ECOLOGICAL ANALYSIS TO SUPPORT UBC'S OKANAGAN CAMPUS MASTER PLAN UPDATE

THE UNIVERSITY OF BRITISH COLUMBIA

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TABLE OF CONTENTS

REFERENCES

MAPS

APPENDIX

1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by The University of British Columbia (UBC) to complete an ecological analysis of the UBC Okanagan Campus (the Campus). Ecoscape understands that the scope of work includes an ecological classification, inclusive of ecosystem mapping, identification of plant and wildlife species, and designation of environmentally sensitive areas (ESA). The ESA polygons were overlaid with the seven precincts defined in the 2009 Master Plan Update and used to make recommendations for future environmental management planning based on existing environmental features. This report provides a discussion of the potential impacts of climate change with regard to general trends on annual precipitation, surface and groundwater availability, and flow patterns within the context of the identified ecosystems.

1.1 Objective and Scope

The objective of the project is to collect baseline ecological inventory information that can be used to guide future sustainable Campus planning and development. Existing data, including Sensitive Ecosystem Inventory (SEI) and Terrestrial Ecosystem Mapping (TEM), has been incorporated, updated, and refined to a scale appropriate for the Campus and inclusive of the information outlined in the project objectives, described below:

- Provide an ecological classification of what currently exists;
- Conduct reconnaissance field work to ground truth mapping data and to identify sensitive ecological areas;
- Classify distinct ecological communities based on landform, vegetation cover, and use;
- Review the 2009 Master Plan guidelines and other planning documents with regards to the preservation/conservation of natural areas within the Campus; and
- Provide background information on the predicted effects of climate change and weather patterns, noting general trends. Describe the watershed and note any projected changes in surface and groundwater availability and flow patterns.

1.2 Study Area

The approximately 202 ha Campus is located at the north end of the City of Kelowna and has grown rapidly over the last 10 years, including the construction and expansion of new buildings, facilities, and associated infrastructure to support a growing student body. The Campus boundary has recently expanded to the west to include lands within the Agricultural Land Reserve (ALR). There is potential that a new public road connection will extend from Glenmore Road to Highway 97 across the Campus via the ALR lands.

The lands surrounding the Campus are also undergoing a transformation. The lands north of the Campus (known as the Gateway) include sand and gravel extraction operations that will soon become light industrial, high tech, and service commercial use. Lands near the southwest corner of the Campus include a development known as University Heights that, when built, will offer residential and commercial uses, as well as Aberdeen Hall Preparatory School, which is a rapidly expanding private school.

The 2009 Master Plan Update divided the Campus into precincts for the purposes of development planning. Those precincts were used during the mapping and inventory components of this project and to develop recommendations for future landuse planning and conservation or restoration efforts. The precincts include:

- The Core
- The Commons
- Health, Wellness, and Recreation
- Okanagan Landscape
- Hilltown
- Pine Forest
- University Reserve Lands

The Campus also includes lands to the west of the developed areas that occur within the ALR. These lands (referred to as West Campus Lands) are not currently part of the Campus Masterplan but were mapped and evaluated to determine sensitive areas and considerations for future development, including potential future road access.

The ecological setting of the Campus occurs within the Okanagan Very Dry Hot Ponderosa Pine (PPxh1) zone which is described by the Biogeoclimatic Ecosystem Classification (BEC) system (Lloyd *et al*. 1990). Areas of the ponderosa pine (PP) zone are generally the driest forested regions in BC, with hot dry conditions in the summer, and cool with little snow in the winter.

1.3 Methods

Ecoscape conducted a biophysical inventory and environmental assessment of the Campus, during which existing signs of wildlife presence and activity, wildlife habitat, vegetation communities, and aquatic resources were identified and documented. Significant environmental features and potential for occurrences of rare and/or endangered species were also recorded.

The biophysical inventory had two general objectives. First, ecological communities, soils, and landforms identified in the TEM and SEI data were field verified and polygon boundary adjustments and classification changes were made. Second, the inventory

focused on identification of existing wildlife (vertebrate and invertebrate) and at risk species and other critical habitat features.

Due to time and budget constraints, detailed wildlife sampling was not conducted. The inventory methodology for wildlife was adapted from the BC Resources Inventory Standards Committee (RISC) standards for general presence/not detected surveys. Mapping of significant features and habitats was conducted using a Trimble Nomad Global Positioning System (GPS) unit with XT Receiver and Hurricane antenna. The updated polygons and features were compiled into a Geographic Information System (GIS) for mapping and analysis. Ecoscape utilized existing resources documenting known biophysical features present within the Campus, including:

- 2009 Sensitive Ecosystem Inventory (SEI) data;
- 2008 Wetland Inventory Mapping (WIM) data;
- BC Conservation Data Centre (CDC); and
- RDCO Parks Biophysical Inventory (Robert Lake Regional Park).

The gathered information was reviewed prior to field investigations and incorporated into the assessment results. Vegetation communities were identified prior to the site assessment using air photo interpretation and existing SEI and TEM data. Vegetation communities were classified according to the Biogeoclimatic Ecosystem Classification (BEC) System (Lloyd *et.al.*, 1990). Following field verification and refinement, the ecosystem mapping was used to conduct an analysis of Environmentally Sensitive Areas (ESA), identify potential management zones, and develop recommendations.

2.0 BIOPHYSICAL INVENTORY

The following section presents the results of the biophysical inventory and environmental assessment conducted by Mary Ann Olson-Russello, R.P.Bio. and Adam Patterson, R.P.Bio. Field investigations were conducted on May 27 and June 5, 2014.

2.1 Landforms and Soils

The Campus topography generally varies from flat (recreational fields and parking areas) to gently sloping hillsides. Slopes range from 0% to approximately 30%, with some steep slopes associated with cutbanks, fill slopes, and other modified landforms. Rocky outcrops, cliffs, and talus are largely absent from the Campus. Several low-lying and moisture receiving areas occur throughout the Campus which have developed into shallow open water or wetland features.

The Campus occurs within the McKinley Escarpment with north-south aligned ridges and valleys formed during the last glaciation of the Okanagan Valley (Roed and Greenough

1995). Surficial soils and parent materials were determined from available TEM data and are shown on Map 1. The Campus has a diverse range of surficial material and texture. The developed portion of the campus is generally dominated by anthropogenic materials (i.e., non-native fill materials used during construction and development) while fluvial and morainal materials dominate the undeveloped and natural landscapes. Organic materials are associated with the open water and wetland areas.

2.2 Terrestrial Ecosystems

The ecosystem mapping component of this project incorporated previously described TEM polygons from the most recently updated SEI for the central Okanagan (Haney and Iverson 2009). The existing TEM polygon extents were adjusted and classification changes were made to more accurately describe the polygons at a finer spatial scale based upon the field inventory and professional judgment.

2.2.1 Terrestrial Ecosystem Mapping

Ecoscape divided the Campus into polygons representing distinct habitat types based on vegetation cover and adapting the nomenclature and site series used by TEM and the BC Wetland Classification System (BCWCS) (MacKenzie and Moran 2004). The Campus was divided into fifty seven (57) polygons representing fifteen (15) different ecosystem classifications (Map 2). Table 1 presents the ecosystem codes, their associated site series, and provincial status, as defined by the CDC.

Table 1. Ecosystem communities occurring within the Campus.

Ecosystem Code	Site Series	Site Series Name	Provincial Status[1]
AK	-	Alkali Lake	*
CF	-	Cultivated Field	-
CT	00	Cattail Marsh	Blue
FO	00	Douglas-fir - Ponderosa pine - Saskatoon - Mock Orange	*
GP	-	Gravel Pit	-
Gs01	-	Alkali saltgrass – Nuttall's alkaligrass	Red
Gs02	-	Nuttall's alkaligrass – foxtail barley	Red
OW	-	Shallow Open Water	*
PC	04	Ponderosa pine - Bluebunch wheatgrass	Blue
PF	05	Ponderosa pine - Bluebunch wheatgrass - Rough fescue	Red
PT	02	Ponderosa pine - Red three-awn	Blue
PW	01	Ponderosa pine - Bluebunch wheatgrass - Idaho fescue	Blue
RW	-	Rural	-
SP	06	Douglas-fir/Ponderosa pine - Snowberry - Pinegrass	Red
UR	-	Urban/Suburban	-

1 Source: http://www.env.gov.bc.ca/cdc/
Blue: Of special concern. **Red:** Endangered or threatened.
* Not recognized by the CDC.

Essentially all of the forested ecosystems occurring within the Campus are identified by the CDC as being at risk. Two (2) of the forested ecosystem communities are Red-listed, indicating that they are endangered or threatened in BC and three (3) are Blue-listed

meaning they are of special concern. The three (3) wetland communities (i.e., CT, Gs01 and Gs02) are also Red-listed. Non-vegetated and anthropogenic communities (i.e., CF, GP, RW, and UR) are not provincially listed.

Several other communities, including aquatic (i.e., AK and OW) and forest communities, (i.e., FO) are not provincially listed. These site series are based on SEI and BCWCS classifications and are not recognized and ranked by the CDC. Despite the lack of provincial status designation, these are known to be highly sensitive and regionally significant ecosystems.

2.3 Broad Ecosystem Communities

The Campus has been divided into five (5) broad ecosystem communities to simplify and organize the reporting. Overall, the Campus is characterized by a matrix of woodland communities occurring within a mixture of urban and rural landuse settings. Rural landuse areas such as cultivated fields and gravel pit areas make up a large proportion of the Campus and pockets of open water and wetland communities occur throughout. A complete list of plant species observed during the Campus assessment is provided in Appendix A, including the scientific name associated with each plant.

2.3.1 Coniferous Woodland

The woodland communities are generally characterized by an overstory of young stands of ponderosa pine and interior Douglas-fir with scattered and infrequent mature trees and snags. Douglas-fir tends to dominate on cool, east-facing slopes while ponderosa pine dominates the warmer south to west-facing slopes and ridge-top areas. The largest contiguous area of woodland occurs within the Pine Forest precinct. Other smaller patches of woodland occur throughout the Campus and outlying precincts, including the Health, Wellness and Recreation and Okanagan Landscape precincts.

The understory shrubs associated with the woodland communities include Saskatoon, tall Oregon-grape, common snowberry, spreading dogbane, and common rabbit-brush. Other scattered and less frequently occurring shrubs include mock-orange, prairie rose, smooth sumac, Rocky Mountain juniper, and chokecherry, which are generally associated with the warmer, drier sites. In cooler, moisture-receiving areas, shrubs include patches of willow, Nootka rose, Douglas maple, birch-leaved spirea, and black hawthorn. Non-native and

weedy shrubs are also scattered throughout the woodland communities, especially where they abut disturbed areas, such as the gravel pit and other anthropogenic sites. These include Siberian elm, black locust, and Chinese sumac.

The herb layer within the woodland communities is typically comprised of grasses including bluebunch wheatgrass, junegrass, and rough fescue which are interspersed with arrow-leaved balsamroot, yarrow, buckwheat, and pussytoes. Other common herb species include timber milk-vetch, rockcress, fern-leaved desert parsley, meadow death-camas, wild strawberry, lemonweed, and hawkweed. Wildflowers observed during the site visit include chocolate lily, larkspur, paintbrush, and daisy. Mosses and lichens also provide scattered groundcover.

Cheatgrass is widespread throughout the woodland communities, as well as other non-native and invasive plants of concern, such as sulphur cinquefoil, Dalmatian toadflax, knapweed, and yellow salsify.

2.3.2 Urban and Rural Communities

The urban areas are associated with the developed portions of the Campus, including the university buildings, residences, and other facilities that make up the Core, Hilltown, Commons, and Health, Wellness, and Recreation precincts. These include paved areas such as parking lots, roads, and sidewalks, as well as pockets of manicured landscaping. Ornamental and cultivated varieties of trees and shrubs were not inventoried for the purposes of this project; however, Ecoscape understands that UBCO maintains a database of landscape plants used within the Campus grounds.

For the purposes of this report, the rural community classification was used to describe disturbed areas with permeable surfaces (i.e., unpaved) and maintained vegetation cover dominated by non-native species, such as old roads, fields, and disturbed areas associated with clearing for parking or other human activity. Some of the rural areas have been used to dispose of or store waste materials, such as tires, concrete, wood, grass clippings, mulch, and discarded equipment.

The rural areas are generally dominated by non-native and invasive weedy species such as Siberian elm, black locust, hoary cress, cheatgrass, sulphur cinquefoil, woolly vetch, alfalfa, tumble-mustard, knapweed, thistle, mullein, horseweed, summer cypress, yellow salsify, and grasses associated with roadside seeding, such as crested wheatgrass, smooth

brome, and orchardgrass. In particular, the area known as the 'grassland' within the Okanagan Landscape precinct is almost entirely comprised of non-native and invasive plants, many of which have been deemed noxious weeds by both the City of Kelowna and the RDCO. Patches of native vegetation persist throughout the rural areas, including species adapted to disturbance, such as black cottonwood, willow, and yarrow.

2.3.3 Gravel Pit

The gravel pit area occurs within the University Reserve Lands precinct which is characterized by exposed soils, compacted roadways, and weedy vegetation cover dominated by tumble-mustard and hoary cress. Tree and shrub cover is generally absent, apart from planted ornamental species (e.g., cedar hedging between the gravel pit and parking lot) and scattered elm, locust, willow, and cottonwood.

2.3.4 Open Water and Wetland Communities

Several aquatic communities occur throughout the Campus, including shallow open water wetlands and alkaline ponds. These features are rare within the Campus as well as at a regional scale.

A cattail marsh and shallow open water wetland feature occurs within the Okanagan Landscape precinct (pictured). This wetland community is used as a retention pond and receives stormwater from the majority of the developed portions of the Campus. Stormwater discharges via outfall to a small basin which allows sediments and other particulate matter to settle prior to waters being conveyed via culvert to the larger wetland complex. Both the basin and the wetland complex are characterized by cattails with riparian shrubs that include willow, red-osier dogwood, black hawthorn, Nootka rose, chokecherry, and snowberry. Upland herbaceous vegetation includes fireweed, field mint, and reed canarygrass. Weedy species are well-established throughout the wetland perimeter, and include burdock, dandelion, mustard, hoary cress, Canada thistle, sulphur cinquefoil, and mullein.

Another small shallow-open water community occurs within the Okanagan Landscape precinct. This community has little aquatic vegetation and is surrounded by non-native and invasive weed species, including woolly vetch, burdock, sulphur cinquefoil, hoary cress, and grasses.

Within the West Campus Lands, are two alkaline ponds, known locally as Robert Lake and Little Robert Lake (pictured below). The vegetation associated with the riparian fringe around the lakes is comprised of herbaceous plants that are well-adapted to the alkaline nature of the surrounding environment. Trees and shrubs are generally absent from the shoreline and riparian area. The herbaceous community includes grasses such as Nuttall's alkaligrass, and alkali saltgrass. Patches of bulrush, cattail, and sedge occur along the lake shorelines and shallow areas within the lakes. Patches of exposed alkaline crust occur where water levels have receded. An unknown green algae occurs in patches within Little Robert Lake. Weeds are prevalent surrounding the lakes and include sulphur cinquefoil, lamb's-quarters, cleavers, field pennycress, tumble-mustard, perennial sow-thistle, alfalfa, and various non-native grasses such as cheatgrass, crested wheatgrass, and bluegrass.

2.3.5 Cultivated Field

The West Campus Lands are characterized by cultivated fields dominated by agronomic grass crops. Some of the non-native grass species and other weedy plants have encroached beyond the cultivated field boundaries and into the adjacent woodland and wetland communities. Invasive plant species of concern in these areas includes sulphur cinquefoil, thistle, tumble-mustard, woolly vetch, field pennycress, sow-thistle, and grasses such as cheatgrass, smooth brome, and crested wheatgrass.

2.4 Rare and Endangered Plants

The British Columbia Conservation Data Centre (CDC) was queried for potential occurrences of rare plants within the Campus. The search distribution was refined using the following criteria: Regional District of Central Okanagan, Ponderosa pine Biogeoclimatic Zone, and agriculture (cultivated field), anthropogenic (urban/suburban/rural), forest (coniferous woodland), lakes (pond and open water), wetland (marsh) and alkali ponds/salt flats habitat types. The resulting list includes nine (9) rare vascular plant species (Table 2). None of the listed plants were observed during the site visits.

Table 2. Summary of rare plants with the potential to occur within the Campus.		
Common Name	**Scientific Name**	**Provincial Status[1]**
awned cyperus	*Cyperus squarrosus*	Blue
Englemann's spike-rush	*Eleocharis engelmannii*	Red
giant helleborine	*Epipactis gigantea*	Blue
hairy water-clover	*Marsilea vestita*	Red
many-headed sedge	*Carex sychnocephala*	Blue
northern linanthus	*Leptosiphon septentrionalis*	Blue
obscure cryptantha	*Cryptantha ambigua*	Blue
oniongrass	*Melica bulbosa*	Blue
ovate spike-rush	*Eleocharis ovata*	Red
red-rooted cyperus	*Cyperus erythrorhizos*	Red
slender hawksbeard	*Crepis atribarba ssp. atribarba*	Red
yellowseed false pimpernel	*Lindernia dubia var. dubia*	Red

1 Source: http://www.env.gov.bc.ca/cdc/
Blue: Special concern. **Red:** Endangered or threatened.

2.5 Wildlife

The following sections describe the wildlife observed during the site assessment of the Campus. Detailed surveys for wildlife were not conducted; therefore the species lists are not exhaustive and may not include all of the potential species that utilize the Campus habitats regularly or seasonally. As such, the lack of wildlife detections is not indicative of absence of the species. A list of observed wildlife species is provided in Appendix B.

2.5.1 Vertebrate Wildlife

The open water, alkaline ponds, old field, coniferous woodland, and rural communities provide suitable habitats for a variety of wildlife. Over 60 species of birds were observed throughout the Campus. Songbird species were typically associated with the woodland, wetland, cultivated field, and rural areas, while a number of ducks and shorebirds were observed in association with the open water communities. A complete list of bird species observed is included in Table 3. Species of management concern include those that have highly specific habitat requirements and are listed by the BC Conservation Data Centre, as described below. Within the Campus, several listed species were observed, including Great Blue Heron, Barn Swallow, and American Avocet.

Table 3. Summary of bird species and habitat associations observed within the Campus.					
Bird Group	**Common Name**	**Scientific Name**	**BC Status[1]**	**COSEWIC Listing[2]**	**Habitat Association**
Passerine	American crow	*Corvus brachyrhynchos*	-	-	All Types
	American goldfinch	*Carduelis tristis*	-	-	All Types
	American robin	*Turdus migratorius*	-	-	All Types
	barn swallow	*Hirundo rustica*	Blue	Threatened	Mixed Forest
	black-billed magpie	*Pica pica*	-	-	All Types
	black-capped chickadee	*Poecile atricapillus*	-	-	Mixed Forest
	Brewer's blackbird	*Euphagus cyanocephalus*	-	-	Mixed Forest
	brown-headed cowbird	*Molothrus ater*	-	-	All Types

	Bullock's oriole	*Ictercus bullockii*	-	-	Coniferous Forest
	Cassin's vireo	*Vireo cassinii*	-	-	Mixed Forest
	cedar waxwing	*Bombycilla cedrorum*	-	-	Mixed Forest
	chipping sparrow	*Spizella passerina*	-	-	Coniferous Forest
	clay-colored sparrow	*Spizella pallida*	-	-	Grassland
	common raven	*Corvus corax*	-	-	All Types
	European starling	*Sturnus vulgaris*	-	-	Rural/Urban
	evening grosbeak	*Coccothraustes vespertinus*	-	-	Forest/Shrubland
	house finch	*Carpodacus mexicanus*	-	-	Rural/Urban
	house sparrow	*Passer domesticus*	-	-	Rural/Urban
	house wren	*Troglodytes aedon*	-	-	Forest/Shrubland
	lazuli bunting	*Passerina amoena*	-	-	Forest/Shrubland
	northern flicker	*Colaptes auratus*	-	-	Mixed Forest
	northern rough-winged swallow	*Stelgidopteryx serripennis*	-	-	Mixed Forest
	pygmy nuthatch	*Sitta pygmaea*	-	-	Coniferous Forest
	red crossbill	*Loxia curvirostra*		-	Coniferous Forest
	red-winged blackbird	*Agelaius phoeniceus*	-	-	Wetland
	savannah sparrow	*Passerculus sandwichensis*	-	-	Grassland
	Say's phoebe	*Sayornis saya*	-	-	Forest/Shrubland
	song sparrow	*Melospiza melodia*	-	-	Riparian
	spotted towhee	*Pipilo maculatus*	-	-	Forest/Shrubland
	tree swallow	*Tachycineta bicolor*	-	-	Riparian
	vesper sparrow	*Pooecetes gramineus*	-	-	Shrubland/Grassland
	violet-green swallow	*Tachycineta thalassina*	-	-	Mixed Forest
	western bluebird	*Sialia mexicanus*	-	-	Forest/Shrubland
	western kingbird	*Tyrannus verticalis*	-	-	Forest/Shrubland
	western meadowlark	*Sturnella neglecta*	-	-	Grassland
	western tanager	*Piranga ludoviciana*	-	-	Coniferous Forest
	western wood-pewee	*Contopus sordidulus*	-	-	Coniferous Forest
	Wilson's warbler	*Wilsonia pusilla*	-	-	Riparian
	yellow warbler	*Dendroica petechial*	-	-	Riparian
	yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-	-	Wetland
	yellow-rumped warbler	*Dendroica coronata*	-	-	Mixed Forest
Non-passerine	California gull	*Larus californicus*	Blue	-	Rural/Urban
	California quail	*Callipepla californica*	-	-	Rural/Urban
	mourning dove	*Zenaida macroura*	-	-	Forest/Shrubland
	ring-billed gull	*Larus delawarensis*	-	-	Rural/Urban
	rock pigeon	*Columba livia*	-	-	Rural/Urban
Raptor	red-tailed hawk	*Buteo jamaicensis*	-	-	Mixed Forest
	turkey vulture	*Cathartes aura*	-	-	Mixed Forest
Ducks and Waders	American avocet	*Recurvirostra americana*	Blue	-	Shallow water
	American coot	*Fulica americana*	-	-	Open water
	blue-winged teal	*Anas discors*	-	-	Open water
	bufflehead	*Bucephala albeola*	-	-	Open water
	Canada goose	*Branta canadensis*	-	-	Shallow water
	cinnamon teal	*Anas cyanoptera*	-	-	Open water
	eared grebe	*Podiceps nigricollis*	-	-	Open water
	gadwall	*Anas strepera*	-	-	Open water
	great blue heron	*Ardea herodias*	Blue	-	Shallow water
	killdeer	*Charadrius vociferus*	-	-	Shoreline
	mallard	*Anas platyrhynchos*	-	-	Open water
	ruddy duck	*Oxyura jamaicensis*	-	-	Open water
	sora	*Porzana carolina*	-	-	Wetland
	spotted sandpiper	*Actitis macularia*	-	-	Shallow water
	Wilson's phalarope	*Phalaropus tricolor*	-	-	Shallow water

1 Source: http://www.env.gov.bc.ca/cdc/. 2 Source: http://www.cosewic.gc.ca/

Mammals observed include an adult coyote and three pups, along the woodland ridge immediately west of Robert Lake. Shortly after observing the pups, the den site was located, near a large mature ponderosa pine tree (pictured). Marmots and Columbia ground squirrels were frequently observed within the rural areas. An unknown vole was observed, which is presumed to be a meadow vole, as it was noted within a weedy area of the cultivated fields within the West Campus Lands. Signs of pocket gophers (i.e., push-up mounds) were also observed throughout the cultivated fields and rural areas. Other mammals expected to utilize the Campus include deer, raccoon, and a variety of small mammals, including squirrels, rodents, and bats.

Amphibian observations were limited to a single Great Basin spadefoot, within a rural area near the gravel pit. This is a significant discovery as this small toad has become an increasingly rare species within the region. Reptiles were not observed during the assessment; however, western painted turtle are known to inhabit the stormwater receiving wetland within the Okanagan Landscape precinct. Suitable basking and denning habitats for snakes were observed west of Robert Lake along the woodland ridge and the cultivated field, grassland, and open forest communities provide suitable hunting and foraging habitats.

2.5.2 Invertebrate Wildlife

Invertebrate wildlife of the central Okanagan is abundant, diverse, and generally poorly understood, particularly at risk species (Heron 2004). To identify and describe each individual species with the potential to occur within the Campus would be an enormous undertaking and is not within the scope of this report. Instead, provincially and federally listed species that are of management concern with the potential to occur within the Campus were identified and are listed in Appendix B. Other common species or species of management concern (e.g., forest pests, parasites) are described as they pertain to Campus management.

The moist environments associated with the shallow open water wetlands and alkaline ponds provide habitats for a diverse range of invertebrates. Terrestrial invertebrates such as insects (e.g., ants, beetles) and spiders were observed, as well as flying insects such as mosquitoes, flies, and moths. Dragonflies were also observed in association with the aquatic habitats within the Campus. These invertebrate groups represent some of the most rare and sensitive species within the Okanagan (Cannings and Cannings 1995).

Butterflies observed include swallowtails and various sulphurs and blues. Rare butterflies such as common sootywing and monarch may occur within the central Okanagan and are typically associated with ecosystems that include host plants (caterpillar food) or provide nectar sources such as milkweed, buckwheat, and yarrow, which were observed within the Campus.

Mountain pine beetle and western pine beetle have had major impacts on ponderosa pine communities throughout the Okanagan. Mountain pine beetle epidemics are well-documented throughout BC and the effects have been considerable on wildlife habitat (Chan-McLeod 2006). Signs of beetle activity were not observed during the site assessment; however, the open stands of pine within the Pine Forest precinct may be susceptible to outbreaks in the future which may pose increased risk of windthrow and wildfire. It was noted that pheromone packets had been affixed to mature pine trees throughout the Campus to deter pine beetle attacks.

2.6 Species at Risk

Species at risk are identified in the context of provincial and national ranking systems. The provincial ranking system applies to species that have been assessed by the BC Conservation Data Centre (CDC). The national ranking system applies to species that have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The British Columbia Conservation Data Centre (CDC) was queried for potential occurrences of at risk wildlife with the potential to occur within the Campus (Table 3). The search distribution was refined using the following criteria: Okanagan Ministry of Environment Region, Regional District of Central Okanagan, Ponderosa pine Biogeoclimatic Zone, and agriculture (cultivated field), anthropogenic (urban/suburban/rural), forest (coniferous-dry/mesic), lakes (pond/open water), wetland (marsh) and alkali ponds/salt flats habitat types.

The Campus contains a matrix of coniferous woodland, cultivated field, urban/rural areas and wetlands. Great Basin spadefoot toad tadpoles were documented within a detention ditch designed to collect runoff from a Campus parking lot. An adult toad was also observed using a moist basin upslope of the gravel pit. Western painted turtles have previously been documented within the detention pond, although none were observed during the May 27th site visit. Snags surrounding the detention pond provide suitable nesting, roosting, and foraging habitat for primary cavity nesting species such as the provincially Red-listed Lewis's woodpecker (Fenger et al. 2006). The open coniferous woodland and cultivated field provide feeding habitat for reptiles and birds

such as the Great Basin gopher snake and the Swainson's Hawk. Wetland and aquatic communities provide breeding habitat for American Avocet and feeding habitat for birds such as the Barn Swallow. Other sensitive species that may occur within the Campus are summarized in Table 4.

Table 4. Summary of species at risk with the potential to occur within the Campus.

Species Group	Common Name	Scientific Name	Provincial Status[1]	COSEWIC Listing[2]
Amphibian	Great Basin spadefoot*	*Spea intermontana*	Blue	Threatened
	western toad	*Anaxyrus boreas*	Blue	Special Concern
Bird	Barn Swallow*	*Hirundo rustica*	Blue	Threatened
	Western Screech-Owl	*Megascops kennicottii macfarlanei*	Red	Threatened
	Rusty Blackbird	*Euphagus carolinus*	Blue	Special Concern
	American Avocet*	*Recurvirostra americana*	Blue	-
	American Bittern	*Botaurus lentiginosus*	Blue	-
	California Gull*	*Larus californicus*	Blue	-
	Common Nighthawk	*Chordeiles minor*	Yellow	Threatened
	Flammulated Owl	*Otus flammeolus*	Blue	Special Concern
	Great Blue Heron*	*Ardea herodias*	Blue	-
	Lark Sparrow	*Chondestes grammacus*	Red	-
	Lewis's Woodpecker	*Melanerpes lewis*	Red	Threatened
	Olive-sided Flycatcher	*Contopus cooperi*	Blue	Threatened
	Short-eared Owl	*Asio flammeus*	Blue	Special Concern
	Swainson's Hawk	*Buteo swainsoni*	Red	-
Invertebrate	abbreviate pondsnail	*Stagnicola apicina*	Blue	-
	dark saltflat tiger beetle	*Cicindela parowana*	Red	Endangered
	lilac bordered copper	*Lycaena nivalis*	Blue	
	black gloss	*Zonitoides nitidus*	Blue	-
	common sootywing	*Pholisora catullus*	Blue	-
	lance-tipped darner	*Aeshna constricta*	Red	-
	monarch	*Danaus plexippus*	Blue	Special Concern
	Nevada skipper	*Hesperia nevada*	Blue	-
	pale jumping-slug	*Hemphillia camelus*	Blue	-
	silky vallonia	*Vallonia cyclophorella*	Blue	-
	twelve-spotted skimmer	*Libellula pulchella*	Blue	-
	umbilicate sprite	*Promenetus umbilicatellus*	Blue	-
Mammal	American badger	*Taxidea taxus*	Red	Endangered
	fringed myotis	*Myotis thysanodes*	Blue	Data Deficient
	Merriam's shrew	*Sorex merriami*	Red	-
	Preble's shrew	*Sorex preblei*	Red	-
	spotted bat	*Euderma maculatum*	Blue	Special Concern
	Townsend's big-eared bat	*Corynorhinus townsendii*	Blue	-
	western harvest mouse	*Reithrodontomys megalotis*	Blue	Special Concern
	western small-footed myotis	*Myotis ciliolabrum*	Blue	-
Reptile	gopher snake	*Pituophis catenifer deserticola*	Blue	Threatened
	western painted turtle*	*Chrysemys picta*	Blue	Special Concern
	western rattlesnake	*Crotalus oreganus*	Blue	Threatened
	western skink	*Plestiodon skiltonianus*	Blue	Special Concern
	western yellow-bellied racer	*Coluber constrictor mormon*	Blue	Special Concern

1 Source: http://www.env.gov.bc.ca/cdc/
Yellow: Not considered at risk. **Blue:** Of special concern. **Red:** Endangered or threatened.
2 Source: http://www.cosewic.gc.ca/
Threatened: A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not at Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Endangered: A wildlife species facing imminent extirpation or extinction.
Data Deficient : A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.
***observed, or are known to occur within the Campus**

2.7 Aquatic Resources

Wetland Inventory and Mapping (WIM) data is available for the two open water communities that occur within the cultivated field on the west side of the Campus. The retention basin was documented from airphoto interpretation, but access was not permitted at the time of the assessment (Hawes and Schleppe 2009).

Robert Lake (Watershed Code: 310-808200-13900-99100) is identified by the Kelowna WIM project (D1-4) and is described as a transitional saline meadow. Little Robert Lake and the associated wetland complex are classified as shallow open water basin (Wa), with associated tall rush and low rush marshes (Wm06 and Wm07) that occur within the outer wetland margins and transition to alkali saltgrass (Gs01) and Nuttall's alkaligrass – foxtail barley (Gs02) saline meadow site associations. The lake and wetlands are surrounded by various agricultural and rural residential properties and the new landfill access road occurs within 300 m of the northern end of the lake.

Robert Lake and Little Robert Lake have been formed by water draining into the basin from surrounding environments during winter thaw and spring freshet. There is no defined inlet channel, although there is evidence that water may be conveyed from Little Robert Lake to Robert Lake during periods of high water. There is no defined outlet channel and water tends to evaporate from the lakes over the dry summer months rather than drain away. As such, the various salts conveyed into the lake basin (e.g., calcium carbonates, sodium, magnesium, etc.) are left to accumulate and form a crust upon the exposed surface of the lake bottom as water levels decrease. This creates the alkaline environment that gives rise to the highly specialized plant communities that are able to tolerate these conditions. There are no known fish occurrences within the lake, likely due to the high salinity content and alkaline nature of the lake.

The riparian communities surrounding the lake are comprised of herbaceous vegetation that is well-adapted to the alkaline nature of the lake and associated wetland communities. Herbs are mainly comprised of grasses such as foxtail barley, Nuttall's alkaligrass, and alkali saltgrass. Patches of bulrush, cattail, and sedges occur along the

lake shoreline and in wet pockets. Patches of exposed alkaline crust also occur close to shore where water levels have receded. Unknown green algae occurs along the wetted perimeter of the lake. Weeds are prevalent within the cultivated field communities surrounding the lakes and there is evidence of mowing up to within less than 5 m of the wetted level.

The stormwater-receiving wetland within the Okanagan Landscape precinct includes cattail marsh and shallow open water components. Stormwater is discharged to a basin that allows sediment to settle out of the water prior to discharging to the larger wetland complex. An unnamed ephemeral pool occurs approximately 30 m northwest of the stormwater retention basin (pictured). Based on a review of historical imagery, this appears to be an ephemeral waterbody that developed sometime after the construction of the stormwater retention basin (GoogleEarth, 2012 Imagery). The pool appears to dry up over the summer months and there is evidence that is becomes covered with weedy vegetation and is mowed during Campus maintenance (GoogleEarth, 2014 Imagery). There are no known fish occurrences within either of the open water features.

3.0 ENVIRONMENTAL SENSITIVITY ANALYSIS

Environmentally Sensitive Areas (ESA) were classified based on ecosystem characteristics and wildlife habitat suitability to rank each delineated polygon within the Campus. Professional judgment was used to evaluate ecosystem polygons based on criteria including: provincial CDC status (i.e., Red or Blue listed), rare and endangered species occurrence potential, landscape condition (i.e., connectivity, fragmentation), successional status, regional rarity, and relative biodiversity. Each polygon was assigned a value rating based on the above criteria, which reflect the relative habitat condition (i.e., higher scores represent higher value). Ecosystem polygons were ranked using the environmental sensitivity classes described below:

- Very High: These areas represent extremely high ecological value and typically contain rare or critical habitat areas for sensitive or at risk species, undisturbed or pristine ecosystems and habitats, and biodiversity hotspots (e.g., wetlands, old growth forest). They substantially contribute to the regional habitat function and connectivity and are highest priority for conservation.

- High: These areas contribute to the regional biodiversity and connectivity of the surrounding landscape but lack critical habitats for at risk species (e.g., riparian areas, mature forest). Development should generally avoid these areas to conserve the important features or to allow potential progression to the Very High category (e.g., mature forest becoming old growth). Encroachment into these areas should be compensated for by restoration in other areas to work towards achieving a no net loss of High value habitats.

- Moderate: Ecosystems of moderate significance represent disturbed habitats or fragmented features with the potential to return to High value through natural succession (e.g., young or fragmented forest, degraded habitats). Moderate areas contribute to the diversity of the landscape; however their condition and adjacency may limit significant function. These areas will benefit from restoration and enhancement activities which will facilitate succession to higher value habitats.

- Low: These areas contribute little to no value with regard to habitat diversity and have limited potential for supporting significant wildlife (e.g., heavily impacted or disturbed sites). Development is typically focused on these areas based on their limited contribution to regional biodiversity and limited capacity to return to high value through natural succession. These areas may be restored through intensive remediation and management practices.

The ESA composition of the Campus is summarized in Table 5 and depicted on Map 3.

Table 5. Percent composition of ESAs within the Campus.

ESA Value	ESA Area (m^2)	Percentage of Campus (%)
Very High (ESA 1)	149836.10	7.4
High (ESA 2)	362577.70	17.9
Moderate (ESA 3)	949445.55	47.0
Low (ESA 4)	558805.60	27.7
Total	2020664.95	100%

Environmental sensitivity analysis indicates that approximately 25% of the Campus has a Very High and High sensitivity. The alkali lake, open water and cattail marsh communities are classified as having Very High value and represent approximately 7.4% of the Campus. The woodland communities are generally classified as High value (17.9%), while cultivated field and rural areas are considered to have Moderate sensitivity (47%) and urban/suburban and gravel pit areas are Low value.

4.0 PRECINCT ASSESSMENT

The UBCO Master Plan Update (2009) outlines the role and character of seven precincts. Here, we discuss the environmental sensitivity of each precinct and include recommendations for future management.

4.1 The Core

The Core precinct is the compact heart of the Campus centered on University Way. It has the highest density of buildings and has retained little ecological function. The land surrounding the buildings consists of either hardscape or is landscaped with horticultural species including turf lawn. Wildlife activity within this area is largely limited to common avian species that are tolerant to human presence such as House Sparrow, American Robin or Black-billed Magpie. The entire Core precinct is rated as having low environmental sensitivity (i.e., ESA 4). The following recommendations pertain to the Core area:

- Where possible include drought tolerant native plants within landscaped areas, and limit the amount of turf lawn. Appropriate native species include Saskatoon, common snowberry, tall-Oregon grape, and native rose species such as prickly rose and prairie rose.
- Artificial turf could be substituted for lawn in areas where students congregate or recreational activities require a turf-like surface.
- Plant additional drought-tolerant trees to enhance areas of shade, wind and sound barriers, and to provide additional habitat for birds.
- Control the spread of invasive plants by targeting specific plant species and removing them either by hand pulling or mowing prior to seeding.
- The core area is suitable for future development and should be in-filled where possible.

4.2 The Commons

The Commons consists of a large open lawn lined with buildings, except on the east side where panoramic views of the valley are featured. It provides a soft landscape as opposed to the hardscape nature of the courtyards within the Core precinct. The turfed open lawn, although better than hardscape, is a homogenous feature that provides little support for wildlife. Ninety-four (94) percent of the commons is rated as having low environmental value and six percent as having moderate

environmental value. The slope of coniferous woodland that occurs east of the Commons is the moderate sensitivity area (Map 2; polygon 45). This forested polygon was degraded from a High environmental sensitivity to a Moderate sensitivity due to its isolated nature, with a disturbed slope and parking lot to the east and a road and the large open lawn to the west. It is also experiencing encroachment by invasive plant species. Weedy plants are particularly prevalent along the edge of roads/parking lots and within the disturbed slope to the east. Weeds appear to be out-competing native bunchgrasses and herbs along the edges of polygon 45. The following recommendations pertain to the Commons:

- Works should be undertaken to limit the spread of invasive plants. The disturbed slope that is located between the lower parking lot and polygon 45 should be hydroseeded with native grass seed mix at a rate of 40 kg/ha (35 lbs/acre). Seeding should occur in late spring and again in late summer/early fall (September), in combination with fertilization. A sample grass seed mix is provided below (Table 6). Seeding may be required over several growing seasons to obtain adequate coverage and reduce competition by invasive plant species.

Table 6. Recommended native grass seed mix for disturbed upland areas

Common Name	Scientific Name	Seed Weight
Bluebunch wheatgrass	*Pseudoroegneria spicata*	40%
Rough fescue	*Festuca campestris*	25%
Idaho fescue	*Festuca idahoensis*	15%
Perennial ryegrass	*Lolium perenne*	10%
Sandberg bluegrass	*Poa secunda*	5%
Junegrass	*Koeleria macrantha*	4%
Canada bluegrass	*Poa compressa*	1%
	Total	100%

- Creation of planting pockets of native shrubs and trees throughout the slope should occur. Plants should be concentrated in multiple planting pockets rather than evenly spaced across the slope, so as to make avoidance with invasive species control more manageable. Ponderosa pine and native shrub species are proposed for the area. Spacing of shrubs should be 1 to 1.5 m on centre, with trees spaced 3 m on centre.
- Perform rough cutting monthly during the first growing season. Cut grass/invasive species to a height of 500 mm, taking care not to damage planted trees and shrubs.

- Cluster planting of trees and shrubs in dense pockets and designated areas will help prevent plant mortality due to invasive species control. Flagging of native plants will also help, although flagging must not be tied around the main stem such that girdling of the plant will occur as it grows.
- Seed and plant material should be sourced from within the southern interior to avoid complications associated with transplanting coastal species or northern species into dry southern interior conditions.
- Wood fibre or mulch used around plants will increase moisture retention.
- Placement of coarse woody debris should occur sporadically across the slopes. This will help with erosion control, and will create habitat and microsites for planting.
- If plant mortality due to deer browse occurs, the area may need to be fenced or plastic tree cones may be required.

4.3 Health, Wellness and Recreation

The Health, Wellness and Recreation precinct has indoor and outdoor recreation facilities. The outdoor features consist of a sports playing field constructed of artificial turf and volleyball courts. A pocket of coniferous woodland (see Map 2; polygon 34) occurs within this precinct. It is rated as having High environmental sensitivity compared to the Low rating for the rest of the precinct. This wooded area is bound by John Hindle Drive to the south and the main campus on its remaining sides.

The polygon is classified as Ponderosa pine - Bluebunch wheatgrass - Idaho fescue (PW) which is a blue listed ecosystem (Of special concern) within the PPxh1 variant. The coniferous woodland extends beyond the Campus boundary to the southwest, and provides a corridor for wildlife moving to and from Robert Lake. Woodland pockets such as polygon 34, act as important stepping stones for wildlife movement within a highly fragmented landscape such as this one. There are several well-defined trails that extend through the polygon from the developed portion of campus towards John Hindle Drive. Invasive species are encroaching into this polygon from non-landscaped, disturbed areas that occur behind buildings and adjacent to parking areas. Polygon 34 may also be affected by the future road that will provide connection between Glenmore Road and Highway 97, although Ecoscape understands that its exact alignment has yet to be determined. The following recommendations pertain to the Health, Wellness and Recreation precinct:

- It is expected that the use of polygon 34 will increase once housing options within University Heights are more available. Already, students appear to be parking on John Hindle Drive and Academy Way, and walking through polygon 34 to campus. The use of multiple walking routes through this polygon will degrade its natural condition with further edge effects and invasive species encroachment. Split rail fencing and signage should be used to encourage the use of one main trail through the polygon. The placement of large woody debris across unsanctioned trails is also a helpful tool to discourage use.
- Non-landscaped, perimeter areas that occur behind buildings and adjacent to roads and parking lots should be brush cut regularly to prevent the spread of invasive plants.
- If possible the future road alignment between Glenmore Road and Highway 97 should avoid the coniferous woodland that has High environmental sensitivity (polygons that could be affected include #25, 27, 28 and 35). The preferred route would extend across the cultivated field from the landfill entrance and curve to the south, staying within the edge of the cultivated field, leaving a natural woodland buffer between the road and the Campus. Despite the addition of this road, if carefully placed, the buffered area could continue to function as a movement corridor for wildlife.

4.4 Okanagan Landscape

This precinct occurs between the Core and Highway 97 and consists of the recently constructed engineering building, parking lots, patches of coniferous woodland, disturbed rural areas, a stormwater receiving wetland and an ephemeral pond. The 2009 Masterplan update indicates that additional buildings may be sited within this precinct. The Okanagan Landscape contains all classes of environmental sensitivity. The stormwater receiving wetland is classified as Very High, the coniferous woodland polygon that surrounds the stormwater receiving wetland and the ephemeral pond as High, the disturbed rural areas and isolated pockets of woodland as Moderate, and the hardscape parking lots and buildings as Low.

The rural area that occurs between Hollywood Road North and the Engineering building (aka the 'grassland') is highlighted in the 2009 Masterplan Update as a landscape that is iconic to the Okanagan (pictured). In reality, this area has little to no native vegetation remaining and is comprised almost

entirely of weeds, some of which are known to be highly invasive or deemed noxious by regional and municipal pest management legislation.

Other areas of note within this precinct are the detention ditch that occurs at the north end of the lower parking lot at the interface between the Okanagan Landscape and University Reserve Land precincts. Despite its basic design as a ditch to collect runoff from the parking lot, it is currently providing open water habitat for Blue-listed Great Basin spadefoot tadpoles.

There are also isolated pockets of coniferous woodland that occur within the Okanagan Landscape precinct. These natural areas likely function as steeping stones for wildlife movement and provide cover during resting and feeding periods. These pockets include the narrow band of coniferous woodland that surrounds the stormwater receiving wetland, as well as small wooded areas along University Way. Map 3 highlights the probable movement corridors for wildlife and highlights the importance of these remaining pockets of woodland. The following recommendations pertain to the Okanagan Landscape precinct:

- Given the extent of weedy species that occur within the non-forested area between the Engineering building and Hollywood Road North, it would be very difficult to successfully restore it to a native grassland community. Alternatively, to enhance the environmental values of this area, the existing wetland complex could be expanded toward Hollywood Road North to include additional open water features with cattail and bulrush components. The focal wetland complex could then be interspersed with a native plant garden that would feature varieties of drought tolerant, native plants and the use of xeriscaping techniques. If this work is undertaken, a number of points should be considered to maximize the benefit for Species At Risk:
    - The necessary habitats to support the life history requirements of the blue-listed painted turtle should be included within the design. Because painted turtles are known to disperse between wetlands, it would be most advantageous to include all necessary habitats within the wetland complex. This may help to encourage movement within the complex, rather than across bordering roads where road mortality will occur.
    - Additional research on the existing painted turtle population on campus is warranted before undertaking the wetland expansion. Ecoscape did not document the painted turtle during our site visit, but understand that they have been previously documented as using the stormwater receiving wetland. Topics that could be addressed through additional research include population size, availability and location of nesting habitat, dispersal routes, etc. Evelyn Jensen, a PhD student at UBC Okanagan recently completed her Master's thesis on painted turtles and she would

likely be an excellent resource, as would Bob Lalonde, Associate Professor in the Unit of Biology.
https://people.ok.ubc.ca/mirussel/ejensen/ejensen.html
https://people.ok.ubc.ca/blalonde/Bobspage.html
Other resources include:
http://publications.gc.ca/collections/Collection/CW69-14-505-2006E.pdf

- The expanded wetland complex should also include optimal habitat (e.g. ephemeral basins) for the Blue-listed Great Basin spadefoot. This species was documented at the northern end of the Okanagan Landscape precinct and also within the Hilltown precinct.
- Additional structures that could be included within the expanded wetland complex to benefit wildlife are bird and bat boxes, artificial snags for perching and cavity nesting, and course woody debris to enhance basking habitat.
- The following websites provide additional information that may be useful in planning the wetland expansion / native garden complex.
  http://water.epa.gov/type/wetlands/restore/upload/constructed-wetlands-handbook.pdf
  http://www.summerlandornamentalgardens.org/index.htm
  http://okanaganxeriscape.org/
  http://www.naturescapebc.ca/
  http://www.osca.org/okanagan/eco/nature/159-At%2BHome
  http://www.okwaterwise.ca/waterwise-in-the-yard.html

- In the interim, the weedy species that occur within the non-forested portion of the Okanagan Landscape precinct should be controlled to prevent seed dispersal and further expansion of invasive plants. Given the size of the area, the use of a riding mower is likely the most efficient means of controlling the weeds. The grounds should be mowed regularly during the summer months since the target species flower/seed at varying times.
- It would also be useful if the maintenance crew is generally aware of and can identify invasive plants that should be targeted, as well as can differentiate between native and introduced species. The following websites provide additional information on invasive plant species of British Columbia.
  http://www.bcinvasives.ca/
  http://www.weedsbc.ca/
  http://www.agf.gov.bc.ca/cropprot/weeds.htm
- The City of Kelowna has a Noxious Weed and Grass Control Bylaw (#8133) that identifies twenty-six weeds as noxious. These species are priority for control.
  http://www.kelowna.ca/CityPage/Docs/PDFs/Bylaws/Noxious%20Weed%20and%20Grass%20Control%20Bylaw%20No.%208133.pdf
- The pockets of coniferous woodland that occur within the Okanagan Landscape precinct have an understory that is comprised of both native and weedy species. Within these areas, it is important to target weedy plants for removal and not

mow the entire understory. The weedy species should be hand pulled regularly during the growing season. This will prevent further degradation of these important woodland pockets.

4.5 Hilltown

The Hilltown precinct includes the Weather Office building, existing and future residences, the Campus daycare, and parking lots. Sixty-eight (68) percent of the precinct is rated as having Low environmental sensitivity and 28% as having Moderate environmental sensitivity. Areas immediately adjacent to the residences are manicured with lawn and horticultural species. Natural areas within this precinct do exist and typically contain a native plant understory with encroachment by weedy species. An example of this type of community is a narrow band of coniferous woodland located between the Campus daycare and the student residences to the north. There are also areas within the Hilltown precinct that have been previously cleared but remain vacant. Examples include disturbed sites south of Weather Office building and areas north of the existing residences at the north end of the Common. These disturbed areas harbor vegetation that is almost predominately weedy. A single adult Great Basin spadefoot was discovered in a recently dried ephemeral pool within the disturbed site north of the residences. The following recommendations pertain to the Hilltown precinct:

- Weedy species that are encroaching into natural woodland habitats should be individually targeted and hand pulled.
- Disturbed areas that consist almost entirely of weeds should be regularly mowed to prevent further expansion of these species.

Spadefoot Habitat Enhancement

Opportunities exist to enhance or create suitable spadefoot habitat to help with the recovery strategy for this at risk species (BC Southern Interior Reptile and Amphibian Recovery Team 2008). Spadefoot are known to breed within temporary waterbodies, including man-made features such as ditches. The stormwater detention ditch that occurs between the lower parking lot and gravel pit provides suitable breeding habitat and the disturbed soils and cutbanks in the vicinity of the ditch likely provide suitable terrestrial habitats for burrowing and estivation (summer dormancy). Rodent burrows from ground squirrels, voles and marmots were also observed near the ditch, and may provide suitable refuge. The nearby rural areas and coniferous woodland provide suitable semi-arid foraging and overwintering habitats as well.

It is unknown if the detention ditch represents a population source or sink, as the waters may dry out prior to metamorphoses of the tadpoles and reduce the recruitment of adult toads. However, given the potential for securing suitable habitats for this endangered species, consideration should be given to expanding, enhancing, and/or constructing

habitats to improve recruitment and survivability of the local population. Some opportunities may include:

- Expansion and enhancement of the existing detention ditch.
    - Widening or deepening the ditch to create a larger potential breeding area and extend the period of water retention;
    - The inclusion of wetland vegetation (e.g. cattails) along the parking lot edge to sequester pollutants from the stormwater runoff and to ultimately improve the water quality of the ditch.
    - Planting of native tree species at optimal locations adjacent to the ditch to provide shade and reduce evaporation.
    - Seeding the banks with suitable native riparian grasses or other vegetation to reduce erosion and maintain stability;
    - Restricting the timing of ditch maintenance, such as grubbing or dredging, to reduce potential for destroying subterranean individuals.
- Expansion and/or enhancement of the ephemeral pool where the adult spadefoot was documented.
    - The basin may be expanded or deepened to allow a longer period of water retention and a greater overall area;
    - Planting of adjacent riparian vegetation and upland vegetation to provide cover;
    - The basin area may be protected and buffered to restrict future development or other human activity (e.g., waste disposal, off road vehicle use, etc.).
- Construct new ephemeral basins
    - During planning of future development in this area, ephemeral wetland features may be constructed to provide suitable habitats for spadefoots and other sensitive wildlife species;
    - Constructed basins may be connected to future stormwater systems to allow detention of surface flows rather than conveying them via culvert directly to downstream aquatic environments.

Other general recommendations to help enhance the spadefoot habitat include:

- Maintain connectivity between the detention ditch, the ephemeral pool, and adjacent woodland habitats to allow migration of adults.
- Consider translocation of adults from unsuitable or marginal areas to constructed or enhanced habitats.
- Monitor population trends and migration patterns of spadefoots to determine or estimate population size, survivability, distribution, mortality rates and causes, etc.

4.6 Pine Forest

The Pine Forest precinct is characterized by young ponderosa pine woodland that has been fragmented by human activities including road and trail building, recreational use,

and adjacent development (i.e., gravel pit, golf course, and cultivated fields). To maintain the remnant ecological value and availability as a movement corridor and habitat refuge, the following recommendations are provided:

- Maintain connectivity with adjacent natural lands to the north and south. Currently, there is a relatively intact movement corridor for wildlife through the Campus that connects with forested lands adjacent to the golf course and the Quail Ridge subdivision to the north, along the Quail Ridge Linear Park. These corridors are shown on Map 3. As this precinct represents the last large, contiguous patch of woodland within the Campus, future development in this area is not recommended.
- A Wildland Fire Management Plan was completed for the Campus in 2006. The plan includes recommendations for wildfire mitigation activities, including thinning and brushing to reduce forest fuels and reduce risk of large, stand-replacing fires. As a result of years of fire suppression, insect outbreaks, and forest fuel accumulation, the Pine Forest precinct appears to be at increased risk of wildfire. The 2006 plan should be reviewed and, if necessary, additional treatments should be conducted by low impact methods (e.g., by hand or using rubber-tracked equipment and conducted over the winter) and using existing roads and trails. Mature or veteran trees, snags, and large woody debris should be retained as habitat features (Scott et al. 1977).
- Noxious and invasive weed species were noted throughout this precinct, especially along roads, trails, and other cleared areas. A management plan for the control of these weeds should be completed and efforts undertaken to remove or reduce the amount of weed cover. This may also include restoration planting or seeding efforts to promote natural regeneration along the forest edges.
- Restrict future recreational activity in the area, including reducing the amount of unsanctioned trail building. If recreational use is deemed suitable for the area, the official trails should be improved and users should be encouraged to use them rather than creating a larger network of trails.
- Restrict overnight camping and fires. This concern is focused on a specific area of the Pine Forest precinct where there is evidence of clearing, trail building, overnight use, and campfires. The university has indicated awareness of the unsanctioned use and the difficulties associated with enforcement. The fire building greatly increases the risk for wildfire and potential impacts to the safety of Campus residents and infrastructure.

4.7 University Reserve Lands

The University Reserve Lands precinct is currently characterized by the gravel pit use and associated effects, including exposed soils, cutbanks, roadways, vehicles, equipment, and a prevalence of noxious weeds. The environmental sensitivity of the entire University

Reserve Lands precinct is rated as Low. This area is considered suitable for future intensive development, given certain considerations for effects on other adjacent habitats and existing wildlife species, including the blue-listed Great Basin spadefoot. Some general recommendations for this area include:

- Maintain connectivity with the adjacent Pine Forest and identified 'stepping stone' migration refuges, as indicated on Map 3.
- Maintain or create vegetated or naturalized buffers between future development and adjacent precincts.
- Develop a long-term weed management plan and steps towards controlling the current population and seed bank of noxious weeds, including tumble-mustard, hoary cress, and knapweed.

Invasive Plant Management

The widespread establishment of non-native and invasive plants throughout this precinct suggests the need to control the spread and expansion through a variety of methods, including routine mowing, re-seeding, and/or landscaping.

- Mowing should be conducted as required during the growing season prior to the weeds going to seed. This method may require mowing several times a year as different weeds go to seed or as weeds re-grow following prior mowing and go to seed multiple times.
- Re-seeding or landscaping is a more cost and labour intensive method but will provide a longer term solution to controlling weed populations. If this method is used, a layer of soil should be stripped prior to seeding or planting to remove the seed bank present. Following this, screened topsoil should be placed and then seeded or landscaped and covered with mulch.
- Grass seed and/or native plantings, if used, should be of native stock and suitable for the growing conditions (e.g., slope, aspect, moisture availability, etc.). Grass seed used within the Campus should be Certified Agricultural Grade 1 and should be a mix of native species with fast-establishing, non-invasive species, such as annual rye grass.
- Both of these methods will require maintenance and monitoring to identify new infestations of weeds and to address the establishment and encroachment.

Areas that have been identified as having erosion concerns or potential (e.g., cutbanks, ditches, roads) should be restored with seeding or erosion control matting. Coconut-fibre blankets can be used in conjunction with grass seeding or planting to maintain bank stability and prevent the establishment of invasive species. Prevention of erosion will also protect the riparian and aquatic ecosystem from the introduction of sediments which may negatively affect water quality.

Stormwater Management

As the Reserve Lands are built out, it is anticipated that impermeable surfaces will expand in area and result in greater stormwater runoff from roofs, roads, sidewalks, and other paved areas. The runoff should be directed to ground as much as possible and used to enhance or create aquatic habitats for species identified during the assessment. Development planning in this area should incorporate integrated stormwater management practices, wherever possible. Some considerations may include:

- Incorporate integrated stormwater management designs, including landscaping that promotes infiltration of stormwater flows and directing flows towards detention or retention basins.
- Reduce the potential for flooding during major storm events.
- Reduce the potential to convey pollutants to aquatic habitats and downstream environments (e.g., Mill Creek).
- Utilize stormwater runoff to enhance or create aquatic environments onsite, such as detention basins that act as vernal ephemeral pools or shallow open water wetlands with cattail marsh communities (as with the stormwater-receiving wetland within the Okanagan Landscape precinct).
- Use the guidelines and principles of provincial best management practices such as:
    - http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/guidebook/pdfs/stormwater.pdf
    - http://www.waterbucket.ca/rm/sites/wbcrm/documents/media/56.pdf
    - http://www.obwb.ca/fileadmin/docs/rain_to_resource/Rain_to_Resource_2010_Report.pdf
    - http://www.obwb.ca/obwrid/docs/24_2001_Water_Management_South_Okanagan.pdf
    - http://www.obwb.ca/fileadmin/docs/rain_to_resource/2010_10_29_technical_4_ehren_lee_don_dobson_stormwater_and_watershed_vulnerability.pdf.

5.0 CLIMATE CHANGE IMPLICATIONS

The Preliminary Climate Adaptation Scoping and Potential Implications for UBC Okanagan Campus Planning document provides an overview of the expected climate change impacts to the central Okanagan region over the next 50 years, as well as possible considerations for the UBC Okanagan campus (Bilodeau 2014). Compass Resource Management Ltd. (2007) addresses climate change impacts on biodiversity management in British Columbia. Ecoscape has kept potential climate change impacts in mind when preparing this document. In many cases, our recommendations to improve environmental values go hand in hand with climate change considerations. For example, climate change is expected to result in periods of intense rain followed by hotter, drier summers. This

suggests that the existing drainage infrastructure and the stormwater receiving wetland on campus may not have the necessary capacity once climate change effects are realized.

One of our core recommendations is to expand the existing wetland complex east towards Hollywood Road North, and to surround it with a native species garden comprised of drought tolerant plants. The additional wetland development within this area will enhance stormwater retention capacity, benefit wildlife and species at risk, and will act as a focal feature for enjoyment by campus faculty, staff, and students. Further, the native plant garden can be used to highlight Okanagan ecosystems of interest, such as native wildflowers and grasslands, which are under threat due to expanding development. In addition, recommendations such as the replacement of existing horticultural plants with native varieties, and making a switch from lawn to artificial turf will further reduce water consumption. The planting of trees in hardscape areas (i.e., along sidewalks, within parking lots, and other paved areas) will increase shade and cool temperatures naturally. Currently the Campus has a fairly significant establishment of weeds and invasive plants. Tackling the weed problem now is important, as the situation will likely worsen with increasing summer temperatures and will allow the invasive species to further out-complete native species (Scott and Suffling 2000).

The addition of trees and other vegetation will also promote carbon uptake and release oxygen to the atmosphere while providing local level benefits such as wind and sound barriers. Currently, the Campus is exposed to the effects of wind which, when coupled with extensive exposed soils and large amounts of pollen from weedy species, can lead to airborne dust and allergens which have detrimental effects on air quality and human health. The planting of fast-growing native vegetation will reduce the need for intensive maintenance or watering while still providing the benefits described above and mitigating the potentially harmful effects of climate change at the local level.

Climate change is anticipated to have an effect on coniferous woodland ecosystems which occur in pockets throughout the Campus. The woodland within the Pine Forest precinct represents the Campus's least disturbed natural ecosystem and is a valuable refuge for wildlife within a highly fragmented landscape. Other isolated pockets of coniferous forest provide refuge for wildlife and act as stepping stones for movement and migration. With projected longer, hotter summers and extended periods of drought, wildfire risk to these forest ecosystems will increase and will have to be managed accordingly, through prescribed burning or other measures that mimic fire such as mechanical thinning and brushing. Maintenance of a healthy woodland community will also help prevent infestations of pine beetle and other forest pests and diseases. Seasonal restrictions of unsanctioned campfires will also be important to ensure that this resource is preserved over the long term.

The Central Okanagan is a water-deficient area due to low precipitation and high rates of evaporation. Seasonal and long-term variability of precipitation affects available surface

and groundwater. Clarke et al. (2012) provides a thorough review of both the surface and groundwater resource within the Central Okanagan. In short, surface and groundwater and interconnected, so water extraction at one location can affect the water resource in another location. Surface water is thought to be the most susceptible; with water quantities potentially affected by natural processes such as climate change, drought, forest fire and mountain pine beetle, as well as anthropogenic activities including forest development, urbanization and consumption (Clarke et al. 2012).

The availability of groundwater is dependent on factors such as geology, recharge to the subsurface, direction of flow, seasonal variability in climate, and others. The groundwater aquifer near the Campus is a bedrock aquifer that is 116 hectares; is undeveloped and has low yield potential (Quail Ridge / University aquifer (253 F)) (Clarke et al. 2012). Groundwater development will likely increase as surface water availability becomes more limited, but the sustainability of groundwater withdrawal is dependent on the withdraw volumes not exceeding the natural recharge to the source aquifer (Alley et al. 1999).

Water availability and demand models for the Okanagan point towards increased water stresses, with surface water supplies not expected to withstand multi-year droughts (Geoscience Ltd. 2012). Coupled with this, increased implementation of water efficiency measures is only expected to decrease water use by 6-7%. This alone will not be sufficient during extended periods of drought (Borden et al. 2010, Summit 2009, 2010, 2012, 2013a, Polar Geoscience Ltd. 2012). There is therefore a need to increase resilience to drought by minimizing consumption and by preparing drought preparedness plans.

6.0 RECOMMENDATIONS FOR FUTURE CAMPUS PLANNING

6.1 The Growth and Campus Experience Workshop

6.1.1 Background

The Growth and Campus Experience Workshop was held on June 16th and 17th 2014. The workshop included a roundtable Charrette, which is a collaborative design exercise that was used to generate new ideas by engaging directly with stakeholders, experts and residents. The four Charrette teams were asked to incorporate an additional 3500 beds (6-storeys of residential), doubling of current academic / research space (4-storeys of academic), an additional sports field, 4000 additional parking spaces, a new Transit Hub to serve the campus and surrounding areas, and to generally enhance the public realm / open space of the Campus. The main goal of the exercise was to incorporate the aforementioned facilities, while also integrating whole systems thinking that considered environmental, economic and social sustainability.

6.1.2 Specific Direction and Strategies Pertaining to the Environment

Based on the Charrette, the following points and subsequent strategies/direction were identified that specifically pertain to the Environment.

- The Charrette exercise revealed that there is adequate disturbed space for campus expansion, and that it should be feasible to avoid disturbance of existing natural areas (e.g. Pine Forest) that are currently functioning as habitat for native species and as stepping stones for wildlife movement. During the build out of the Campus, efforts should be made to isolate natural areas, with snow fencing or other, to prevent accidental disturbance by construction activities.
- There was a desire by the Charette participants to incorporate and enhance ecological values within the Campus. At least two of the groups recommended the expansion of wetlands to provide additional habitat for rare species and to enhance capacity for storm water detention. Ecological restoration of upland habitats was also seen as important (e.g. native species planting) to combat invasive species encroachment.
- The additional planned access points (e.g. Glenmore Connector) and overall growth of the Campus and surrounding areas will result in impacts to the environment, especially due to the loss of natural habitats. The incorporation of native plant species within landscaping is important to offset these losses, as well as to maintain pockets of native ecosystems wherever possible.
- Given the extent of the planned expansion and the current conditions on Campus, it would be prudent for the grounds personnel to have a comprehensive understanding of the various plants groups (native, horticultural and invasive) in order to maintain a desirable landscape that is also environmentally friendly.
- An existing conditions analysis was completed on utilities that detailed constraint levels within several of the precincts. The expansion and upgrade of existing utilities have the potential to create extensive ground disturbance and encroachment of invasive species into surrounding natural environments. Utility upgrade work should include environmental monitoring and site specific recommendations to mitigate environmental impacts.

6.2 Future Studies

Future studies should further address the presence of at risk plants and wildlife within the Campus. During the site visits, six (6) at risk species were documented. It is likely that additional species at risk are utilizing the Campus and would be encountered with an enhanced survey effort. Knowledge of the presence of rare and endangered plants and wildlife enables further opportunities for habitat enhancement and conservation. Identification of specific nest trees, burrows, dens, or caves that provide critical habitats for sensitive species will allow site-specific conservation and may direct future development away from these important areas.

6.3 Environmental Assessment and Monitoring

The Campus expansion should include environmental impact assessments of specific build-out phases. This is especially important when expanding the campus into higher sensitivity areas, or to locations that are known to have rare species. Mitigative measures such as timing of construction, isolation of sensitive features, etc. can be effective at reducing impacts on the environment.

6.4 Monitoring

UBC should undertake regular monitoring of forest health, invasive species presence, water quality of stormwater receiving wetlands, and expansion impacts on the Campus lands as components of ongoing monitoring. Awareness of these factors will provide input for adaptive management and ensure that intended standards, policies, and objectives are being met while protecting the natural environment and sensitive features inherent within.

7.0 CLOSURE

This report has been prepared for UBC and considers the existing ecological condition of the Okanagan Campus with respect to aquatic and terrestrial ecosystems and intrinsic habitat values. Ecoscape has prepared this report with the understanding that all available information on the past, present, and proposed conditions of the site have been disclosed. UBC has acknowledged that in order for Ecoscape to properly provide the professional service, Ecoscape is relying upon full disclosure and accuracy of this information.

If you have any questions or comments, please contact the undersigned at your convenience.

Respectfully Submitted
ECOSCAPE ENVIRONMENTAL CONSULTANTS LTD.

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REFERENCES

Alley et al. 1999. Sustainability of Groundwater Resources. U.S. Geological Survey Circular 1186.

BC Ministry of Environment (BC MOE). 1999. Wildlife in British Columbia at Risk: Great Basin Spadefoot Toad.

BC Southern Interior Reptile and Amphibian Recovery Team (BC SIRART). 2008. Recovery Strategy for the Great Basin Spadefoot (*Spea intermontana*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 20 pp.

Bilodeau, L. 2014. Preliminary Climate Adaption Scoping and Potential Implications for UBCO Campus Planning. Draft for internal purposes. April 25, 2014.

Borden, C., Delaney, P., Ying, Q., Kobor, J., and Guy, B. 2010. A Modeling Approach to Evaluating the Impacts of Climate Change and Mountain Pine Beetle Infestation on Water Resources in the Okanagan Basin, British Columbia. Presented at the 2010 Western Snow Conference.

Cannings, S. and R. Cannings. 1995. Rare Invertebrates of the South Okanagan. BC Ministry of Environment, Lands, and Parks. Technical Publication.

Chan-McLeod, A.C.A. 2006. A review and synthesis of the effects of unsalvaged mountain-pine-beetle-attacked stands on wildlife and implications for forest management. BC Journal of Ecosystems and Management 7(2):119–132.

Clarke, J., Allard, R. and Schleppe, J. 2012. Regional Growth Strategy: Water Resources, Lakes and Streams Discussion Paper. Prepared by: Ecoscape Environmental Consultants in association with Clarke Geoscience Ltd. and Western Water Resources Ltd. Prepared for: Regional District of Central Okanagan. Ecoscape File: 12-897.02.

Compass Resource Management Ltd. 2007. An Assessment of Climate Change Impacts on Biodiversity Management in B.C. Prepared for: Biodiversity BC Technical Subcommittee for the Report on the Status of Biodiversity in B.C.

Diamond Head Consulting Ltd. 2006. University of British Columbia Okanagan Campus Wildland Fire Management Plan. Prepared For: Campus and Community Planning. July, 2006.

Fenger, M., T. Manning, J. Cooper, S. Guy, and P. Bradford. 2006. Wildlife and Trees in British Columbia. Lone Pine Publishing, Edmonton, AB. 336 pp.

Haney, A. and Iverson, K. 2009. Conservation Analysis and Updated Ecosystem Mapping for the Central Okanagan Valley: Central Okanagan, South Slopes, Kelowna, Ellison and Joe Rich Project

Areas. Prepared for: Okanagan Collaborative Conservation Program. Prepared by: Ophiuchus Consulting and Iverson & MacKenzie Biological Consulting Ltd. March 2009.

Hawes, K and J. Schleppe. 2009. Wetland Inventory, Classification, Evaluation, and Mapping. Ecoscape Environmental Consultants Ltd. File No. 07-151. Prepared for the City of Kelowna, Environment Division. 24 pp + Appendices.

Heron, J. 2004. A Summary of Terrestrial and Freshwater Invertebrate Conservation in British Columbia. Proceedings of the Species at Risk 2004 Pathways to Recovery Conference. T.D. Hopper, editor. March 2-6, 2004. Victoria, B.C.

Kittel, G.M., C. Cadrin, D. Markovic, and T. Stevens. 2011. Central Interior Ecoregional Assessment: Terrestrial ecological system representation in regional conservation planning. BC Journal of Ecosystems and Management. 12(1):54–71.

Klinkenberg, Brian. (Editor) 2010. E-Fauna BC: Electronic Atlas of the Fauna of British Columbia [www.efauna.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver.

Lehmkuhl, J.F. and L.F. Ruggiero. 1991. Forest Fragmentation in the Pacific Northwest and its Potential Effects on Wildlife. Pages 35-46 in J.F. Lehmkuhl, L.F. Ruggiero, K.B. Aubrey, and M.H. Huff, editors. Wildlife and Vegetation of Un-Managed Douglas-fir Forests. General Technical Report. PNW-GTR-285. US Forest Service, Portland, OR.

Lloyd, D., K. Angove, G. Hope, and C. Thompson. 1990. A guide to site identification and interpretation for the Kamloops Forest Region. Land Management Handbook No. 23. February, 1990. BC Ministry of Forests.

MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia: A Guide to Identification. Resource Branch, BC Ministry of Forests. Victoria, BC. Land Management Handbook No. 52.

Maclauchlan, L.E., P.M. Hall, I.S. Otvos, and J.E. Brooks. 2009. An integrated management system for the Douglas-fir tussock moth in southern British Columbia. BC Journal of Ecosystems and Management 10(2):22–36.

Polar Geoscience Ltd. 2012. Projected Water Supply and Use in the Okanagan (2011-2040) for the Okanagan Water Supply and Demand Project. Prepared for the Okanagan Basin Water Board (OBWB). Kelowna, BC.

Roed, M. A. and J. D. Greenough. 1995. Okanagan Geology. Published By: The Kelowna Geology Committee.

Scott, Virgil E., Keith E. Evans, David R. Patton, and Charles P. Stone. 1977. Cavity-nesting birds of North American forests. U.S. Dep. Agric. Handb. 511, 112 pp.

Scott and Suffling, 2000. Climate change and Canada's National Park System. Environment Canada/ Parks Canada.

Smerdon & Allen. 2009. Regional-Scale Groundwater Flow Model of the Kelowna Area, and the Mission Creek Watershed, Central Okanagan, BC. Prepared by SFU Department of Earth Sciences for the BC Ministry of Environment, Water Stewardship Division.

Summit Environmental Consultants Ltd. (Summit). 2009. Phase 2 Okanagan Water Supply and Demand Project, Surface Water Hydrology and Hydrologic Modelling Study "State of the Basin" Report. Prepared for Okanagan Basin Water Board, September 2009.

Summit Environmental Consultants Ltd. (Summit). 2010. Okanagan Water Supply and Demand Project. Phase 2 Summary Report. Prepard for the Okanagan Basin Water Board, July 2010.

Summit Environmental Consultants Ltd. (Summit). 2012. Okanagan Hydrologic Connectivity Model: Summary Report. Prepared for the Okanagan Basin Water Board, March 2012.

Summit Environmental Consultants Ltd. (Summit). 2013a. Okanagan Hydrologic Connectivity Model Summary Report. Prepared for the Okanagan Basin Water Board. May 2013.

MAPS

Ecological Analysis to Support UBC's Okanagan Campus Master Plan Update

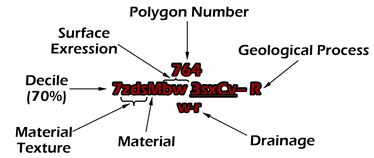
Bioterrain and Landform Information

Legend

- Subject Property
- Parcels
- Bioterrain Polygon
- Wetland Inventory and Mapping Polygon
- Contour

N

Simplified Bioterrain Polygon Key



Bioterrain Unit Letter Notation

TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION
a=blocks	A=anthropogenic materials	a=moderate slope
b=boulders	C=colluvium	b=blanket
c=clay	D=weathered bedrock	c=cone
d=mixed fragments	E=eolian sediments	d=depression(s)
f=fines	F=fluvial material	f=fan
g=gravel	Fl=saline fluvial (salt precipitation)	h=hummocky
k=cobbles	F^A=active fluvial materials	j=gentle slope
m=mud	F^G=glaciofluvial sediments	k=moderately steep slope
p=pebbles	L=lacustrine sediments	m=rolling
s=sand	Ll=saline lacustrine (salt precipitation)	p=plain
r=rubble	L^G=glaciolacustrine sediments	r=ridges
x=angular fragments	M=morainal materials (till)	s=steep slope(s)
z=silt	N=not mapped (water bodies)	t=terrace(s)
	O=organic material	u=undulating
ORGANIC	R=bedrock	v=veneer
e=fibric	U=undifferentiated material	w=mantle of variable thickness
u=mesic		x=thin veneer
h=humic		

GEOLOGICAL PROCESS	SOIL DRAINAGE CLASS
A=avalanches	x=very rapdily drained
B=braiding channel	r=rapidly drained
C=cryoturbation	w=well drained
D=deflation	m=moderatley well drained
E=glacial meltwater channels	i=imperfectly drained
F=failing (slow mass movement)	p=poorly drained
H=kettled	v=very poorly drained
I=irregular channel	
J=anastamosing channel	
K=karst processes	
L=surface seepage	
M=meandering channel	
N=nivation	
P=piping	
R=rapid mass movement	
S=solifluction	
U=inundation	
V=gully erosion	
W=washing	
X=permafrost	
Z=periglacial processes	

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Ecological Analysis to Support UBC's Okanagan Campus Master Plan Update

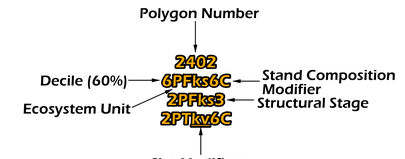
Ecosystem Classification

Legend

- Subject Property
- Parcels
- Ecosystem Polygons
- Wetland Inventory and Mapping Polygon
- Noteworthy Wildlife Occurrences

N

Ecosystem Polygon Key



Ecosystem Classification Codes

Ecosystem Code	Site Series	Site Series Name	Provincial Status[1]
AK	-	Alkali Lake	*
CF	-	Cultivated Field	-
CT	0	Cattail Marsh	Blue
FO	0	Douglas-fir - Ponderosa pine - Saskatoon - Mock Orange	*
GP	-	Gravel Pit	-
Gs01	-	Alkali saltgrass – Nuttall's alkaligrass	Red
Gs02	-	Nuttall's alkaligrass – foxtail barley	Red
OW	-	Shallow Open Water	*
PC	4	Ponderosa pine - Bluebunch wheatgrass	Blue
PF	5	Ponderosa pine - Bluebunch wheatgrass - Rough fescue	Red
PT	2	Ponderosa pine - Red three-awn	Blue
PW	1	Ponderosa pine - Bluebunch wheatgrass - Idaho fescue	Blue
RW	-	Rural	-
SP	6	Douglas-fir/Ponderosa pine - Snowberry - Pinegrass	Red
UR	-	Urban/Suburban	-

1 Source: http://www.env.gov.bc.ca/cdc/
Blue: Of special concern. Red: Endangered or threatened.
* Not recognized by the CDC.

Site Modifiers	Structural Stage	Structural Stage Modifiers
c=coarse-textured soils	1=Sparse/Bryoid	s=single-storied
d=deep soils (> 100 cm to bedrock)	2=Herb	t=two-storied
f=fine-textured soils	2d=Dwarf Shrub	m=multistoried
j=gentle slope (slope <25%)	3=Shrub/Herb	i=irregular
k=cool aspect (285°-135 °, slope >25%)	3a=Low Shrub	h=shelterwood
m=medium-textured soils	3b=Tall Shrub	
p=peaty material	4=Pole/Sapling	Stand Composition
s=shallow soils (20-100 cm to bedrock)	5=Young Forest	C=coniferous
v=very shallow (< 20 cm to bedrock)	6=Mature Forest	B=broadleaf
w=warm aspect (135 o-285 o, slope >25%)	7=Old Forest	M=mixed
x=drier than typical		

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Ecological Analysis to Support UBC's Okanagan Campus Master Plan Update

Environmental Sensitivity Analysis

Legend

- Subject Property
- Parcels
- Wetland Inventory and Mapping Polygon
- Noteworthy Wildlife Occurrences
- Movement Corridor for Wildlife

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

Environmental Sensitivity Classes

Very High: These areas represent extremely high ecological value and typically contain rare or critical habitat areas for sensitive or at risk species, undisturbed or pristine ecosystems and habitats, and biodiversity hotspots (e.g., wetlands, old growth forest). They substantially contribute to the regional habitat function and connectivity and are highest priority for conservation.

High: These areas contribute to the regional biodiversity and connectivity of the surrounding landscape but lack critical habitats for at risk species (e.g., riparian areas, mature forest). Development should generally avoid these areas to conserve the important features or to allow potential progression to the Very High category (e.g., mature forest becoming old growth). Encroachment into these areas should be compensated for by restoration in other areas to work towards achieving a no net loss of High value habitats.

Moderate: Ecosystems of moderate significance represent disturbed habitats or fragmented features with the potential to return to High value through natural succession (e.g., young or fragmented forest, degraded habitats). Moderate areas contribute to the diversity of the landscape; however their condition and adjacency may limit significant function. These areas will benefit from restoration and enhancement activities which will facilitate succession to higher value habitats.

Low: These areas contribute little to no value with regard to habitat diversity and have limited potential for supporting significant wildlife (e.g., heavily impacted or disturbed sites). Development is typically focused on these areas based on their limited contribution to regional biodiversity and limited capacity to return to high value through natural succession. These areas may be restored through intensive remediation and management practices.

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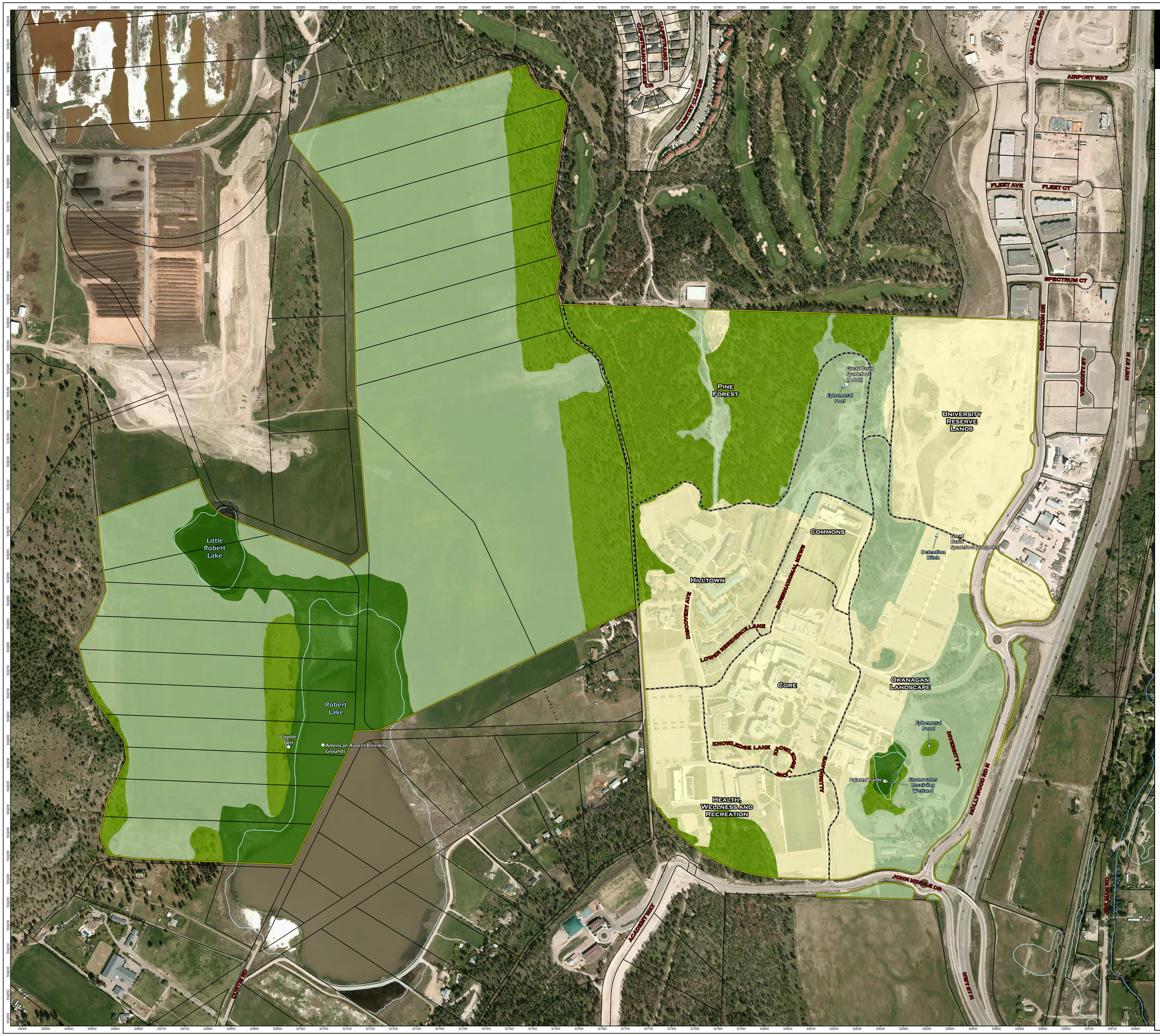
Ecological Analysis to Support UBC's Okanagan Campus Master Plan Update

Environmental Sensitivity and UBC Precincts



Legend

- Subject Property
- Parcels
- UBC Precinct
- Wetland Inventory and Mapping Polygon
- Noteworthy Wildlife Occurrences

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

Environmental Sensitivity Classes

Very High: These areas represent extremely high ecological value and typically contain rare or critical habitat areas for sensitive or at risk species, undisturbed or pristine ecosystems and habitats, and biodiversity hotspots (e.g., wetlands, old growth forest). They substantially contribute to the regional habitat function and connectivity and are highest priority for conservation.

High: These areas contribute to the regional biodiversity and connectivity of the surrounding landscape but lack critical habitats for at risk species (e.g., riparian areas, mature forest). Development should generally avoid these areas to conserve the important features or to allow potential progression to the Very High category (e.g., mature forest becoming old growth). Encroachment into these areas should be compensated for by restoration in other areas to work towards achieving a no net loss of High value habitats.

Moderate: Ecosystems of moderate significance represent disturbed habitats or fragmented features with the potential to return to High value through natural succession (e.g., young or fragmented forest, degraded habitats). Moderate areas contribute to the diversity of the landscape; however their condition and adjacency may limit significant function. These areas will benefit from restoration and enhancement activities which will facilitate succession to higher value habitats.

Low: These areas contribute little to no value with regard to habitat diversity and have limited potential for supporting significant wildlife (e.g., heavily impacted or disturbed sites). Development is typically focused on these areas based on their limited contribution to regional biodiversity and limited capacity to return to high value through natural succession. These areas may be restored through intensive remediation and management practices.

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APPENDIX A

Plant Occurrences

Common Name	Latin Name	Class	Noxious
alkali saltgrass	*Distichlis spicata* var. *stricta*	Alkaline	
Nuttall's alkaligrass	*Puccinellia nuttalliana*	Alkaline	
cattail	*Typha latifolia*	Aquatic	
great bulrush	*Scirpus lacustris*	Aquatic	
blue wildrye	*Elymus glaucus*	Grass	
bluebunch wheatgrass	*Agropyron spicatum*	Grass	
cheatgrass	***Bromus tectorum***	Grass	y
crested wheatgrass	***Agropyron cristatum***	Grass	
foxtail barley	*Hordeum jubatum*	Grass	
junegrass	*Koeleria macrantha*	Grass	
Kentucky bluegrass	***Poa pratensis***	Grass	
needle-and-thread grass	*Stipa comata*	Grass	
orchardgrass	***Dactylis glomerata***	Grass	
quackgrass	***Agropyron repens***	Grass	y
reed canarygrass	*Phalaris arundinacea*	Grass	
rough fescue	*Festuca campestris*	Grass	
sedge	*Carex sp.*	Grass	
smooth brome	***Bromus inermis***	Grass	
alfalfa	***Medicago sativa***	Herb	
American vetch	*Vicia americana*	Herb	
arrow-leaved balsamroot	*Balsamhoriza sagittata*	Herb	
brown-eyed Susan	*Gaillardia aristata*	Herb	
buckwheat	*Eriogonum sp.*	Herb	
burdock	***Arctium lappa***	Herb	y
Canada thistle	***Cirsium arvense***	Herb	y
chocolate lily	*Fritillaria lanceolata*	Herb	
cinquefoil	*Potentilla sp.*	Herb	
cleavers	***Galium aparine***	**Herb**	y
clover	***Trifolium*** **sp.**	Herb	
common dandelion	***Taraxacum officinale***	Herb	
common red paintbrush	*Castilleja miniata*	Herb	
common St. John's-wort	***Hypercium perforatum***	Herb	y
curled dock	***Rumex crispus***	Herb	y
cut-leaved daisy	*Erigeron compositus*	Herb	
Dalmatian toadflax	***Linaria genistifolia***	Herb	y
deadly nightshade	***Atropa belladonna***	Herb	
diffuse knapweed	***Centaurea*** **diffusa**	Herb	y
fern-leaved desert-parsley	*Lomatium dissectum*	Herb	
field mint	*Mentha arvensis*	Herb	
field pepper-grass	***Lepidium campestre***	**Herb**	
fireweed	*Epilobium angustifolium*	Herb	
hawkweed	*Hieracium* sp.	Herb	
hoary cress	***Cardaria draba***	Herb	y
Holboell's rockcress	*Arabis holboellii*	Herb	
hound's-tongue	***Cynoglossum officinale***	Herb	y
lamb's-quarters	***Chenopodium album***	Herb	y

Common Name	Latin Name	Class	Noxious
lemonweed	*Lithospermum ruderale*	Herb	
low pussytoes	*Antennaria dimorpha*	Herb	
Lyall's rockcress	*Arabis lyallii*	Herb	
meadow death-camas	*Zigadenus venenosus*	Herb	
mullein	***Verbascum thapsus***	Herb	y
night-flowering catchfly	***Silene noctiflora***	Herb	
orange hawkweed	***Hieracium aurantiacum***	Herb	y
parsnip-flowered buckwheat	*Eriogonum heracleoides*	Herb	
perennial sow-thistle	***Sonchus arvensis***	Herb	y
pineapple weed	***Matricaria discoidea***	Herb	y
prickly lettuce	***Lactuca serriola***	Herb	y
purple peavine	*Lathyrus nevadensis*	Herb	
pussytoes	*Antennaria* sp.	Herb	
red clover	***Trifolium pratense***	Herb	
rockcress	*Arabis* sp.	Herb	
rosy pussytoes	*Antennaria microphylla*	Herb	
round-leaved alumroot	*Heuchera cylindrica*	Herb	
showy milkweed	*Asclepias speciosa*	Herb	
snow buckwheat	*Eriogonum niveum*	Herb	
spotted knapweed	***Centaurea maculosa***	Herb	y
sulphur cinquefoil	***Potentilla recta***	Herb	y
summer cypress	***Kochia scoparia***	Herb	y
timber milk-vetch	*Astragalus miser*	Herb	
tumble-mustard	***Sisymbrium spp.***	Herb	y
upland larkspur	*Delphinium nuttallianum*	Herb	y
white sweet-clover	***Melilotus alba***	Herb	
wild strawberry	*Fragaria virginiana*	Herb	
woolly vetch	*Vicia villosa*	Herb	
yarrow	*Achillea millefolium*	Herb	
yellow salsify	***Tragopogon dubius***	Herb	y
birch-leaved spirea	*Spiraea betulifolia*	Shrub	
black hawthorn	*Crataegus douglasii*	Shrub	
black locust	***Robinia pseudoacacia***	Shrub	
blue elderberry	*Sambucus caerulea*	Shrub	
Chinese sumac	***Ailanthus altissima***	Shrub	
chokecherry	*Prunus virginiana*	Shrub	
common rabbit-brush	*Chrysothamnus nauseosus*	Shrub	
common snowberry	*Symphoricarpos albus*	Shrub	
Douglas maple	*Acer glabrum*	Shrub	
mock orange	*Philadelphus lewisii*	Shrub	
Nootka rose	*Rosa nutkana*	Shrub	
Pacific willow	*Salix lucida ssp. Lasiandra*	Shrub	
prairie rose	*Rosa woodsii*	Shrub	
red-osier dogwood	*Cornus stolonifera*	Shrub	
Rocky mountain juniper	*Juniperus scopulorum*	Shrub	
Saskatoon	*Amelanchier alnifolia*	Shrub	

Common Name	Latin Name	Class	Noxious
Siberian elm	***Ulmus pumila***	Shrub	
smooth sumac	*Rhus glabra*	Shrub	
spreading dogbane	*Apocynum androsaemifolium*	Shrub	
tall Oregon-grape	*Mahonia aquifolium*	Shrub	
willow	*Salix* sp.	Shrub	
black cottonwood	*Populus balsamifera* ssp. *trichocarpa*	Tree	
interior Douglas-fir	*Pseudotsuga menziesii* var. *glauca*	Tree	
ponderosa pine	*Pinus ponderosa*	Tree	
trembling aspen	*Populus tremuloides*	Tree	

Non-native plants are in **bold**

A noxious weed is a plant considered harmful to animals or the environment. The noxious weed list is as per the City of Kelowna Noxious Weed Bylaw.

APPENDIX B

Wildlife Species Occurrences

Common Name	Latin Name	Class	COSEWIC	Provincial Status	SARA
Great Basin spadefoot	*Spea intermontana*	amphibian	T (Apr 2007)	Blue	1-T (2003)
American avocet	*Recurvirostra americana*	bird		Red	
American coot	*Fulica americana*	bird			
American crow	*Corvus brachyrhynchos*	bird			
American goldfinch	*Carduelis tristis*	bird			
American robin	*Turdus migratorius*	bird			
barn swallow	*Hirundo rustica*	bird		Blue	
black-billed magpie	*Pica pica*	bird			
black-capped chickadee	*Poecile atricapillus*	bird			
blue-winged teal	*Anas discors*	bird			
Brewer's blackbird	*Euphagus cyanocephalus*	bird			
brown-headed cowbird	*Molothrus ater*	bird			
bufflehead	*Bucephala albeola*	bird			
Bullock's oriole	*Ictercus bullockii*	bird			
California gull	*Larus californicus*	bird		Blue	
California quail	*Callipepla californica*	bird			
Canada goose	*Branta canadensis*	bird			
Cassin's vireo	*Vireo cassinii*	bird			
cedar waxwing	*Bombycilla cedrorum*	bird			
chipping sparrow	*Spizella passerina*	bird			
cinnamon teal	*Anas cyanoptera*	bird			
clay-colored sparrow	*Spizella pallida*	bird			
common raven	*Corvus corax*	bird			
eared grebe	*Podiceps nigricollis*	bird			
European starling	*Sturnus vulgaris*	bird			
evening grosbeak	*Coccothraustes vespertinus*	bird			
gadwall	*Anas strepera*	bird			
great blue heron	*Ardea herodias*	bird		Blue	
house finch	*Carpodacus mexicanus*	bird			
house sparrow	*Passer domesticus*	bird			
house wren	*Troglodytes aedon*	bird			
killdeer	*Charadrius vociferus*	bird			
lazuli bunting	*Passerina amoena*	bird			
mallard	*Anas platyrhynchos*	bird			
mourning dove	*Zenaida macroura*	bird			
northern flicker	*Colaptes auratus*	bird			
northern rough-winged swallo	*Stelgidopteryx serripennis*	bird			
pygmy nuthatch	*Sitta pygmaea*	bird			
red crossbill	*Loxia curvirostra*	bird			
red-tailed hawk	*Buteo jamaicensis*	bird			
red-winged blackbird	*Agelaius phoeniceus*	bird			
ring-billed gull	*Larus delawarensis*	bird			
rock pigeon	*Columba livia*	bird			
ruddy duck	*Oxyura jamaicensis*	bird			
savannah sparrow	*Passerculus sandwichensis*	bird			
Say's phoebe	*Sayornis saya*	bird			
song sparrow	*Melospiza melodia*	bird			
sora	*Porzana carolina*	bird			
spotted sandpiper	*Actitis macularia*	bird			
spotted towhee	*Pipilo maculatus*	bird			
tree swallow	*Tachycineta bicolor*	bird			
turkey vulture	*Cathartes aura*	bird			

Common Name	Latin Name	Class	COSEWIC	Provincial Status	SARA
vesper sparrow	*Pooecetes gramineus*	bird			
violet-green swallow	*Tachycineta thalassina*	bird			
western bluebird	*Sialia mexicanus*	bird			
western kingbird	*Tyrannus verticalis*	bird			
western meadowlark	*Sturnella neglecta*	bird			
western tanager	*Piranga ludoviciana*	bird			
western wood-pewee	*Contopus sordidulus*	bird			
Wilson's phalarope	*Phalaropus tricolor*	bird			
Wilson's warbler	*Wilsonia pusilla*	bird			
yellow warbler	*Dendroica petechia*	bird			
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	bird			
yellow-rumped warbler	*Dendroica coronata*	bird			
Columbian ground squirrel	*Spermophilus columbianus*	mammal			
coyote	Canis latrans	mammal			
eastern grey squirrel	*Sciurus carolinensis*	mammal			
meadow vole	*Microtus pennsylvanicus*	mammal			
mule deer	*Odocoileus hemionus*	mammal			
red squirrel	*Tamiasciurus hudsonicus*	mammal			
yellow pine chipmunk	*Neotamias amoenus*	mammal			
yellow-bellied marmot	*Marmota flaviventris*	mammal			
western painted turtle	*Chrysemys picta bellii*	reptile	SC (Apr 2006)	Blue	1

Source: http://www.env.gov.bc.ca/cdc/ Blue: Of special concern. Red: Endangered or threatened.

Source: http://www.cosewic.gc.ca/

Threatened (T): A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern (SC): A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Endangered (E): A wildlife species facing imminent extirpation or extinction.