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**ENVIRONMENTAL IMPACT STUDY  
FOR**

**BIOSOLIDS COMPOSTING FACILITY,  
VERNON, BRITISH COLUMBIA**

Submitted to:

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## **1.0 PROJECT SUMMARY**

### **1.1 Project Proponent**

City of Kelowna  
1435 Water Street  
Kelowna, BC V1Y 1J4  
Project Manager:  
Mark Watt  
Environment and Solid Waste Manager  
(250) 469-8725

Corporation of the City of Vernon  
3400 – 30<sup>th</sup> Street  
Vernon, BC V1T 5E6  
Contact:  
Dale Danallanko  
Manager, Environmental Services  
(250) 545-1361

Prime consultant for the pre-design and design of the biosolids composting facility is:

Associated Engineering (BC) Ltd.

### **1.2 Title of Project**

The project name is ‘Biosolids Composting Facility.’

### **1.3 Construction Schedule**

Pre-design and planning for the biosolids composting facility commenced in the spring of 2005. Initial site clearing and grading was conducted in the fall of 2005, and construction of the new facility is scheduled to start in early 2006 following the procurement of project approvals, with the facility operational by the end of 2006.

### **1.4 Provincial Departments/Agencies Involved**

Conrad Pryce  
Senior Environmental Protection Officer  
Ministry of Environment (MOE)  
Environmental Management Section  
102 Industrial Place  
Penticton, BC V2A 7CB  
(250) 490-8208

## **2.0 PROJECT DESCRIPTION**

### **2.1 Background**

The City of Kelowna has operated an aerated static pile biosolids composting facility since 1994 at the Winfield compost site. The biosolids composition operation produces a “Class A” product marketed as “Ogogrow.” In addition, a leaf and yard waste composting facility using a static windrow system has been operational at the Glenmore Landfill. Long-term use of the leased property at the Winfield compost site has not been achieved by the City of Kelowna, resulting in the need to identify and plan for an alternative site.

The City of Vernon’s Water Reclamation Plant is now capable of dewatering its biosolids. Since late February 2005, the dewatered biosolids from the City of Vernon’s Water Reclamation Plant have been transported to the City of Kelowna biosolids composting facility near Winfield. Prior to the new dewatering facility, the City of Vernon applied liquid biosolids to agricultural and silvicultural land in the Commonage Road area under the City’s Ministry of Environment Operational Certificate.

The City of Kelowna and City of Vernon have undertaken a joint venture to develop a composting facility for biosolids. After receiving the appropriate approvals from the Agricultural Land Commission (ALC), a 28.35 ha parcel of land located in the Regional District of North Okanagan (RDNO), east of Commonage Road south of Vernon, will be leased from the landowners with the intention of developing a portion of the land (approximately 8.1 ha) for the proposed biosolids composting facility.

The new biosolids composting facility will be designed to accommodate current and projected biosolids production from both the Kelowna and Vernon wastewater treatment facilities. The composting facility will compost biosolids, and will be capable of producing “Class A” compost.

## 2.2 Location of Project

The biosolids composting facility is located east of Commonage Road, south of Vernon (Figure 1). The property is within the RDNO, Electoral Area B, Commonage/Cosen's Bay and has been zoned as Large Holding (L.H.) as per the *Regional District of North Okanagan Zoning Bylaw No. 1888, 2003*. The general property coordinates are as follows:

- Latitude: 50° 12' 12"
- Longitude: 119° 20' 1"

The relationship of the project to the local geography and environmental features are shown in Figure 2. The detailed location of project components for the biosolids composting facility Project are shown in Figure 3. Photographs taken during the March 18, 2005, site reconnaissance are included as Appendix I.

## 2.3 Detailed Project Activities

Bio-solids (de-watered sludge) from the City of Vernon and the City of Kelowna wastewater treatment plants will be transported to the site via trucks. The trucks will transfer the sludge into concrete sludge bins in the sludge storage building. The sludge will then be mixed in the building with a bulking agent (i.e., wood chips) to obtain a mix with approximately 40% dry solids. This will prevent leaching when stored outside, increase the porosity of the sludge to facilitate decomposition, and add a source of carbon for microbes. This mixture will then be aerated on an open concrete pad to stimulate decomposition of the organic matter by micro-organisms. The biosolids mixture is then transferred from the aeration pads via front-end loader and piled in windrows on a paved outdoor storage compound for curing. During the curing process, microbial activity will cause an increase in temperature that will destroy most pathogens and eventually degrade the biosolids into a humus-like material, which can be packaged and sold commercially.

## 3.0 SCOPE OF THE ASSESSMENT

### 3.1 Scope of the Project and Its Assessment

Based on discussions with the City of Kelowna and City of Vernon, it was determined that the project will only require a limited scope Environmental Impact Study (EIS) for compliance with the Organic Matter Recycling Regulation (OMRR) Part 5 (under section 23(2)&(3), Odour and Leachate Management Plans, Operating and Closure Plans, and Specifications (under section 24) and Environmental Impact Assessments (under section 26(4)). Golder was retained by Associated Engineering to conduct the necessary studies and to prepare the EIS required by OMRR.

In general, an EIS details the nature and scale of the proposed composting facility, how the project will impact the geophysical and biological environment and its inhabitants, and the measures that can be taken to reduce, alleviate, and monitor these impacts (Forgie et al. 2004). The purpose of the EIS at this stage will be to provide a description of the environmental resources at the site and identify the potential environmental concerns and regulatory requirements associated with the project. The EIS will be structured as per recommendations for a lower risk, limited scope EIS, as defined in the *Environmental Impact Study Guidelines – A Companion Document to the Municipal Sewage Regulation* (MELP 2000) and from information provided in *Compost Facility Requirements Guideline: How to Comply With Part 5 of the Organic Matter Recycling Regulation* (Forgie et al. 2004).

The scope of this EIS does not include an archaeological assessment. Consultation with the Okanagan First Nation was not conducted upon the advice and recommendations of the City of Kelowna (pers. comm. Mr. Mark Watt, Environment and Solid Waste Manager, March 18, 2005) and City of Vernon (pers. comm. Mr. Dale Danallanko, Manager, Environmental Services, March 23, 2005). The property for the proposed biosolids composting facility is privately owned land and a portion of the land will be leased from the landowner for the facility.

The study area boundaries for evaluating potential impacts to geophysical and biological environments from the construction and operation of the biosolids composting facility are defined on both a local as well as a regional basis. The “site” is the parcel of land where development and construction of the composting facility will occur and areas immediately adjacent to this land that might be influenced by the project. The “regional study area” encompasses the 70-acre parcel of leased land, the un-named pond down slope and south of the proposed facility, as well as Roses Pond located east of Commonage Road (Figure 1).

## **3.2 Methodology of the Assessment**

### **3.2.1 General Methodology**

The EIS has been compiled based on a review of existing and accessible information pertaining to the natural environment of the site and regional study area, including the most recent and applicable environmental legislation. Sources of information reviewed, included the Conservation Data Centre (CDC), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the *Species at Risk Act* (SARA), and the BC Fisheries Information Summary System (FISS). The preliminary design options for the biosolids composting facility were reviewed and all reports available from the City of Kelowna were reviewed.

### **3.2.2 Field Visit**

A reconnaissance of the site was conducted by Ms. Nancy Elliott (R.P.Bio.) on March 18, 2005. Mr. Dale Danallanko, City of Vernon, was on site briefly to describe the project boundaries and background. No sampling or chemical testing was conducted during the site reconnaissance or as part of the environmental impact study.

### **3.2.3 Assessment of Effects**

Based on the review of available information, and site reconnaissance, an assessment of potential adverse effects that may potentially result from the construction and operation of the proposed biosolids composting facility was conducted. Control mechanisms and mitigation measures have been recommended to minimize, and where possible, avoid the potential for adverse effects from occurring.

## **4.0 ENVIRONMENTAL SETTING AND SITE CHARACTERIZATION**

This section describes the existing environmental setting and characteristics of the site and regional study area for each of the following:

- geophysical conditions;
- aquatic environment and resources;
- terrestrial environment and resources; and
- atmospheric conditions.

### **4.1 Geophysical Environment**

#### **4.1.1 Site Location**

The proposed compost facility site approximately 8.1 ha in area is located on the east side of Commonage Road approximately 1.5 km north of the intersection of Commonage and Bailey Roads, south of Vernon, BC (See Figure 1). The site forms the south part of a north-south ridge that has been used as a cultivated field for agricultural purposes. The site is located within a primarily rural agricultural area; however, there are some rural residences located north and south of the site. The Predator Ridge Golf Course and residential development is located approximately 5 km to the southwest. Other residential developments within the City of Vernon are located between 3.5 and 3.8 km to the north and northeast, respectively. The RDNO Landfill is located approximately 2.9 km northeast of the site.

### 4.1.2 Geology

Based on the report titled “*Late Glacial History and Surficial Deposits of the Okanagan Valley, B.C.*” (Nasmith, 1962), the surficial geology of the surrounding area has been identified as a series of alluvial fans, deltas and associated gullies and stream channels, and generally consists of deposits ranging from silty sand to coarse gravels with cobbles to boulders.

Based on specific site information obtained from subsurface investigations completed by Golder, surficial soils consist of approximately 0.3 to 0.6 m of loose organic silt containing trace gravel. The surficial organic soils are followed by a layer of sand and gravel containing a variable silt and cobble content, varying from about 0.5 to 2.8 m thick. The sand and gravel layer is underlain by a heterogeneous mixture of silt, sand, and gravel, containing a variable cobble content, inferred to be glacial till. The glacial till is approximately 8.5 m thick and is assumed to be a confining layer.

### 4.2 Aquatic Environment

There are no natural watercourses (i.e., streams, lakes, or wetlands) located on the site; however, there are two man-made sewage lagoons that were once operated by the RDNO. The lagoons will be decommissioned as part of the project and a leachate treatment lagoon and engineered wetland will be constructed on a portion of the area where the sewage lagoons are currently located. The leachate lagoon and engineered wetland will be designed to control surface run-off from the site and treat leachate from the composting facility (See Figure 3). The lagoon and wetland will have both shallow and deep areas with emergent vegetation, such as cattails (*Typha latifolia*), sedges (*Carex spp.*), and rushes (*Scirpus spp.*), which will not only treat the leachate but also create wildlife habitat.

Nearby watercourses in the regional study area include Roses Pond, located approximately 310 m north-west of the site across Commonage Road. Boltres Creek, a tributary to Kalamalka Lake, is located approximately 780 m north-east of the site. A unnamed pond and tributary to Boltres Creek are located approximately 150 m south of the site, and Kalamalka Lake is located approximately 1.6 km south-east of the site (Figure 2). Kalamalka Lake is an important aquatic resource for both fisheries, recreation, and as a source of drinking water. Kalamalka Lake has been reported as oligotrophic (low nutrient levels and productivity). Kalamalka Lake receives no known point source discharge of nutrients and is largely influenced by anthropogenic or human related non-point source nutrient inputs from septic tanks, agriculture, urbanization, and forestry. A dam is located at the outlet of Kalamalka Lake that controls lake levels the flow from Kalamalka Lake into the outlet stream, Vernon Creek, which in turn flows into

Okanagan Lake. The surface area of Kalamalka Lake is 2,590 ha and the lake has a mean depth of 59 m and maximum recorded depth of 142 m. The elevation of the lake is 391 m ASL. Kalamalka Lake has a watershed area of 572 km<sup>2</sup>.

Based on the Ministry of Sustainable Resource Management's Fisheries Information Summary System (FISS) database, game fish species present in Kalamalka Lake include cutthroat trout (*Oncorhynchus clarki*), kokanee (*O. nerka*), rainbow trout (*O. mykiss*), lake trout (*Salvelinus namaycush*), and mountain whitefish (*Prosopium williamsoni*). Other fish species include: largescale sucker (*Catostomus macrocheilus*), northern pikeminnow (*Ptychocheilus oregonensis*), peamouth chub (*Mylocheilus caurinus*), perch (*Perca flavescens*), and reidside shiner (*Richardsonius balteatus*) (Ministry of Sustainable Resource Management 2004a). Additionally, the FISS database indicates there are no fish present in Rose's Pond, Boltres Creek, or the un-named pond south of the site.

#### **4.2.1 Hydrogeology and Groundwater**

A detailed hydrogeological study was not within the scope of this EIS. However, a geotechnical subsurface investigation was conducted in March 2005 and involved advancing eight boreholes to depths between 11.9 and 15.9 m below the existing ground surface. Standpipe piezometers were installed in the selected boreholes to permit monitoring of the local groundwater conditions. In March when the investigation was conducted, groundwater was encountered at approximately 9.8 m below the existing ground surface in one piezometer. It should be noted that groundwater is subject to seasonal variations with the highest levels typically occurring in the late spring and early summer months or during times of sustained precipitation. Based on the subsurface geological conditions, it is inferred that groundwater encountered in the piezometer is likely present as perched groundwater potentially within a localized sand and gravel layer. Based on this preliminary subsurface investigation, it does not appear that groundwater will be encountered during site construction.

### 4.3 Terrestrial Environment

A hierarchical Ecoregion classification system<sup>1</sup> has been developed for B.C. to provide a systematic view of the small-scale ecological relationships in the province. The biosolids composting facility site is classified under the Ecoregion classification system as described by Demarchi (1996) in Table 1.

**Table 1**  
**Ecoregion Classification of the Site**

<b>Ecodomain</b>	Dry
<b>Ecodivision</b>	Semi-Arid Steppe Highlands
<b>Ecoprovince</b>	Southern Interior
<b>Ecoregion</b>	Thompson Okanagan Plateau
<b>Ecosection</b>	North Okanagan Highland

The Southern Interior Ecoprovince has been modified by urbanization and agricultural use as it contains a favorably warm climate that attracts many people and has a favorable climate and soils for fruit and vine crops. The North Okanagan Highland Ecosection is a cool, moist, transitional mountain area, dominated by a rolling upland (Demarchi, 1996).

The site is located within the Interior Douglas Fir (IDF) biogeoclimatic zone as described by Meidinger and Pojar (1991) and Lloyd et al. (1996). The IDF zone is the second warmest forest zone of the dry southern interior and wildfire is a dominant natural forest modifier. The IDF is the third driest of all biogeoclimatic zones compared to the bluebunch wheatgrass and ponderosa pine zones, and of the forested zones it is the second driest (Lloyd et al., 1990).

Open to closed, mature forests containing Douglas-fir (*Pseudotsuga menziesii* ssp. *menziesii*) cover much of the IDF landscape in the uplands, whereas natural grassland vegetation communities of bluebunch wheatgrass (*Agropyron spicatum*) and rough fescue (*Festuca scabrella*) are more common in the lowlands. Based on information from the Ministry of Sustainable Resource Management Land and Resource Data Warehouse Catalogue database (2004b), the site is located in the IDF very dry hot grassland (IDFxb1a) subzone.

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<sup>1</sup> Five hierarchical levels based on macroclimatic processes and physiography have been used to classify sites in B.C.: Ecodomains and Ecodivisions place B.C. in a global context and Ecoprovinces, Ecoregions, and Ecosections relate the province to other parts of North America or the Pacific Ocean.

#### **4.3.1 Flora**

The project site is located in a former agriculture field, used primarily for crop production (i.e., hay). There were no trees and very little native vegetation identified at the site. Clearing required for construction of the facility will be limited to the boundaries of the site only. As such, potential environmental effects to flora resulting from the construction and operation of the biosolids composting facility are considered to be negligible.

#### **4.3.2 Fauna**

The IDF Biogeoclimatic Zone and Southern Interior Ecoprovince support a wide variety of both native and introduced wildlife species, including large and small mammals, reptiles, amphibians, birds, and fish (Stevens, 1995). Based on known home ranges and general habitat requirements, the following 40 bird, 2 amphibian, 6 reptile, and 13 listed mammal species are considered to have some potential to exist within the regional study area boundaries which are listed in Table 2, Section 4.4.

There were no wildlife species observed on site during the March 2005 site visit; however, there was evidence of small mammals, i.e., mice or voles, observed throughout the site. Additionally, several species of waterfowl were noted in Roses pond, within the regional study area.

The overall wildlife value at the site is considered low due to the previous agricultural use of the property. Due in part to these land uses and activities, the site of the proposed biosolids composting facility generally lacks suitable habitats for resident populations of wildlife, including birds, mammals, reptiles, and amphibians. The grassy areas provide moderate quality habitat for rodents such as mice and voles, and therefore, may provide foraging habitat for predators such as coyote and raptors. However, due to the existing level of disturbance at the site, it is unlikely that the limited area to be used for the construction and operation of Biosolids Composting Facility represents critical habitat for wildlife species.

#### 4.4 Rare and Endangered Species

In British Columbia, the Conservation Data Centre (CDC) assigns a provincial rank or listing of 'red' or 'blue' to a species based solely on its status within British Columbia (BC Conservation Data Centre, 2004a). The rankings highlight wildlife and plant species as well as natural plant communities that require special attention and the following are the provincial listing categories (BC Conservation Data Centre, 2004a):

- **Red** - any indigenous species, subspecies or plant community that is Extirpated, Endangered, or Threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed.
- **Blue** - any indigenous species, subspecies or community considered to be Vulnerable (Special Concern) in British Columbia. Vulnerable elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered, or Threatened.

Federally, species ranking is conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), established under Section 14 of the *Species at Risk Act* (SARA). COSEWIC is a committee of experts that assesses and designates, under Sections 15 to 21 of SARA, which wild species of animal, plant or other organisms are in danger of disappearing from Canada (Government of Canada, 2004). Below is a listing of the status categories used by COSEWIC to rank or list a species:

- **Extinct** - a species that no longer exists.
- **Extirpated** - a species no longer existing in the wild in Canada, but occurring elsewhere.
- **Endangered** - a species facing imminent extirpation or extinction.
- **Threatened** - a species likely to become endangered if limiting factors are not reversed.
- **Special Concern** - a species that is particularly sensitive to human activities or natural events, but is not an endangered or threatened species.
- **Data Deficient** - a species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.
- **Not At Risk** - a species that has been evaluated and found to be not at risk.

The following listed species are considered to have some potential to exist within the regional study area boundaries:

**Table 2**  
**Listed wildlife species of the Okanagan Area with the**  
**potential to occur on or near the Site**

<b>Species Group</b>	<b>Common Name</b>	<b>COSEWIC status</b>	<b>CDC listing</b>
<i>Birds</i>	American avocet ( <i>Recurvirostra Americana</i> )	N/A	Red
	American bittern ( <i>Botaurus lentiginosus</i> )	N/A	Blue
	American golden-plover ( <i>Pluvialis dominica</i> )	N/A	Blue
	American white pelican ( <i>Pelecanus erythrorhynchos</i> )	Not at Risk	Red
	Barn owl ( <i>Tyto alba</i> )	Special concern	Blue
	Bay-breasted warbler ( <i>Dendroica castanea</i> )	N/A	Red
	Bobolink ( <i>Dolichonyx oryzivorus</i> )	N/A	Blue
	Brewer's sparrow ( <i>Spizella breweri</i> )	N/A	Red
	Burrowing owl ( <i>Athene cunicularia</i> )	Endangered	Red
	California gull ( <i>Larus californicus</i> )	N/A	Blue
	Canyon wren ( <i>Catherpes mexicanus</i> )	Not at Risk	Blue
	Caspian tern ( <i>Sterna caspia</i> )	Not at Risk	Blue
	Ferruginous hawk ( <i>buteo regali</i> )	Special concern	Red
	Flammulated owl ( <i>Otus flammeolus</i> )	Special concern	Blue
	Forster's tern ( <i>Sterna forsteri</i> )	Data Deficient	Red
	Grasshopper sparrow ( <i>Ammodramus savannarum</i> )	N/A	Red
	Great blue heron ( <i>Ardea herodias</i> )	Special concern	Blue
	Gyrfalcon ( <i>Falco rusticolus</i> )	Not at Risk	Blue
	Hudsonian godwit ( <i>Limosa haemastica</i> )	N/A	Red
	Lark sparrow ( <i>Chondestes grammacus</i> )	N/A	Red
	Lewis' woodpecker ( <i>Melanerpes lewis</i> )	Special concern	Blue
	Long-billed curlew ( <i>Numenius americanus</i> )	Special concern	Blue
	Long-tailed duck ( <i>Clangula hyemalis</i> )	N/A	Blue
	Peregrine falcon ( <i>Falco peregrinus</i> )	Threatened	Red
	Prairie falcon ( <i>Falco mexicanus</i> )	Not at Risk	Red
	Red-necked phalarope ( <i>Phalaropus lobatus</i> )	N/A	Blue
	Sage thrasher ( <i>Oreoscoptes montanus</i> )	Endangered	Red
	Sandhill crane ( <i>Grus Canadensis</i> )	Not at Risk	Blue
	Sharp-tailed grouse ( <i>Tympanuchus phasianellus</i> )	N/A	Blue
	Short-eared owl ( <i>Asio flammeus</i> )	Special concern	Blue

**Table 2**  
**Listed wildlife species of the Okanagan Area with the**  
**potential to occur on or near the Site**

<b>Species Group</b>	<b>Common Name</b>	<b>COSEWIC status</b>	<b>CDC listing</b>
<b>Birds</b>	Sprague's pipit ( <i>Anthus spragueii</i> )	Threatened	-
	Surf scoter ( <i>Melanitta perspicillata</i> )	N/A	Blue
	Swainson's hawk ( <i>Buteo swainsoni</i> )	N/A	Red
	Upland sandpiper ( <i>Bartramia longicauda</i> )	N/A	Red
	Western grebe ( <i>Aechmophorus occidentalis</i> )	N/A	Red
	Western screech owl ( <i>Otus kennicottii</i> )	Endangered	Red
	White-headed woodpecker ( <i>Picoides albolarvatus</i> )	Endangered	Red
	White-throated swift ( <i>Aeronautes saxatalis</i> )	N/A	Blue
	Yellow breasted chat ( <i>Icteria virens</i> )	Endangered	Red
	<b>Amphibian</b>	Great basin spadefoot toad ( <i>Spea intermontana</i> )	Threatened
Tiger salamander ( <i>Ambystoma tigrinum</i> )		Endangered	Red
<b>Reptile</b>	Gopher snake ( <i>Pituophis catenifer deserticola</i> )	Threatened	Blue
	Night snake ( <i>Hypsiglena torquata</i> )	Endangered	Red
	Painted turtle ( <i>Chrysemys picta bellii</i> )	N/A	Blue
	Racer ( <i>Coluber constrictor</i> )	N/A	Blue
	Rubber boa ( <i>Charina bottae</i> )	Special concern	-
	Western rattlesnake ( <i>Crotalus viridis</i> )	Threatened	Blue
<b>Mammal</b>	Badger ( <i>Taxidea taxus</i> )	Endangered	Red
	Basin pocket mouse ( <i>Parognathus parvus</i> )	N/A	Blue
	Bighorn sheep ( <i>Ovis Canadensis</i> )	N/A	Blue
	Caribou ( <i>Rangifer tarandus</i> )	Threatened	Red
	Fisher ( <i>Martes pennanti</i> )	N/A	Red
	Fringed myotis ( <i>Myotis thysanodes</i> )	N/A	Blue
	Grizzly bear ( <i>Ursus arctos</i> )	Special concern	Blue
	Northern bog lemming ( <i>Synaptomys borealis</i> )	N/A	Blue
	Spotted bat ( <i>Synaptomys borealis</i> )	Special concern	Blue
	Townsend's big-eared bat ( <i>Plecotus townsendii</i> )	N/A	Blue
	Western harvest mouse ( <i>Reithrodontomys megalotis</i> )	Special concern	Blue
	Western small-footed myotis ( <i>Myotis ciliolabrum</i> )	N/A	Blue
	Wolverine ( <i>Gulo gulo ssp. Luscus</i> )	Special concern	Blue

Source: BC Conservation Data Centre, 2004 (a); Douglas et. al., 2002; Government of Canada, 2004

#### 4.4.1 Vegetation Species of Management Concern

Based on CDC records and the Ministry of Sustainable Resource Management Land and Resource Data Warehouse Catalogue database, there is a record of a rare element occurrence (#14827) on the site. The rare element occurrence is the blue-listed vascular plant species, many-headed sedge (*Carex sychnocephala*). The rare element occurrence was recorded in 1993, and indicates the many-headed sedge is located around the sewage lagoons, and consists of approximately 10,000 plants within a 10 m<sup>2</sup> area. Additional information regarding this rare element occurrence is presented in Appendix II. The CDC records also indicate that rare element occurrence (#7892), blue vervain (*Verbena hastata* var. *scabra*), a red-listed species, was reported near Okanagan Landing in 1977; however, this is considered to be located outside of the study area boundaries for this project.

The CDC has identified five red-listed natural vegetation communities, listed below in Table 3, that are typically found within the very dry hot grassland (IDFxl1a) biogeoclimatic subzone. Therefore, they are considered to have potential to exist within or adjacent to the site. Of the natural vegetation communities listed in Table 3 below, the communities containing bluebunch wheatgrass and sagebrush are considered to provide wildlife habitats that are limited in the north Okanagan, due in part to losses by encroaching urban developments and agricultural pressures from grazing livestock.

**Table 3**  
**Rare natural vegetation communities and listed plant species of the IDFxl1a**  
**Biogeoclimatic subzone with the potential to be found on or adjacent to the site**

	<i>Common name</i>	<i>COSEWIC status</i>	<i>CDC Listing</i>
<b><i>Vegetation Community</i></b>	trembling aspen / common snowberry / Kentucky bluegrass	N/A	Red
	prairie rose / Idaho fescue	N/A	Red
	big sagebrush / bluebunch wheatgrass / balsamroot	N/A	Red
	Idaho fescue / bluebunch wheatgrass	N/A	Red
	bluebunch wheatgrass / balsamroot	N/A	Red

Source: BC Conservation Data Centre, 2004 (a) and (b)

The vegetation communities listed in Table 4 were not observed on the site during the reconnaissance in March 2005. Therefore, based on the site-specific requirements and due to the disturbance from agricultural practices, the likelihood of occurrence of the rare or endangered plant species or natural plant communities occurring at the site is considered to be low.

#### 4.4.1 Wildlife Species of Management Concern

Although the CDC database did not have any specific records for red or blue-listed wildlife species within the site boundaries, there are 4 records of 'masked element occurrences' for wildlife species in the regional study area. Two of the masked element occurrences, #5794 and #5796, identified the red-listed Swainson's hawk (*Buteo swainsonii*), which in 2000 reportedly had nested in the regional study area. Swainson's hawk habitat includes open, dry plains, mountain valleys, and foothills. Swainson's hawk breed mainly in open areas such as grasslands, savannahs, open woodlands, and farmlands; they typically nest in scattered trees in riparian areas, planted shelter belts, wetland borders, abandoned farmyards, or prairie bluffs. There were no trees present on the site, so the potential nesting habitat opportunities at the site or immediate surrounding area is low. However, Swainson's hawk forage mainly on small mammals, including voles, deer mice, ground squirrels, pocket gophers, and also eats large numbers of insects such as grasshoppers. As such, the biosolids composting facility may disturb some foraging habitat for the Swainson's hawk. However, due to agricultural practices on the site the foraging habitat on the site is considered moderate compared to the surrounding natural grasslands. Furthermore, the total footprint of the site disturbance is small, approximately 8.1 hectares, compared to the existing foraging habitat of the surrounding area.

The two other of the masked element occurrences in the area, #25431 and #25792, identified the blue-listed Great Basin gophersnake (*Pituophis catenifer deserticola*). The Great basin gophersnake inhabit grasslands, shrub steppes, and open forests. They typically use abandoned mammal burrows as nesting sites, and rock outcrops for hibernacula. These sites are usually on south facing slopes, with no perennial vegetation. The site and the regional study area contain some limited foraging habitat for the gophersnake. However, considering the critical habitat requirements for these species, and the previous and current agricultural land uses on and immediately surrounding the site, there are likely no nesting or over-wintering habitat for this wildlife species within the site.

## **4.5 Atmospheric Environment**

### **4.5.1 Climate**

The climate in the Okanagan valley is continental, characterized by long warm, dry growing seasons and cool winters with moderate snowfall (Lloyd et al., 1990). The warm, dry climate of the Okanagan valley is created by a rain shadow effect of the Coastal and Cascade mountain ranges. The driest climates of the province lie in the valley bottoms in the lee of the Coastal and Cascade range barrier (<http://srmwww.gov.bc.ca/soils/landscape/1.2climate.html>).

The climate of the site consists of warm to hot summers and cool, moist winters. According to *Canadian Climate Normals, 1971 – 2000 for B.C.* (Environment Canada, 2004), a weather station located in Vernon, B.C. indicated an average annual daily temperature of 8.1° C, with daily mean temperatures ranging from - 4.2° C in January to 19.7° C in July. Total annual precipitation is 409.9 mm, of which 308.0 mm is rain. Approximately 102.9 cm of snow falls each year on average. Winds are predominantly from the south-southeast with an average wind speed is 11 km/hr.

### **4.5.2 Air Quality**

Reports from the British Columbia Ministry of Environment (MOE) have shown that there are periods of poor air quality in the North Okanagan. The Vernon Science Center began gathering data specific to this region in October of 2002. Conclusions from this data, as determined by MOE, are that air quality is an issue that needs addressing and that pollution in the North Okanagan is attributable primarily to two sources: road dust and open burning. There will be no open burning at the site, and all roads will be paved so road dust will not be generated; however, emissions of greenhouse gases (i.e., carbon dioxide from the composting process and vehicle exhaust) are anticipated as result of the biosolids facility. Appropriate control mechanisms and measures to mitigate potential adverse effects to the air quality of the site and the regional study area are discussed in Section 5.0.

### **4.5.3 Odour**

There was no measurement of existing odour levels at the site; however, an increase in odours at the site is anticipated as result of composting process at the biosolids facility. Appropriate measures to mitigate potential adverse effects of odour on the site and the regional study area are discussed in Section 5.0.

#### **4.5.4 Noise**

Existing noise levels at the site were not measured; however, an increase in noise levels from equipment operation are anticipated as result of the biosolids facility. Appropriate measures to mitigate potential adverse effects of noise on the site and the regional study area are discussed in Section 5.0

### **5.0 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES**

#### **5.1 Aquatic Environment**

Adverse effects to the aquatic environment are a potential concern at the site. Nutrient rich (i.e., nitrogen and phosphorus) leachate from biosolids composting sites can eutrophy surface water bodies or enter the groundwater aquifer and render groundwater unfit for human consumption. Consequently, management of leachate at the site is the key component of mitigation measures for the aquatic environment at the site. The following section provides a description of the leachate management at the site.

#### **5.2 Leachate Control**

The mixture of woody debris and dewatered biosolids will be controlled to obtain about a 40% dry solids mixture. As such, the compost mixture on its own will not create leachate. However, leachate could be generated when precipitation comes in contact with the exposed compost placed in windrows on the outdoor paved curing pads. In addition, leachate could be generated when precipitation on paved areas of the site comes in contact with loose compost mixture that has fallen out of the front end loader bucket during transport from the mix building to the aeration pads or from the aeration pads to the curing pads. To control leachate, all precipitation that comes in contact with compost material will be directed into a drainage collection system in the middle of the composting area. The controlled drainage of the collected leachate will then flow into to a two-stage leachate treatment system on the site. The first stage is a sedimentation pond on the upper composting site. This pond will promote the separation of large solids (primarily dirt and/or woody debris), which will subsequently be removed from the pond and recycled back into the composting process.

The second level of leachate treatment will be a combined treatment lagoon and engineered wetland located in the area adjacent to the former sewage lagoons that were once operated by the RDNO. This new treatment lagoon and wetland will have both shallow and deep areas and planted emergent vegetation to treat and polish the leachate. The treated leachate will then be pumped from the lagoon on the basis of a rainfall event

protocol that is designed to maximize the retention time in the lagoon while minimizing the land area required to accomplish the treatment. The discharge from the pumping station will be injected into the force main on Bailey Road that is carrying reclaimed City of Vernon wastewater up to the McKay reservoir where it will remain for approximately two years before being used in a spray irrigation program.

### **5.2.1 Surface Hydrology and Aquatic Habitat**

Surface water runoff from the site during precipitation events or from snowmelt could have potential adverse effects to the adjacent aquatic environments, including Roses Pond, Boltres Creek, and the un-named pond down-gradient and south of the site. When surface or melt water contacts exposed soils, erosion can occur resulting in sediment-laden runoff being conveyed into the adjacent surface water bodies. It is therefore recommended that best management practices (BMP) as outlined in “*Land Development Guidelines for the Protection of Aquatic Habitat*” (DFO and MELP, 1992) be implemented during construction and the ongoing operation of the facility. Specifically, the following sediment and erosion control mechanisms should be implemented to control the potential sediment-laden runoff originating from the site:

- Install runoff control measures (i.e., silt fences) between exposed soils and aquatic habitat to prevent sediment-laden runoff from entering aquatic habitat;
- Wheel washes to control the tracking of sediment and mud from the construction site onto local roads and the highway;
- Direct runoff away from aquatic habitat into sedimentation pond(s) or ditches to enable the settling of elevated sediments from site runoff; and
- Re-vegetate (e.g., hydroseed) exposed soils surfaces with a mix of native grasses and herbs to stabilize slopes and prevent erosion.

Provided the above mentioned measures are implemented, the project is not anticipated to adversely affect aquatic habitat in the regional study area and is not anticipated to result in a “harmful alteration, disruption, or destruction” (HADD) of aquatic habitat, which would otherwise need to be authorized by Fisheries and Oceans Canada (DFO).

### **5.2.2 Groundwater**

Groundwater may be susceptible to potential contamination from spills of deleterious substances (e.g., diesel fuel, oil) during the construction or operation of the biosolids facility. To minimize the potential for deleterious spills or the release of other hazardous materials to the groundwater, it is recommended that the contractor implement spill prevention measures and have spill response materials on site in case of an accident. Spill prevention measures and materials should include and address the following:

- spill or release notification and alerting procedures;
- prepared spill incident report forms;
- containment, recovery, and clean-up procedures;
- on-site spill/release clean-up materials, equipment, and locations; and
- names and telephone numbers of persons and organizations that may be contacted in the event of a potential environmental incident.

General spill prevention provisions can be met by ensuring that machinery used for site clearing and construction of the project is in good repair and free of external oil and grease or other substances that may cause adverse environmental impacts. Furthermore, on-site refueling should be monitored and an effective communication protocol should be followed to minimize potential for accidental release or overfilling of equipment. Secondary containment (i.e., oil-water separator) will be in place in the designated refueling area in case a spill occurs there is second barrier in place to protect groundwater. The oil-water separator should be serviced regularly to ensure it is functioning properly, and if a significant amount of product or sludge has accumulated, it should be pumped out and disposed of appropriately. Inspection and monitoring of product and sludge accumulation in the separator should be conducted quarterly with inspection records kept on site.

Should a reportable spill involving deleterious substances or hazardous materials occur, written incident reports should be submitted to Environment Canada, the Provincial Emergency Program (PEP), the City of Kelowna, and other agencies having jurisdiction within 24 hours. Notification of the Provincial Emergency Program (PEP) may be required if the spill is in a quantity that exceeds amounts listed in *Spill Reporting Regulation* of the *Waste Management Act*. Reporting of spills is regulated (provincially) under the *Spill Reporting Regulation* BC Reg. 263/90 under the *Waste Management Act*.

Groundwater may also be susceptible to potential contamination from nutrient rich leachate. Although the leachate will be contained in the leachate collection system, there is the potential for leakage into the groundwater while in the treatment lagoon and engineered wetland. To help prevent potential contamination of groundwater, the treatment lagoon and engineered wetland should be lined with an impermeable barrier such as a high-density polyethylene (HDPE) geosynthetic liner. To determine if the leachate is adversely affecting groundwater quality, background groundwater monitoring of water quality would be required. In addition, periodic groundwater monitoring would be required during the operation of the facility to determine if leachate is adversely affecting groundwater quality.

## 5.3 Terrestrial Environment

### 5.3.1 Flora

The site does not support native grasslands of either bunchgrass, sagebrush, or any other native vegetation communities that are rare or threatened in the Okanagan. The site has been affected by agricultural and grazing activity. Therefore, with the exception of the known rare element occurrence, it is considered unlikely that red- and blue-listed plant species identified as potentially occurring within the regional study area will be affected by the construction or operation of the biosolids facility. The known rare element occurrence identified on the site, a blue-listed vascular plant (many-headed sedge), should be identified and demarcated. This will protect it from any incidental disturbance during decommissioning of the current sewage lagoon, and the construction of the new leachate lagoon and engineered wetland. However, if disturbance in this area cannot be completely avoided, the individual plant species should be salvaged and re-planted at the treatment lagoon and engineered wetland after construction has been completed.

Additional mitigative measures should include re-vegetation and landscaping of all exposed surfaces to minimize the potential for the proliferation of non-native weed species and to encourage the re-establishment of native trees, shrubs, and grasses.

### 5.3.2 Fauna

Site construction, and operation of the biosolids composting facility may result in adverse effects to typical avian activities such as nesting, breeding, migrating, and overwintering. Potential effects as a result of construction noise, air emissions, heavy equipment use, increased vehicular activity, and increased personnel on site may temporarily alienate or displace avian species such as waterfowl and songbirds. This may result in a potential reduction in nesting activities and breeding success by some bird species during the breeding bird season. Section 34 of the B.C. *Wildlife Act*, and concurrently, Article V of the *Canada Migratory Birds Convention Act* protects birds and their nests.

Scheduling of construction activities should avoid nesting seasons, which in the Okanagan is typically from April 1<sup>st</sup> to July 31<sup>st</sup> of each year. Scheduling construction activities around daily sensitive times for wildlife, such as dawn or dusk, would further reduce the likelihood of sensory interference. Enhancement measures that could be considered include re-vegetation and landscaping with native trees, shrubs, and grasses following construction to enhance habitat for small mammals and birds within the regional study area. In addition, re-vegetation with native vegetation species will help to minimize the potential for the proliferation of non-native weed species such as diffuse knapweed, and dalmation toadflax.

The existing terrestrial wildlife habitat value of the site is considered to be low due to agricultural practices which included crop production. As a result, there is little native vegetation or terrestrial wildlife habitat remaining on site. Although the undeveloped portion of the site may offer some limited food cover for a few wildlife species (i.e., coyote, mice, voles) the site generally lacks the life requisites such as food, nesting or denning, shelter, and cover habitat for a wide range of wildlife species. Furthermore, the subject property does not constitute an integral component of a wildlife corridor, nor does it appear to provide opportunities for connectivity between other ecosystems within the regional study area. Therefore, wildlife and wildlife habitat identified in the Okanagan area are not likely to be adversely affected by the construction and operation activities of the proposed biosolids composting facility.

#### **5.4 Atmospheric Environment**

The atmospheric environment component of the assessment provides a qualitative evaluation of potential air quality effects associated with the proposed project. It also includes a general description of the expected emissions from construction and operation of the facility is provided, along with a discussion of how these emissions could affect neighbouring properties. However, this component of the assessment does not quantify the magnitude of potential adverse effects to air quality as a result of the biosolids project.

##### **5.4.1 Air Quality**

Potential adverse effects to air quality include organic dust, airborne particulate matter, and fungal spores (*Aspergillus fumigatus*) from the composting biosolids, and greenhouse gases from vehicle engine combustion and composting biosolids.

Organic dust, airborne particles, and fungal spores are potential adverse environmental effects to air quality typical of composting operations. The contaminants are primarily a concern to workers at the facility; contaminants are generally not present outside the facility in quantities that would cause reactions in most individuals. As such, to mitigate these potential adverse effects, workers at the facility should wear dust masks or other protective devices, and front end loaders should be equipped with filters or air conditioners. Additional mitigation measures include the following:

- Mechanical sweeping of concrete areas to control dust;
- Physically covering composting windrows with tarps or plastic; and
- Avoid handling composting biosolids during periods of high wind.

During the construction and operation phases heavy equipment (i.e., front-end loaders, transport trucks) will create localized greenhouse gas emissions (i.e., carbon dioxide) that may adversely affect air quality. The types of emissions expected during construction relate to diesel combustion from equipment movement. However, the adverse effects are localized and not expected to contribute substantially to periods of poor air quality in the North Okanagan. Furthermore, the composting facility layout is centralized, which reduces the distance for equipment to travel to transport biosolids across the site, thereby minimizing emissions.

Carbon dioxide, a greenhouse gas, is a byproduct of organic decomposition, and is typical of biosolids composting facilities. Methane is another greenhouse gas that can be produced during composting; however, methane emissions can be controlled by good management practices. The biosolids composting process will be continuously aerated. Therefore, methane production should be negligible if the compost is maintained in an aerobic environment with the proper moisture content. Monitoring these components throughout the process will reduce the production of greenhouse gases that can adversely affect air quality.

#### **5.4.2 Odour**

Composting odors are caused by ammonia, amine, sulfur-based compounds, fatty acids, aromatics, and hydrocarbons from the wood products (bulking agent). Some odour production from this composting operation is anticipated, and can be a nuisance and a potential irritant to nearby residences. The most effective control mechanism is to locate the composting facility with a large buffer between the facility and residential development such that the odour that is generated is not a nuisance. The site is located in a rural agricultural area with a few residences adjacent the site to the north and south, but the nearest major residential development is approximately 3.5 km from the site. As such, the location of the facility in the rural agricultural setting should mitigate the effects of odour on major residential developments; however, given the predominant wind direction from the south-southeast, some nearby rural residences to the north of site could be exposed to odour from the composting facility. Control mechanisms and management practices can control most odour problems at the site; however, some local, periodic adverse effects of odour on the local environment are anticipated.

There are three main sources of odour: odour from transporting the dewatered sludge, odour from the storage and mixing of the sludge, and odour from the composting operations. The initial source of odour will come from the trucks hauling the dewatered sludge to the site from Kelowna and Vernon. These trucks will be specially designed and will have tight covers to minimize the release of odours.

Another source of odour could occur from the sludge trucks that are emptied into the concrete sludge bins in the sludge storage building. There will be a short-term release of fugitive odour during this very short-duration (i.e., 3 to 5 minutes) discharge. The doors on the sludge bin building will then be closed minimizing the release of odour. There is an air extraction fan system on the sludge bin building that will be used to keep the building safe from any gas build up. There will also be dilution air from the mix building entrained with this sludge building air to decrease the concentration of odour. The mix building also has doors that will be kept shut as much as possible and the air extraction fans should help to keep the mix building under negative aeration. Should the discharge of this diluted air cause a problem, provision has been made to add further odour control, either in the form of a biofilter or through UV irradiation (as used throughout the City of Vernon wastewater treatment system) on the northeast corner of the building.

Odour from the composting operation will be controlled through the closed-loop aeration system and operation of the system so that no air is released from the system unless it passes through a compost pile (which will act as a biofilter) under positive aeration (blowing up from the bottom). Finished compost on top of the actively composting piles will be utilised to create the biofilter effect. There will be some odour when the compost piles are taken down and moved to the aerated curing area, but this will typically be of short duration. The aerated curing will be done with positive aeration and the use of a finished layer of compost to act as a biofilter.

Screening will release some odour, but because the screening will occur on cured compost, the odour will be characteristic of the "earthy, musty" odour of fresh top soil and, therefore, will not likely to cause any concern or irritation for nearby residents. However, due to the location of the site in a rural agricultural area with an approximate 3.5 km buffer distance to the nearest major residential developments from the site, it is unlikely the ongoing operation of the facility will generate unacceptable odour. If odour complaints do occur additional control mechanisms such as air scrubbing may be required. In addition, a variety of additional management practices may be employed to reduce odour problems at the site. These may include reducing compost handling during periods of stagnant, humid summer climate conditions, during strong prevailing winds, or during times of the day, such as early morning and early evening, when neighbours are most likely to be outdoors.

### **5.4.3 Noise**

Sound will be generated on the site during both the construction and operation phases of the project. These sounds may be perceived as noise (i.e., unwanted sound) on neighboring properties. There will be two main periods of noise generation associated with the project: the remaining construction of the facility infrastructure and the ongoing

operation of the composting facility. The main source of noise generation during the construction phase will be from the operation of heavy equipment (i.e., excavators, front-end loaders, and transport trucks). The noise generation from trucks and front-end loaders will also occur during the operational phase. Additional noise generation during the operation phase will be from two 60 hp aeration fans, which will be running almost continually, but at varying speeds, depending on the aeration requirements.

The activity with greatest impact on noise levels will be equipment operations. The types of noises heard are dominated by equipment engines; however, miscellaneous short-term and impulse noises (e.g., hammers, back-up beepers, dump truck gates, metallic bangs and clangs) are often heard. Some construction noise is expected to be audible at nearby rural residences south and north of the site; however, construction noise is not expected to be audible at residential developments in Predator Ridge or City of Vernon approximately 3.5 km from the site. In general, site construction of the facility will be restricted to the hours of between 7:00 a.m. to 7:00 p.m. Additional scheduling of various site activities can minimize the impact of noise on neighboring properties. For example, activities that generate noise should be planned during weekdays when there would be fewer people home or participating in recreational activities. All equipment used on site should be fitted with appropriate mufflers and be well maintained in order to minimize noise levels. Additionally, the active portion of the site is in a low lying area, hidden from Commonage Road by a natural berm that will be augmented with tree plantings. These factors will help to mitigate noise from the equipment.

Due to the location of the site in a natural bowl area, and the approximate 3.5 km buffer distance to the nearest major residential developments from the site, it is unlikely the ongoing operation of the facility will generate unacceptable levels of noise at nearby residences. However, if noise complaints do occur, adjustments should be made to site operations to lessen noise levels.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

This Environmental Impact Study report has been prepared to satisfy the requirements for compliance with the Organic Matter Recycling Regulation (OMRR) Part 5 (under section 23(2)&(3), Odour and Leachate Management Plans, Operating and Closure Plans, and Specifications (under section 24) and Environmental Impact Assessments (under section 26(4)). This report included an evaluation of potential effects of the biosolids composting facility on the following physical and biological resources:

- Surface water and groundwater resources;
- Aquatic and terrestrial resources and related habitat;
- Rare and endangered species; and
- Atmospheric resources.

This report does not include a detailed hydrogeological study of groundwater resources.

### 6.1 Conclusions

In summary, this Environmental Impact Study has concluded the following:

- There is some potential for surface water runoff during construction and operation to adversely affect adjacent aquatic habitat during precipitation events and during spring snowmelt.
- Any leachate generated at the facility will be controlled by a leachate collection system and treated on site in a treatment lagoon and engineered wetland.
- Groundwater resources are not expected to be adversely affected due to the leachate collection and treatment system; however, a hydrogeological investigation would be required to determine if the groundwater resources are adversely affected.
- A blue-listed vascular plant, the many-headed sedge, is recorded in the BC Conservation Data Centre database as occurring near the sewage lagoons on the site.
- Construction and operation activities may result in some interference with local wildlife, nesting, breeding, migrating, and overwintering activities, including species listed under the *Species at Risk Act*.
- There are potential adverse effects to air quality from emissions associated with biosolids composting and combustion from heavy equipment.
- Noise from construction and operation activities will likely be audible on properties adjacent to the site, however will typically only occur during regular work hours of 7:00 a.m. to 7:00 p.m., and is not expected to be audible to major residential developments at Predator Ridge or within the City of Vernon.

- Odour from the facility operation is anticipated and will likely be noticeable on properties nearby the project site. Therefore, management controls and mitigation measures should be implemented.

## **6.2 Recommendations**

The following mitigation measures are recommended to further reduce and/or avoid potential for adverse environmental effects occurring during the construction and operation of the biosolids composting project:

- Provide sediment control during construction (e.g., silt fences) to minimize potential for water quality impacts associated with sediment releases and erosion of exposed soils;
- Implement spill prevention measures to minimize the potential for a deleterious spill or release of hydrocarbons or other hazardous materials;
- Schedule construction activities to avoid breeding bird and nesting season and other sensitive wildlife times (i.e., dawn and dusk) to minimize potential impacts to wildlife resources and habitats;
- Re-vegetate exposed surfaces following construction, including utilization of native trees and shrubs to provide habitat for wildlife and discourage the proliferation of noxious weeds;
- Implement recommended controls and best management practices to mitigate the potential adverse effects from noise and odour, and on air quality;
- Construct a leachate control system to collect all leachate and surface water runoff from the site and direct it to a leachate treatment lagoon and engineered wetland for treatment on site; and
- Develop a plan to protect the blue-listed vascular plant, the many-headed sedge, located near the current sewage lagoons and incorporate them into the design of the engineered wetland.

## **6.3 Monitoring Programs**

To oversee and report on the effectiveness of the above-referenced mitigation measures, the following construction and post-construction monitoring programs are proposed to be implemented to evaluate and report on the effectiveness of the mitigation measures, and to help achieve compliance with regulatory requirements and best management practices.

- Environmental Construction Monitoring; and
- Post-construction Monitoring of the re-vegetated areas.

The biosolids composting facility is not anticipated to result in adverse environmental effects if the above-mentioned mitigation measures are implemented.

Yours very truly,

**GOLDER ASSOCIATES LTD.**

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**APPENDIX I**  
**SITE PHOTOGRAPHS**



**Photo 1 : View of the sewage lagoon and Roses Pond west of the site.**



**Photo 2 : View of the un-named pond south of the site. Leachate and Erosion control measures should be constructed to protect this nearby aquatic habitat.**

PROJECT NO. 05-1440-041 DRAWN: GGG REVIEWED BY: DK DATE: 02-20-06 FILE LOCATION: FINAL.....



Site Photos  
Kelowna/Vernon  
Biosolids Project  
Vernon, B.C.

Drawn: DK

App'd: Dk

Date: ~~Mar 20, 2005~~

Figure: 1

**1**

Project No.: 05-1440-041

Revision No.:

PROJECT NO. 05-1440-041 DRAWN: GGG REVIEWED BY: DK DATE: 02-20-06 FILE LOCATION: FINAL\.....



**Photo 3 : View of the site facing north. Note the agricultural land use at the site and the lack of natural vegetation and high quality wildlife habitat.**



**Photo 4 : Limited wildlife (mice or voles) presence was observed at the site.**



Site Photos  
Kelowna/Vernon  
Biosolids Project  
Vernon, B.C.

Drawn: DK

App'd: Dk

Date: ~~Mar 28, 2005~~

Figure: 1

**2**

Project No.: 05-1440-041

Revision No.:

**APPENDIX II**

**RARE AND ENDANGERED SPECIES INFORMATION**

**BC Species and Ecosystems Explorer Search Results****Status****Scientific Name English Name Global Provincial COSEWIC BC Status**

*Carex sychnocephala* many-headed sedge G4 S3 Blue

**Search Summary**

**Time Performed** Mon Feb 20 10:23:46 PST 2006

**Results** 1 records.

**Search Criteria** Species Name: English Name like MANY\*HEADED\*SEDGE  
Species Group:Vascular Plants  
BC Conservation Status:Blue List (Special Concern) or Yellow List (Not at Risk)  
Sort Order:Scientific Name Ascending

**Notes** 1.Citation Guidelines

[Change Criteria](#) | [New Search](#) | [Results](#)



## BC Conservation Data Centre: Species Summary - *Carex sychnocephala*

### IDENTIFIERS

Scientific Name: *Carex sychnocephala*

Author: Carey

English Name: many-headed sedge

Scientific Name - Concept Reference: Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.

Classification Level: Species

Name Category: Vascular Plant

RISC Code: CARESYC

Kingdom	Phylum	Class	Order	Family
Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae

### CONSERVATION STATUS / LEGAL DESIGNATION

Global Rank: G4

Prov. Rank: S3

BC List: Blue

Identified Wildlife:

Provincial Wildlife Act:

COSEWIC Status:

COSEWIC Comments:

SARA Schedule:

National General Status:

### INVENTORY

Inventory Priority:

Ownership of occurrences (Known locations):

Inventory Need:

Inventory Comments:

### DISTRIBUTION

BGC: BGxh - Bunchgrass - Very Dry Hot  
 BGxw - Bunchgrass - Very Dry Warm  
 IDFdk - Interior Douglas-fir - Dry Cool  
 IDFdm - Interior Douglas-fir - Dry Mild  
 IDFMw - Interior Douglas-fir - Moist Warm  
 IDFxh - Interior Douglas-fir - Very Dry Hot  
 IDFXm - Interior Douglas-fir - Very Dry Mild  
 MSdk - Montane Spruce - Dry Cool  
 PPxh - Ponderosa Pine - Very Dry Hot  
 SBPSxc - Very Dry Cold  
 SBSdk - Dry Cool

Forest District: Chilcotin Forest District (DCH)  
 Columbia Forest District (DCO)  
 Cascades Forest District (DCS)  
 Kamloops Forest District (DKA)  
 Okanagan Shuswap Forest District (DOS)  
 Rocky Mountain Forest District (DRM)  
 Vanderhoof Forest District (DVA)

Endemic:

Global Range Comment: Ont. to B.C., south to NY, IA, MT, and WA. Sparse.

Regional Distribution:

Disjunct, more common elsewhere:

Peripheral, major distribution elsewhere:

Global Latitudinal Zone:

Prov. Latitudinal Zone:

## **ECONOMIC ATTRIBUTES**

Global Crop relative:

Prov. Crop relative:

Global Commercial Importance:

Prov. Commercial Importance:

Global Negative Attributes:

Prov. Negative Attributes:

Global Production Methods:

Prov. Production  
Methods:

Global Economic  
Use:

Prov. Economic  
Use:

Global Economic  
Comments:

Prov. Economic  
Comments:

Genus Economic  
Value:

## ECOLOGY & LIFE HISTORY

**General Description:** Many-headed Sedge forms clumps without rhizomes and has slender stems that are 5-50 cm high. The lowest leaves are reduced to scales; the upper are flat and 1-4 mm wide. Flowers occur in 4-15 globose spikes clustered together at the top of the stem. The lower spikes are subtended by long, leaf-like bracts that greatly surpass the inflorescence. Inconspicuous male flowers (recognized by the old stamens) occur at the base of each spike. Pale green or tan perigynia are 5-7 mm long and ca. 1 mm wide and narrowly lance-shaped with a long beak and serrated margins. The pale, thin, lance-shaped scales have a green midvein and are ca. 1/2 the length of the perigynia that they subtend. There are 2 styles, and the achenes are 2-sided.

Technical  
Description:

**Diagnostic Characteristics:** The combination of long, leaf-like lower bracts, and long, narrow perigynia is distinctive.

Subspecies  
Comments:

Identification  
Comments:

Look-alikes:

Global  
Reproduction  
Comments:

Prov.  
Reproduction  
Comments:

Global Ecology  
Comments:

Prov. Ecology  
Comments:

Habitats-Marine:

Habitats-  
Lacustrine: Shallow water

Habitats-  
Estuarine:

Habitats- HERBACEOUS WETLAND

Palustrine: Riparian

Habitats-Riverine:

Habitats- Terrestrial: Bare rock/talus/scree  
Grassland/herbaceous

Global Habitat  
Comments:

Prov. Habitat  
Comments:

Prov. Seasonal  
Phenology:  
(1st half / 2nd  
half)

Global Phenology  
Comments:

Prov. Phenology  
Comments:

Prov. Min / Max /  
Elevation (m):

Soil  
Characteristics -  
Moisture:

Soil  
Characteristics -  
pH:

Soil  
Characteristics -  
Texture:

Geologic  
Substrate:

Known Pests:

Nitrogen Fixation:

Tolerance:

Pollen Vector:

Pollinator:

Dispersal:

#### **VERSION**

Prov. Version  
Author:

Prov. Version  
Date:

Last Literature  
Search:

#### **GLOBAL REFERENCES**

Lesica, P. and J. S. Shelly. 1988. The vegetation and flora of glaciated prairie potholes on the Blackfeet Indian Reservation, Montana: Progress report. Unpublished report to the Montana Nature Conservancy, Helena, MT. 19 pp.

#### PROVINCIAL REFERENCES

Douglas, G.W., D. Meidinger, and J. Pojar, eds. 2001. Illustrated Flora of British Columbia, Vol. 6, Monocotyledons (Acoraceae through Najadaceae). B.C. Minist. Environ., Lands and Parks, and B.C. Minist. For., Victoria, BC. 361pp.

Please visit the website <http://srmwww.gov.bc.ca/atrisk/toolintro.html> for definitions of the data fields used in this summary report.

**Citation:** B.C. Conservation Data Centre. 2006. Species Summary: *Carex sychnocephala*. B.C. Minist. of Sustainable Resour. Manage. Available: <http://srmapps.gov.bc.ca/apps/eswp/> (accessed Feb 20, 2006).



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# SPECIES AT RISK

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## Great Basin Gophersnake

*Previous names: Great Basin Gopher Snake*

**Scientific name:** *Pituophis catenifer deserticola*  
**Taxonomic group:** Reptiles  
**Range:** BC

**Status under SARA\*:** Threatened, on Schedule 1  
**Last COSEWIC\*\* designation:** Threatened (May 2002)

\*SARA: The Species at Risk Act

\*\*COSEWIC: The Committee on the Status of Endangered Wildlife in Canada

**Quick Links:** | [Taxonomy](#) | [Photo](#) | [Description](#) | [Distribution and Population](#) | [Habitat](#) | [Biology](#) | [Threats](#) | [Protection](#) | [Recovery Initiatives](#) | [Population Estimates](#) | [Recovery Team](#) | [National Recovery Program](#) |



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### Taxonomy

There are three subspecies of *Pituophis catenifer* recognized in Canada: the Bullsnake *P.c. sayi*; the Great Basin Gophersnake *P.c. deserticola*; and the Pacific Gophersnake *P.c. catenifer*.

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### Description

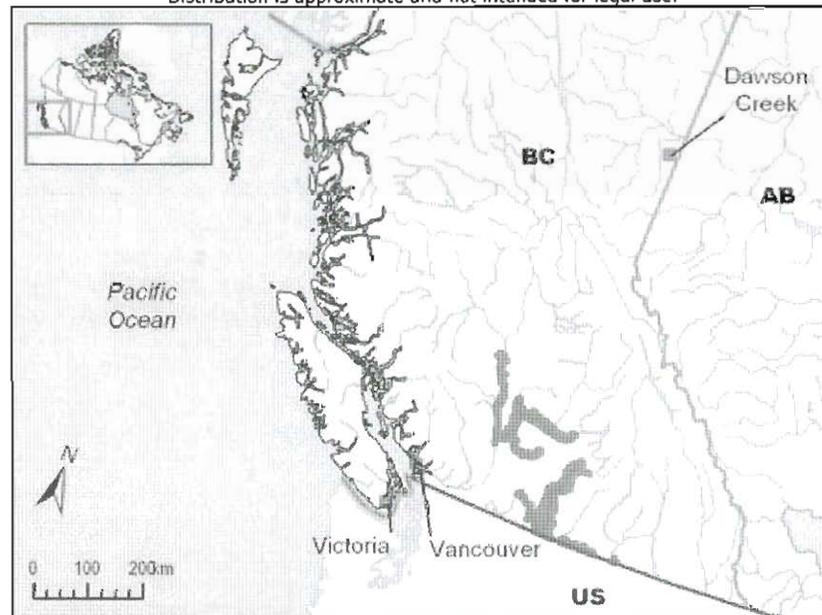
This species of snake (*P. catenifer*) is relatively large, with a moderately long tail; adults in the northwestern part of the range are smaller than those in the south, but can still reach 1.8 m. The background colour is yellowish, with black, brown, or red-brown dorsal blotches, usually more widely spaced on the tail than the body. A dark line runs across the head in front of the eyes. The dorsal scales are ridged, while those on the sides and undersurface are smooth.

On the Great Basin Gophersnake, the dorsal blotches toward the front of the body are connected to each other; they are separated in the Pacific Gophersnake. The belly is cream-coloured with black or brown spots on the sides of the body. Males and females are not significantly different in size, and the young resemble the adults in colour.

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### Canadian Distribution of the Great Basin Gophersnake (shown in red)<sup>1,2</sup>

Distribution is approximate and not intended for legal use.



<sup>1</sup> Author: Canadian Wildlife Service, 2004

<sup>2</sup> Data Sources: The main source of information and data is the COSEWIC Status Report. In many cases additional data sources were used; a complete list will be available in the future.

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**Distribution and Population**

The Great Basin Gophersnake is distributed throughout the western United States and reaches its northern limit in southern British Columbia. There are five separate populations within the interior of the province, four of which are connected to populations south of the Canada-United States border. The most northerly population, however, has become completely isolated from the remainder of the range.

There are no population estimates available for the Great Basin Gophersnake, and the British Columbia Conservation Data Centre has fewer than 100 occurrences on record.

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**Habitat**

Canadian populations of the Great Basin Gophersnake inhabit grasslands, shrub steppes, and open forests. Summers in the Okanagan Valley are hot and dry, and the winters are comparatively mild with little snow. In the United States, studies in Utah revealed that the Great Basin Gophersnake typically uses the abandoned burrows of mammals as nesting sites. These sites usually are on south-facing slopes, with no perennial vegetation.

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**Biology**

Great Basin Gophersnakes are typically active during the day. However, when it is very hot, they switch to being active at night. They are constrictors, squeezing prey with their coils until it suffocates. They feed mostly on small mammals, birds, birds' eggs, and other snakes.

Mating takes place after the snakes emerge from hibernation. The eggs are laid in mid-July and have smooth shells. Their number is related to the female's size, and ranges from two to eight in British Columbia. Nesting sites often are shared with other snakes of the same or different species. Roughly equal numbers of males and females hatch in the fall. The young shed their skin soon after hatching, but probably do not feed until spring. One study in British Columbia revealed that almost 40% of females were not carrying fertilized eggs. This observation is consistent with populations occurring at the edge of a species' range, and would suggest that females do not reproduce every year. This low reproduction would limit the ability of a population to grow or recover from a decline.

Hibernation in British Columbia is apparently from late September/mid-October until late March/mid-April. Hibernation sites may be a considerable distance from the habitat where the snakes spend the summer (an average of 933 m in one BC study); and this distance usually is traveled in a relatively short time (typically a few days). Males begin returning to the hibernacula at the end of July, while females appear in September.

When agitated, Gophersnakes will hiss loudly and may flatten

their heads and vibrate their tails. This behaviour sometimes results in these snakes being mistaken for rattlesnakes and killed.

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### Threats

Degradation or loss of habitat is the most important factor in the decline of the Great Basin Gophersnake. Suitable habitat is present in only a very small area in the province, where it is being rapidly destroyed by urbanization and cultivation. Humans also are a direct threat to the Great Basin Gophersnake. These snakes are inadvertently killed on roads, and purposely killed because many people dislike and fear snakes (especially those that resemble rattlesnakes).

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### Protection

The Great Basin Gophersnake is protected under the federal *Species at Risk Act* (SARA). More information about SARA, including how it protects individual species, is available in the *Species at Risk Act: A Guide*.

The *Wildlife Act* of British Columbia prohibits the collection, handling, and trade of all native wildlife species without a permit; but does not provide habitat protection.

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### Recovery Initiatives

#### Status of Recovery Planning

##### Recovery Strategies:

**Name:** Draft Recovery strategy for Great Basin Gophersnake (*Pituophis catenifer deserticola*)

**Status:** Draft completed

**Number of Action Plans:** 0

**Name:** Recovery Strategy for Species at Risk in the South Okanagan and Lower Similkameen Valleys of BC: Towards integrating the landscape-level and single-species approaches to conservation

**Status:** Draft completed

**Number of Action Plans:** 0

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#### Population Estimates

decreasing	3000-5000 adults	
------------	------------------	--

### Recovery Progress and Activities

#### Summary of Progress to Date

The goals of the SOSCP are to (1) maintain a diversity of habitats that will sustain ecosystem function; (2) maintain viable populations of all native species in the ecosystem; and (3) balance the ecological, economic, and social needs of local communities in the area. The draft strategy ([www.soscp.org/media/Sokrecovery.pdf](http://www.soscp.org/media/Sokrecovery.pdf)) integrates a landscape-level approach to conservation planning with species-specific recovery planning.

Since the SOSCP started in the 1980s substantial progress has been made in the protection and restoration of natural habitat, including landowner awareness of stewardship practices that protect habitat for species at risk. Over this time, knowledge has been gathered on local species at risk, the ecosystems upon which they depend, and conservation practices that can protect them. However, over the same twenty years, a great deal of habitat has been lost, as urban and agricultural developments have grown. The need to protect remaining parcels of natural habitat and to improve stewardship of agricultural and other modified lands is as urgent as ever.

### **Summary of Research/Monitoring Activities**

Research projects conducted under SOSCP's "umbrella" have attempted to answer questions at the ecosystem level, the habitat level and the species level. For example, one project is evaluating the use of a computer modeling technique for identifying sets of areas across the landscape that, if protected, would provide the greatest contribution of biodiversity to existing conservation networks. This project is helping to prioritize areas to focus conservation effort. A project at the habitat level is comparing the effect of several cattle grazing prescriptions on plant communities that provide habitat for endangered or threatened plants and animals. Results from this research will be used to produce recommendations for "biodiversity friendly grazing practices". Research at the species level includes assessments of endangered species' habitat requirements as well as other projects informing species-level recovery planning.

The result of years of research, the Habitat Atlas for Wildlife at Risk in the South Okanagan and Lower Similkameen (<http://wlapwww.gov.bc.ca/sir/fwh/wld/atlas/index.html>) includes 32 species accounts with descriptions of threats and management recommendations. The Habitat Atlas also describes broad habitat types, activities that degrade these habitats and stewardship options available to landowners.

Many SOSCP conservation initiatives include a research and monitoring component in order to continually improve the techniques used for habitat protection and restoration. For example, the Nature Trust is currently testing the relative effectiveness of chemical, mechanical and biological agents for controlling invasive weeds on its properties.

### **Summary of Recovery Activities**

SOSCP partners facilitate private land stewardship in numerous ways. Stewardship information is provided on-line, at habitat restoration workshops and other public events, and outreach also takes place at the habitat interpretation centre operated by the Osoyoos Desert Society. Landowners and land trusts work together to establish stewardship agreements, conservation covenants, and management prescriptions that conserve and restore habitat on their property. Several organic farms, orchards and vineyards have signed agreements with The Land Conservancy (TLC) as "Conservation Partners". In recognition of their protection and enhancement of habitat, these producers receive a Conservation Partners label for their products. Similarly, the Nature Trust of BC has worked with ranches in this region to integrate conservation activities with grazing.

TLC, the Nature Trust and the Nature Conservancy of Canada also acquire properties for conservation and restoration by donation or purchase. Public involvement is necessary for such initiatives and fundraising by land trusts is on-going.

The En'owkin Centre (Okanagan Indian Educational Resources Society) has embarked on a land-use planning and restoration project for First Nations Lands, which provide crucial habitat for many species at risk. Input will also be provided to recovery teams based on the work of Traditional Ecological Knowledge councils and traditional conservation practices.

In 2005, the SOSCP began a two-year project to support local decision makers in the development of environmental policy for the Regional Growth Strategy. The SOSCP provides expert knowledge in conservation science and conservation policy, and will identify knowledge gaps that need to be filled to evaluate policy options.

#### URLs

<http://www.soscp.org/media/Sokrecovery.pdf>

<http://wlapwww.gov.bc.ca/sir/fwh/wld/atlas/index.html>

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### **Recovery Team**

#### **South Okanagan - Similkameen Conservation Program Recovery Team**

##### **Ken Brock - Chair - Environment Canada**

Phone: 604-940-4690 Fax: 604-946-7022 [Send Email](#)

##### **Trish Hayes - Chair - Environment Canada**

Phone: 604-940-4658 Fax: 604-946-7022 [Send Email](#)

#### **Southern Interior Reptile-Amphibian Recovery Team**

##### **Christine Bishop - Chair - Environment Canada**

Phone: 604-940-4671 Fax: 604-946-7022 [Send Email](#)

**Orville Dyer - Chair - Government of BC**

Phone: 250-490-8244 [Send Email](#)

David Cunnington - Member - Environment Canada

Laura Friis - Member - Government of BC

Ron Hall - Member - Aboriginal group

Stephen Hureau - Member - Environment Canada

Karl Larsen - Member - University or college

Pippa Shepherd - Member - Parks Canada

John Surgenor - Member - Government of BC

Bryn White - Member - University or college

**Southern Interior Reptiles and Amphibians Recovery Team**

**Orville Dyer - Chair - Government of BC**

Phone: 250-490-8244 [Send Email](#)

Christine Bishop - Member - Environment Canada

David Cunnington - Member - Environment Canada

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Last update: 2006-02-14

[Important Notices](#)

URL of this page:

[http://www.speciesatrisk.gc.ca/search/speciesDetails\\_e.cfm?  
SpeciesID=722](http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=722)

## BC Species and Ecosystems Explorer Search Results

### Status

#### Scientific Name English Name Global Provincial COSEWIC BC Status

<i>Buteo swainsoni</i>	Swainson's Hawk	G5	S2B	Red
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### Search Summary

**Time Performed** Mon Feb 20 15:52:30 PST 2006

**Results** 1 records.

**Search Criteria** Species Name: Scientific Name or English Name like SWAINSON'S\*HAWK  
 Species Group:Birds  
 BC Conservation Status:Red List (Extirpated, Endangered, or Threatened) or Blue List (Special Concern) or Yellow List (Not at Risk)  
 Sort Order:Scientific Name Ascending

**Notes** 1.Citation Guidelines

[Change Criteria](#) | [New Search](#) | [Results](#)



## BC Conservation Data Centre: Species Summary - *Buteo swainsoni*

### IDENTIFIERS

Scientific Name: *Buteo swainsoni*

Author: Bonaparte, 1838

English Name: Swainson's Hawk

Scientific Name - Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.

Classification Level: Species

Name Category: Vertebrate Animal

RISC Code: B-SWHA

Kingdom	Phylum	Class	Order	Family
Animalia	Craniata	Aves	Falconiformes	Accipitridae

### CONSERVATION STATUS / LEGAL DESIGNATION

Global Rank: G5

Prov. Rank: S2B

BC List: Red

Identified Wildlife:

Provincial Wildlife Act:

COSEWIC Status:

COSEWIC Comments:

SARA Schedule:

National General Status: 3 - Sensitive

### DISTRIBUTION

BGC: BG - Bunchgrass  
IDF - Interior Douglas-fir

Forest District: Cascades Forest District (DCS)  
Kamloops Forest District (DKA)  
Okanagan Shuswap Forest District (DOS)  
Skeena Stikine Forest District - Bulkley component (DSS\_B)

Endemic:

Global Range Comment: BREEDS: known to have bred in east-central Alaska east into Yukon Territory and extreme northwestern Mackenzie; central Alberta, central Saskatchewan, southern Manitoba, western and southern Minnesota, and western Illinois south (mainly east of Cascades and Sierra Nevada) to southern California (rarely), Baja California (formerly), Sonora, Durango,

Chihuahua, central and southern Texas and western Missouri; eastern breeding limits unstable. WINTERS: according to AOU (1983), primarily on pampas of southern South America (south to Uruguay and Argentina), irregularly north to Costa Rica and Panama, casually or irregularly north to the southwestern U.S. (especially Texas) and southern Florida.

## ECOLOGY & LIFE HISTORY

### General

Description:

### Diagnostic

Characteristics:

### Subspecies

Comments:

### Identification

Comments:

### Global

Reproduction

Comments:

Egg dates: mainly April-May in southwestern U.S., California, and Oregon; mainly May-June in central plains states and Canada. Clutch size usually is 2-3. Incubation lasts 34-35 days per egg, almost exclusively by female (male provides food). Young are tended by both adults, leave nest in about 30 days, attain flight at 42-44 days (around 3rd week in July in southwestern U.S.), dependent on parents for 4-4.5 weeks after fledging. First breeds at 2 years. Usually 0.1-0.2 pairs per sq km; average of 1.4-2.4 km between nests. See Bednarz (1988) for information on reproduction in New Mexico. Reported nest density throughout range varies from 0.08-1.61 nests per sq km.

### Prov.

Reproduction

Comments:

### Global Ecology

Comments:

May form premigratory aggregations in summer. Nesting density in suitable habitat varies throughout range from 0.1-1.6 nests per 10 sq km (Bednarz and Hoffman 1988); nests average 1.4-2.4 km apart (see Rothfels and Lein 1983). At one site in California, five nests typically found along a 1 km riparian strip, the nearest nests only 60 meters apart (England et al. 1997). Home ranges during breeding season vary greatly--from 69 to 8718 hectares (reviewed in England et al. 1997). Interspecific territoriality with Red-tailed Hawk in some areas; in other areas may compete with Ferruginous Hawk or be limited by presence of and predation by Great Horned Owl (Palmer 1988).

In California, dispersal distances from natal sites to subsequent breeding sites ranged from 0 to 18 kilometers, mean 8.8 kilometers (Woodbridge et al. 1995). In contrast, none of 697 banded nestlings in Saskatchewan returned to the study area; three were found 190, 200 and 310 kilometers away (Houston and Schmutz 1995).

### Prov. Ecology

Comments:

### Migration

Characteristics:

(Global / Prov.)

Nonmigrant: N /  
Local Migrant: N /  
Distant Migrant: Y /  
Within Borders Migrant: na /

### Global

Mobility/Migration

Comments:

In migration, occurs regularly in most of Middle America, and rarely east along the Gulf Coast to Florida (AOU 1983). In California, migrates March-early May, with a peak in the first half of April, and September-October (Biosystems Analysis, Inc. 1989). Migrants are greatly concentrated as they pass through Panama (mostly March-early April and October-early November; Ridgely and Gwynne 1989). Migrates through Costa Rica late September-November and late February-early May (Stiles and Skutch 1989). In Colombia, flocks of various sizes reported mainly February-March and September-early November (Hilty and Brown 1986). Main northward migration passes through Panama in mid-March, Veracruz in

latter half of March and early April, southern Texas and southwestern U.S. chiefly in April (Palmer 1988); fall concentrations and movements occur in August-September in the north, mainly early October in Texas; peak in migration occurs in September in the southwestern U.S.; arrives in Argentina in late November (Palmer 1988). Annual migration flight may be 18,000-27,000 km, encompasses 4 months of the year. See Houston (1990) for information on migrations of Saskatchewan breeders. Migrates in large, often immense, flocks. Migrates over terrain where updrafts provide needed buoyancy for soaring. May roost at night on ground during migration.

Prov.

Mobility/Migration  
Comments:

Habitats-Marine:

Habitats-  
Lacustrine:

Habitats-Special  
Habitat Factors:

Habitats-  
Subterranean:

Habitats-  
Estuarine:

Habitats-  
Palustrine: Riparian

Habitats-Riverine:

Habitats-  
Terrestrial: Cropland/hedgerow  
Desert  
Grassland/herbaceous  
Savanna  
Woodland - Mixed

Global Habitat  
Comments: Savanna, open pine-oak woodland and cultivated lands (e.g., alfalfa and other hay crops, and certain grain and row croplands) with scattered trees. Tolerates extensive cultivation in nesting area (Schmutz 1989), though vineyards, orchards, rice, corn, and cotton are not suitable foraging habitat. In migration and winter also in grasslands and other open country (AOU 1983). Migrants may roost at night on ground in very large fields (Ridgely and Gwynne 1989). Nests typically in solitary tree, bush, or small grove; many nests on old black-billed magpie nests; sometimes on rock ledge. Readily nests in trees in shelterbelts and similar situations produced by humans (Gilmer and Stewart 1984). Recently reported nesting in city trees and on railway signal gantry in Regina, Saskatchewan (Condor 94:773-774). In the Central Valley of California, nests often are within one mile of a riparian zone; Great Basin nests, usually in junipers, are not near riparian zones (Biosystems Analysis, Inc. 1989). Evidently often returns to area where it nested in previous year.

Prov. Habitat  
Comments:

Food Habits: Carnivore: Adult, Immature  
Invertivore: Adult, Immature

Global Food  
Habits Comments: Vertebrates (mainly mammals) dominate the diet during the breeding season; invertebrates (especially crickets and grasshoppers) are common food at other times and sometimes for nonbreeders in summer. Hawks wintering in Argentina ate mainly dragonflies (Condor 95:475-479, Wilson Bull. 105:365-366). Mammals consumed often include young ground squirrels and pocket gophers. Depending on availability, also eats other small mammals, snakes, lizards, birds, amphibians, and some carrion (e.g., road kills). Hunts for insects on ground; may also catch insects in air. Hunts while soaring or from perch. Does not feed during most of migration (occasional feeding during initial and terminal stages) (Palmer

1988).

Prov. Food Habits  
Comments:

Global Phenology: Diurnal: Adult, Immature

Prov. Seasonal  
Phenology:  
(1st half / 2nd  
half)

Global Phenology  
Comments:

Prov. Phenology  
Comments:

Colonial Breeder: N

Length(cm)/width  
(cm)/Weight(g): 53 / / 1069

Global Min / Max /  
Elevation (m):

Prov. Min / Max /  
Elevation (m):

#### VERSION

Prov. Version  
Author:

Prov. Version  
Date:

#### GLOBAL REFERENCES

American Ornithologists' Union (AOU), Committee on Classification and Nomenclature. 1983. Check-list of North American Birds. Sixth Edition. American Ornithologists' Union, Allen Press, Inc., Lawrence, Kansas.

Bechard, M. J., R. L. Knight, D. G. Smith, and R. E. Fitzner. 1990. Nest sites and habitats of sympatric hawks (BUTEO spp.) in Washington. *J. Field Ornithol.* 61:159-170.

Bednarz, J. C. 1988. A comparative study of the breeding ecology of Harris' and Swainson's hawks in southeastern New Mexico. *Condor* 90:311-323.

Bednarz, J. C. 1988. Swainson's hawk. Pages 87-96 in Glinski et al., eds. Proc. Southwest Raptor Manage. Symp. and Workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.

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Please visit the website <http://srmwww.gov.bc.ca/atrisk/toolintro.html> for definitions of the data fields used in this summary report.

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