# Mission Creek Restoration Initiative (MCRI) Monitoring Report

## MCRI Partnership Project



ECOSCAPE
Environmental Consultants Ltd.

**Prepared For:**
**Mission Creek Restoration Initiative**

**Prepared By:**
**Ecoscape Environmental Consultants Ltd.**

**November, 2015**

**File No.: 14-1257**

# Mission Creek Restoration Initiative (MCRI) Monitoring Report

***MCRI Partnership project***

Prepared For:

MISSION CREEK RESTORATION INITIATIVE
c/o: Joanne de Vries
Fresh Outlook Foundation
12510 Ponderosa Road
Lake Country, BC V4V 2G9

Prepared By:

ECOSCAPE ENVIRONMENTAL CONSULTANTS LTD.
102 - 450 Neave Court
Kelowna, BC V1V 2M2
(250) 491-7337
ecoscape@ecoscapeltd.com

November, 2015

File No. 14-1257

## TABLE OF CONTENTS

**LIST OF TABLES**



**LIST OF FIGURES**



**MAPS**

**APPENDICES**

## 1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by the Mission Creek Restoration Initiative (MCRI) to conduct baseline biophysical inventories for selected ecological resources, including wildlife and plant species of management concern, along a section of Mission Creek between Casorso Road and Gordon Drive, in Kelowna, BC (Study Area shown on Map 1). The Terms of Reference (TOR) outline a scope of work that includes a comprehensive suite of biophysical inventories for various wildlife with a focus on identified species of concern. The following report provides a summary of the project results, data analysis, and a monitoring framework to involve volunteer and public participation that will allow the detection of community and population change over time. The report also includes avoidance and mitigation strategies for future landuse planning, including the proposed re-location of dikes, construction of spawning channels, and other forms of restoration or enhancement.

Photo 1. Oxbow channel off the right bank (looking downstream) opposite Mission Recreation Park.

## 2.0 PROJECT BACKGROUND

The MCRI partnership goal is to restore natural ecological function to Mission Creek and associated aquatic and riparian environments within the Study Area, with a focus on restoration of fish and wildlife habitat. Key objectives include the enhancement of local biodiversity, improvement of flood protection, and identification and protection of species at risk. The restoration efforts are meant to involve local communities and public stewardship, including government, First Nations, non-profit organizations, and naturalist groups. The MCRI vision is summarized as:

*"Restoring and protecting Mission Creek to enrich historical, ecological, and recreational values for the Okanagan."*

The scope of work for this project generally includes project meetings, background review of existing data and literature, gap analysis, as well as fieldwork planning, execution, and data analysis. The results of statistical analysis have been used to produce summary statistics for wildlife communities and to form a basis for monitoring and landuse planning strategies.

### 2.1 Project Objectives

The overall objectives of the MCRI can be summarized with the mission statement, which includes the following:

- Restore fish and wildlife stocks and habitat;
- Conserve and expand biodiversity and protect species at risk;
- Improve flood protection;
- Inspire and support community stewardship; and
- Nurture partnerships and secure funds that support Mission Creek restoration.

To that end, the key project objectives include the following restoration goals:

- Setting back the dikes to widen the Mission Creek channel;
- Re-establish the historic floodplain;
- Reconnect remnant oxbows;
- Restore creek banks and plant riparian vegetation;
- Create wetlands and habitat for species at risk;
- Maintain the Mission Creek Greenway and public access to the greenway; and
- Improve drainage for agricultural land.

The baseline biophysical inventory is part of Stage 2 (Creek Restoration) of the MCRI project and is meant to identify the presence and distribution of wildlife and ecological communities of concern within the identified Study Area to help develop mitigation and avoidance strategies for future landuse planning, including the

construction of setback dikes. The information will be used to inform and guide engineering plans, opportunities for public involvement, and develop performance monitoring parameters.

## 2.2 Legislative Framework

The following section provides a summary of various governmental levels of legislation that will regulate and guide the proposed restoration works. Other guidance documents and best practices are also provided.

### 2.2.1 Federal

- *Fisheries Act*
- *Canada Wildlife Act*
- *Migratory Birds Convention Act*
- *Species At Risk Act*
- *Canadian Environmental Assessment Act*
- *Canadian Environmental Protection Act*
- *Navigable Waters Act*

### 2.2.2 Provincial

- *Water Act* (Section 9, Section 8)
- *Sustainable Water Use Act* (2016)
- *Dike Maintenance Act*
- *Wildlife Act*
- *Environmental Management Act*
- *Environmental Assessment Act*
- *Fish Protection Act* (Riparian Areas Regulation)
- Tree Replacement Criteria

### 2.2.3 Municipal

- *Local Government Act*
- Kelowna 2030: Greening our Future Official Community Plan
- RDCO Official Regional Park Plan
- RDCO Regional Growth Strategy
- Zoning and Bylaws
- Erosion and Sediment Control Instream Works (City of Kelowna)
- City of Kelowna Natural Environment Development Permit

### 2.2.4 First Nations

- Westbank First Nation
- Okanagan Nation Alliance

### 2.2.5 Best Management Practices

- Develop With Care (2014)
- Guidelines for Amphibian and Reptile Conservation during Urban and Rural Development in British Columbia (2014)
- Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia
- Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013)
- Standards and Best Management Practices for Instream Works (2004)
- Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia (2009)
- Best Management Practices for Tree Topping, Limbing and Removal in Riparian Areas (2006)
- Best Management Practices for Invasive Plants in Parks and Protected Areas of British Columbia (2011)

### 2.2.6 Other Guidelines

- Mission Creek Water Use Plan (2010)
- Mission Creek Community Watershed Adaptive Management Plan (2001)
- Kelowna Wetland Habitat Management Strategy (1998)
- BC Wetland Action Plan (2010)
- Wetlands in BC: A Primer for Local Governments (2010)
- Adapting Watershed Tools to Protect Wetlands (2005)
- Canada - BC Environmental Farm Plan (EFP) Program Drainage Management Guide (2005)
- Stormwater Planning: A Guidebook for British Columbia (2002)
- Green Bylaws Toolkit (2007)

## 3.0 METHODOLOGY

As indicated in the TOR, field studies were designed, planned, and undertaken with the objective of identifying all occurrences of species through complete coverage of potential habitats to determine if specific species are at risk of being adversely affected by proposed restoration works. Data collection was conducted using the provincial Resources Information Standards Committee (RISC) protocols as a basis for all inventories.

## 3.1 Data Compilation

Prior to conducting the field inventories, Ecoscape conducted a review of available background data related to previous biophysical inventories and identified species and ecosystems of concern within the Study Area and surrounding lands. The review included data from the following sources:

- Sensitive Habitat and Inventory Mapping (SHIM)
- City of Kelowna Wetland Inventory and Mapping (WIM)
- Sensitive Ecosystems Inventory (SEI)
- RDCO Regional Parks Biophysical Inventory (Mission Creek Greenway)
- Wildlife Tree Stewardship Program (WiTS)
- Environmental Development Permit Areas
- Mission Creek Ranch oxbow topographic survey
- Terrestrial Ecosystem Mapping (TEM)
- Conservation Data Centre (CDC) occurrence records
- BC Species and Ecosystems Explorer
- Fisheries Information Summary System (FISS)

From the data collection and background review, a gap analysis was completed to help focus and refine the planning of the biophysical inventories. In general, the inventories were planned to address the presence, use, and distribution of fish, wildlife, plants, and ecological communities that are known to occur or have the potential to occur within the Study Area. Prior to conducting surveys, a map of ecosystem polygons was developed to help plan surveys (Map 2). A map of aquatic features and wetland habitats (from the Kelowna WIM) was also produced (Map 3).

## 3.2 Biophysical Inventory Work Plan

The fieldwork program was developed based on the results of the background review and gap analysis, as well as discussions with the MCRI and project partners. All field program protocols were developed using the Resources Information Standards Committee (RISC) standards, except where otherwise noted. Our general work plan methodology for the biophysical inventories is summarized below.

### 3.2.1 Sample Stations

Sample stations were selected in a systematic, non-random way to maximize coverage of the Study Area based upon the fixed radius associated with aural point count stations for birds (songbirds and owls) and amphibians. The Study Area was stratified into distinct habitat types to help determine sample station locations based on associations with the wildlife species of interest (RISC 1998). A total of 30 sample stations were created and are depicted on Map 4.

### 3.2.2 Data Forms

Ecoscape created point count forms for songbirds and amphibians for recording observation data. A variable radius point count form was used as a basis for mapping observations within distance categories. To help improve accuracy and achieve a measure of spot mapping detail, orthophotos were used in conjunction with the avian and amphibian point count radius to allow the observer to pinpoint the exact location of each observation. Example data sheets are provided in Appendix A for songbirds, owls, and amphibian surveys.

### 3.2.3 Surveyors

Surveys were generally carried out by the qualified professionals described in the project proposal. Efforts were made to include members of the Central Okanagan Naturalists Club (CONC) during the avian point count surveys but coordination was unsuccessful. Surveyors included:

- Kyle Hawes, B.Sc., R.P.Bio.
  Project Manager, Field Biologist (songbird point counts, time-area searches, owl call-playback surveys, amphibian aural surveys, plant surveys);
- Adam Patterson, B.Sc., R.P.Bio.
  Field Biologist (songbird point counts, time-area searches, owl call-playback surveys, amphibian aural surveys, plant surveys);
- Angela Cormano, B.Sc., R.P.Bio., R.P.F.
  Field Biologist (rare plant surveys, plant surveys, ecosystem mapping);
- Mary Ann Olson-Russello, M.Sc., R.P.Bio.
  Field Biologist (songbird point counts);
- Katharina Huebel, M.Sc., B.I.T.
  Field Biologist (owl call-playback surveys, amphibian aural surveys).

## 3.3 Species Surveys

The following sections describe the methods used for the surveys for each species group. In general, protocols were adapted from the BC RISC methods, except where otherwise noted. A summary of all the surveys conducted and timing of each is provided in Table 1.

| Table 1. Summary of surveys completed in 2014 | | | |
|---|---|---|---|
| **Month** | **Date** | **Survey Type** | **Surveyor** |
| April | 21 | general site reconnaissance, time constrained survey (1) | AP, KH |
| | 24 | amphibian survey reconnaissance | AP |
| | 29 | bird survey reconnaissance | AP, MAO |
| | 29 | owl survey (1) | AP, KHu |
| | 30 | plant survey (1) | AC |
| May | 1 | bird point count (1) | AP, KH, MAO |
| | 1 | amphibian aural survey (1) | AP, KHu |
| | 5 | owl survey (2) | AP, KHu |
| | 7 | bird point count (2) | AP, KH, MAO |
| | 12 | amphibian aural survey (2) | AP |
| | 13 | owl survey (3) | AP, KH |
| | 14 | plant survey (2) | AC |
| | 15 | bird point count (3) | AP, KH, MAO |
| | 21 | bird point count (4) | KH, MAO |
| | 21 | plant survey (3) | AC |
| | 30 | bird point count (5) | AP, KH, MAO |
| | 31 | plant survey (4) | AC |
| June | 11 | bird point count (6) | AP, KH |
| | 11 | plant survey (5) | AC |
| | 18 | amphibian aural survey (3) | AP, KH |
| | 19 | time constrained survey (2) | AP, KH |
| July | 8 | plant survey (6) | AC |
| | 9 | plant survey (7) | AC, KH |
| | 17 | plant survey (8) | AP |
| October | 19 | plant survey (9) and ecosystem mapping | AC |
| November | 2 | ecosystem mapping | AC |
| | 23 | ecosystem mapping | AC |

In addition to the 2014 surveys, two passive remote-sensing devices were deployed in 2015 to determine winter use of the study area. An Anabat SD2 acoustic monitoring device was set up adjacent to Michaelbrook Pond to determine bat activity over the winter months. A wildlife camera was also set up along the north side of the greenway trail, near Casorso Road. An additional survey for owls was also conducted in March, 2015.

### 3.3.1 Amphibians and Reptiles

A combination of systematic visual and aural surveys and time-constrained searches were conducted to determine presence/absence of herptile species (reptiles and amphibians), species richness, and estimate relative abundance based on habitat associations. Survey design was based on the RISC Inventory Methods for Pond Breeding Amphibians and Painted Turtle (1998).

Aural Surveys

Nighttime aural surveys for frogs and toads were carried out along the Greenway trail and other known habitats (i.e., Mission Creek Ranch oxbow and Michaelbrook wetlands) to determine relative abundance in association with suitable habitats identified within the Study Area. A sub-set of the point count stations were selected for the amphibian surveys, based on habitat suitability, access, and overall coverage of the Study Area. A total of 17 sampling stations were selected for aural surveys (see Map 4).

- Surveys started a half hour before dusk and continued for 2 to 3 hours.
- Surveys were conducted in calm, warm weather, following a recent rain event (i.e., within last several days).
- Listening period was 3 minutes at each station following a 1 minute quiet period.
- 2 minutes of listening was added if noise impaired observations during first 3 minutes (e.g., vehicles, human activity).
- Species, direction, and distance were recorded where possible.
- Numbers were recorded in calling index categories (these vary slightly from the RISC protocol):
  - 0 = no calls
  - 1 = single individual
  - 2 = 2 distinct individuals, some calls overlap
  - 3 = 3-5 individuals, multiple but distinct, overlapping calls
  - 4 = >5 individuals, overlapping calls, cannot be distinguished (full chorus)

A total of 3 aural surveys were completed at each of the 17 stations. The nighttime aural surveys were combined with passive and opportunistic observations of nocturnal birds (e.g., nightjars) and active monitoring for bats using an echolocation device (Anabat SD2), described further below.

Time-Constrained Searches

Time-constrained searches (TCS) were conducted systematically within known and suitable micro-habitats for herptiles, including Michaelbrook Pond and other open water, wetland, and moisture-receiving sites. Systematic searches for amphibians, larvae, and egg masses were conducted using our knowledge and experience of suitable habitats within the Study Area. Besides visual and aural detections, a D-style dipnet was used to sweep for adult and larval amphibians and other incidental aquatic organisms, such as invertebrates. Trapping and marking were not conducted. Two (2) TCS were conducted, representing approximately 20 person-hours of effort.

- A two-person crew searched and captured herptiles using nets within aquatic habitats throughout the Study Area with a focus on Michaelbrook wetlands and wetted ditches.
- A two person crew also searched along the greenway trail by lifting rocks, woody debris, and cover objects (e.g. coarse woody debris) for other wildlife.

### 3.3.2 Birds

The breeding bird point count survey design was based on the RISC Inventory Methods for Forest and Grassland Songbirds (1999). Owl call-playback survey protocols were based on the RISC Inventory Methods for Owl Surveys (2006). Early morning (dawn) point counts were conducted for passerine bird species (between May 1 and June 11) and nighttime call-playback surveys for owls were conducted at a sub-set of 5 point count stations within the Study Area. We used 75 m radius point counts in an effort to determine relative abundance of songbirds for each point count station. Habitats and territory associations were determined using spot mapping with aerial imagery.

Songbird Point Count

Distance based point counts and spot mapping were used to allow estimates of species richness, diversity, and relative abundance, and measure population changes over time during future monitoring (i.e., determine if populations are increasing or declining). A total of six (6) point count surveys were conducted at each of the 30 point count stations. All birds seen or heard (song, call, visual, etc.) were recorded within radius distance based point count data sheets with aerial images to help pinpoint observation locations.

- Surveys were completed from May 1 to June 11, between sunrise and 10:00 am, with no rain or wind.
- Each point count station was surveyed 6 times with photos taken in each cardinal direction. Surveys were conducted no closer than 6 days apart.
- The 30 stations were divided amongst the surveyors (typically 3 individuals, each with bird identification experience) with the division and order of stations being alternated each survey.
- The data sheet used for surveys is provided in Appendix A. Observations were recorded on a 75 m radius circle with 10 m radial lines used to categorize distance of observations from the surveyor. Aerial imagery was included on each data sheet to help the surveyor accurately spot map each observation (i.e., using landmark features such as trees, posts, buildings, roads, pathways, etc.).

Upon arrival at each point count station, the following protocols were used:

- The surveyor oriented themselves to face north.

- The surveyor waited for a 1 minute quiet period.
- The point count lasted 10 minutes with observations being recorded in 3 time periods (0-3 minute, 3-5 minute, 5-10 minute)
- All birds heard/seen were recorded within the specified radius of the Point Count Station in each time interval.
- Observation locations were recorded by placing an 'X' or 'dot' on the Distance Estimate Circle at the appropriate distance and location. The location was labelled with the bird species using 4 letter alpha codes.
- The species code for the bird was recorded next to the mark along with:
  - detection type: Visual/Call/Song
  - sex (M/F)
  - age class (adult/juvenile)
  - and any other relevant information
  - e.g., AMRO (S, M, A) = singing, male, adult American Robin.
- For Fly-overs, a line was drawn across the Distance Estimate Circle in the direction of movement starting from the point the bird was first detected. If >1 bird was observed, a number was indicated in front of the species code.

Opportunistic observations during other surveys (e.g., nighttime) or between point count stations were also recorded and added to the species list. Incidental nest observations (including cavity and stick nests) and nest site mapping were conducted.

Owl Call-Playback

The RISC Inventory Methods for Owl Surveys (2006) were used as a basis to determine presence or occupancy (Level 1) of owls within the Study Area, with a focus on the Western Screech-owl. Nighttime call-playback surveys for Western Screech-owl were conducted using strategic sampling locations based on knowledge of suitable habitats and previous occurrence records. A sub-set of the point count stations were selected for the owl surveys, based on habitat suitability, coverage of the call-playback, access, and overall coverage of the Study Area. The stations used for owl surveys include 3, 5, 8, 11, and 20 (5 stations total). Surveys were conducted as follows:

- Surveys focused on Western Screech-owl (*Megascops kennicottii kennicottii*) (WSOW)
- A WSOW MP3 recording was broadcast using an MP3 player connected to a 40 Watt Megaphone with Auxiliary Input (3.5 mm headphone jack cable);
- The call was played for 1 minute followed by a 4 minute listening period which was repeated three times (15 minute survey at each station).
- Based on the megaphone output, survey stations were spaced up to 250 m apart.
- Surveys began no earlier than 30 minutes after sunset.
- Surveys were conducted in optimal weather conditions with no wind or rain.

To avoid alarming potentially occurring WSOW, other owls calls (e.g., Great Horned Owl) were not broadcast. Instead, visual (using spot lights) and auditory detection for other species of owls were recorded between WSOW surveys and during other nighttime surveys (i.e., amphibian aural surveys). Squeaking sounds were made near rural outbuildings as a call-playback for Barn Owl.

### 3.3.3 Mammals

Detailed surveys targeting mammals were not conducted, although mammals were observed and recorded during the time-constrained surveys (TCS) and incidentally during other surveys and reconnaissance. Active monitoring of bat activity was conducted during other nighttime surveys using an Anabat device. Opportunistic observations of mammal activity, presence, or signs were recorded during all reconnaissance and other surveys. Animal observations, tracks, scat, burrows, dens, and other signs were recorded as detected.

### 3.3.4 Fish

Detailed surveys for fish were not conducted. The BC Fisheries Information Summary System (FISS) was queried for fish presence. The species composition of Mission Creek is well documented and to complete population indexing would require extensive efforts, including installation of stop nets, electrofishing, mark-recapture efforts, and numerous hours of sampling to accurately measure fish community structure. This was deemed to be beyond the scope and budget of the work program.

### 3.3.5 Rare Plant Surveys

The rare plant surveys generally followed methods outlined by the BC E-Flora atlas (Penny and Klinkenberg 2013) as well as the Guidelines for Rare Vascular Plant Surveys in Alberta (Alberta Native Plant Council 2012). Ecoscape is not aware of any BC specific standard for rare plant surveys, such as those methods outlined by the RISC for other biophysical inventories. In the absence of a formal provincial standard, a combination of the protocols and guidelines listed above was used.

A preliminary review of existing terrestrial ecosystem mapping and imagery was used to determine the predominant habitat types within the Study Area. The results of this review focused sampling efforts on those areas where rare species are more likely to be found. Disturbed habitats were not excluded from the search area entirely as it is not uncommon to find rare species in disturbed areas.

The background review included a search of provincial and federal vegetation at risk in BC using BC Conservation Data Centre (CDC) Species and Ecosystems Explorer (MOE 2014). This information was used to generate a species list for targeted searches. The search criteria included geographic and habitat based parameters.

Species with the potential to occur in both the Ponderosa Pine and Interior Douglas-fir Biogeoclimatic Zones were selected as the Mission Creek watercourse runs through both of these zones (although the Study Area only includes the Ponderosa Pine Biogeoclimatic Zone). In addition, a variety of habitats were selected to reflect the variability of environments present at the local landscape level. Multiple habitat types were also chosen to include the potential for species that are able to tolerate a range of growing conditions to be present across a range of environments. The CDC Mapped Known Locations online website was also referenced for potential mapped occurrences. Only non-sensitive occurrences were targeted as sensitive records are typically not disclosed by the CDC except in specific circumstances.

The preliminary list generated by the CDC search was used to develop field keys for rare plants surveys. This list has been provided in Appendix B for reference. The list was organized by predominant habitat type (i.e. riparian/aquatic, forested, grassland/agricultural) and flowering period. Three sets of reference pages with photos were produced to organize search efforts by season and habitat. In addition to the reference pages created by Ecoscape, Species at Risk Fact Sheets produced by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO 2014) were used as an additional resource.

Given the small size of the Study Area, purposeful meandering in targeted habitats was selected as the primary search method instead of formal transects. Lists of common vegetation were collected as part of this inventory, as a means of identifying some of the predominant vegetation types within the Study Area. The vegetation list is not meant to be exhaustive or comprehensive as search efforts primarily targeted uncommon species. References used to identify species included local field guides, the Illustrated Flora of BC, E-flora and other references commonly used in floristic surveys.

Where rare species were encountered, a voucher specimen was collected for taxonomic verification by provincial Ministry of Environment staff and local experts. In those situations where only a small number of individuals was present, a voucher specimen would not be collected but instead the location information would be collected for field verification by an expert. Surveys were completed in early and late spring, summer, and fall to cover the range of flowering periods and increase the potential for detection.

### 3.4 Ecosystem Mapping

Ecosystem mapping included a preliminary review of available TEM, surficial geology, SEI, aerial imagery and topography information. Ecosystems were mapped following a modified version of the TEM standards outlined in the RISC guidelines. A preliminary sampling plan was developed prior to field surveys to ensure field plots covered the range of habitats present. Given the homogeneity of the Study Area (i.e. single variant, with a few predominant habitat types), ground inspection forms (GIFs)

were completed rather than full plots. Full plots are time intensive and it was felt that more information could be collected by focusing on GIF sample plots. In addition, detailed wildlife surveys were already being completed through targeted surveys. Plots were located in predominantly natural or semi-natural areas and anthropogenic portions of the Study Area were characterized by visual inspection only.

The field inventory included field verification of ecological communities, soils, and landforms identified in the TEM and SEI data. Polygon boundary adjustments and classification changes were made and the updated polygons and features were compiled into GIS and included in the final database. The results of the field inventory were summarized to reflect the range of ecosystem variability present. Wetlands within the Study Area were characterized by Ecoscape in a previous wetland specific inventory for Kelowna. This information was carried forward into this report and field surveys were used to confirm that conditions in these areas had not changed.

To account for habitat differences between plots, the updated polygons were classified into the four broad ecosystem classifications of riparian, aquatic, anthropogenic, and wetland. The updated polygons were clipped according to the plot boundary and if the clipped polygon did not have a dominate ecosystem type it had further boundary adjustments made. The percentage of the four habitat types was determined by calculating the areas of each polygon in a plot.

## 3.5 Data Analysis

Summary statistics of bird community metrics were calculated for point count data that were within 75 m of a point count station. The mean relative abundance was calculated for each site by calculating the average abundance for 6 site visits. For all sites, the minimum, mean, median and maximum of the calculated mean relative abundances were summarized for each species. Species richness, Shannon–Wiener index, and mean total abundance were also calculated for each site. Mean total abundance and the Shannon-Wiener index (below) were summarized according to minimum, mean, median and maximum values across all sites.

$$H = -\sum_{i=1}^{S} p_i \ln(p_i)$$

The bird species were grouped into 8 categories, which include: Hawks, Eagles, Falcons, and Allies; Pheasants and Quail; Pigeons and Doves; Shorebirds; Gulls, and Allies; Songbirds; Waterfowl; and, Woodpeckers. A stacked bar chart was used to visualize each site's mean relative abundance for the above bird types.

A Redundancy Analysis (RDA) was performed to examine how the bird community structure varied across sites and how it was correlated to the habitat composition of the sites. RDA used the percentages of each habitat type as the explanatory variables

and the Hellinger-transformed mean relative abundance data as response variables. Before the Hellinger transformation was performed species that had mean relative abundances of 0 across all sites were deleted from the species matrix. Redundancy analysis (RDA) is a form of canonical ordination analysis that determines RDA axes from linear combinations of explanatory variables (Legendre and Legendre, 1998). The linear combinations are determined by maximizing the correlation between the response and explanatory variables (Legendre and Legendre, 1998). All statistical analysis was performed in R version 3.13 (R Core Team 2015). The R package vegan version 2.2-1 was used for RDA (Oksanen et al., 2015).

## 4.0 RESULTS

The following section provides a summary of the species survey results.

### 4.1 Amphibians and Reptiles

Amphibian and reptile survey results include the relative abundance estimate provided by the amphibian aural surveys and presence/not detected results from the Time-Constrained Searches.

Aural Surveys

The only amphibian species detected during the aural surveys was the Pacific chorus frog (*Pseudacris regilla*). This species was detected at 15 of the 17 stations surveyed. The total effort for the aural surveys based on 3 surveys at 17 stations for 3 minutes each is 153 minutes (2.55 hours). A summary of the detections using the calling index categories is provided in Table 2.

**Table 2. Summary of Pacific chorus frog detection index categories during aural surveys in 2014.**

| Survey Station | Survey 1 May 1 | Survey 2 May 12 | Survey 3 June 18 |
|---|---|---|---|
| 3 | 4 | 4 | 0 |
| 5 | 4 | 4 | 0 |
| 8 | 3 | 4 | 0 |
| 11 | 3 | 4 | 3 |
| 12 | 1 | 4 | 0 |
| 13 | 3 | 4 | 1 |
| 14 | 3 | 4 | 1 |
| 16 | 0 | 4 | 0 |
| 18 | 1 | 0 | 0 |
| 20 | 4 | 4 | 0 |
| 23 | 4 | 4 | 3 |
| 24 | 1 | 0 | 0 |
| 25 | 4 | 0 | 0 |
| 26 | 1 | 0 | 0 |
| 27 | 1 | 0 | 0 |
| 28 | 0 | 0 | 0 |
| 29 | 0 | 0 | 0 |

Overall, it was found that relative abundance was greatest during the mid-May survey period and decreased in mid-June. Relative abundance was greatest at sample stations 3, 5, 8, 11, 13, 14, 20, and 23. The clustered histogram shown in Figure 1 illustrates the total abundance of chorus frogs observed on each survey date.

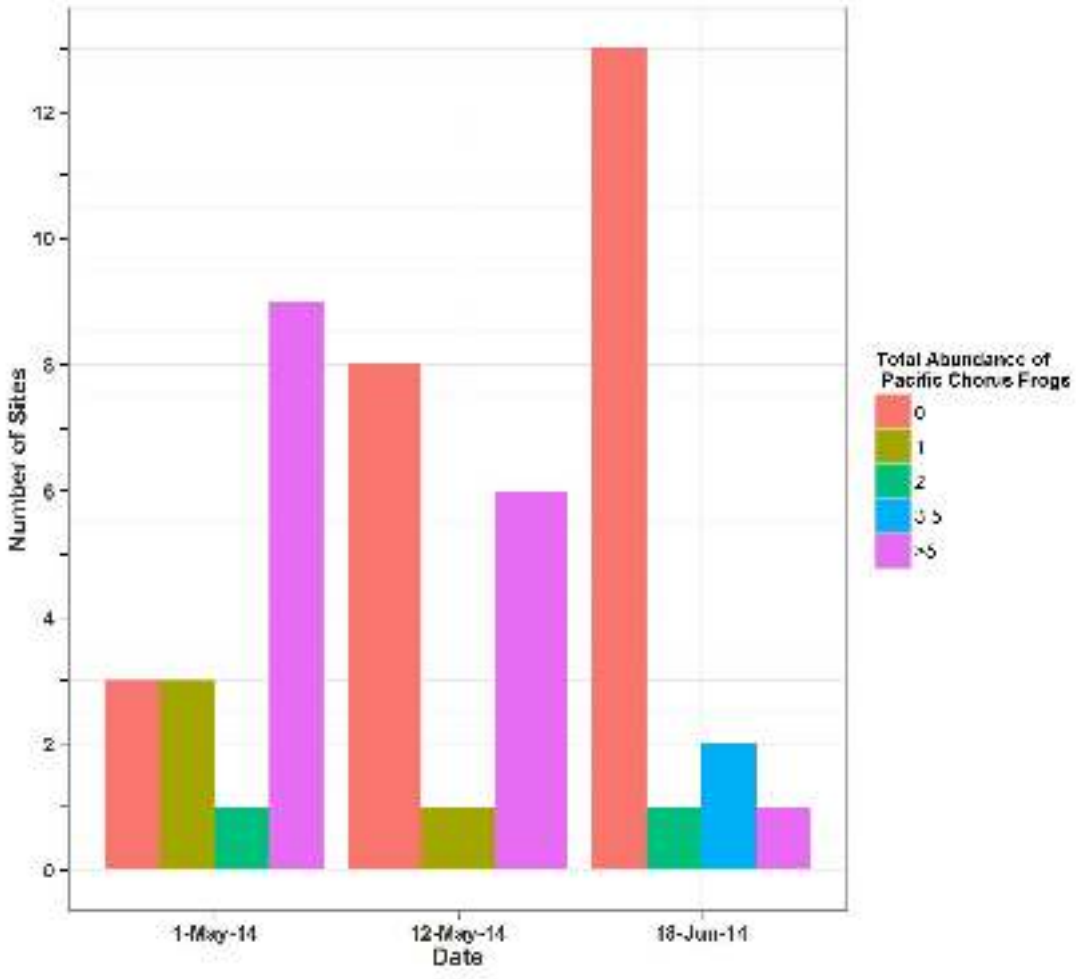



**Figure 1. Total abundance of Pacific chorus frog observations during each aural survey.**

It was noted that frogs were not detected along Thomson Marsh (i.e., point count stations 28 and 29). These stations are associated with appropriate open water and wetland communities with emergent vegetation; however the presence of fish, including non-native species (e.g. pumpkinseed sunfish), may have an effect on the viability of amphibian populations through predation of eggs or tadpoles. This has not been confirmed through sampling or analysis.

Time-Constrained Searches

Two (2) TCS surveys were conducted in crews of two people for a total effort of 20 person hours (2 surveys for 5 hours each with two people). Searches focused on wetlands and other aquatic habitats along Mission Creek, ditches, and other wet or moisture-receiving areas throughout the Study Area. Over that period of time, a number of amphibians, reptiles, and other wildlife were encountered, documented,

and locations mapped (see Map 4). Table 3 provides a summary of the species detections resulting from the TCS.

**Table 3. Summary of Time-Constrained Search (TCS) results**

| Species Group | Common Name | Life Stage | Location (survey station) | Habitat association |
|---|---|---|---|---|
| Amphibian | Columbia spotted frog | adult | 13, 14, 16 | Wetted ditch |
| | long-toed salamander | adult, tadpole | 12, 13, 20 | Wetland, wetted ditch |
| | Pacific chorus frog | adult, tadpole, egg mass | 11, 12, 13, 20 | Wetland, wetted ditch |
| Invertebrate | lance-tipped darner[1] | larval | 11, 13 | Wetted ditch |
| Reptile | common garter snake | adult, mating ball | 12 | Riparian |
| | western painted turtle | adult | 11 | Wetland |
| | western terrestrial garter snake | adult | 16 | Riparian |

1. Lance-tipped darner (*Aeschna constricta*) is Red-listed by the B.C. Conservation Data Center

Species detections include species at risk, including painted turtle and lance-tipped darner (*Aeshna constricta*). Observation data forms for site specific detections have been submitted to the CDC and are provided in Appendix B. It is worth noting that while Great Basin spadefoot toads (*Spea intermontana*) were not detected during the aural or TCS surveys, they have been previously observed and formally documented within the Study Area (K. Hawes, pers. comm.). A single adult was discovered within a playground area near sample station 13 in July, 2006.

## 4.2 Birds

The following section provides a summary of the results of bird surveys, including point counts and owl call-playback surveys. Summaries are provided as a baseline for comparison with future monitoring studies.

### 4.2.1 Breeding Bird Point Count

Point count surveys were conducted at 30 stations, 6 times each (180 total point counts) for 10 minutes per survey for a total survey effort of 1,800 minutes (30 hours). The point count stations and significant observations (e.g., raptor nests) are shown on Map 4. A list of all birds observed in provided in Appendix C. Surveys were conducted between May 1 and June 11, 2014 with at least 6 days between each survey. A total of 2,994 observations were made of 82 different bird species. After eliminating bird observations outside of the 75 m point count radius and flyovers, the number of observations for analysis was reduced to 2,693. Bird observations were grouped into categories of bird types, including songbirds, waterfowl, woodpeckers, shorebirds, pigeons and doves, quail, and raptors (hawks, eagles, owls). A summary of the detections within each group at each point count station is provided in Table 4.

**Table 4. Summary of bird observations within each broad group at each point count station.**

| Site ID | Hawks, Eagles, Falcons, Allies | Herons | Hummingbirds | Owls | Pheasants, Quail | Pigeons and Doves | Rails | Shorebirds, Gulls, Allies | Songbird | Waterfowl | Woodpeckers | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ST01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 85 | 0 | 3 | **90** |
| ST02 | 4 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 61 | 7 | 6 | **82** |
| ST03 | 0 | 0 | 0 | 0 | 2 | 5 | 1 | 1 | 79 | 0 | 13 | **101** |
| ST04 | 0 | 0 | 1 | 0 | 3 | 6 | 0 | 0 | 80 | 4 | 7 | **101** |
| ST05 | 4 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 38 | 0 | 4 | **50** |
| ST06 | 0 | 0 | 0 | 0 | 15 | 1 | 3 | 5 | 77 | 1 | 0 | **102** |
| ST07 | 0 | 0 | 0 | 3 | 3 | 9 | 1 | 1 | 69 | 0 | 6 | **92** |
| ST08 | 1 | 0 | 0 | 0 | 3 | 7 | 0 | 2 | 68 | 4 | 8 | **93** |
| ST09 | 0 | 0 | 0 | 0 | 4 | 2 | 1 | 3 | 76 | 1 | 8 | **95** |
| ST10 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 42 | 25 | 0 | **72** |
| ST11 | 0 | 0 | 0 | 0 | 2 | 6 | 1 | 1 | 110 | 27 | 3 | **150** |
| ST12 | 1 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 81 | 6 | 3 | **97** |
| ST13 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 72 | 11 | 2 | **86** |
| ST14 | 0 | 0 | 0 | 0 | 4 | 4 | 1 | 0 | 85 | 4 | 4 | **102** |
| ST15 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 1 | 72 | 0 | 5 | **87** |
| ST16 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 1 | 59 | 0 | 8 | **73** |
| ST17 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 34 | 5 | 0 | **43** |
| ST18 | 0 | 0 | 1 | 0 | 5 | 1 | 1 | 0 | 62 | 0 | 7 | **77** |
| ST19 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 72 | 0 | 9 | **84** |
| ST20 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 98 | 17 | 8 | **127** |
| ST21 | 0 | 0 | 0 | 0 | 7 | 3 | 0 | 0 | 58 | 0 | 3 | **71** |
| ST22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 84 | 0 | 3 | **87** |
| ST23 | 0 | 0 | 0 | 0 | 8 | 2 | 0 | 4 | 85 | 9 | 2 | **110** |
| ST24 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 9 | 72 | 0 | 2 | **87** |
| ST25 | 0 | 0 | 0 | 0 | 5 | 3 | 0 | 4 | 70 | 8 | 0 | **90** |
| ST26 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 6 | 83 | 19 | 1 | **113** |
| ST27 | 1 | 0 | 0 | 0 | 10 | 0 | 0 | 2 | 74 | 7 | 3 | **97** |
| ST28 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 72 | 5 | 1 | **81** |
| ST29 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 69 | 2 | 1 | **73** |
| ST30 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 73 | 0 | 4 | **80** |
| **Total** | **11** | **1** | **2** | **3** | **87** | **81** | **13** | **49** | **2160** | **162** | **124** | **2,693** |

Songbirds were the most commonly observed bird group, comprised of 2,160 individual species (80% of all observations). Waterfowl and woodpeckers were the next most commonly observed bird groups, representing 6% and 4%, respectively. The station with the highest number of observations was ST11 (150 individual observations), with ST20 and ST26 being the next highest in terms of observations (127 and 113, respectively). The fewest observations were at ST17 (Map 4).

For the purposes of the analysis, only birds observed within 75 m of the plot centre were considered. Fly-overs were not included since birds observed passing over the point count station were not considered to be strongly associated with the surrounding habitat. Mean total abundance was calculated at each point count station and was determined from the average number of bird observations at each station during each point count survey. The most abundant species observed overall throughout the study area is the red-winged blackbird (*Agelaius phoeniceus*) (522 observations). The next two most commonly observed species are the European starling (*Sturnus vulgaris*) and the American robin (*Turdus migratorius*) (300 and 185 observations, respectively). A summary of the abundance at each point count station is illustrated in Figure 2.

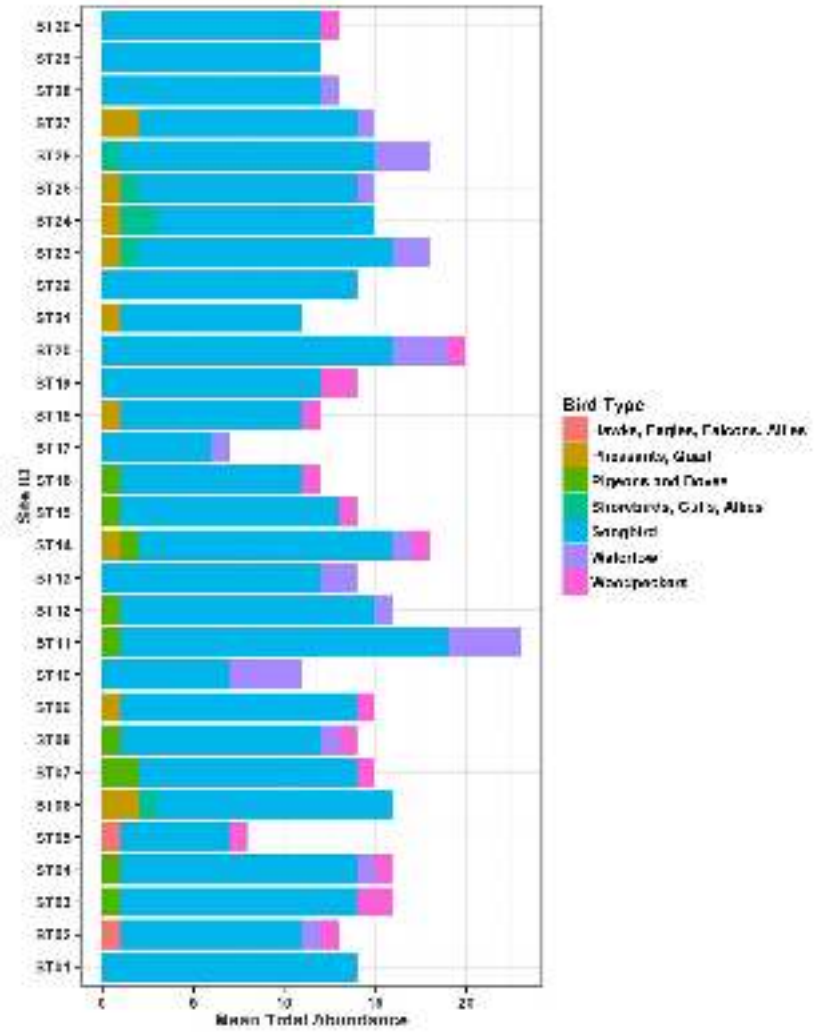



**Figure 2. Summary of mean total abundance of each bird group at each point count station.**

Figure 3 shows that the site with the highest mean total abundance is ST11 and the most commonly observed bird type was songbird. Sites ST17 and ST05 had the

lowest abundance of bird observations. A box plot summary of the total abundance is provided below.

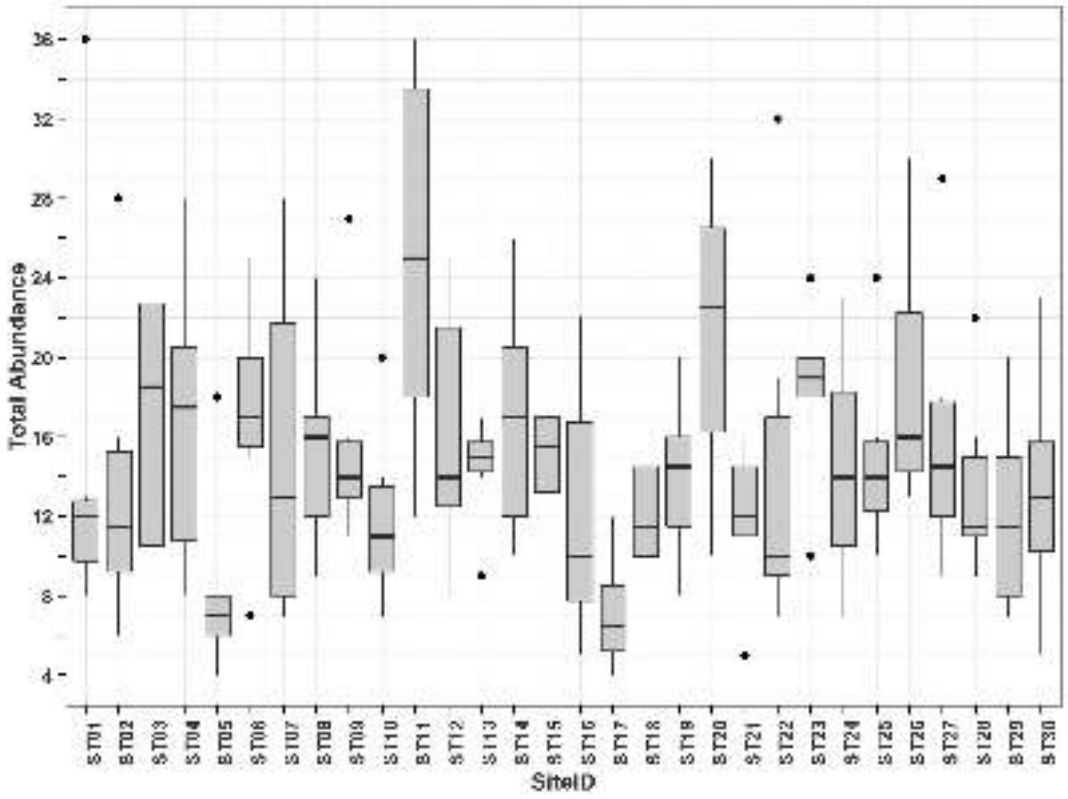



**Figure 3. Box plot summary of total abundance at each point count station.**[1]

Figure 3 highlights that ST11 had the greatest overall abundance of bird observations but with relatively high variation of abundance over the different survey periods. Sites ST05 and ST17 had the lowest overall total abundance with little variation.

Species richness was calculated as the total number of species observed at each point count station over the total number of surveys (i.e., six point counts). Species diversity was determined for each point count station using the Shannon-Weiner Index. The Figure 4 box plot summary of species richness shows that the greatest species richness was found at ST11.

[1] The box shows the interquartile range that contains values between 25th and 75th percentile. The line inside the box show the median. The two "whiskers" show adjacent values. The upper adjacent value (upper mark) is the value of the largest observation that is less than or equal to the upper quartile plus 1.5 the length of the interquartile range. Analogously the lower adjacent value (lower mark) is the value of the smallest observation that is greater than or equal to the lower quartile less 1.5 times the length of interquartile range. Outliers are observations outside lower-upper mark range.

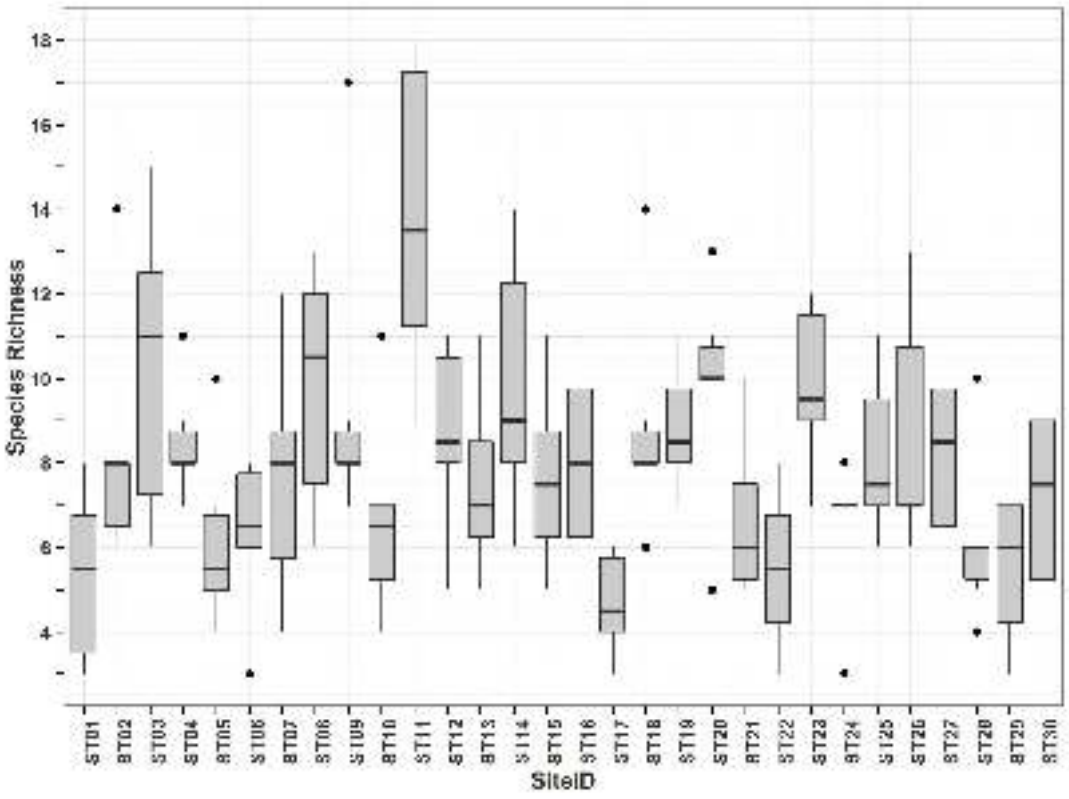



**Figure 4. Box plot summary of species richness at each point count station.**

An overall summary of the descriptive statistics associated with each point count stations is provided in Table 5.

| Table 5. Summary of the point count station analysis | | | |
|---|---|---|---|
| **Station ID** | **Mean Total Abundance** | **Species Richness** | **Diversity Index** |
| ST01 | 15 | 11 | 1.41 |
| ST02 | 14 | 26 | 1.46 |
| ST03 | 17 | 25 | 2.14 |
| ST04 | 17 | 20 | 2.01 |
| ST05 | 8 | 16 | 1.75 |
| ST06 | 17 | 15 | 1.07 |
| ST07 | 15 | 20 | 1.82 |
| ST08 | 16 | 27 | 1.83 |
| ST09 | 16 | 24 | 2.14 |
| ST10 | 12 | 16 | 1.75 |
| ST11 | **25** | **36** | **2.63** |
| ST12 | 16 | 24 | 1.95 |
| ST13 | 14 | 18 | 1.91 |
| ST14 | 17 | 25 | 2.31 |
| ST15 | 14 | 24 | 1.54 |
| ST16 | 12 | 18 | 2.15 |
| ST17 | 7 | 15 | 1.56 |
| ST18 | 13 | 25 | 1.83 |
| ST19 | 14 | 19 | 2.02 |
| ST20 | 21 | 24 | 1.97 |
| ST21 | 12 | 19 | 1.49 |
| ST22 | 14 | 12 | 1.48 |
| ST23 | 18 | 22 | 2.25 |
| ST24 | 14 | 14 | 1.93 |
| ST25 | 15 | 24 | 1.97 |
| ST26 | 19 | 22 | 2.26 |
| ST27 | 16 | 24 | 1.67 |
| ST28 | 14 | 19 | 1.54 |
| ST29 | 12 | 15 | 1.36 |
| ST30 | 13 | 19 | 1.80 |

The point count station ST11 has the highest results in each of the summary statistics. This survey station is located between the northern shoreline of the Michaelbrook Pond and Mission Creek. The lowest mean total abundance (7) is associated with station ST17 which is located in a rural agricultural setting. The lowest species richness (11) is at ST01 which is located along the edge of Casorso Road, adjacent to a golf course. The lowest diversity (1.07) is at ST06, which is located in a rural agricultural setting (Map 4).

The results of the Redundancy Analysis (RDA) are provided in Figure 5 to show how the bird community structure varied across sites and how it was correlated to the habitat composition of the sites. Affinity propagation (AP) clustering used site scores

of the RDA1 and RDA2 axes to classify sites into groups that had similar community structure and habitat composition. The results from AP clustering and RDA were used to determine redundant sites that should not be included in future monitoring programs. The R package apcluster was used (Bodenhofer *et al.,* 2011). AP is a clustering method that determines the number of clusters by iteratively searching through different combinations of clusters, until the similarities of the data points (observations) are maximized (Frey and Dueck, 2007). The clusters are defined by determining the suitability of a given data point being chosen as an exemplar. An exemplar is the most representative data point of a cluster (Bodenhofer *et al.,* 2011; Frey and Dueck, 2007).

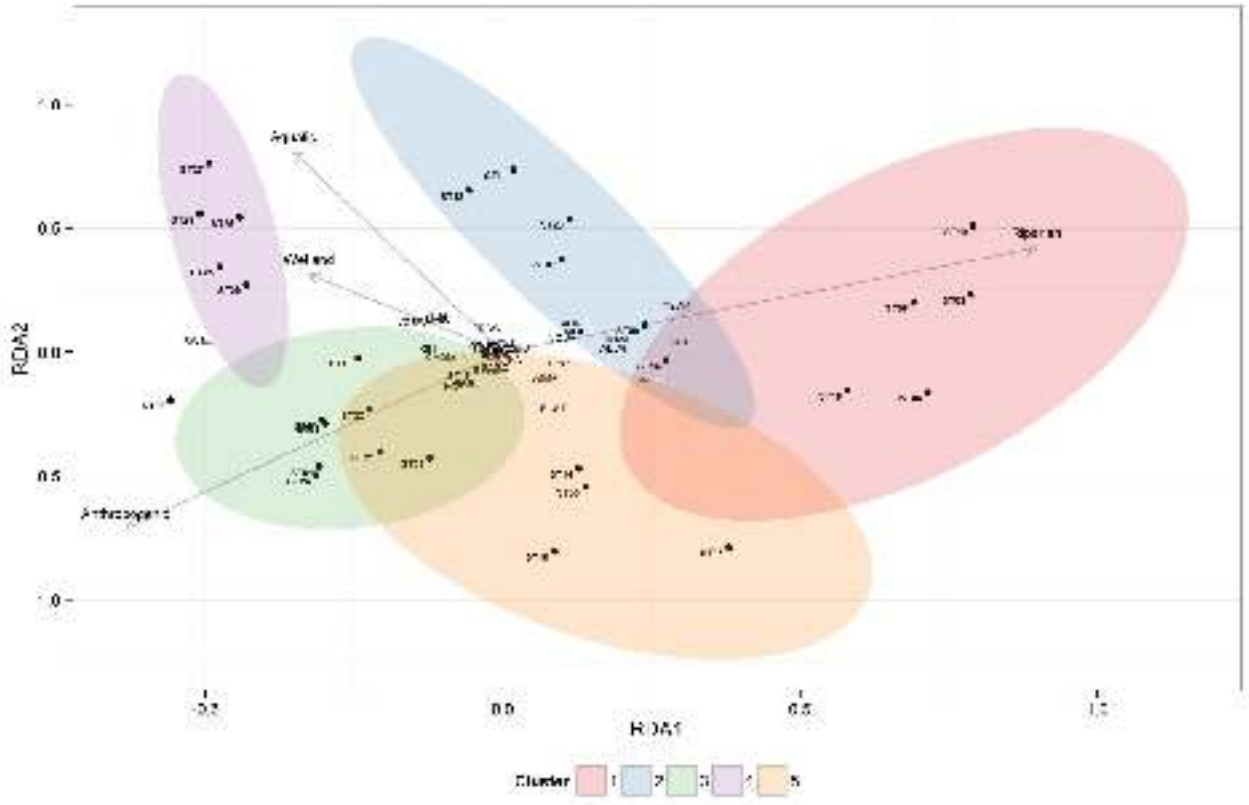



**Figure 5. Redundancy Analysis (RDA) for the comparison of bird community to habitat type.**

Redundant sites were identified as sites that had similar RDA1 and RDA2 axis scores. To include the most representative sites in future monitoring programs, cluster exemplars were not selected as redundant sites. Exemplar sites could be used in the future for intensive monitoring. There are 15 sites that may be eliminated as redundant sites, including ST03, ST05, ST10, ST12-ST15, ST17, ST18, ST22, ST24, ST25, ST27, ST29, and ST30.

### 4.2.3 Call-Playback Survey

Owl call-playback surveys targeting Western Screech-owl were conducted 3 times at 5 stations for 15 minutes each for a total effort of 225 minutes (3.75 hours). During that time, a Screech-owl response was detected twice, both at sample station 20 which is associated with the Casorso Swamp area (located just north of the Study Area across Casorso Road on the left bank of Mission Creek). Detections occurred on April 29 and May 13, 2014. This station was selected specifically because there are historical occurrences of Western Screech-owl in the area and it provided a control site to determine if the call-playback surveys were successful. Based on this response, it is not likely that there were other Screech-owls breeding within the Study Area in 2014. The approximate location of the calling Screech-owl is provided on Map 4. A CDC observation form has been submitted and provided in Appendix B.

Other owls observed incidentally during the call-playback surveys (while walking between survey stations or during songbird point counts and other surveys) include Great Horned Owl (*Bubo virginianus*). A breeding pair was discovered and Great-Horned Owl fledglings were observed on May 30, 2014, near sample station 7. The approximate location of the nest (based on calls and fledgling observations) is provided on Map 4.

## 4.3 Mammals

Incidental mammal observations are summarized in Table 6. None of the observed mammals are listed provincially, although the unknown shrew was not identified to species.

**Table 6. Summary of mammal observations within the Study Area**

| Common Name | Latin Name | Location (nearest survey station) | Habitat association |
|---|---|---|---|
| American beaver | *Castor canadensis* | 20 | Wetland |
| Columbian ground squirrel | *Spermophilus columbianus* | various | Rural |
| common muskrat | *Ondatra zibethicus* | 11 | Wetland |
| eastern grey squirrel | *Sciurus carolinensis* | various | Rural |
| mule deer | *Odocoileus hemionus* | various | Riparian |
| northern raccoon | *Procyon lotor* | 5 | Rural |
| red squirrel | *Tamiasciurus hudsonicus* | various | Riparian |
| shrew (unknown species) | *Sorex sp.* | 16 | Riparian |
| vole (unknown species) | *Microtus sp.* | various | Rural |
| white-tailed deer | *Odocoileus virginianus* | various | Riparian |
| yellow-bellied marmot | *Marmota flaviventris* | various | Rural |

The shrew was observed during the time-constrained searches. The rest of the mammals were observed during other surveys (e.g., bird point counts) and travelling between stations within the study area. Total numbers and distribution information

was not collected and the observations are only meant to provide a list of known species presence. The list can be updated as additional surveys are conducted.

A motion-activated camera was mounted on a tree within the study area to document other wildlife occurrences. The camera was deployed from January 26 to March 20, 2015 and then again from March 20 to June 11, 2015. The only observations obtained from the first deployment of the camera include park users with dogs and horses, cows, white-tailed deer (*Odocoileus virginianus*), and raccoon (*Procyon lotor*). The camera was removed/stolen from the second monitoring site and thus no photo records of wildlife use were obtained.

### 4.3.1 Bats

The potential for resident bats was determined based on summer roost habitat availability and overwintering requirements. These are summarized in table 7.

**Table 7. Summary of potentially occurring bats within the Study Area**

| Common Name | Latin Name | COSEWIC Listing | BC | Typical Roost Sites |
|---|---|---|---|---|
| big brown bat | *Eptesicus fuscus* | - | - | Crevice, Cavity, Building |
| California myotis | *Myotis californicus* | - | - | Crevice, Building, Tree Cavity |
| hoary bat | *Lasiurus cinereus* | - | - | Foliage, Mixed Forest |
| little brown myotis | *Myotis lucifugus* | - | - | Crevice, Building, Tree Cavity |
| long-legged myotis | *Myotis volans* | - | - | Crevice, Tree Cavity |
| silver-haired bat | *Lasionycteris noctivagans* | - | - | Tree Cavity, Forest |
| spotted bat | *Euderma maculatum* | SC | Blue | Cliff |
| western long-eared myotis | *Myotis evotis* | - | - | Crevice, Building, Tree Cavity |
| western red bat | *Lasiurus blossevillii* | - | Red | Trees, Foliage |
| western small-footed myotis | *Myotis ciliolabrum* | - | Blue | Crevice, Mature Cottonwood |
| yuma myotis | *Myotis yumanensis* | - | - | Building, Tree Cavity |

Within the Study Area, summer roosting habitats are provided by mature black cottonwood (*Populus balsamifera ssp. trichocarpa*), rural outbuildings, and other structures (e.g., old pump station, bridges). There were no suitable overwintering habitats (i.e., hibernacula) observed, except possibly in buildings such as barns, sheds, and other rural structures. These were not searched during the wildlife surveys.

Active Monitoring

Active monitoring of bats consisted of recording bat activity during other evening or nighttime surveys (i.e., frog and owl surveys). An Anabat SD2 device was used to record bat echolocations at survey stations and while walking between survey stations. The recordings were generally obtained along the Mission Creek corridor

between Gordon Drive and Casorso Road. A summary of the echolocation results of the Anabat active monitoring and the interpretation of the species or species group identification is provided below. The interpretation of calls was completed using the RISC protocol (BC MELP 1998) and the NABat Acoustics Training course (Cori Lausen-Instructor).

A total of 232 bat calls were recorded over four surveys. Due to the inherent difficulty in interpreting calls to positively identify bats to species, the calls were used to classify general categories of bats (Table 8). The categories are based on common call characteristics, including minimum frequency and slope of the recorded calls. Each of the categories includes several bat species that may be associated with that call type. Overall, the Myotis bats with high frequency calls (in the 40 KHz range) were the most commonly observed (112 records). Several distinct 'flat' calls typically associated with the silver-haired bat (*Lasionycteris noctivagans*) were observed which were included in the low frequency, low slope bat calls (25 to 30 KHz).

**Table 8. Summary of identified species groups from bat call recordings**

| Call Category | Potential Species | June 18 | May 1 | May 5 | May 13 | Total |
|---|---|---|---|---|---|---|
| Low frequency (25 KHz); low slope | *Lasiurus cinereus*, *Eptesicus fuscus*, or *Lasionycteris noctivagans* | 17 | 8 | 0 | 27 | **52** |
| Low Frequency (30 KHz); steep slope | *M. evotis* | 1 | 0 | 2 | 2 | **5** |
| High Frequency (40Khz); steep slope | *M. yumanensis, M. californicus, M. lucifugus, M. ciliolabrum*, or *M. volans* | 45 | 27 | 6 | 34 | **112** |
| High Frequency (40 KHz); low slope | *Lasiurus blossevillii*, or *M. lucifugus* | 3 | 4 | 7 | 0 | **14** |
| High Frequency (50 KHz); steep slope | *M. yumanensis* or *M. californicus* | 18 | 5 | 8 | 18 | **49** |
| | **Totals** | **84** | **44** | **23** | **81** | **232** |

The active monitoring was conducted on foot while walking between other survey stations (i.e., during owl and frog auditory surveys) and there was no specific protocol followed. Instead, all bats observed along the creek corridor were opportunistically recorded where possible. As such, it is likely that bats were recorded multiple times and the numbers above cannot be used to estimate relative abundance, density, or other population metrics. The surveys were only meant to get a sense of species/group occurrences and distribution.

Passive Monitoring

Passive monitoring of winter bat activity was conducted from January 26 to February 12, 2015 (recordings were obtained for the duration of the battery life of the device). The Anabat SD2 was deployed adjacent to Michaelbrook Pond (i.e., at Station 11) within a modified bird nest box. The device was positioned facing towards the open

water wetland community to determine winter bat use of the habitat. Recordings were obtained on 18 different days but were limited to background noise and there were no discernible bat vocalizations observed. The results suggest that bats do not normally use the Michaelbrook Pond for foraging during winter months.

## 4.4 Fish

Population indexing was not conducted for fish within the Study Area. Mission Creek (Watershed Code: 310-794400) provides habitat to a variety of fish species and spawning habitat to species of concern such as kokanee (*Oncorhynchus nerka*) and rainbow trout (*O. mykiss*). The subject reach of Mission Creek (between Casorso Road and Gordon Drive) is generally characterized by a channelized run with armoured dikes forming both banks. The dikes prevent fish passage to adjacent shallow open water habitats, including the oxbows, and there is no active floodplain, as the dikes confine the spring freshet flows to reduce potential flooding of adjacent properties. There is little riffle or pool habitat within the reach and, apart from pocket spawning, there is little suitable spawning habitat for salmonid species over this reach of the river.

Substrates within the reach are characterized by larger material such as cobble and boulder with some pebble, gravel, and sand occurring within mid-channel bars. There is little instream woody debris and overhanging vegetation is limited to black cottonwood trees growing within the dike structures and mature cottonwood growing beyond the dike banks. The shrub and herb layer along the riparian edge is poorly developed and weedy vegetation such as clover and alfalfa are commonly observed species. According to the FISS, the following fish species are known to occur within Mission Creek. None of the fish species are provincially listed or considered at risk.

**Table 9. Species of fish found in Mission Creek**

| Common Name | Scientific Name |
|---|---|
| Burbot | *Lota lota* |
| Eastern Brook Trout | *Salvelinus fontinalis* |
| Kokanee | *Oncorhynchus nerka* |
| Longnose Dace | *Rhinichthys cataractae* |
| Mountain Whitefish | *Prosopium williamsoni* |
| Peamouth Chub | *Mylocheilus caurinus* |
| Rainbow Trout | *Oncorhynchus mykiss* |
| Redside Shiner | *Richardsonius balteatus* |
| Sculpin | *Cottus* sp. |
| Sucker | *Catostomus* sp. |

**1 Source:** http://a100.gov.bc.ca/pub/fidq/fissSpeciesSelect.do

Non-native species, including carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), and pumpkinseed (*Lepomis gibbosus*), are known to occur within the open water community associated with Thomson Marsh (K. Hawes pers. comm. 2015). Carp were

observed jumping out of the water during other surveys in the Thomson Marsh area. Other species presence was not confirmed.

## 4.5 Terrestrial Ecology

The following sections summarize the terrestrial ecology of the Study Area.

### 4.5.1 Surficial Geography and Topography

The surficial geology for the Study Area is predominantly alluvial fan deposits with a minor component of organic "sediments" (Paradis et al. 2010). The following descriptors of post glacial surficial deposits were available from a study of the surficial geology and geochemistry of the Kelowna-Westbank-Mission Creek area (Paradis et al. 2010).

> ***Alluvial fan sediments:*** *poorly sorted gravel, sand, silt and clay; these sub-aerial deposits, found throughout the area, occur mainly as fan-shaped forms where creeks or stream debouch in lakes or at the toe of slopes where creeks or streams debouch on flat valley floor. Fan sediments could have been transported from far away or can reflect local provenance.*
>
> ***Organic sediments:*** *muck, mucky peat, marl and peat, from 0.3 to 3 m thick. Accumulations of organic material are commonly found in shallow closed depressions or on gently sloping poorly drained surfaces. They can be thin on underlying parent material (O/Ap).*

### 4.5.2 Ecosystems

The Study Area is situated within the Okanagan Very Dry Hot Ponderosa Pine (PPxh1) variant according to the Biogeoclimatic Ecosystem Classification (BEC) system for BC. The PPxh1 variant is part of the Ponderosa Pine BEC zone, the driest forested zone in BC. Climax forests on zonal sites include mature stands of ponderosa pine and interior Douglas fir. The Study Area is characterized by a mixture of young to mature deciduous forest, urban/rural areas, agricultural areas, and wetland features. The cottonwood forest that primarily exists along the banks of Mission Creek has developed on what would have historically been the Mission Creek floodplain. Extensive clearing for urban, rural and agricultural development occurs beyond forested areas. Wetlands are dispersed throughout and are likely fragments of what was historically a much larger wetland complex that has been replaced by urban/rural development and agriculture. The riparian area is representative of a floodplain ecosystem however it is not a floodplain ecosystem in the traditional sense as dykes have been constructed on both sides of the creek. The local hydrology is largely influenced by a high water table and groundwater as opposed to seasonal inundation from flooding.

The ecological communities or ecosystem units that represented 10% of a polygon or more were mapped in the field and are represented in this report (Map 2). Previous terrestrial ecosystem mapping (TEM) and Wetland Inventory Mapping (WIM) information were referenced where available (Hawes 2007). The table below represents a mix of both the terrestrial ecosystem mapping described by the BEC system and wetland classification described in the reference guide Wetlands of British Columbia: A Guide to Identification (Mackenzie and Moran 2004). Wetland units differ from the terrestrial ecosystems described in BEC because their development over time or successional progression is not typically consistent with that of terrestrial systems. Furthermore, some of the wetland communities present do not exactly match the descriptions provided in the Wetlands of British Columbia guide. The guide describes this and provides a rationale for the difference:

> *It should not be expected that sites will perfectly match all details in the description of site units in this guide. The descriptions presented here represent a range of conditions around a central concept for a population of more variable individual sites that are part of the Association. It is also important to note that the classification is based on relatively undisturbed wetlands and that identification of highly disturbed or heavily managed wetlands is problematic.*
>
> *This guide describes ecosystems that recur throughout the landscape and appear to be relatively stable in vegetation composition. Although this guide represents the majority of wetland sites in the province it is likely that users will find units that do not match any of the units described.*
> *This can be for one of four reasons:*
> *1) The plot location was placed in a transitional area between two ecosystems*
> *2) The site is a hybrid of two types*
> *3) The site is disturbed or in transition from one type to another*
> *4) The site represents a new ecosystem not previously recognized.*

For this study, the wetland unit that most closely matches the ecosystems that were observed has been used. Ecosystems present locally are heavily influenced by urban and rural development. In some cases the wetland unit descriptor was modified slightly to better reflect the conditions observed.

Table 10 presents the ecosystem or wetland codes, their associated site series, and provincial status. Anthropogenic units are also represented. In some cases both the TEM and wetland classification systems provide descriptors for this ecosystem unit and both descriptors have been listed. All of the wetland ecosystems are either red or blue listed in BC. The other ecosystems are not at risk and included ecosystem units that are non-vegetated and anthropogenic units.

**Table 10. Ecosystem and wetland communities occurring within the Study Area**

| Ecosystem/Wetland Code | Site Series | Site Series Name, Wetland Site Association or Anthropogenic Code | Provincial Status |
|---|---|---|---|
| CD | 00 | Black cottonwood/Douglas-fir - Common snowberry - Red-osier dogwood riparian | Red |
| CF | - | Cultivated field | - |
| Fl03 | - | Willow - Red-osier dogwood - Horsetail | Red |
| Fm01 | - | Black cottonwood - Snowberry - Rose | Red |
| DM | 08 | Douglas-fir - Water birch - Douglas maple | Red |
| GC | - | Golf course | - |
| OW | - | Open Water | - |
| RI | - | River | - |
| RW | - | Rural | - |
| RZ | - | Road Surface | - |
| UR | - | Urban | - |
| Wa | - | Shallow Open Water | - |
| Wm00 | - | Reed canarygrass/Mixed grass-forb | - |
| CT/Wm05 | - | Cattail Marsh | Blue |

Ecological communities are assigned to one of four provincial lists depending on their conservation status (Ministry of Environment 2014):
**Extinct:** Ecological communities that no longer exist.
**Red:** Includes any ecological community that is Extirpated, Endangered, or Threatened in British Columbia.
**Blue:** Includes any ecological community considered to be of Special Concern (formerly Vulnerable) in British Columbia.
**Yellow:** Includes ecological communities that are apparently secure and not at risk of extinction.

A brief description of each of the non-anthropogenic wetland or ecosystem units is provided below. These descriptions are based on the Wetlands of British Columbia guidebook.

**Willow-red osier dogwood-horsetail (Fl03):** Low bench floodplain site association observed along large low-gradient rivers with prolonged spring flooding in locations protected from erosive currents. Pacific willow (and in this case other willow species) are present with a sparse to dense understory of red osier dogwood and mountain alder, with a horsetail component. Soils are mostly regosols derived from deposits of fluvial fine sands and silts. These sites are intermixed with Fm01 throughout the Study Area. The dominant species is sometimes Pacific willow but other willow species are also present.

**Black cottonwood/Douglas-fir-Common snowberry-Red osier dogwood riparian (Fm01/DS):** Mid bench floodplain that occurs adjacent to streams, rivers, and lakes on sandy-gravelly flats that are part of the active floodplain. Flood events are short during the spring freshet and may not occur annual. This floodplain community is characterized by an open black cottonwood overstory and a dense understory shrub community dominated by red osier dogwood, common snowberry and rose species. Soils are commonly loamy or sandy regosols or gleyed brunisols.

**Reed canarygrass/mixed-grass forb (Wm00/Fl00):** These communities were observed intermixed with other wetland associations (Wm05 and Fm01) and were dominated by grasses and forbs. Weeds are typically prevalent in these areas and some are thought to have formed from previous clearing and disturbance of other wetland associations. The wetland guide indicates that these sites represent "a dis-climax community that establishes on cleared willow swamps and low-bench sites." Soils are commonly gleysol and fine textured.

**Common cattail marsh (Wm05):** Occur in protected lake embayments and in urban areas such as ditches and drainage ponds. Cattail dominates these sites but sedges and bulrush are sometimes also present. Soils are humisols or humic gleysols.

**Great bulrush (Wm06):** These sites are found mixed with cattail marsh communities. Lake embayments with significant water movements and grassland potholes with exposed substrates are some of the sites where this site association is found. Plant diversity is generally low; these sites are often found adjacent to water and associated with Wm05 described above. Soils are mostly gleysols although humisols occur occasionally.

The riparian fringe located along Mission Creek is predominantly an Fm01 site association. The overstory is dominated by an open, two-storied to multi storied black cottonwood forest, although trembling aspen is present in the main canopy but uncommon. Mountain alder, interior Douglas-fir and paper birch are occasionally present within the understory but not in sufficient numbers to warrant splitting these areas into separate site associations. Other wetland associations such as Wm05 and Wm00 are occasionally interspersed in small patches in these areas. Most of these forests likely originated after the dykes along Mission Creek were constructed. They represent a young to maturing forest with the average stand age being in the range of 75 to 80 years, although there are single veteran cottonwood occasionally present in this area that may have persisted along the old floodplain of the river. Alder, interior Douglas-fir and paper birch are typically much younger and were present in the understory. The shrub layer in these areas is typically a well-developed snowberry-rose community. Weeds and invasive species are common throughout.

Beyond the riparian fringe a mixture of urban/rural/agricultural areas and wetland features exists. The wetlands often coincide with old oxbows that were present prior to construction of the dykes along the creek. These oxbows typically include open water or a cattail dominated marsh surrounded by cattail and bulrush or willow low bench floodplain association. Open water areas typically have a low percent cover of emergent vegetation but floating and submerged vegetation is present. These shallow open water sites likely persist throughout the year although in some areas, the margins of these sites appeared to be inundated only seasonally. Weeds are present throughout these areas but tend to be present in higher proportions along the sites on

the left bank of Mission Creek. Beyond the forested and wetland areas, cultivated fields, sports fields, fallow fields and rural and urban development are prevalent.

Soils throughout the Study Area are typically gleysols, modified brunisols or brunisols. There is an overall lack of "organic" soil, even in proximity to wetland areas, however this is likely partially a reflection of where plots were located. It is expected that organic soils would be more common in the middle of shallow open water sites and along the margin of permanently inundated areas. Hummocky terrain is common particularly in areas where standing water was present at the surface. Medium to rich soils are present along with thin humus forms characteristic of mulls and mull-moders. Gleying and mottling were observed in some horizons which likely results from the fluctuating water table. Soil moisture regimes are typically subhygric to subhydric. The mineral soil texture is highly variable with loamy to sandy soil textures and even clay represented. This is consistent with fluvial deposits which tend to be heterogeneous across large areas and reflects the history of these sites as part of the active channel of Mission Creek.

### 4.5.3 Sensitive Ecosystem Inventory

A sensitive ecosystem inventory (SEI) was completed for the City of Kelowna in 2007 (Iverson 2008) and referenced during background review. Sensitive ecosystems present within the Study Area include wetlands, riparian and broadleaf woodlands. Seasonally flooded agricultural fields are also represented.

## 4.6 Rare Plants

The CDC search results did not reveal any non-sensitive mapped occurrences of rare plants within a 10 km radius centered on the Study Area. In addition, no sensitive records were available for species at risk within the Study Area itself (It is not possible to search by radius for sensitive occurrences, only non-sensitive occurrences can be searched by radius). Nine (9) surveys targeting rare plants were completed between April and October. The duration of these surveys ranged from two to six hours. Purposeful meandering of targeted habitats was used to search for rare plants. A vegetation list was compiled and has been included in Appendix D.

Two potentially rare species were located as a result of these surveys (Map 4). The aquatic macrophyte Mexican mosquito fern (*Azolla mexicana*) was identified in the large open water area near Gordon Drive and in another open water feature nearby. Both the federal and provincial species at risk reports produced for this species highlight the difficulty in identifying it correctly (COSEWIC 2008; Southern Interior Rare Plants Recovery Team 2008). A specimen was collected and information on the location of this species was forwarded to provincial ecosystems staff for follow up and identification by a rare plant specialist. The size of the individual plants matches the general description for the species. One of the difficulties in identifying the mosquito fern macrophyte correctly is that it is often distinguished based on its reproductive

structures or megasporangia. Because the plants spores sink to the bottom of a waterbody at maturity in the summer months, the timing of the survey precluded the detection of megasporangia. The Mexican mosquito fern is reportedly sensitive to changes in aquatic chemistry and habitat. Given the location of these ponds within a well-developed urban area, these threats are likely to be important considerations for management of these areas in future.

Ecoscape also observed what appears to be a young shoot of a potentially rare plant species, cut leaved water parsnip (*Berula erecta*). An observation form is included in Appendix B. The location of the sighting should be reviewed in 2016 to confirm identification with a taxonomic or rare plant specialist.

## 5.0 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas (ESA) were classified based on ecosystem characteristics and wildlife habitat suitability to rank each delineated polygon within the Study Area. 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), historical disturbance, successional status, regional rarity, and relative biodiversity. Each polygon was assigned a value rating based on the above criteria, which reflects 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). 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., enhancement of degraded wetlands). 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 Study Area is summarized in Table 11 and depicted on Map 5.

**Table 11. Percent composition of ESAs within the Study Area**

| ESA Value | ESA Area ($m^2$) | Percentage of Study Area (%) |
|---|---|---|
| Very High (ESA 1) | 82,153.57 | 5.3 |
| High (ESA 2) | 194,472.79 | 12.5 |
| Moderate (ESA 3) | 110,657.06 | 7.1 |
| Low (ESA 4) | 1,166,603.17 | 75.1 |
| **Total** | **1,553,886.59** | **100** |

Environmental sensitivity analysis indicates that the majority of the Study Area (i.e., 75.1%) has a Low value (ESA 4) rating. High value areas (i.e., ESA 2) represent approximately 12.5% of the Study Area. Moderate (ESA 3) and Very High (ESA 1) value areas comprise the remaining 7.1% and 5.3%, respectively.

The Low value areas represent previously disturbed areas that have generally been cleared for agricultural and recreational purposes. Other Low value areas include roads, pavement, actively cultivated and mowed fields, and other urban landuse. The Moderate value ESA areas are associated with patches of natural habitat, including riparian forest, wetted ditch, and landscaped rural areas that have been modified by human activity but still provide habitat for wildlife including nesting, perching, foraging, and cover. The High ESA areas include valuable wetland, aquatic, and riparian forest habitats that have been degraded, fragmented, and/or isolated from contiguous natural habitats. As such, these areas have the greatest potential for enhancement to improve the ESA from High to Very High.

In general, the Very High ESA areas are associated with functional wetlands that are contiguous with other natural ecosystems and/or have occurrences of rare, sensitive, or at risk species. Open water habitats, including the Michaelbrook Pond, Casorso Swamp, and Mission Creek are included in this category. These areas are considered to provide critical habitats and must be the highest priority for conservation.

### 5.1 Corridors and Core Conservation Areas

Corridors and key habitat areas generally follow the High and Very High ESA habitats, with the most obvious corridor being represented by the Mission Creek channel and associated riparian and floodplain communities. Key habitats identified during the study, such as raptor nests and breeding amphibians, also tend to occur along this corridor. Thomson Marsh and associated wetted ditches and channels also provide a movement corridor for a variety of aquatic and semi-aquatic wildlife. Maintenance of these linkage corridors with adjacent natural lands, such as the Casorso Swamp area across Casorso Road, is crucial to allowing migration of wildlife from the valley bottom to upper elevation areas. These linkages generally fit within the overall biodiversity strategy for the Central Okanagan Biodiversity Strategy and Regional Growth Strategy (RGS).

## 6.0 MONITORING PLAN

The following monitoring plan provides a framework to incorporate local and/or volunteer involvement to contribute to future data collection and analysis. Depending on sample size and level of effort, to accurately determine population characteristics such as richness, diversity, and abundance with meaningful statistical significance may take at least 2 or 3 years of data collection (Nur et al. 1999). To identify population trends, such as increases or decreases in population numbers, may take 10 years or more depending on the level of effort. Measuring more detailed population information such as productivity and survivorship will require greater sampling efforts such as mist netting and/or nest searching and monitoring. The overview monitoring plan includes timing and locations suitable for photo point locations, bird surveys, spawning fish counts, and other surveys of local species of interest.

The long-term goal of the monitoring plan is to encourage involvement and partnerships between non-governmental or volunteer groups and local government to provide consistent and regular monitoring. Key volunteer groups include the Central Okanagan Naturalists Club (CONC), Central Okanagan Land Trust (COLT), and the Friends of Mission Creek. These groups are active in fish and wildlife observation as well as general observations of ecological condition along the Greenway. Many of the members of these groups are highly skilled and experienced in wildlife identification, including birds, and many are active during seasonal surveys, such as the Christmas Bird Count. Other groups that may be suitable for involvement include the BC Wetlandkeepers, the BC Wildlife Federation, and Wild BC. Participation with UBC Okanagan and the Okanagan College may also promote the involvement of professors and students.

The monitoring plan includes recommendations for optimal timing of species specific surveys and use of standardized forms to ensure consistent and meaningful data collection. In general, the RISC standards and the methods used for the 2014 surveys

should be followed as closely as possible. A summary of the monitoring plan is provided below.

**Table 12. Summary of monitoring plan**

| Survey | Effort | Timing | Location | Surveyors |
|---|---|---|---|---|
| Photo Point | Photo points to be determined | Various (same dates each year) | Photo point locations to be determined | Volunteers and members of general public |
| Amphibian Aural Survey | Minimum 3 surveys at 17 stations | April 1 to June 30 (RISC) | 17 survey stations (3, 5, 8, 11-14, 16, 18, 20, 23-29) | Qualified Personnel (as per RISC) |
| Time-Constrained Searches (TCS) | Minimum of 20 person-hours | May 1 to July 31 | Various (throughout Study Area) | Qualified Personnel (as per RISC) |
| Songbird Point Counts | Minimum 6 surveys at 30 stations | May 1 to July 10 (RISC) | All 30 survey stations | Qualified Personnel (as per RISC) |
| Owl Call-Playback Surveys | Minimum 3 surveys at 5 stations | February 1 to June 15 (RISC) | 5 survey stations (3, 5, 8, 11, 20) | Qualified Personnel (as per RISC) |
| Bio-Blitz* | Minimum 1 day of surveying | late May to early June | Various (throughout Study Area) | Volunteers and members of general public |
| Christmas Bird Count | Minimum 10 person-hours | December 14 to January 5 (December 20, 2014) | Various (throughout Study Area) | Volunteers (CONC, Friends of Mission Creek) |
| Rare Plant Surveys | Minimum 50 person-hours | Various (between May and October) | Various (throughout Study Area) | Qualified Personnel (as per RISC) |

* described as a one or two day event led by volunteer biologists or naturalists with the intention of documenting as many species as possible.

## 6.1 Photo Points

To help document change in the Study Area over time, the installation of permanent bollard sign posts is recommended to mark photo point locations (see picture). The installation of a simple angle bracket on the bollard and some instructional information can be used to allow people to take consistent photos (direction, distance) of the proposed restoration areas over time. The sign may also direct people to share their photos online using social media (e.g., Twitter, Instagram, Flickr, Facebook) and organized using hashtags. The photo record may be used to develop a time-lapse documenting the restoration works or other

community changes within the Study Area. Example of the use of these signposts is available at: http://monitorchange.org and http://nerdsfornature.org/monitor-change.

Photo point locations have not been determined but should be positioned and oriented towards proposed locations of restoration works. The photo locations should also be easily accessible and in frequented areas to encourage public use and involvement. One suitable example location is along the trail connecting the parking lot near the dog park to the Greenway trail, oriented to the northeast. This will allow photo documentation of the proposed restoration in the area recently acquired by the City of Kelowna to be used for dike relocation and channel restoration efforts.

Other locations where changes in forest cover, wetland condition, or changes in setback alignment or Mission Creek channel morphology are proposed should also be used. If possible, all photo documentation should be conducted using high-resolution digital camera using consistent image quality and size settings. Photos should be taken in the same direction and at the same general angle (i.e., no zoom lens) to facilitate comparison. Photos should be taken at the same time of year (i.e., same date if possible) over subsequent years. Photos should also be taken at various times of year, each season, at varying water levels, etc. Over time, the crowd-sourced photo record will help show ecosystem changes, maturation of forest stands, and the results of any future restoration efforts.

## 6.2 Amphibian Surveys

Amphibian aural surveys should be conducted over a period of time maximizing the opportunities to detect as many calling frogs as possible. Generally, this should occur between the beginning of April and the end of June to correspond with the chorus frog, Columbia spotted frog (*Rana luteiventris*), and spadefoot breeding periods. Surveyors must be suitably qualified to identify frogs and toads by call and be familiar with the Study Area, including the survey station locations. Other methodology described in this report must also be followed, including use of the standard data forms.

Time Constrained searches should also be conducted by qualified personnel experienced in the identification of herptiles and invertebrates by sight and familiar with the habitat requirements of species of interest. Documentation should include photo records and level of effort (i.e., number of hours searching per person). Time constrained searches may also be incorporated into the bioblitz surveys, described below.

Less formal surveys may be conducted by volunteer naturalists and citizen scientists. Field protocols, data collection, data entry, and other information is available at the BC Frog Watch Atlas (www.env.gov.bc.ca/wld/frogwatch/frogwatching/atlas.htm).

## 6.3 Bird Surveys

A generic bird point count form is provided for routine or incidental bird observations, including the Christmas Bird Count. Surveys should follow the RISC protocols, be conducted during the spring/early summer period (May to June), and occur at least 6 days apart. The point count forms with the aerial image overlay should be used to allow accurate distance estimates and spot mapping. This data should then be entered into a master GIS database which can be used to output diversity, abundance, and distribution information, including changes over time, quickly and easily.

Owl surveys must be conducted earlier in the year although the timing of the 2014 surveys resulted in successful calling response of Screech-owl within the nearby Casorso Swamp area. In order to maximize potential to identify breeding pairs and locate nest trees, surveys should be scheduled to occur approximately once every 10 days over a period of several months, between February and May. Bird surveyors must be qualified to identify birds by song/call and familiar with the Study Area, including points of access and private property boundaries.

Volunteer opportunities include the bioblitz (described below) and Christmas bird counts. The CBC is an annual event held from December 14 to January 5 where volunteers submit avian observations. In Kelowna, the event is coordinated by the CONC and in 2014 the section of the survey that includes the Mission Creek and Thomson Marsh areas occurred on December 20. The observations from the CBC will provide valuable additions to the avian species lists and help refine the data on richness and diversity.

## 6.4 Rare Plant Surveys

Continuing searches for rare plants should be conducted at various times of year to maximize the potential to identify potentially occurring rare plants during their flowering or fruiting periods. Personnel must be suitably qualified to identify plants and should take detailed photo and observation records (time, date, location, etc.).

## 6.5 Fish Surveys

Fish counts were not conducted during the 2014 surveys. Future surveys, if conducted, should focus on presence/absence and relative abundance within the subject reach of Mission Creek and new habitats created by the MCRI. This will likely require capture surveys (i.e., electrofishing, trapping) conducted by suitably qualified professionals and appropriate fish collection permits. Isolation of sections of the subject reach with stop nets would be required with multiple electrofishing passes to determine relative abundance within the area. Otherwise, passive methods, such as minnow trapping, could be used to determine presence/absence of species.

### 6.6 Bioblitz

A bioblitz is generally a one or two day event that brings together a group of volunteer scientists, naturalists, and other outdoor enthusiasts, to identify and document as many organisms as possible within a given area. The bioblitz promotes volunteer involvement as well as opportunities for residents to learn about local wildlife and biodiversity. Whistler (http://www.whistlerbioblitz.ca/) began one of the earliest bioblitz projects in BC and has documented nearly 3,000 species to date. A Kelowna bioblitz was held in 2015 through the UBC Okanagan campus

Conducting an annual bioblitz within the study area would likely contribute greatly to the documented species richness and diversity and determine the presence of rare or unusual species. Timing of the bioblitz event to occur during the late May to early June period will help maximize the number of bird species presence and the leafing out and flowering of many native plants.

## 7.0 ENVIRONMENTAL CONSIDERATIONS

The following section provides a summary of environmental considerations that should be incorporated into future planning and design of restoration and enhancement projects.

### 7.1 Conservation of Rare Habitats

- The Red-listed riparian cottonwood forest community (CD) along the Mission Creek corridor provides important habitat for various cavity nesting species, including the endangered Western Screech-owl, which was observed within the Casorso Swamp area. The riparian ecosystems must be maintained where possible efforts to restore or enhance adjacent pockets of riparian woodland, wetlands, and oxbows should be a high priority. The identified nest sites and other locations of species at risk provide a basis for management planning and promote the success of sensitive species. Based on the bird surveys, these CD sites with adjacent open water and wetlands and riverine habitats support the greatest richness and diversity of wildlife in the study area.

- Veteran trees and snags should be conserved where possible for the important nesting, denning, and perching habitat features they provide. The retention of snags must be conducted with public safety in mind and there are techniques that can be used to retain wildlife trees while ensuring public safety (e.g., danger tree assessment, topping, limbing). Fallen trees and other coarse woody debris should also be retained where possible for the important habitat and nutrients they provide to the forest ecosystems.

- Similarly, conservation of wetland and open water habitats must be a high priority for planning and development. These habitats are critical for many of the wildlife species observed, including a number of sensitive or at risk species. Connectivity between these habitats with adjacent riparian or upland communities will be important to provide movement and dispersal corridors as well as buffering against edge effects and human disturbance (i.e., noise, light).

## 7.2 Sensitive Wildlife

- During the 2014 surveys, a total of eight (8) at risk species were observed. The habitats associated with these species must be conserved and/or enhanced to ensure their populations remain healthy and they are able to migrate through the Study Area to other adjacent suitable habitats. As indicated in Table 13, most of the sensitive species observed or believed to occur within the Study Area are strongly associated with wetland and riparian ecosystems for critical life stages (i.e., breeding, nesting, overwintering, foraging, etc.).

**Table 13. Summary of species at risk observed or with the potential to occur within the Study Area**

| Species Group | Common Name | Scientific Name | Provincial Status[1] | COSEWIC Listing[2] | Habitat Association |
|---|---|---|---|---|---|
| Amphibian | Great Basin spadefoot* | *Spea intermontana* | Blue | Threatened | Wetland |
| Bird | California gull | *Larus californicus* | Blue | - | Rural |
| | common nighthawk | *Chordeiles minor* | Yellow | Threatened | Open/Grassland |
| | barn swallow | *Hirundo rustica* | Blue | Threatened | Rural/Riparian |
| | great blue heron | *Ardea herodias* | Blue | - | Wetland/Riparian |
| | western screech-owl | *Otus kennicottii* | Red | Threatened | Riparian |
| Invertebrate | lance-tipped darner | *Aeshna constricta* | Red | - | Wetland |
| Mammal | spotted bat* | *Euderma maculatum* | Blue | Special Concern | Wetland/Riparian |
| | western red bat* | *Lasiurus blossevillii* | Red | - | Wetland/Riparian |
| | western small-footed myotis* | *Myotis ciliolabrum* | Blue | - | Wetland/Riparian |
| Reptile | western painted turtle | *Chrysemys picta bellii* | Blue | Special Concern | Wetland |
| Plant | cutleaf waterparsnip | *Berula erecta* | Blue | - | Wetland |
| | Mexican mosquito fern | *Azolla mexicana* | Red | - | Wetland |

**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.
**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.
*** Not confirmed during 2014 surveys.**

- High quality amphibian breeding and rearing wetland habitats, including Michaelbrook Pond and associated ditches and other wet areas must be retained. This means fish access must not be permitted to prevent increased predation pressure on larval and adult frogs and salamanders. It is possible that frogs were not detected within Thomson Marsh during aural surveys due to the presence of non-native carp and pumpkinseed within that system.

- Turtle breeding, rearing, and overwintering potential must be retained and could be enhanced within Michaelbrook Pond by installing basking logs, providing access to suitable sandy egg-laying areas, and providing protected movement corridors to reduce the potential for mortalities from vehicles.

- Little is known about bat use within the Study Area and further effort should be made to document suitable roosting sites. As a result of the Anabat surveys, it appears that bats utilize the Mission Creek corridor, cottonwood riparian forest, wetlands, and open water areas for foraging. Bat populations can be enhanced through construction of bat boxes or a bat 'condo' for maternity colonies that are suitable for the local species. The existing potential for roosting or overwintering in rural outbuildings, barns, sheds, abandoned structures, should be explored by qualified professionals and all outbuildings should be assessed prior to demolition.

- Light pollution (discussed below) from the baseball diamonds likely have an effect on the behaviour of nocturnal species, including owls. Effects may include decreased predation success due to prey being able to detect the owls in the increased light conditions. It may also lead to increased predation of screech-owl by great horned owls in the area.

### 7.3 Timing Windows

- Clearing and other construction work will be subject to the least-risk work window for breeding birds which typically occurs from April 1 to July 31 in the Okanagan Valley. However, certain large-bodied birds, such as raptors, herons, and owls, are known to begin nest site selection and breeding much earlier (i.e., early February).

- Raptor Nest BMP (Caskey & Chutter 2013) apply to the eagle and red-tailed hawk nests as well as Great Horned Owl nest (approximate) and potential American Kestrel and Western Screech-

owl nests. Given that the raptors present within the Study Area are generally all considered Moderate to High tolerance to human presence and activity and the surrounding area considered to be rural in character, a 100 m no-disturb buffer surrounding the nest site would be reasonable. The Western Screech-owl is considered only moderately tolerant of human activity and any confirmed nest location would require a no-disturb buffer of at least 200 m. Both of these would be subject to an additional 100 m noise buffer during the breeding season, which generally occurs between February and August for these species.

**Table 14. Summary of least risk work windows for birds**

| Species | Least Risk Window |
|---|---|
| Raptors (eagles, hawks, falcons, & owls) | August 15 – January 30 |
| Herons | August 15 – January 30 |
| Other Birds | August 1 – March 31 |

Source: Ministry of Forests, Lands, and Natural Resource Operations

- Amphibians and turtles do not have designated timing windows and can be vulnerable year-round to works around wetlands during periods of breeding, migrating, and/or hibernating. A summary of the timing of key life history stages for turtles is provided below.

**Painted Turtle**
***Chrysemys picta***

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hibernation in the Water | | | | | | | | | | | |
| | | | | | | | | | | | |
| Mating in the Water | | | | | | | | | | | |
| | | | | | | | | | | | |
| Nesting on Land | | | | | | | | | | | |
| | | | | | | | | | | | |
| Hatching (occurs during following spring) | | | | | | | | | | | |
| | | | | | | | | | | | |

Adapted From Orchard, 1984

- Proposed works within Mission Creek will be subject to the regional least-risk fisheries work window of July 22 to August 24.

## 7.3 Light Pollution

- Potential adverse effects of light pollution was noted during nighttime surveys for amphibians and owls that floodlights and street lights throughout the Study Area cast substantial light into core riparian habitats. This was particularly evident along the Greenway trail adjacent to the baseball diamonds where artificial light was sufficient to write notes without other supplementary lighting (e.g., flashlight, headlamp). The lighting was observed as late as 1130 pm.

- Artificial lighting is known to have detrimental impacts on the activities of nocturnal species, including owls and other birds, bats, and small mammals (Deda et al. 2007). The lighting also effects breeding amphibians (Perry et al. 2008). The ultimate local effects are not known at this time; however potential site-specific effects may include increased predation on Western Screech-owl by Great Horned Owl or avoidance of otherwise suitable habitats due to the disturbance effects of the lighting. Best practices and management strategies suitable for the Study Area can be found in the Vancouver Bird Strategy (City of Vancouver 2015).

## 7.4 Noise

- Noise was an observed disturbance to wildlife during early morning point count surveys, especially near roads and recreational facilities. The noise may have effects on breeding birds (interrupting or overshadowing songs), amphibians, and other wildlife that rely on sound for carrying out life stages (e.g., bats).

## 7.5 Off-leash Dogs


- The Greenway trail and other areas of the Study Area are popular with dog walkers and care must be taken to ensure dogs waste is appropriately cleaned up and removed. The dog park within the Study Area provides a suitable area for off-leash dogs and dogs should be kept on leash within all other areas to prevent conflicts with wildlife and disturbance to native vegetation. In particular, dogs should not be allowed within the wetland and open water communities due to potential negative impacts to aquatic and riparian vegetation and wildlife, dispersal of invasive plant seeds, and degradation of soils and water quality.

## 7.6 Non-native and Invasive Species

- Invasive wildlife species of concern are listed in the table below. The effects of invasive species include competition with native species for resources, reduced biodiversity, degradation of water quality, and loss of wildlife habitat. Invasive plants are indicated in the plant database (Appendix D).

**Table 15. Summary of non-native wildlife occurring within the Study Area**

| Species Group | Common Name | Scientific Name |
|---|---|---|
| Bird | California quail | *Callipepla californica* |
| | Eurasian Collared-dove | *Streptopelia decaocto* |
| | European Starling | *Sturnus vulgaris* |
| | House Sparrow | *Passer domesticus* |
| | Rock Dove | *Columba livia* |
| Mammal | eastern grey squirrel | *Sciurus carolinensis* |
| Fish | Carp | *Cyprinus carpio* |
| | Pumpkinseed | *Lepomis gibbosus* |

- Invasive fish species such as carp and pumpkinseed occurring within Thomson Marsh may be associated with the lack of amphibians observed calling in that area during the breeding season. These invasive fish species must be kept out of Michaelbrook Pond and the open water communities within the oxbows to prevent negative impacts to resident amphibian populations as well as on invertebrate community structure that currently includes the Red-listed lance-tipped darner.

- Non-native, noxious, and weedy plant species are widespread throughout the Study Area. These species are highlighted within the plant list provided in Appendix D. Control of priority species may include programs to remove weeds manually (i.e., hand pulling, mowing) and bagging for offsite disposal.

## 7.7 Rural and Recreational Activities

- Rural farming activities that may directly or indirectly impact wildlife and vegetation include:
  - mowing grasses and crops;
  - spraying pesticides;
  - construction of fences, buildings;
  - improper disposal of waste, including manure, yard waste, clippings, etc.;
  - spread of non-native and invasive plants;
  - tree clearing and removal of native vegetation;
  - allowing farm animals (cattle) to wander and graze; and
  - recreational horseback riding.

- Many of the activities listed above were observed during the 2014 surveys, including cattle grazing, horseback riding, vegetation removal, and installation of fencing. These activities were observed in the rural properties along the right bank (i.e., north) of Mission Creek.

## 7.8 Riparian Management Area Setbacks

- As indicated in the OCP, the City of Kelowna has established a minimum 50 m Riparian Management Area (RMA) setback guidelines for streams and other aquatic habitats occurring within the city.
  - Mission Creek, upstream from Gordon Drive (which represents the downstream limit of the Study Area) has a minimum setback of 50 m.
  - Wetlands with no fish presence have 15 m RMA setbacks while those associated with fish habitat are given 30 m RMA setbacks.
  - Wetted ditches and springs also have 15 m RMA setbacks unless otherwise subject to provincial guidelines or criteria.

- The reconstruction of the dikes will effectively move the entire RMA, which may have effects on neighbouring properties. Private landowners may have reduced potential for land development as a result of the new setbacks.

# 8.0 RECOMMENDATIONS AND MITIGATION

Existing and potential threats resulting from proposed future developments (e.g., dike construction) were identified during the background review and surveys. The following section outlines recommendations for avoidance and mitigation based on our species and ecosystem observations. Cost estimates cannot be determined until works are proposed, including scope, design, and plan. Standard rates used in restoration works may be used as a guide for potential future restoration works per unit area. Examples include hydroseeding, riparian planting (i.e., labour), plant plugs and seedlings, excavator rates (including cost to outfit with biodegradable fluids for works near water), and materials such as topsoil, rip-rap, and spawning substrates (gravel).

## 8.1 Conservation and Restoration Targets

Conservation target ecosystems generally follow the sensitive Very High value (i.e., ESA 1) polygons, including wetlands, oxbows, and other aquatic and wetted habitats. These critical habitats and associated key wildlife features must be retained and any proposed future works must avoid impacts or disturbance within these areas.

Restoration targets include those polygons adjacent to Mission Creek and associated riparian, wetland, and oxbow communities. Although technically outside of the Study Area boundary, areas along Thomson Marsh may also be good candidates for enhancement or restoration. Wetland or aquatic habitats that have been degraded or are isolated and fragmented (i.e., ESA 2) have the best potential to be restored or enhanced to improve habitat quality and ecological value (i.e., raised to ESA 1).

The dike embankments along Mission Creek are generally characterized by rip-rap armour and in many areas the riparian community has been heavily impacted or removed altogether. Parks maintenance routinely mow and brush vegetation, including small diameter cottonwood trees along the dikes. Encroachment from adjacent rural and agricultural properties has resulted in the clearing of riparian vegetation to the edges of the regional park boundary. Restoration of the riparian community through planting, seeding, or live staking should be attempted where possible or feasible.

Long term goals should be enhancement and restoration to improve habitat conditions for the sensitive species that exist within or nearby. These include western screech-owl, painted turtle, great blue heron, and potentially Great Basin spadefoot. The intention should be to facilitate and encourage the development and expansion of existing mature cottonwood riparian communities and restoration and enhancement of wetlands and other aquatic habitats suitable for sensitive species will also provide habitats for many other wildlife species (top down approach).

Improvement of wetland and oxbow habitats will enhance amphibian populations as long as fish passage is kept separate. Expansion of creek channel and creation of floodplain habitat will improve suitability for fish, including potential spawning habitats.

## 8.2 Offsite Effects

Offsite effects from realignment of dikes include the potential impact of fish access on amphibian and invertebrate populations within the oxbow and wetlands. Michaelbrook and associated ditches and wet areas are rich in amphibian life and as such should not be connected to fish bearing waterbodies. Fish passage opportunities should be explored along the right bank where few to no amphibians have been observed and risk to recreational areas and public infrastructure is lower. Constructed spawning channels for kokanee occur upstream from the Study Area, adjacent to the Environmental Education Centre for the Okanagan (EECO). Similar spawning channels may be suitable for the Study Area, given the considerations to amphibian habitats described in this report.

## 8.3 Environmental Management Plan

To ensure avoidance and/or mitigation of potential negative impacts, proposed works should incorporate the following general principles.

### 8.3.1 General Mitigation

- Must not remove any mature cottonwood, especially those with cavities, or large nest potential such as the eagle trees, red-tailed hawk nest, wood duck nesting trees, flicker or pileated cavities, etc.

- Flagging or snow fencing should be used to clearly delineate the proposed work footprint (i.e., construction limits) prior to the commencement of any works. Flagging or snow fencing will also be used to clearly identify setbacks and buffers associated with other identified environmentally sensitive areas (e.g., wildlife trees, nests).

- If vegetation clearing activities are required during the identified avian nesting period (i.e., April 1 to July 31), pre-clearing surveys must be conducted by the EM to identify active nests and other critical habitat features, such as burrows, dens, etc. Surveys will focus on songbird, raptor and heron nests, stick nests, and snags and cavities that may be used over multiple years or year-round. Section 34 of the Wildlife Act protects all birds and their eggs, and Section 34(c) protects their nests while they are occupied by a bird or egg.

- If active nests are found within the clearing limits, a buffer will be established around the nest until such time that it can determine the nest has become

inactive. The size of the buffer will depend on the species and nature of the surrounding habitat. Buffer sizes will generally follow provincial BMP guidelines or other accepted protocol (e.g., Environment Canada). In general, a minimum 20 m buffer will be established around songbird nests or other non-sensitive (i.e., not at risk) species.

- Clearing and other construction activities must be conducted within 72 hours following the completion of the pre-clearing nest surveys. If works are not conducted in that time, the nest surveys are considered to have expired and a follow-up survey will be completed to ensure that no new nests have been constructed.

- If active nests are found within the clearing limits, a buffer will be established around the nest until such time that the EM can determine that nest has become inactive. The size of the buffer will depend on the species and nature of the surrounding habitat. Buffer sizes will generally follow provincial BMP guidelines or other accepted protocol (e.g., Environment Canada). In general, a minimum 20 m buffer will be established around songbird nests or other non-sensitive (i.e., not at risk) species.

- Wherever possible, trees with high wildlife value, such as veteran trees and large snags, should be conserved. Hazardous trees with wildlife value within the vicinity of the construction works should be assessed by a certified wildlife/danger trees assessor to determine levels of risk.

### 8.3.2 Aquatic Habitat

- Must not disturb or impact the Michaelbrook wetlands and associated amphibian breeding areas. Includes ditches and swales and other wetted areas connected to Michaelbrook.

- All proposed works must be conducted in accordance with the provincial Water Act and Fish Protection Act and the federal Fisheries Act. A Water Act Section 9 notification will be required for works occurring in and around wetted environments, including Mission Creek, wetlands, and oxbows.

- Works with the potential to directly impact fish or other aquatic organisms will require an aquatic lifeform salvage to capture and relocate wildlife. This includes the isolation of the aquatic environment and capture of wildlife species by qualified professionals. Appropriate wildlife collection permitting will also be required.

- If required, diversion of surface water flows should be conducted with appropriately sized pumps or suitable alternative (e.g., gravity-fed system). Gravity-fed systems should use appropriate diameter pipes to convey flows. If

dewatering of aquatic habitats is required, it should be conducted with suitably sized submersible pumps with appropriate fish screens to prevent the entrainment of fish and other aquatic organisms, as per DFO guidelines (DFO 1995).

### 8.3.3 Erosion and Sediment Control

- An Erosion and Sediment Control Plan should be developed prior to any proposed works and should incorporate the measures described below to mitigate risks to water quality and aquatic habitats. The plan should be based upon provincial BMPs and other specifications and include the following principles:
  - Construction works should be conducted during periods of warm, dry weather with no forecasted precipitation;
    - Construction works should be scheduled to reduce the overall amount of time soils are exposed;
    - Natural drainage patterns should be maintained where possible;
    - Existing native vegetation should be retained where possible;
    - Stormwater and sediment-laden runoff should be directed away from exposed soils within the construction area;
    - Sediment-laden water should not be directed to any surface water feature, gully, or other drainage system;
    - Slopes should be stabilized as soon as possible following disturbance;
    - Other erosion and sediment control measures should be implemented, inspected, maintained, and/or replaced as required to provide appropriate mitigation.

## 9.0 CONCLUSION

This report provides a summary of the methods and result from the 2014 baseline biophysical inventories conducted along Mission Creek between Casorso Road and Gordon Drive and other adjacent properties in Kelowna, BC. A framework for future monitoring to compare results and identify significant change is also provided. Mapping has been completed that shows the ecosystem polygons, environmentally sensitive areas (ESA), and other significant wildlife and habitat features. Overall, there following numbers of species were observed:

- 82 bird species
- 3 amphibian species (with a historical record of a fourth)
- 3 reptile species
- 11 mammal species (as well as several unidentified bats)
- 12 ecological communities

Summary statistics from the songbird point count data show that ST11, along the north shore of Michaelbrook Pond has the highest abundance, richness, and diversity of all the point count stations. The statistical analysis found that 15 of the point count stations are redundant and can be eliminated. This will allow more focused surveys and reduce effort and budget in the future while still providing meaningful population results. Statistically exemplar sites that should remain the focus of future surveys include: ST08, ST20, ST23, ST26, and ST30. Comparison of summary statistics between habitats was not feasible due to the mosaic of various habitats within each of the point count stations and throughout the Study Area. It was not feasible to situate point count stations with a 50 m radius within a single habitat type. As such, comparisons can only be made between point count stations.

Additional surveys should be conducted to continue to build upon the species database and to attempt to discover other rare or at risk species, where possible. Efforts should include a mix of detailed surveys conducted by qualified environmental professionals and volunteer efforts from local interest groups and naturalist clubs. First Nations traditional knowledge should be incorporated where possible. Annual bioblitz surveys and Christmas bird counts will provide opportunities for volunteer involvement and maximize the numbers of species that can be discovered in a short period of time. Photo point locations should be situated in such a way that promotes the use of the public to collect comparable photos (same location, direction, framing, etc.). Encouraging the sharing of the photo record through social media (e.g., Twitter, Flickr, Instagram, Facebook, etc.) to document changes within the Study Area and to generate a time-lapse record of specific areas.

The project results, data analysis, and monitoring plan framework summarized in this report provide a baseline of ecological information to measure future changes in wildlife and plant species presence, distribution, abundance, and diversity. The monitoring plan will facilitate volunteer and public participation that will allow the detection of community and population change over time. The report also includes avoidance and mitigation strategies for future landuse planning, including the proposed re-location of dikes, construction of spawning channels, and other forms of restoration or enhancement. Site specific mitigation measures will be developed during the planning stages of dyke design and construction and additional focused surveys should also be considered at that time. The identification and conservation of at risk wildlife and vegetation resources is of the utmost priority and impacts to these resources must be avoided at all times as the restoration initiative moves forward.

## 10.0 CLOSURE

This report has been prepared for the Mission Creek Restoration Initiative (MCRI) as a summary of methods and results from the 2014 biophysical inventories conducted within the Study Area along Mission Creek, between Casorso Road and Gordon Drive. Ecoscape trusts that this report meets the expectations and requirements outlined in the Terms of Reference provided by MCRI. 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. The MCRI 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

Prepared By:


Adam Patterson, R.P.Bio.
Natural Resource Biologist
(250) 491-7337 ext. 207

Angela Cormano, R.P.Bio., R.P.F.
Natural Resource Biologist
(250) 491-7337 ext. 214

Reviewed By:


Kyle Hawes, R.P.Bio.
Senior Natural Resource Biologist
(250) 491-7337 ext. 203

## REFERENCES

Alberta Native Plant Council. 2012. ANPC Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update. Alberta Native Plant Council, Edmonton, AB. Available on-line at http://www.anpc.ab.ca/content/resources.php.

BC Conservation Data Centre (BC CDC). 2014. BC Conservation Data Centre Home. Species and Ecosystem Search. Available at http://www.env.gov.bc.ca/cdc/.

BC Ministry of Environment. 2005. Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia. Prepared by: Mike W. Demarchi, MSc, RPBio and Michael D. Bentley LGL Limited environmental research associates. Prepared for: B.C. Ministry of Environment Ecosystem Standards and Planning Biodiversity Branch. March, 2005.

BC Ministry of Environment, Lands and Parks. 1998. Inventory Methods for Bats. Version 2.0. Standards for Components of British Columbia's Biodiversity No. 20. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. March 13, 1998.

BC Ministry of Environment, Lands and Parks. 1998. Inventory Methods for Pond Breeding Amphibians and Painted Turtle. Version 2.0. Standards for Components of British Columbia's Biodiversity No. 37. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. March 13, 1998.

BC Ministry of Environment, Lands and Parks. 1998. Species Inventory Fundamentals. Version 2.0. Standards for Components of British Columbia's Biodiversity No. 1. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. November, 1998.

BC Ministry of Environment, Lands and Parks. 1999. Inventory Methods for Forest and Grassland Songbirds. Version 2.0. Standards for Components of British Columbia's Biodiversity No. 15. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. March 16, 1999.

BC Ministry of Forests, Land and Natural Resource Operations. 2014. Plant Species at Risk Fact Sheets.

BC Ministry of Water, Land, Air, and Parks. 2004. Accounts and Measures for Managing Identified Wildlife. Version 2004. Biodiversity Branch, Identified Wildlife Management Strategy, Victoria, BC.

Bennett, A.F. 2003. Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation. IUCN Forest Conservation Programme. Conserving Forest Ecosystems Series No. 1.

Bodenhofer, U., Kothmeier, A., & Hochreiter, S. (2011). APCluster: an R package for affinity propagation clustering. *Bioinformatics*, *27*(17), 2463-2464.

Caskey, M. and M. Chutter. 2013. Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013). A companion document to Develop with Care 2012. Ministry of Forests, Lands and Natural Resource Operations.

Caskey, M., G. Bracher, T. Chatwin. 2014. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (2014). A companion document to Develop with Care 2012. Ministry of Forests, Lands and Natural Resource Operations.

City of Vancouver. 2015. Vancouver Bird Strategy. http://vancouver.ca/files/cov/vancouver-bird-strategy.pdf

COSEWIC 2002. COSEWIC assessment and update status report on the Western Screech-owl otus kennicottii in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 31 pp.

COSEWIC. 2008. COSEWIC assessment and update status report on the Mexican Mosquito-fern Azolla mexicana in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vi + 35 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Deda, P., I. Elbertzhagen, and M. Klussmann. 2007. Light Pollution and the Impacts on Biodiversity, Species and their Habitats. From Starlight: A Common Heritage Proceedings III. Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (UNEP-CMS).

Dobson Engineering Ltd. 2003. 2002 Interior Watershed Assessment Update for the Mission Creek Watershed (Penticton Forest District). Prepared For: Riverside Forest Products Ltd. (Kelowna), Gorman Bros. Lumber Ltd. (Westbank), Tolko Industries Ltd. (Lavington), Small Business Forest Enterprise Program (Penticton). January, 2003.

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.

Frey, B. J., & Dueck, D. (2007). Clustering by passing messages between data points. *Science*, *315*(5814), 972-976.

Gregory, R. D., D. W. Gibbons, and P. F. Donald. 2004. Bird census and survey techniques. In 'Bird Ecology and Conservation'. Techniques in Ecology & Conservation. Oxford University Press.

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.

Hausleitner, D. 2006. Inventory Methods for Owl Surveys. Standards for Components of British Columbia's Biodiversity No. 42. Version 1.0. Prepared For: Ecosystems Branch of the Ministry of Environment for the sources Information Standards Committee. July, 2006.

Hawes, K. 2007. Wetland Inventory, Classification, Evaluation and Mapping (WIM). Inventory Summary Report. Ecoscape Environmental Consultants Ltd. Prepared for the City of Kelowna in Partnership with the Okanagan Basin Waterboard and Ducks Unlimited.

Iverson, K. and P. Uunila. 2008. Terrestrial Ecosystem Mapping with Sensitive Ecosystems Inventory – City of Kelowna.

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.

Legendre, P., & Legendre, L. (1998). Numerical ecology: second English edition. *Developments in environmental modelling*, *20*.

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.

Longcore, T. and C. Rich. 2004. Ecological Light Pollution. Frontiers in Ecology and the Environment. Vol. 2, No. 4 (May, 2004), pp. 191-198

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.

Nur, N., S.L. Jones, and G.R. Geupel. 1999. A statistical guide to data analysis of avian monitoring programs. U.S. Department of the Interior, Fish and Wildlife Service, BTP-R6001-1999, Washington, D.C.

Official Regional Park Plan (ORPP). 2000. Our Regional Parks: The Central Okanagan's Official Plan for the Regional Park System. "Schedule A". Prepared By: Residents and Enthusiastic Park Users of the Central Okanagan with the Assistance of the Parks and Recreation Department, Regional District Central Okanagan. November 2000.

Oksanen, J., Blanchet, F. G., Kindt, R., Legendre, P., Minchin, P. R., O'Hara, R. B., & Oksanen, M. J. (2015). Package 'vegan'. *Community ecology package, version*, 2.1-2.

Orchard, S.A. 1984. Amphibians and Reptiles of BC: An Ecological Review. Research Branch, Ministry of Forests. WHR-15. Victoria, BC.

Paradis, S., J. Boisvert, E. Smirnoff, A. Deblonde, C. Grasby, S. Telka, A. Pugin, A. Pullan and S; Thomson. 2010. Surficial geology, geochemistry and 3D modeling of the Kelowna-Westbank-Mission Creek area. Geological Survey of Canada. Natural Resources Canada.

Penny, J and R. Klinkenberg. 2013. Protocols for Rare Plant Surveys (Red and Blue-listed Species). In: Klinkenberg, Brian. (Editor) 2013. E-Flora BC: Electronic Atlas of the Flora of British Columbia [eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. [Accessed: May –October 2014].

Perry, G., B. W. Buchanan, R. N., Fisher, M. Salmon, and S. E. Wise. 2008. Effects of artificial night lighting on amphibians and reptiles in urban environments. Pages 239–256 in J. C. Mitchell, R. E. Jung Brown, and B. Bartholomew, editors. Urban Herpetology. Society for the Study of Amphibians and Reptiles, Salt Lake City, UT. Herpetological Conservation Number Three.

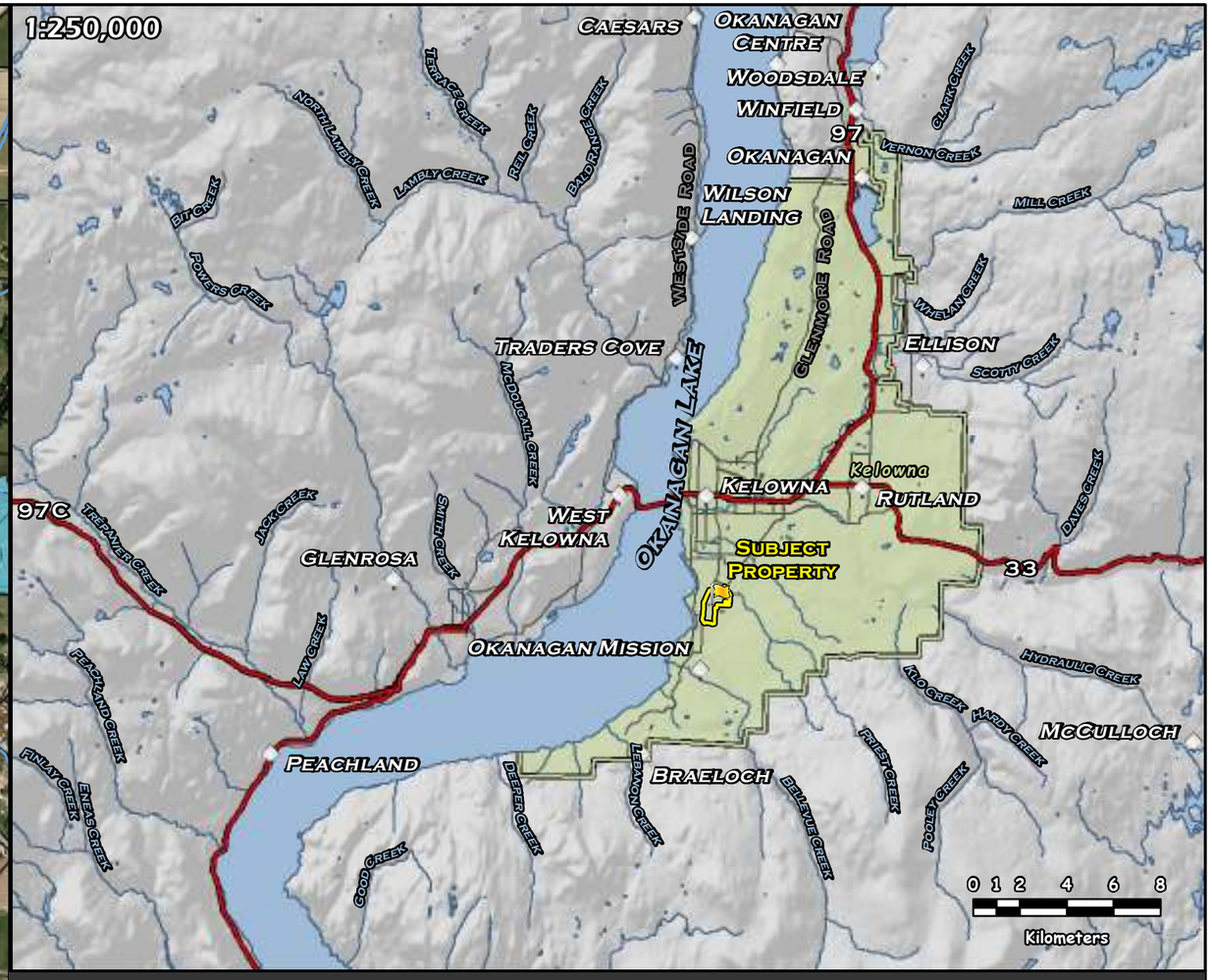
R Core Team. (2015). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing, http://www.R-project.org/

Ralph, C. J., J. R. Sauer, and S. Droege. 1995. Monitoring Bird Populations by Point Counts. Gen. Tech. Rep. PSW-GTR-149. Albany, CA: Pacific Southwest Research Station, Forest Service, US. Department of Agriculture; 187 p.

Southern Interior Rare Plants Recovery Team. 2008. Recovery Strategy for the Mexican Mosquito Fern (Azolla Mexicana) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 16 pp.

# MAPS


**DISCLAIMER**
The data displayed is for conceptual purposes only and should not be interpreted as a legal survey or for legal purposes. If discrepancies are found between the data portrayed in this report and that of a legal survey, the legal survey will supersede any data presented herein.




# FIGURE 1
*Site Location*

| | |
|---|---|
| Project: | Mission Creek Restoration Initiative Baseline Inventory |
| Location: | City of Kelowna |
| Project No.: | 14-1257 |
| Prepared for: | Fresh Outlook Foundation |
| Prepared by: | Ecoscape Environmental Consultants Ltd. |
| Drawn by: | Robert Wagner |
| Checked by: | Adam Patterson |
| Projection: | NAD83-UTM Zone 11 |
| Date: | November 26, 2014 |

N

ECOSCAPE

## LEGEND

- Places
- Regional Location of Subject Property
- Major Highway
- Major Roads
- Subject Property
- Municipal Boundary
- City of Kelowna
- Lake
- Wetlands
- Streams and Rivers

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 1


### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

N

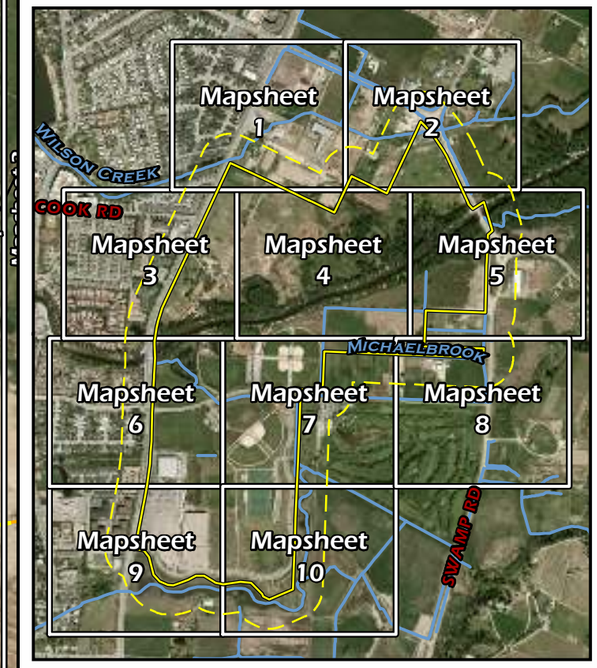
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%) → 6PFks6C ← Stand Modifier

Ecosystem Unit → 2PFks3 ← Structural Stage

2PTkv6C ← Site Modifiers



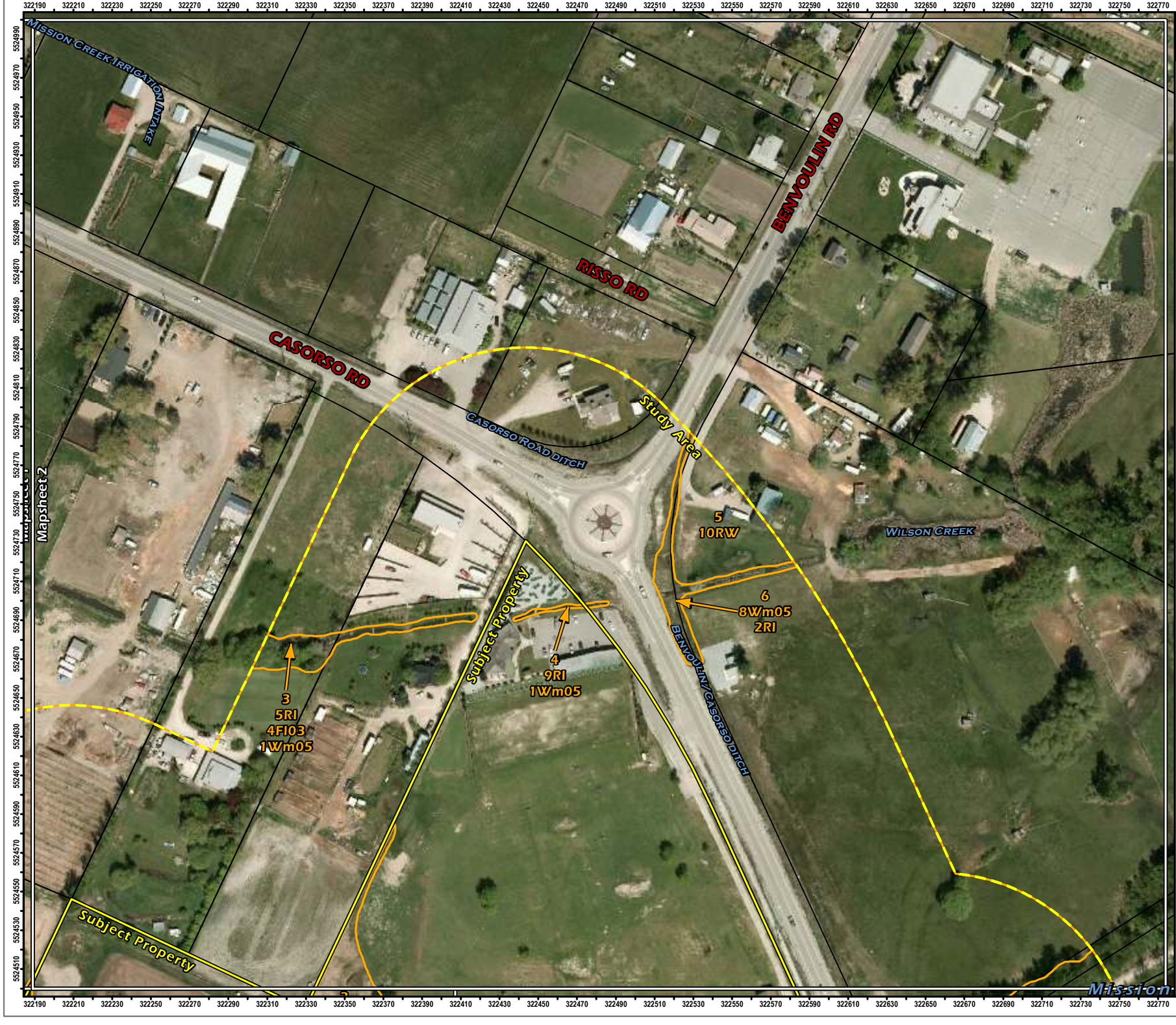

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 2




### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

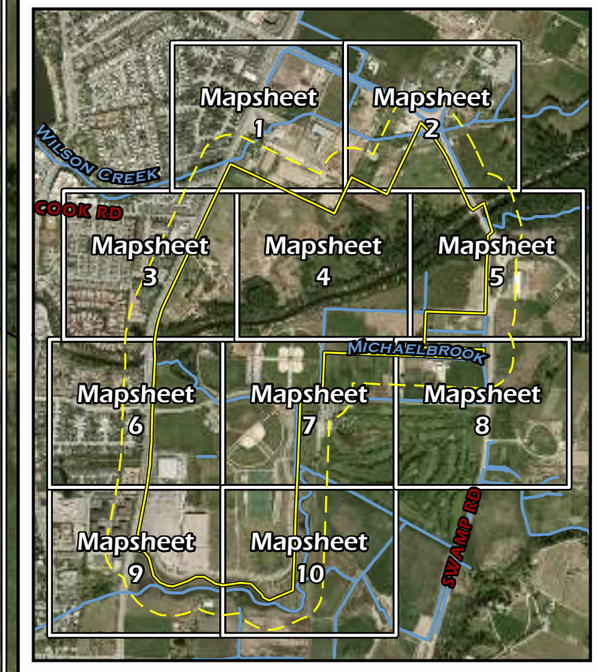
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C — Stand Modifier

Ecosystem Unit: 2PFks3 — Structural Stage

2PTkv6C — Site Modifiers



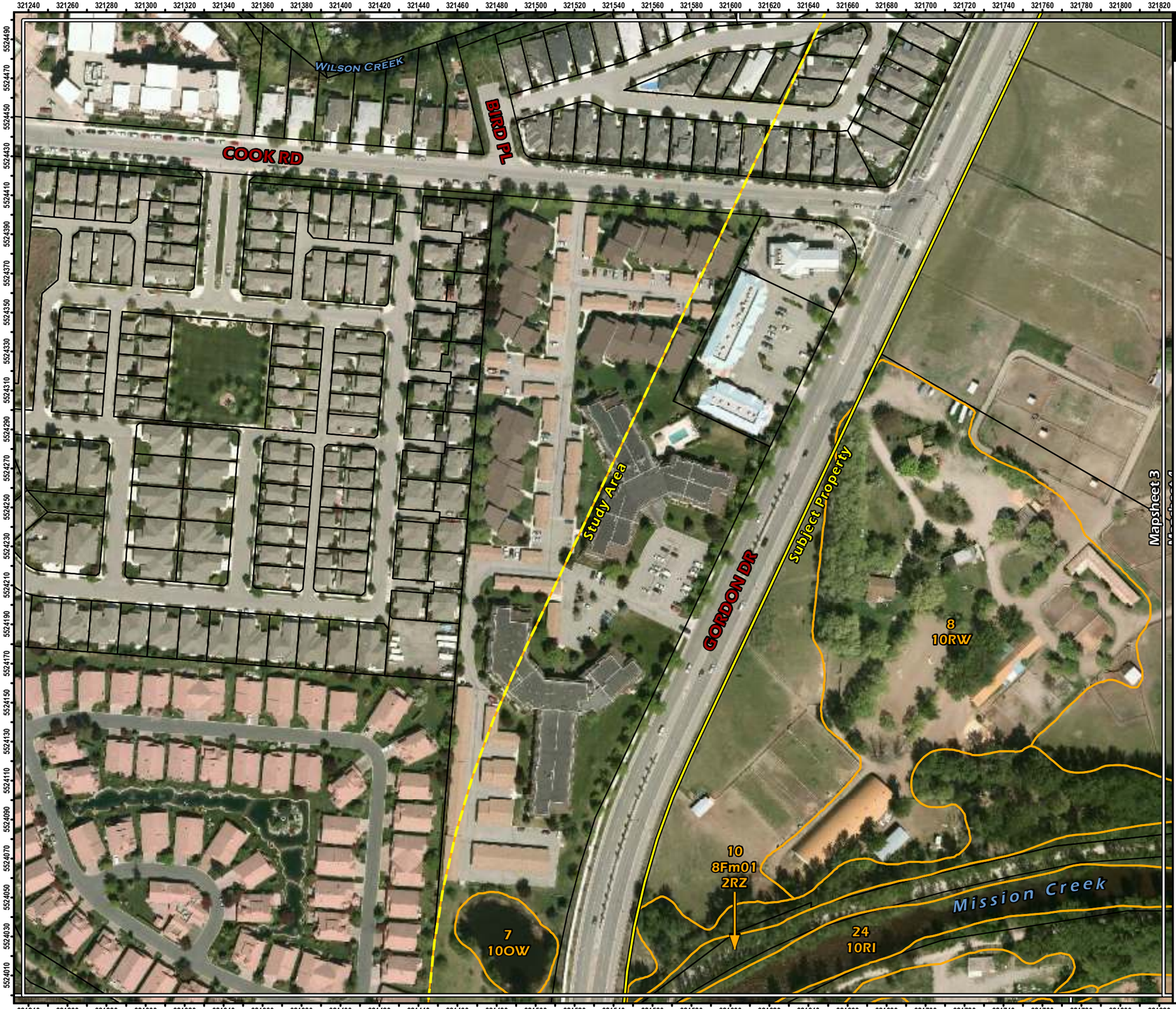

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 3




### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

N

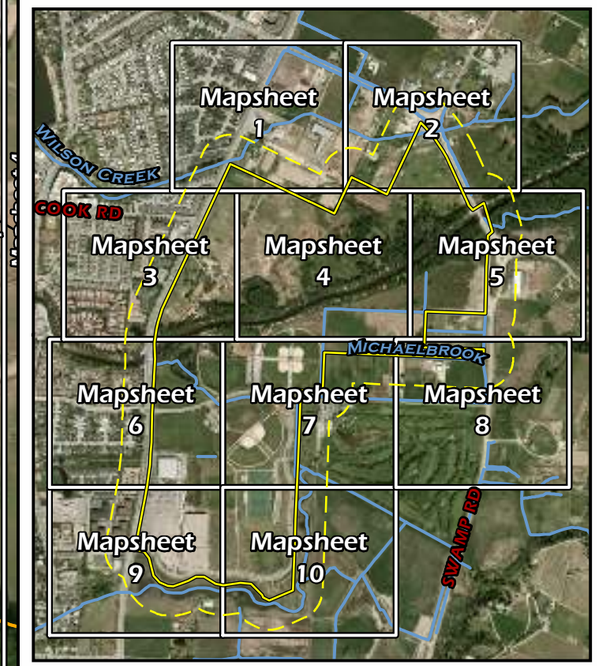
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C — Stand Modifier

Ecosystem Unit: 2PFks3 — Structural Stage

2PTkv6C — Site Modifiers




ECOSCAPE

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 4


### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

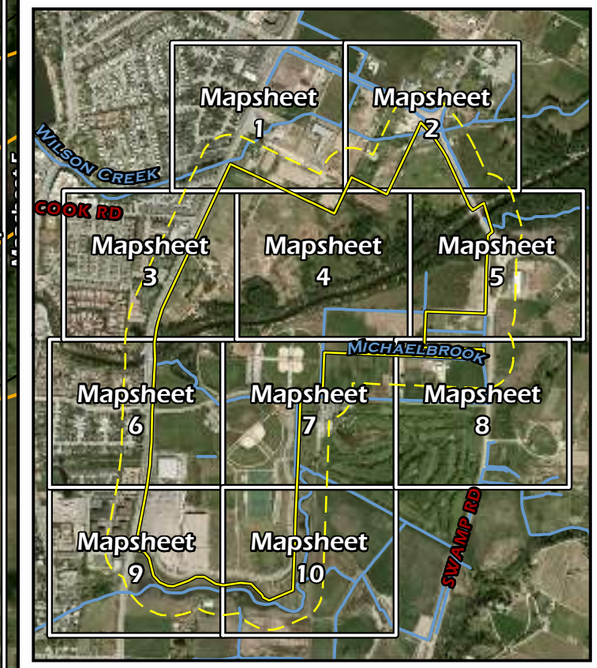
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C — Stand Modifier

Ecosystem Unit: 2PFks3 — Structural Stage

2PTkv6C — Site Modifiers




ECOSCAPE

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 5

322410 322430 322450 322470 322490 322510 322530 322550 322570 322590 322610 322630 322650 322670 322690 322710 322730 322750 322770 322790 322810 322830 322850 322870 322890 322910 322930 322950 322970 322990

5524490 5524470 5524450 5524430 5524410 5524390 5524370 5524350 5524330 5524310 5524290 5524270 5524250 5524230 5524210 5524190 5524170 5524150 5524130 5524110 5524090 5524070 5524050 5524030 5524010

Mapsheet 5

10
8Fm01
2RZ

23
8Fm01
2RZ

25
10Fm01

26
10RI

27
10Fm01

28
10Wm05

29
5FI03
5RW

24
10RI

31
10Wm05

32
10Wm05

33
6RW
4Wm05

38
6Wm05
2OW
2FI03

35
7CF
3RW

30
8RZ
2RW

36
8Wm05
2FI03

37
10Wm05

39
10OW

Mission Creek

PRIEST CREEK

CASORSO RD

SWAMP RD

MICHAELBROOK

Subject Property

Study Area

### LEGEND

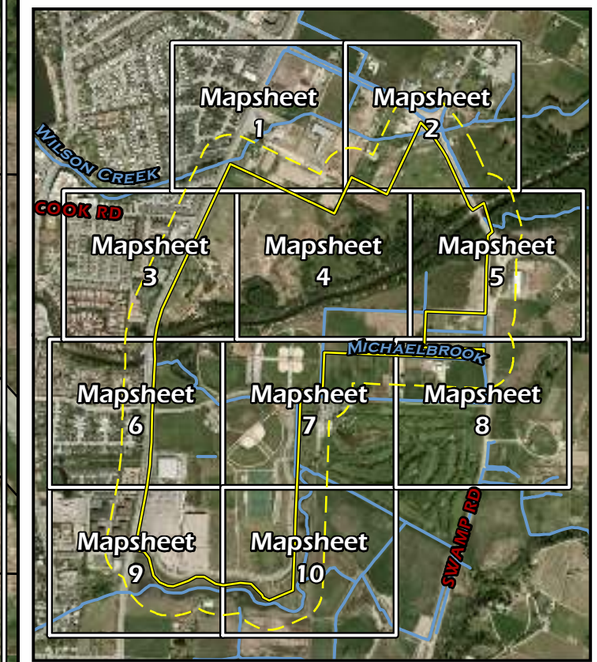
- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

N

**Ecosystem Polygon Key**

Polygon Number

2402
6PFks6C — Stand Modifier
Decile (60%)
2PFks3 — Structural Stage
Ecosystem Unit
2PTkv6C — Site Modifiers




MISSION CREEK

ECOSCAPE

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

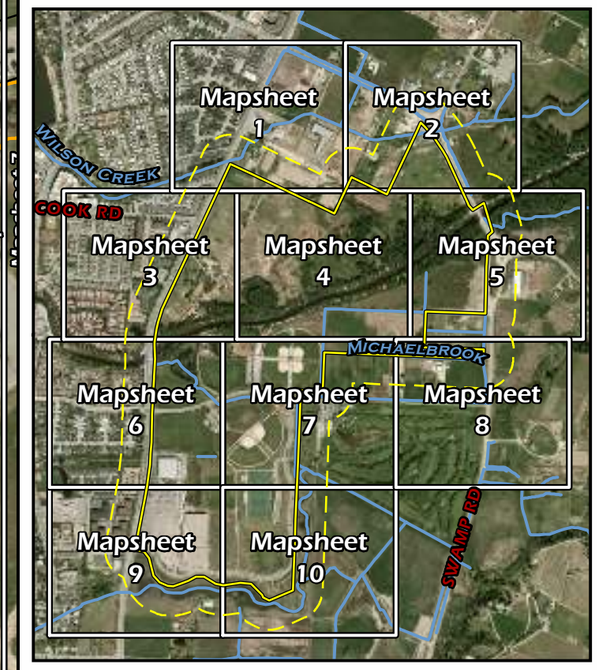
## Mapsheet 6

**LEGEND**

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

**Ecosystem Polygon Key**

Polygon Number: 2402
Decile (60%): 6PFks6C ← Stand Modifier
Ecosystem Unit: 2PFks3 ← Structural Stage
2PTkv6C ← Site Modifiers




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 7

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

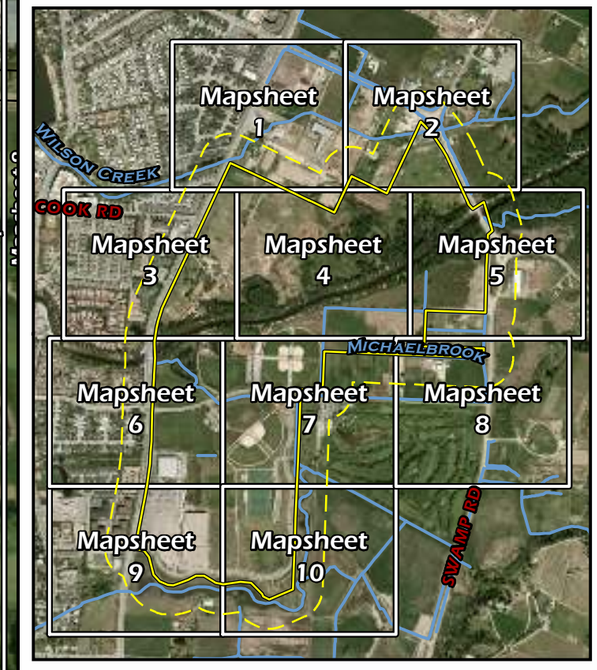
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C — Stand Modifier

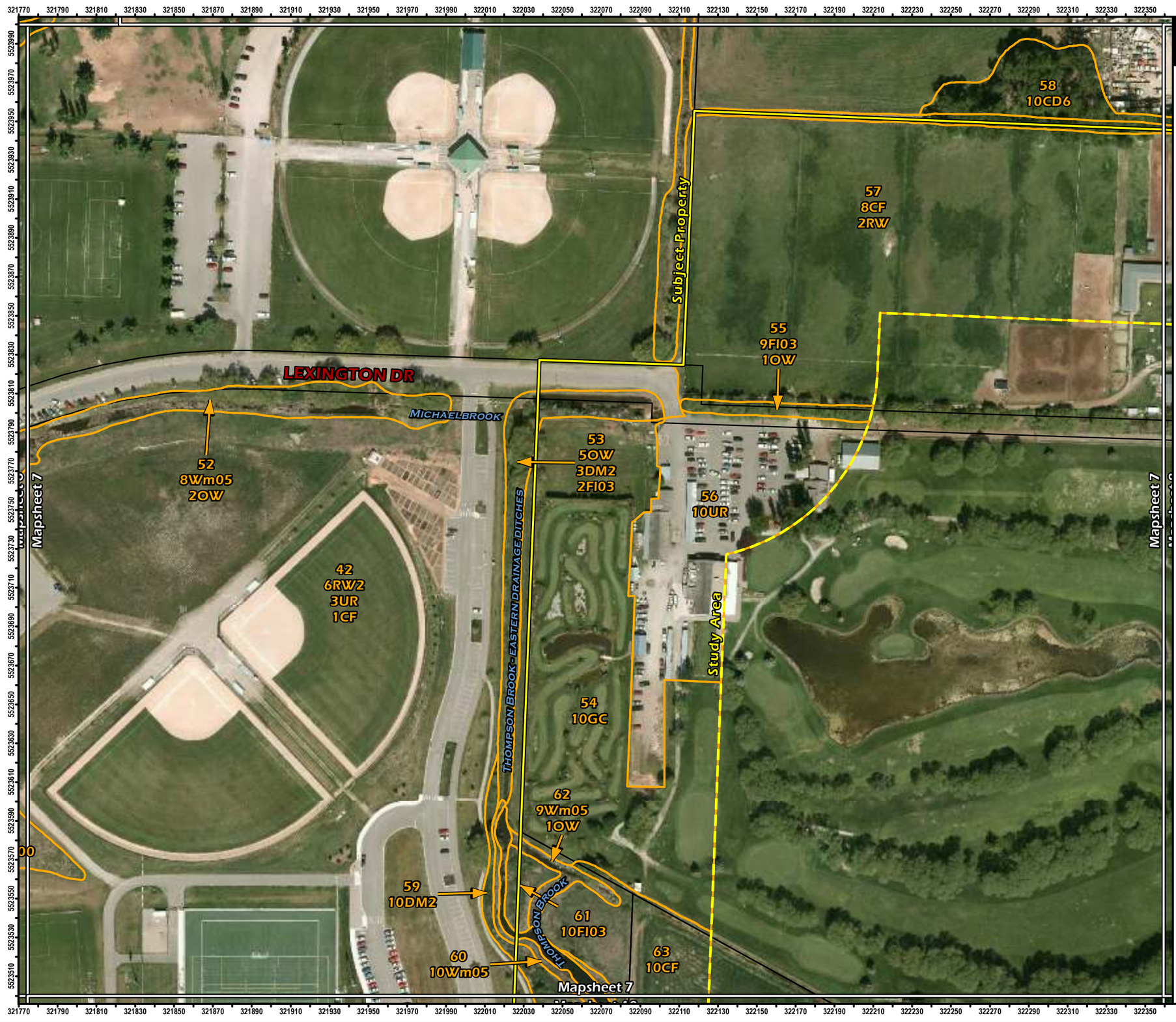
Ecosystem Unit: 2PFks3 — Structural Stage

2PTkv6C — Site Modifiers




40 20 0 40 80 120 Meters

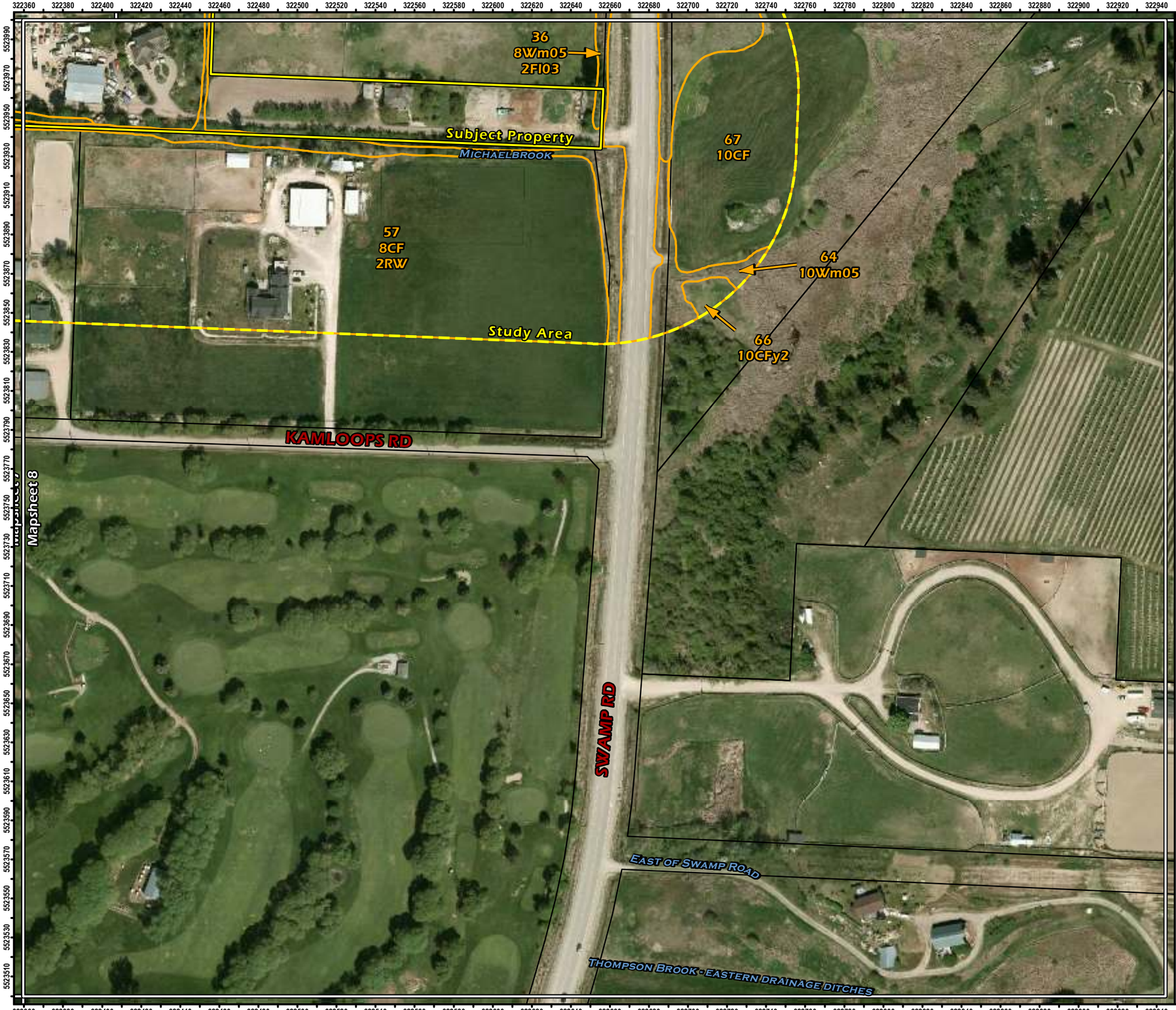
1:2,000



# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 8




### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

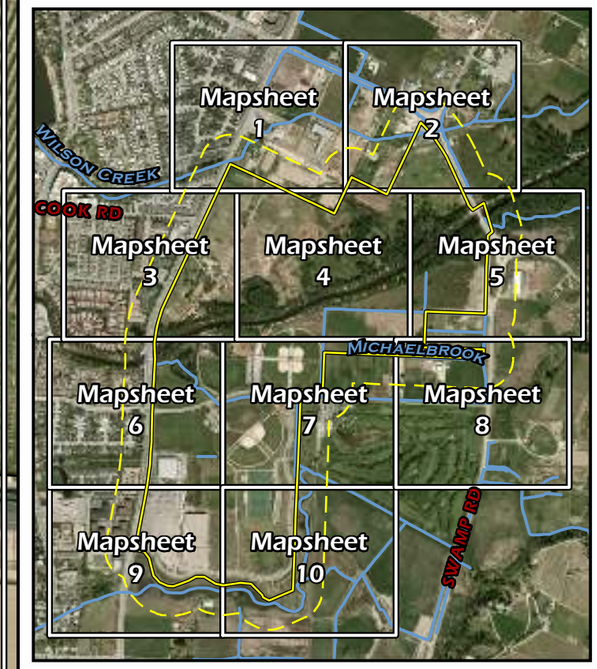
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C — Stand Modifier

Ecosystem Unit: 2PFks3 — Structural Stage

2PTkv6C — Site Modifiers




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 9


### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

N

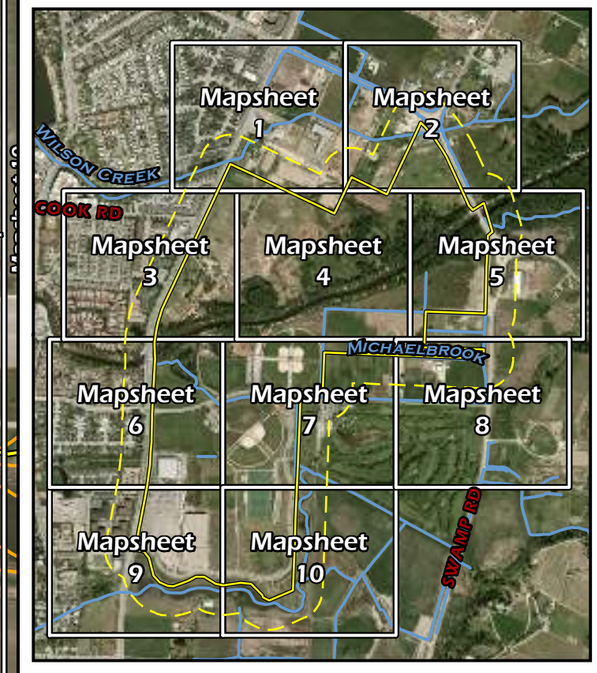
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%) → 6PFks6C ← Stand Modifier

Ecosystem Unit → 2PFks3 ← Structural Stage

2PTkv6C ← Site Modifiers



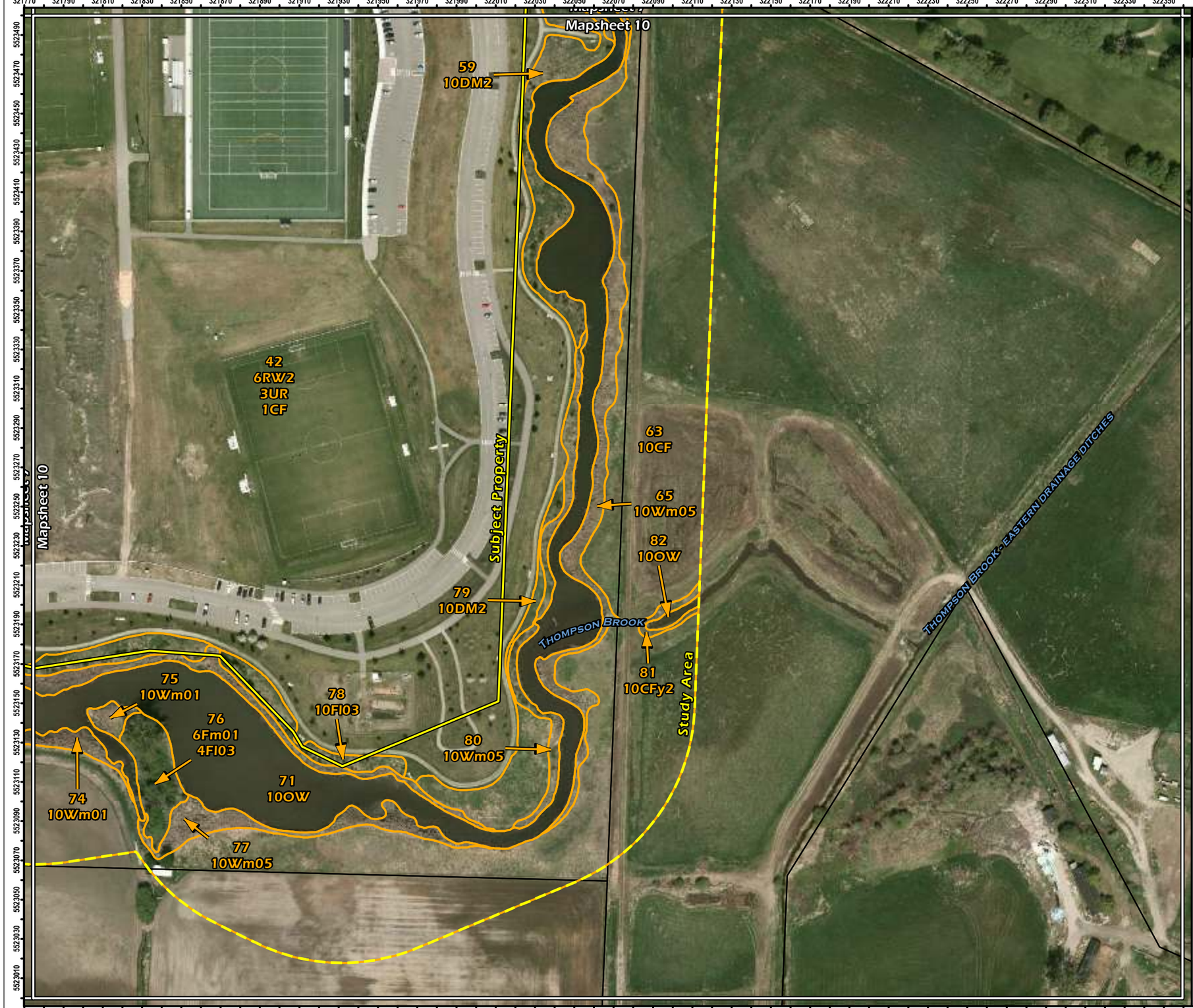

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 2 - Ecosystem Polygons

## Mapsheet 10




### LEGEND

- Subject Property
- Study Area
- Cadastre
- Ecosystem Polygons
- Streams

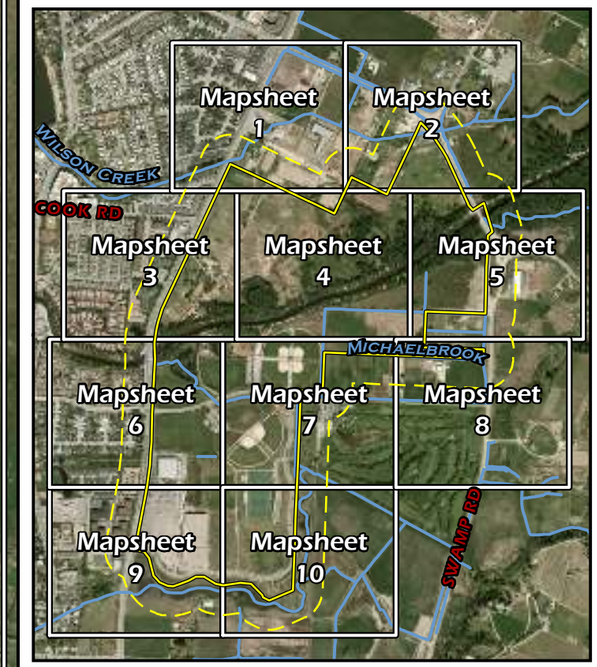
**Ecosystem Polygon Key**

Polygon Number: 2402

Decile (60%): 6PFks6C ← Stand Modifier

Ecosystem Unit: 2PFks3 ← Structural Stage

2PTkv6C ← Site Modifiers




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 3

### Surface Water and Groundwater Features


| Aquifer Information | |
|---|---|
| Name | 464 IC (14) |
| Aquifer Number | 464 |
| Materials | Sand and Gravel |
| Productivity | High |
| Vulnerability | Low |
| Demand | High |
| Classification | IC |
| Quality Concerns | None |
| Quantity Concerns | Isolated |
| Size (Square Km) | 68 |
| Type of Water Use | Multiple |
| Productivity Code | U-H |
| Damand Code | U-H |
| Vulnerability Code | U-L |
| Classification Code | U-IC |

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Aquifer
- Streams
- Current Points of Diversion - Licensed Spring
- Well

Wetland Inventory and Mapping (WIM)
Wetland Hydrogeomorphic Group

- Riverine
- Lacustrine
- Palustrine Basin (Isolated)
- Palustrine Basin (Linked)
- Palustrine Slope/Spring
- Other

N

100 50 0 100 200 300 400 500 Meters

1:7,500

ECOSCAPE

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## MAP 4

## Wildlife Observations and Features

### LEGEND

- Point Count Stations
- Subject Property
- Study Area
- Cadastre
- Streams
- Nest No Disturb Buffer
- Nest Noise Buffer

**Wildlife Observations and Species Provincial Listing**

- Red-listed
- Blue-listed
- Not Listed

N

ST01 ST02 ST03 ST04 ST05 ST06 ST07 ST08 ST09 ST10 ST11 ST12 ST13 ST14 ST15 ST16 ST17 ST18 ST19 ST20 ST21 ST22 ST23 ST24 ST25 ST26 ST27 ST28 ST29 ST30

red-tailed hawk nest

great horned owl nest (approximate)

western screech-owl (approximate)

American kestrel nest (approximate)

bald eagle nest

B. erecta

western painted turtle

lance-tipped darner

A. mexicana

Great Basin spadefoot (K. Hawes 2006)

Subject Property

Study Area

COOK RD

TRUSWELL RD

LAKESHORE RD

GORDON DR

LEXINGTON DR

BELMONT RD

PIMLICO RD

LEQUIME RD

KAMLOOPS RD

SWAMP RD

HUGHES RD

BENVOULIN/CASORSO DITCH

CASORSO RD

WILSON CREEK

PRIEST CREEK

MISSION CREEK

MICHAELBROOK

THOMPSON BROOK

THOMPSON BROOK - EASTERN DRAINAGE DITCHES

100 50 0 100 200 300 400 500 Meters

1:7,500

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 1

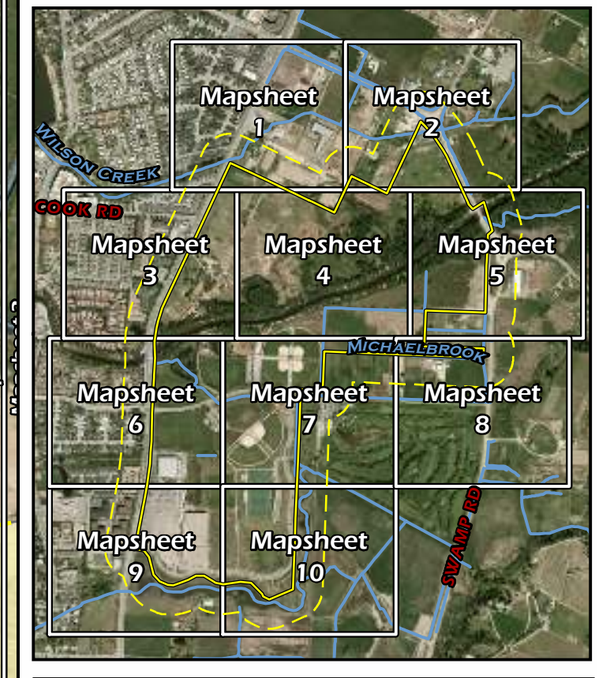

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

### Mapsheet 2


**LEGEND**

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N

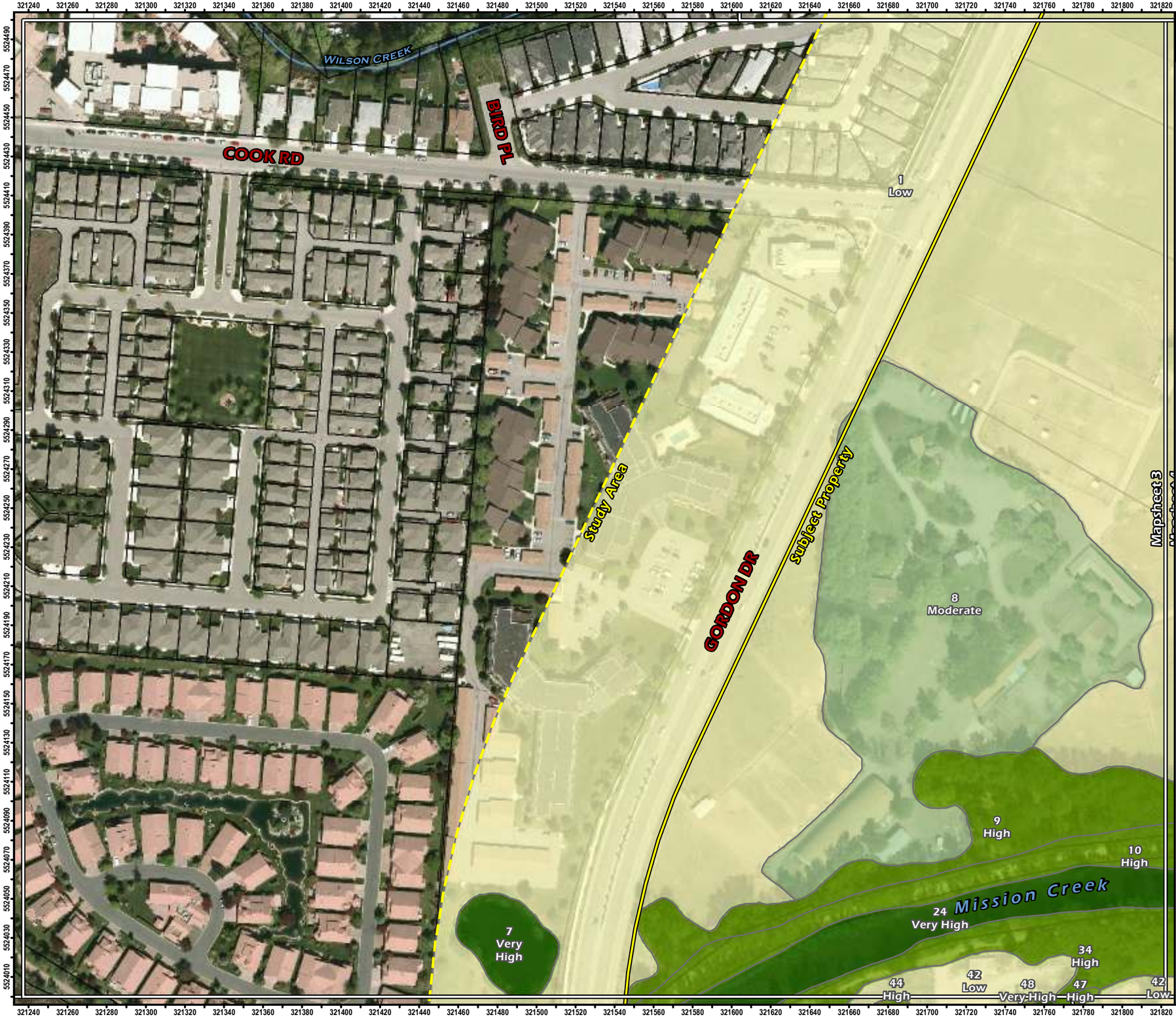
40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 3

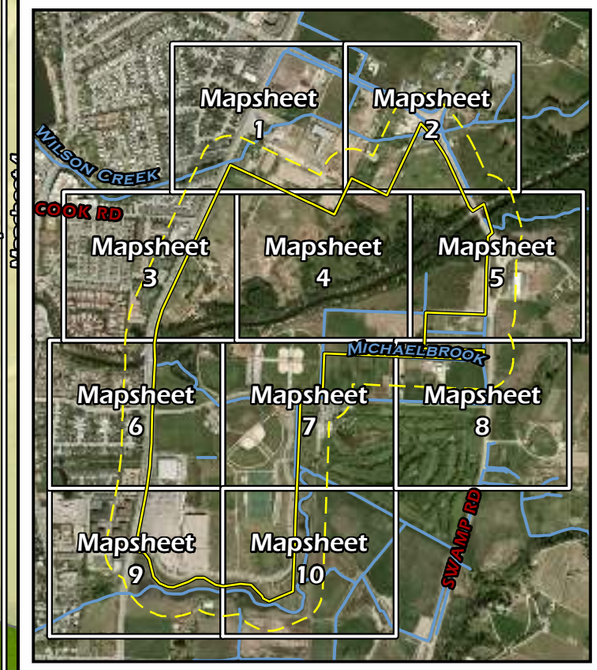



### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 4

**LEGEND**

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N

Subject Property

1 Low
2 High
1 Low
22 Moderate
2 High
16 High
17 Moderate
1 Low
21 High
19 High
18 Moderate
9 High
20 Moderate
13 High
15 Low
14 High
12 Moderate
11 Very High
34 High
40 Low
24 Very High
10 High
41 Low
42 Low
38 Moderate

Mapsheet 4

Mapsheet 4

Mission Creek

MICHAELBROOK

WILSON CREEK

COOK RD

SWAMP RD

Mapsheet 1
Mapsheet 2
Mapsheet 3
Mapsheet 4
Mapsheet 5
Mapsheet 6
Mapsheet 7
Mapsheet 8
Mapsheet 9
Mapsheet 10

40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

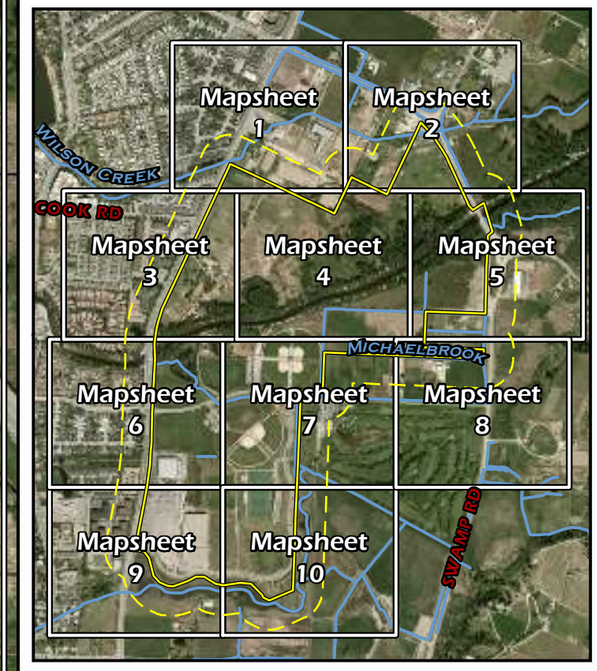
## Mapsheet 5


### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
## Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 6

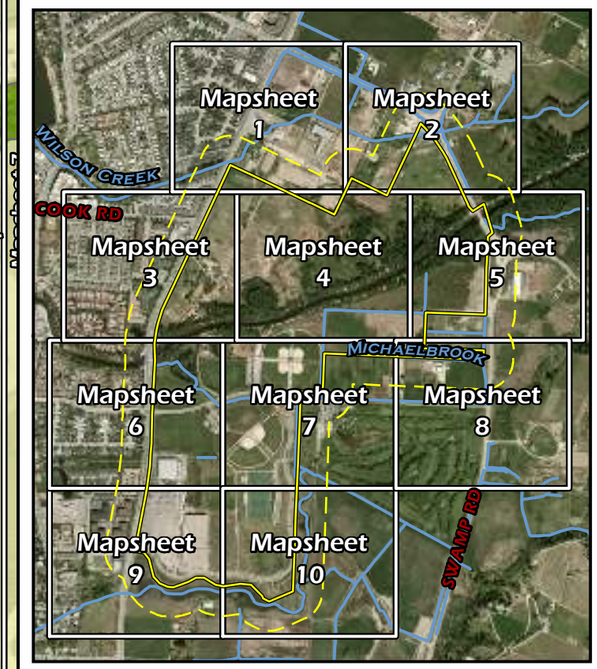

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

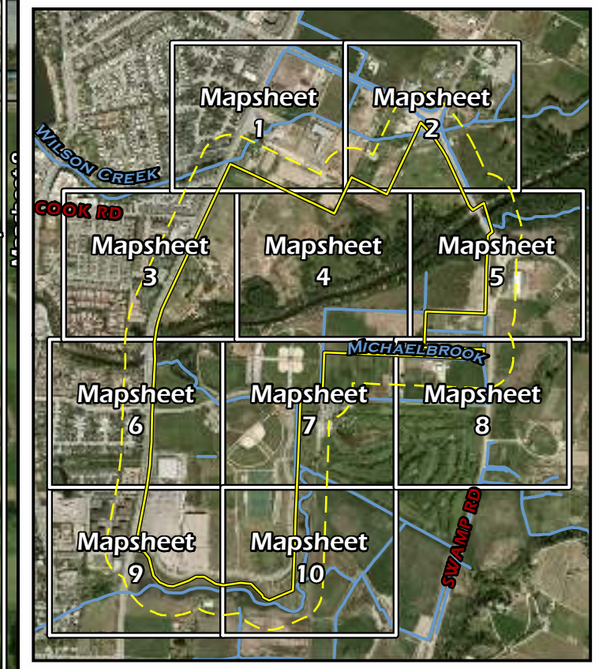
## Mapsheet 7


### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 8

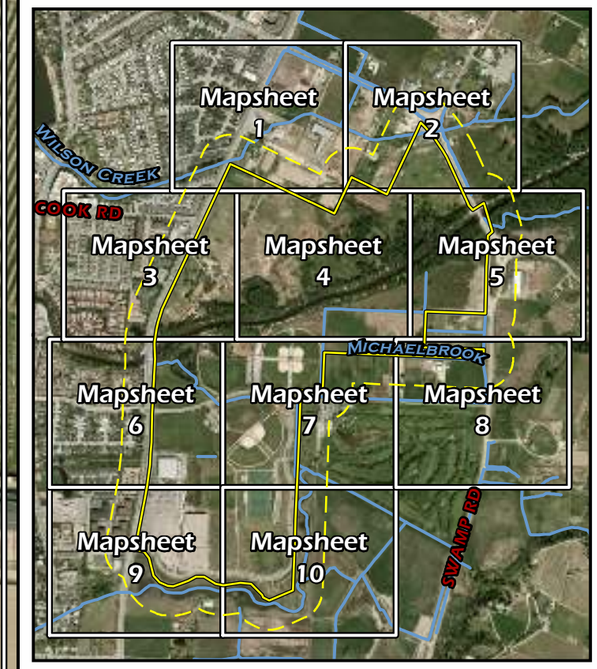

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

## Mapsheet 9

### LEGEND

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low

N

Mapsheet 9

Subject Property

Study Area

LEQUIME RD

LAKESHORE RD

ARMOUR CR

GORDON DR

THOMPSON BROOK

42
Low

68
Very High

70
Moderate

69
High

71
Very High

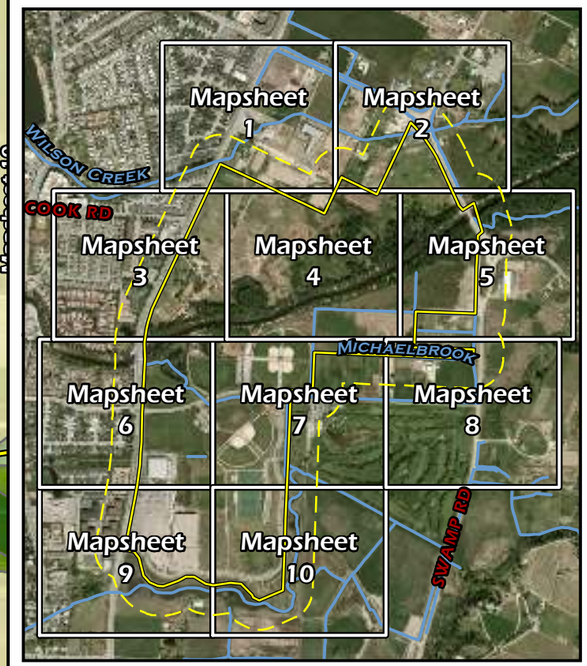
74
High

72
Low

73
Low

63
Low

Mapsheet 9




40 20 0 40 80 120 Meters

1:2,000

# Mission Creek Restoration Initiative (MCRI)
# Baseline Inventory - MCRI Partnership Project

## FIGURE 5 - Environmental Sensitivity Analysis

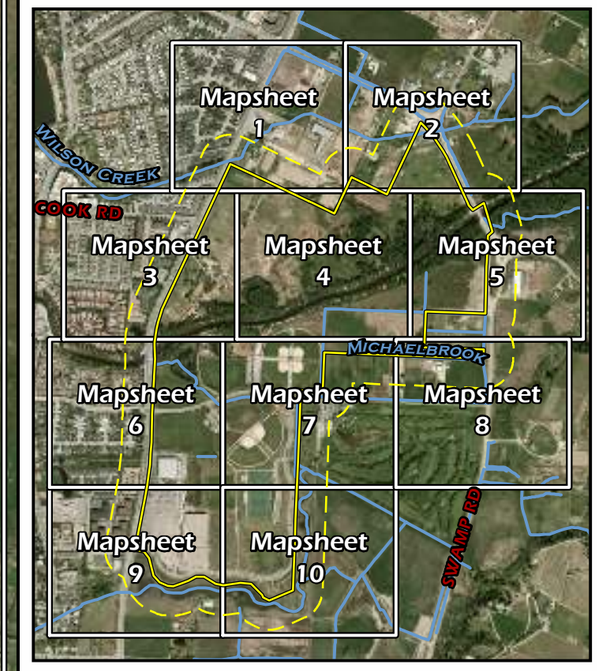
## Mapsheet 10


**LEGEND**

- Subject Property
- Study Area
- Cadastre
- Streams

Environmental Sensitivity

- Very High
- High
- Moderate
- Low




40 20 0 40 80 120 Meters

1:2,000

# APPENDIX A
Example Data Forms

**Bird Survey Data Sheet**
Ecoscape Environmental Consultants Ltd.
250-491-7337

Project:_____ Surveyors:_____

Site ID:_____ Location: E_____N_____Z_____NAD83

Date:_____ Photo Number(s):_____

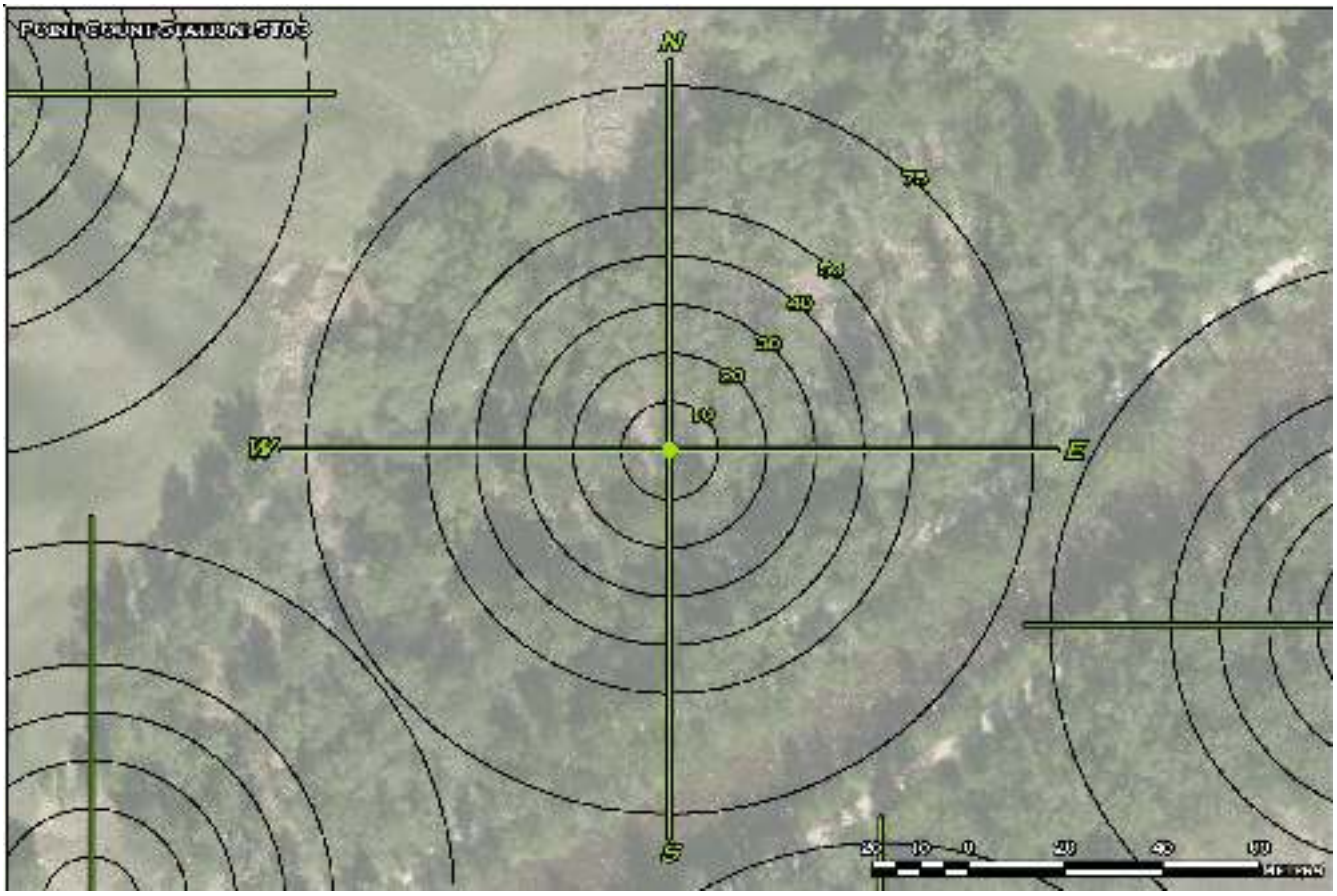
Temp (°C):_____ Wind: 0 1 2 3 4 5 Cloud Cover (%):_____ Precip:_____

Habitat Description:_____

Vegetation Description:_____
_____
_____
_____

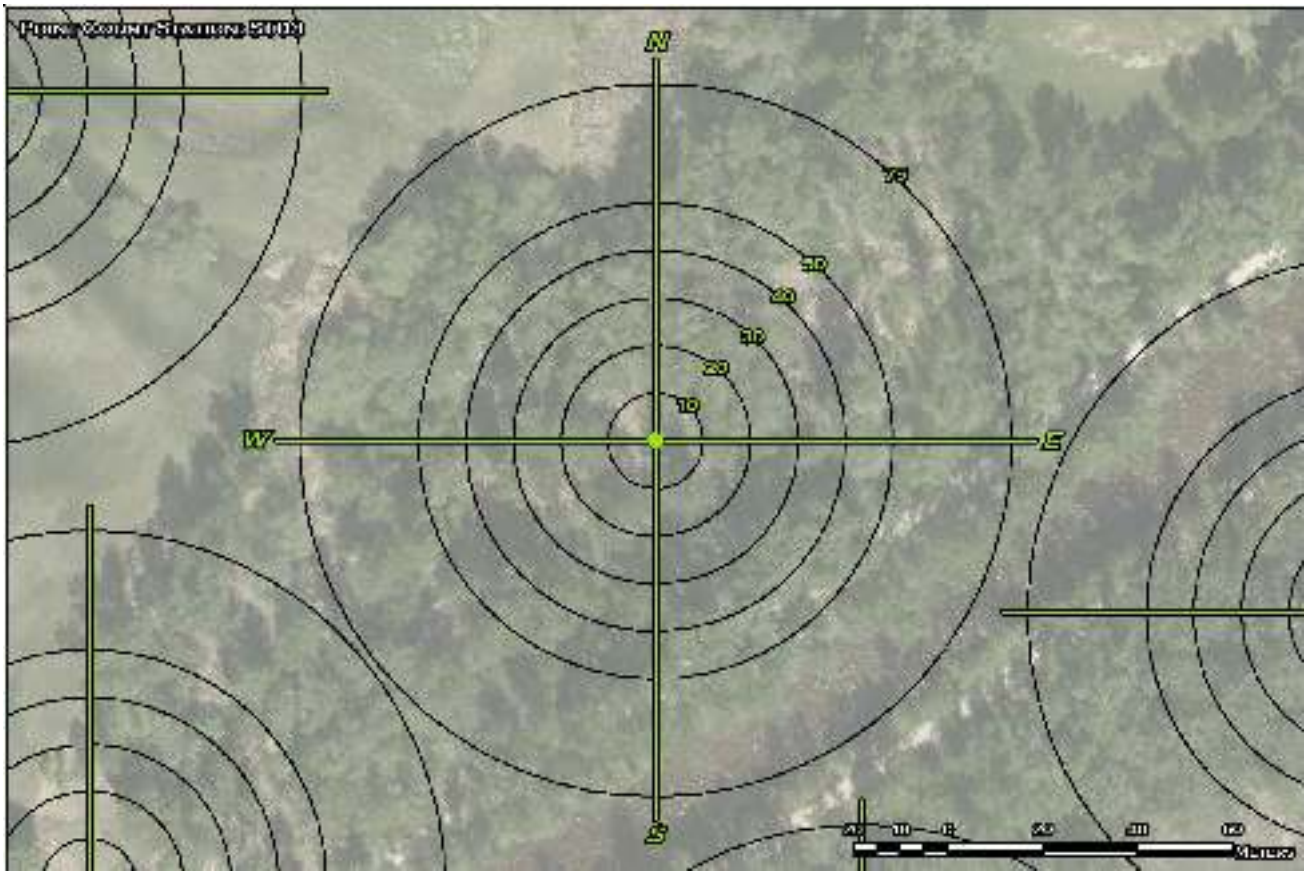
Start Time:_____ End Time:_____

Time Interval: 0-3 minutes

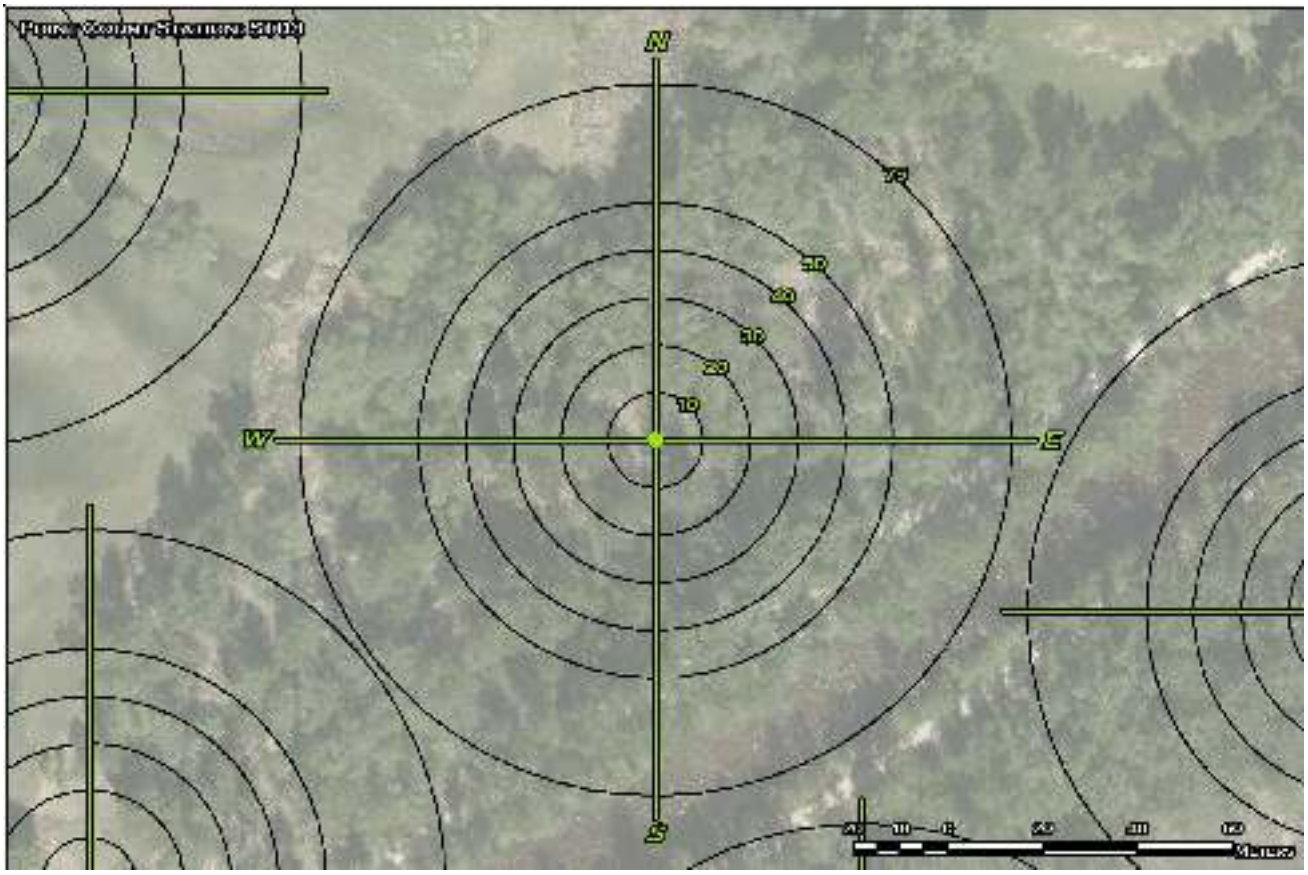


# Bird Survey Data Sheet

Time Interval: 3-5 minutes




Time Interval: 5-10 minutes



**Owl Survey Data Sheet**
**Ecoscape Environmental Consultants Ltd.**
**250-491-7337**

Project:_____ Surveyors:_____
Location: E_____N_____Z_____NAD83
Date:_____ Photo Number:_____
Temp (°C):_____ Wind: 0 1 2 3 4 5 Cloud Cover (%):_____ Precip:_____
Habitat Description:_____
_____
Start Time:_____ End Time:_____

| Site ID | Species Code | Survey Time (1, 2, 3) | Noise (1-4) | Direction (azimuth) | Distance Category (0-100, 100-200, >200) | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Comments:_____
_____
_____

**Amphibian Survey Data Sheet**
Ecoscape Environmental Consultants Ltd.
250-491-7337

Project:_____ Site ID:_____ Surveyors:_____

Date:_____ Photo Number(s):_____

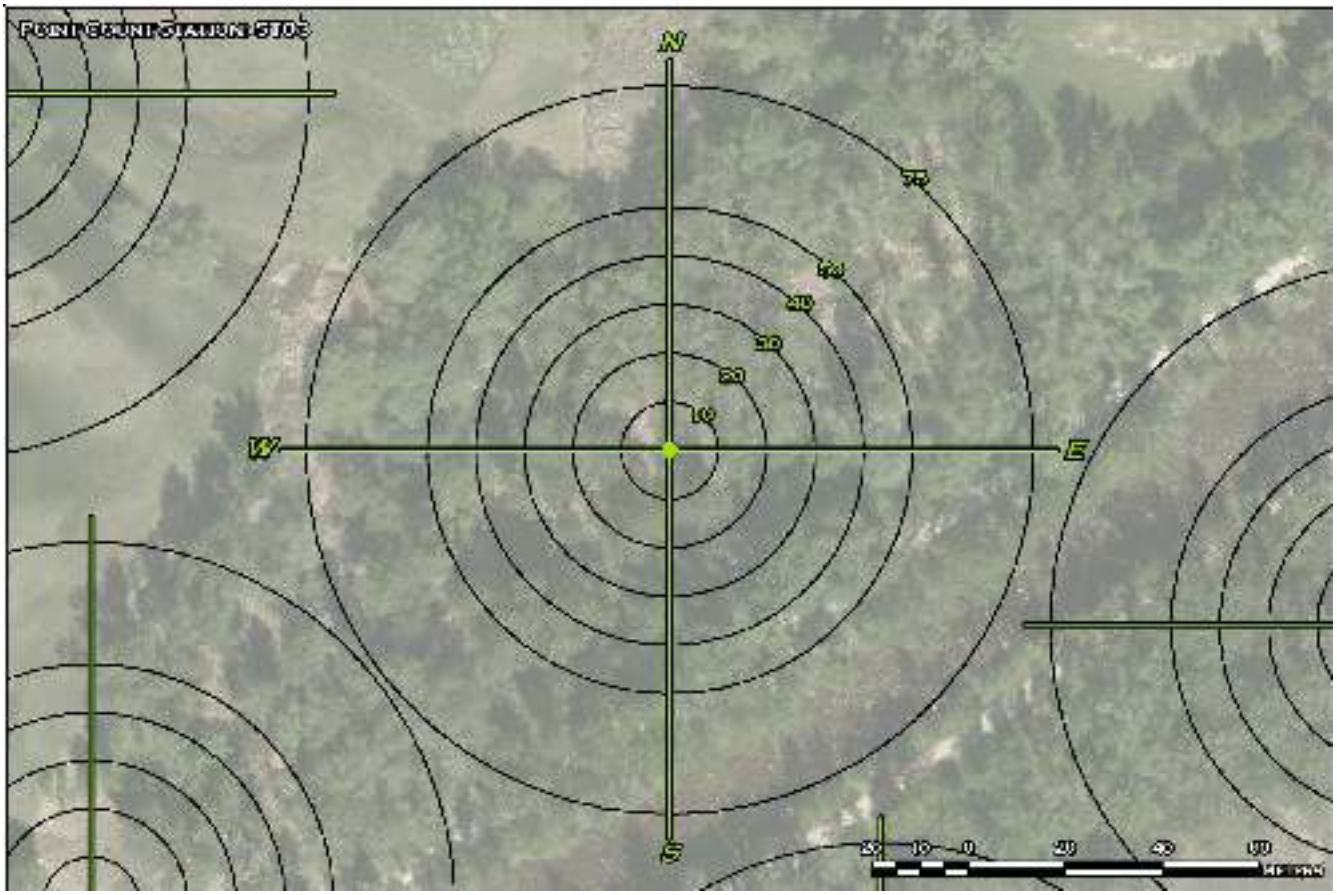
Temp (°C):_____ Wind: 0 1 2 3 4 5 Cloud Cover (%):_____ Precip:_____

Notes:_____

_____

Start Time:_____ End Time:_____

Time Interval: 0-3 minutes




0 = nothing;
1 = single individual;
2 = two distinct individuals, some calls overlap;
3 = 3-5 individuals, multiple but distinct calls;
4 = >5 individuals, overlapping calls, cannot be distinguished (chorus).

Species Codes: CSFR, BULL, GBSP, NLFR, PCFR, WETO, WOFR

# APPENDIX B
## Conservation Data Centre Occurrence List

| Scientific Name | English Name | COSEWIC | BC List | SARA | BGC | Habitat Subtype |
|---|---|---|---|---|---|---|
| *Acorus americanus* | American sweet-flag | | Blue | | ICHdw;ICHxw;IDFmw;SBSdk;SBSmh;SBSwk | Swamp;Marsh;Riparian Shrub;Lake;Pond/Open Water;Riparian Herbaceous |
| *Agastache urticifolia* | nettle-leaved giant-hyssop | | Blue | | BGxh;ESSFdc;ICHdw;ICHmk;ICHmw;IDFdm;IDFxh;MSxk;PPdh;PPxh | Riparian Shrub;Shrub - Natural;Sagebrush Steppe;Conifer Forest - Dry |
| *Alopecurus carolinianus* | Carolina meadow-foxtail | | Red | | CDFmm;CWHdm;CWHds;IDFxh | Vernal Pools/Seasonal Seeps;Meadow;Garry Oak Vernal Pool;Garry Oak Maritime Meadow |
| *Ammannia robusta* | scarlet ammannia | E (May 2001) | Red | 1-E (Jun 2003) | BGxh | Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats;Riparian Shrub;Beach |
| *Antennaria flagellaris* | stoloniferous pussytoes | E (May 2004) | Red | 1-E (Jul 2005) | IDFxh | Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated Rock |
| *Arnica longifolia* | seep-spring arnica | | Blue | | ESSFxcp;ICHvk;IMAun | Meadow;Riparian Herbaceous;Alpine/Subalpine Meadow |
| *Atriplex argentea* ssp. *argentea* | silvery orache | | Red | | BGxh;BGxw;IDFdm;IDFxh;IDFxm;PPxh | Alkali Ponds/Salt Flats;Pasture/Old Field |
| *Atriplex truncata* | wedgescale orache | | Blue | | BGxh;BGxw;IDFdk;IDFxh;IDFxm | Alkali Ponds/Salt Flats |
| *Azolla mexicana* | Mexican mosquito fern | T (Nov 2008) | Red | 1-T (Jun 2003) | ICHmw;IDFmw;IDFxh | Riparian Shrub;Pond/Open Water |
| *Berula erecta* | cut-leaved water-parsnip | | Blue | | BGxh;CWHdm;IDFxh;PPxh | Marsh;Riparian Shrub;Stream/River;Pond/Open Water;Riparian Herbaceous;Cold Spring |
| *Bidens vulgata* | tall beggarticks | | Red | | BGxh;ICHxw | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps;Riparian Shrub;Riparian Herbaceous |
| *Bolboschoenus fluviatilis* | river bulrush | | Red | | BGxh;CWHvh | Estuary;Marsh;Riparian Shrub |
| *Botrychium ascendens* | upswept moonwort | | Red | | BAFA;CMA;CWHxm;ESSFdk;ESSFmm;IDFdk;IDFxh;IMA | Riparian Forest;Meadow;Conifer Forest - Mesic (average);Alpine/Subalpine Meadow |
| *Botrychium hesperium* | western moonwort | | Blue | | ESSFwc;ESSFxc;ICHmw | Pasture/Old Field;Meadow;Grassland |
| *Callitriche heterophylla* var. *heterophylla* | two-edged water-starwort | | Blue | | BAFAunp;CDFmm;CWHvm;CWHwh;CWHxm | Pond/Open Water |
| *Carex comosa* | bearded sedge | | Red | | BGxh;CWHdm;CWHds;ICHmw;ICHxw;IDFmw;IDFxh | Marsh;Riparian Herbaceous |
| *Carex hystericina* | porcupine sedge | | Blue | | BGxh;BGxw;IDFww;IDFxh;MSxk;PPxh;SBPSxc | Bog;Fen;Swamp;Marsh;Meadow;Riparian Herbaceous |
| *Carex scopulorum* var. *bracteosa* | Holm's Rocky Mountain sedge | | Blue | | BGxh;ESSFdcp;ESSFwc;ESSFxc;ESSFxcp;IDFxh;IMA | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps;Riparian Forest;Riparian Shrub;Meadow;Alpine/Subalpine Meadow |

| Scientific Name | English Name | COSEWIC | BC List | SARA | BGC | Habitat Subtype |
|---|---|---|---|---|---|---|
| *Carex sychnocephala* | many-headed sedge | | Blue | | BGxh;BGxw;IDFdk;IDFdm;IDFmw;IDFxh;IDFxm;MSdk;PPxh;SBPSxc;SBSdk | Bog;Fen;Swamp;Marsh;Meadow;Riparian Herbaceous |
| *Carex vulpinoidea* | fox sedge | | Blue | | BGxh;CWHdm;CWHxm;ICHmw;ICHxw;IDFmw;IDFxh | Bog;Fen;Swamp;Marsh;Beach |
| *Castilleja minor* ssp. *minor* | annual paintbrush | | Red | | BGxh;IDFdm | Alkali Ponds/Salt Flats;Vernal Pools/Seasonal Seeps;Meadow |
| *Chamaesyce serpyllifolia* ssp. *serpyllifolia* | thyme-leaved spurge | | Blue | | BGxh;BGxw;CDFmm;CWHxm;IDFmw;IDFxh | Vernal Pools/Seasonal Seeps;Meadow;Grassland;Sagebrush Steppe |
| *Chenopodium atrovirens* | dark lamb's-quarters | | Red | | ICHdw;ICHmk;IDFdm;IDFxh;IDFxw;MSxk;SBSdw | Pasture/Old Field;Cultivated Field;Meadow;Grassland |
| *Cuscuta campestris* | field dodder | | Blue | | BGxh;CDFmm;CWHdm;CWHxm;IDFxh | Bog;Fen;Swamp;Marsh;Pasture/Old Field;Cultivated Field;Rock/Sparsely Vegetated Rock;Sagebrush Steppe;Antelope-brush Steppe |
| *Cyperus erythrorhizos* | red-rooted cyperus | | Red | | BGxh;IDFxh;PPxh | Riparian Shrub;Beach |
| *Cyperus squarrosus* | awned cyperus | | Blue | | BGxh;CDFmm;CWHxm;IDFmw;IDFxh;PPxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps |
| *Delphinium glareosum* | rockslide larkspur | | Red | | ESSFmw | Cliff;Rock/Sparsely Vegetated Rock;Talus;Tundra;Avalanche Track |
| *Descurainia sophioides* | northern tansy mustard | | Red | | BWBSdk;IDFdk;MSxk | Rock/Sparsely Vegetated Rock;Talus;Meadow;Urban/Suburban/Rural;Gravel Bar |
| *Dryopteris cristata* | crested wood fern | | Blue | | ESSFwc;ICHdw;ICHmc;ICHmw;ICHvk;ICHwk;ICHxw;IDFmw;IDFxh;SBSmk | Swamp;Riparian Shrub;Conifer Forest - Moist/wet |
| *Elatine rubella* | three-flowered waterwort | | Blue | | BGxh;CDFmm;CWHdm;CWHxm;IDFxh | Estuary;Bog;Fen;Swamp;Marsh;Pond/Open Water;Mudflats - Intertidal |
| *Eleocharis coloradoensis* | dwarf spike-rush | | Red | | BGxh | Bog;Fen;Swamp;Marsh |
| *Eleocharis elliptica* | elliptic spike-rush | | Blue | | BAFA;ESSFdk;ESSFvc;ESSFwc;ICHmw;ICHvk;I | Fen;Meadow |
| *Eleocharis engelmannii* | Englemann's spike-rush | | Red | | PPxh | Bog;Fen;Swamp;Marsh;Riparian Shrub |
| *Eleocharis geniculata* | bent spike-rush | E (Apr 2009) | Red | 1-E (Feb | BGxh | Bog;Fen;Swamp;Marsh;Riparian Shrub |
| *Eleocharis ovata* | ovate spike-rush | | Red | | PPxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Eleocharis rostellata* | beaked spike-rush | | Blue | | CDFmm;CWHdm;CWHxm;ICHmw;IDFdm;ID | Marsh;Meadow;Hot Spring |
| *Elodea nuttallii* | Nuttall's waterweed | | Blue | | BGxh;CWHdm;ICHdw;ICHmk;ICHxw | Stream/River;Lake;Pond/Open Water |
| *Epilobium glaberrimum* ssp. | smooth willowherb | | Blue | | BAFA;CMA;CWHds;CWHvh;ESSFmw;ESSFvc; | Stream/River;Cliff;Rock/Sparsely Vegetated |
| *Epilobium halleanum* | Hall's willowherb | | Blue | | BGxh;BGxw;CDFmm;ESSFdcp;ICHdw;ICHwk; | Vernal Pools/Seasonal |
| *Epilobium mirabile* | hairy-stemmed willowherb | | Red | | ESSFmw | Vernal Pools/Seasonal Seeps;Talus |
| *Epilobium oregonense* | Oregon willowherb | | Blue | | ESSFxc;ICHmw;IDFxh;MHmm | Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian |
| *Epipactis gigantea* | giant helleborine | SC (May 1998) | Blue | 3 | BGxh;CWHdm;ICHdw;ICHmw;ICHxw;IDFdm; | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Floerkea proserpinacoides* | false-mermaid | NAR (May 1984) | Blue | | ICHdw;ICHmk;IDFmw;MSxk | Vernal Pools/Seasonal Seeps |
| *Gayophytum humile* | dwarf groundsmoke | | Blue | | BGxh;ESSFmw;ICHmk;IDFxh;MSdk;MSxk | Vernal Pools/Seasonal Seeps;Meadow;Grassland;Conifer |
| *Gayophytum racemosum* | racemed groundsmoke | | Red | | IDFdm | Vernal Pools/Seasonal Seeps;Grassland;Conifer Forest - |
| *Glycyrrhiza lepidota* | wild licorice | | Blue | | ICHdw;IDFdm;PPdh | Riparian Forest;Grassland;Riparian Herbaceous |
| *Heterocodon rariflorum* | heterocodon | | Blue | | CDFmm;CWHds;CWHxm;ICHdw;IDFdm;IDFx | Vernal Pools/Seasonal Seeps;Conifer Forest - Mesic |
| *Hornungia procumbens* | ovalpurse | | Blue | | BGxh;BGxw;CDFmm;CWHxm;IDFxh | Alkali Ponds/Salt Flats |
| *Idahoa scapigera* | scalepod | | Red | | CDFmm;CWHxm;ICHxw;IDFww;PPxh | Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated |

| Scientific Name | English Name | COSEWIC | BC List | SARA | BGC | Habitat Subtype |
|---|---|---|---|---|---|---|
| *Impatiens aurella* | orange touch-me-not | | Blue | | BWBSmw;ICHdw;ICHmc;ICHmw;IDFxh | Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian |
| *Juncus confusus* | Colorado rush | | Red | | BGxh;ICHdw;ICHmk;IDFxh;MSdm | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Lewisia triphylla* | three-leaved lewisia | | Blue | | BAFA;CMA;ESSFdcp;ESSFwc;ICHdw;IDFdm;I | Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated |
| *Limosella acaulis* | Owyhee mudwort | | Red | | BGxh | Bog;Fen;Swamp;Marsh |
| *Lindernia dubia* var. *anagallidea* | false-pimpernel | | Blue | | BGxh;CWHdm;CWHxm;IDFxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Lindernia dubia* var. *dubia* | yellowseed false pimpernel | | Red | | CWHxm;PPxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps |
| *Liparis loeselii* | yellow widelip orchid | | Red | | ICHmw;IDFmw | Bog;Fen;Riparian Shrub;Riparian Herbaceous |
| *Lipocarpha micrantha* | small-flowered lipocarpha | E (Nov 2002) | Red | 1-E (Jan | BGxh | Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian |
| *Marsilea vestita* | hairy water-clover | | Red | | BGxh;IDFmw;IDFxh;PPxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps |
| *Megalodonta beckii* | water marigold | | Blue | | CDFmm;ICHdw;ICHmw;ICHxw;IDFdm;IDFun | Lake;Pond/Open Water |
| *Mimulus breviflorus* | short-flowered monkey- | | Blue | | ICHdw;ICHmk;IDFdm;MSdm | Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated |
| *Mimulus breweri* | Brewer's monkey-flower | | Blue | | ESSFdcp;ESSFwc;ESSFxv;ICHdw;ICHmk;ICHm | Vernal Pools/Seasonal Seeps;Riparian Forest;Riparian |
| *Mimulus suksdorfii* | Suksdorf's monkey-flower | | Red | | IDFdk;IDFxh;PPdh | Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated |
| *Navarretia intertexta* | needle-leaved navarretia | | Red | | CDFmm;CWHxm;ICHmk;IDFxh | Vernal Pools/Seasonal Seeps;Meadow |
| *Neoholmgrenia andina* | Andean evening-primrose | | Red | | BGxh | Vernal Pools/Seasonal Seeps;Grassland;Sagebrush Steppe |
| *Nicotiana attenuata* | wild tobacco | | Red | | BGxh | Cliff;Rock/Sparsely Vegetated Rock;Talus;Sagebrush |
| *Polygonum polygaloides* ssp. | close-flowered knotweed | | Red | | ICHmk;MSdk | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps |
| *Polygonum polygaloides* ssp. *kelloggii* | Kellogg's knotweed | | Blue | | ESSFwc;ICHdw;ICHmk;IDFdk;IDFww;IDFxh;I | Vernal Pools/Seasonal Seeps |
| *Potamogeton nodosus* | long-leaved pondweed | | Red | | BGxh;CWHdm;ICHmw;IDFmw | Bog;Fen;Swamp;Marsh;Lake;Pond/Open Water |
| *Potamogeton oakesianus* | Oakes' pondweed | | Blue | | CDFmm;CWHvm;ICHmw | Lake;Pond/Open Water |
| *Potentilla paradoxa* | bushy cinquefoil | | Red | | BGxh;IDFxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Psilocarphus brevissimus* var. | dwarf woolly-heads | E (Apr 2006) | Red | 1-E (Dec | IDFxh | Vernal Pools/Seasonal Seeps |
| *Rhynchospora capillacea* | brown beak-rush | | Red | | ICHmw | Bog;Fen;Swamp;Marsh |
| *Ribes oxyacanthoides* ssp. *cognatum* | northern gooseberry | | Red | | IDFdm;PPdh;SBSdk | Riparian Forest;Riparian Shrub;Talus;Conifer Forest - Dry |
| *Rotala ramosior* | toothcup meadow-foam | E (May 2000) | Red | 1-E (Jun | BGxh | Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal |
| *Salix amygdaloides* | peach-leaf willow | | Red | | BGxh;IDFxh | Riparian Shrub |
| *Salix boothii* | Booth's willow | | Blue | | ICHmk;ICHmw;IDFdk;IDFdm;IDFun;IDFxh;ID | Riparian Forest;Riparian Shrub;Meadow |
| *Salix tweedyi* | Tweedy's willow | | Blue | | ESSFdc;ESSFxc;ICHmw;IDFdk;MSdm;MSxk | Fen;Marsh;Stream/River;Meadow |
| *Schoenoplectus americanus* | Olney's bulrush | | Red | | BGxh;CDFmm;CWHds;PPxh | Estuary;Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats |
| *Schoenoplectus saximontanus* | Rocky Mountain clubrush | | Red | | BGxh;IDFmw | Bog;Fen;Swamp;Marsh;Lake;Pond/Open Water |
| *Senecio hydrophiloides* | sweet-marsh butterweed | | Red | | ESSFdk;ICHdw;ICHmk;MSdk;PPdh | Marsh;Vernal Pools/Seasonal Seeps;Riparian |
| *Solidago gigantea* | smooth goldenrod | | Red | | | Riparian Shrub;Meadow;Riparian Herbaceous |
| *Sphenopholis obtusata* | prairie wedgegrass | | Red | | BGxh;ICHdw;IDFdm | Bog;Fen;Swamp;Marsh;Stream/River;Meadow;Hot |
| *Spiranthes diluvialis* | Ute lady's tresses | | Red | | BGxh;PPxh | Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats |
| *Stellaria obtusa* | blunt-sepaled starwort | | Blue | | CWHms;ESSFdk;ESSFwc;ESSFwcp;ESSFwk;IC | Riparian Forest;Riparian Shrub;Meadow;Alpine/Subalpine |
| *Stuckenia vaginata* | sheathing pondweed | | Blue | | BGxw;BWBSdk;BWBSmw;IDFdk;IDFdm;IDFu | Stream/River;Lake;Pond/Open Water |
| *Symphyotrichum frondosum* | short-rayed aster | E (Apr 2006) | Red | 1-E (Dec | BGxh;PPxh | Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats |
| *Taraxia breviflora* | short-flowered evening- | | Red | | IDFdk;MSxk;SBSmk | Vernal Pools/Seasonal Seeps;Grassland;Sagebrush Steppe |
| *Trifolium cyathiferum* | cup clover | | Red | | BGxh;CDFmm;CWHmm;CWHxm;ICHdw;ICH | Vernal Pools/Seasonal Seeps;Riparian Forest;Riparian |
| *Triglochin debilis* | slender arrow-grass | | Red | | BGxh;IDFmw | Alkali Ponds/Salt Flats;Lake |
| *Utricularia ochroleuca* | ochroleucous bladderwort | | Blue | | BWBSdk;CDFmm;ESSFmv;ICHmw | Fen;Marsh;Pond/Open Water |
| *Verbena hastata* var. *scabra* | blue vervain | | Blue | | BGxh;CWHdm;CWHxm;IDFxh | Marsh;Meadow |
| *Viola septentrionalis* | northern violet | | Red | | ICHdw;ICHmw;IDFxh | Marsh;Conifer Forest - Mesic (average);Conifer Forest - |
| *Zeltnera exaltata* | western centaury | | Red | | BGxh | Alkali Ponds/Salt Flats;Vernal Pools/Seasonal Seeps |

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 |  | **B.C. Conservation Data Centre: Plant Observation Form (for Red- or Blue-listed specie** | | | | | | **Kyle Hawes** | |
| 2 | | | | | | | | khawes@ecoscapeltd.com | |
| 3 | | **Essential fields are highlighted in green, but please complete as many fields as possible.** | | | | | | | |
| 4 | | **Move cursor over the red triangle in the top right hand corner of a field for guiding comments.** | | | | | | | |
| 5 | | **Fields with purple headings have drop-down lists. Return forms to: cdcdata@gov.bc.ca THANK YOU!** | | | | | | | |
| 6 | ***Observations in columns*** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| 7 | **Observer** | **K. Hawes** | | | | | | | |
| 8 | **Taxon name** | Berula erecta | | | | | | | |
| 9 | **Source of Report** | Observation form/photo | | | | | | | |
| 10 | **Location/Directions** | ~50 m south of Mission Creek in a ditchline located ~ 300m northeast of the junction of Lexington and Lequime | | | | | | | |
| 11 | **Habitat type** | Lakes and ponds | | | | | | | |
| 12 | **Habitat** | Ditchline along agricultural field | | | | | | | |
| 13 | **Associated spp.** | Cattail | | | | | | | |
| 14 | ***Landowner Name** | City of Kelowna | | | | | | | |
| 15 | ***Landowner permissions** | Permission to survey/collect/share data obtained | | | | | | | |
| 16 | **Survey Date (yyyy/mm/dd)** | 31-Jul-15 | | | | | | | |
| 17 | **Zone** | 11 | | | | | | | |
| 18 | **Easting** | 322117 | | | | | | | |
| 19 | **Northing** | 5524061 | | | | | | | |
| 20 | **Source for coordinate** | Google Earth | | | | | | | |
| 21 | **Waypoint numbers (if applicable)** | | | | | | | | |
| 22 | **# of Individuals (exact)** | | | | | | | | |
| 23 | **# of Individual (range estimates)** | Jan-50 | | | | | | | |
| 24 | **Area Occupied: Length** | 20 m | | | | | | | |
| 25 | **Area Occupied: Width (m)** | 2 m | | | | | | | |
| 26 | **Area Occupied (m²)** | | | | | | | | |
| 27 | **Description of Area Occupied** | Ditchline with both native and weed species surrounded by agricultural fields | | | | | | | |
| 28 | **Condition of Population (& potential threats to plants within occupied** | Plants flowering at the time of the assessment. Plants generalliy small in size | | | | | | | |
| 29 | **Condition of Landscape (& potential threats at landscape level)** | Potentially threatened by agricultural activities (tilling, etc.) | | | | | | | |
| 30 | **Recent (20-40 yrs) Landscape Disturbance** | Other | | | | | | | |
| 31 | **Overall Quality of Occurrence** | Fair | | | | | | | |
| 32 | **Elevation (m)** | ~340 m | | | | | | | |
| 33 | **Slope (%)** | 0 | | | | | | | |
| 34 | **Slope (°)** | | | | | | | | |
| 35 | **Aspect** | level | | | | | | | |
| 36 | **Crown closure** | Open | | | | | | | |
| 37 | **Slope Position** | Level | | | | | | | |
| 38 | **Moisture** | Seasonal fluctuation (saturated/flooded to very dry) | | | | | | | |
| 39 | **Substrate/soil** | fines/organics | | | | | | | |
| 40 | **General Notes** | | | | | | | | |
| 41 | **Collector name (if different from observer)** | | | | | | | | |
| 42 | **Herbarium and Specimen Collection #** | | | | | | | | |
| 43 | **Plot # (if applicable)** | | | | | | | | |
| 44 | **Photo details** | | | | | | | | |

**B.C. Conservation Data Centre**
**FIELD OBSERVATION FORM (ANIMALS)**
Complete only for Red or Blue listed species. Complete as many fields as able, particularly ones denoting exact location.

EO: Create ____
Update ____
EO #: _____
DONE: ____

**SPECIES:** western painted turtle.
**Name of recorder/reporter:** ADAM PATTERSON.
**Address:** 102 - 450 NEAVE CT. KELOWNA BC V1V 2M2

**Phone#:** 250-491-7337 **e-mail:** apatterson@ecoscapeltd.com.

**Location:** *(We use the information you provide to map locations, and to relocate sites on the ground. Please be as precise as possible. Provide written directions below and sketch a map. A photocopy of a 1:50,000 topographic map or other showing the location would be appreciated).*
painted turtles observed at Michael Brook Ponds near Kelowna H2O centre.

**UTM grid reference:** (from blue grid on 1:50,000 NTS map) **NTS MAPSHEET NO.:** _____
***Please note which North American Datum (NAD) was used (found below the contour interval scale on NTS map): 27 or 83***
**ZONE:** *(e.g. 10U)* 11 **NORTHING:** 5523926 **EASTING:** 321591 **NAD:** 83

Did you use a GPS unit to determine this UTM point? Y / (N) **Precision of point:***(+/- metres)* from Google Earth.

| Date | | | Numbers | | | | | | Comments | Observer |
|---|---|---|---|---|---|---|---|---|---|---|
| year | month | day | Adult | | | Immature | | | | |
| | | | m | f | u | m | f | u | | |
| 2014 | 6 | 19 | | | 3 | | | | turtles observed basking. | APatterson. |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

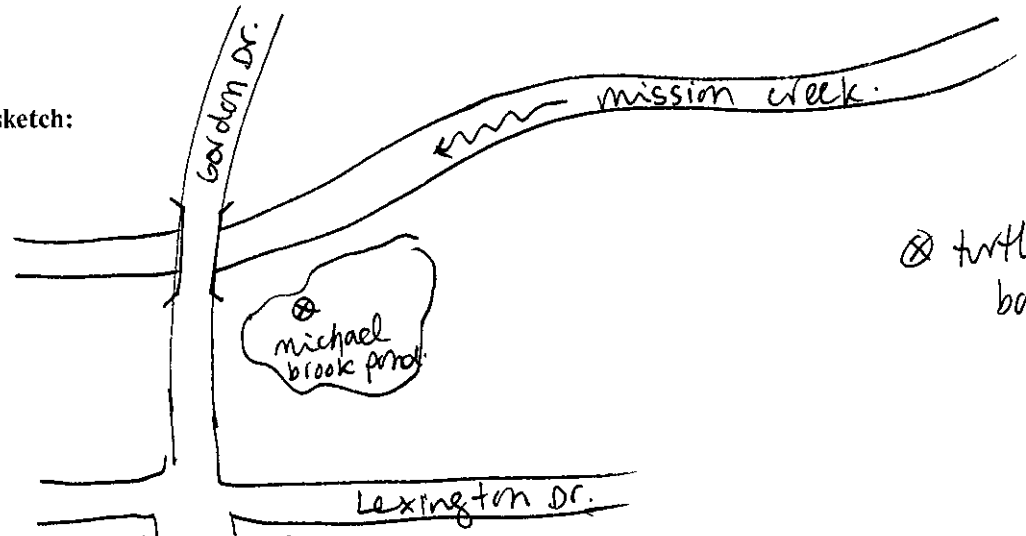
**Evidence of breeding:** ☐ none ☐ mating observed ☐ nest found ☐ young being fed out of nest
☐ singing/displaying male(s) ☐ egg-laying observed ☐ larva/pupa found
☑ other: basking.
Comments: on logs

**Habitat:** *(include. dominant plants if possible; a general description of area):*
open water wetland w known population of turtles.

**Elevation:** 345 (metres) feet *(circle one)* **Slope %:** 0 **Aspect:** n/a.

**Comments/Remarks:**

**Area for sketch:**




⊗ turtles observed basking.

**Size (square meters, kilometres or hectares):** *(area covered by the population at this location).*_____

**Landscape context:** *(Is the area fragmented? Generally describe the surrounding area and adjacent land uses including species composition and any other biological or abiotic factors that may affect the population):*

open water wetland along left bank of Mission Creek. surrounded by soccer fields, separated from creek by dyke, bush roadway nearby.

**Condition:** *(Condition is a measure of the quality of biotic and abiotic factors, within the occurrence, and how they may affect the continued existence of the occurrence. Some factors to consider are: habitat degradation, disturbance and presence of exotic species)*

wetland appears to be in good condition but is/is isolated from other wetland habitats by roads, recreational landuse.

**Notes:** *(Land ownership, development plans, management activities or recommendations, if any other comments):*

**Known threats:**_____

**Ownership/Jurisdiction:** city of Kelowna park land.

A private land owner **may request** that the exact location **not** be released to the public. The CDC will only release the location in response to an FOI request.

Does the landowner want the exact location withheld from the public? YES ____ NO ___ ?

Was the landowner contacted about the release of the exact location? YES ____ NO X

LANDOWNER'S NAME: city of Kelowna. PHONE: _____ E-MAIL:_____

Please return forms to: CDC, Ministry of Environment, Ecosystems Branch, P.O. Box 9358 Station Provincial Government, Victoria BC V8W 9M2 (fax: 250-387-2733) cdcdata@gov.bc.ca THANK YOU!

**B.C. Conservation Data Centre**
**FIELD OBSERVATION FORM (ANIMALS)**
Complete only for Red or Blue listed species. Complete as many fields as able, particularly ones denoting exact location.

EO: Create ___
Update ___
EO #: _____
DONE: ___

**SPECIES:** WESTERN SCREECH OWL.
**Name of recorder/reporter:** ADAM PATTERSON
**Address:** 102-450 NEAVE CT. KELOWNA BC V1V 2M2

**Phone#:** 250-491-7337 **e-mail:** apatterson@ecoscapeltd.com.

**Location:** *(We use the information you provide to map locations, and to relocate sites on the ground. Please be as precise as possible. Provide written directions below and sketch a map. A photocopy of a 1:50,000 topographic map or other showing the location would be appreciated).*
owl detected during call-playback survey at intersection of Casorso Rd + Swamp Rd in Kelowna (north of round-about).

**UTM grid reference:** (from blue grid on 1:50,000 NTS map) **NTS MAPSHEET NO.:** _____
***Please note which North American Datum (NAD) was used (found below the contour interval scale on NTS map): 27 or 83***
**ZONE:** *(e.g. 10U)* 1 1 **NORTHING:** 5 5 2 4 4 2 8 **EASTING:** 3 2 2 7 6 7 **NAD:** 83

Did you use a GPS unit to determine this UTM point? Y /(N) **Precision of point:***(+/- metres)* ? FROM GOOGLE EARTH.

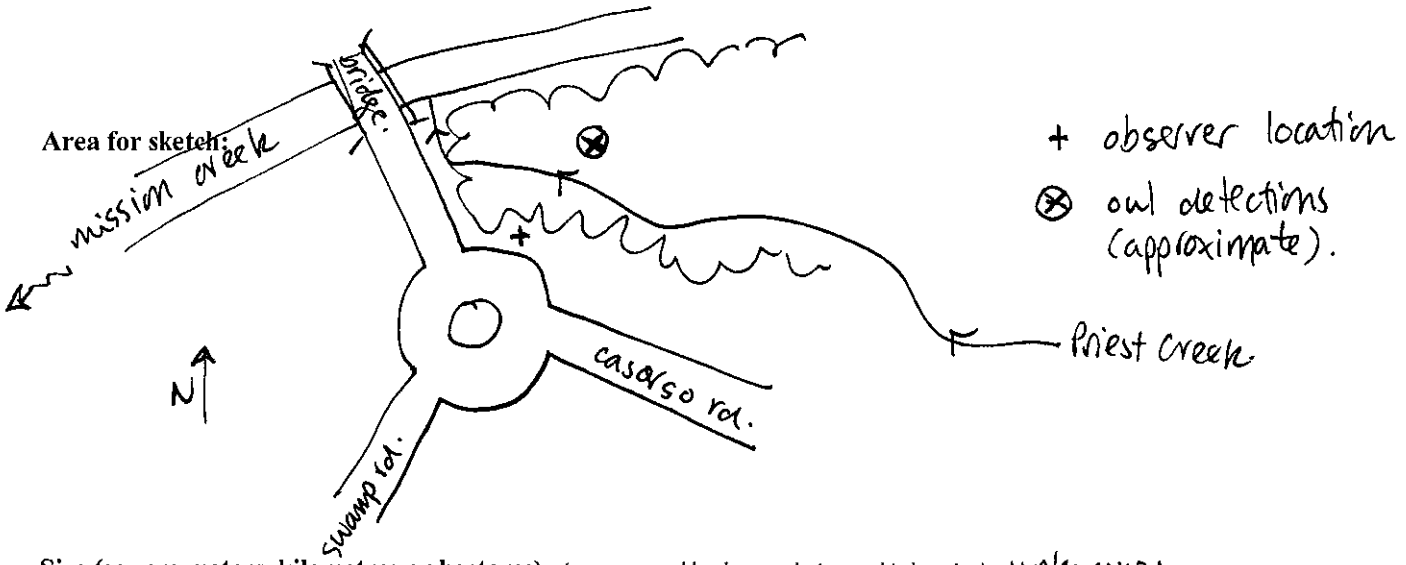
| Date | | | Numbers | | | | | | Comments | Observer |
|---|---|---|---|---|---|---|---|---|---|---|
| year | month | day | Adult | | | Immature | | | | |
| | | | m | f | (u) | m | f | u | | |
| 2014 | 4 | 29 | | | (u) | | | | response to call playback | A. Patterson. |
| 2014 | 5 | 13 | | | U | | | | " | " |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

**Evidence of breeding**: ☐ none ☐ mating observed ☐ nest found ☐ young being fed out of nest
☑ singing/displaying male(s) ☐ egg-laying observed ☐ larva/pupa found
☐ other:_____
Comments: _____
**Habitat:** *(include. dominant plants if possible; a general description of area):*
cottonwood riparian stand along Mission Creek corridor

**Elevation:** 347 (metres) feet *(circle one)* **Slope %:** 0 **Aspect:** n/a.

**Comments/Remarks:** _____

**Area for sketch:**




**Size (square meters, kilometres or hectares):** *(area covered by the population at this location).* unknown.

**Landscape context:** *(Is the area fragmented? Generally describe the surrounding area and adjacent land uses including species composition and any other biological or abiotic factors that may affect the population):*

remnant patch of mature riparian forest along Mission Creek corridor at confluence w/ Priest Creek.

**Condition:** *(Condition is a measure of the quality of biotic and abiotic factors, within the occurrence, and how they may affect the continued existence of the occurrence. Some factors to consider are: habitat degradation, disturbance and presence of exotic species)*

Good condition of forest patch although surrounded by rural + agricultural land use.

**Notes:** *(Land ownership, development plans, management activities or recommendations, if any other comments):*

private land.

**Known threats:**

**Ownership/Jurisdiction:** city of Kelowna, private land.

A private land owner **may request** that the exact location **not** be released to the public. The CDC will only release the location in response to an FOI request.

Does the landowner want the exact location withheld from the public? YES ____ NO ___ ?

Was the landowner contacted about the release of the exact location? YES ____ NO ✕

LANDOWNER'S NAME: unknown. PHONE: _____ E-MAIL: _____

Please return forms to: CDC, Ministry of Environment, Ecosystems Branch, P.O. Box 9358 Station Provincial Government, Victoria BC V8W 9M2 (fax: 250-387-2733) cdcdata@gov.bc.ca THANK YOU!

**B.C. Conservation Data Centre**
**FIELD OBSERVATION FORM (ANIMALS)**
Complete only for Red or Blue listed species. Complete as many fields as able, particularly ones denoting exact location.

EO: Create ____
Update ____
EO #: _____
DONE: ____

**SPECIES:** lance-tipped darner
**Name of recorder/reporter:** K. HAWES.
**Address:** 102-450 NEAVE CT. KELOWNA BC V1V 2M2

**Phone#:** 250-491-7337 **e-mail:** khawes@ecoscapeltd.com.

**Location:** *(We use the information you provide to map locations, and to relocate sites on the ground. Please be as precise as possible. Provide written directions below and sketch a map. A photocopy of a 1:50,000 topographic map or other showing the location would be appreciated).*
lance-tipped darner (A. constricta) observed within wetland habitats near Kelowna H2O centre.

**UTM grid reference:** (from blue grid on 1:50,000 NTS map) **NTS MAPSHEET NO.:** _____
***Please note which North American Datum (NAD) was used (found below the contour interval scale on NTS map): 27 or 83***
**ZONE:** *(e.g. 10U)* 11 **NORTHING:** 5523782 **EASTING:** 321764 **NAD:** 83

Did you use a GPS unit to determine this UTM point? (Y) N **Precision of point:** *(+/- metres)* 5

| Date | | | Numbers | | | | | | Comments | Observer |
|---|---|---|---|---|---|---|---|---|---|---|
| year | month | day | Adult | | | Immature | | | | |
| | | | m | f | u | m | f | u | | |
| 2014 | 06 | 19 | | | AH | | | X | ~~pupal stage~~ larval stage | K. HAWES. |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

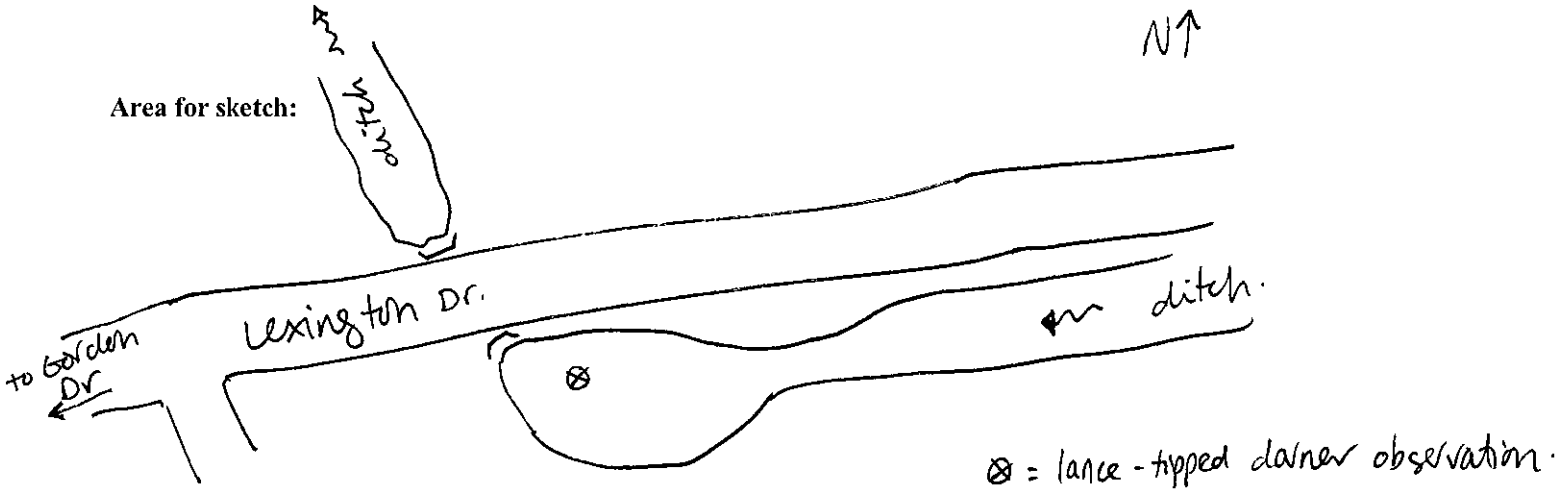
**Evidence of breeding:** ☐ none ☐ mating observed ☐ nest found ☐ young being fed out of nest
☐ singing/displaying male(s) ☐ egg-laying observed ☑ larva/pupa found
☐ other: _____
Comments: _____

**Habitat:** *(include. dominant plants if possible; a general description of area):*
open water wetland / ditch w/ cattail + bulrush fringe surrounded by recreational land.

**Elevation:** 344 (metres) feet *(circle one)* **Slope %:** 0 **Aspect:** n/a

**Comments/Remarks:** _____

**Area for sketch:**




**Size (square meters, kilometres or hectares):** *(area covered by the population at this location).* ~ 1 m2

**Landscape context:** *(Is the area fragmented? Generally describe the surrounding area and adjacent land uses including species composition and any other biological or abiotic factors that may affect the population):*

area occurs within an urban recreational setting surrounded by soccer fields, playground, roads, parking areas, dog park, H2O centre etc.

**Condition:** *(Condition is a measure of the quality of biotic and abiotic factors, within the occurrence, and how they may affect the continued existence of the occurrence. Some factors to consider are: habitat degradation, disturbance and presence of exotic species)*

wetland is functional although appears to receive stormwater and other surface runoff from adjacent recreational fields.
invasive species are present along wetland / ditch fringe

**Notes:** *(Land ownership, development plans, management activities or recommendations, if any other comments):*

occurs within city of Kelowna park land.

**Known threats:**

**Ownership/Jurisdiction:** City of Kelowna.

A private land owner **may request** that the exact location **not** be released to the public. The CDC will only release the location in response to an FOI request.

Does the landowner want the exact location withheld from the public? YES ___ NO ?

Was the landowner contacted about the release of the exact location? YES ___ NO ✗

LANDOWNER'S NAME: city of Kelowna. PHONE: _____ E-MAIL: _____

Please return forms to: CDC, Ministry of Environment, Ecosystems Branch, P.O. Box 9358 Station Provincial Government, Victoria BC V8W 9M2 (fax: 250-387-2733) cdcdata@gov.bc.ca THANK YOU!

# APPENDIX C
Wildlife List

| Category | Common Name | Scientific Name | COSEWIC | BC | SARA |
|---|---|---|---|---|---|
| Amphibian | Columbia spotted frog | *Rana luteiventris* | NAR (May 2000) | Yellow | |
| | Great Basin spadefoot | *Spea intermontana* | T (Apr 2007) | Blue | 1-T (2003) |
| | long-toed salamander | *Ambystoma macrodactylum* | | Yellow | |
| | Pacific chorus frog | *Pseudacris regilla* | | Yellow | |
| Bird | American coot | *Fulica americana* | | | |
| | American crow | *Corvus brachyrhynchos* | | | |
| | American dipper | *Cinclus mexicanus* | | | |
| | American goldfinch | *Carduelis tristis* | | | |
| | American kestrel | *Falco sparverius* | | | |
| | American robin | *Turdus migratorius* | | | |
| | American wigeon | *Anas americana* | | | |
| | bald eagle | *Haliaeetus leucocephalus* | NAR (May 1984) | | |
| | barn swallow | *Hirundo rustica* | | Blue | |
| | black-billed magpie | *Pica pica* | | | |
| | black-capped chickadee | *Poecile atricapillus* | | | |
| | blue-winged teal | *Anas discors* | | | |
| | Brewer's blackbird | *Euphagus cyanocephalus* | | | |
| | brown-headed cowbird | *Molothrus ater* | | | |
| | bufflehead | *Bucephala albeola* | | | |
| | Bullock's oriole | *Ictercus bullockii* | | | |
| | California gull | *Larus californicus* | | Blue | |
| | California quail* | *Callipepla californica* | | | |
| | Canada goose | *Branta canadensis* | | | |
| | Cassin's vireo | *Vireo cassinii* | | | |
| | cedar waxwing | *Bombycilla cedrorum* | | | |
| | cinnamon teal | *Anas cyanoptera* | | | |
| | common goldeneye | *Bucephala clangula* | | | |
| | common merganser | *Mergus merganser* | | | |
| | common nighthawk | *Chordeiles minor* | T (Apr 2007) | | 1 |
| | common raven | *Corvus corax* | | | |
| | common tern | *Sterna hirundo* | | | |
| | common yellowthroat | *Geothlypis trichas* | | | |
| | dark-eyed junco | *Junco hyemalis* | | | |
| | downy woodpecker | *Picoides pubescens* | | | |
| | dusky flycatcher | *Empidonax oberholseri* | | | |
| | eastern kingbird | *Tyrannus tyrannus* | | | |
| | Eurasian collared-dove* | *Streptopelia decaocto* | | | |
| | European starling* | *Sturnus vulgaris* | | | |
| | evening grosbeak | *Coccothraustes vespertinus* | | | |
| | gadwall | *Anas strepera* | | | |
| | gray catbird | *Dumetella carolinensis* | | | |
| | great blue heron | *Ardea herodias* | | Blue | |
| | great horned owl | *Bubo virginianus* | | | |
| | hairy woodpecker | *Picoides villosus* | | | |
| | house finch | *Carpodacus mexicanus* | | | |
| | house sparrow* | *Passer domesticus* | | | |
| | killdeer | *Charadrius vociferus* | | | |
| | least flycatcher | *Empidonax minimus* | | | |
| | MacGillivray's warbler | *Oporornis tolmiei* | | | |
| | mallard | *Anas platyrhynchos* | | | |
| | mourning dove | *Zenaida macroura* | | | |
| | northern flicker | *Colaptes auratus* | | | |

| | | | | | |
|---|---|---|---|---|---|
| | northern rough-winged swallow | *Stelgidopteryx serripennis* | | | |
| | northern shoveler | *Anas clypeata* | | | |
| | Pacific-slope flycatcher | *Empidonax difficilis* | | | |
| | pileated woodpecker | *Dryocopus pileatus* | | | |
| | red-eyed vireo | *Vireo olivaceus* | | | |
| | red-tailed hawk | *Buteo jamaicensis* | | | |
| | red-winged blackbird | *Agelaius phoeniceus* | | | |
| | ring-billed gull | *Larus delawarensis* | | | |
| | ring-necked pheasant* | *Phasianus colchicus* | | | |
| | rock pigeon* | *Columba livia* | | | |
| | ruby-crowned kinglet | *Regulus calendula* | | | |
| | savannah sparrow | *Passerculus sandwichensis* | | | |
| | song sparrow | *Melospiza melodia* | | | |
| | sora | *Porzana carolina* | | | |
| | spotted sandpiper | *Actitis macularia* | | | |
| | spotted towhee | *Pipilo maculatus* | | | |
| | Swainson's thrush | *Catharus ustulatus* | | | |
| | tree swallow | *Tachycineta bicolor* | | | |
| | turkey vulture | *Cathartes aura* | | | |
| | veery | *Catharus fuscescens* | | | |
| | violet-green swallow | *Tachycineta thalassina* | | | |
| | Virginia rail | *Rallus limicola* | | | |
| | warbling vireo | *Vireo gilvus* | | | |
| | western screech-owl | *Otus kennicottii* | E (May 2002) | Red | 1 |
| | western tanager | *Piranga ludoviciana* | | | |
| | western wood-pewee | *Contopus sordidulus* | | | |
| | white-crowned sparrow | *Zonotrichia leucophrys* | | | |
| | willow flycatcher | *Empidonax traillii* | | | |
| | Wilson's snipe | *Gallinago delicata* | | | |
| | Wilson's warbler | *Wilsonia pusilla* | | | |
| | wood duck | *Aix sponsa* | | | |
| | yellow warbler | *Dendroica petechia* | | | |
| | yellow-headed blackbird | *Xanthocephalus xanthocephalus* | | | |
| | yellow-rumped warbler | *Dendroica coronata* | | | |
| Mammal | American beaver | *Castor canadensis* | | | |
| | American black bear | *Ursus americanus* | | | |
| | big brown bat | *Eptesicus fuscus* | | | |
| | California myotis | *Myotis californicus* | | | |
| | Columbian ground squirrel | *Spermophilus columbianus* | | | |
| | common muskrat | *Ondatra zibethicus* | | | |
| | coyote | *Canis latrans* | | | |
| | eastern grey squirrel* | *Sciurus carolinensis* | | | |
| | ermine | *Mustela erminea* | | | |
| | little brown myotis | *Myotis lucifugus* | | | |
| | long-eared myotis | *Myotis evotis* | | | |
| | long-legged myotis | *Myotis volans* | | | |
| | mule deer | *Odocoileus hemionus* | | | |
| | northern raccoon | *Procyon lotor* | | | |
| | red squirrel | *Tamiasciurus hudsonicus* | | | |
| | silver-haired bat | *Lasionycteris noctivagans* | | | |
| | spotted bat | *Euderma maculatum* | SC (May 2004) | Blue | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | white-tailed deer | *Odocoileus viginianus* | | | |
| | yellow-bellied marmot | *Marmota flaviventris* | | | |
| | yuma myotis | *Myotis yumanensis* | | | |
| Reptile | common gartersnake | *Thamnophis sirtalis* | | | |
| | western painted turtle | *Chrysemys picta bellii* | SC (Apr 2006) | Blue | 1 |
| | western terrestrial gartersnake | *Thamnophis elegans* | | | |
| Fish | common carp* | *Cyprinus carpio* | | | |
| Invertebrate | lance-tipped darner | *Aeshna constricta* | | Blue | |

* Indicates exotic or non-native species.

# APPENDIX D
Vegetation List

| **Common Name** | ***Latin Name*** |
|---|---|
| alfalfa* | *Medicago sativa* |
| American brookline | *Veronica americana* |
| American vetch | *Vicia americana* |
| Baltic rush | *Juncus balticus* |
| barclay's willow | *Barclay's willow* |
| bastard toadflax | *Comandra umbellata* |
| beaked hazlenut | *Corylus cornuta* |
| beaked sedge | *Carex utriculata* |
| Bebb's willow | *Salix bebbiana* |
| birds-foot trefoil* | *Lotus corniculatus* |
| black cottonwood | *Polulus balsamifera* ssp. *trichocarpa* |
| black hawthorn | *Crataegus douglasii* |
| black locust* | *Robinia pseudoacacia* |
| black medic* | *Medicago lupulina* |
| black twinberry | *Lonicera involucrata* |
| bladder campion* | *Silene vulgaris* |
| blue wildrye | *Elymus glaucus* |
| broad-fruited bur-reed | *Sparganium eurycarpum* |
| Canada goldenrod | *Solidago canadensis* |
| Canada thistle* | *Cirsium arvense* |
| catnip* | *Nepeta cataria* |
| celery leaved buttercup | *Ranunculus sceleratus* |
| cheatgrass* | *Bromus tectorum* |
| chicory* | *Cichorium intybus* |
| choke cherry | *Prunus virginiana* |
| clasping leaved peppergrass* | *Lepidium perfoliatum* |
| cleavers | *Galium aparine* |
| climbing nightshade* | *Solanum dulcamara* |
| clover* | *Trifolium sp.* |
| common barberry* | *Berberis vulgaris* |
| common cattail | *Typha latifolia* |
| common dandelion* | *Taraxacum officinale* |
| common duckweed | *Lemna minor* |
| common horsetail | *Equisetum arvense* |
| common mallow* | *Malva neglecta* |
| common mare's tail | *Hippuris vulgaris* |
| common mullein* | *Verbascum thapsus* |
| common parsnip* | *Pastinaca sativa* |
| common plantain* | *Plantago major* |
| common snowberry | *Symphoricarpos albus* |
| common spike-rush | *Eleocharis palustris* |
| common St. John's wort* | *Hypericum perforatum* |
| common timothy * | *Phleum pretense* |
| cow parsnip | *Heracleum maximum* |
| Crawford's sedge | *Carex crawfordii* |
| creeping buttercup* | *creeping buttercup* |
| crested wheatgrass | *Agropyron cristatum* |
| curled dock* | *Rumex crispus* |
| cut-leaved water parsnip[1] | *Berula erecta* |
| dame's rocket* | *Hesperis matronalis* |
| Douglas' water hemlock | *Cicuta douglasii* |
| false azalea | *Menziesia ferruginea* |
| field bindweed* | *Convolvulus arvensis* |
| field pennycress* | *Thlaspi arvense* |
| flixweed* | *Descurainia sophia* |
| forget me not* | *Myosotis stricta* |
| foxtail barley | *Hordeum jubatum* |
| fragrant white bog orchid | *Platanthera dilatata* |
| fringed loosestrife | *Steironema ciliatum* |

| **Common Name** | ***Latin Name*** |
|---|---|
| giant wildrye | *Leymus cinreus* |
| goatsbeard | *Aruncus dioicus* |
| graceful cinquefoil | *Potentilla gracilis var. fastigiata* |
| hard-stemmed bulrush | *Schoenoplectus acutus* |
| heart-podded hoary-cress* | *Cardaria draba* |
| hemp dogbane | *Apocynum cannabinum* |
| hoary alysum* | *Berteroa incana* |
| hounds' tongue* | *Cynoglossum officinale* |
| interior Douglas-fir | *Pseudotsuga menziesii var. glauca* |
| lamb's-quarters* | *Chenopodium album* |
| leafy aster | *Symphyotrichum foliaceum* |
| leafy spurge* | *Euphorbia esula* |
| mallow ninebark | *Physocarpus malvaceus* |
| maple-leaved currant | *Ribes acerifolium* |
| meadow larkspur | *Delphinium distichum* |
| Mexican mosquito fern[2] | *Azolla mexicana* |
| mock-orange | *Philadelphus lewisii* |
| mountain alder | *Alnus incana* ssp. *Bicolor* |
| narrow-leaved willow | *Epilobium leptophyllum* |
| night-flowering catchfly* | *Silene noctiflora* |
| Nootka rose | *Rosa nutkana* |
| Orange touch-me-not | *Impatiens aurella* |
| orchard grass* | *Dactylis glomerata* |
| pacific willow | *Salix lucida subsp. Lasiandra* |
| paper birch | *Betula papyrifera* |
| pasture sage | *Artemesia frigida* |
| peavine | *Lathyrus sp.* |
| Pennsylvania buttercup | *Ranunculus pensylvanicus* |
| perennial ryegrass* | *Lolium perenne* |
| perennial sow-thistle* | *Sonchus arvensis* |
| pineapple weed* | *Matricaria discoidea* |
| pinegrass | *Calamagrostis rubescens* |
| poison ivy | *Toxicodendron rydbergii* |
| Prairie rose | *Rosa woodsii* |
| prickly lettuce* | *Lactuca serriola* |

| **Common Name** | ***Latin Name*** |
|---|---|
| prickly rose | *Rosa acicularis* |
| purple-leaved willowherb | *Epilobium ciliatum* |
| quackgrass* | *Agropyron repens* |
| queen's cup | *Clintonia uniflora* |
| red elderberry | *Sambucus racemosa* |
| red-osier dogwood | *Cornus stolonifera* |
| reed canarygrass* | *Phalaris arundinacea* |
| reed mannagrass | *Glyceria grandis* |
| Russian olive* | *Elaeagnus angustifolia* |
| sandbar willow | *Salix interior* |
| Saskatoon | *Amelanchier alnifolia* |
| scentless mayweed* | *Tripleurospermum inodorum* |
| scouring rush | *Equisetum hymenale* |
| showy milkweed | *Asclepias speciosa* |
| shrubby penstemon | *Penstemon fruticosus* |
| Siberian elm* | *Ulmus pumila* |
| small flowered bulrush | *Scirpus microcarpus* |
| smooth brome* | *Bromus inermis* |
| soopolallie | *Shepherdia canadensis* |
| spike trisetum | *Trisetum spicatum* |
| spotted knapweed* | *Centaurea maculosa* |
| spotted touch-me-not | *Impatiens capensis* |
| star-flowered false Solomon's-seal | *Maianthemum stellatum* |
| stinging nettle* | *Urtica dioica* |
| sulphur cinquefoil* | *Potentilla recta* |
| swamp horsetail | *Equisetum fluviatile* |
| tall Oregon grape | *Mahonia aquifolium* |
| tall tumble mustard* | *Sismbrium altissimum* |
| tea-leaved willow | *Salix planifolia* |
| thread-leaved fleabane | *Erigeron filifolius* |
| timber milk vetch | *Astragalus miser* |
| trailing fleabane | *Erigeron flagellaris* |
| tree of heaven* | *Ailanthus altissima* |
| trembling aspen | *Populus tremuloides* |
| Utah honeysuckle | *Lonicera utahensis* |
| Virginia creeper* | *Parthenocissus quinquefolia* |
| water smartweed | *Plolygonum amphibium* |
| weeping willow* | *Salix babylonica* |
| western mountain ash | *Sorbus scopulina* |
| western redcedar | *Thuja plicata* |
| white clematis | *Clematis ligusticifolia* |
| wild sarasparilla | *Aralia nudicaulis* |
| wooly sedge | *Carex lauginosa* |
| wormwood* | *Artemesia absinthium* |
| yellow iris* | *Iris pseudacorus* |
| yellow monkey flower | *Mimulus guttatus* |
| yellow salsify* | *Tragopogon dubius* |
| **Notes:** | |
| * Indicates exotic or non-native species. | |
| 1. Pending confirmation next growing season. Potential rare species. | |
| 2. Prelim. identification of Mexican mosquito fern pending confirmation from rare species expert. | |