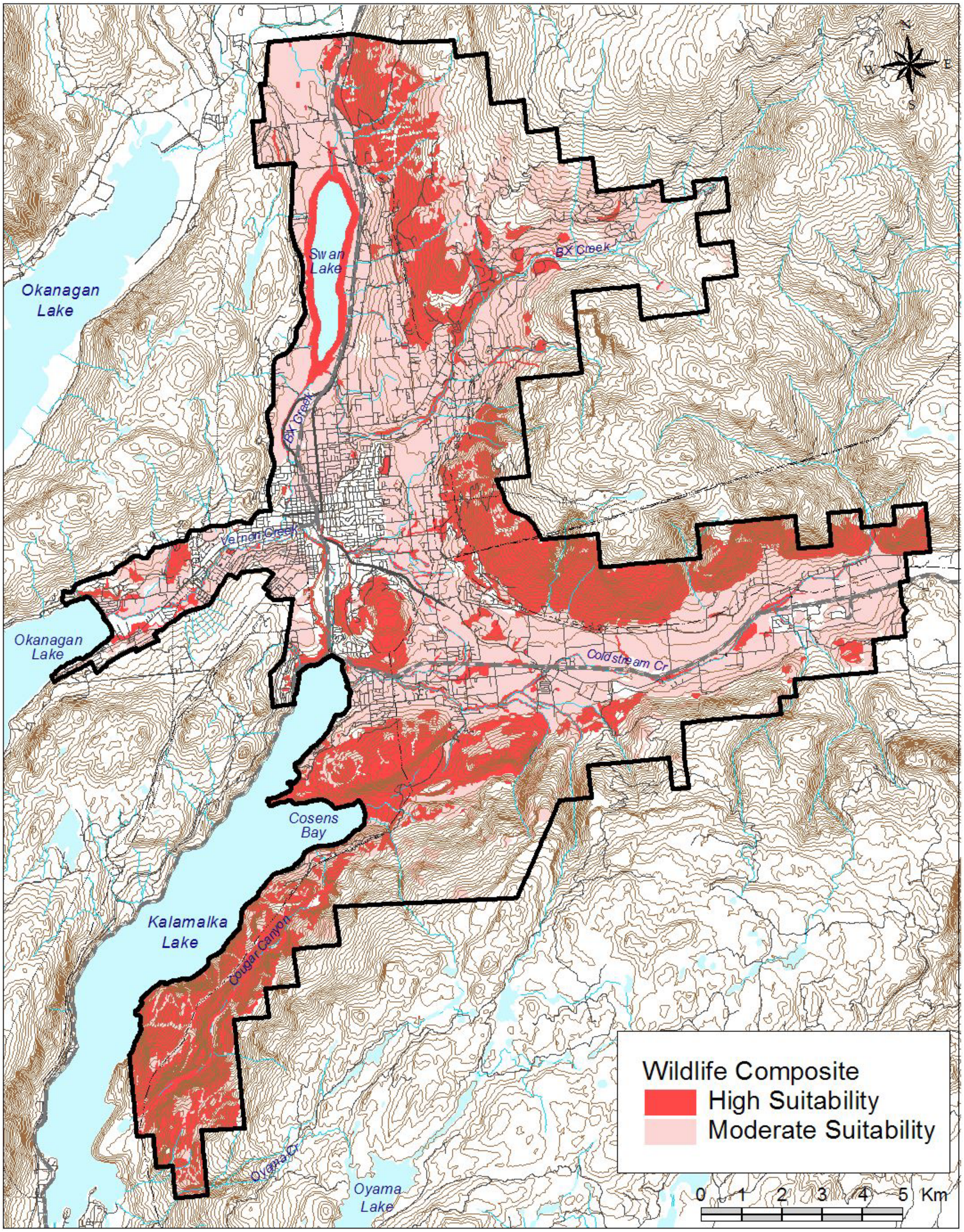

Figure 24: High and Moderate ratings for ten critical life requisites, displayed using highest value method.

3.8 Conservation Analysis

The Conservation Analysis described in Volume 1[35] (Figure 25) takes into account not only the rarity and fragility of ecosystems, but also the condition of the ecosystems, and wildlife values.

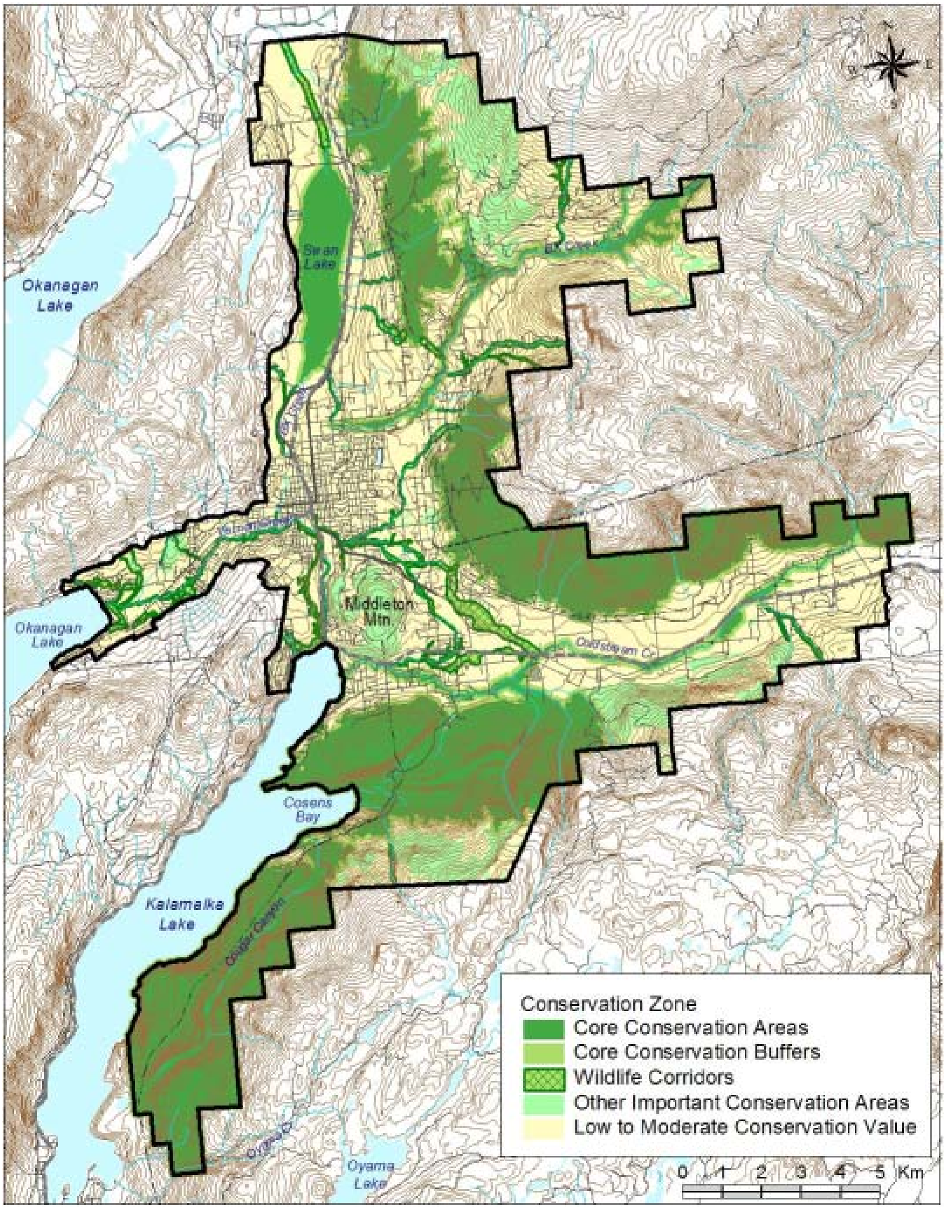

Figure 25: Conservation Zones resulting from the SEI Conservation Analysis.

The Core Conservation Areas identified in the Conservation Analysis appear to protect the bulk of important habitat for all project species. However, the importance of Middleton Mtn. should be stressed, despite the area not being identified as core conservation. It is not considered credible as a core

[35] Iverson 2008

conservation area because of the condition and fragmentation of this area, but priority habitats for many project species do occur here. Additionally, the location is vital in maintaining the limited connectivity of surrounding areas.

Critical wildlife corridors were identified as part of the analysis as well. Corridors between Core Conservation Areas and Other Important Conservation Areas are critical to many species; the habitat connectivity permits individuals to move between core areas of suitable habitat, often between different habitat types that are necessary to fulfill multiple life requisites, and it also permits gene flow between local populations. Even highly motile species such as birds may be reluctant to travel across unsuitable habitats, and may still be subject to road mortality or increased predation. Past development limits the opportunity for corridors in many areas. Many of the landscape-level corridors identified in the Conservation Analysis are narrow, fragmented, or degraded, but may have high potential for restoration. At more detailed planning levels, existing or potential corridors need to be refined or identified.

4 Recommendations

The wildlife models can be used individually or in conjunction with the SEI as used in the Conservation Analysis, for landscape level to detailed site level planning. At all scales of planning, ecological corridors need to be considered, as they are critical to many wildlife species.

As a landscape-level planning tool, the Conservation Zones (Figure 25) resulting from the Conservation Analysis should be used to direct development towards less sensitive areas, and to ensure corridors and habitat connectivity is maintained. In some cases the integrity of the identified landscape corridors is poor due to narrowness, large gaps between natural areas, and road mortality risk. But many of the corridors are in productive areas such as riparian ecosystems, and would quickly benefit from habitat enhancement efforts. Restoration of the habitat, and establishing underpasses with drift fencing in key areas, would increase the effectiveness of corridors for permitting safe movement, particularly near Swan Lake and Okanagan Landing.

Alternatively, the models can be applied to discreet areas for detailed site level planning, to guide detailed inventories and assessments. Individual wildlife models should be consulted and ground-truthed to determine areas that are important for each priority species. Appendix B provides a list of rare species likely to occur in the area. Lists of species at risk that may be associated with each sensitive or other important ecosystem are provided in Volume 1[36], which also contains additional environmental impact assessment guidelines. Detailed recommendations on conducting impact assessments and incorporating SEI information are also available in the SEI report for the entire Okanagan Valley[37]. The Regional District of Central Okanagan's 'Terms of Reference: Professional Reports for Planning Services' should also be consulted and used as a guide for minimum standards for conducting environmental assessments[38]. Development permit bylaws are needed to ensure that this process is followed. Conducting thorough assessments of wildlife habitats should result in the protection of discreet wildlife habitats and features with appropriate buffers. These assessments should always be compared with the landscape conservation model to ensure that conservation objectives are fully addressed.

Anyone conducting environmental impact assessments using this information should have a good understanding of each species' habitat requirements and associated threats when evaluating development impacts and establishing environmentally sensitive areas (ESA). Best Management Practices are being developed for many species at risk, and these should be consulted in addition to the management recommendations outlined here and in SEI reports. Many wildlife species require connectivity throughout their range, and this should be given consideration when assessing the lands of interest in context with the surrounding area.

The individual wildlife suitability maps can be used in wildlife management activities and strategies as well, such as directing inventory for the project species, or habitat restoration.

The following are brief management guidelines for each of the project wildlife species. These guidelines should form the basis of the assessments and conservation planning for each species within environmental impact assessments.

[36] Iverson 2008
[37] Iverson et al. 2008
[38] CORD 2005

4.1 Great Basin Spadefoot

All wetlands should be protected from disturbance. More inventories are required to determine which ponds are used for breeding, and this data can be used with the suitability of terrestrial habitats to apply buffers. Generally, buffers around breeding sites should be at least 350 m[39] to protect both breeding and adjacent terrestrial habitats and to avoid road and other mortality. However, this could vary depending on the suitability of upland habitat. Spadefoots may travel several hundred metres from ponds, and occasionally up to 1.5 km, so buffers should be extended to encompass the highest-suitability surrounding habitat, attempting to capture at least 5 ha of terrestrial area[40].

Corridors must be maintained between ponds and foraging sites. Developments that pose a hazard or obstruction to spadefoots, including roads, retaining walls, and steep-sided trenches, should not occur between aquatic breeding habitats and nearby suitable terrestrial habitats. Management should also consider the connectivity between aquatic habitats, to maintain gene flow between spadefoot populations. Artificial breeding habitats can be created as part of mitigation programs.

4.2 Western Rattlesnake and Gopher Snake

Management of any potential denning habitats should include a no-development zone unless an inventory (including inquiring with local residents and people familiar with the area) has demonstrated conclusively that the depicted habitats are not used. Recreational trails should avoid these areas to minimize human-snake conflicts, including mortality from mountain bikes and vehicles. Summer foraging areas should be carefully assessed to determine whether any development is appropriate, and if so, what mitigation measures are required. Although corridors to allow snake movement from winter security/thermal habitats to summer foraging habitats have not been mapped, they should be identified and applied to project planning. Roads should not intersect any of these areas unless appropriate mitigation measures are employed to avoid traffic mortalities. Paved roads are a particularly large threat to snakes due to their habit of basking on the warm surface for thermoregulation. Snake exclusion fencing may be required to reduce encounters and mortality in developed areas.

4.3 Long-Billed Curlew

Conduct inventories in suitable habitats during the breeding season to determine whether Long-billed Curlews are present. Curlews require an expanse of level to gently sloping grasslands or meadows. Any development in these areas, including roadways and recreational corridors, will significantly impact these birds. Livestock should not access these areas during the breeding season to protect nests from trampling.

4.4 Swainson's Hawk

Inventories during the breeding season should be conducted to locate nest trees, which should be protected from disturbance, including an appropriate buffer. Conservation of large areas of open habitats such as grassland and agricultural fields is required to maintain a population of hawks in the area.

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[39] Semlitsch and Bodie 2003
[40] Sarell 2004

4.5 Western Screech-owl

Further inventories are required to determine the location of all nest sites in the study area. These should be protected from any type of disturbance. Maintain all mature and old riparian stands, including important habitat features such as large snags. Incorporate surrounding natural habitats, particularly meadows, as a buffer to these areas. Retain younger stands of riparian forest for potential future habitat. Nest boxes can help to increase the suitability of marginal nesting habitat.

4.6 Grasshopper Sparrow

Breeding season inventories are required to determine the extent to which they occur in grassland habitats, including weedy sites. They are semi-colonial but often shift their breeding territories between years. Therefore, additional suitable grassland habitats should be retained to accommodate breeding in subsequent years. A buffer to reduce disturbances is also recommended. Livestock should not access these areas during the breeding season (May to July) to protect nests from trampling. Domestic cats should not be permitted in these areas as they may prey upon adults and nestlings. Landowner education, and possibly bylaws in new development areas, may help encourage owners to avoid allowing free-roaming cats.

4.7 Yellow-breasted Chat

Inventories are required to determine the location of any breeding territories in the study area. All riparian ecosystems should be maintained, and degraded shrubby understories should be restored, particularly with wild rose. Restrict livestock access to these areas as they reduce the shrubby component of these ecosystems. Buffers should be incorporated to reduce disturbances to these areas. Domestic cats should not be permitted in these areas, as they may prey upon adults and nestlings. Landowner education, and possibly bylaws in new development areas, may help encourage owners to avoid allowing free-roaming cats.

4.8 Badger

Conserving large areas of deep-soiled grassland and preventing road mortality are required to recover this species. Corridors and connectivity should be maintained with other natural areas to allow for their high degree of motility and dispersion. Road placement should avoid intersecting suitable badger habitat, as road mortality is the major cause of death for this species (Weir et al. 2005). Underpasses in key areas may reduce the risk of mortality.

Inventories should be conducted to locate maternal dens, which usually occur in deep soils on gently to moderately sloping grasslands, often adjacent to significant populations of prey species including ground squirrels, marmots or pocket gophers. Management should ensure there is no disturbance to occupied or maternal burrow sites and that no activities significantly affect prey species or create barriers between suitable areas.

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Appendices

Appendix A: Data Access

Spatial and non-spatial data for the Sensitive Ecosystems Inventory and Terrestrial Ecosystem Mapping (TEM), including wildlife mapping, are available for download at 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
- SEI report (Volume 1)[41]
- Arc/Info *.E00 Export Files includes two spatial coverages: ECI field sampling points and a ECP TEM polygon coverage
- TEM Polygon Attributes
- TEM and SEI Map Legend Files
- TEM report with expanded legend (Volume 2)[42]
- Wildlife Species Accounts
- Wildlife Ratings Tables
- Wildlife Report (Volume 3)

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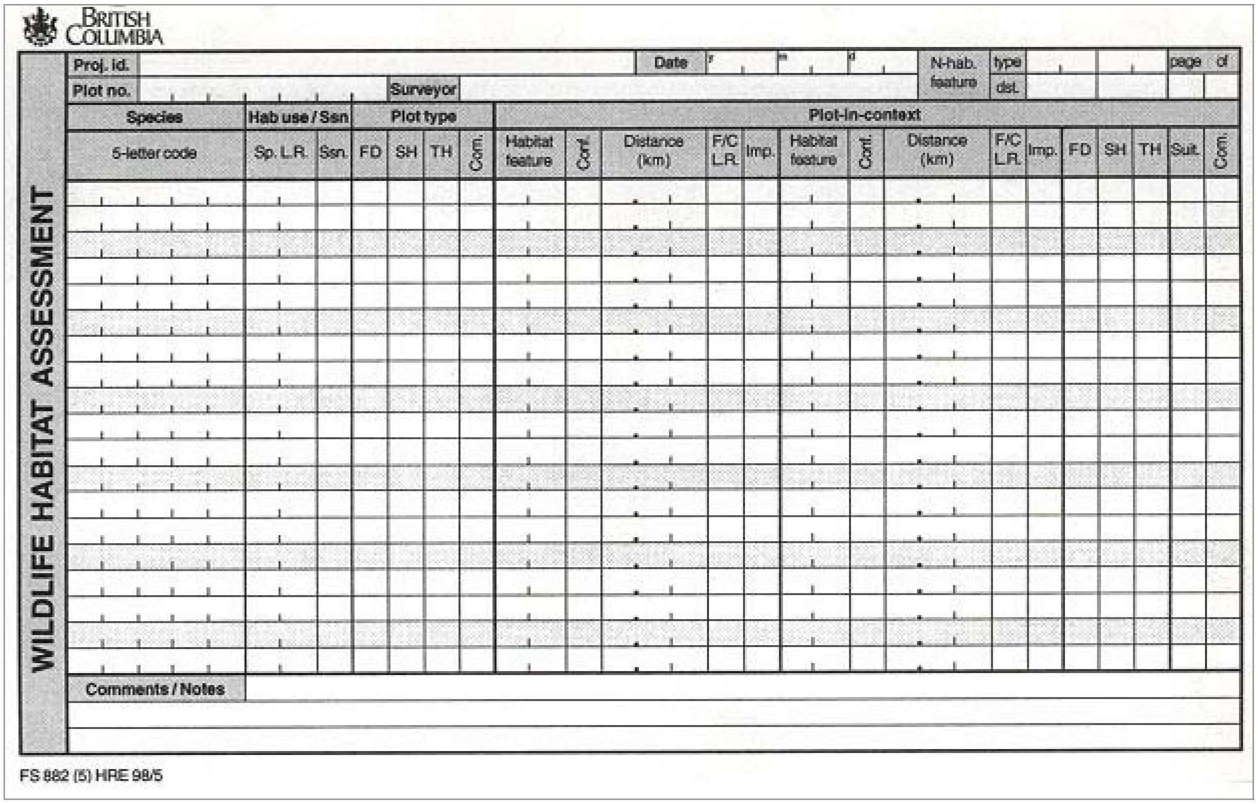
[41] Iverson 2008

[42] Iverson and Uunila 2008

Appendix B: Known and potential rare wildlife 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*	scattered records, likely throughout	Blue	Threatened
Racer	*Coluber contrictor*	unknown, likely throughout	Blue	Special Concern
Rubber Boa	*Charina bottae*	southern half	-	Special Concern
Birds				
Western Grebe	*Aechmophorus occidentalis*	historic 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
Fringed Myotis	*Myotis thysanodes*	historic 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

Appendix C: Wildlife Habitat Assessment Form



BRITISH COLUMBIA

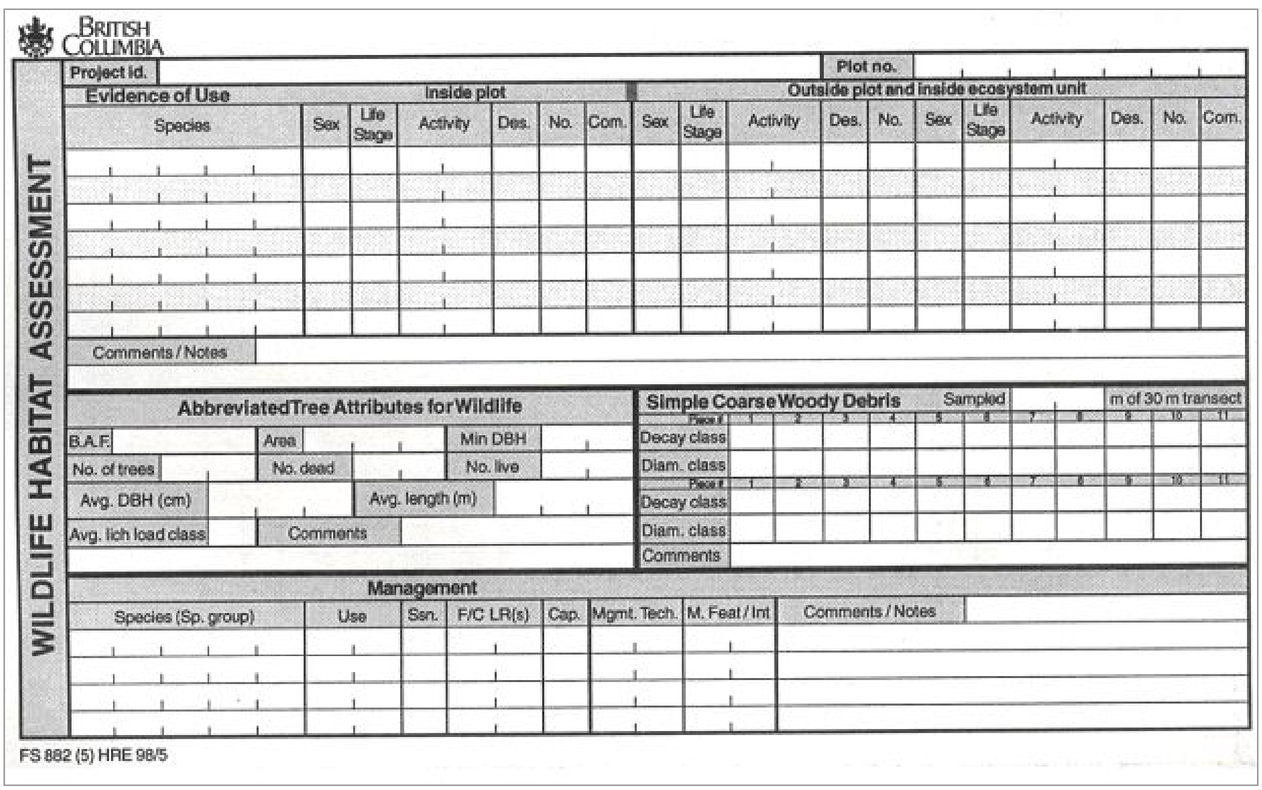
WILDLIFE HABITAT ASSESSMENT

Proj. id.		Date	y	m	d	N-hab. feature	type		page	of
Plot no.		Surveyor					dst.			

Species	Hab use / Ssn		Plot type				Plot-in-context														
5-letter code	Sp. L.R.	Ssn.	FD	SH	TH	Com.	Habitat feature	Conf.	Distance (km)	F/C L.R.	Imp.	Habitat feature	Conf.	Distance (km)	F/C L.R.	Imp.	FD	SH	TH	Suit.	Com.

Comments / Notes

FS 882 (5) HRE 98/5



BRITISH COLUMBIA

WILDLIFE HABITAT ASSESSMENT

Project id. | Plot no.

Evidence of Use	Inside plot						Outside plot and inside ecosystem unit											
Species	Sex	Life Stage	Activity	Des.	No.	Com.	Sex	Life Stage	Activity	Des.	No.	Sex	Life Stage	Activity	Des.	No.	Com.

Comments / Notes

Abbreviated Tree Attributes for Wildlife

B.A.F.		Area		Min DBH	
No. of trees		No. dead		No. live	
Avg. DBH (cm)		Avg. length (m)			
Avg. lich load class		Comments			

Simple Coarse Woody Debris Sampled | m of 30 m transect

Piece #	1	2	3	4	5	6	7	8	9	10	11
Decay class											
Diam. class											
Piece #	1	2	3	4	5	6	7	8	9	10	11
Decay class											
Diam. class											
Comments											

Management

Species (Sp. group)	Use	Ssn.	F/C LR(s)	Cap.	Mgmt. Tech.	M. Feat / Int	Comments / Notes

FS 882 (5) HRE 98/5

Completed data forms submitted to the Ministry of Environment.

Appendix D: Ratings Table

Ratings Table filename: Coldstream_wl ratings table_10Feb2008.csv (See Appendix A for access)

Example of Ratings Table format:

ECO_SEC	BGC_ZONE	BGC_SUBZON	BGC_VRT	SITEMC_S	SITE_MA	SITE_MB	STRCT_S	STRCT_M	STAND_A	SERAL	A-SPIN_RE	A-SPIN_LIA	RCHPI_LIA	RCHPI_RE	R-CROR_LIS	R-CROR_LIA	R-PICA_LIG	R-PICA_RE	B-SWHA_RE	B-SWHA_LIG	B-LBCU_RE	B-LBCU_LIG	B-WSOW_RE	B-YBCH_LIG	B-GRSP_LIG	M-TATA_LIA
NOB	IDF	xh	1	AS			3				L	L	N	N	H	N	M	N	N	N	N	N	N	M	N	N
NOB	IDF	xh	1	AS			4		B		L	L	N	N	H	N	M	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS			5		B		L	L	N	N	H	N	M	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS			6		B		L	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS			7		B		L	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	g		3				L	L	N	N	H	N	M	N	N	N	N	N	N	M	N	N
NOB	IDF	xh	1	AS	g		4		B		L	L	N	N	H	N	M	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS	g		5		B		L	L	N	N	H	N	M	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS	g		6		B		L	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	g		7		B		L	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	g	k	5		B		N	N	N	N	M	N	L	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS	g	w	3				N	L	N	N	H	N	M	N	N	N	N	N	N	M	N	N
NOB	IDF	xh	1	AS	g	w	4		B		N	L	N	N	H	N	M	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS	g	w	5		B		N	L	N	N	H	N	M	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS	g	w	6		B		N	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	g	w	7		B		N	L	N	N	H	N	M	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	k		3				N	N	N	N	M	N	L	N	N	N	N	N	N	M	N	N
NOB	IDF	xh	1	AS	k		4		B		N	N	N	N	M	N	L	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS	k		5		B		N	N	N	N	M	N	L	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS	k		6		B		N	N	N	N	M	N	L	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	k		7		B		N	N	N	N	M	N	L	N	N	N	N	N	M	H	N	N
NOB	IDF	xh	1	AS	n		4		B		N	L	N	N	H	N	M	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS	w		3				N	L	N	N	H	N	H	N	N	N	N	N	N	M	N	N
NOB	IDF	xh	1	AS	w		4		B		N	L	N	N	H	N	H	N	N	N	N	N	N	H	N	N
NOB	IDF	xh	1	AS	w		5		B		N	L	N	N	H	N	H	N	N	N	N	N	L	H	N	N
NOB	IDF	xh	1	AS	w		6		B		N	L	N	N	H	N	H	N	N	N	N	N	M	H	N	N