

Appendix 15-E

Bird Community Baseline Report



DILLON
CONSULTING

NWP COAL CANADA LTD

Bird Community Baseline Report

Crown Mountain Coking Coal Project



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Acronyms and Abbreviations

AIR	Application Information Requirements
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BC EAA	<i>British Columbia Environmental Assessment Act</i>
BC EAO	British Columbia Environmental Assessment Office
BC MFLNRO	British Columbia Ministry of Forest Lands, Natural Resource Operation and Rural Development
BC MOE	British Columbia Ministry of Environment
BEC	Biogeoclimatic Ecosystem Classification
BGC	Biogeoclimatic
CEA Act	<i>Canadian Environmental Assessment Act</i>
CEAA	Canadian Environmental Assessment Agency
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DBH	Diameter at Breast Height
dw	dry weight
EA	Environmental Assessment
EC10	10% Effect Concentration
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EKRD	East Kootenay Regional District
ESSFdkp	Dry Cool Parkland Engelmann Spruce Subalpine Fir
ESSFdkw	Dry Cool Woodland Engelmann Spruce Subalpine Fir
ESSFdk1	Elk Dry Cool Engelmann Spruce Subalpine Fir Elk Dry
EVWQP	Elk Valley Water Quality Plan
ft	feet
GPS	Global Positioning System
ha	hectare
HHERA	Human Health and Ecological Risk Assessment
IBA	Important Bird Area
km	kilometre
km ²	square kilometre
LSA	Local Study Area

m	metres
MBCA	<i>Migratory Bird Convention Act</i>
mg/kg	milligram per kilogram
MSdw	Dry Warm Montane Spruce
No.	Number
NWP	NWP Coal Canada Ltd
RISC	Resources Information Standards Committee
RMERF	Rocky Mountain Eagle Research Foundation
RSA	Regional Study Area
SARA	<i>Species at Risk Act</i>
SE	Standard Error
Teck	Teck Coal Limited
TEM	Terrestrial Ecosystem Mapping
TSA	Timber Supply Area
VC	Valued Component
wt	wet weight

Executive Summary

NWP Coal Canada Ltd (NWP) is proposing to develop the Crown Mountain Coking Coal Project (“the Project”), an open pit metallurgical coal mine in the Elk Valley coal field of southeastern British Columbia. The proposed Project is situated proximate to existing metallurgical coal mines, including the Teck Coal Limited (Teck) Elkview Operations located 8 km to the southwest and the Teck Line Creek Operations located 12 km to the north. The mine is expected to produce approximately 10,150 tonnes per day and up to 4.0 million run-of-mine tonnes per year for 15 years. The proposed Project footprint covers approximately 1,300 ha.

The Project is reviewable under both the federal *Canadian Environmental Assessment Act* (2012) and provincial *Environmental Assessment Act* (2002). A bird community baseline program was completed as part of Project baseline studies to support the development of an environmental assessment. The baseline program, with studies completed in 2014, 2017, 2018, and 2019, focused on collecting information to document bird occupancy (presence/non-detect), extent of occurrence and abundance, and bird habitat availability and distribution within and surrounding the Project footprint. This baseline report summarizes information gathered through the bird community baseline program. Information gathered through the bird community baseline program will be used to assess potential effects on the bird community as a result of the proposed Project.

The bird community baseline program focused on the following groups: landbirds; raptors; and waterbirds. These groups were selected to capture bird Valued Components identified in the Application Information Requirements (British Columbia Environmental Assessment Office, 2018) and the Environmental Impact Statement Guidelines (Canadian Environmental Assessment Agency, 2015). The bird groups identified encompass 25 bird species of conservation concern that have the potential to occur near the Project. Landbirds include all birds that use terrestrial habitats, including key families such as passerines, woodpeckers, and nighthawks. Raptors include all birds of prey such as owls, vultures, eagles, hawks, and falcons. Waterbirds include wetland and riverine birds; birds that require water or wetland habitat to complete their life cycles.

Surveys completed for the bird community baseline program included:

- Landbird breeding and migration point count and transect surveys;
- Common Nighthawk (*Chordeiles minor*) surveys;
- Raptor migration standwatch surveys;
- Northern Goshawk (*Accipiter gentilis atricapillus*) call-playback and habitat assessment surveys;
- Nocturnal owl surveys;
- Wetland bird breeding and migration season standwatch surveys;
- Riverine bird surveys; and,
- Riverine bird egg tissue collection.

The breeding landbird surveys included completion of 242 variable radius point count surveys at 138 locations across the Project Local Study Area (LSA) in June and July of 2014 and 2017 to 2019. Evening Common Nighthawk surveys were completed at 16 locations in late June and early July 2018. Key findings of these surveys include:

- 80 species were documented in the LSA across the four survey years;
- Swainson's Thrush (*Catharus ustulatus*), Pine Siskin (*Spinus pinus*), and Yellow-rumped Warbler (*Setophaga coronata*) were the most abundant species observed;
- Federally and/or provincially-listed species of conservation concern observed included Barn Swallow (*Hirundo rustica*), Common Nighthawk, Evening Grosbeak (*Coccothraustes vespertinus*), Great Blue Heron (*Ardea Herodias*), and Olive-sided Flycatcher (*Contopus cooperi*);
- The highest average relative abundance, species richness, and diversity of breeding landbirds was documented in the Grave Prairie area, west of Grave Lake, and along the mainstem of Alexander Creek; and,
- Grasslands, mixed shrub forests, and wetlands supported the most abundant, species-rich, and diverse breeding landbird communities.

The landbird migration surveys in 2018 and 2019 were conducted at 26 point count locations and along two encounter transects. Spring survey effort comprised 85 point count surveys and 32 transect surveys, and fall survey effort comprised 37 point count surveys and 7 transect surveys. Key findings of the migration surveys include:

- 51 landbird species were documented in the spring and 33 species in the fall;
- The most frequently encountered species included Dark-eyed Junco, American Robin (*Turdus migratorius*), and Pine Siskin;
- Two species of conservation concern, Evening Grosbeak and Olive-sided Flycatcher, were observed;
- The highest average relative abundance, species richness, and diversity during the spring and fall occurred within the Grave Prairie area, west of Grave Lake, and along the mainstem of Alexander Creek; and,
- Landbird communities were found to be the most abundant, species-rich, and diverse in mixed shrub forests in the spring and in wetlands in the fall.

The raptor migration surveys in 2018 and 2019 included completion of 22 standwatch surveys at six locations in the spring and eight standwatch surveys at five locations in the fall. Key findings of these surveys include:

- 13 species were documented in the spring and 10 species were documented in the fall;
- The only known migrant raptor species was a Broad-winged Hawk (*Buteo platypterus*) observed in fall 2019;

- Red-tailed Hawk (*Buteo jamaicensis*) were the most frequently observed resident species in the spring and Golden Eagle (*Aquila chrysaetos*) were the mostly frequently observed resident species in the fall; and,
- The highest average raptor abundance and species richness was observed along southern Alexander Creek in the spring and along the upper reaches of Grave Creek in the fall.

Northern Goshawk survey effort comprised 151 call-play back surveys at 51 stations between 2014 and 2017 to 2019 and 42 habitat assessments in July 2018 and July 2019. Key findings include:

- 10 Northern Goshawk were observed in the LSA across the four survey years;
- Goshawk were distributed throughout the LSA but were primarily observed in the mainstem of Alexander Creek, West Alexander Creek, the Elk River, the Grave Prairie area, upper Grave Creek, and Deadman Pass;
- Most Goshawk observations occurred in forested areas;
- No Goshawk nests were observed during the habitat assessments;
- The habitat assessment stations with the highest overall habitat suitability ratings were located near Alexander Creek (mainstem), West Alexander Creek, and upper Alexander Creek (east fork); and,
- The LSA offers primarily low to moderate quality Goshawk habitat.

Owl surveys were conducted at 15 locations along three different road routes in April 2018. No owls were observed during the nocturnal owl surveys; however, five Great Horned Owl and three Barred Owl were incidentally-observed during other surveys conducted within the LSA.

Wetland bird surveys in the summer of 2014 and 2017 to 2019 included completion of 112 surveys at 28 wetland survey sites and two ephemeral areas. In 2018 and 2019, spring wetland bird migration surveys included completion of 86 surveys at 22 wetland sites, and fall migration surveys included 22 surveys at 14 wetland sites. Key findings of the wetland bird surveys include:

- 23 wetland bird species were observed in the spring, 14 species in the summer, and two species in the fall;
- Red-winged Blackbird (*Agelaius phoeniceus*), Mallard (*Anas platyrhynchos*), and Northern Shoveler (*Spatula clypeata*) were the most abundant wetland bird species observed in the spring;
- Mallard, Spotted Sandpiper (*Actitis macularius*), and Red-winged Blackbird were the most abundant wetland bird species observed in the summer;
- Mallard and Hooded Merganser (*Lophodytes cucullatus*) were the only wetland bird species observed in the fall;
- Higher abundance areas in the spring occurred at two wetlands near the Elk River, two wetlands near Grave Creek, and one wetland along Harmer Creek;

- Higher abundance areas in the summer occurred at two wetlands near the Elk River, one wetland on the shore of Grave Lake, two wetlands along Harmer Creek, and one wetland along Alexander Creek; and,
- Few wetland birds were seen in the LSA during the fall.

Riverine bird surveys were completed in June and July of 2017 to 2019 and covered 28.3 km across five creeks in the LSA. Four Spotted Sandpiper egg tissue samples were collected in 2017 and 2018 during the surveys to inform the Project ecological risk assessment. Key findings include:

- Five riverine bird species were observed in the LSA;
- Spotted Sandpiper were the most frequently observed species, followed by American Dipper (*Cinclus mexicanus*) and Harlequin Duck (*Histrionicus histrionicus*);
- Riverine bird species were observed in four of the five creeks surveyed: Alexander Creek; West Alexander Creek; Grave Creek; and Harmer Creek;
- No riverine birds were observed in Grave Creek upstream of the confluence with Harmer Creek or in the unnamed creek in Deadman Pass;
- Alexander Creek had the highest bird abundance, species richness, and diversity in the LSA, particularly the middle and lower reaches in the southern portion of the LSA;
- Sections of Alexander Creek surveyed were found to be the most abundant and diverse riverine bird habitat in the LSA compared to other watercourse sections surveyed; and,
- The selenium concentrations measured in the Spotted Sandpiper egg samples were below provincial guidelines and regional benchmark values in three of the four samples analyzed, with the 2017 tissue sample from Harmer Creek having a selenium concentration above the provincial guideline and 10% effect size for the regional benchmark.

1.0 Introduction

1.1 Project Overview

NWP Coal Canada Ltd (NWP) is proposing to develop the Crown Mountain Coking Coal Project (the Project) which is intended as an open pit metallurgical coal mine located within the Elk Valley coal field in the East Kootenay Regional District of southeastern British Columbia (BC; **Figure 1-1**). NWP is jointly owned by Jameson Resources Limited and Bathurst Resources Limited (Canada). The Project comprises ten coal licenses as shown on **Figure 1-1**. The Project is located between several existing metallurgical coal mines in the Elk Valley and Crowsnest coal fields, with Teck Coal Limited's (Teck) Elkview mine located approximately 8 kilometres (km) southwest of the Project area and their Line Creek mine located approximately 12 km north of the Project area. The Project area is located approximately 30 km by road from Sparwood, BC and is accessible by several Forest Service Roads, including Grave Creek Road in the northwest and Alexander Creek Road from the south.

The anticipated production capacity of the Project is up to 4.0 million run-of-mine tonnes per annum for a production duration of approximately 15 years. This equates to a coal production capacity of approximately 10,150 tonnes per day. Exploration activities have indicated that the coal at the Project site is typical of coking coals produced from existing mines in the Elk Valley. The high quality metallurgical coal would be transported via railway to coastal BC, where it would be shipped overseas to be used in steelmaking.

Key components of the proposed Project include, but are not limited to:

- Surface extraction areas (3 pits – north pit, east pit, and south pit);
- Waste rock management areas;
- Plant area (includes raw coal stockpile area, a processing plant, and site support facilities);
- Clean coal transportation route (via an overland conveyor and haul road);
- Rail load-out facility and rail siding (includes various auxiliary facilities);
- Power supply;
- Natural gas supply;
- Explosives storage;
- Fuel storage;
- Sewage treatment; and,
- Water supply.

1.2 Purpose and Objectives of Baseline Study

The Project is subject to both the *Canadian Environmental Assessment Act (CEA Act) 2012* and the *British Columbia Environmental Assessment Act (BC EAA) 2002*. Provincially, the Project is considered a Reviewable Project given that the production capacity of the mine will be greater than 250,000 tonnes per year of clean coal and will result in a disturbance greater than 750 hectares (ha)

that was not previously permitted for disturbance (BC EAA, 2002). Federally, the Project is considered a Designated Project under the *CEA Act (2012) Regulations Designating Physical Projects*, as the mine will have a production capacity of more than 3,000 tonnes per day. Project-specific terms of reference were developed for the provincial environmental assessment (EA) process (BC Environmental Assessment Office [BC EAO], 2018) and the federal EA process (Canadian Environmental Assessment Agency [CEAA], 2015).

Under the project-specific provincial Application Information Requirements (AIR; BC EAO, 2018) and federal Environmental Impact Statement (EIS) Guidelines (CEAA, 2015) for the Project's EA, birds, including migratory and non-migratory (i.e., resident) species, are identified as Valued Components (VCs) and as such, an understanding of existing migratory and non-migratory bird communities and their habitats is required to adequately assess potential effects on this wildlife group as a result of Project activities. The key objective of the bird community baseline program was to determine and describe existing migratory and non-migratory bird communities within and surrounding the Project. Specific to this, the baseline program focused on collecting information to document bird occupancy (presence/non-detect), occurrence and abundance, and bird habitat availability and distribution. This baseline report presents a summary of the information on the bird communities encountered during the bird surveys and provides regional context based on publically-available information.

The bird community baseline program focused on the following groups: landbirds; raptors; and waterbirds. These groups were selected to capture bird VCs identified in the AIR (BC EAO, 2018) and the EIS Guidelines (CEAA, 2015) and will form the foundation by which potential impacts to birds are evaluated in the environmental assessment. Landbirds include all birds that use terrestrial habitats, including key families such as passerines, woodpeckers, and nighthawks. Raptors include all birds of prey such as owls, vultures, eagles, hawks, and falcons. Waterbirds include wetland and riverine birds; birds that require water or wetland habitat to complete their life cycles. The specific VCs for the three bird groups include:

- Landbirds:
 - Migratory Birds (as defined under the *Migratory Bird Convention Act [MBCA], 1994*) and represented by Olive-sided Flycatcher (*Contopus cooperi*), Barn Swallow (*Hirundo rustica*), and woodpeckers (family Picidae).
- Raptors:
 - Northern Goshawk (*Accipiter gentilis atricapillus*).
- Waterbirds:
 - American Dipper (*Cinclus mexicanus*);
 - Harlequin Duck (*Histrionicus histrionicus*);
 - Mallard (*Anas platyrhynchos*);
 - Red-winged Blackbird (*Agelaius phoeniceus*); and
 - Spotted Sandpiper (*Actitis macularius*).

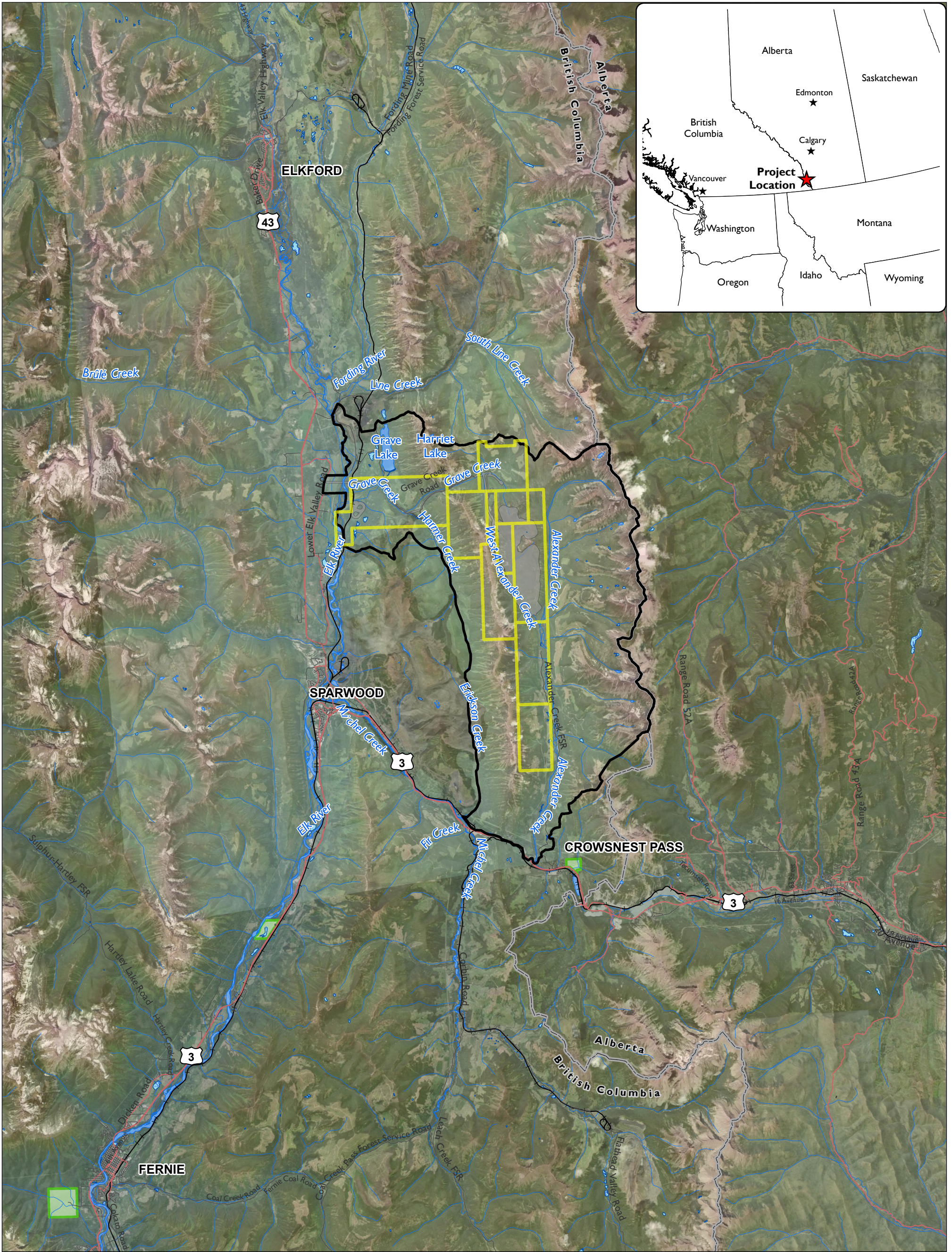


FIGURE I-1.
Project Location

- LEGEND**
- Terrestrial Local Study Area
 - Project Footprint
 - Coal Licences
 - Highways
 - Arterial Roads
 - Local/Resource Roads
 - Railway (Canadian Pacific)
 - Watercourse
 - Waterbody
 - Wetland
 - Provincial Park
 - BC/Alberta Border

0 1 2 3 4 Kilometers
SCALE 1:200,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-17

1.3 Applicable Legislation and Guidelines

Birds and their habitat are protected under several pieces of federal and provincial legislation. The primary pieces of legislation include the federal *Migratory Birds Convection Act* (1994), the federal *Species at Risk Act* (SARA; 2002), and the provincial *Wildlife Act* (1996) and *Forest and Range Practices Act* (2002).

1.3.1 Federal

The *CEA Act* (2012) requires the assessment of effects on the environment and its components for designated projects. This process helps in planning and decision making and allows for the prediction of adverse environmental effects and the development of mitigation measures (Government of Canada, 2019).

Prohibitions under the *MBCA* (1994) provide legislative protection to migratory birds listed under its Schedule 1 and their nests. Migratory bird families listed under Schedule 1 of the *MBCA* (1994) and their likelihood to inhabit the general region surrounding the Project are provided in **Table 1-1**. The *Migratory Birds Regulations* (2018) under the *MBCA* (1994) specifically states under Section 6 that:

“no person shall:

- (a) disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or*
- (b) have in his possession a live migratory bird, or a carcass, skin, nest or egg of a migratory bird”*).

The *SARA* (2002) provides legislative protection to specific listed species and their critical habitat in Schedule 1 of the *Act*. Schedule 1 of *SARA* (2002) is the official list of species at risk in Canada. Species are recommended to be designated on Schedule 1 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). As per Section 34 (1) of *SARA* (2002), all *SARA*-listed species of fish and migratory birds (those included under the *MBCA*) are protected on any lands within Canada, while other listed species are only protected under *SARA* (2002) if they occur on federal lands.

The purpose of *SARA* (2002) is to prevent wildlife species from being extirpated or becoming extinct (Government of Canada, 2002). *SARA* explicitly states that:

“No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species” (*SARA* 2002, s. 32(1)).

In addition to individual protection for listed species, the habitat and residences of listed species are also protected:

“No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species” (SARA 2002, s. 33).

Definitions of residences are also provided for some species at risk.

Table 1-1: Bird Families Listed under the MBCA (1994) and their Potential Presence near the Project

Family	Potential Presence
Anatidae, or waterfowl (ducks, geese and swans)	Yes
Aegithalidae (long-tailed tits and bushtits)	Unlikely
Alaudidae (larks)	Yes
Alcidae (auks, auklets, guillemots, murre, and puffins)	Unlikely
Apodidae (swifts)	Yes
Ardeidae (bitterns and herons)	Yes
Bombycillidae (waxwings)	Yes
Calcariidae (longspurs and buntings)	Unlikely
Caprimulgidae (goatsuckers)	Yes
Cardinalidae (tanagers, cardinals, grosbeaks and buntings)	Yes
Certhiidae (creepers)	Yes
Charadriidae (lapwings and plovers)	Yes
Ciconiidae (storks)	Unlikely
Cinclidae (dippers)	Yes
Columbidae (doves and wild pigeons)	Yes
Cuculidae (cuckoos)	Unlikely
Diomedidae (albatrosses)	Unlikely
Emberizidae (emberizid sparrows)	Yes
Fringillidae (cardueline finches)	Yes
Gaviidae (loons)	Yes
Gruidae (cranes)	Yes
Haematopodidae (oystercatchers)	Unlikely
Hirundinidae (swallows)	Yes
Hydrobatidae (storm petrels)	Unlikely
Icteridae (bobolinks, meadowlarks, and orioles, but not including Icterid blackbirds and cowbirds, as was clarified in the 1995 Protocol)	Unlikely
Laniidae (shrikes)	No*

Family	Potential Presence
Laridae (gulls and terns)	Yes
Mimidae (catbirds, mockingbirds, thrashers, and allies)	Yes
Motacillidae (wagtails and pipits)	Yes (high elevation)
Muscicapidae (Old World flycatchers)	Unlikely
Paridae (titmice)	Unlikely
Parulidae (wood-warblers)	Yes
Picidae (woodpeckers and allies)	Yes
Podicipedidae (grebes)	Yes
Poliophtilidae (gnatcatchers)	Unlikely
Procellariidae (petrels and shearwaters)	Unlikely
Ptilonotidae (silky-flycatchers)	Yes
Rallidae (coots, gallinules and rails)	Yes
Recurvirostridae (stilts and avocets)	Yes
Regulidae (Kinglets)	Yes
Scolopacidae (sandpipers and allies)	Yes
Sittidae (nuthatches)	Yes
Sturnidae (starlings, mynas)	Unlikely
Sulidae (gannet)	Unlikely
Threskiornithidae (ibises)	Unlikely
Trochilidae (hummingbirds)	Yes
Troglodytidae (wrens)	Yes
Turdidae (robins and thrushes)	Yes
Tyrannidae (tyrant flycatchers)	Yes

*Overwinters in the area, but unlikely to breed there.

1.3.2

Provincial

The BC *EAA* (2002) allows for the review of major projects in order to assess their potential impacts to the environment (*EAA*, 2002). These projects are reviewed to ensure they meet environmental, economic, and social sustainability goals. Projects that fall under the *EAA* (2002) are assessed for adverse environmental, economic, social, heritage, and health effects that have the potential to result throughout the duration of the project (*EAA*, 2002).

The BC *Wildlife Act* (1996) provides legislative protection from harm and harassment to all wildlife, with the exception of those activities permitted by regulations, such as hunting and trapping

(*Wildlife Act*, 1996). The *Wildlife Act* provides legislative protection to all native birds and their occupied nests. Specifically, Section 34 states that states that:

“A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys

(a) a bird or its egg,

(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or

(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg”.

The *BC Forest and Range Practices Act* (2002) outlines how resource-based activities can be conducted on Crown land in BC, while ensuring protection of everything in and on them, such as plants, animals, and ecosystems (*Forest and Range Practices Act*, 2002). Broad habitat and species protection measures in the *Forest and Range Practices Act* provide direction for the protection of birds during activities such as clearing and road-building by forest and range licensees. Under the *Act*, habitats such as riparian areas and wetlands require special management and mitigation measures.

1.3.3

Guidelines

The BC Conservation Data Centre (BC CDC) assists in the conservation of BC’s biodiversity by collecting and sharing scientific data and information about wildlife and ecosystems in BC (BC CDC, 2019). The primary functions of the CDC are to:

- Compile a list of species and ecosystems that occur in BC;
- Assess conservation status ranks;
- Map known locations (element occurrences); and,
- Make data and information available.

The CDC assigns conservation status ranks to BC’s species and ecosystems according to the level of risk of being lost. Based on that, the CDC assigns a provincial Conservation Status Rank (red, blue, or yellow) that can be used to set conservation priorities. Red-listed species and ecosystems are at risk of being lost (extirpated, endangered or threatened); blue-listed species and ecosystems are of special concern; and yellow-listed species and ecosystems are at the least risk of being lost (BC CDC, 2019).

The *Develop with Care 2014 Environmental Guidelines for Urban and Rural Development* is a comprehensive guide for preserving environmental values during land development practices (Government of British Columbia, 2014). The document lists the program priorities of the Ministry of Forests, Lands and Natural Resource Operations, the BC Ministry of Environment (BC MOE), and other agencies, and promotes methods for retaining and creating environmental function and resilience. The guidelines include a terms of reference for conducting biological inventories that were used to guide the bird baseline program.

Provincial guidelines have been developed for selenium in bird egg tissue, and are typically used as a surrogate for all wildlife, including sensitive wildlife (BC MOE, 2014). The BC tissue guideline for selenium in bird egg tissue is 6 milligrams per kilogram (mg/kg) dw. The guideline was based on a weight of evidence with selenium as the most direct or sensitive measure (derivation from 10% Effect Concentration [EC10] for a Mallard egg with an uncertainty factor of 2 applied).

Regionally-specific benchmark tissue concentrations for selenium were developed for bird egg tissues in the Elk Valley Water Quality Plan (EVWQP; Teck Resources Limited, 2015). The benchmark concentrations are those resulting in a critical effect size for bird reproduction of ~10% (12 mg/kg dw) and ~20% (16 mg/kg dw), quantified according to dose-response curves representing the following:

- Negligible potential for population-level effects if <10%;
- A possibility of population-level effects if between 10% and 20%; and,
- A potential for measureable and ecologically meaningful population-level if >20%.

2.0

Baseline Program Overview

2.1

Study Areas

The Project is located approximately 30 km by road from Sparwood, British Columbia at 114°43.6'W and 49°48.4'N (**Figure 2-1**). The Project is situated in an area of steep topography of the Front Ranges Rocky Mountains of BC and accessed by several Forest Service Roads, including Grave Creek Forest Service Road from the west and Alexander Creek Road from the south. The Project is in the Elk River, Erickson Creek, Harmer Creek, Grave Creek, and Alexander Creek watersheds. Alexander Creek flows south from the Project area and subsequently joins Michel Creek. Michel Creek eventually discharges to the Elk River, which flows generally southwest and discharges to Lake Koochanusa, a lake which partially occurs in the State of Montana. Grave Creek flows in a westerly direction from the upper extent of the Project area and discharges to the Elk River. Harmer Creek, a tributary to Grave Creek, flows from the south to the north and joins Grave Creek east of the Elk River.

Three spatial boundaries have been developed to guide the completion of the bird community baseline program and to evaluate potential impacts to the terrestrial environment. The spatial boundaries include the Project footprint, the Local Study Area (LSA), and the Regional Study Area (RSA). Project-specific surveys conducted at the LSA scale are presented in this report, while the evaluation of birds at the RSA level is presented in a separate habitat modelling report.

The Project footprint covers approximately 1,300 ha (**Figure 2-1**) and includes all anticipated Project components, such as the active mining area, waste rock management areas piles, and associated infrastructure following the Grave Creek Forest Service Road west to the Elk River.

The LSA covers approximately 24,100 ha (**Figure 2-1**). Rationale for selecting the LSA boundaries includes:

- Includes the Project footprint and areas that may experience potential direct and indirect impacts as a result of Project activities;
- Includes terrestrial habitat that may experience changes at an ecosystem level as well as changes to connectivity between ecosystems and landscapes;
- Includes watersheds that have the immediate potential to be directly or indirectly impacted by the Project, including Grave Creek, West Alexander Creek, and Alexander Creek; and,
- Encompasses landscape features and known bird migration routes/movement corridors (e.g., Grave Creek Canyon).

The west side of the LSA is characterized by steep sided ridges and subdued mountains, while those on the east are rugged with many cirques and U-shaped valleys (**Photo 1-1 and Photo 1-2**). Elevations in the LSA range from 1,170 metres (m; 3,838 feet [ft]) along the Elk River west of Grave

Lake up to almost 2,500 m (8,200 ft) along Erickson Ridge. The dominant wildlife habitat in the LSA consists of riparian habitat along Alexander and Grave Creeks and their tributaries, mature and immature conifer forest (including regenerating cutblocks), non-forested or sparsely forested areas on steep slopes dominated by grasses, forbs and shrubs created primarily by avalanches, and alpine grasslands.

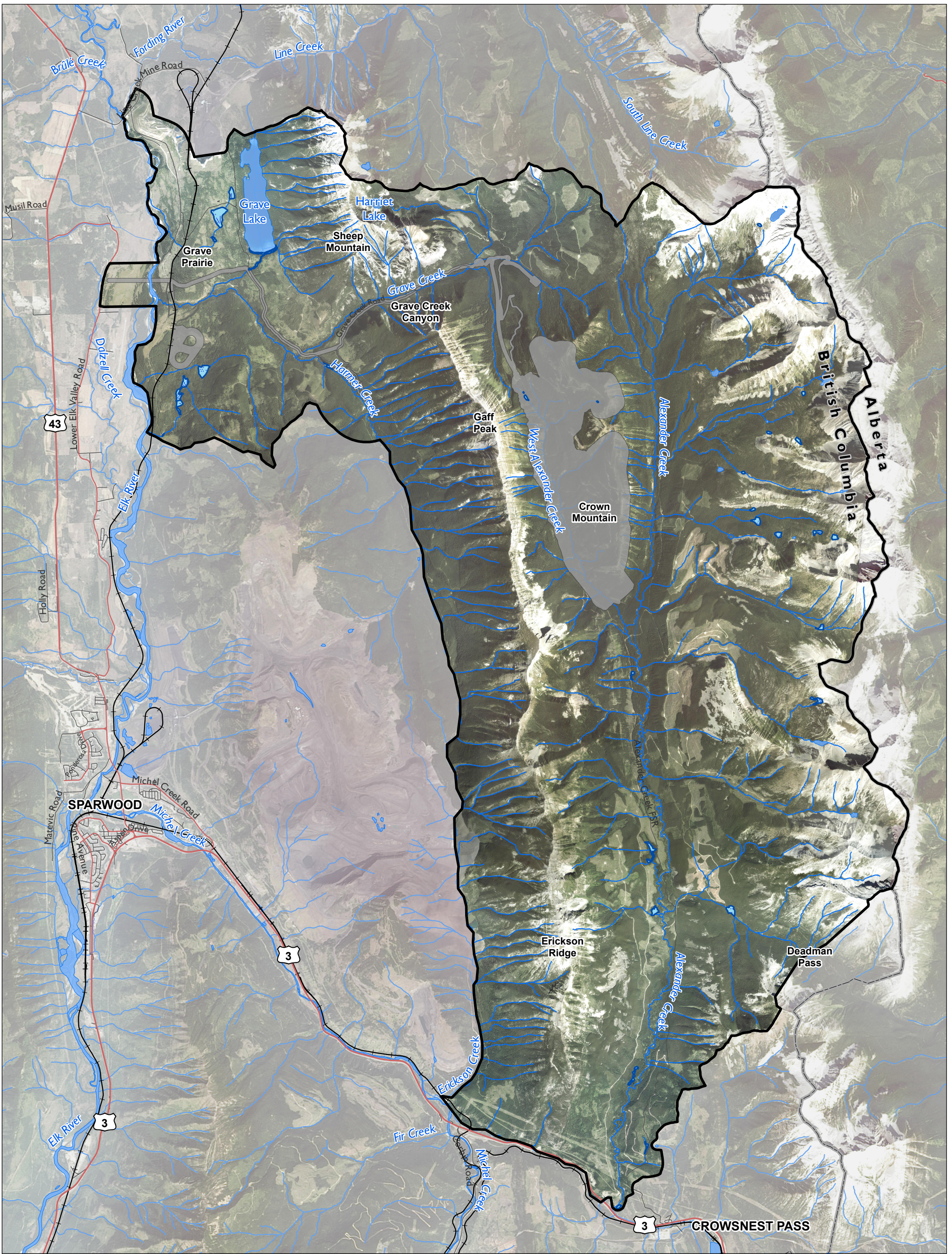


FIGURE 2-1.
Bird Community Baseline Program Study Areas


- LEGEND**
- Terrestrial Local Study Area
 - Project Footprint
 - BC/Alberta Border
 - Highways
 - Arterial Roads
 - Local/Resource Roads
 - Railway (Canadian Pacific)
 - Watercourse
 - Waterbody
 - Wetland

0 1 2 3 4 Kilometers

SCALE 1:82,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-17



Photo 2-1: Looking East at the Grave Creek Valley between Sheep Mountain (left) and Gaff Peak (right; July 7, 2019)



Photo 2-2: Looking South at the Alexander Creek Valley in the Central/Southern Area of the LSA from Crown Mountain (August 22, 2019)

2.2

Species of Conservation Concern

Species of conservation concern are species with rare or declining populations or habitats that are provincially blue or red-listed, federally-listed under SARA (2002) and COSEWIC, or globally-listed by NatureServe. Species were identified using the BC CDC Species and Ecosystems Explorer (BC CDC, 2019). The following search terms were utilized:

- Birds, All OR birds, Breeding in BC;
- MOE Regions: 4-Kootenay (restricted to Red, Blue, and Legally designated species);
- Regional Districts: East Kootenay (EKRD); and,
- Biogeoclimatic (BGC) Zone.

Twenty-five bird species of conservation concern are found with the East Kootenay Regional District and have the potential to occur near the Project (**Table 2-1**). Based on these findings, field surveys were designed to target migrating and breeding landbirds, raptors, and waterbirds with specific additional methods and approaches for detecting rare species or those with nocturnal or crepuscular behaviours.

Table 2-1: Species of Conservation Concern Likely to Occur within the East Kootenay Regional District (BC CDC, 2019)

Common Name	Scientific Name	BC Conservation List ¹	BC Status Rank ²	COSEWIC Status ³	SARA Status ⁴	Global Status ⁵
Landbirds						
Bank Swallow*	<i>Riparia riparia</i>	Yellow	S4B	T	1-T	G5
Barn Swallow*	<i>Hirundo rustica</i>	Blue	S3S4B	T	1-T	G5
Black Swift*	<i>Cypseloides niger</i>	Blue	S2S3B	E	1-E	G4
Bobolink*	<i>Dolichonyx oryzivorus</i>	Blue	S3B	T	1-T	G5
Common Nighthawk*	<i>Chordeiles minor</i>	Yellow	S4B	SC	1-T	G5
Evening Grosbeak*	<i>Coccothraustes vespertinus</i>	Yellow	S5	SC	1-SC	G5
Lewis's Woodpecker*	<i>Melanerpes lewis</i>	Blue	S2S3B	T	1-T	G4
Long-billed Curlew*	<i>Numenius americanus</i>	Blue	S3B	SC	1-SC	G5
Olive-sided Flycatcher*	<i>Contopus cooperi</i>	Blue	S3S4B	SC	1-T	G4
Williamson's Sapsucker*	<i>Sphyrapicus ruber</i>	Blue	S3B	E	1-E	G5

Common Name	Scientific Name	BC Conservation List ¹	BC Status Rank ²	COSEWIC Status ³	SARA Status ⁴	Global Status ⁵
Raptors						
Flammulated Owl	<i>Psiloscops flammeolus</i>	Blue	S3B	SC	1-SC	G2
Northern Goshawk (<i>atricapillus</i> ssp.)	<i>Accipiter gentilis atricapillus</i>	Blue	S3S4	NAR		G5T5
Peregrine Falcon	<i>Falco peregrinus</i>	No Status	S3	SC	1-SC	G4
Peregrine Falcon (<i>anatum</i> spp.)	<i>Falco peregrinus anatum</i>	Red	S2?	NAR	1-SC	G4T4
Short-eared Owl	<i>Asio flammeus</i>	Blue	S3B, S2N	SC	1-SC	G5
Swainson's Hawk	<i>Buteo swainsoni</i>	Red	S2B			G5
Western Screech Owl	<i>Megascops kennicottii</i>	No Status	S4	T	1-T	G4G5
Western Screech Owl (<i>macfarlanei</i> spp.)	<i>Megascops kennicottii macfarlanei</i>	Blue	S3	T	1-T	G4G5T4
Waterbirds						
American Avocet*	<i>Recurvirostra americana</i>	Blue	S2S3B			G5
American Bittern*	<i>Botaurus lentiginosus</i>	Blue	S3B			G5
Eared Grebe*	<i>Podiceps nigricollis</i>	Blue	S3B			G5
Great Blue Heron (<i>herodias</i> spp.)*	<i>Ardea herodias herodias</i>	Blue	S3?			G5T5
Horned Grebe*	<i>Podiceps auritus</i>	Yellow	S4B, SNRN	SC	1-SC	G5
Rusty Blackbird	<i>Euphagus carolinus</i>	Blue	S3S4B	SC	1-SC	G4
Sandhill Crane*	<i>Antigone canadensis</i>	Yellow	S4B	NAR		G5

* Listed under the MBCA (1994).

¹ Yellow: at the least risk of being lost. Blue: special concern (BC CDC, 2019).

² S= Subnational rank assigned by BC CDC. B= Breeding Population. 2 = Imperiled. 3= Special Concern, vulnerable to extirpation or extinction. 4= Apparently Secure. SNRN=species not ranked. ?= inexact or uncertain rank (BC CDC, 2019).

³ Based on COSEWIC Status Reports. SC=Special Concern. T=Threatened. E=Endangered. NAR=Not at Risk (COSEWIC, 2015).

⁴ 1= Listed on Schedule 1 of SARA (2002). SC=Special Concern. T=Threatened. E=Endangered. NAR=Not at Risk.

⁵ NatureServe Global (G) Conservation Status Rank. G2=Imperiled. G4=Secure. G5=Secure. G#G#: Range rank, uncertainty about the exact status. T: Intraspecific Taxon (subspecies or varieties). (NatureServe, 2020).

2.3 Baseline Surveys

Bird community baseline surveys were conducted in 2014, 2017, 2018, and 2019 to document bird occupancy, occurrence and abundance, and bird habitat availability and distribution within the

Project footprint and LSA. A summary of all completed surveys for the bird community baseline program is provided in **Table 2-2**.

Survey methods followed provincial survey standards where applicable, which are further described in the method section for each bird group. Biologists spent 85 days (approximately 2,040 person hours) within the LSA, of which 53 days (approximately 1,270 person hours) were during the breeding seasons in June and July over the four survey years.

Baseline surveys were conducted by a team of two experienced biologists from Dillon Consulting Limited (Dillon) or Keefer Ecological Services Ltd. (KES; fall 2018 only) and targeted a wide range of land cover types, elevations, slopes, and stand ages across the LSA. The LSA was accessed via logging roads using a 4x4 truck, and at times by ATV and on foot. Surveys were conducted during the spring, summer, and fall to capture the migration periods and the breeding bird nesting window. No winter surveys were conducted due to safety concerns. Incidental observations were recorded during bird surveys and terrestrial wildlife surveys completed for other baseline programs.

The bird community baseline report is organized by bird group and information on specific studies conducted to target each group are presented for landbirds, raptors, and waterbirds in **Sections 3.0 to 5.0**, respectively. Information on migratory birds is presented as subsections in the landbirds, raptors, and waterbirds sections.

Table 2-2: Bird Surveys Completed as part of the Bird Community Baseline Program

Survey Type	Survey Dates	No. Survey Sites/Length of Transects	Targeted Species
Landbird Point Count Surveys	June 4 – 11, 2014	138 locations	Breeding Landbirds
	June 28 – July 5, 2014		
	June 5 – 11, 2017		
	June 29 – July 3, 2017		
	June 30 – July 8, 2018		
	July 4 – July 10, 2019		
Landbird Roadside Surveys	June 4 – 11, 2014	14 locations	Breeding Landbirds
	June 28 – July 5, 2014		
Nighthawk Surveys	July 26 – 30, 2018	16 roadside surveys	Breeding Nighthawks
Spring Landbird Migration Point Surveys	April 21 – 26, 2018	35 locations	Migratory Landbirds
	May 3 – 9, 2018		
	May 3 – 9, 2019		
	May 21 – 25, 2019	35 locations	Migratory Landbirds
October 3 – 5, 2018			

Survey Type	Survey Dates	No. Survey Sites/Length of Transects	Targeted Species
Fall Landbird Migration Point Surveys	September 10 – 13, 2019		
Owl Surveys	April 21 – 26, 2018	15 roadside surveys	Breeding Owls
Northern Goshawk Call-playback and Habitat Assessment Surveys	June 4 – 11, 2014	51 locations	Northern Goshawks
	June 28 – July 5, 2014		
	June 5 – 11, 2017		
	June 29 – July 3, 2017		
	June 30 – July 8, 2018		
Spring Raptor Standwatch Surveys	April 21 – 26, 2018	6 locations	Migratory and Resident Raptors
	May 3 – 9, 2018		
	May 3 – 9, 2019		
	May 21 – 25, 2019		
Fall Raptor Standwatch Surveys	October 3 – 5, 2018	6 locations	Migratory and Resident Raptors
	September 10 – 13, 2019		
Riverine Walks	June 29 – July 3, 2017	28.3 km	Riverine Birds: American Dipper, Harlequin Duck, Spotted Sandpiper, Belted Kingfisher, Osprey
	July 25 – 28, 2017		
	June 30 – July 8, 2018		
	July 26 – July 8, 2018		
	July 6 – 8, 2019		
Wetland Bird Surveys	All June and July visits	30 wetland and ephemeral sites	Breeding Wetland Birds
Wetland Bird Surveys	All April, May, September, and October surveys	24 wetland sites	Migratory Wetland Birds

2.4 Data Sources

To inform the bird community baseline program development, this report, and gain an understanding of existing conditions in the local and regional areas, a variety of publically-available information was reviewed. Information sources included studies completed for other mining projects in the area, provincial and federal resources, orthoimagery of the regional area, and baseline data collected as part of other wildlife programs being completed for the Project. Where relevant, information is presented in each of the bird group sections.

Examples of information reviewed included but was not limited to:

- Teck Elkview Operations Baldy Ridge Extension Project, Annex J – Wildlife and Wildlife Habitat Baseline Report (Golder Associates Ltd., 2015a);
- Line Creek Operations Phase II Project Wildlife and Wildlife Habitat Baseline Report, Annex J Part 1 and Part 2 – Wildlife and Habitat (Teck Coal Ltd., 2011);
- Characterization of High Elevation Grasslands in the Upper Elk Valley (EBA Engineering Consultants Ltd. [EBA], 2005);
- A Comparison of Historic, Current, and Future Nesting Habitat for the Northern Goshawk in the East Kootenay Region of British Columbia (Stuart-Smith, Wells, & Harrower, 2011);
- Columbia Wetlands Waterbird Survey (Columbia Wetlands Waterbird Survey, 2019);
- BC CDC's database of known rare species occurrences;
- Federal Species at Risk Species Explorer;
- Federal Species at Risk Critical Habitat locations;
- eBird Canada Checklists; and,
- BC Breeding Bird Atlas Species Accounts.

3.0

Landbirds

For the purposes of this baseline report, landbirds refers to terrestrial bird species that generally do not require waterbodies to complete their life cycles, unlike waterbirds such as waterfowl or shorebirds. Both migratory and non-migratory resident species have been included in this section. For the purposes of this report, migratory birds are not limited to those birds specifically listed under the *MBCA* (1994). Migratory birds are those that move seasonally for the purpose of moving to a new location where conditions are alternately favourable (Dingle & Drake, 2007). Migratory movements are on a greater scale and include longer distances than movements of typical daily activity (Dingle & Drake, 2007). Raptors, large predatory birds that maintain much larger territories than typical landbirds and have different life histories, are discussed separately in **Section 4.0**.

3.1

Breeding Birds

3.1.1

Introduction and Objectives

In temperate North America, where winters are cold and summers are warm, the majority of birds breed during the spring and summer when food sources are the most abundant and conditions are the most tolerable for sensitive young (Rousseu & Drolet, 2017). While nesting, many landbirds are territorial and defend their territories through conspicuous visual and auditory displays. Territorial displays typically occur in the morning and evening. Display patterns are unique to each species and are primarily conducted by males. It is generally assumed that for every male defending a territory there is an equivalent number of females in that territory (Toms, Schmiegelow, Hannon, & Villard, 2006). This behavior enables enumeration of bird abundance and species richness for a given area.

Habitats used by breeding songbirds are diverse and varied. Some habitats are known to be hotspots for bird diversity and have dense bird abundance, such as wetlands (Weller, 1988). Some species like Black-capped Chickadee (*Poecile atricapillus*) and Golden-crowned Kinglet (*Regulus satrapa*) are generalists and can be found in a diversity of habitats. Others, like the Varied Thrush (*Ixoreus naevius*) and Wilson's Snipe (*Gallinago delicata*), are specialists and require specific land cover types like continuous mature forest and wetlands, respectively. Habitat requirements for breeding landbirds are generally specific to each species. There are some general features that many species require, such as vegetation for foraging, nesting and cover, access to water and often mud for making nests, and access to wildlife trees for foraging, nesting, and perching (Morrisette, Cobb, Brigham, & James, 2002; Prior, Heimovics, & Soma, 2013).

Breeding bird surveys conducted as part of the bird community baseline program were undertaken to determine species richness, abundance, and diversity of breeding birds across a variety of land cover types in the LSA during the summer breeding season. Species of conservation concern were also documented as part of the breeding bird surveys.

Common Nighthawk is a migratory, crepuscular (active at dawn and dusk), aerial insectivore bird species (COSEWIC, 2018). They occur and breed across Canada in a variety of open and partially open habitats, such as forest openings, rocky or sandy areas, bogs, and urban environments that contain suitable open areas for foraging and bare surfaces for ground-nesting (COSEWIC, 2018). Currently, this species is designated as Threatened under SARA (2002), Special Concern under COSEWIC (Environment and Climate Change Canada [ECCC], 2019) and is provincially yellow-listed (not-at-risk; BC CDC, 2009a). According to the Canadian Species at Risk Registry database, data suggests that Common Nighthawk experienced an 80% population decline across Canada between 1968 and 2005 (ECCC, 2019).

Common Nighthawk Surveys were undertaken to determine if this species is present and using habitat within the LSA.

3.1.2 Methods

3.1.2.1 Study Design

Point count surveys were selected as the main method by which to document breeding landbirds as it is a common technique that allows for consistent, comparable, comprehensive, and extensive coverage to assess the richness and relative abundance of forest birds (Bart, 2005). Breeding bird surveys followed the following guidelines and standards:

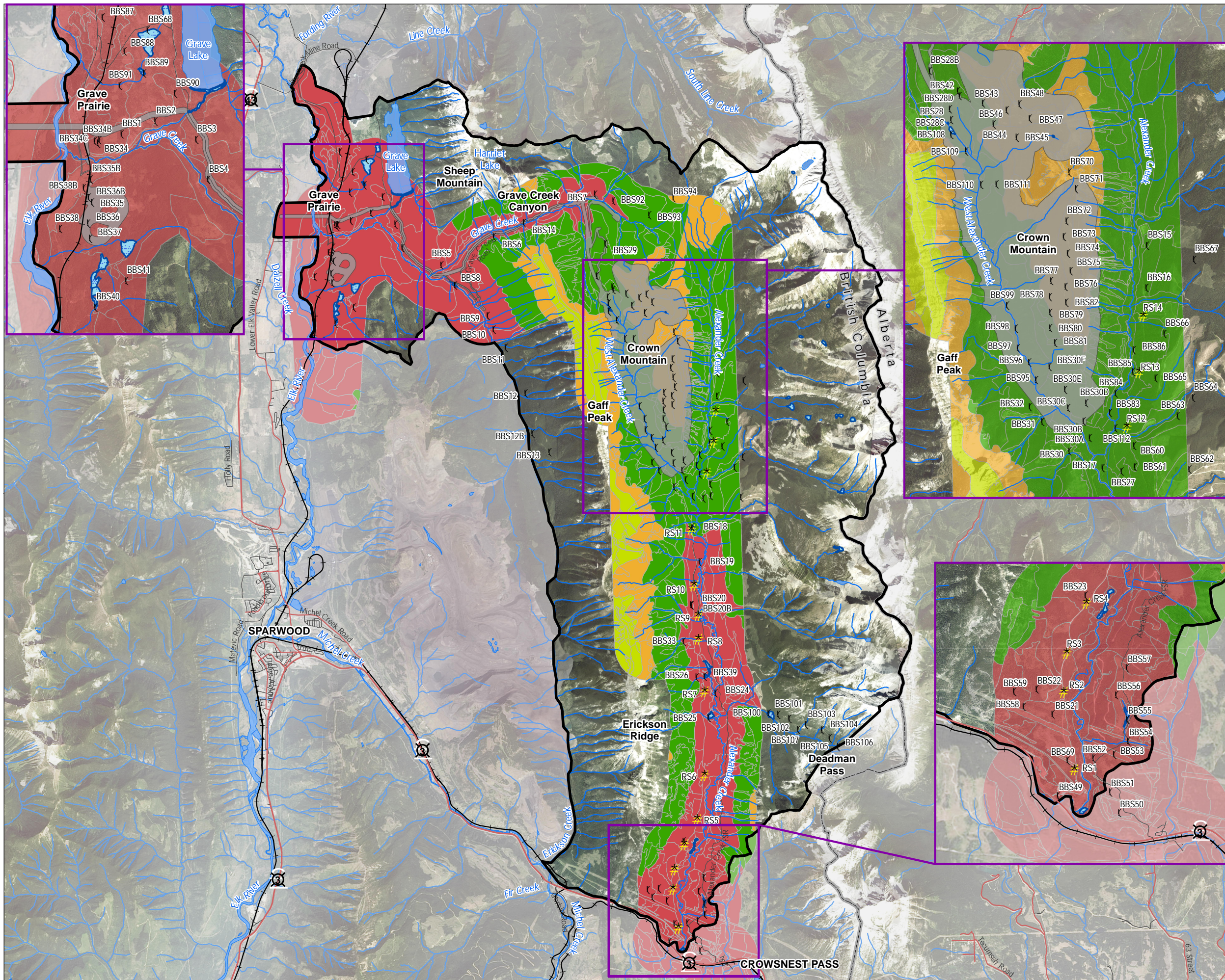
- *Inventory Methods for Forest and Grassland Songbirds* (Ministry of Environment, Lands and Parks, 1999a);
- *Handbook of Field Methods for Monitoring Landbirds* (Ralph, Geupel, Pyle, Martin, & DeSandte, 1993); and,
- *Monitoring Bird Populations by Point Counts* (Ralph, Sauer, & Droege, 1995).

The point counts surveys were circular plots with a 75 m radius and 25 m radius bands. Each survey was conducted for seven minutes and observations were recorded on a standard survey form (blank form provided in **Appendix A1**). Surveys were conducted under optimal weather conditions, within acceptable weather conditions as per Resources Inventory Standards Committee (RISC) guidelines: no rain or snow, calm winds, and temperatures greater than 3°C (Ministry of Environment, Lands and Parks, 1999a). Habitat data were collected at each location and included the dominant land cover type (forest, grassland, wetland, alpine, avalanche chute, mixed-shrub forest, rocky outcrop, cutblock), canopy type (coniferous, deciduous, or mixed), and structural stage (old, mature, immature, and sapling). The movements of individual birds were carefully monitored to minimize the probability of double-counting. Documentation of incidental bird observations, those seen within the point count before and after the seven minute period, were also recorded. Incidental observations of landbirds between survey locations and during other surveys were recorded and georeferenced.

Available orthoimagery, watershed information from the *Freshwater Atlas* (GeoBC, 2019), and the BC Biogeoclimatic Ecosystem Classification (BEC) were used to determine broad land cover types within the LSA and guide the location of point count locations (**Figure 3-1**). The four BEC subzones within the LSA targeted for the breeding bird surveys include: Dry Warm Montane Spruce (MSdw); Elk Dry Cool Engelmann Spruce-Subalpine Fir (ESSFdk1); Dry Cool Woodland Engelmann Spruce Subalpine Fir (ESSFdkw); and Dry Cool Parkland Engelmann Spruce-Subalpine Fir (ESSFdkp; Keefer Ecological Services Ltd., 2020). Project-specific BEC information was based on the Terrestrial Ecosystem Mapping (TEM) completed by Keefer Ecological Services Ltd. (2020), which was based on a one km buffer from the Project footprint. Where necessary, provincially-available TEM data (Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2018) was used to determine the BEC of some point count survey locations. Due to high elevation and restricted access, no surveys were conducted within the Dry Cool Parkland Engelmann Spruce-Subalpine Fir Subzone (ESSFdkp).

A total of 228 breeding bird surveys (BBS) were completed at 124 locations using a variable-radius point count (point count) survey locations approach in June and early July (up to July 10) of 2014, 2017, 2018, and 2019. Surveys were completed across broad land cover types and BEC subzones within the LSA (**Figure 3-1; Table 3-1**), though two surveys (BBS 50 and 51) were completed outside the LSA during initial site reconnaissance. Point count survey locations were a minimum of 250 m apart from one another and were at least 50 m away from roads (where possible). Survey locations were established at many accessible wetlands within the LSA as these ecosystems are known to have higher abundances and diversities of breeding birds (Weller, 1998). In addition to the point count surveys, 14 roadside surveys were also conducted in 2014 during initial site reconnaissance. Roadside survey locations were adjacent to roads and otherwise followed all the same methods as the point counts. The roadside surveys were not repeated.

Of the 138 point count and roadside survey locations, single surveys were completed at 80 locations and replicates were completed at 58 locations (15 survey locations with one replicate; 40 survey locations with 2 replicates; and 3 survey locations with 3 replicates). Some survey locations were considered to be of low value and were not revisited. Twenty-eight survey locations were added in 2019; within year and multi-year replications of these locations were not conducted.



Crown Mountain Coking Coal Project

FIGURE 3-1.
Breeding Bird Survey Point Count Locations

LEGEND

- Point Count Survey Location
- Roadside Survey Location
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- BC/Alberta Border

Biogeoclimatic Ecosystem Classification

- ESSFdk1
- ESSFdkp
- ESSFdkw
- MSdw



Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited, TEM Provided by Keefer Ecological Services Ltd.

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-17

File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Bird\126231 Baseline Bird Breeding Bird Survey Point Count Locations.mxd

Table 3-1: Point Count Survey Effort for Land Cover Types in each BEC Subzone

BEC Subzone and Land Cover Types	No. Survey Locations	No. Surveys (Includes Replicates)
MSdw		
Avalanche Chute	1	3
Cutblock	9	17
Forest	38	85
Grassland	4	9
Mixed Shrub Forest	8	16
Wetland	7	19
Sub-total for BEC subzone	67	149
ESSFdk1		
Avalanche Chute	1	2
Cutblock	2	2
Forest	46	61
Rocky Outcrop	1	2
Wetland	4	4
Sub-total for BEC subzone	55	72
ESSFdkw		
Alpine	2	2
Forest	14	19
Subtotal for BEC subzone	16	21
All		
Forest	98	165
Cutblock	11	19
Alpine	2	2
Avalanche Chute	3	6
Grassland	4	9
Mixed Shrub Forest	8	16
Rocky Outcrop	1	2
Wetland	11	23
Total	138	242

3.1.2.2

Data Analysis**Breeding Bird Populations**

To support an understanding of bird communities and individual species within the LSA, metrics to quantify bird abundance, species richness, and species diversity were calculated. For the breeding bird surveys, these metrics were calculated for each point count location. Where two or more replicate surveys were conducted at a point count location, the averages and standard errors (SE) for each metric were reported. Incidental observations were not included in the population metrics.

Relative abundance is defined as the number of individual birds observed per unit of area (Gaines, Harrod, & Lehmkuhl, 1999). The relative abundance of breeding birds was estimated based on the number of birds detected at each point count survey location. Species richness refers to the number of bird species present in a given area (Gaines et al., 1999). Species richness was tallied for each point count survey location.

Diversity can be calculated using the relative abundance, species richness, and species abundance (evenness) for a given area (Gaines et al., 1999). Evenness is the degree to which species are equally abundant (Rietz & Wing, 1999). The Shannon-Weiner Diversity Index, or “Shannon’s H”, was used to consider both the richness and the evenness of the species present and is a widely used metric for quantifying diversity (Rosenzweig, 1995). The Shannon-Weiner Diversity Index (H) was calculated using the following equation:

$$H = -\sum_{i=1}^s p_i \ln p_i \quad \text{Or} \quad H' = -\sum_{i=1}^s \frac{n_i}{N} \ln \frac{n_i}{N}$$

In the above equations, **H'** is the Diversity Index, **P_i** is the proportion of each species in the sample, **lnP_i** is the natural logarithm of this proportion, and **S** is the total number of species in a community. The value of the Shannon-Weiner Diversity Index typically falls between 1.5 and 3.5 and only rarely surpasses 4.5 (Gaines et al., 1999). A value near 4.6 indicates that the numbers of individuals are evenly distributed between all the species (Bibi & Ali, 2013).

Land Cover Associations

Land cover associations for the documented breeding birds were determined throughout the LSA, for each BEC subzone, and for the dominant land cover types determined to be present within the LSA during the point count surveys and the TEM (Keefer Ecological Services Ltd., 2020). The TEM was developed using the Biogeoclimatic Ecosystem Classification (BEC) system and through consultation with a BC Ministry of Forest Lands, Natural Resource Operation and Rural Development (MFLNRO) regional ecologist. **Figure 3-1** shows the point count survey locations as they fall within the BEC subzones in the LSA.

For each point count location, bird species abundance, richness, and diversity were determined by BEC subzone. As well, the matrices were determined for each broad land cover type, including forest, cutblock, wetland, mixed shrub forest, grassland, avalanche chute, rocky outcrop, and alpine. **Table 3-1** outlines the number of point count surveys conducted in each BEC subzone and land cover type.

3.1.2.3 Common Nighthawk Survey Methods

Common Nighthawk surveys within the LSA were completed in 2018 in general accordance with the *Canadian Nightjar Survey Protocol* (Knight, 2018). However, survey timing followed the Saskatchewan Ministry of Environment *Common Nighthawk Survey Protocol* (2015) and *Sensitive Species Inventory Guidelines* (Alberta Environment and Sustainable Resource Development - Wildlife Management, 2013), whereby surveys commenced one hour before sunset and ended half an hour after sunset, resulting in a total survey window of one and a half hours (rather than 30 minutes prior to sunset, resulting in a total survey window of approximately two hours, as recommended in the *Canadian Nightjar Survey Protocol* [Knight, 2018], or at sunset as per the *Government of BC Inventory Methods for Nighthawk and Poorwill* [Ministry of Environment, Lands, and Parks, 1998]). This timing increased the survey window to observe Common Nighthawk during peak periods of activity. Surveys were conducted during the nightjar breeding season between June 15 and July 15 during periods of calm weather (i.e., no rain, high winds, or thunderstorms; Knight, 2018).

A total of 16 point count locations, located a minimum of 1.6 km apart, were surveyed for Common Nighthawk on June 30 and July 5, 2018. At each of the 16 point count locations, the surveys consisted of a six minute observation period for Common Nighthawk. Weather conditions were also recorded, including temperature, wind speed and direction, cloud cover, visibility of the moon, and noise levels. Habitat information was also collected at each point count location. Incidental observations of Common Nighthawk were also recorded during all other bird and wildlife surveys that occurred within the LSA in 2014, 2017, 2018, and 2019 (see **Table 2-2** in **Section 2.0** for a list of the dates for all surveys conducted within the LSA).

3.1.3 Results

3.1.3.1 Breeding Bird Populations

Within the breeding bird windows of June and July, 2014 and 2017 to 2019, a total of 2,088 individual birds of 80 species were observed; 72 species during point count surveys and 8 additional species incidentally (**Table 3-2**; see **Appendix A2** and **A3** for detailed survey results). The six most frequently encountered species across the survey years were Swainson's Thrush (*Catharus ustulatus*), Pine Siskin (*Spinus pinus*), Yellow-rumped Warbler (*Setophaga coronate*), Dark-eyed Junco (*Junco hyemalis*), Townsend's Warbler (*Setophaga townsendi*), and Warbling Vireo (*Vireo gilvus*).

There were 12 species that were seen over 50 times during the point count surveys (not including incidentals), 13 species were observed between 20 and 50 times, 7 species were observed between 10 and 20 times, 40 species were observed under 10 times, and 8 species were observed only incidentally and never during point count surveys. The species incidentally observed included Mountain Bluebird (*Sialia currucoides*), Calliope Hummingbird (*Selasphorus calliope*), Barn Swallow, Barred Owl (*Strix varia*), Common Nighthawk, European Starling (*Sturnus vulgaris*; exotic species), Great Horned Owl (*Bubo virginianus*), and Harlequin Duck.

Two SARA-listed (2002) and provincially blue-listed species were observed, Barn Swallow and Olive-sided Flycatcher (**Table 3-2**). One Barn Swallow was observed incidentally in July 2018, along with several other species of swallow, near the Sparwood Rifle Range across Alexander Creek from wetland 1 in the south of the LSA (**Figure 3-2**). Olive-sided Flycatcher were observed throughout the LSA (**Figure 3-2**).

Species that are federally-listed under SARA (2002), but provincially yellow-listed, included Common Nighthawk and Evening Grosbeak (*Coccothraustes vespertinus*). Common Nighthawk are discussed in more detail in **Section 3.1.3.3**. Great Blue Heron (*Ardea herodias*) is provincially blue-listed, but is not listed under SARA (2002).

Table 3-2: Breeding Birds Observed During Point Count Surveys or Incidentally

Common Name	Scientific Name	Conservation Status (Federal; Provincial)	No. Observations	No. Incidental Observation	Total No. Observed
American Dipper	<i>Cinclus mexicanus</i>	Yellow	1	0	1
American Robin	<i>Turdus migratorius</i>	Yellow	80	7	87
American Three-toed Woodpecker	<i>Picoides dorsalis</i>	Yellow	1	0	1
Barn Swallow	<i>Hirundo rustica</i>	SARA 1-T; Blue	0	1	1
Barred Owl	<i>Strix varia</i>	Yellow	0	1	1
Black-capped Chickadee	<i>Poecile atricapillus</i>	Yellow	1	1	2
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Yellow	1	0	1
Boreal Chickadee	<i>Poecile hudsonica</i>	Yellow	15	3	18
Brown Creeper	<i>Certhia americana</i>	Yellow	1	0	1
Brown-headed Cowbird	<i>Molothrus ater</i>	Yellow	20	1	21

Common Name	Scientific Name	Conservation Status (Federal; Provincial)	No. Observations	No. Incidental Observation	Total No. Observed
Calliope Hummingbird	<i>Selasphorus calliope</i>	Yellow	0	2	2
Canada Goose	<i>Branta canadensis</i>	Yellow	1	1	2
Cassin's Finch	<i>Carpodacus cassinii</i>	Yellow	2	0	2
Cassin's Vireo	<i>Vireo cassinii</i>	Yellow	12	3	15
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Yellow	5	3	8
Chipping Sparrow	<i>Spizella passerina</i>	Yellow	36	7	43
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Yellow	1	0	1
Common Loon	<i>Gavia immer</i>	Yellow	1	0	1
Common Nighthawk	<i>Chordeiles minor</i>	SARA 1-T; Yellow	0	1	1
Common Raven	<i>Corvus corax</i>	Yellow	27	3	30
Common Yellowthroat	<i>Geothlypis trichas</i>	Yellow	3	0	3
Dark-eyed Junco	<i>Junco hyemalis</i>	Yellow	114	5	119
Downy Woodpecker	<i>Picoides pubescens</i>	Yellow	2	0	2
European Starling	<i>Sturnus vulgaris</i>	Exotic	0	1	1
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	SARA 1-SC; Yellow	2	2	4
Fox Sparrow	<i>Passerella iliaca</i>	Yellow	6	1	7
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Yellow	63	7	70
Gray Jay	<i>Perisoreus canadensis</i>	Yellow	7	6	13
Great Blue Heron	<i>Ardea herodias</i>	Blue	2	0	2
Great Horned Owl	<i>Bubo virginianus</i>	Yellow	0	1	1
Hammond's Flycatcher	<i>Empidonax hammondii</i>	Yellow	20	4	24
Harlequin Duck	<i>Histrionicus histrionicus</i>	Yellow	0	1	1
Hairy Woodpecker	<i>Picoides villosus</i>	Yellow	8	3	11
Hermit Thrush	<i>Catharus guttatus</i>	Yellow	85	16	101
House Wren	<i>Troglodytes aedon</i>	Yellow	2	0	2
Least Flycatcher	<i>Empidonax minimus</i>	Yellow	4	2	6

Common Name	Scientific Name	Conservation Status (Federal; Provincial)	No. Observations	No. Incidental Observation	Total No. Observed
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	Yellow	20	1	21
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	Yellow	51	2	53
Marsh Wren	<i>Cistothorus palustris</i>	Yellow	1	0	1
Mountain Bluebird	<i>Sialia currucoides</i>	Yellow	0	3	3
Mountain Chickadee	<i>Poecile gambeli</i>	Yellow	31	11	42
Northern Flicker	<i>Colaptes auratus</i>	Yellow	8	3	11
Northern Waterthrush	<i>Parkesia noveboracensis</i>	Yellow	28	2	30
Olive-sided Flycatcher	<i>Contopus cooperi</i>	SARA 1-T; Blue	36	27	63
Orange-crowned Warbler	<i>Oreothlypis celata</i>	Yellow	32	2	34
Pacific Wren	<i>Troglodytes pacificus</i>	Yellow	24	3	27
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	Yellow	1	0	1
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Yellow	2	5	7
Pine Grosbeak	<i>Pinicola enucleator</i>	Yellow	6	1	7
Pine Siskin	<i>Carduelis pinus</i>	Yellow	178	3	181
Purple Finch	<i>Carpodacus purpureus</i>	Yellow	2	0	2
Red Crossbill	<i>Loxia curvirostra</i>	Yellow	24	0	24
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Yellow	62	6	68
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	Yellow	9	5	14
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Yellow	5	1	6
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Yellow	16	0	16
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Yellow	78	6	84
Ruffed Grouse	<i>Bonasa umbellus</i>	Yellow	15	3	18

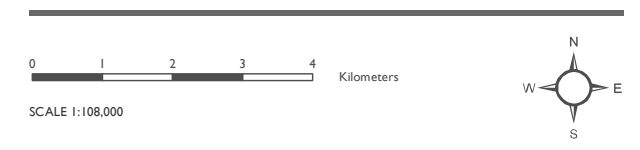
Common Name	Scientific Name	Conservation Status (Federal; Provincial)	No. Observations	No. Incidental Observation	Total No. Observed
Rufous Hummingbird	<i>Selasphorus rufus</i>	Yellow	4	4	8
Song Sparrow	<i>Melospiza melodia</i>	Yellow	7	1	8
Sora	<i>Porzana carolina</i>	Yellow	6	0	6
Spotted Sandpiper	<i>Actitis macularius</i>	Yellow	3	1	4
Spruce Grouse	<i>Falciennis canadensis</i>	Yellow	2	0	2
Swainson's Thrush	<i>Catharus ustulatus</i>	Yellow	182	7	189
Tennessee Warbler	<i>Oreothlypis peregrina</i>	Yellow	4	0	4
Townsend's Solitaire	<i>Myadestes townsendi</i>	Yellow	4	12	16
Townsend's Warbler	<i>Setophaga townsendi</i>	Yellow	109	2	111
Tree Swallow	<i>Tachycineta bicolor</i>	Yellow	9	1	10
Unidentified Chickadee	-	-	3	0	3
Unidentified Flycatcher Species	-	-	1	0	1
Unidentified Hummingbird	-	-	3	0	3
Unidentified Songbird Species	-	-	4	0	4
Unidentified Woodpecker Species	-	-	2	0	2
Varied Thrush	<i>Ixoreus naevius</i>	Yellow	46	7	53
Vesper's Sparrow	<i>Poocetes gramineus</i>	Yellow	3	0	3
Violet-green Swallow	<i>Tachycineta thalassina</i>	Yellow	5	2	7
Warbling Vireo	<i>Vireo gilvus</i>	Yellow	106	3	109
Western Tanager	<i>Piranga ludoviciana</i>	Yellow	18	3	21
Western Wood-pewee	<i>Contopus sordidulus</i>	Yellow	13	0	13
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Yellow	7	2	9
White-winged Crossbill	<i>Loxia leucoptera</i>	Yellow	8	2	10

Common Name	Scientific Name	Conservation Status (Federal; Provincial)	No. Observations	No. Incidental Observation	Total No. Observed
Willow Flycatcher	<i>Empidonax traillii</i>	Yellow	17	1	18
Wilson's Warbler	<i>Cardellina pusilla</i>	Yellow	33	2	35
Yellow Warbler	<i>Setophaga petechia</i>	Yellow	6	0	6
Yellow-rumped Warbler	<i>Setophaga coronata</i>	Yellow	130	9	139
Total			1,887	201	2,088

FIGURE 3-2.
Species of Conservation Concern Observations

LEGEND

- Survey Observation ○ Incidental Observation
- Barn Swallow
- Common Nighthawk
- Evening Grosbeak
- Great Blue Heron
- Olive-sided Flycatcher
- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- ▭ BC/Alberta Border

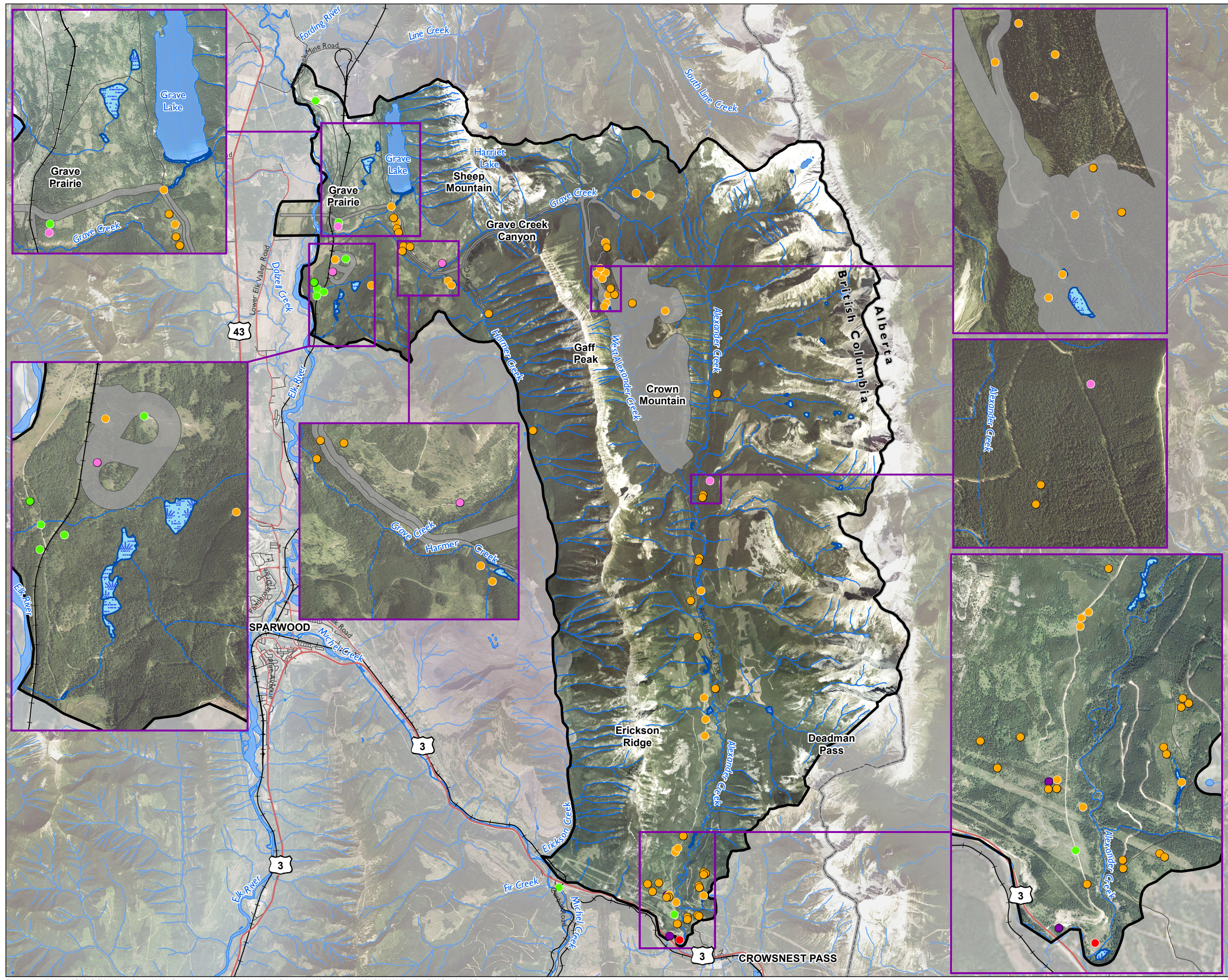


Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-20



Breeding landbirds were observed at all 138 point count survey locations. The relative abundance across the survey locations ranged from 1 to 39 birds, with an average abundance \pm SE of 7.8 ± 0.3 across all locations (**Table 3-3; Appendix A4**). In general, the Grave Prairie area, west of Grave Lake, and Alexander Creek (mainstem) had the highest average relative abundance (**Figure 3-3**). The highest relative abundance (39) occurred at survey location BBS36B in the Grave Prairie area in June 2017. The average relative abundance across the 2 visits to BBS36B in 2017 was 25.0 ± 14.0 (**Appendix 4**). Survey location BBS108 also had a high abundance (28), although this location was only surveyed once in July 2019. There were two point count locations at which a single species was observed, BBS65 above the Alexander Creek confluence with West Alexander, and BBS70 near the peak of Crown Mountain. Surveys were only conducted once at these locations.

The species richness ranged from 1 to 14, with an average richness of 5.9 ± 0.2 across the 138 point count survey locations (**Table 3-3; Appendix A4**). In general, the Grave Prairie area, west of Grave Lake, and Alexander Creek (mainstem) had the highest average species richness (**Figure 3-3**). The highest species richness (14) occurred at BBS20, located in the mainstem of Alexander Creek, in July 2017. The average richness for BBS20 across three replicate surveys in 2014 and 2017 was 10.0 ± 6.8 (**Appendix A4**). The survey locations with the lowest recorded species richness (1) across all survey years were BBS65 (2014) and BBS70 (2018).

The average Shannon-Weiner Diversity Index across all point survey locations ranged from 0 to 2.60, with an average of 1.59 ± 0.03 (**Table 3-3; Appendix A4**). The highest diversity (2.60) occurred at BBS25 along Alexander Creek to the east of Erickson Ridge. The survey location with the highest average diversity index across replicate surveys was BBS25 (2.42 ± 0.10) located in the Alexander Creek valley east of Erickson Ridge (**Appendix A4**). A result of 0 indicates that there was only one species observed at the point count surveys; this only occurred at two survey locations (BBS65 and BBS70). Out of the 138 point count survey locations, 79 (57.2%) had a Shannon-Weiner Diversity Index value above 1.50 (**Appendix A4**). A Shannon-Weiner Diversity Index between 1.50 and 3.50 is within the typical range of most ecological studies (Gaines et al., 1999).

Table 3-3: Summary Statistics for the 138 Breeding Bird Point Count Survey Locations

Population Metric	Minimum (Location)	Maximum (Location)	Average Across All Locations
Relative Abundance	1 (BBS65, BBS70)	39 (BBS36B)	8.0
Species Richness	1 (BBS65, BBS70)	14 (BBS20)	6.0
Shannon-Weiner Diversity Index	0.00 (BBS65, BBS70)	2.60 (BBS25)	1.59

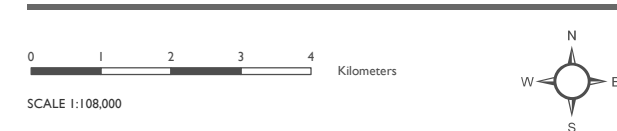
Crown Mountain Coking Coal Project

FIGURE 3-3.
Breeding Bird Average Relative Abundance
and Species Richness

LEGEND

Average Species Richness	Average Abundance
● 0 (No Birds Detected)	○ 0 (No Birds Detected)
● 0.1 - 2.9 (Lowest)	○ 0.1 - 7.9 (Lowest)
● 3 - 5.9	○ 8 - 15.9
● 6 - 8.9	○ 16 - 23.9
● 9 - 12.9 (Highest)	○ 24 - 31.9 (Highest)

▭ Terrestrial Local Study Area	○ BC/Alberta Border
▭ Project Footprint	
— Highways	
— Arterial Roads	
— Local/Resource Roads	
— Railway (Canadian Pacific)	
— Watercourse	
■ Waterbody	
■ Wetland	
▭ BC/Alberta Border	

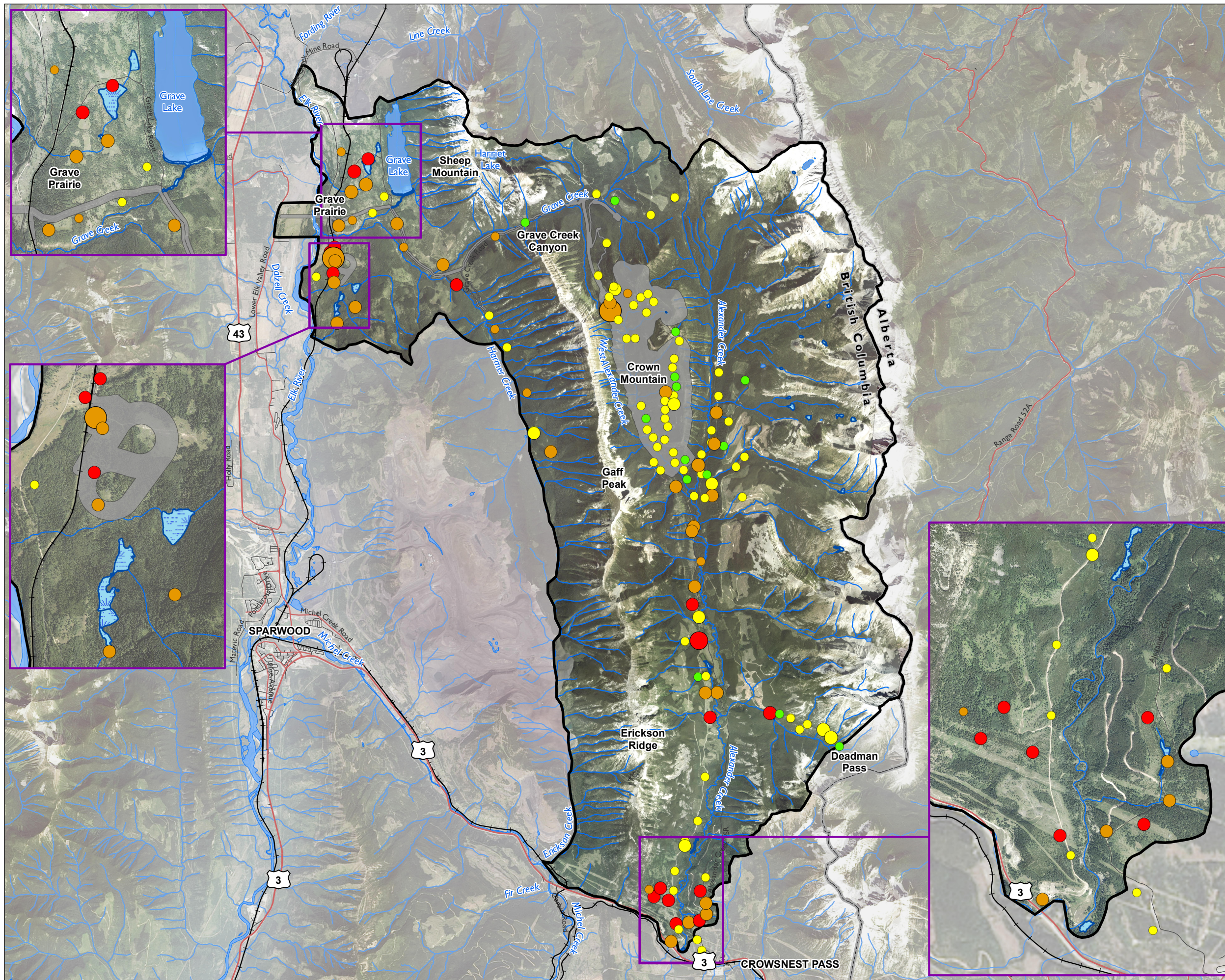


Map Drawing Information: Data Provided by
Province of British Columbia, NWP Coal Canada Ltd.,
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3.1.3.2 Land Cover Associations

The BEC subzone with the highest average relative abundance (9.1 ± 0.4), species richness (6.9 ± 0.2), and Shannon-Weiner Diversity Index (1.74 ± 0.04) was MSdw (**Table 3-4; Figure 3-4; Appendix A5**). Relative abundance ranged from 1 to 39 birds; species richness ranged from 1 to 14; and diversity indices ranged from 0.00 to 2.60 across the MSdw subzone (**Appendix A5**). The ESSFdk1 subzone had the second highest average relative abundance (6.0 ± 0.4), species richness (4.5 ± 0.2), and Shannon-Weiner Diversity Index (1.37 ± 0.05), and ESSFdkw had the lowest average relative abundance, species richness, and diversity (5.1 ± 0.5 , 4.0 ± 0.4 , and 1.25 ± 0.10 , respectively; **Figure 3-4**).

The most abundant species in the MSdw subzone included Swainson's Thrush (131), Pine Siskin (103), Warbling Vireo (93), and Yellow-rumped Warbler (85; **Table 3-4**). The most abundant species in the ESSFdk1 subzone included Pine Siskin (52), Swainson's Thrush (49), Hermit Thrush (*Catharus guttatus*; 41), and Townsend's Warbler (36). The most abundant species in the ESSFdkw subzone included Hermit Thrush (25) and Pine Siskin (23).

Table 3-4: Number of Individual Breeding Birds Observed Across BEC Subzones

Species	Biogeoclimatic Subzone			Total
	MSdw	ESSFdk1	ESSdkw	
American Dipper	0	1	0	1
American Robin	75	5	0	80
American Three-toed Woodpecker	0	1	0	1
Black-capped Chickadee	1	-	0	1
Black-headed Grosbeak	1	0	0	1
Boreal Chickadee	12	2	1	15
Brown Creeper	0	1	0	1
Brown-headed Cowbird	20	0	0	20
Canada Goose	1	0	0	1
Cassin's Finch	1	0	1	2
Cassin's Vireo	11	1	0	12
Cedar Waxwing	5	0	0	5
Chipping Sparrow	29	7	0	36
Clark's Nutcracker	0	0	1	1
Common Loon	1	0	0	1
Common Raven	24	2	1	27
Common Yellowthroat	3	0	0	3

Species	Biogeoclimatic Subzone			Total
	MSdw	ESSFdk1	ESSdkw	
Dark-eyed Junco	74	30	10	114
Downy Woodpecker	2	0	0	2
Evening Grosbeak	2	0	0	2
Fox Sparrow	0	4	2	6
Golden-crowned Kinglet	42	21	0	63
Gray Jay	5	2	0	7
Great Blue Heron	2	0	0	2
Hammond's Flycatcher	18	2	0	20
Hairy Woodpecker	6	0	2	8
Hermit Thrush	19	41	25	85
House Wren	2	0	0	2
Least Flycatcher	4	0	0	4
Lincoln's Sparrow	20	0	0	20
MacGillivray's Warbler	43	8	0	51
Marsh Wren	1	0	0	1
Mountain Chickadee	21	5	5	31
Northern Flicker	8	0	0	8
Northern Waterthrush	26	2	0	28
Olive-sided Flycatcher	32	4	0	36
Orange-crowned Warbler	31	1	0	32
Pacific Wren	8	14	2	24
Pacific-slope Flycatcher	0	1	0	1
Pileated Woodpecker	2	0	0	2
Pine Grosbeak	1	0	5	6
Pine Siskin	103	52	23	178
Purple Finch	2	0	0	2
Red Crossbill	16	8	0	24
Red-breasted Nuthatch	42	12	8	62
Red-naped Sapsucker	8	1	0	9
Red-tailed Hawk	5	0	0	5
Red-winged Blackbird	16	0	0	16

Species	Biogeoclimatic Subzone			Total
	MSdw	ESSFdk1	ESSdkw	
Ruby-crowned Kinglet	63	12	3	78
Ruffed Grouse	12	3	0	15
Rufous Hummingbird	1	2	1	4
Song Sparrow	6	1	0	7
Sora	6	0	0	6
Spotted Sandpiper	3	0	0	3
Spruce Grouse	0	2	0	2
Swainson's Thrush	131	49	2	182
Tennessee Warbler	3	1	0	4
Townsend's Solitaire	0	3	1	4
Townsend's Warbler	73	36	0	109
Tree Swallow	8	1	0	9
Unidentified Chickadee	3	0	0	3
Unidentified Flycatcher Species	1	0	0	1
Unidentified Hummingbird	2	1	0	3
Unidentified Songbird Species	4	0	0	4
Unidentified Woodpecker Species	1	1	0	2
Varied Thrush	15	27	4	46
Vesper's Sparrow	2	1	0	3
Violet-green Swallow	5	0	0	5
Warbling Vireo	93	13	0	106
Western Tanager	17	1	0	18
Western Wood-pewee	13	0	0	13
White-crowned Sparrow	7	0	0	7
White-winged Crossbill	0	7	1	8
Willow Flycatcher	17	0	0	17
Wilson's Warbler	25	7	1	33
Yellow Warbler	6	0	0	6
Yellow-rumped Warbler	85	40	5	130
Total	1,347	436	104	1,887
No. Point Count Survey Replicates	149	72	21	242

Species	Biogeoclimatic Subzone			Total
	MSdw	ESSFdk1	ESSdkw	
Average Relative Abundance per Point Count Location	9.1	6.0	5.1	8.0

Note: Incidental observations not included.

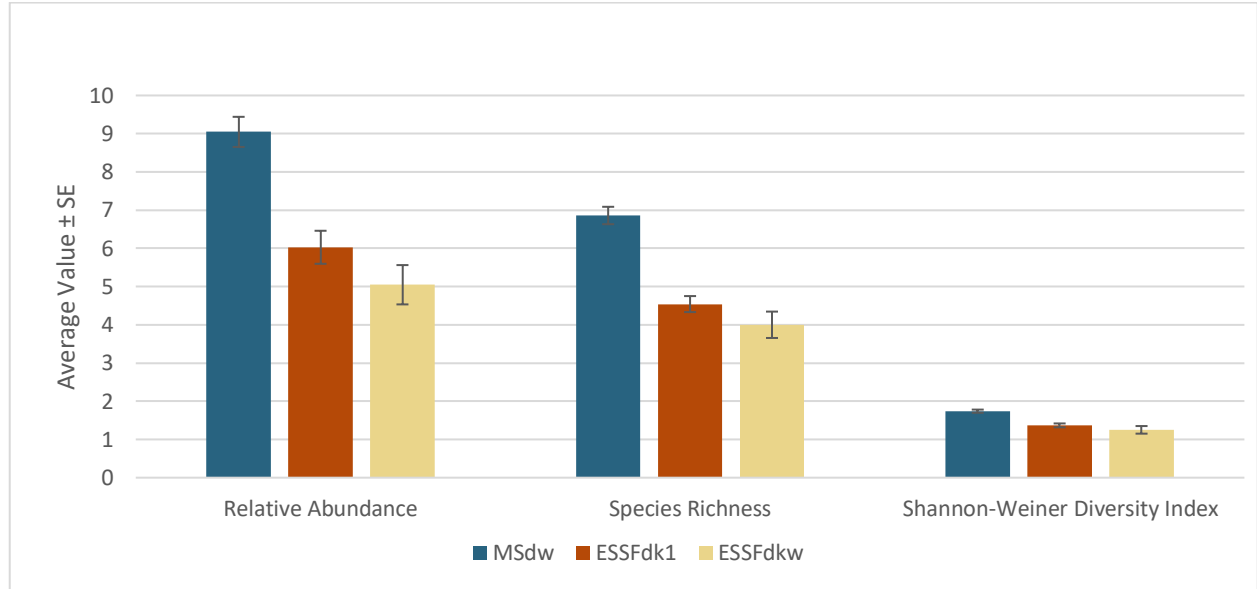


Figure 3-4: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index in Each BEC Subzone of the LSA for Breeding Landbirds

Breeding birds observed across land cover types are detailed in **Table 3-5**. The land cover type with the highest average relative abundance (12.4 ± 1.1) and species richness (9.3 ± 0.6) was grasslands (**Table 3-5; Table 3-6; Appendix A5**). Relative abundance ranged from 8 to 14 birds; species richness ranged from 7 to 12; and diversity ranged from 0.00 to 2.49 in grasslands (**Appendix A5**). Wetlands and cutblocks were the most diverse land cover types, with average Shannon-Weiner Diversity Indices of 1.96 ± 0.09 in both types, with ranges of 0.76 to 2.60 in wetlands and 1.04 to 2.44 in cutblocks (**Appendix A5**). Wetlands and mixed shrub forests were the second most abundant and species rich, followed by cutblocks. Avalanche chutes, forests, and rocky outcrops yielded moderate levels of relative abundance, species richness, and diversity, and alpine areas had the lowest levels of these metrics.

Forests were the most common land cover type across all BEC subzones and as a result, were also the land cover type with the most point count survey locations and replicates (**Table 3-1**). The forest land cover type encompassed coniferous, deciduous, and mixed forests, including immature and mature stages (**Appendix A2**).

Pine Siskin were the most abundant species in wetlands (30), mixed shrub forests (43), grasslands (13), and the alpine (2). Swainson’s Thrush (110) were the most abundant in forests, Dark-eyed

Junco (18) in cutblocks, Warbling Vireo and MacGillivray's Warbler (*Geothlypis tolmiei*; 5 each) in avalanche chutes, and American Robin (*Turdus migratorius*) in rocky outcrops (Table 3-5).

Table 3-5: Breeding Birds Observed Across Land Cover Types

Species	Land Cover Type								Total
	Alpine	Avalanche Chute	Cutblock	Forest	Grassland	Mixed Shrub Forest	Rocky Outcrop	Wetland	
American Dipper	0	0	0	1	0	0	0	0	1
American Robin	0	3	18	36	12	4	7	0	80
American Three-toed Woodpecker	0	0	0	1	0	0	0	0	1
Black-capped Chickadee	0	0	0	0	0	1	0	0	1
Black-headed Grosbeak	0	0	0	1	0	0	0	0	1
Boreal Chickadee	0	0	1	10	3	0	0	1	15
Brown Creeper	0	0	0	1	0	0	0	0	1
Brown-headed Cowbird	0	0	5	2	5	6	0	2	20
Canada Goose	0	0	0	0	0	1	0	0	1
Cassin's Finch	0	0	0	0	1	1	0	0	2
Cassin's Vireo	0	0	1	9	1	1	0	0	12
Cedar Waxwing	0	0	0	0	0	1	0	4	5
Chipping Sparrow	0	0	12	18	0	4	2	0	36
Clark's Nutcracker	0	0	0	1	0	0	0	0	1
Common Loon	0	0	0	1	0	0	0	0	1
Common Raven	0	0	1	14	2	9	0	1	27

Species	Land Cover Type								Total
	Alpine	Avalanche Chute	Cutblock	Forest	Grassland	Mixed Shrub Forest	Rocky Outcrop	Wetland	
Common Yellowthroat	0	0	0	0	0	0	0	3	3
Dark-eyed Junco	1	2	18	73	6	9	1	4	114
Downy Woodpecker	0	0	1	1	0	0	0	0	2
Evening Grosbeak	0	0	1	0	0	1	0	0	2
Fox Sparrow	0	1	0	4	0	0	0	1	6
Golden-crowned Kinglet	0	4	1	45	1	3	0	9	63
Gray Jay	0	0	1	4	1	0	0	1	7
Great Blue Heron	0	0	0	1	0	1	0	0	2
Hammond's Flycatcher	0	2	3	8	1	5	0	1	20
Hairy Woodpecker	0	0	2	5	1	0	0	0	8
Hermit Thrush	1	1	4	75	0	0	1	3	85
House Wren	0	0	0	0	0	1	0	1	2
Least Flycatcher	0	0	0	1	0	0	0	3	4
Lincoln's Sparrow	0	0	2	3	4	1	0	10	20
MacGillivray's Warbler	0	5	12	15	2	6	1	10	51
Marsh Wren	0	0	0	0	0	0	0	1	1
Mountain Chickadee	0	2	3	19	0	1	0	6	31
Northern Flicker	0	0	0	5	2	0	0	1	8
Northern Waterthrush	0	0	3	4	0	3	0	18	28

Species	Land Cover Type								Total
	Alpine	Avalanche Chute	Cutblock	Forest	Grassland	Mixed Shrub Forest	Rocky Outcrop	Wetland	
Olive-sided Flycatcher	0	0	13	19	2	1	0	1	36
Orange-crowned Warbler	0	0	8	9	2	9	0	4	32
Pacific Wren	0	0	0	23	0	0	0	1	24
Pacific-slope Flycatcher	0	0	0	1	0	0	0	0	1
Pileated Woodpecker	0	0	0	1	1	0	0	0	2
Pine Grosbeak	0	0	0	6	0	0	0	0	6
Pine Siskin	2	1	4	85	13	43	0	30	178
Purple Finch	0	0	1	1	0	0	0	0	2
Red Crossbill	0	0	2	18	2	2	0	0	24
Red-breasted Nuthatch	1	3	6	41	4	3	0	4	62
Red-naped Sapsucker	0	0	2	5	1	1	0	0	9
Red-tailed Hawk	0	0	1	2	1	0	0	1	5
Red-winged Blackbird	0	0	0	3	0	0	0	13	16
Ruby-crowned Kinglet	0	1	6	43	7	12	0	9	78
Ruffed Grouse	0	1	4	4	1	0	0	5	15
Rufous Hummingbird	0	2	0	2	0	0	0	0	4
Song Sparrow	0	0	0	2	0	2	0	3	7
Sora	0	0	0	0	0	0	0	6	6
Spotted Sandpiper	0	0	0	2	0	0	0	1	3
Spruce Grouse	0	0	0	0	0	0	2	0	2

Species	Land Cover Type								Total
	Alpine	Avalanche Chute	Cutblock	Forest	Grassland	Mixed Shrub Forest	Rocky Outcrop	Wetland	
Swainson's Thrush	0	4	11	110	10	25	1	21	182
Tennessee Warbler	0	0	0	0	0	1	0	3	4
Townsend's Solitaire	0	0	0	4	0	0	0	0	4
Townsend's Warbler	0	4	2	81	3	1	1	17	109
Tree Swallow	0	0	0	0	0	0	0	9	9
Unidentified Chickadee	0	0	0	1	0	2	0	0	3
Unidentified Flycatcher Species	0	0	0	0	0	0	0	1	1
Unidentified Hummingbird	0	0	1	0	0	0	1	1	3
Unidentified Songbird Species	0	0	1	3	0	0	0	0	4
Unidentified Woodpecker Species	0	0	0	2	0	0	0	0	2
Varied Thrush	0	0	3	37	0	0	0	6	46
Vesper's Sparrow	0	0	1	0	1	1	0	0	3
Violet-green Swallow	0	0	0	0	0	5	0	0	5
Warbling Vireo	0	5	16	50	9	12	2	12	106
Western Tanager	0	0	4	11	2	1	0	0	18
Western Wood-pewee	0	0	3	3	4	0	0	3	13
White-crowned Sparrow	0	0	0	3	3	0	0	1	7

Species	Land Cover Type								Total
	Alpine	Avalanche Chute	Cutblock	Forest	Grassland	Mixed Shrub Forest	Rocky Outcrop	Wetland	
White-winged Crossbill	0	0	0	8	0	0	0	0	8
Willow Flycatcher	0	0	1	4	0	0	0	12	17
Wilson's Warbler	0	2	2	18	1	2	0	8	33
Yellow Warbler	0	0	0	0	0	2	0	4	6
Yellow-rumped Warbler	0	4	15	93	2	3	2	11	130
Total	5	47	196	1,053	111	187	21	267	1,887
No. Point Count Survey Replicates	2	6	19	165	9	16	2	23	242
Average Relative Abundance per Point Count Location	2.5	7.8	10.3	6.4	12.4	11.7	6.0	12.0	8.0

*Note: Incidental observations not included.

Table 3-6: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index Across the Eight Dominant Land Cover Types in the LSA

Land Cover Type	No. Replicate Surveys	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
Alpine	2	2.5	2.5	0.69
Avalanche Chute	6	7.8	6.2	1.76
Cutblock	19	10.3	8.0	1.96
Forest	165	6.4	5.0	1.46
Grassland	9	12.4	9.3	1.90
Mixed Shrub Forest	16	11.7	7.3	1.77

Land Cover Type	No. Replicate Surveys	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
Rocky Outcrop	2	6.0	5.0	1.56
Wetland	23	12.0	8.4	1.96

Across the three BEC subzones, wetlands in the ESSFdk1 subzone had the greatest average relative abundance (**Figure 3-5**), grasslands in the MSdw subzone had the greatest species richness (**Figure 3-6**), and wetlands in the MSdw subzone had the greatest Shannon-Weiner Diversity Index (**Figure 3-7**). The average relative bird abundance in the dominant land cover types ranged from 2.5 birds to 13.0 birds observed per point count (**Figure 3-5, Appendix A5**). The average species richness in the dominant land cover types ranged from 2.5 species to 9.3 species observed per point count (**Figure 3-6**). The average Shannon-Weiner Diversity Index values in the dominant land cover types ranged from 0.69 to 2.05 (**Figure 3-7**).

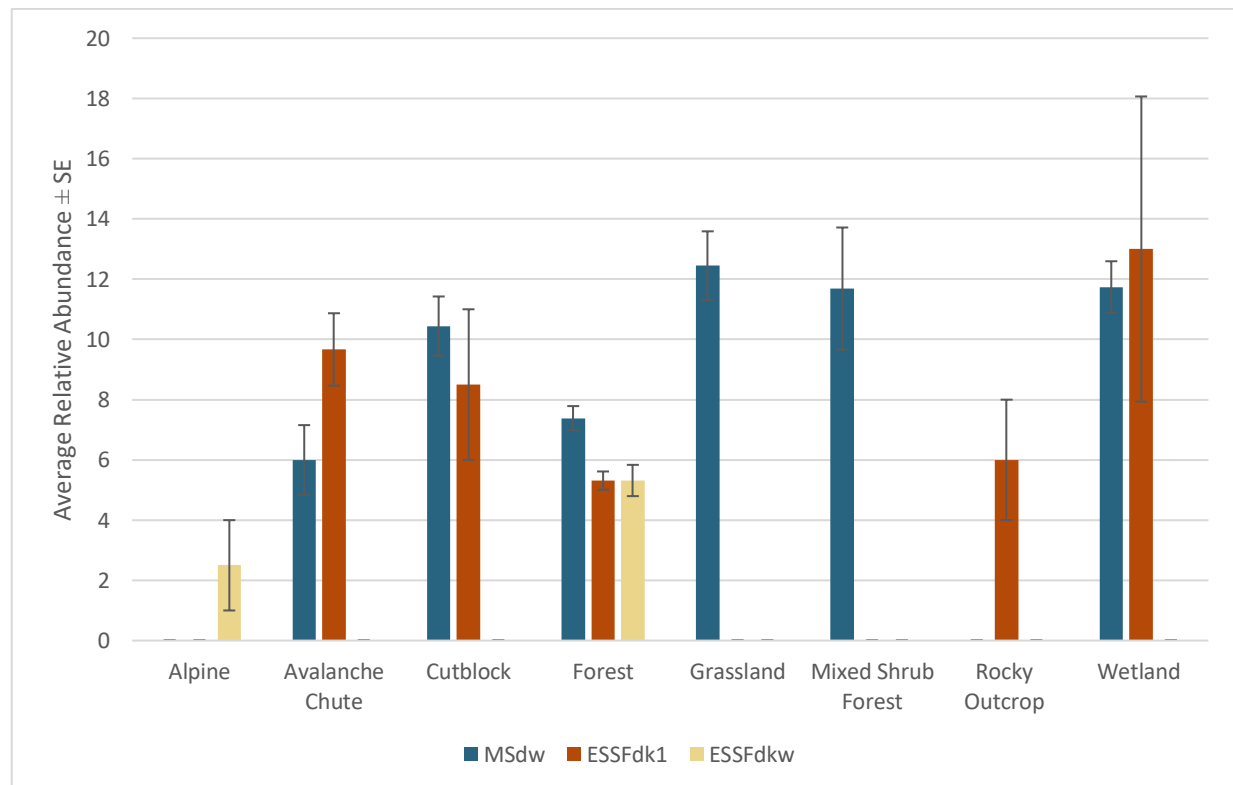


Figure 3-5: Average Relative Abundance of Breeding Landbirds for Each Land Cover Type within Each BEC Subzone

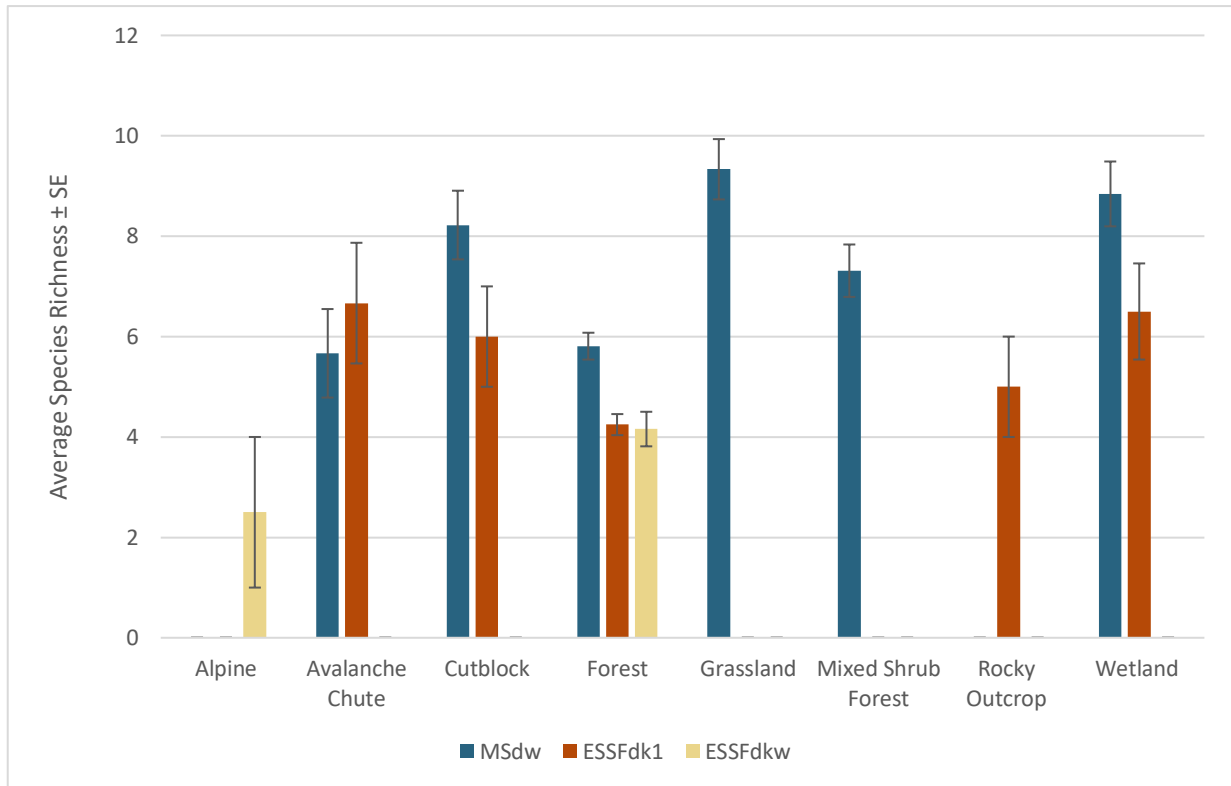


Figure 3-6: Average Species Richness of Breeding Landbirds for Each Land Cover Type within Each BEC Subzone

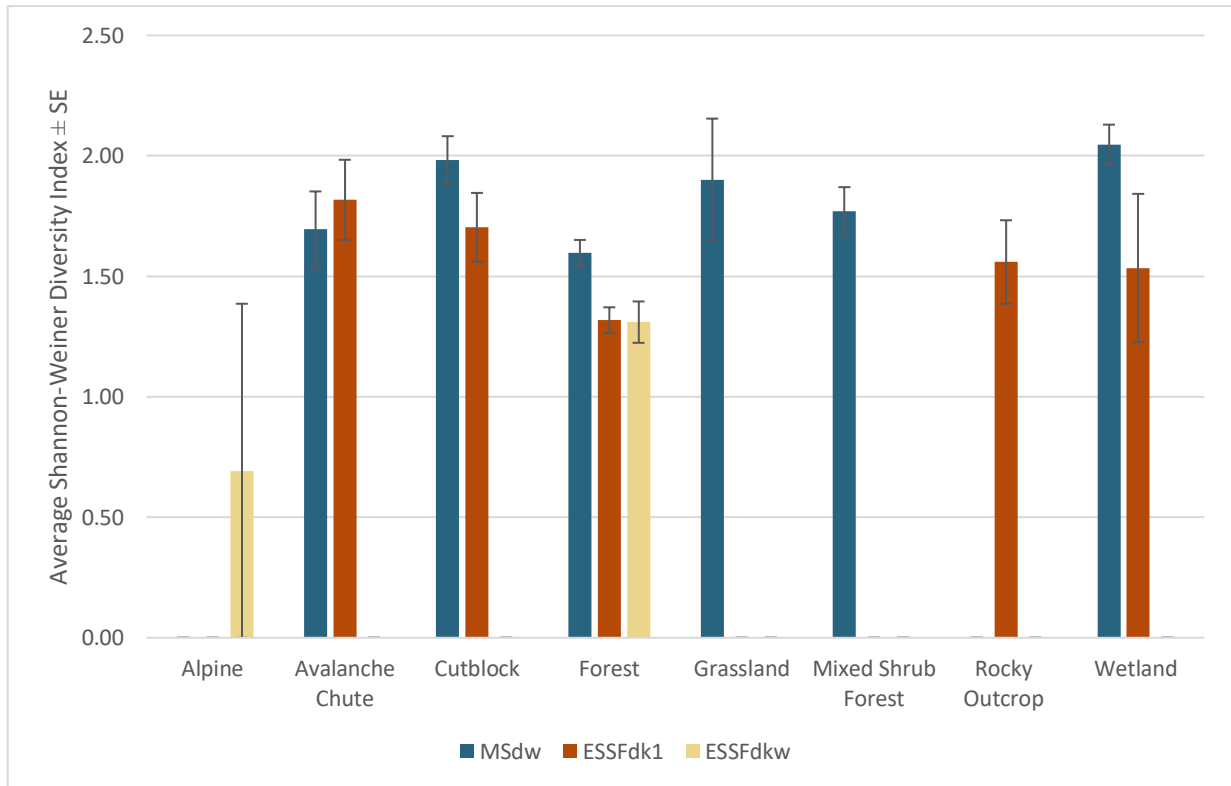


Figure 3-7: Average Breeding Bird Shannon-Weiner Diversity Index for Each Land Cover Type within Each BEC Subzone

3.1.3.3

Common Nighthawk Survey Results

One Common Nighthawk was observed during the 16 point count surveys conducted in 2018. The single Common Nighthawk, flying west to east over trees, was observed on June 30, 2018 approximately 100 m north of point count location CN2, a survey location approximately 160 m south of the Grave Prairie area. At the same location in July 2019, three more Common Nighthawk were incidentally observed to be foraging above the road.

A total of nine Common Nighthawk were incidentally observed within the LSA during the 2014, 2018, and 2019 field studies, as summarized in **Table 3-7** and shown in **Figure 3-2**. No Common Nighthawk were incidentally observed during baseline surveys conducted in 2017. Overall, observations generally occurred at low elevations in the valleys along southern Alexander Creek, along the Elk River, and in the lower reaches of Grave Creek. All observations occurred in or adjacent to open habitat. All Common Nighthawk observed were actively foraging, with one exception of the observation on July 9, 2018 in which the individual was exhibiting “booming” behaviour.

Land cover at the 2018 Common Nighthawk survey point count locations and at the locations where incidental observations occurred generally appeared to be suitable habitat for Common Nighthawk (**Table 3-7**). Survey details and raw observation data are provided in **Appendix A6**. Suitable habitat

observed included natural (e.g., large wetlands) and anthropogenic (e.g., clear-cut) open areas for foraging and/or nesting, and trees in semi-open areas for roosting.

Table 3-7: Common Nighthawk Observations within the LSA

Observation No.	Date	Location	Observation Type	No. Individuals Observed	Behaviour	Land Cover
1	June 28, 2014	Grave Prairie, Elk River Valley 11U 653250, 5527273	Incidental	1	Foraging	Grassland
2	June 29, 2014	Grave Prairie, Elk River Valley 11U 653905, 5523714	Incidental	1	Foraging	Grassland/Mature Forest
3	June 30, 2018	Grave Prairie, Elk River Valley 11U 653217, 5521967	CN Point Count (CN2)	1	Foraging	Clearing
4	May 3, 2018	Grave Prairie, Elk River Valley 11U 654134, 5522651	Incidental	1	Foraging	Mature Forest
5	July 9, 2018	Southern Alexander Creek Valley 11 U 663741, 5503470	Incidental	1	Aerial display ("booming")	Open; Human Altered
6*	July 9, 2018	Southern Alexander Creek Valley 11U 663741, 5503470	Incidental	1	Foraging	Clearing
7	July 5 2019	Grave Prairie, Elk River Valley 11U 653297, 5521768	Incidental	3	Foraging	Grassland

*This observation of a Common Nighthawk occurred close to, but outside of, the LSA boundaries.

3.1.4

Discussion

There were 80 landbird species documented within the LSA during the 2014 and 2017 to 2019 baseline surveys; 72 during point count surveys and 8 observed incidentally. At each point count survey location, an average of 6 species and 8 individual birds were observed. The most abundant species, observed over 100 times throughout 242 surveys, included: Swainson's Thrush, Pine Siskin, Yellow-rumped Warbler, Dark-eyed Junco, Townsend's Warbler, and Warbling Vireo.

The breeding landbird point count surveys targeted the window of time during which breeding landbirds arrive and actively defend their territories; however, it should be noted that the exact timing of migration, mating, and nesting of birds varies among years and bird species (Government of Canada 2018). Several species were infrequently observed during the point counts. It is possible

those species occur in lower abundances in the LSA; however, it is also possible that the timing of the surveys did not encapsulate the breeding windows for some species and therefore the species were not as expressive (i.e., less noticeable) at the time of surveys. Examples of birds that may be early breeders over the years surveyed include Black-capped Chickadee and Brown Creeper (*Certhia americana*), which exhibit nesting periods of April 15 to July 17 and April 15 to July 23, respectively (Rousseu & Drolet, 2015). If the timing of the surveys did not encapsulate the breeding windows for all species, the baseline results may reflect a smaller proportion of the true breeding landbirds at each survey location.

The Grave Prairie area, west of Grave Lake, and Alexander Creek (mainstem) had the highest average relative abundance, species richness, and diversity of breeding landbirds. The BEC subzone most common across these areas is the MSdw subzone, which occurs in lower elevations across the LSA. Lower elevation areas of the LSA, and in the MSdw, contain food sources for breeding birds (e.g., insects and seeds), temperatures that are more consistent and warm, and experience longer periods of warm weather compared to the other BEC subzones in the LSA. Areas of the LSA with lower average relative abundance, species richness, and diversity were found near Upper Grave Creek, across Crown Mountain, and in the upper reaches of Alexander Creek. Higher elevations are found across these areas and food sources may be more limited, with cooler conditions and shorter periods of warm weather. These factors may support a lower bird species diversity as there is less diverse habitat.

Within the LSA, breeding landbird communities were found to be the most abundant, species-rich, and diverse in grasslands, mixed shrub forests, and wetlands. Grasslands and mixed shrub forests surveyed during the breeding bird program only occur in MSdw subzone; however, wetlands occur in both the MSdw and ESSFdk1 subzones. Grasslands and mixed shrub forests typically occur in areas of low elevation and tend to warm up quickly each spring. They likely contain abundant food resources including insects, seeds, and berries, and plentiful nesting habitat such as dense shrubs like wild rose, willows, and cattails. These areas appeared to be well used by other species groups like mammals, fish, and amphibians.

Avalanche chutes and forestry cutblocks had relatively moderate breeding landbird abundance, species richness, and diversity. Avalanche chutes, where snowmelt systems drain into the valleys, produce lush, productive herbs and shrubs that form the base of food sources for breeding landbirds, and may contain streams that have abundant flowing water throughout the spring and summer. Micro-valleys, formed by regular avalanche activity, warm up rapidly in the summer as shade from canopy tree species is prevented from establishing. These areas provide a break in continuous, cool forested slopes and provide perching locations and viewpoints for breeding birds. The edge habitat of the micro-valleys and adjacent forest also provide greater diversity of structure and plant community, which supports a broader diversity of species than more contiguous cover.

In the first few years after harvest disturbance, cutblocks also provide habitats that warm up quickly and support lush herbivorous vegetation until trees grow to 1.5 to 2 m tall and dominate the area. In addition, cutblocks surrounded by mature trees provide an edge habitat, a break that may also attract birds, as these areas provide perching locations with clear viewpoints for foraging and hunting. Olive-sided Flycatcher are associated with this type of edge, either natural or modified (Campbell et al., 1997).

Relative to most other land cover types surveyed, forests had lower breeding landbird abundance, species richness, and diversity. Forests are home to some of the species that were most frequently encountered, such as Swainson's Thrush (observed 182 times), and Hermit Thrush (observed 106 times), both of which require continuous forested habitats (Starzomski, 2015a; 2015b). It is logical that forest landbird species were the most frequently observed because forests make up the majority of the LSA, and were the most frequently surveyed land cover type. However, relative to the other land cover types, forested habitats are darker and contain denser vegetation, making observations of birds at the edge of the point count circle difficult to see. Therefore, some birds may not have been visually observed during the surveys, leading to lower bird estimates in this land cover type. However, most detections during breeding bird surveys are auditory and low visibility is unlikely to have had a significant impact on the survey results.

Rocky outcrops had similar relative abundance, richness, and diversity to forests. These areas tend to have few herbaceous plants, which provide foraging and cover habitat, and limited access to water. However, only two point count surveys were conducted in rocky outcrops, and thus, the results are limited.

Alpine areas had the lowest breeding landbird relative abundance, richness, and diversity of all land cover types surveyed. This is likely due to harsh conditions at high elevations, where temperatures are cooler, the growing season is shorter, and weather events more extreme. The plant community can also be more limited, restricting food sources and nesting opportunities in alpine areas.

European Starling, the only exotic bird species observed within the LSA, was seen in the Grave Prairie area. One Barn Swallow was observed incidentally over the course of the baseline program and was observed in the southern lower reaches of Alexander Creek, near the Sparwood Rifle Range, where there are a few buildings that may provide nesting habitat. The low occurrence of Barn Swallow may be due to the limited suitable nesting locations throughout the LSA, as this species is specifically adapted to nesting in artificial structures like barns, outbuildings, and bridges (COSEWIC, 2011). Baseline studies conducted for the baseline program for Teck's Elkview Operations (2015) did not detect any Barn Swallow in the project's study area.

Olive-sided Flycatcher were observed on 36 occasions within the LSA in forested areas as part of the baseline program. Logging has occurred throughout the LSA, creating numerous edge habitats, which may explain why this species was frequently encountered throughout the LSA. Consistent

with the results of this survey program, Olive-sided Flycatcher were observed 19 times during the breeding bird surveys conducted as part of the Elkview Operations baseline study (Teck Coal Ltd., 2015).

Breeding bird abundance results are similar to the findings of the baseline study completed for Teck's Elkview Operations (2015), in which 105 bird species were documented within the study's LSA. Similar to the breeding bird surveys completed for the Crown Mountain Project, frequently observed breeding birds included Swainson's Thrush, Warbling Vireo, MacGillivray's Warbler, Townsend's Warbler, Dark-eyed Junco, and Yellow-rumped Warbler.

The baseline study conducted for Teck's Line Creek Operations in 2011 included observations of 47 individual birds during breeding bird surveys and incidentally during other surveys conducted in 2009 and 2010 (Teck Coal Ltd., 2011). The most frequently observed bird species were Yellow-rumped Warbler, Ruby-crowned Kinglet (*Regulus calendula*), Dark-eyed Junco, Black-capped Chickadee, Hermit Thrush, Chipping Sparrow (*Spizella passerina*), Gray Jay (*Perisoreus canadensis*), Varied Thrush, and Swainson's Thrush. Olive-sided Flycatcher were identified twice by song during the baseline study.

3.1.4.1

Common Nighthawk Discussion

Observations of Common Nighthawk between June and July of 2014, 2018, and 2019 indicate that this species is present and possibly nesting within the LSA. Common Nighthawk observations, including incidental observations, were limited and infrequent during the 85 days spent on site, including 53 days during the breeding window when Common Nighthawk are more easily detected. These findings are similar to regional studies in the Columbia Basin (Manley, n.d.) and studies for other EAs in close proximity to the Project, in which few Common Nighthawk were observed (TAESCO Environmental Consultants Ltd. [TAESCO], 1985; EBA, 2004; Golder Associates, 2015a). Given the low detection of Common Nighthawk across the LSA as part of the bird community baseline program, relative abundance could not be determined.

All locations where Common Nighthawk were observed, including incidentals, were revisited on multiple occasions during other surveys over the four years of the baseline program. Station CN2, east of the Elk River and in the Grave Prairie area, is the only location where observations of Common Nighthawk were recorded across multiple years (CN2 in 2018; incidentals in 2014, 2018, and 2019). This area may be a nesting location, as Common Nighthawk have been shown to exhibit nest fidelity (COSEWIC, 2018). The incidental observation along southern Alexander Creek (observation No. 5), under the power lines in the southern LSA, was of a Common Nighthawk booming. Booming is used as both a courting or territorial behaviour (Brigham et al., 2011a) and as a defence tactic intended to deter potential predators away from nests (Manley, n.d.). As this observation was in July, rather than at the start of the breeding season, this behaviour suggests there was an active nest nearby.

Common Nighthawk require open areas like grasslands and clearings for nesting, similar to where observations of Common Nighthawk occurred in the LSA. These habitats are found throughout the LSA and some examples include (but are not limited to):

- Forestry cutblocks, which are common throughout the LSA;
- Open forests like those found throughout the lower Grave Creek watershed;
- Wetlands and riverbanks, which are distributed throughout the LSA;
- Grasslands (both natural and non-natural), such as Grave Prairie east of the Elk River;
- Mixed shrub areas and grasslands found under the power lines in the southern LSA; and,
- Exposed areas with gravel, bare rock, and cliffs, such as along scree slopes found at higher elevations in the LSA, including within the proposed Project footprint near Crown Mountain.

Common Nighthawk were observed in a limited extent of the LSA, and in areas of moderate to low value to songbirds (Saskatchewan Ministry of Environment, 2015). Common Nighthawk appear to be opportunistic generalists with respect to foraging habitat selection, although they favour areas with open water and may aggregate in areas where flying insects are concentrated; therefore, they may favour areas near wetlands and grasslands where insects concentrate (Brigham et al., 2011; ECCC, 2016). Within the LSA, Common Nighthawk were documented in the open areas near Grave Prairie, and in the open scrublands under the power lines. Based on their habitat preferences for foraging, they may also be present in other areas in the LSA, such as near the reservoir along Harmer Creek just north of the confluence with Grave Creek, and near wetlands present throughout the LSA.

3.2 Migratory Birds

3.2.1 Introduction and Objectives

The majority of birds in Canada are migratory. Most migrating birds are not able to carry out their full migrations non-stop and halt at various locations known as stopover sites (Moore, Gauthreaux, Kerlinger, & Simons, 1995). These important areas allow birds to rest and restock fat reserves while on route to their destination. Stopover locations are selected for both their geographic location and their ability to provide resources like water, food and resting habitat (Moore et al., 1995; Petit, 2000). Riparian habitats (those adjacent to waterbodies), in particular, have been shown to be disproportionately important stopover habitats (Carlisle et al., 2009). Migration routes and stopover locations are not consistent between spring and fall (Petit, 2000). It was therefore important to determine use of the LSA by migratory birds in both the spring and in the fall, as areas may be used differently in each season (Petit, 2000).

Landbird migration surveys were conducted in the spring and fall over multiple years to understand where potential important stopover locations occur within the LSA, to identify which species use the LSA during migration, and to generate estimates of bird species richness and diversity during the migration seasons. The primary objectives of the landbird migration surveys were to:

- Obtain a quantitative assessment of species composition, relative abundance, distribution, and spatial patterns of migratory birds during daytime hours within the terrestrial LSA;
- Identify routes used by diurnal bird species passing through or near the area of proposed development; and,
- Identify stopover sites that are important resting grounds and sources of nutrients for migratory birds.

3.2.2 Methods

3.2.2.1 Study Design

Migration surveys targeting terrestrial landbird passerine species were conducted in the spring and fall of 2018 and 2019. Surveys targeting migrating raptors and waterbirds are described in **Section 4.1 and Section 5.1**, respectively and as such, these species are not discussed in detail in this section.

A total of 161 surveys were conducted at 26 point count survey locations and 8 locations along 2 encounter transects established within the LSA at accessible locations that covered as many land cover types as possible (**Table 3-8, Figure 3-8**). There were 85 point count surveys and 32 transect surveys completed in the spring of 2018 and 2019, and 37 point count surveys and 7 transect surveys completed in the fall of 2018 and 2019. As there are no definitive protocols for bird migration surveys in BC, survey methods were adapted from the Environment Canada's *Guidance Document for Environmental Assessment for Wind Turbines and Birds* (Environment Canada-Canadian Wildlife Service, 2007) and the *Inventory Methods for Forest and Grassland Songbirds*, version 2.0 (Ministry of Environment, Lands and Parks Resources Inventory Branch, 1999a).

Point count radius plots were stationed a minimum of 250 m apart with a radius of 75 m in open areas and 50 m in forested areas. All birds observed audibly and visually were recorded for a period of 10 minutes at each survey location. Surveys were also completed along six fixed-width transects. Transects were 100 m long and 50 m wide on either side of transect line (a path or road). Observers walked transects on foot, recording all birds encountered, and took precautions to prevent double counting individuals (when in doubt, the bird was not recorded). Surveys were performed on multiple survey dates during each season and during favourable weather for migration. Point count and transect surveys were not conducted during precipitation events, in fog, strong winds, or during other circumstances that may have hampered visibility or auditory detection. Details on each point count and transect location are provided in **Appendix B1**.

Variable radius point counts (point counts) were selected as the method to survey landbirds during the migration window because they are a common technique that allows for consistent, comparable, comprehensive, and extensive coverage to assess the richness and relative abundance of forest birds (Bart, 2005). This technique focuses on landbirds that have 'touched down', resting in areas where snow and ice cover has melted away, revealing food sources on the ground, or where vegetation buds are beginning to burst and leaf out. No surveys targeting birds migrating over the

LSA without stopping were conducted. Riparian and wetted areas are known to be preferred habitat by migrating birds; as such, those areas were targeted for these surveys (Carlisle et al., 2009).

The specific point count survey locations (**Figure 3-8**) were determined in the field due to limited access to some areas of the LSA during spring snowmelt. During the spring (April 2018, May 2018, and May 2019) surveys, parts of the LSA were still covered in snow. The winter of 2018 was a particularly high snowfall year and for both the April and May surveys, snow covered the ground throughout most of the LSA, with especially high snow depths in the Alexander Creek valley. The open grassy areas of Grave Prairie tended to be snow free. The wetlands, particularly in the first few surveys, and early each morning, had ice and snow covering the entire area. The streams, creeks, and rivers were high and flooded from the spring snowmelt process, but had not yet reached their peak flows (assumed to be in May). These conditions limited and slowed access and guided the selection of survey locations. During the fall (October 2018, September 2019), all roads were clear of snow and ice and all existing spring identified locations were accessible. The weather did not limit access to survey locations during the fall; however, for consistency, locations identified in the spring were repeated in the fall.

Table 3-8: Landbird Migration Survey Effort by BEC Subzone and Land Cover Type

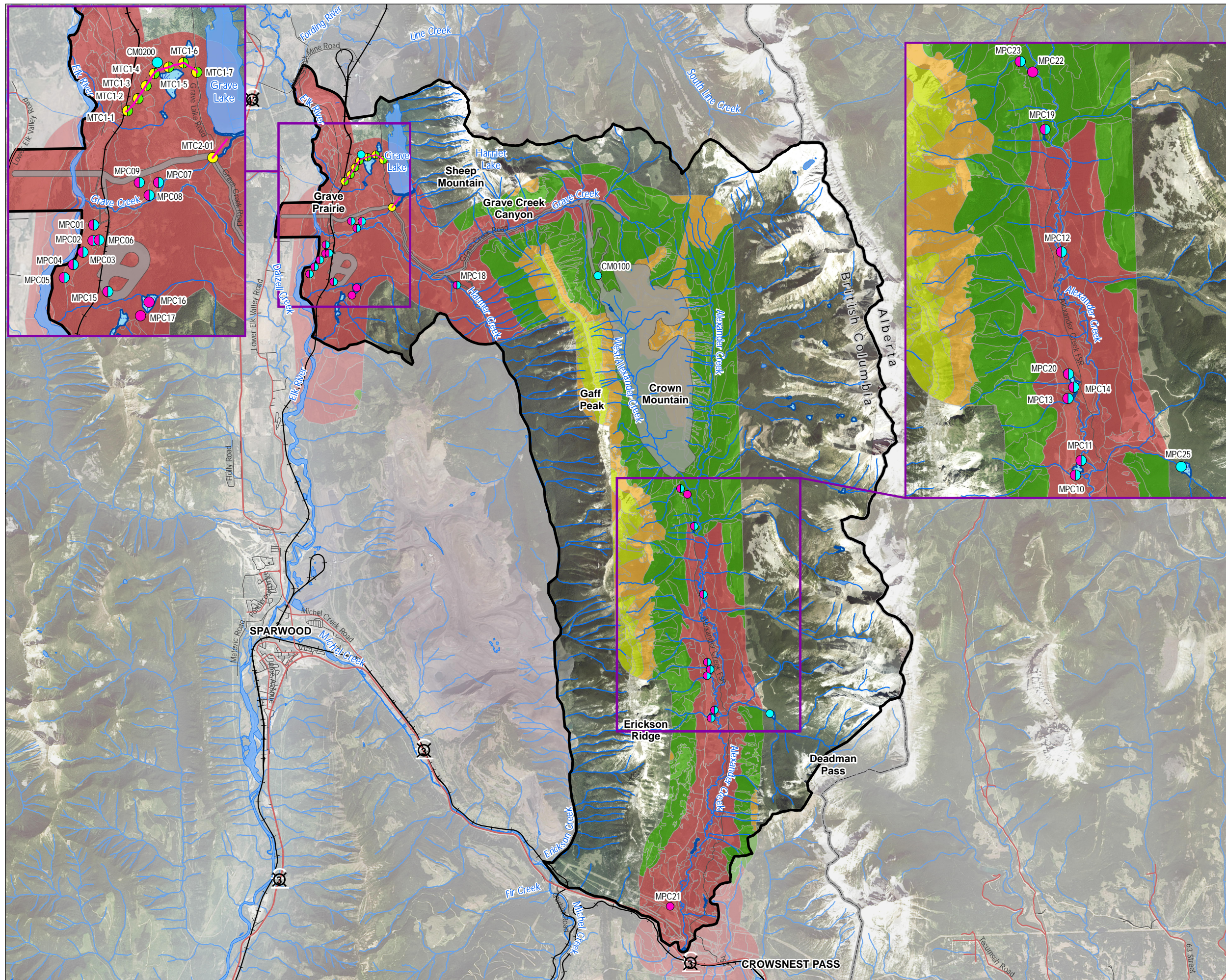
BEC Subzone & Land Cover Type	Point Count Surveys			Transect Surveys		
	No. Locations	Total No. Spring Replicates	Total No. Fall Replicates	No. Locations	Total No. Spring Replicates	Total No. Fall Replicates
MSdw						
Forest	4	14	5	-	-	-
Grassland	7	28	11	-	-	-
Mixed Shrub Forest	3	10	4	7	31	7
Wetland	10	26	12	1	1	-
Sub-total for BEC subzone	23	78	32	8	32	7
ESSFdk1						
Avalanche Chute	1	2	1	-	-	-
Forest	2	2	2	-	-	-
Wetland	1	3	2	-	-	-

Sub-total for BEC subzone	4	7	5	-	-	-
Total	27	85	37	8	32	7

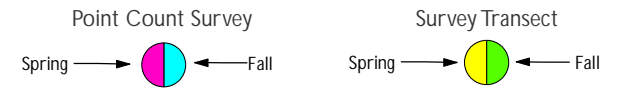
Where feasible, biologists attempted to replicate point count locations within the same year and across different years. There was one survey location (MPC24) with a single point count survey that was added during the final year of surveys (2019); all others were replicated at least once.

Crown Mountain Coking Coal Project

FIGURE 3-8.
Landbird Migration Survey Point Count Locations



LEGEND



- Migratory Bird Survey Transect
 - Terrestrial Local Study Area
 - Project Footprint
 - Highways
 - Arterial Roads
 - Local/Resource Roads
 - Railway (Canadian Pacific)
 - Watercourse
 - Waterbody
 - Wetland
 - BC/Alberta Border
- Biogeoclimatic Ecosystem Classification
- ESSFdk1
 - ESSFdkp
 - ESSFdkw
 - MSdw



2

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited, TEM Provided by Keefer Ecological Services Ltd.

Map Created By: JFC/RBB
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File Location: \\42\dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Bird\126231 Baseline Bird Landbird Migration Survey Point Count Locations.mxd

3.2.2.2 Data Analysis

To inform the status of the landbird community, and of individual species during the migration seasons, matrices that quantify bird abundance, species richness, and species diversity were calculated for each point count and transect location and averages were determined for each season, where possible. Data analysis followed the procedures outlined in **Section 3.1.2.2**. To assess bird presence in the LSA, the average relative abundance of birds was calculated from all the point count survey location data for each BEC subzone and each land cover type. To assess species richness in the LSA, the average species richness was calculated from richness data for point count survey locations in each BEC subzone or land cover type. To assess species diversity in the LSA, the average Shannon-Weiner Diversity Index was calculated from the abundance and richness data for point count survey locations in each BEC subzone or land cover type. Transect surveys were conducted in one BEC subzone (MSdw) and two land cover types (mixed shrub forest and wetland), so population metrics across BEC subzones and land cover types were not determined for the transects surveys.

3.2.3 Results

During the landbird migration surveys in 2018 and 2019, biologists spent 24 days on site: 18 in the spring (April-May) and 6 in the fall (September-October). A total of 77 species were observed during both seasons across the point count and transect locations (**Table 3-9**, see **Appendix B2** for detailed survey data); 60 species during the surveys and 17 additional species observed incidentally. There were 51 species observed during the spring surveys and 33 species observed during fall surveys. **Table 3-9** lists all bird species observed during the landbird migration surveys at both transect and point count locations. The surveys detected 1,175 individual landbirds; 878 in the spring and 297 in the fall. During the spring surveys, 654 birds were observed at point count locations and 224 were observed along the transects. During the fall surveys, 221 birds were observed at point count locations and 76 were observed along the transects.

The total number of observations for any one species during the spring and fall migration surveys ranged from 1 to 156 times. Across both seasons, the species observed most frequently were Dark-eyed Junco (156 times), followed by American Robin (133 times) and Pine Siskin (117 times). Only 13 species were observed 20 or more times and 47 species were observed 19 or fewer times. On average, 15.1 ± 3.8 individuals of a single species were observed. Two species at risk, Evening Grosbeak and Olive Sided Flycatcher, were observed once in the spring and once in the fall, respectively.

Eight landbird species were observed during the migration seasons that were not detected within the summer breeding season: Black-billed Magpie (*Pica hudsonia*), Bohemian Waxwing (*Bombycilla garrulous*), Brewer's Blackbird (*Euphagus cyanocephalus*), Clay-coloured Sparrow (*Spizella pallida*), Gray-crowned Rosy-Finch (*Leucosticte tephrocotis*), Savannah Sparrow (*Passerculus sandwichensis*), Steller's Jay (*Cyanocitta stelleri*), and Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*; **Photo 3-1**).

Table 3-9: Bird Species Observed During the Spring and Fall Migration Surveys

Common Name	Scientific Name	Total Observed in Spring	Total Observed in Fall	No. Incidental Observations	Total Observed
American Dipper	<i>Cinclus mexicanus</i>	1	0	0	1
American Robin	<i>Turdus migratorius</i>	127	6	21	154
American Three-toed Woodpecker	<i>Picoides dorsalis</i>	5	0	1	6
Belted Kingfisher	<i>Megaceryle alcyon</i>	1	2	1	4
Black-billed Magpie	<i>Pica hudsonia</i>	0	0	3	3
Black-capped Chickadee	<i>Poecile atricapillus</i>	3	20	6	29
Bohemian Waxwing	<i>Bombycilla garrulus</i>	0	40	0	40
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	0	1	0	1
Brown Creeper	<i>Certhia americana</i>	0	1	1	2
Brown-headed Cowbird	<i>Molothrus ater</i>	15	0	6	21
Calliope Hummingbird	<i>Selasphorus calliope</i>	0	0	1	1
Canada Goose	<i>Branta canadensis</i>	3	0	4	7
Cassin's Finch	<i>Haemorhous cassinii</i>	6	13	1	22
Cedar Waxwing	<i>Bombycilla cedrorum</i>	0	12	0	12
Chipping Sparrow	<i>Spizella passerina</i>	8	0	0	8
Clark's Nutcracker	<i>Nucifraga columbiana</i>	0	0	3	3
Clay-coloured Sparrow	<i>Spizella pallida</i>	1	0	0	1
Common Raven	<i>Corvus corax</i>	8	4	14	26
Common Yellowthroat	<i>Geothlypis trichas</i>	0	0	1	1
Cooper's Hawk	<i>Accipiter cooperii</i>	1	1	0	2
Dark-eyed Junco	<i>Junco hyemalis</i>	97	59	3	156
Downy Woodpecker	<i>Dryobates pubescens</i>	3	2	8	13
European Starling ¹	<i>Sturnus vulgaris</i>	12	0	0	12
Evening Grosbeak ²	<i>Coccothraustes vespertinus</i>	1	0	0	1
Fox Sparrow	<i>Passerella iliaca</i>	5	0	1	6
Golden-crowned Kinglet	<i>Regulus satrapa</i>	38	9	2	49
Gray Jay	<i>Perisoreus canadensis</i>	5	0	4	9
Gray-crowned Rosy-finch	<i>Leucosticte tephrocotis</i>	0	0	1	1
Hammond's Flycatcher	<i>Empidonax hammondii</i>	19	0	3	22

Common Name	Scientific Name	Total Observed in Spring	Total Observed in Fall	No. Incidental Observations	Total Observed
Hairy Woodpecker	<i>Dryobates villosus</i>	4	5	4	13
Hermit Thrush	<i>Catharus guttatus</i>	1	3	1	5
Hooded Merganser	<i>Lophodytes cucullatus</i>	2	0	0	2
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	12	0	1	13
Mallard	<i>Anas platyrhynchos</i>	2	0	2	4
Merlin	<i>Falco columbarius</i>	0	0	1	1
Mountain Bluebird	<i>Sialia currucoides</i>	9	1	2	12
Mountain Chickadee	<i>Poecile gambeli</i>	48	13	0	60
Northern Flicker	<i>Colaptes auratus</i>	13	1	30	44
Northern Goshawk	<i>Accipiter gentilis</i>	0	1	0	1
Northern Harrier	<i>Circus hudsonius</i>	0	0	2	2
Northern Waterthrush	<i>Parkesia noveboracensis</i>	2	0	1	3
Olive-sided Flycatcher ³	<i>Contopus cooperi</i>	0	1	5	6
Orange-crowned Warbler	<i>Leiothlypis celata</i>	14	0	0	14
Osprey	<i>Pandion haliaetus</i>	0	0	1	1
Pacific Wren	<i>Troglodytes pacificus</i>	1	0	0	1
Pileated Woodpecker	<i>Dryocopus pileatus</i>	0	0	2	2
Pine Grosbeak	<i>Pinicola enucleator</i>	0	0	2	2
Pine Siskin	<i>Spinus pinus</i>	97	20	24	141
Purple Finch	<i>Haemorhous purpureus</i>	1	0	0	1
Red Crossbill	<i>Loxia curvirostra</i>	0	20	0	20
Red-breasted Nuthatch	<i>Sitta canadensis</i>	11	10	11	32
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	19	0	25	44
Red-tailed Hawk	<i>Buteo jamaicensis</i>	0	0	3	3
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	14	0	2	16
Ruby-crowned Kinglet	<i>Regulus calendula</i>	90	10	17	117
Ruffed Grouse	<i>Bonasa umbellus</i>	4	0	7	11
Rufous Hummingbird	<i>Selasphorus rufus</i>	0	0	1	1
Savannah Sparrow	<i>Passerculus sandwichensis</i>	9	0	1	10
Sharp-shinned Hawk	<i>Accipiter striatus</i>	3	1	3	7
Song Sparrow	<i>Melospiza melodia</i>	3	1	0	4

Common Name	Scientific Name	Total Observed in Spring	Total Observed in Fall	No. Incidental Observations	Total Observed
Steller's Jay	<i>Cyanocitta stelleri</i>	0	0	2	2
Townsend's Solitaire	<i>Myadestes townsendi</i>	2	0	2	4
Townsend's Warbler	<i>Setophaga townsendi</i>	9	0	3	12
Tree Swallow	<i>Tachycineta bicolor</i>	58	0	2	60
Unidentified Chickadee	-	0	2	0	2
Unidentified Hummingbird	-	1	0	1	2
Unidentified Songbird	-	1	0	2	3
Unidentified Sparrow	-	0	2	1	3
Unidentified Woodpecker	-	2	1	12	15
Varied Thrush	<i>Ixoreus naevius</i>	5	3	4	12
Vesper's Sparrow	<i>Pooecetes gramineus</i>	6	0	0	6
Warbling Vireo	<i>Vireo gilvus</i>	3	0	2	5
Western Tanager	<i>Piranga ludoviciana</i>	0	0	1	1
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	4	2	0	6
White-throated Sparrow	<i>Zonotrichia albicollis</i>	0	1	0	1
White-winged Crossbill	<i>Loxia leucoptera</i>	26	7	9	42
Wild Turkey	<i>Meleagris gallopavo</i>	0	0	2	2
Wilson's Snipe	<i>Gallinago delicata</i>	0	0	2	2
Wilson's Warbler	<i>Cardellina pusilla</i>	2	0	1	3
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	0	0	2	2
Yellow Warbler	<i>Setophaga petechia</i>	0	10	0	10
Yellow-rumped Warbler	<i>Setophaga coronata</i>	41	12	8	61
Total		878	297	289	1,464

¹ Exotic.

² SARA 1-SC; Yellow-listed.

³ SARA 1-T; Blue-listed.



Photo 3-1: Yellow-headed Blackbird Foraging (May 21, 2019)

3.2.3.1 Spring

Spring Bird Populations

During the spring, birds were observed at all point count and transect locations and in all land cover types surveyed. The relative abundance at each point count location ranged from 0 to 33 birds (see **Appendix B3** for complete population metrics). The average relative abundance at each point count location ranged from 2.5 to 19.0 birds, and the average across all locations was 7.7 ± 0.6 birds (**Table 3-10**). In general, the highest average relative abundance occurred within the Grave Prairie area, west of Grave Lake, and along the mainstem of Alexander Creek (**Figure 3-9**). There were three surveys conducted that had observations over 20 individuals (MPC02, MPC03, MPC21) and in 2018, there were 5 point count surveys where no birds were observed at all (MPC03, MPC04, MPC12, MPC17, and MPC22). On average, there were 2.0 to 7.4 bird species observed per location, with an average of 4.5 ± 0.3 species observed across all survey locations. In general, the highest average species richness occurred within the Grave Prairie area, west of Grave Lake, and along the mainstem of Alexander Creek (**Figure 3-9**).

The average spring Shannon-Weiner Diversity Index across all point count locations was 1.24 ± 0.08 and ranged from 0.66 to 1.80. The 10 point count survey locations with the highest average Shannon-Weiner Diversity Indices were distributed across the Grave Prairie area, west of Grave Lake, and along Alexander Creek south of the confluence with West Alexander Creek.

The relative abundance at each transect location ranged from 1-20 birds (**Appendix B3**). The average relative abundance at each transect location ranged from 5.2 to 11.0 birds, and the average

across all locations was 7.0 ± 0.7 birds (**Table 3-10**). The only survey that had observations over 20 individuals was MTC1-5 in 2019, but birds were consistently observed at all transect locations. On average, 3.6 to 6.4 species were observed per survey location, with an average of 4.6 ± 0.3 species across all survey locations (**Table 3-10**). The average spring Shannon-Weiner Diversity Index at each transect location was 1.36 ± 0.08 and ranged from 1.17 to 1.76. All survey locations within the two transects were located west or southwest of Grave Lake.

Table 3-10: Landbird Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the 2018 and 2019 Spring Migration Point Count and Transect Survey Locations

Survey ID	BEC Subzone	Dominant Land Cover Type	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
Bird Point Count Surveys					
MPC01	MSdw	Grassland	5.0	3.8	1.21
MPC02	MSdw	Grassland	13.2	5.6	1.52
MPC03	MSdw	Grassland	10.2	2.4	0.74
MPC04	MSdw	Grassland	4.2	2.2	0.69
MPC05	MSdw	Grassland	10.2	5.7	1.56
MPC06	MSdw	Grassland	11.4	7.4	1.80
MPC07	MSdw	Grassland	7.3	5.7	1.28
MPC08	MSdw	Grassland	7.0	5.0	1.02
MPC09	MSdw	Forest	6.3	4.3	1.36
MPC10	MSdw	Wetland	10.2	6.0	1.65
MPC11	MSdw	Wetland	6.8	5.8	1.69
MPC12	MSdw	Forest	5.8	4.4	1.13
MPC13	MSdw	Wetland	5.0	3.5	1.13
MPC14	MSdw	Wetland	4.8	3.8	1.21
MPC15	MSdw	Forest	5.7	3.3	1.06
MPC16	MSdw	Grassland	4.0	2.5	0.78
MPC17	MSdw	Forest	5.0	4.0	1.15
MPC18	MSdw	Wetland	9.3	4.3	0.90
MPC19	ESSFdk1	Wetland	9.0	5.3	1.56
MPC20	MSdw	Wetland	6.3	5.0	1.51
MPC21	MSdw	Grassland	19.0	7.0	1.65

Survey ID	BEC Subzone	Dominant Land Cover Type	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
MPC22	ESSFdk1	Forest	4.5	2.5	0.71
MPC23	ESSFdk1	Avalanche Chute	2.5	2.0	0.66
Total			7.7	4.5	1.24
Transect Surveys					
MTC1-01	MSdw	Forest	5.2	3.6	1.17
MTC1-02	MSdw	Forest	6.4	4.6	1.38
MTC1-03	MSdw	Forest	7.2	5.0	1.44
MTC1-04	MSdw	Forest	5.8	4.2	1.22
MTC1-05	MSdw	Forest	11.0	6.4	1.76
MTC1-06	MSdw	Forest	7.8	4.8	1.37
MTC1-07	MSdw	Forest	3.0	2.0	0.64
MTC2-01	MSdw	Wetland	4.0	3.0	1.04
Total			7.0	4.6	1.36

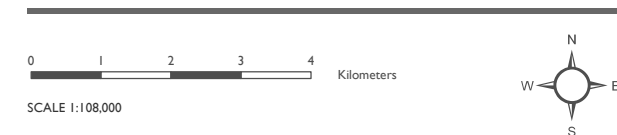
Crown Mountain Coking Coal Project

FIGURE 3-9.
Spring Landbird Average Relative Abundance
and Species Richness

LEGEND

Average Species Richness	Average Abundance
● 0 (No Birds Detected)	○ 0 (No Birds Detected)
● 0.1 - 1.9 (Lowest)	○ 0.1 - 4.9 (Lowest)
● 2 - 3.9	○ 5 - 9.9
● 4 - 5.9	○ 10 - 14.9
● 6 - 7.9 (Highest)	○ 15 - 19.9 (Highest)

▭ Terrestrial Local Study Area	▭ Project Footprint
▬ Highways	▬ Arterial Roads
▬ Local/Resource Roads	▬ Railway (Canadian Pacific)
▬ Watercourse	▭ Waterbody
▭ Wetland	▭ BC/Alberta Border

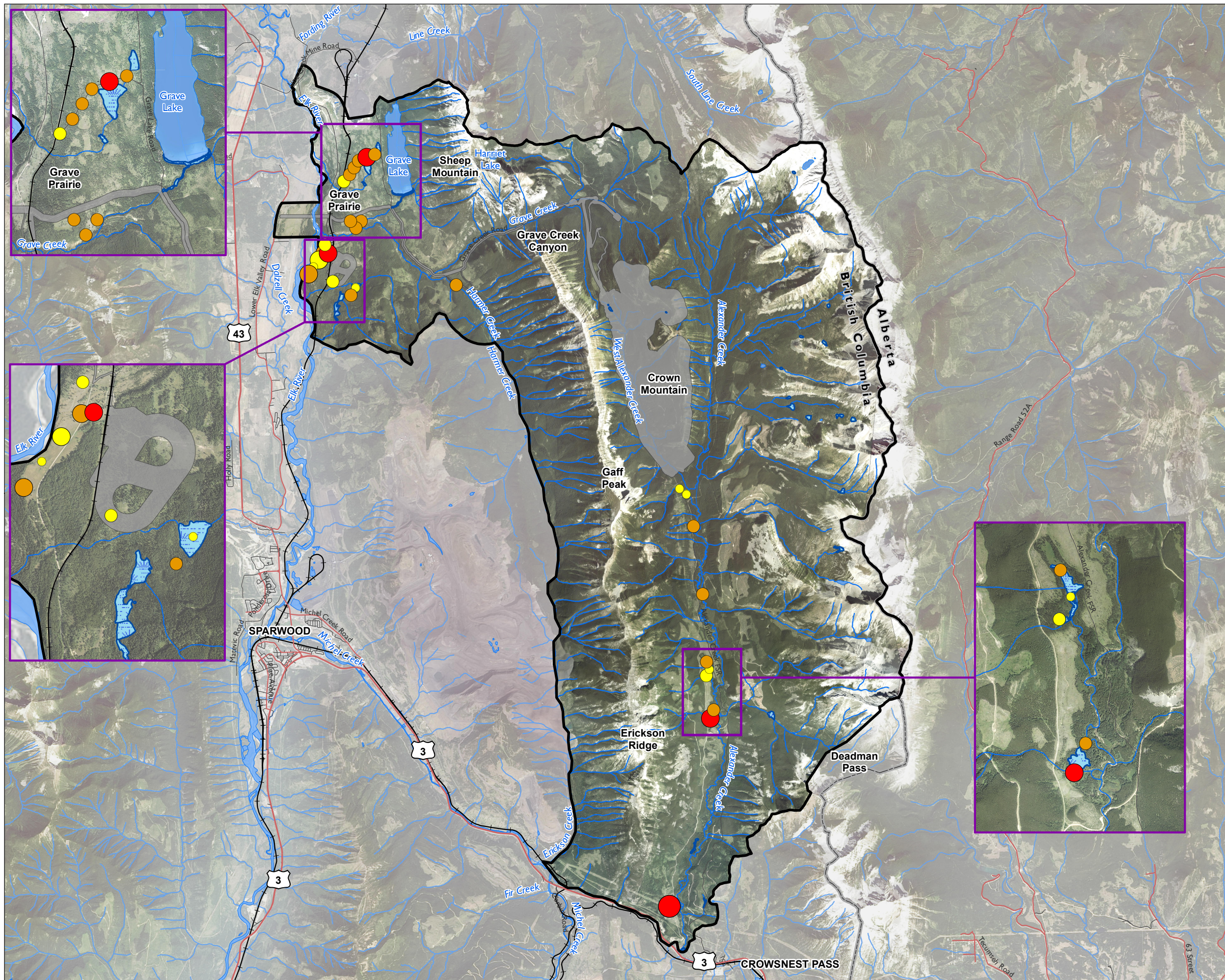


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Land Cover Associations

Transect surveys were conducted in one BEC subzone (MSdw) and two land cover types (mixed shrub forest and wetland), so population metrics across BEC subzones and land cover types were not determined for the transects. Point counts were completed in two BEC subzones, MSdw and ESSFdk1. The BEC subzone with the highest average relative abundance (7.9 ± 0.7), species richness (4.6 ± 0.3), and Shannon-Weiner Diversity Index (1.26 ± 0.07) was MSdw (**Table 3-11; Figure 3-10; Appendix B4**), although error bars overlap in all cases. In ESSDdk1, the average relative abundance was 5.9 ± 1.5 , the species richness was 3.6 ± 0.9 , and the Shannon-Weiner Diversity Index was 1.06 ± 0.24 (**Figure 3-10**).

The most abundant species in the MSdw subzone included American Robin (126), Dark-Eyed Junco (97), and Pine Siskin (89; **Table 3-11**). The most abundant species in the ESSFdk1 subzone included Pine Siskin (8), and Golden-crowned Kinglet, Tree Swallow (*Tachycineta bicolor*), and Yellow-rumped Warbler (all 7; **Table 3-11**).

Table 3-11: Number of Individual Birds Observed Across BEC Subzones during the Spring Migration Point Count and Transect Surveys

Species	Biogeoclimatic Subzone		Total
	MSdw	ESSFdk1	
American Dipper	1	0	1
American Robin	126	1	127
American Three-toed Woodpecker	2	3	5
Belted Kingfisher	1	0	1
Black-capped Chickadee	3	0	3
Brown-headed Cowbird	15	0	15
Canada Goose	3	0	3
Cassin's Finch	6	0	6
Chipping Sparrow	8	0	8
Clay-coloured Sparrow	1	0	1
Common Raven	8	0	8
Cooper's Hawk	1	0	1
Dark-eyed Junco	97	0	97
Downy Woodpecker	3	0	3
European Starling	12	0	12
Evening Grosbeak	1	0	1
Fox Sparrow	5	0	5

Species	Biogeoclimatic Subzone		Total
	MSdw	ESSFdk1	
Golden-crowned Kinglet	31	7	38
Gray Jay	5	0	5
Hammond's Flycatcher	19	0	19
Harry Woodpecker	4	0	4
Hermit Thrush	1	0	1
Hooded Merganser	2	0	2
Lincoln's Sparrow	12	0	12
MacGillivray's Warbler	0	0	0
Mallard	2	0	2
Mountain Bluebird	9	0	9
Mountain Chickadee	48	0	48
Northern Flicker	13	0	13
Northern Waterthrush	2	0	2
Orange-crowned Warbler	14	0	14
Pacific Wren	0	1	1
Pine Siskin	89	8	97
Purple Finch	0	1	1
Red-breasted Nuthatch	11	0	11
Red-naped Sapsucker	19	0	19
Red-winged Blackbird	14	0	14
Ruby-crowned Kinglet	88	2	90
Ruffed Grouse	4	0	4
Savannah Sparrow	9	0	9
Sharp-shinned Hawk	3	0	3
Song Sparrow	3	0	3
Townsend's Solitaire	2	0	2
Townsend's Warbler	7	2	9
Tree Swallow	51	7	58
Unidentified Hummingbird	1	0	1
Unidentified Songbird	1	0	1
Unidentified Woodpecker	2	0	2

Species	Biogeoclimatic Subzone		Total
	MSdw	ESSFdk1	
Varied Thrush	4	1	5
Vesper's Sparrow	6	0	6
Warbling Vireo	3	0	3
White-crowned Sparrow	4	0	4
White-throated Sparrow	0	0	0
White-winged Crossbill	25	1	26
Wilson's Warbler	2	0	2
Yellow-rumped Warbler	34	7	41
Total	837	41	878
No. Point Count Survey Replicates	110	4	114
Average Relative Abundance per Point Count Location	7.9	5.9	7.7

Note: Incidental observations not included.

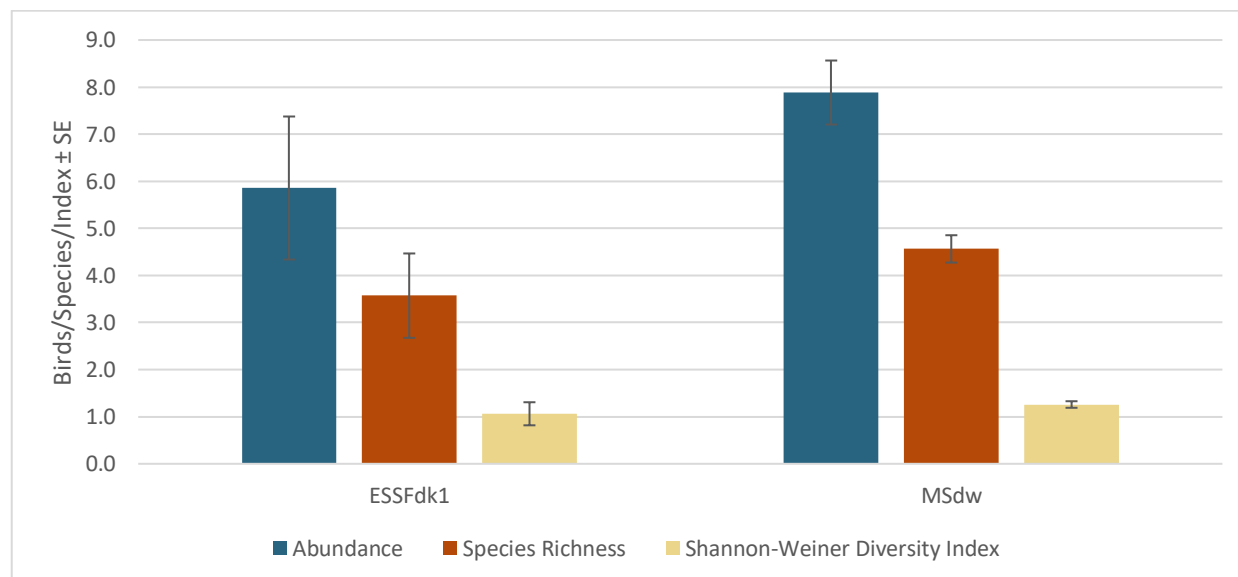


Figure 3-10: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the Spring Migration Point Count Surveys in the ESSFdk1 and MSdw BEC Subzones of the LSA

Birds observed across land cover types during the point count and transect surveys are detailed in **Table 3-12**. Mixed shrub forests were the land cover type with the most point count survey locations and replicates (**Table 3-12**). The land cover type with the highest average relative abundance (9.3 ± 1.8), species richness (6.4 ± 1.2), and Shannon-Weiner Diversity Index (1.49 ± 0.28) was mixed shrub forests (**Table 3-12; Figure 3-11; Appendix B4**). Relative abundance ranged

from 1 to 20 birds; species richness ranged from 1 to 11; and diversity ranged from 0.00 to 2.30 in mixed shrub forests (**Appendix B4**). Wetlands and grasslands were the second and third most diverse land cover types, with average Shannon-Weiner Diversity Indices of 1.34 ± 0.09 and 1.18 ± 0.11 , respectively, with ranges of 0.00 to 2.04 in wetlands and 0.00 to 2.03 in grasslands (**Appendix B4**). Grasslands and wetlands were the second and third most abundant and species rich, followed by forests. Avalanche chutes had the lowest levels of these metrics.

Pine Siskin were the most abundant species in avalanche chutes (2) and wetlands (46); Ruby-crowned Kinglet were the most abundant species in forests (19); and American Robin were the most abundant species in grasslands (70) and mixed shrub forests (46; **Table 3-12**).

Table 3-12: Birds Species Observed Across Land Cover Types during the Spring Migration Point Count and Transect Surveys

Species	Land Cover Type					Total
	Avalanche Chute	Forest	Grassland	Mixed Shrub Forest	Wetland	
American Dipper	0	1	0	0	0	1
American Robin	0	2	70	46	9	127
American Three-toed Woodpecker	0	1	1	0	3	5
Belted Kingfisher	0	0	0	0	1	1
Black-capped Chickadee	0	0	2	1	0	3
Brown-headed Cowbird	0	2	5	6	2	15
Canada Goose	0	0	3	0	0	3
Cassin's Finch	0	0	0	6	0	6
Chipping Sparrow	0	0	4	4	0	8
Clay-coloured Sparrow	0	0	0	1	0	1
Common Raven	0	1	6	1	0	8
Cooper's Hawk	0	0	0	1	0	1
Dark-eyed Junco	0	7	45	33	12	97
Downy Woodpecker	0	0	0	3	0	3
European Starling	0	0	9	3	0	12
Evening Grosbeak	0	0	0	0	1	1
Fox Sparrow	0	1	0	0	4	5
Golden-crowned Kinglet	1	8	2	11	16	38
Gray Jay	0	0	1	1	3	5
Hammond's Flycatcher	0	3	1	15	0	19

Species	Land Cover Type					Total
	Avalanche Chute	Forest	Grassland	Mixed Shrub Forest	Wetland	
Harry Woodpecker	0	0	1	1	2	4
Hermit Thrush	0	0	0	0	1	1
Hooded Merganser	0	0	0	0	2	2
Lincoln's Sparrow	0	1	2	1	8	12
Mallard	0	0	0	2	0	2
Mountain Bluebird	0	0	3	6	0	9
Mountain Chickadee	0	9	8	24	7	48
Northern Flicker	0	0	5	8	0	13
Northern Waterthrush	0	0	1	0	1	2
Orange-crowned Warbler	0	0	1	13	0	14
Pacific Wren	0	0	0	0	1	1
Pine Siskin	2	11	18	20	46	97
Purple Finch	0	1	0	0	0	1
Red-breasted Nuthatch	0	4	2	5	0	11
Red-breasted Sapsucker	0	0	1	1	1	3
Red-naped Sapsucker	0	2	5	8	1	16
Red-winged Blackbird	0	2	1	1	10	14
Ruby-crowned Kinglet	1	19	10	40	20	90
Ruffed Grouse	0	1	0	1	2	4
Savannah Sparrow	0	0	8	1	0	9
Sharp-shinned Hawk	0	0	2	0	1	3
Song Sparrow	0	0	0	0	3	3
Townsend's Solitaire	0	0	1	0	1	2
Townsend's Warbler	0	3	0	0	6	9
Tree Swallow	0	0	21	25	12	58
Unidentified Hummingbird	0	0	0	1	0	1
Unidentified Songbird	0	0	0	1	0	1
Unidentified Woodpecker	0	0	0	1	1	2
Varied Thrush	0	0	1	0	4	5
Vesper's Sparrow	0	0	5	1	0	6
Warbling Vireo	0	0	0	1	2	3

Species	Land Cover Type					Total
	Avalanche Chute	Forest	Grassland	Mixed Shrub Forest	Wetland	
White-crowned Sparrow	0	1	0	0	3	4
White-winged Crossbill	1	1	14	2	8	26
Wilson's Warbler	0	0	0	1	1	2
Yellow-rumped Warbler	0	8	1	12	20	41
Total	5	89	260	309	215	878
No. Point Count Survey Replicates	2	16	28	41	30	117
Average Relative Abundance per Point Count Location	2.5	5.6	9.3	9.3	7.2	7.7

Note: Incidental observations not included.

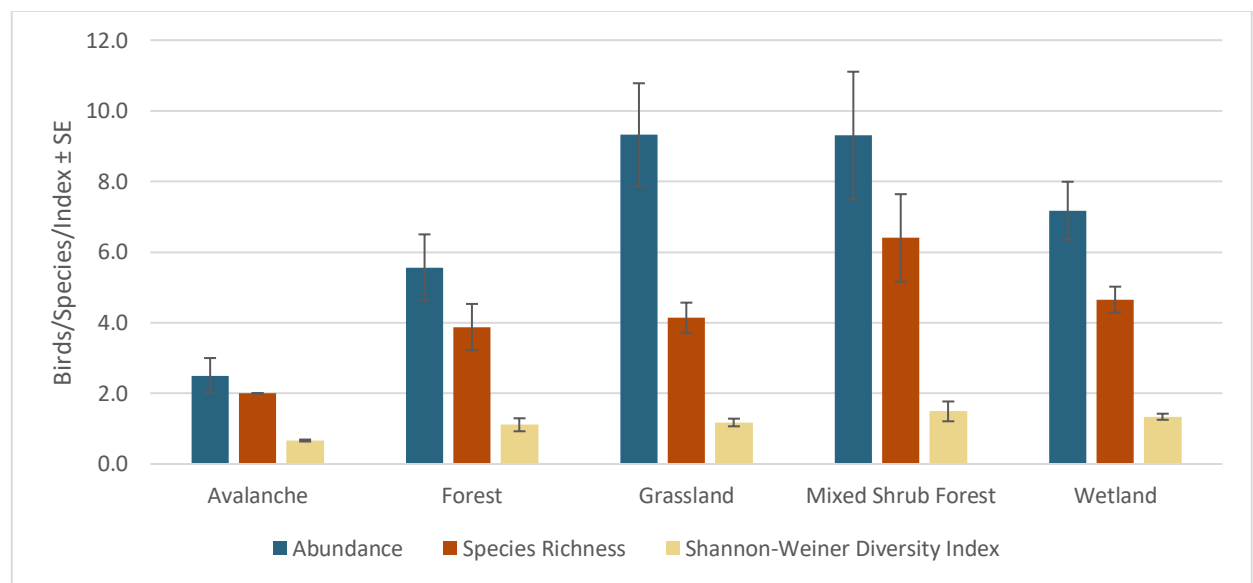
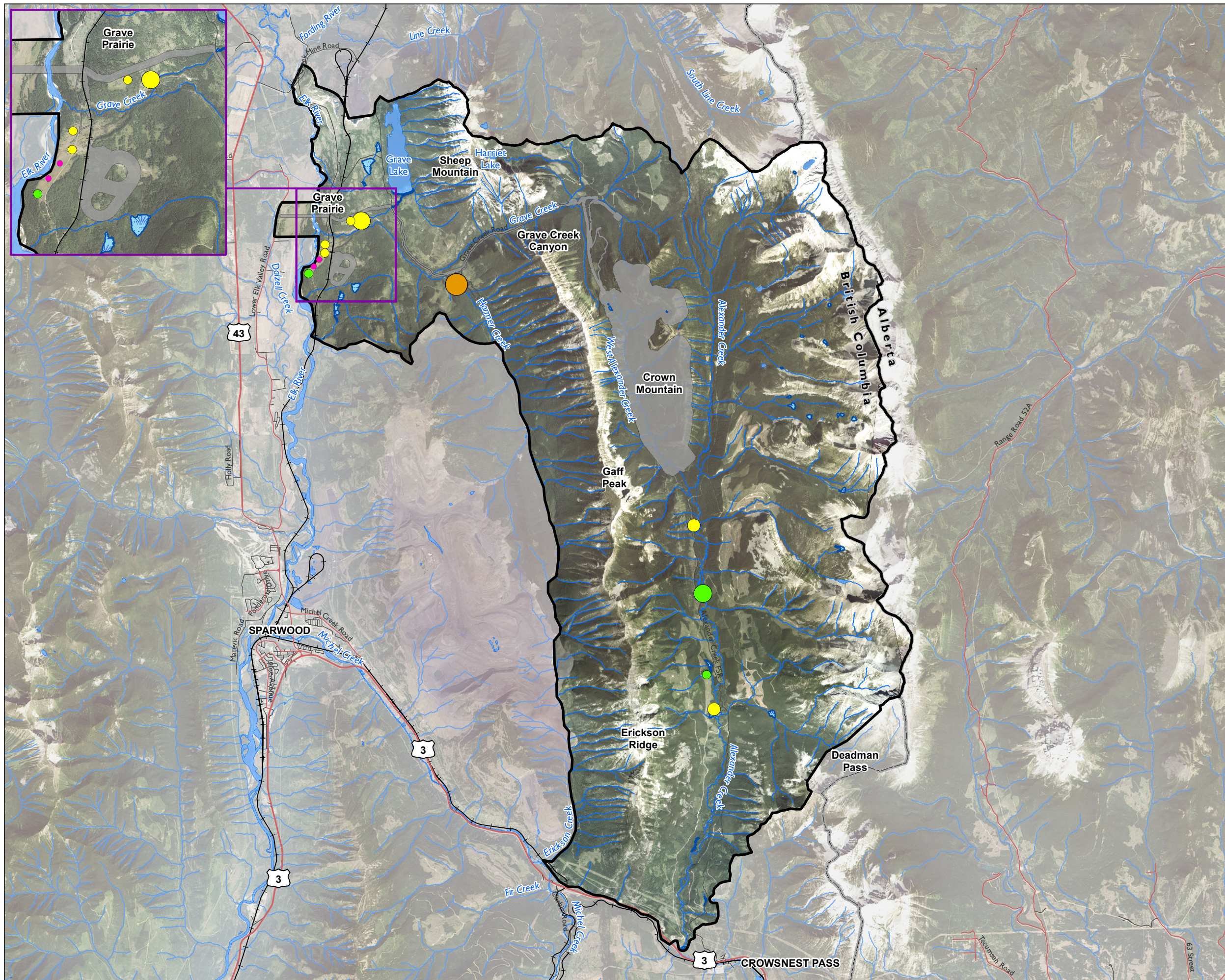


Figure 3-11: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the Spring Migration Point Count Surveys for Each Dominant Land Cover Type in the LSA

Fall Bird Populations

During the fall, birds were observed at most, but not all, point count and transect survey locations (**Table 3-13**) and in all land cover types surveyed. The relative abundance at each point count survey location ranged from 0 to 54 birds (see **Appendix B3** for complete population metrics). The average relative abundance at each point count location ranged from 0.0 to 29.5 birds, and the average across all locations was 6.0 ± 1.7 birds (**Table 3-13**). There were three surveys conducted that had observations over 20 individuals (MPC10, MPC12, and MPC18) and there were six point count surveys where no birds were observed at all (MPC03 in both years, MPC04 in both years, MPC15 in 2018, and CM01 in 2018). On average, there were 0.0 to 4.5 bird species observed per location, with an average of 2.0 ± 0.3 species observed across all survey locations. The point count survey locations with the highest average abundance and species richness were distributed across the Grave Prairie area, west of Grave Lake, and along Alexander Creek south of the confluence with West Alexander Creek (**Figure 3-12**). The average fall Shannon-Weiner Diversity Index across all point count locations was 0.52 ± 0.06 and ranged from 0.00 to 0.93.

Transect surveys were not repeated in 2019 due to access issues; therefore, averages per transect survey location were not determined. The relative abundance at each transect location ranged from 2 to 43 birds (**Appendix B3**) and the average was 10.9 ± 5.4 across all transect locations (**Table 3-13**). The only survey that had observations over 20 individuals was MTC1-7, but birds were observed at all transect locations. Species richness at each survey location ranged from 2 to 6 species and the average was 4.1 ± 0.6 across all survey locations. The Shannon-Weiner Diversity Index at each transect location ranged from 0.45 to 1.79 with an average of 1.23 ± 0.18 across all survey locations. All survey locations within the two transects were located west or southwest of Grave Lake.



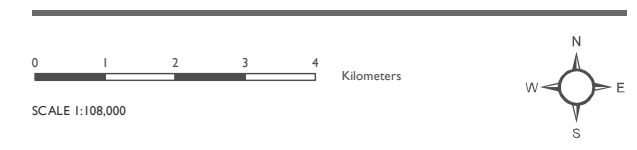
Crown Mountain Coking Coal Project

FIGURE 3-12.
Fall Landbird Average Relative Abundance
and Species Richness

LEGEND

Average Species Richness	Average Abundance
● 0 (No Birds Detected)	○ 0 (No Birds Detected)
● 0.1 - 1.9 (Lowest)	○ 0.1 - 4.9 (Lowest)
● 2 - 3.9	○ 5 - 9.9
● 4 - 5.9	○ 10 - 14.9
● 6 - 7.9 (Highest)	○ 15 - 19.9 (Highest)

- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- ▭ BC/Alberta Border



Map Drawing Information: Data Provided by
Province of British Columbia, NWP Coal Canada Ltd.,
Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-03

Table 3-13: Landbird Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the 2018 and 2019 Fall Migration Point Count Surveys

Survey ID	BEC Subzone	Dominant Land Cover Type	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
Point Count Surveys					
MPC01	MSdw	Grassland	3.5	2.5	0.89
MPC02	MSdw	Grassland	4.5	2.5	0.85
MPC03	MSdw	Grassland	0.0	0.0	-
MPC04	MSdw	Grassland	0.0	0.0	-
MPC05	MSdw	Grassland	2.3	1.0	0.24
MPC06*	MSdw	Grassland	2	2	0.60
MPC07	MSdw	Grassland	14.5	3.5	0.89
MPC08*	MSdw	Grassland	1	1	0.00
MPC09	MSdw	Forest	4.0	2.0	0.38
MPC10	MSdw	Wetland	29.5	4.0	0.80
MPC11	MSdw	Wetland	5.5	2.5	0.86
MPC12	MSdw	Forest	10.5	1.5	0.53
MPC13	MSdw	Wetland	2.5	1.5	0.46
MPC14*	MSdw	Wetland	1	1	0.37
MPC15*	MSdw	Forest	0	0	-
MPC18	MSdw	Wetland	17.0	4.5	0.93
MPC19	ESSFdk1	Wetland	5.0	2.5	0.64
MPC20*	MSdw	Wetland	1	1	0.37
MPC23*	ESSFdk1	Avalanche Chute	2	2	0.60
MPC25*	MSdw	Wetland	9	4	0.84
CM0100*	ESSFdk1	Forest	0	0	-
MSW02*	ESSFdk1	Forest	3	2	0.64
WL1*	MSdw	Wetland	2	2	0.69
Total			6.0	2.0	0.52
Transect Surveys					
MTC1-01*	MSdw	Forest	6	4	1.33
MTC1-02*	MSdw	Forest	2	2	0.69

Survey ID	BEC Subzone	Dominant Land Cover Type	Average Relative Abundance	Average Species Richness	Average Shannon-Weiner Diversity Index
MTC1-03*	MSdw	Forest	6	2	0.45
MTC1-04*	MSdw	Forest	8	4	1.32
MTC1-05*	MSdw	Forest	6	6	1.79
MTC1-06*	MSdw	Forest	5	5	1.61
MTC1-07*	MSdw	Forest	43	6	1.44
Total			10.9	4.1	1.23

*Value based on a single visit.

Land Cover Associations

Transect surveys were conducted in one BEC subzone (MSdw) and land cover type (forest), so population metrics across BEC subzones and land cover types were not determined for the transects. Point counts were completed in two BEC subzones, MSdw and ESSFdk1 (**Figure 3-8**). The BEC subzone with the highest average relative abundance (6.4 ± 1.9), species richness (2.0 ± 0.3), and Shannon-Weiner Diversity Index (0.52 ± 0.07) was MSdw (**Table 3-14; Figure 3-13; Appendix B4**). In ESSDdk1, the average relative abundance was 3.0 ± 0.9 , the species richness was 1.8 ± 0.5 , and the Shannon-Weiner Diversity Index was 0.50 ± 0.13 (**Figure 3-13**).

The most abundant species in the MSdw subzone included Dark-Eyed Junco (54), Bohemian Waxwing (40), and Black-capped Chickadee (20; **Table 3-14**). The most abundant species in the ESSFdk1 subzone included Red Crossbill (*Loxia curvirostra*; 4) and Golden-crowned Kinglet (3; **Table 3-14**).

Table 3-14: Number of Individual Birds Observed Across BEC Subzones during the Fall Migration Point Count and Transect Surveys

Species	BEC Subzone		Total
	MSdw	ESSFdk1	
American Robin	6	0	6
Belted Kingfisher	2	0	2
Black-capped Chickadee	20	0	20
Bohemian Waxwing	40	0	40
Brewer's Blackbird	1	0	1
Brown Creeper	1	0	1

Species	BEC Subzone		Total
	MSdw	ESSFdk1	
Cassin's Finch	13	0	13
Cassin's Vireo	0	0	0
Cedar Waxwing	12	0	12
Common Raven	4	0	4
Cooper's Hawk	1	0	1
Dark-eyed Junco	55	4	59
Downy Woodpecker	2	0	2
Golden-crowned Kinglet	6	3	9
Hairy Woodpecker	5	0	5
Hermit Thrush	3	0	3
Mountain Bluebird	1	0	1
Mountain Chickadee	13	0	13
Northern Flicker	1	0	1
Northern Goshawk	1	0	1
Olive-sided Flycatcher	1	0	1
Pine Siskin	20	0	20
Red Crossbill	16	4	20
Red-breasted Nuthatch	9	1	10
Ruby-crowned Kinglet	10	0	10
Sharp-shinned Hawk	0	1	1
Song Sparrow	1	0	1
Unidentified Chickadee	2	0	2
Unidentified Sparrow	2	0	2
Unidentified Woodpecker	1	0	1
Varied Thrush	3	0	3
White-crowned Sparrow	2	0	2
White-throated Sparrow	1	0	1
White-winged Crossbill	7	0	7
Yellow Warbler	10	0	10
Yellow-rumped Warbler	11	1	12

Species	BEC Subzone		Total
	MSdw	ESSFdk1	
Total	283	14	297
No. Point Count Survey Replicates	32	5	37
Average Relative Abundance per Point Count Location	6.4	3.0	6.0

Note: Incidental observations not included.

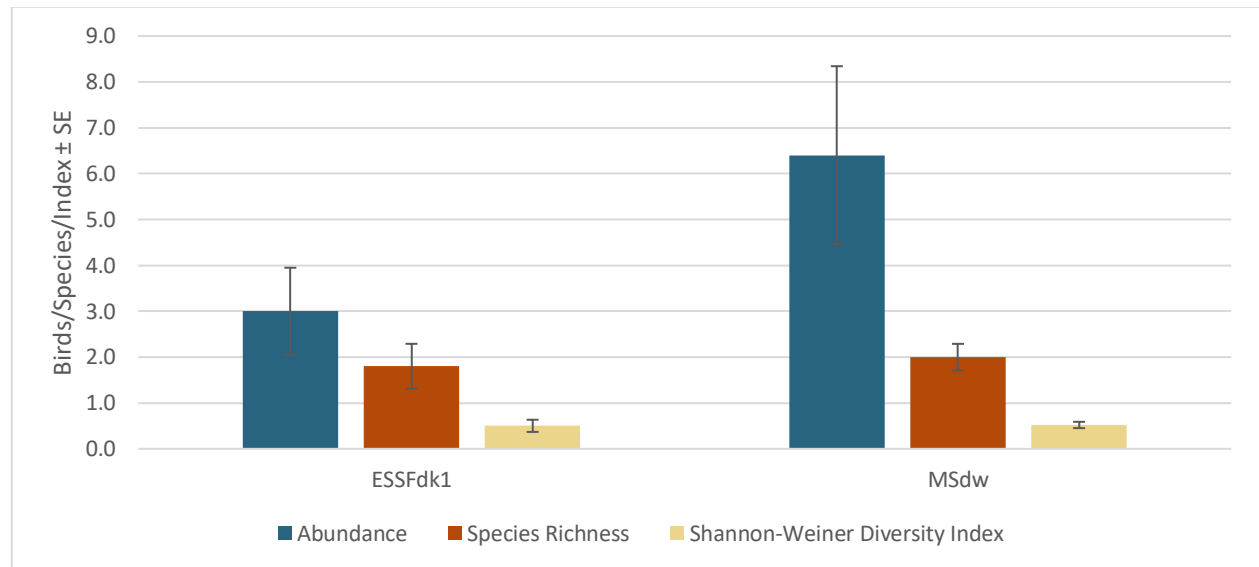


Figure 3-13: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the Fall Migration Point Count Surveys in the ESSFdk1 and MSdw BEC Subzones of the LSA

Birds observed across land cover types during the point count and transect surveys are detailed in **Table 3-15**. Wetlands were the land cover type with the most survey replicates (**Table 3-15**). The land cover type with the highest average relative abundance (9.4 ± 4.0), species richness (2.7 ± 0.4), and Shannon-Weiner Diversity Index (0.69 ± 0.07) was wetlands (**Table 3-15; Figure 3-14; Appendix B4**). Relative abundance ranged from 1 to 54 birds; species richness ranged from 1 to 6; and diversity ranged from 0.36 to 1.14 in wetlands (**Appendix B4**). Mixed shrub forests and grasslands were the second and third most diverse land cover types, with average Shannon-Weiner Diversity Indices of 0.59 ± 0.27 and 0.38 ± 0.13 , respectively, with ranges of 0.00 to 1.03 in mixed shrub forests and 0.00 to 1.10 in grasslands (**Appendix B4**). Mixed shrub forests and forests were the second and third most abundant and species rich, followed by grasslands. The single avalanche chute survey location had the lowest levels of these metrics based on a single observation.

Dark-eyed Junco were the most abundant species in forests (12) and mixed shrub forests (20); Black-capped Chickadee (7) were the most abundant species in grasslands; and Bohemian Waxwing (40) were the most abundant species in wetlands (**Table 3-15**). Only two individuals were observed

in the single avalanche chute location; one Golden-crowned Kinglet and one Sharp-shinned Hawk (*Accipiter striatus*).

Table 3-15: Birds Species Observed Across Land Cover Types during the Fall Migration Point Count and Transect Surveys

Species	Land Cover Type					Total
	Avalanche Chute	Forest	Grassland	Mixed Shrub Forest	Wetland	
American Robin	0	0	0	1	5	6
Belted Kingfisher	0	0	1	0	1	2
Black-capped Chickadee	0	2	7	6	5	20
Bohemian Waxwing	0	0	0	0	40	40
Brewer's Blackbird	0	0	0	0	1	1
Brown Creeper	0	0	0	0	1	1
Cassin's Finch	0	0	5	8	0	13
Cedar Waxwing	0	0	0	12	0	12
Common Raven	0	1	0	2	1	4
Cooper's Hawk	0	0	0	0	1	1
Dark-eyed Junco	0	12	0	20	27	59
Downy Woodpecker	0	0	0	2	0	2
Golden-crowned Kinglet	1	0	0	3	5	9
Harry Woodpecker	0	0	3	2	0	5
Hermit Thrush	0	0	1	0	2	3
Mountain Bluebird	0	0	0	1	0	1
Mountain Chickadee	0	0	0	6	7	13
Northern Flicker	0	0	0	1	0	1
Northern Goshawk	0	0	0	0	1	1
Olive-sided Flycatcher	0	0	0	0	1	1
Pine Siskin	0	0	1	16	3	20
Red Crossbill	0	0	2	14	4	20
Red-breasted Nuthatch	0	0	0	9	1	10
Ruby-crowned Kinglet	0	4	0	4	2	10
Sharp-shinned Hawk	1	0	0	0	0	1
Song Sparrow	0	0	0	0	1	1
Unidentified Chickadee	0	0	1	0	1	2
Unidentified Sparrow	0	0	0	1	1	2
Unidentified Woodpecker	0	0	0	1	0	1
Varied Thrush	0	0	2	0	1	3
White-crowned Sparrow	0	0	0	0	2	2
White-throated Sparrow	0	1	0	0	0	1
White-winged Crossbill	0	0	0	0	7	7

Species	Land Cover Type					Total
	Avalanche Chute	Forest	Grassland	Mixed Shrub Forest	Wetland	
Yellow Warbler	0	10	0	0	0	10
Yellow-rumped Warbler	0	1	0	0	11	12
Totals	2	31	23	109	132	292
No. Point Count Survey Replicates	1	7	11	4	14	37
Average Relative Abundance per Point Count Location	2.0*	4.6	2.1	8.0	9.4	6.0

Note: Incidental observations not included.

* Value based on a single survey.

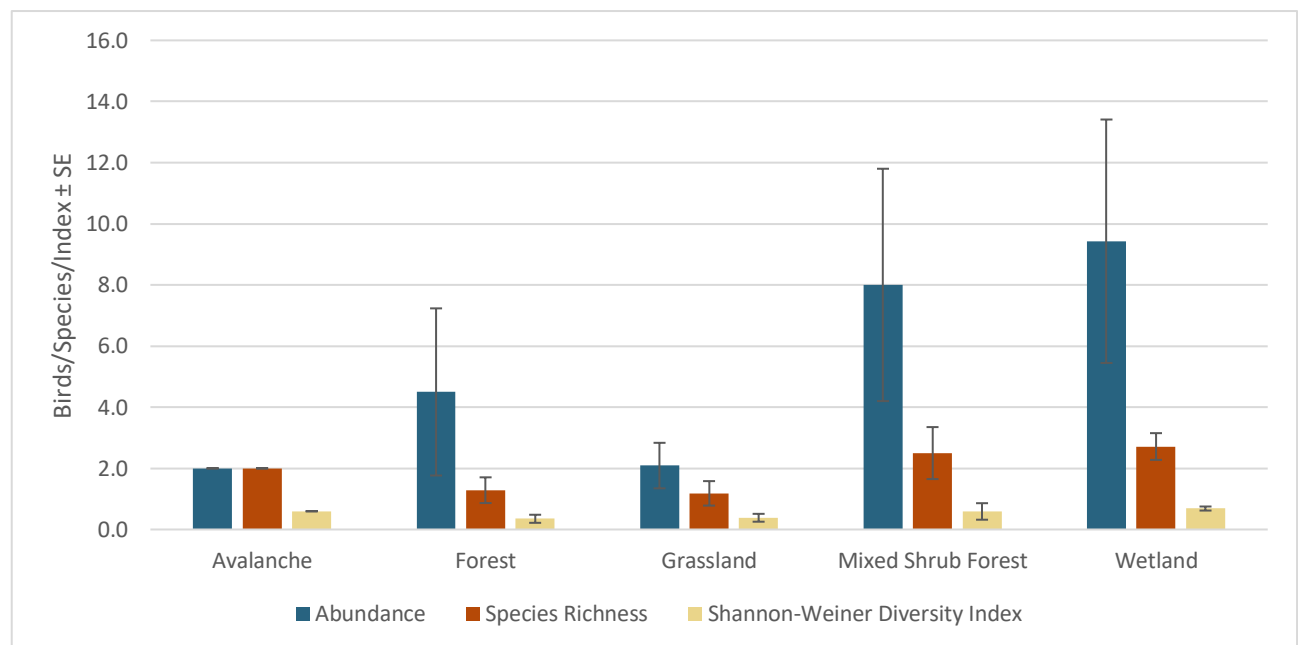


Figure 3-14: Average Relative Abundance, Species Richness, and Shannon-Weiner Diversity Index for the Fall Migration Point Count Surveys for Each Dominant Land Cover Type in the LSA

3.2.3.3

Seasonal Comparison

During the landbird migration surveys in 2018 and 2019, 51 species were observed during the spring surveys and 33 species during the fall surveys. The point count surveys detected 654 individual birds in the spring and 221 in the fall. Transect surveys documented 224 individual birds in the spring and 76 in the fall. Across all point count locations, average abundance was similar between seasons (7.7 in the spring and 6.0 in the fall); however, average richness (4.5 species in the spring versus 2.0 in the fall) and Shannon-Weiner Diversity Index (1.24 versus 0.52) were both greater in the spring. Transect surveys conducted in the fall were not replicated so a seasonal comparison between the transect survey results was not possible.

Across the two BEC subzones surveyed, relative abundance in the spring and fall were similar but species richness and diversity were higher in the spring. Mixed shrub forest was the land cover type with the highest abundance, species richness, and diversity in the spring, while wetlands had the highest of these metrics in the fall.

Although species composition in the BEC subzones varied across the seasons surveyed, Dark-Eyed Junco were consistently among the most abundant species in MSdw and Golden-crowned Kinglet were among the most abundant in ESSFdk1 in both the spring and fall. Species composition across land cover types differed between the spring and fall; for example, Pine Siskin were the most abundant in wetlands in the spring but Bohemian Waxwing were the most abundant in the fall and American Robin were the most abundant in grasslands and mixed shrub forests in the spring but Black-capped and Dark-eyed Junco were the most abundant species in grasslands and mixed shrub forests in the fall, respectively.

3.2.4

Discussion

Landbirds were observed in the LSA during the spring and fall migration surveys in 2018 and 2019. Although it is difficult to distinguish migrating birds from residents, for those that have winter ranges that overlap the Project, it is likely that most of the birds observed in the LSA during these times were migratory. Most of the survey locations were located in or near a water feature, such as a wetland or river, or a grassland opening. These areas tend to be warmer in the spring, with snow melting away earlier than in surrounding areas, and the ground and vegetation were more accessible.

Although the fall survey effort was limited (six days in total), the survey results suggest that birds may be using the LSA differently in the fall than in the spring. For example, grasslands that had higher bird abundances in the spring were not as heavily used in the fall. Although the reason for decreased grassland use in the fall is not clear, possible explanations include: survey timing; vocalizing; food availability; temperature; cover; and visibility (i.e., higher erect vegetation in the fall). Moreover, migration routes, stopover locations, rates, and timing are known to differ between the spring and fall (Petit, 2000). Other land cover types, such as wetlands and mixed shrub-forests, had similar results between seasons.

Only eight point count locations and one transect location in the spring and two transects in the fall had an average Shannon-Weiner Diversity Index within the typical range of 1.5-3.5 (the rest were less than 1.5). This suggests that overall bird diversity was low and that numbers of individuals are not evenly distributed between all the species (Gaines, Harrod, & Lehmkuhl, 1999). Unfortunately, nearby existing projects where biological studies have been completed, such as baseline programs at nearby mine sites (e.g., Teck Elkview Operations and Line Creek Operations), did not include surveys during the migration seasons. Other information pertaining to habit use by migratory birds in the general area of the Project is limited.

In the fall, there were a number of large flocks (groups of more than five birds from a single species) observed that were not observed in the spring, nor in the summer. Species observed in large flocks in the fall included: Bohemian Waxwing (40), Cedar Waxwing (12), Dark-eyed Junco (20; seen in large flocks multiple times), Yellow Warbler (10), and Pine Siskin (10). Although Bohemian Waxwing are not known to breed in East Kootenay, they form large flocks in the winter that range nomadically south in response to food supplies (Ryder, 2015a). It therefore possible that the flock observed in the LSA during the baseline study was migrating south in search of food.

There were eight species observed during the migration season that were not observed in the summer breeding season. Of these species, Black-billed Magpie, Brewer's Blackbird, Clay-coloured Sparrow, Gray-crowned Rosy-Finch, Savannah Sparrow, and Steller's Jay are likely to occur in the LSA during the summer (Jardine & Thomas, 2015; Siddle, 2015; Ryder, 2015a; Martell, 2015; Ryder, 2015b; Thomas & Jardine, 2015). Bohemian Waxwing and Yellow-headed Blackbird have not been recorded to breed in the vicinity of the LSA (Davidson, 2015a; Ryder, 2015c), and it is therefore possible that these two species are truly migratory within the LSA.

There were a number of potential study limitations that may have affected the landbird migration survey results. Survey timing may not have adequately captured the migration windows, as peak migration is difficult to determine and is variable between years (Petit, 2000). Weather conditions also varied between the survey years, and site access was limited, which resulted in limited coverage of the LSA and its environmental features (i.e., BEC subzones).

4.0 Raptors

Raptors are birds of prey and include hawks, eagles, falcons, and owls. Raptors are widespread in BC and occupy nearly all terrestrial habitats (Caskey & Chutter, 2013). Fourteen raptor species have the potential to occur in East Kootenay, and Osprey (*Pandion haliaetus*) are particularly known to be common in this region due to the abundance of fish-bearing waterbodies and watercourses (Caskey & Chutter, 2013). For the purposes of this baseline report, Turkey Vulture (*Cathartes aura*) have been included with raptors, although they eat carrion and are more closely related to storks (University of Missouri, 2019).

Prey abundance is considered to be one of the most important factors influencing raptor dispersal (Widen, 1994). Raptors are generally long-lived birds that feed at high trophic levels; as such, they are considered good ecological indicators for environmental pollution and habitat degradation and destruction (Ministry of Sustainable Resource Management, 2001). In addition to the need for adequate prey, raptors also require habitat suitable for hunting. Many raptors hunt using perches on large, often dead trees or conspicuous upright structures that provide clear views of their prey (either in the ground or air space), and it has been shown that raptors significantly favour habitats with perches (Widen, 1994).

Raptor nests and nest sites vary among species and include buildings (e.g., Barn Owl [*Tyto alba*]), cliff ledges (e.g., Turkey Vulture; Peregrine Falcon [*Falco peregrinus*]), marsh vegetation (e.g., Northern Harrier [*Circus hudsonius*]), trees (e.g., Sharp-shinned Hawk; Bald Eagle [*Haliaeetus leucocephalus*]), and tree cavities (e.g., small owls or kestrels; Caskey & Chutter, 2013). Raptors have been identified as both conspicuous and non-conspicuous breeders (Ministry of Sustainable Resource Management, 2001). Conspicuous breeding raptors have large nests in open habitat, soaring flight, and/or perches in the open, which make them easier to detect (Ministry of Sustainable Resource Management, 2001). Conspicuous breeders include Turkey Vulture, Osprey, eagles, most hawks, some falcons, and Burrowing Owl (*Athene cunicularia*; Ministry of Sustainable Resource Management, 2001). In contrast, inconspicuous breeding raptors, which include most species of owls, Sharp-shinned Hawk, Cooper's Hawk (*Accipiter cooperii*), Northern Goshawk, and Merlin (*Falco columbarius*), are nocturnal and have hidden nest sites and secretive hunting techniques (Ministry of Sustainable Resource Management, 2001).

In BC, raptors generally breed in the early spring. The timing and duration of breeding and egg laying varies by species, but typically occurs between March and July (Caskey & Chutter, 2013). Notable exceptions are Bald Eagle, Great Horned Owl, and Red-tailed Hawk (*Buteo jamaicensis*), which are known to lay eggs as early as February 5, February 10, and February 26, respectively (Caskey & Chutter, 2013). The majority of young raptors fledge by the end of August; however, Burrowing Owl and Short-eared Owl (*Asio flammeus*) may have young present at the nest into mid- to late-September and Barn Owl nest year round (Caskey & Chutter, 2013).

Raptor-specific migration and resident surveys were conducted as part of the bird community baseline program and are summarized in **Section 4.0**. Specifically, the subsections and surveys described include:

- **Section 4.1** Migratory Raptors;
- **Section 4.2** Northern Goshawk;
- **Section 4.3** Owls; and,
- **Section 4.4** Other Raptor Observations.

4.1 Migratory Raptors

4.1.1 Introduction and Objectives

In North America, many birds groups, including raptors, are migratory, meaning that they move seasonally for the purpose of moving to a new location where conditions are alternately favourable (Dingle & Drake, 2007). The majority of migrating North American raptors move in a latitudinal direction and are partial migrants, meaning that less than 90% of the population migrates and the species' winter and summer ranges broadly overlap (Goodrich & Smith, 2008). The distance raptors migrate varies significantly among and within species (Goodrich & Smith, 2008). For example, Swainson's Hawk (*Buteo swainsoni*) are long-distance migrants that may travel more than 5,000 km one way, while Red-tailed Hawk are short- to moderate-distance migrants that may migrate less than 500 km (Goodrich & Smith, 2008). In contrast, Northern Goshawk are primarily non-migratory in BC (Caskey & Chutter, 2013). Some Turkey Vulture populations in BC are long-distance migrants, while others are non-migratory (Davidson, 2015b).

The annual timing of raptor migration in North America varies by species (Goodrich & Smith, 2008). For example, Sharp-shinned Hawk begin their spring migration through the southern interior of BC in early April, and begin their fall migration in September and October (Caskey & Chutter, 2013). The Golden Eagle (*Aquila chrysaetos*) spring migration begins earlier than this (March to April), while the Cooper's Hawk fall migration extends longer (August to November; Caskey & Chutter, 2013). In addition, there are age and sex-specific differences in the timing of migratory movements (Goodrich & Smith, 2008). Migrating raptor species concentrations observed along the same migration route may also differ in the spring and fall (Caskey & Chutter, 2013; Goodrich & Smith, 2008).

Some raptor species converge and migrate along distinct routes (flyways) and are concentrated by geographic features such as mountains, lakes, and rivers (Goodrich & Smith, 2008). The flyways raptors use vary across species and populations (Goodrich & Smith, 2008). Kerlinger (1989) and Bildstein (2006) found that variation in raptor migration resulted from multiple factors, including topography, water barriers, species behaviour, ecology, and meteorology (as cited in Goodrich & Smith, 2008). In BC, known flyways used by raptors include the Pacific Coast, Intermountain, and Rocky Mountain corridors (Goodrich & Smith, 2008). Notably, a Golden Eagle north-south flyway has also been identified to the east of the LSA, between the LSA and the Livingstone Mountain

Range in Alberta (RMERF, n.d.). These flyways are often associated with geographical features such as shorelines and mountain ridges and provide an opportunity to observe raptors where they become concentrated (Ministry of Sustainable Resource Management, 2001).

Migrating raptors cannot be easily distinguished from resident raptors; however, the use of the LSA in the spring and fall by either migrating or resident raptors was determined. Diurnal raptor surveys were conducted during the spring and fall to understand where potential migration routes may occur within the LSA, to identify which species are present in the LSA during the spring and fall, document habitat types used by migratory raptors, and to generate estimates of raptor relative abundance and species richness in the spring and fall.

4.1.2 Methods

Survey methods followed the standwatch procedures listed in the *Inventory Methods for Raptors* (Ministry of Sustainable Resource Management, 2001). These procedures focus on the key geographical features that raptors may be using for migration, and can easily be replicated, particularly during the spring snowmelt season during which site access and travel are limited (Ministry of Sustainable Resource Management, 2001). Six standwatch survey locations were selected based on accessibility, vantage point, range of visibility of key geographical features, and coverage throughout the LSA. Surveys were conducted in the spring and fall of 2018 and replicated in 2019 (**Table 4-1**). Access to the LSA during the winter and early spring was limited due to safety concerns caused by avalanche conditions, which affected the timing of the surveys. In 2018, surveys were conducted as early in the spring as possible, and in 2019, the surveys were conducted in mid- and late-spring. Weather conditions including temperature, cloud cover, and wind speed were recorded during each survey.

Key geographical features near which standwatch surveys were completed included: the Elk River, which runs north to south along the northwestern border of the LSA; Grave Prairie southwest of Grave Lake; Grave Creek, which runs east to west and cuts through a canyon between Sheep and Gaff Mountains; and Alexander Creek, which runs north to south (**Table 4-2**). Raptor migration standwatch survey locations and key geographical features are shown in **Figure 4-1**.

Table 4-1: Raptor Migration Standwatch Surveys Conducted in 2018 and 2019

Season	Dates	No. Days on Site	Number of Surveys
Spring 2018	April 22 - 25, 2018	4	4
Spring 2018	May 3 - 8, 2018	6	8
Fall 2018	October 4 - 5, 2018	2	5
Spring 2019	May 6 - 9, 2019	4	4
Spring 2019	May 22 - 25, 2019	4	6
Fall 2019	September 10 - 13, 2019	4	3
Total		24	30

Table 4-2: Geographical Features near each Raptor Migration Standwatch Survey Location

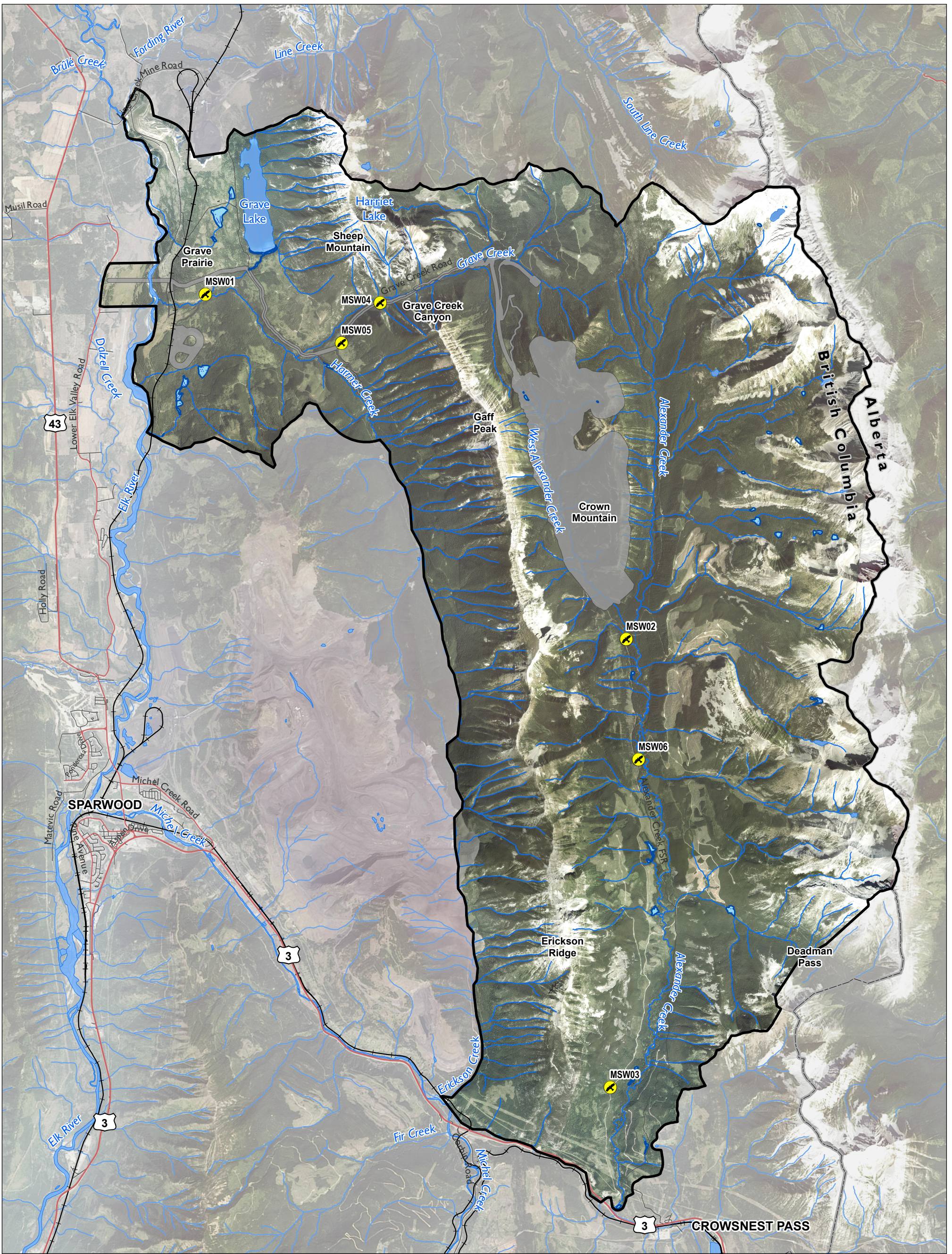
Station	Geographic Features
MSW01	Elk River, Grave Creek, Grave Prairie
MSW02	Upper Alexander Creek and Lower West Alexander Creek, mountains to the east
MSW03	Mid/lower Alexander Creek, mountains to the east and west
MSW04	Pass along Grave Creek between Sheep and Gaff Mountains
MSW05	Grave Creek, Harmer Creek
MSW06	Mid/Upper Alexander Creek, mountains to the east and west

Surveys were conducted for a period of one hour by two qualified biologists using 8x42 magnification binoculars and a 20-60x80 spotting scope. Biologists continuously scanned the skyline and any geographical features present in the view shed (e.g., rivers, mountain ridges) with the naked eye, binoculars, and the spotting scope. Surveys were conducted during the afternoon when the land had warmed up and created thermals that raptors use to passively soar for long distances.

Data collected for each raptor observed during the standwatch surveys included:

- Species, sex, and age class, to the extent possible;
- Relative height of flight;
- Position and flight path relative to the area of proposed development;
- Position and flight path relative to the topography of the area;
- Distance from observation point at first observation, and variations over duration of presence within the survey radius;
- Specific flight behaviour (such as soaring, flapping, circling, gliding, perching, hunting, and/or other);
- General cardinal direction of flight (i.e., S, SSW, NE); and,
- Notes describing the general activity of each bird.












Incidental observations of raptors were documented before or after standwatch surveys or during other spring and fall surveys as part of the bird community baseline program (i.e., landbird migration surveys; Northern Goshawk surveys; wetland bird surveys). The species, age, location, and behaviour were recorded for each incidental observation.



Crown Mountain Coking Coal Project

FIGURE 4-1.
Raptor Migration Standwatch Survey Locations

LEGEND

-  Standwatch Survey Locations
-  Wetland
-  Terrestrial Local Study Area
-  BC/Alberta Border
-  Project Footprint
-  Highways
-  Arterial Roads
-  Local/Resource Roads
-  Railway (Canadian Pacific)
-  Watercourse
-  Waterbody

0 1 2 3 4 Kilometers

SCALE 1:82,000

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4.1.3

Results

During the standwatch surveys in 2018 and 2019, 38 individual raptors were observed; an additional 75 individual raptors were incidentally observed (**Table 4-3**; see **Appendix C1** for detailed survey results). More raptors were observed in the spring than in the fall, and more raptors were observed in 2018 than in 2019 across both seasons (**Table 4-3**). The most raptors observed during the standwatch surveys was in spring 2018. Across all standwatch surveys, 1.4 raptors were observed per hour. The average number of species observed during an individual standwatch survey was 1.0 and the most species observed was 3 (see **Appendix C2** for complete population metrics for the standwatch surveys).

Table 4-3: Summary of Survey Effort, Total Raptors Observed, and Number of Raptors Observed per Hour

Year	Hours of Standwatch Surveys	No. Individual Raptors Observed	Individual Raptors Observed/Hour
Spring			
2018	12.0	25	2.1
2019	9.0	8	0.9
Fall			
2018	4.2	4	1.0
2019	2.5	1	0.4
Total	27.7	38	1.4

Seven raptor species were observed during the migration standwatch surveys: Bald Eagle, Golden Eagle, Osprey, Red-tailed Hawk, Cooper's Hawk, Northern Goshawk, and Turkey Vulture. In addition, incidental observations during the spring and fall included American Kestrel, Barred Owl, Broad-winged Hawk, Great Horned Owl, Merlin, Northern Harrier, Peregrine Falcon, and Sharp-shinned Hawk. In total, 14 species of raptors and Turkey Vulture were observed.

During the spring of both survey years, Red-tailed Hawk was the most frequently observed species during the standwatch surveys (10), as well as incidentally (18). During fall 2018 and 2019, Golden Eagle was the mostly frequently observed species (3) and Red-tailed Hawk (7) was the most frequently observed incidental species. Across all surveys, American Kestrel, Broad-winged Hawk, Peregrine Falcon, and Great Horned Owl were only seen once each. An active Osprey nest and the two parents were observed each year in the spring (see also **Section 4.4**). A summary of the spring and fall raptor migration surveys and incidental raptor observations is provided in **Table 4-4** and shown in **Figure 4-2** and **Figure 4-3**.

Table 4-4: 2018 and 2019 Raptor Migration Standwatch Survey Results and Incidental Raptor Observations

Species	Scientific Name	Standwatch Surveys		Incidental Observations		Total No. Observations
		Spring 2018-2019	Fall 2018-2019	Spring 2018-2019	Fall 2018-2019	
American Kestrel	<i>Falco sparverius</i>	0	0	1	0	1
Bald Eagle	<i>Haliaeetus leucocephalus</i>	4	0	1	0	5
Barred Owl	<i>Strix varia</i>	0	0	1	0	1
Broad-winged Hawk	<i>Buteo platypterus</i>	0	0	0	1	1
Cooper's Hawk	<i>Accipiter cooperii</i>	0	1	1	1	3
Golden Eagle	<i>Aquila chrysaetos</i>	5	3	0	0	8
Great Horned Owl	<i>Bubo virginianus</i>	0	0	1	0	1
Merlin	<i>Falco columbarius</i>	0	0	0	3	3
Northern Goshawk	<i>Accipiter gentilis atricapillus</i>	1	0	2	2	5
Northern Harrier	<i>Circus hudsonius</i>	0	0	2	2	4
Osprey	<i>Pandion haliaetus</i>	1	0	5	6	12
Peregrine Falcon	<i>Falco peregrinus</i>	0	0	1	0	1
Potential Northern Goshawk	<i>Accipiter gentilis atricapillus</i>	0	1	0	0	1
Red-tailed Hawk	<i>Buteo jamaicensis</i>	10	0	18	7	35
Sharp-shinned Hawk	<i>Accipiter striatus</i>	0	0	5	5	10
Turkey Vulture	<i>Cathartes aura</i>	2	0	10	0	12
Unidentified Eagle	---	3	0	0	0	3
Unidentified Raptor	---	7	0	0	0	7
Total		33	5	48	27	113

The number of raptors observed during a single survey ranged from 0 to 4 with an average of 1.3 (Table 4-5). Raptor migration standwatch stations were located in the Grave Prairie area, upper Grave Creek, Alexander Creek mainstem, and lower West Alexander (Figure 4-2 and Figure 4-3).

Incidental observations of raptors along Harmer Creek were also recorded during other bird community baseline surveys. The unidentified eagle, raptor, and potential Northern Goshawk observations were not included in the species richness calculations as the species could not be confirmed. During the spring, the station with the most raptors observations was MSW05 in upper Grave Creek. At MSW05, the average spring relative raptor abundance was 2.5 and the average species richness was highest in both the spring and fall. Station MSW03, located in lower Alexander Creek, had the highest average raptor abundance and average raptor species richness in the spring, but no raptors were observed at the station in the fall.

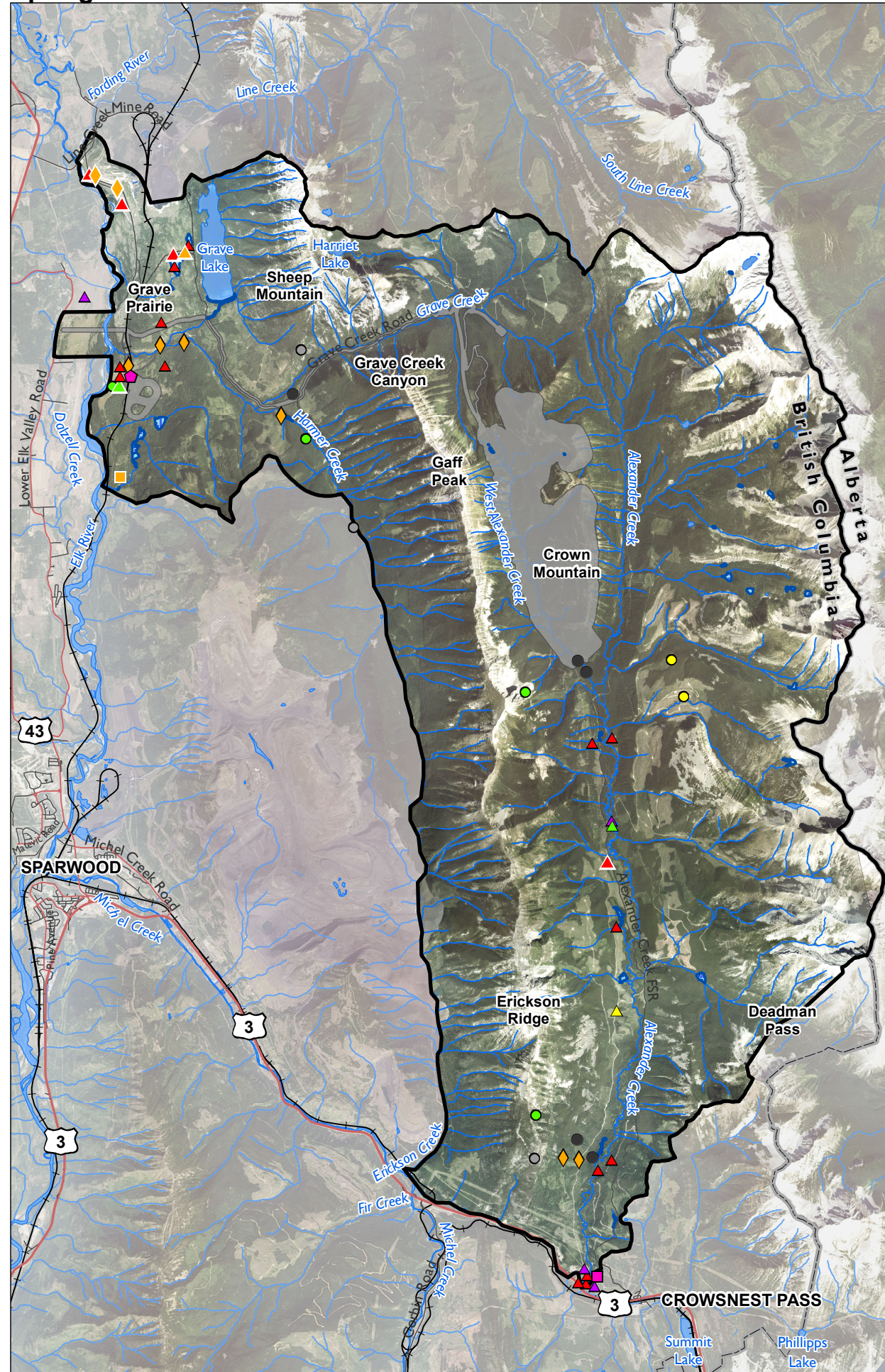
Table 4-5: Total Raptors Observed and Average Spring and Fall Relative Abundance and Species Richness at Each Raptor Migration Standwatch Survey Location

Station	Spring				Fall			
	No. Visits (Hours of Surveys)	No. Raptors Observed	Average Relative Abundance	Average Species Richness	No. Visits (Hours of Surveys)	No. Raptors Observed	Average Relative Abundance	Average Species Richness
MSW01	5 (5)	8	1.6	1.4	2 (2)	0	0.0	0.0
MSW02	5 (4.5)	7	1.4	1.0	2 (1.2)	1	0.5	0.5
MSW03	3 (3)	8	2.7	2.0	1 (1)	0	0.0*	0.0*
MSW04	3 (3)	0	0	0	2 (1.5)	1	0.5	0.5
MSW05	4 (4)	10	2.5	1.8	1 (1)	3	3*	2*
MSW06	2 (1.4)	0	0	0	Not Surveyed			
Total	22 (20.9)	33	1.5	1.1	8 (6.7)	5	0.6	0.5

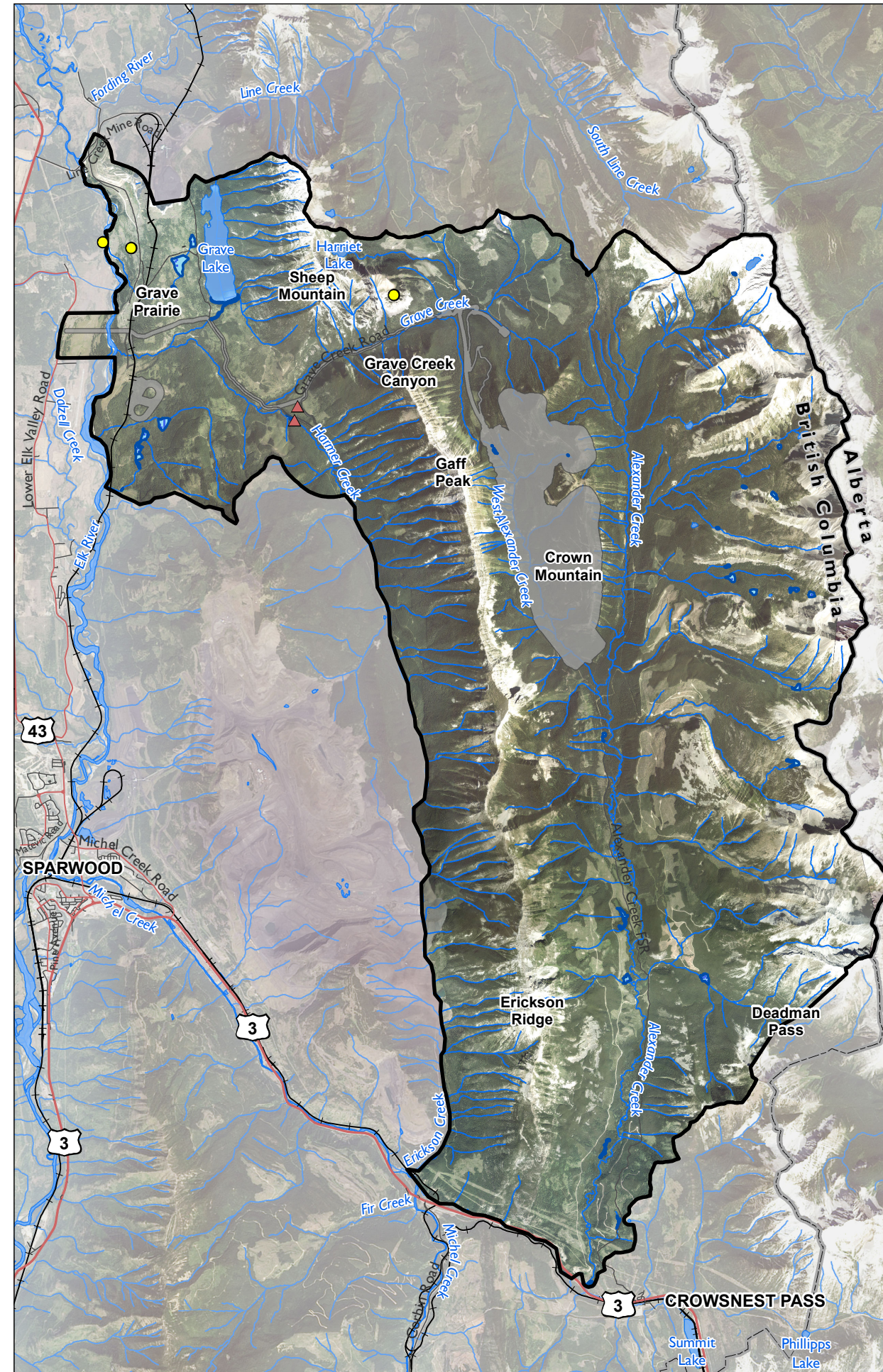
* Value based on a single visit.

In total, 48 raptors were incidentally observed in the spring of 2018 and 2019 over 17 days. Twenty seven raptors were incidentally observed in the fall of 2018 and 2019 over six days. Most incidental raptor observations occurred in the Grave Prairie area during both the spring (25) and fall (18; **Figure 4-2** and **Figure 4-3**). Alexander Creek had the second most incidental raptor observations with 19 observations in the spring and 7 in the fall. Harmer and upper Grave Creeks had between 0 and 3 observations in both seasons.

Spring 2018



Fall 2018



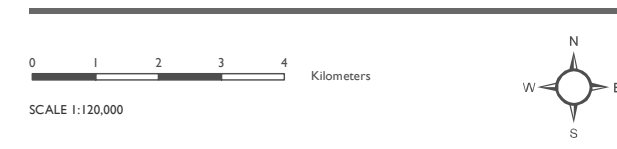
Crown Mountain Coking Coal Project

FIGURE 4-2.
Spring and Fall 2018 Raptor Observations

LEGEND

- Observed
- Incidental
- Eagles**
- Bald Eagle
- Golden Eagle
- Unidentified Eagle
- Falcons**
- American Kestrel
- ▲ Cooper's Hawk
- ▲ Northern Goshawk
- ▲ Northern Harrier
- ▲ Osprey
- ▲ Red-tailed Hawk
- ▲ Sharp-shinned Hawk
- Hawks**
- Unidentified Raptor
- Owls**
- Barred Owl
- Great Horned Owl
- Vultures**
- ◆ Turkey Vulture
- Unidentified**

- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- ▭ BC/Alberta Border



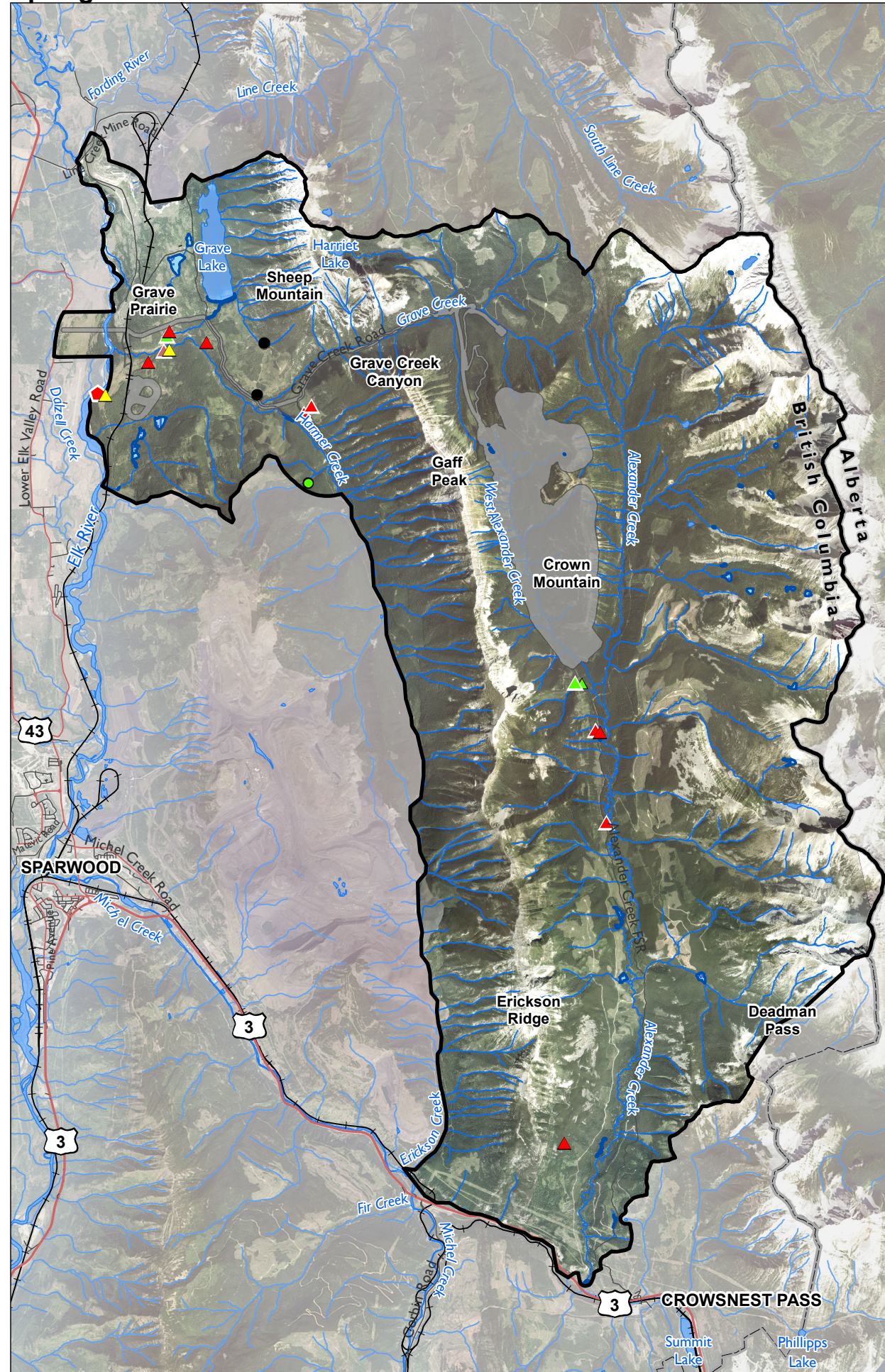
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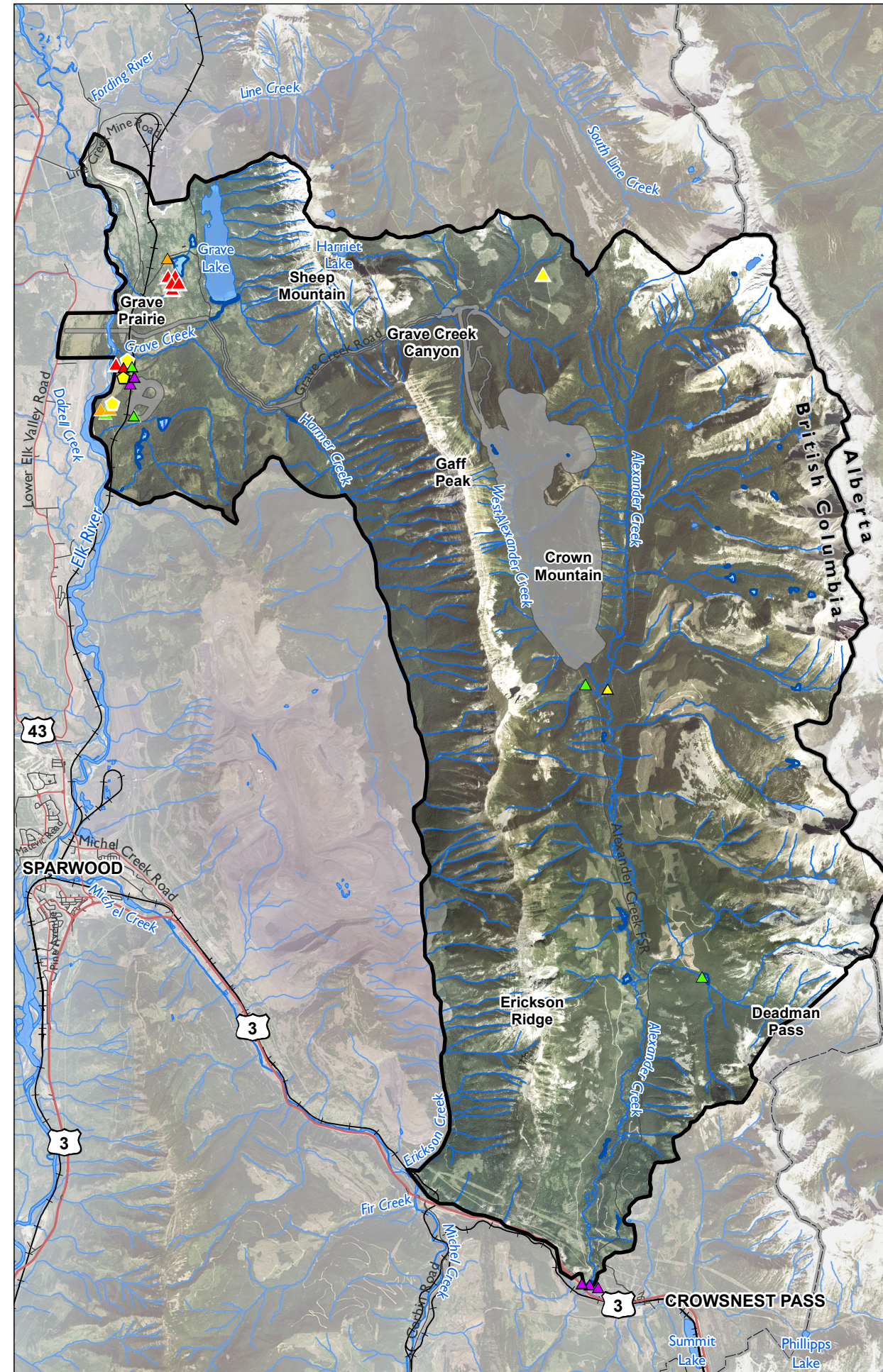
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Spring 2019



Fall 2019



Crown Mountain Coking Coal Project

FIGURE 4-3.
Spring and Fall 2019 Raptor Observations

LEGEND

- Observed
- Incidental
- Eagles**
- Bald Eagle
- Unidentified
- Falcons**
- ◆ Merlin
- ◆ Peregrine Falcon
- Hawks**
- ▲ Cooper's Hawk
- ▲ Northern Goshawk
- ▲ Northern Harrier
- ▲ Osprey
- ▲ Red-tailed Hawk
- ▲ Sharp-shinned Hawk
- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- ▭ BC/Alberta Border

0 1 2 3 4 Kilometers
SCALE 1:120,000



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PROJECT: 12-6231
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4.1.4

Discussion

The 2018 and 2019 raptor migration standwatch surveys and incidental raptor observations confirmed the presence of 14 raptor species and Turkey Vulture within the LSA in the spring and fall seasons. Raptor observations were limited; between zero and four raptors were observed during the hour-long surveys and, on average, less than two birds were observed per survey.

The Rocky Mountain Eagle Research Foundation (RMERF) monitors migratory raptor movements in the spring and fall at Mount Lorette and Beaver Mines in Alberta, and at Steeples Ridge in BC, located respectively to the north, southeast, and southwest of the LSA (RMERF, n.d.). The RMERF conducted spring migratory surveys at the Foundation's stations between March 1 and April 22 in 2018 and 2019. At all three stations surveyed, the highest day count of some species (e.g., Golden Eagle, Bald Eagle) was observed between mid- to late-March and early-April (Sherrington, 2018; Sherrington, 2019). The RMERF migratory surveys resulted in thousands of raptor observations over 51 days (approximately 519 hours of survey effort). For example, in the spring of 2019, the total raptor counts from March 1 to April 22 were 2,460 at Mount Lorette, 1,216 at Beaver Mines, and 455 at Steeples Ridge (Sherrington, 2019). In comparison, the migratory raptor surveys conducted as part of this study documented approximately two to five times fewer raptors (i.e., eight raptors over nine hours of survey effort in spring 2019), although species compositions between the Project and RMERF study areas were similar. Lower numbers of observations across the LSA may be due to the low abundance of raptors moving through the LSA, the limited survey window and duration of the surveys, or the limited number of survey locations.

In terms of seasonality, greater raptor relative abundance and species richness were observed during the migration standwatch surveys in the spring than in the fall. Other migratory raptor surveys in the Rocky Mountains have yielded variation between spring and fall raptor observations. For example, the RMERF Mount Lorette migratory raptor monitoring station in Alberta north of the LSA has also recorded varying counts between the spring and fall. As cited in Goodrich & Smith (2008), the RMERF has found that spring counts of Bald Eagle, Sharp-shinned Hawk, and Rough-legged Hawks routinely average at least 30% higher than fall counts and spring counts of Golden Eagle and Red-tailed Hawk were higher than fall counts in two years out of an 11 year study (1993 to 2005; RMERF, unpubl. data).

Few observations (five individuals of two confirmed species) of raptors occurred during the fall of 2018. These limited observations may be due to the timing of the surveys in October, when it may have been too cold for significant raptor activity.

The highest spring average raptor abundance was observed at Alexander Creek in the southern portion of the LSA (MSW03), while the highest fall average raptor abundance was observed in upper Grave Creek in the northwestern portion of the LSA (MSW05). The most incidental raptor observations occurred in the Grave Prairie area, east of the Elk River. Multiple habitat types are supported in this area including the Elk River and Grave Creek valleys, two prominent geographical

features that raptors may use as flyways. In addition, another unifying feature of the area is the typically open vegetation in the Grave Prairie area. At the confluence of Grave Creek with the Elk River, notable concentrations of raptors were recorded, particularly mid and small sized hawks (**Figure 4-2** and **Figure 4-3**). This grassland habitat may provide suitable hunting habitat for both resident and migratory raptors and create better thermals that attract raptors, or raptors are simply easier to see in open environments.

Only one observation was of a raptor species that is not known to breed in the region. In September 2019, a Broad-winged Hawk was observed perched near the Alexander Forest Service road in the mid-to-lower reaches of the creek. The hawk proceeded to fly south above the road until it was out of site. In BC, this species' breeding range is northwest of the LSA (Phinney, 2015), suggesting the individual was migrating through the LSA on route to its overwintering grounds (Goodrich, Crocoll, & Senner, 2014).

4.2 Northern Goshawk

4.2.1 Introduction and Objectives

The Northern Goshawk *atricapillus* subspecies, henceforth referred to as Goshawk, is a bird species within the hawk family and the largest hawk found in western North America (Kennedy, 2003). It is provincially blue-listed (BC CDC, 2005) and is considered Not at Risk by COSEWIC (Government of Canada, 2011). Goshawk have large home ranges, potentially up to 2,400 ha, and forage on a variety of small and medium sized birds and mammals (Ministry of the Environment, 1997). Their diets change seasonally based on what prey is available; species groups considered to be particularly important include Snowshoe Hare, grouse, and squirrel (both ground and tree) species (Kennedy, 2003). Goshawk forage and build large stick nests in dense mature and old-growth forest stands with open understories and high canopies (Kennedy, 2003). They are associated with mixed, open, dense mature coniferous forests; however, they have been recorded in almost every forest type in BC (Ministry of the Environment, 1997). Eggs are laid between late April and early May, and young are at the nest from late May to late August (Squires & Reynolds, 1997). Goshawk are considered to be resident species, but may move south or to warmer areas during times in which prey is limited (Ministry of the Environment, 1997).

Targeted surveys were conducted as part of the bird community baseline program to determine the occurrence (presence/non-detect) of Goshawk and, if present, to document the distribution of this species within the LSA.

4.2.2 Methods

4.2.2.1 Standwatch Surveys

Standwatch surveys are a common technique used for detecting Goshawk, particularly in the pre-nesting season during courtship (before May) and post-fledgling season (after August; Ministry of

Sustainable Resource Management, 2001). A total of 51 hour-long standwatch surveys were conducted in the spring and fall of 2018 and 2019 that targeted resident and migratory raptors, including Goshawk, at six unique locations throughout the LSA. The standwatch survey methods followed the procedures in the *Inventory Methods for Raptors* (Ministry of Sustainable Resource Management, 2001) and are described in detail in **Section 4.1**.

Targeted nest surveys were not completed with the LSA because this objective was met through call-playback surveys (see below) and habitat assessments. Field surveys confirmed that the LSA landscape is dominated by moderate to poor Goshawk habitat. The fragmented landscape in the LSA consists of many stands of young trees that are structurally unfavourable and suboptimal for Goshawk nesting (Kennedy, 2003). The *Inventory Methods for Raptors* (Ministry of Sustainable Resource Management, 2001) states that it "is important to consider [the objective of the study] due to the amount of time it will take to locate nests, and the potential disturbance it will cause to the birds". As such, specific nest surveys were not undertaken as per the RISC standard.

4.2.2.2

Call-playback Surveys

Daytime call-playback surveys were undertaken during the nestling season (May 15 to July 1) to survey for Goshawk, as recommended by the *Inventory Methods for Raptors* (Ministry of Sustainable Resource Management, 2001). Potential areas of suitable habitat for survey locations (forested and accessible) were randomly stratified across the LSA to concentrate surveys within habitats that were likely suitable for Goshawk. The LSA was divided into 100 m by 100 m grid cells. A random selection of accessible grid cells guided the initial survey location selection process. Final selection of the survey locations within the grid cells occurred in the field based on accessibility to the location and availability of suitable habitat. The final survey locations (referred to as "stations") are shown in **Figure 4-4**. Stations were spaced a minimum of 400 m apart. In total, 151 call-playback surveys were conducted at 51 stations between 2014, 2017, 2018, and 2019.

Surveys were diurnal and conducted in the mid to late afternoon. To control for observation bias due to weather conditions, surveys were conducted under optimal weather conditions only (i.e., no precipitation, calm winds [below 3 on the Beaufort scale], and temperatures greater than 5°C). Weather conditions were recorded at each station. As with other surveys conducted for the bird community baseline program, the surveys were completed by two experienced biologists. A cordless Bluetooth speaker was paired with a cell phone to broadcast the calls. During the playback surveys, juvenile begging calls or adult alarm calls and vocalizations that were appropriate for the time of year (i.e., the latter end of the breeding season, prior to fledging) were broadcasted to maximize the potential to elicit responses. The speaker was placed on the roof of the vehicle when surveys were conducted along the road, or placed on an elevated log or rock when in the forest. The speaker was turned 120° for each of the six recordings. The appropriate call was played six times, with one minute of silence between each, followed by five minutes of silent observation.

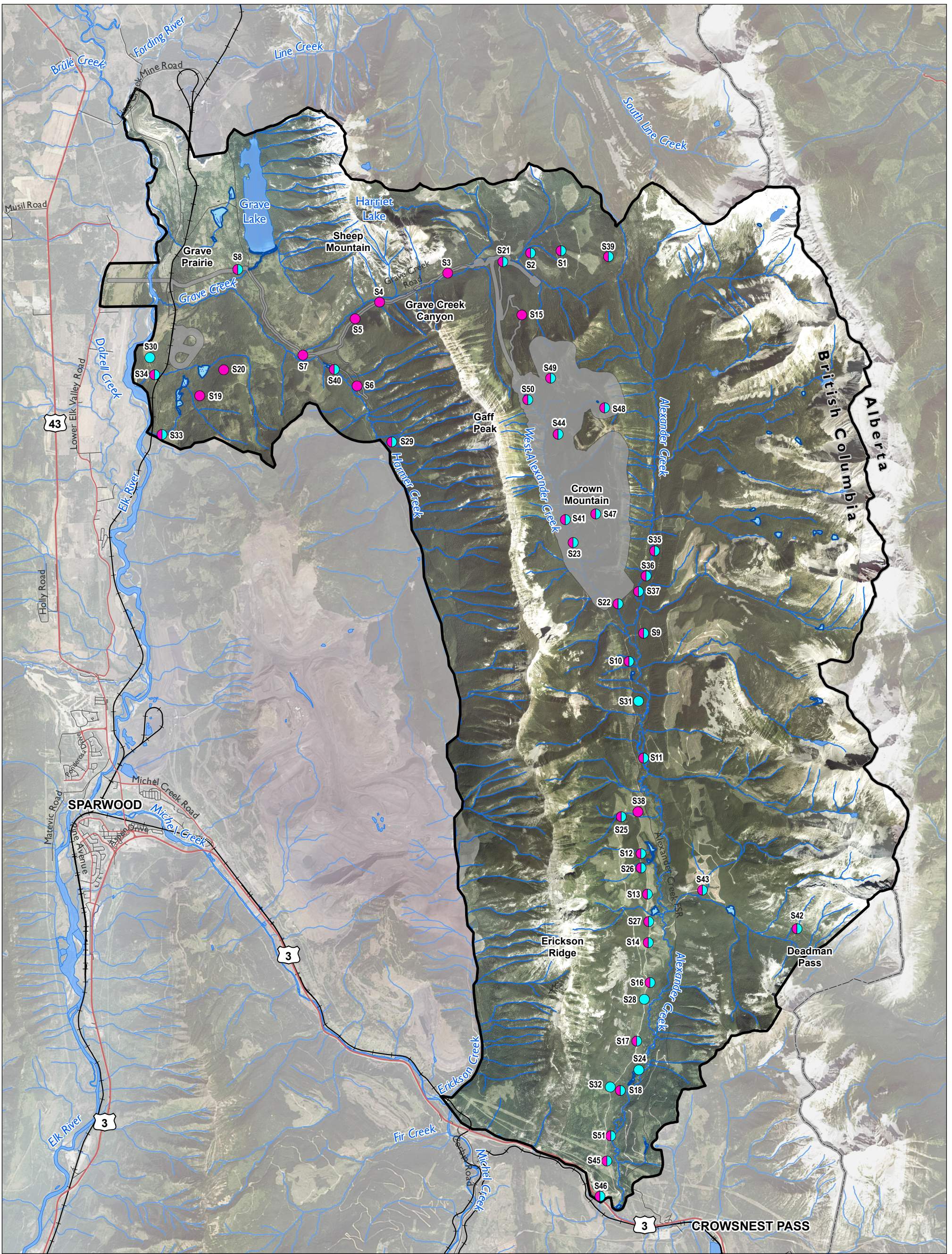
When a Goshawk was observed, playing of the recorded calls was stopped immediately. Notes were recorded on the bird's behaviour, location, and physical description (e.g., adult/juvenile plumage). Notes were recorded on the potential for nesting in the area. If suitable nesting habitat was observed, a nest search was undertaken in the area as per the *Inventory Methods for Raptors* (Ministry of Sustainable Resource Management, 2001). Incidental observations of other birds encountered were also recorded.

4.2.2.3

Habitat Assessments

Forty-two habitat assessments were conducted in July 2018 (13) and July 2019 (29; see **Photo 4-1** for an example of a typical station). Habitat assessment surveys were not completed at all call-playback stations due to lack of accessibility, in particular at the 2014 call-playback stations. The survey included covering, on foot, a 200 m area around the location of the call-playback station, and subsequent completion of the Goshawk Habitat Assessment Form.

A Goshawk Habitat Assessment Form was created for the bird community baseline program and used over the course of the surveys (see **Appendix C3** for an example). Structural aspects of Goshawk habitat were the basis of the assessment, which included a subjective semi-qualitative evaluation of habitat suitability using a relative rating system on a scale of 0 (nil) to 10 (excellent). The attributes were chosen because they are discernable and measurable in the field and are considered important habitat features for Goshawk nesting and foraging. Habitat survey locations are shown in **Figure 4-4** and detailed results are provided in **Appendix C4**. The dominant tree species were also recorded during each habitat assessment (**Appendix C5**).



Crown Mountain Coking Coal Project

FIGURE 4-4.
Northern Goshawk Call-playback and
Habitat Assessment Survey Locations

LEGEND

Call-playback Survey Location		Habitat Assessment Survey Location	
Terrestrial Local Study Area	Waterbody	Wetland	BC/Alberta Border
Project Footprint	Highways	Arterial Roads	Local/Resource Roads
Railway (Canadian Pacific)	Watercourse		

0 1 2 3 4 Kilometers

SCALE 1:82,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

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Map Projection: NAD 1983 UTM Zone 11N

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Photo 4-1: Northern Goshawk Survey Station S14 (June 5, 2014)

4.2.3 Results

4.2.3.1 Goshawk Population

During the 2014-2019 bird community baseline program 10 Goshawk were observed (**Table 4-6**). Given the low number of observations, relative abundance could not be determined. Goshawk were observed three times in response to call-playback surveys, three times incidentally, two times during migration point counts, and two times during migration standwatch surveys. The majority (six) of the Goshawk observations occurred in 2019. Of the 10 Goshawk observations, two occurred outside of the summer nesting period (June/July), three in May during the pre-laying/incubation phase, and three in September during the post-breeding season. Two of the birds observed were juvenile, which are distinguished from adults by a brown, streaky pattern on the breast and narrow dark tail bands (Cornell University, 2019). Complete survey results are provided in **Appendix C6**.

Goshawk observations occurred primarily in the mainstem of Alexander Creek (four), followed by West Alexander Creek (two), and in the Grave Prairie area, along the Elk River, near upper Grave Creek, and in Deadman Pass (one observation per location).

Table 4-6: Northern Goshawk Observations within the LSA

Identifier	Observation Date	Observation Type	Age	General Area	Dominant Land Cover
NOGO 1	June 8, 2014	Call-playback	Adult	Alexander Creek (mainstem)	Immature coniferous forest

Identifier	Observation Date	Observation Type	Age	General Area	Dominant Land Cover
NOGO 2	July 2, 2014	Incidental	Juvenile	Lower West Alexander Creek	Mature coniferous forest
NOGO 3	June 6, 2017	Call-playback	Adult	Alexander Creek (mainstem)	Immature coniferous forest
NOGO 4	May 3, 2018	Incidental	Adult	Alexander Creek (mainstem)	Mature coniferous residual within cutblock
NOGO 5	May 4, 2019	Migration Point Count	Adult	Elk River southwest of Grave Lake	Grassland/River
NOGO 6	May 7, 2019	Migration Standwatch	Adult	Grave Prairie area	Grassland/River
NOGO 7	July 9, 2019	Call-playback	Adult	Alexander Creek (mainstem)	Immature coniferous forest
NOGO 8	September 9, 2019	Incidental	Unknown	Upper Grave Creek	Mature coniferous forest
NOGO 9	September 12, 2019	Migration Standwatch	Adult	Lower West Alexander Creek	Mature coniferous forest
NOGO 10	September 13, 2019	Migration Point Count	Juvenile	Deadman Pass	Wetland

Goshawk responded to 3 of the 151 call-playback surveys conducted. Two of the three (NOGO1 and NOGO 7) were in the same location at Station 14. The third response (NOGO 3) was recorded at Station 17, a few km south of Station 14. Both stations are located along lower Alexander Creek (mainstem). The Goshawks responded on the upslope (west) side at station 14, and from the downslope (east) side closer to the creek at station 17. The majority of Goshawk observations were incidental (seven) and most (five) were made in 2019. The total number of Goshawk observed each year during the targeted call-playback surveys is summarized in **Table 4-7**.

Table 4-7: Northern Goshawk Call-playback Survey Summary

Year	No. Call-playback Surveys Conducted	No. Goshawk Responding to Call-playback Surveys	No. Goshawk Incidental Observations
2014	56	1	1
2017	40	1	0
2018	13	0	1
2019	42	1	5
Total	151	3	7

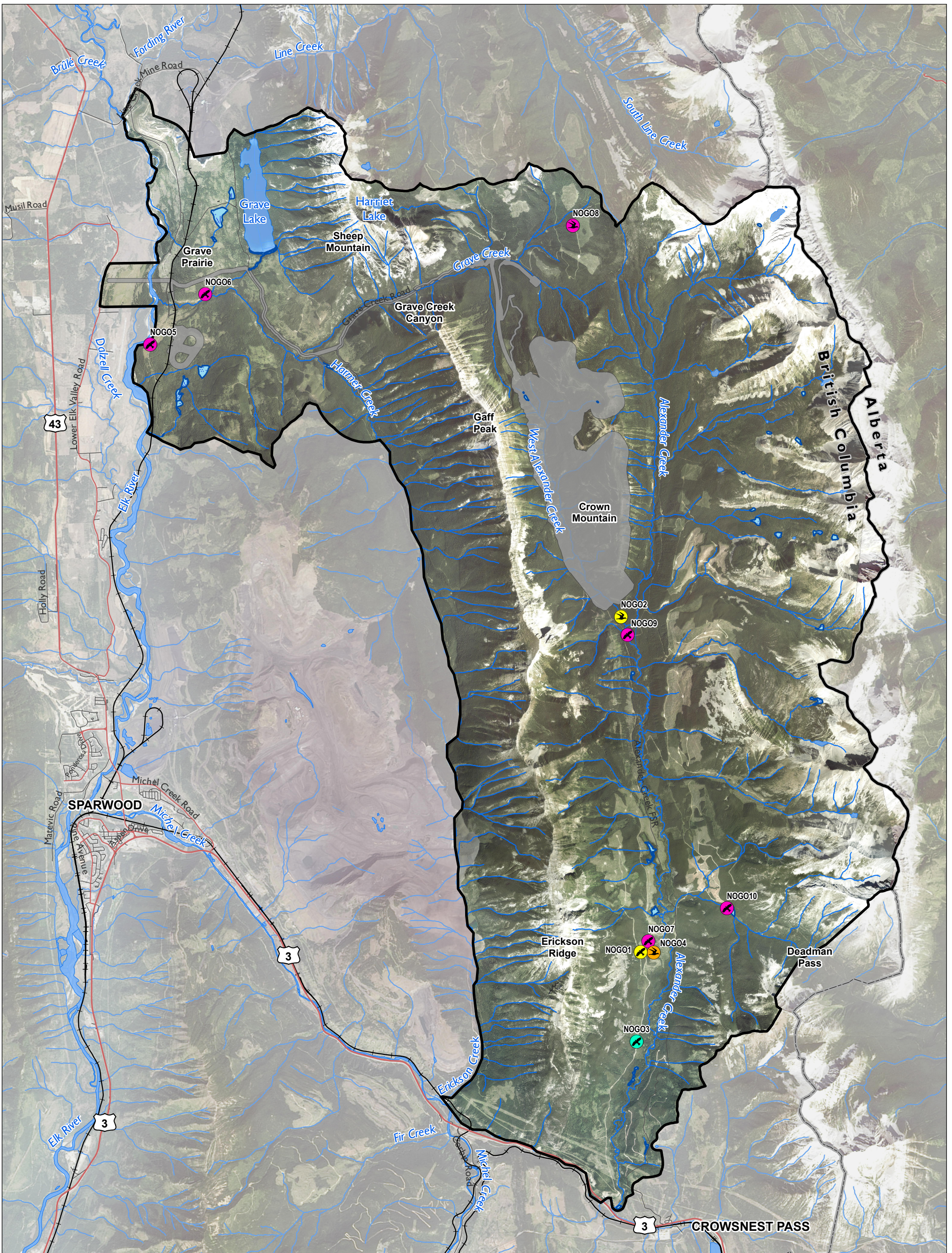


FIGURE 4-5.
Northern Goshawk Observations

LEGEND

Survey Observation	Arterial Roads
2014	Local/Resource Roads
2017	Railway (Canadian Pacific)
2018	Watercourse
2019	Waterbody
Terrestrial Local Study Area	Wetland
Project Footprint	BC/Alberta Border
Highways	

0 1 2 3 4 Kilometers

SCALE 1:82,000

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Map Projection: NAD 1983 UTM Zone 11N

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4.2.3.2

Goshawk Habitat

The habitat quality relative rating of the call-playback stations ranged from 1 to 6.5 (**Table 4-8**). The most frequent habitat rating encountered through the habitat assessments was 3, and the average rating across all habitat assessments was 3.3 (**Table 4-8**). The majority of stations were found to have few spaces and closed canopies (rating 1) or some spaces and flyways (rating 2), and seven stations were observed to have a sparse understory with flyways present (rating 3; **Table 4-8**). No Goshawk nests were observed during the habitat assessments.

Habitat assessments for all 42 stations assessed are provided in **Appendix C4**. Canopy cover at the habitat assessment stations was most often less than 40%. The structural stage ranged from 5 (young forest) to 6 (mature forest), with mature being the most dominant stage observed (generally 80 to 140 years old). At most assessment sites, less than 10% of the trees had a Diameter at Breast Height (DBH) of greater than 40 cm. Stand density ranged from trees far apart/sparse (0) to trees very close together/dense (4). The majority of stations had trees that were moderately and somewhat evenly spaced (2). Suitable nest tree abundance was ranked (0-4) based on the presence of large trees, large branches, and smaller trees with suitable nest platforms. Suitable nest tree abundance surrounding each station ranged from no large trees/branches (0) to abundant large trees (3), with the majority of stations having a few large trees suitable for nesting. The average stand height surrounding the stations was predominantly greater than 24 m (2), and the slope was primarily less than 60%. Twenty-nine of the habitats assessed did not have insular forest area (a portion of the forest greater than 200 m from a hard edge), while 13 habitats did have insular forest area.

The majority of the Goshawk observations occurred in forested areas; however, Goshawk were also observed in areas with edge habitats between forests and grasslands, and creeks and wetlands. Habitat surrounding the concentrated Goshawk observations around stations 14 and 17 included a mixture of mature coniferous forest with some mature deciduous trees, primarily along drainages, and recently harvested cutblocks that were replanted or contained natural regrowth of dense young conifers.

Station 14 had an overall subjective rating of 6 (**Appendix C4**). The habitat included mature forest dominated by Engelmann Spruce (40%), Lodgepole Pine (40%), and Trembling Aspen (20%). Understory and flyways (i.e., open sub-canopy) were sparse, and canopy cover was greater than 40%. The trees were moderately and somewhat evenly spaced and more than 10% were large diameter (DBH>40 cm). A few large trees were observed to provide suitable nesting habitat and the overall stand height was greater than 24 m. No insularity was observed.

In contrast, Station 17 had an overall subjective ranking of 2 and habitat was comprised of pole saplings dominated by Engelmann Spruce (50%) and Subalpine Fir (50%). Station 17 had closed/few flyway spaces and more than 40% canopy cover, and were trees situated close together, and less than 10% were large diameter (DBH>40 cm). Few large trees were observed that could provide

suitable nesting habitat, and the overall stand height was greater than 24 m. The forest was insular, with portions greater than 200 m from a hard edge.

Table 4-8: Results of the Northern Goshawk Habitat Surveys

General Area	Average Subjective Rating ¹	Average Flyway Rating ²	Average Canopy Cover ³	Average Structural Stage ⁴	Average No. Large Diameter Trees (DBH>40cm) ⁵	Average Stand Density ⁶	Average Suitable Nest Tree Abundance ⁷	Average Stand Height ⁸	Average Slope ⁹
Alexander Creek	3.38	1.84	1.50	5.84	1.38	2.31	1.81	1.81	1.88
Crown Mountain	1.67	1.00	1.00	6.00	1.00	3.00	1.33	1.00	1.00
Deadman Pass	2.00	1.00	1.50	5.00	1.00	3.00	0.50	1.00	2.00
Grave Creek	1.50	0.50	2.00	6.00	1.00	3.50	1.00	1.00	2.00
Grave Prairie	3.30	2.00	1.00	5.80	1.20	1.60	1.60	1.40	2.00
Harmer Creek	3.25	1.00	1.50	5.50	1.00	2.50	1.50	1.00	1.00
Upper Alexander Creek	5.25	1.50	1.50	5.75	1.75	2.25	2.00	1.75	1.75
Upper Grave Creek	3.50	2.00	1.00	6.00	1.50	2.50	2.00	2.00	1.50
West Alexander	3.67	1.67	1.33	6.00	1.67	2.17	2.25	1.83	1.83
Total	3.31	1.61	1.38	5.82	1.36	2.36	1.73	1.60	1.76

¹ Overall Subjectivity Rating: 0-10 Ratings: 0 = lowest/nil rating and 10=highest/greatest

(These are subjective ratings and estimations designed to give a general, reliable but not infallible impression/assessment).

² Flyways: 0 = closed/no flyway; 1=closed/few spaces; 2=some spaces/flyways; 3= sparse understory/flyways present; 4=no understory/unobstructed flyways.

³ Canopy Cover: Percentage foliage/canopy cover (in contrast to open space/sky) projected onto the ground 1 for <40% and 2 for >40%.

⁴ Structural Stage: 4 = pole/sapling; 5 = young forest; 6 = mature forest; 7 = old forest.

⁵ # of Large Diameter Trees (DBH>40cm): 1=<10% or 2=>10%.

⁶ Stand Density: 0 = trees sparse/far apart; 1= trees well-spaced/some large gaps; 2=trees moderately and somewhat evenly spaced; 3= trees close together; 4=trees very close together/dense.

⁷ Suitable Nest Tree Abundance: 0=no large trees, branches; 1=very few large trees; 2= a few large trees; 3=large trees abundant; 4=large trees abundant or comprising majority of trees.

⁸ Stand Height: 1=<24m and 2=>24m.

⁹ Slope: 1=<60%; 2=>60%.

4.2.4

Discussion

The 2014 and 2017 to 2019 observations of Goshawk indicate that this species is present within the LSA; however, this species may occur in limited numbers. The observations (10) were infrequent throughout the four survey years, including during targeted surveys for this species as described in **Section 4.2.2**. A low detection rate was anticipated as part of the bird community baseline program as Goshawk are known to have large territories and to avoid human disturbance (Ministry of the Environment, 1997).

Although observations of Goshawk were infrequent, they were distributed throughout the LSA. Occurrences were recorded in lower Alexander Creek (mainstem), lower West Alexander Creek, the Grave Prairie area, along the Elk River, near Upper Grave Creek, and in Deadman Pass. The habitat assessment stations with the highest overall subjectivity rating (5.5-6.5) were located near Alexander Creek (mainstem), West Alexander Creek, and in upper Alexander Creek.

Concentrated Goshawk observations around Station 14 (where NOGO1 and NOGO7 responded to a call-playback survey), an incidental observation (NOGO4), and nearby (within 5 km) observations at the wetland in Deadman Pass (NOGO10) and at Station 17 (NOGO3), may indicate that this area is part of a Goshawk's territorial home range.

The results of the habitat assessments of the sites surveyed suggests that the LSA offers primarily moderate to low quality Goshawk habitat. Of the 42 call-playback stations that were assessed for suitable Goshawk habitat, 19% were considered to be of moderate suitability or greater (overall rating >5). The rest (81%) were below a rating of 4.9. As previously noted, Goshawk have been found in almost every forested habitat in BC (Ministry of the Environment, 1997). In addition, based on the observation of an adult Goshawk at Station 17, which had an overall rating of 2, a low rating does not preclude Goshawk presence. It is important to note that Goshawk habitat is variable; individuals will occupy areas beyond those defined by a narrow set of structural elements and it is possible that prey species habitat may also influence site occupancy and use (Reynolds, Graham, & Boyce Jr., 2008). In other words, the attributes defined by the assessment form, and assessment results may suggest, but not indicate, optimal habitat conditions and greater likelihood of occupancy.

An expert-opinion model developed for Goshawk nesting habitat in East Kootenay suggested that over half the productive forest in the Cranbrook Timber Supply Area (TSA), which overlaps with the LSA, is capable of providing Goshawk nesting habitat (Stuart-Smith, Wells, & Harrower, 2011). However, only 26% of the habitat in the TSA was rated as moderate and high suitability, which is comparable to the 19% of the LSA with the same habitat rating. Although habitat availability for Goshawk in East Kootenay has increased over the last 100 years, the combined effects of climate change and forestry practices are anticipated to decrease habitat availability by three times within the next 100 years (Stuart-smith et al., 2011).

The Goshawk habitat assessment results were similar to the findings of the baseline study completed for Teck's Elkview Operations (2015), during which habitat assessments were completed at call-playback survey stations near the Elk River and Harmer Creek (Golder Associates, 2015a). None of the Baldy Ridge survey stations assessed for Northern Goshawk habitat suitability met the high-suitability nesting habitat criteria, and only 13% of the assessed survey stations were considered to be moderately suitable nesting habitat (Golder Associates, 2015a). Call-playback surveys consistent with RISC standards (and comparable to this study) were conducted in conjunction with the habitat assessment surveys and no Goshawk observations were confirmed (Golder Associates, 2015a). Historically, Northern Goshawk were observed in subalpine meadow and Engelmann Spruce-Lodgepole Pine habitats within and around Teck's Line Creek Operations (Teck Coal Ltd., 2011).

4.3 Owls

4.3.1 Introduction and Objectives

Fifteen owl species from the Tytonidae and Strigidae families occur in BC and all breed in BC with the exception of Snowy Owl, which overwinters in BC (Campbell & Preston, 2009). Eleven owl species are known to occur in East Kootenay, including: Barn Owl, Barred Owl, Flammulated Owl (*Psiloscops flammeolus*), Great Grey Owl (*Strix nebulosi*), Great Horned Owl, Long-eared Owl (*Asio otus*), Northern Hawk Owl (*Surnia ulula*), Northern Pygmy Owl (*Glaucidium gnoma*), Northern Saw-whet Owl (*Aegolius acadicus*), Short-eared Owl, and Western Screech Owl (*Megascops kennicottii*; Caskey & Chutter, 2013). In addition, Boreal Owl (*Aegolius funereus*) and Burrowing Owl have possible or confirmed breeding records immediately adjacent to the region (Caskey & Chutter, 2013).

As top predators, owls are good indicators of ecosystem health. Depending on the season and species, owls may be nocturnal, crepuscular, and/or diurnal (Ministry of Sustainable Resource Management, 2001). For example, Long-eared Owls are nocturnal, but may hunt during the day to feed their young (Ministry of Sustainable Resource Management, 2001). The distribution, population status, movements, habitat preferences, breeding, and diet of owls also vary by species (Caskey & Chutter, 2013). Given that Barn Owl and Short-eared Owl utilize open habitats, these species are more readily observed during roadside surveys conducted during these species' active periods (Ministry of Sustainable Resource Management, 2001).

Night time owl surveys were conducted to determine the presence of owls within the LSA, and, if present, to estimate habitat associations and the distributions and relative abundances of these species.

4.3.2 Methods

Targeted surveys for owls were conducted within the LSA following a modified version of the Bird Studies Canada *Guidelines for Nocturnal Owl Monitoring in North America* (Takats et al., 2001). Three routes with five survey points each (fifteen total survey locations) were conducted in April 2018 to capture crepuscular and nocturnal owl species. Typically surveys would be conducted in March;

however, snow cover throughout the LSA was extensive in March of 2018 which limited access to the survey locations.

Surveys began 30 minutes before dusk (approximately 2000 hours) and continued each night until 2200. Surveys were along roadsides (for safety reasons) and conducted by two experienced biologists. Survey locations were located a minimum of 800 m apart along the road and accessed using motor and all-terrain vehicles. Three different road routes were followed, with nine (OT1), one (OT2), and five (OTS3) stations per route (**Table 4-9**). Each survey consisted of one minute of silence to acclimate followed by four minutes of active listening and visual observation. The location, date, and time of each nocturnal owl survey was recorded (**Table 4-9**). Surveys were only conducted during periods without precipitation and with winds below 4 on the Beaufort scale. Weather conditions were also noted at each location (see **Appendix C7** for the field notes from each survey). Incidental observations were made during the day time surveys that targeted diurnal migratory and breeding landbirds conducted within the LSA in 2014, 2017, 2018, and 2019. Refer to **Table 2-2** in **Section 2.0** for a list of the bird community baseline surveys.

Table 4-9: Summary of Owl Survey Locations

Survey No.	Date	Time	Location		Description
			Easting	Northing	
OT1-1	2018-04-23	2040	653457.7	5520375	Small creek; open field; wetlands; young pine plantation; mature mixed forest
OT1-2	2018-04-23	2052	653350.6	5521142	Mixed mature aspen and spruce forest; east facing slope
OT1-3	2018-04-23	2110	653224.4	5521927	Mature mixed forest
OT1-4	2018-04-23	2018	653398.2	5522612	Grave Prairie; open; shrub and grasses bordered by mature mixed forest
OT1-5	2018-04-23	2026	653623.9	5523429	Near bridge over Grave Creek with clearing and mixed mature forest
OT1-6	2018-04-23	2035	653497.7	5524239	Cutblock/mixed forest
OT1-7	2018-04-23	2043	653782.3	5524944	Cutblock/mixed forest
OT1-8	2018-04-23	2055	653888.3	5525729	Cutblock/mixed forest
OT1-9	2018-04-23	2105	653655.8	5526471	Adjacent to grass/waste slopes and mature riparian forest along the Elk River
OT2-1	2018-04-24	1952	663614.3	5502845	Gravel parking area
OTS3-1	2018-04-25	1941	664203.8	5514898	Mature forest
OTS3-2	2018-04-25	2003	664262.7	5513235	Young forest
OTS3-3	2018-04-25	2033	664400.2	5511622	Replanted forested
OTS3-4	2018-04-25	2047	664602	5510033	Shrub/Herb
OTS3-5	2018-04-25	2101	664558.6	5508420	Mature forest

4.3.3 Results and Discussion

No owls were observed during the nocturnal owl surveys. Incidental daytime observations of Barred Owl and Great Horned Owl are presented in **Sections 4.1** and **4.4**. Both the Great Horned Owl and Barred Owl may be active during the day or night. Give this, there may be a greater potential of encountering these species during surveys conducted in the daytime as part of the bird community baseline program as majority of bird surveys undertaken within the LSA were completed during daylight hours. Other owl species that may be active during the day (i.e., Northern Pygmy Owl, Northern Hawk Owl, Snowy Owl, Short-eared Owl; Caskey & Chutter, 2013) were not observed within the LSA during the baseline program or owl surveys. These species may be less conspicuous, less common, or may not occur or breed in the LSA. Based on the *Atlas of the Breeding Birds of British Columbia 2008-2012* online species mapping (Davidson, Cannings, Couturier, Lepage, & Di Corrado, 2015), there is limited breeding evidence for these species in the vicinity of the LSA. There is limited probable and/or confirmed breeding evidence for these species in the vicinity of the LSA, with the exception of Northern Saw-whet Owl, which is reported to have confirmed breeding evidence south of the LSA (Davidson et al., 2015).

The lack of observations of more strictly nocturnal owl species known to occur in East Kootenay (e.g., Flammulated Owl, Northern Long-eared Owl, Northern Saw-whet Owl; Caskey & Chutter, 2013) may be due to the limited number of nocturnal owl surveys completed, as only 15 surveys were undertaken over three days in April 2018.

4.4 Other Raptor Observations

For the bird community baseline program, incidental raptor observations during summer (June and July) surveys targeting other species were documented and compiled to determine the presence and distribution of raptors throughout the LSA. A summary of incidental raptor observations over the course of the bird community baseline program is provided in **Section 4.4**.

Incidental raptor observations were made during summer surveys that targeted other species or species groups in June and July of 2014 and 2017 to 2019. No specific surveys that targeted raptors were conducted in the summer months (June and July). Surveys conducted during which raptors could have been incidentally observed included: breeding land bird point count surveys; Common Nighthawk surveys; Northern Goshawk call-playback surveys; nocturnal owl surveys; riverine bird surveys; and wetland bird standwatch surveys. **Table 2-2** in **Section 2.0** provides a list of all bird surveys completed during the baseline program. Incidental information for all recorded raptors included the species, date, and location (Global Positioning System [GPS] coordinates) of the observation.

4.4.1 Results

A total of seven raptor species and Turkey Vulture were incidentally observed throughout June and July of 2014 and 2017 to 2019. The species included Bald Eagle, Barred Owl, Cooper's Hawk, Great Horned Owl, Northern Goshawk, Osprey, Red-tailed Hawk, and Turkey Vulture (**Table 4-10**). Thirty-three individual adult raptors were incidentally observed (**Table 4-10**). The most frequently observed raptor

species was Red-tailed Hawk, which was observed 17 times over the course of the baseline program. With the exception of Red-tailed Hawk, all species were observed between one and four times.

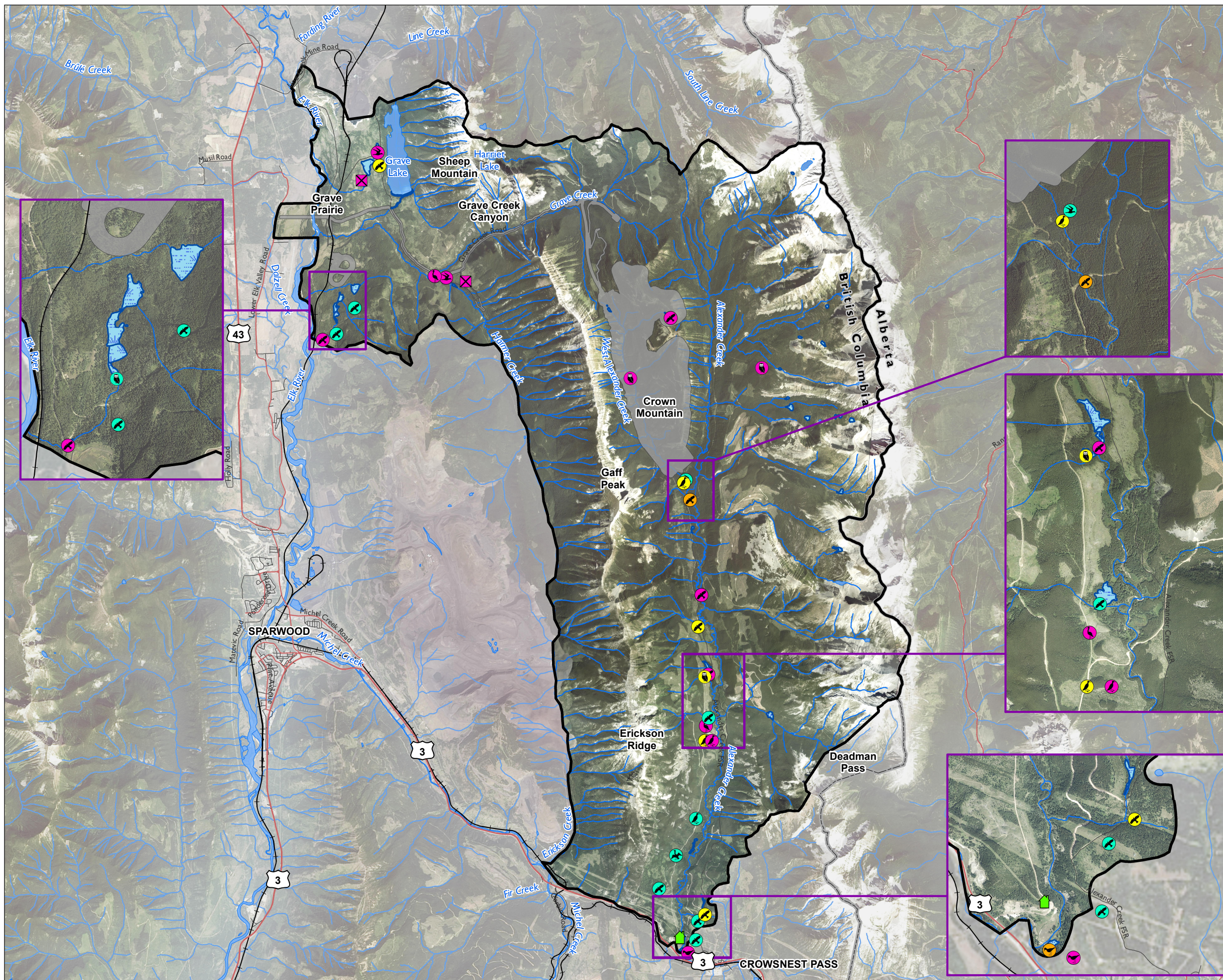
Table 4-10: Incidental Raptor Observations within the LSA, June/July 2014 and 2017 to 2019

Common Name	Total No. Observations	Survey Years Observed
Bald Eagle	1	2019
Barred Owl	2	2017, 2019
Cooper's Hawk	2	2019
Great Horned Owl	4	2014, 2017, 2019
Northern Goshawk	4	2014, 2017, 2019
Osprey	2	2018, 2019
Red-tailed Hawk	17	2014, 2017, 2018, 2019
Turkey Vulture	1	2017
Total	33	-

Osprey were observed each year of the baseline program and in the same general area of southern Alexander Creek in the south of the LSA. Two confirmed raptor nests were observed: one Osprey nest and one Red-tailed Hawk nest (**Figure 4-6**). The Osprey nest was located at the top of a hill in the southern Alexander Creek Valley adjacent to the Alexander Forest Service Road. The Osprey nest was built of sticks and located on a nesting platform adjacent to power lines (**Photo 4-2**). The nest was first observed in 2014 and was occupied in subsequent survey years (2017 to 2019). It was not possible to see into the nest; however, it was assumed that there was at least one chick every year. The Red-tailed Hawk nest was observed in 2019 near the crown of a mature Cottonwood tree in an open mixed aspen-fir forest near a large wetland in Grave Prairie. Two adult and one juvenile Red-tailed Hawk were observed at the nest.

The majority of the incidental raptor observations occurred along Alexander Creek and in the southern extent of the LSA (**Figure 4-6**). Nineteen observations of raptors occurred along the valley bottom of Alexander Creek. Three observations of Red-tailed Hawk were made in the Grave Prairie area east of the Elk River.

FIGURE 4-6.
Incidental Raptor Observations



LEGEND

- | | | | |
|---|------------------------------|---|-----------|
| ✕ | Bald Eagle | ● | 2014 |
| 🦉 | Barred Owl | ● | 2017 |
| 🦅 | Cooper's Hawk | ● | 2018 |
| 🦉 | Great Horned Owl | ● | 2019 |
| 🦉 | Northern Goshawk | ● | All Years |
| 🦅 | Osprey | | |
| 🏠 | Osprey Nest | | |
| 🦅 | Red-tailed Hawk | | |
| 🦅 | Turkey Vulture | | |
| ▭ | Terrestrial Local Study Area | | |
| ▭ | Project Footprint | | |
| — | Highways | | |
| — | Arterial Roads | | |
| — | Local/Resource Roads | | |
| — | Railway (Canadian Pacific) | | |
| — | Watercourse | | |
| ■ | Waterbody | | |
| ■ | Wetland | | |
| ▭ | BC/Alberta Border | | |

0 1 2 3 4 Kilometers
SCALE 1:108,000



Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-17



Photo 4-2: Osprey Nest Located Adjacent to the Alexander Forest Service Road, East of Alexander Creek in the South LSA (July 5, 2019)

4.4.2

Discussion

Seven raptor species and Turkey Vulture were confirmed to be present within the LSA, two of which (Osprey and Red-tailed Hawk) were confirmed to be breeding within the LSA. Both conspicuous and inconspicuous species were present; of the eight species observed, four were conspicuous (Bald Eagle, Osprey, Red-tailed Hawk, and Turkey Vulture) and four were inconspicuous (Barred Owl, Cooper's Hawk, Great Horned Owl, and Northern Goshawk).

As shown in **Figure 4-6**, incidental observations of raptors were concentrated in low elevation areas of watersheds. Areas with higher raptor abundance included the Grave Prairie area east of the Elk River (including the open mixed shrub forests throughout this area), Alexander Creek and lower West Alexander Creek, and the southern area of Alexander Creek. Generally speaking, these areas consist of open forests or open lands dominated by grasses and/or shrubs; contain abundant perches, such as mature or dead trees and transmission towers; and contain abundant mature trees for nesting. The concentration of raptor observations in these areas may be due to greater habitat suitability, greater survey effort and access in these areas over the course of the baseline program, and/or greater ability to see further in these areas relative to other parts of the LSA where mature forests dominate much of the landscape.

Raptor-specific surveys, other than for Northern Goshawk, were not conducted for Teck's Elkview Operations 2015 baseline program (Golder Associates, 2015a), or the baseline conducted for Teck's Line

Creek program (Teck Coal Ltd., 2011). During the baseline program for Teck's Elkview Operations in 2012 and 2013, Turkey Vulture, Sharp-shinned Hawk, Golden Eagle, Red-tailed Hawk, Swainson's Hawk, Bald Eagle, Osprey, Merlin, and American Kestrel were observed, although the numbers of individuals were not provided (Golder Associates, 2015a). During the baseline program for Teck's Line Creek project (Teck Coal Ltd., 2011), five Red-tailed Hawk and one Sharp-shinned Hawk were observed. All of these species were observed either incidentally or during the raptor migration surveys for the Crown Mountain Project, with the exception of Swainson's Hawk, which was not observed during the baseline program. The raptor communities observed during the Elkview Operations and Line Creek baseline programs were therefore similar to those observed within the Project's LSA.

5.0 Waterbirds

For the purposes of the bird community baseline program, waterbirds include water-dependant birds that spend most or part of their lifecycle near waterbodies. Waterbird habitat within the Project region includes both lentic (still) waterbodies such as lakes, ponds, and wetlands, and lotic (moving) waterbodies such as rivers, streams, and creeks.

Waterbirds can reflect the productivity of aquatic ecosystems, as they spend much of their time in the water while foraging on aquatic food resources such as aquatic vegetation, benthic invertebrates, zooplankton, fish, and amphibians. If an aquatic ecosystem inhabited by waterbirds contains contaminants (e.g., selenium, mercury), there is potential for waterbirds to bioaccumulate contaminants in their tissues and pass them on to their young, or transfer contaminants to higher trophic levels through biomagnification (Ohlendorf, Hothem, & Welsh, 1989; Williams, Hothem, & Ohlendorf, 1989).

Waterbird surveys conducted as part of the bird community baseline program were undertaken to determine occurrence, abundance, species richness, and diversity of waterbirds across wetland and riverine habitats in the LSA, and contaminant concentrations in bird egg tissue. **Section 5.1** describes the spring, summer, and fall wetland bird surveys and **Section 5.2** describes the summer riverine bird surveys.

5.1 Wetland Birds

5.1.1 Introduction and Objectives

For the purposes of the baseline program, wetland birds includes birds that use wetlands for foraging, breeding, or staging (i.e., stopovers during migration), such as waterfowl (ducks, swans, and geese) and their allies (rails, coots, grebes, cormorants, cranes, loons, and shore birds). The value of a wetland to different bird species is affected by the presence of surface water or moist soils (Stewart, 1996). Other determining factors include water depth, presence or absence of vegetation, type of vegetation, water chemistry, and soil type. Variations in any of these wetland features will cause distinct differences in bird use (Stewart, 1996). Available wetlands are also important areas for migratory wetland birds because wetlands can act as nutrient reload locations that sustain birds during their spring and fall migrations (Stewart, 1996).

Select wetland ecosystems within the LSA were surveyed as part of the wetland ecosystem baseline assessment (Dillon, 2020). Wetlands in the LSA were generally observed in flat areas, valleys, and bowls, with many wetlands forming in basins, depression, and obstructions along drainage ways (e.g., presence of beaver dams; Dillon, 2020). Wetlands within the LSA vary in size, with most being 1 ha or less. Six wetland classes are represented in the LSA: bog; fen; marsh; swamp; shallow water; and transitional (mineral and marsh-fen; Dillon, 2020). Many of the wetlands in the LSA are wetland complexes of two or

more distinct wetland site associations or wetland types. Marshes occupied the greatest area of all wetland types in the LSA, followed by swamps, transitional marsh-fens, shallow water wetlands, fens, mineral wetlands, and bogs (Dillon, 2020). Flood associations, although non-wetland ecosystems, are also likely to provide wetland bird habitat within the LSA.

The objective of the summer wetland surveys was to document the occurrence, abundance, species richness, and diversity of wetland birds, and to determine summer wetland bird habitat availability and distribution within the LSA. Similar to the landbird migration surveys discussed in **Section 3.2**, wetland bird migration surveys were undertaken to identify which species use the LSA during the spring and fall migration seasons, and to understand abundance, species richness, and diversity of migrating wetland birds in the LSA.

5.1.2 Methods

5.1.2.1 Study Design

Wetland bird surveys followed a modified version of the observation station methods in the *Inventory Methods for Waterfowl and Allied Species: Loons, Grebes, Swans, Geese, Ducks, American Coot, and Sandhill Crane* (Ministry of Environment, Lands and Parks, 1999c). The methods were modified because reconnaissance surveys found that there were few wetlands that had adequate open water to support wetland bird species, but the inventory methods specify that all wetlands in a project area must be surveyed (Ministry of Environment, Lands and Parks, 1999c). Surveys ranged from approximately 10 to 60 minutes in length, depending on the size and accessibility of each wetland.

Twenty-eight (28) wetland survey sites in the LSA with open water were surveyed for wetland birds based on their potential to contain suitable summer habitat (**Table 5-1; Figure 5-1**). Two ephemeral areas were also assessed (**Table 5-1; Figure 5-1**). Ephemeral areas are located throughout the LSA and provide temporary wetted habitats for waterbirds, and therefore were also targeted for surveys. Ephemeral areas include roadside ditches, tire ruts, and natural shallow depressions in the ground, where water can pool and warm up quickly. These areas are often seasonal and can change locations between years (Ministry of Forests, Lands, and Natural Resources Operations, 2015).

During June and July of 2014, 2017, 2018, and 2019, surveyors either walked the perimeter of wetland survey sites or set up standwatch locations such that the majority of the habitat could be observed. Weather conditions (precipitation, cloud cover, temperature, and Beaufort scale) were recorded at each site prior to commencing the survey. Surveys were conducted by a team of two experienced biologists with 8X14 binoculars and a 20-60x80 spotting scope. The approximate locations of encountered wetland birds were marked using a handheld GPS unit. The species and number of individuals and nests observed were recorded, as were incidental observations. Over the four survey years, 28 wetland survey sites and 2 ephemeral areas were surveyed 112 times over 38.4 total survey hours (**Table 5-1; Appendix D1**).

Wetland bird migration surveys followed the same methods and were conducted in the same wetland survey sites as the summer surveys, where possible (**Table 5-1; Figure 5-1**). Due to snow cover and abundant avalanche chutes, not all survey sites were accessible during the migration seasons. In 2018, spring migration surveys were conducted from April 22 to 24 and May 4 to 7, and fall migration surveys were conducted from October 4 to 5. In 2019, spring migration surveys were conducted from May 7 to 9 and May 22 to 24, and fall migration surveys were conducted from September 10 to 13. Surveys were conducted during daylight hours between 0730 and 1800. During the spring surveys, 22 wetland survey sites were visited 86 times over 29.4 hours, and during the fall surveys, 14 wetland survey sites were visited 22 times over 9.0 hours (**Table 5-1; Appendix D1**). Ephemeral areas were not surveyed during the migration seasons due to snow cover and limited access.

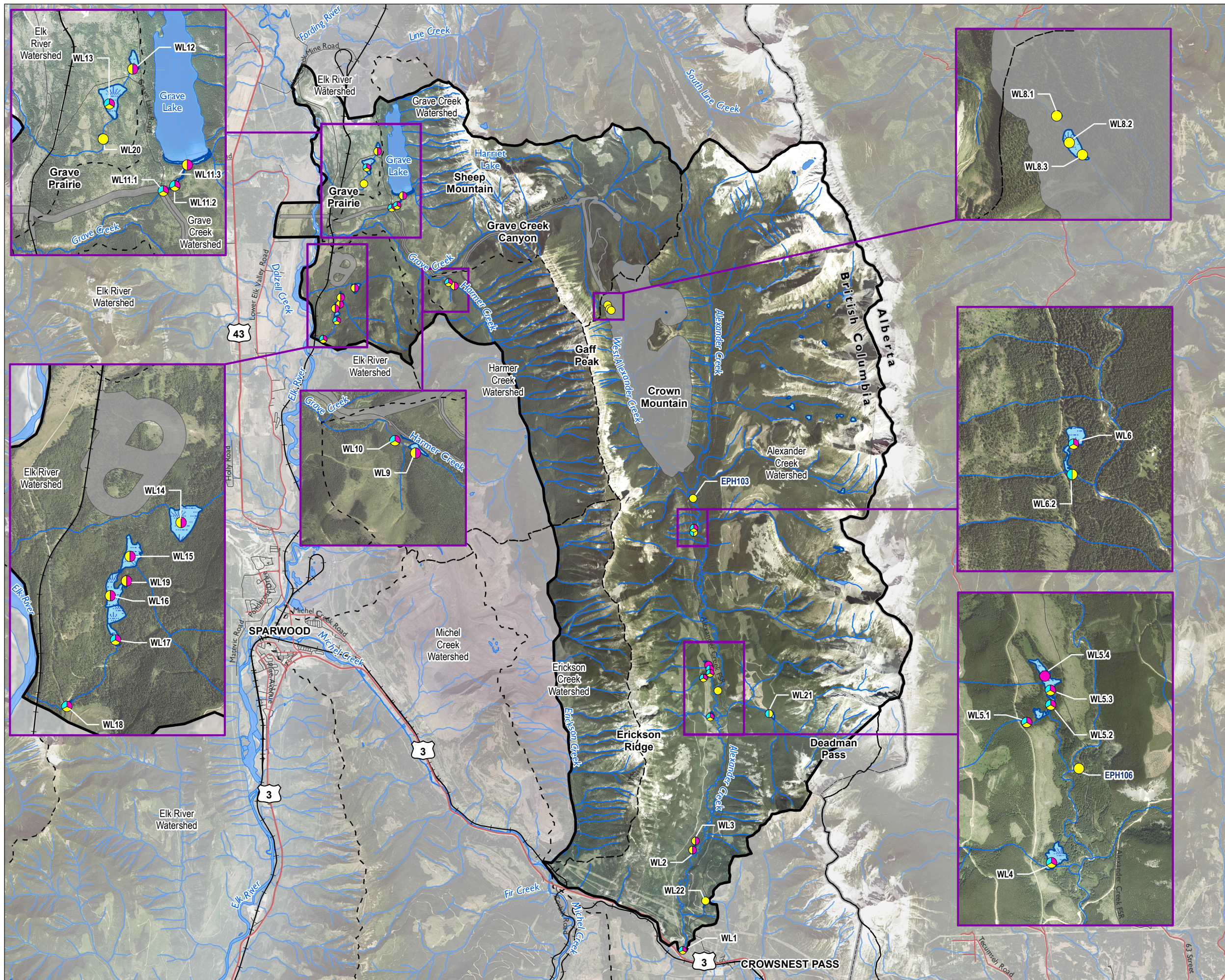
Table 5-1: Wetland and Ephemeral Area Summer Wetland Bird Survey Locations (Dillon, 2020)

Wetland Survey Site ID	Primary Wetland Classification	Wetland Size (ha)	Spring Survey Visits	Summer Survey Visits	Fall Survey Visits	Watershed
WL1	Marsh	0.55	5	7	1	Alexander Creek
WL2	Fen	0.51	1	2	0	Alexander Creek
WL3	Fen	0.76	1	2	0	Alexander Creek
WL4	Marsh	2.12	9	7	3	Alexander Creek
WL5.1	Marsh	0.41	6	2	2	Alexander Creek
WL5.2	Marsh	0.59	1	2	1	Alexander Creek
WL5.3	Marsh	0.14	6	3	2	Alexander Creek
WL5.4	Swamp	1.92	3	0	0	Alexander Creek
WL6	Marsh	0.45	3	7	2	Alexander Creek
WL6.2	Shallow Water	0.02	0	2	1	Alexander Creek
WL8.1	Marsh	0.04	0	5	0	Alexander Creek
WL8.2	Shallow Water	0.55	0	3	0	Alexander Creek
WL8.3	Marsh	0.03	0	3	0	Alexander Creek
WL9	n/a (floodplain; secondary classification shallow water)	0.57	4	9	0	Harmer Creek
WL10	Marsh	0.03	8	11	1	Harmer Creek
WL11.1	Marsh	0.21	6	9	1	Grave Creek
WL11.2	Shallow Water	0.88	2	3	1	Grave Creek
WL11.3	Marsh	0.78	2	1	0	Grave Creek

Wetland Survey Site ID	Primary Wetland Classification	Wetland Size (ha)	Spring Survey Visits	Summer Survey Visits	Fall Survey Visits	Watershed
WL12	Transitional Marsh-Fen	2.44	5	2	0	Elk River
WL13	Swamp	8.84	9	9	1	Elk River
WL14	Marsh	4.79	3	1	0	Elk River
WL15	Marsh	2.59	2	2	0	Elk River
WL16	Marsh	2.44	3	3	0	Elk River
WL17	Marsh	0.67	4	7	1	Elk River
WL18	Shallow Water	0.10	2	2	3	Elk River
WL19	Marsh	0.02	1	1	0	Elk River
WL20	Marsh	0.61	0	1	0	Elk River
WL21	Marsh	2.82	0	1	2	Alexander Creek
WL22	Swamp	0.69	0	1	0	Alexander Creek
EPH103*	n/a (Floodplain)	0.02	0	1	0	Alexander Creek
EPH106*	n/a (Floodplain)	0.01	0	3	0	Alexander Creek
Total Visits		36.59	86	112	22	220

*Ephemeral site.

FIGURE 5-1.
Wetland and Ephemeral Area Bird Survey Locations



LEGEND

-
- Wetland
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers
SCALE 1:108,000



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PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-16

5.1.2.2

Data Analysis

To support an understanding of wetland bird communities and individual species within the LSA during the spring, summer, and fall, metrics to quantify bird abundance, species richness, and species diversity were calculated for each wetland survey site and ephemeral area. Where two or more replicate surveys were conducted at a survey site within a single year or across survey years, the averages and standard errors for each metric were reported. Incidental observations were not included in the population metrics. Data analysis followed the procedures outlined in **Section 3.1.2.2**. Survey effort was limited by weather conditions and site access in the fall, so it was not possible to determine average abundance, species richness, or diversity indices for the fall wetland bird survey results. In this case, values from the single visits were reported.

Wetland bird density (birds/ha) in each primary wetland type and floodplain ecosystem was estimated by dividing the total number of birds documented in each wetland type by the total area surveyed.

5.1.3

Results

5.1.3.1

Spring Wetland Surveys

A total of 583 individual birds of 23 species were recorded in the LSA during the spring wetland surveys in April and May 2018 and 2019 (**Table 5-2**). Red-winged Blackbird, Mallard, Northern Shoveler (*Anas clypeata*), Bufflehead (*Bucephala albeola*), and Ring-Necked Duck were the most abundant species in the wetlands (**Table 5-2**). Observations from each survey are provided in **Appendix D2**. Of the species observed, 10 were not seen during the summer wetland surveys. In particular, large numbers of Northern Shoveler, Ring-necked Duck (*Aythya collaris*), Green-winged Teal (*Anas carolinensis*), and Canada Goose (*Branta canadensis*) were observed (**Table 5-2**).

Four wetland survey sites yielded greater than 15 bird observations (**Table 5-2**), including: WL10 in the Harmer Creek watershed, WL11.1 in the Grave Creek watershed, and WL12 and WL13 in the Elk River watershed west of Grave Lake. Locations with relatively high survey effort (replicate visits and/or hours) and few to no wetland bird (0-10) observations included wetland survey sites WL4 in the central southern LSA along Alexander Creek and WL14, WL16, and WL17 in the Elk River watershed near the western border of the LSA (**Table 5-2**). No wetland birds were observed at wetland survey sites WL2, WL3, or WL5.2 in the central and southern Alexander Creek watershed or at sites WL15, WL16, and WL18 southwest of Grave Lake in the Elk River watershed (**Figure 5-2**).

Wetland survey site WL13 had the highest abundance with an average of 38.2 ± 14.0 wetland birds encountered per survey (**Figure 5-2; Figure 5-3; Appendix D3**). Wetland survey site WL12, with an average abundance of 26.4 ± 15.5 wetland birds, was the site with the second highest abundance. Both WL13 and WL12 are located west of Grave Lake in the Elk River watershed. **Photo 5-1** shows site WL13 in late April 2018 with abundant Northern Shoveler, Bufflehead, American Wigeon (*Mareca americana*), Mallard, and Ring-neck Duck. **Photo 5-2** shows the abundant emergent vegetation and open water within site WL12. Other wetland sites with moderate bird abundances include WL10 in the Harmer

Creek watershed (6.0 ± 0.7 birds) and WL11.3 and WL11.1 near the southern shore of Grave Lake (3.5 ± 1.5 birds and 2.7 ± 1.0 birds, respectively). Wetland sites containing less than 2 birds, on average, included: sites WL1, WL4, WL5.1, WL5.3, WL5.4, and WL6 along Alexander Creek; WL9 along Harmer Creek; WL11.2 south of Grave Lake; and WL14 and WL17 southwest of Grave Lake in the Elk River watershed (**Figure 5-2; Figure 5-3; Appendix D3**). Incidental observations of a Great Blue Heron near the Elk River and one Mallard near Alexander Creek between sites WL5 and WL6 were also recorded (**Appendix D3**).

Between spring 2018 and spring 2019, effort was relatively comparable (12.8 versus 16.6 hours), but 358 birds were observed in 2018 compared to 225 in 2019 (**Appendix D3**). This difference is largely attributable to the number of birds seen in site WL13 in 2018 (270) versus 2019 (74). Conversely, more birds were seen in site WL12 in 2019 (96) versus 2018 (36).

Table 5-2: Birds Species Observed During Spring Wetland Bird Surveys

Common Name	Scientific Name	WL1	WL4	WL5.1	WL5.3	WL5.4	WL6	WL9	WL10	WL11.1	WL11.2	WL11.3	WL12	WL13	WL14	WL17	WL19	Total
American Coot	<i>Fulica americana</i>	0	0	0	0	0	0	0	0	0	0	2	2	4	0	0	0	8
American Wigeon	<i>Mareca americana</i>	0	0	0	0	0	0	0	0	0	0	0	4	15	0	0	0	19
Barrow's Goldeneye	<i>Bucephala islandica</i>	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	5
Blue-winged Teal*	<i>Spatula discors</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Bufflehead	<i>Bucephala albeola</i>	0	0	0	0	0	0	0	12	0	0	0	7	30	0	0	0	49
Canada Goose*	<i>Branta canadensis</i>	2	0	0	0	0	0	0	10	1	0	0	0	13	0	0	0	26
Cinnamon Teal*	<i>Spatula cyanoptera</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Common Loon	<i>Gavia immer</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Common Merganser	<i>Mergus merganser</i>	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Green-winged Teal*	<i>Anas crecca</i>	1	0	0	0	0	0	0	2	0	0	0	11	16	0	0	0	30
Harlequin Duck	<i>Histrionicus histrionicus</i>	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4
Hooded Merganser	<i>Lophodytes cucullatus</i>	0	0	0	0	0	0	0	0	6	0	0	0	5	0	0	0	11
Mallard	<i>Anas platyrhynchos</i>	1	0	0	0	0	2	1	11	8	0	0	22	69	0	5	0	119
Northern Pintail*	<i>Anas acuta</i>	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
Northern Shoveler*	<i>Spatula clypeata</i>	0	0	0	0	0	0	0	0	0	0	0	6	85	0	0	0	91
Redhead*	<i>Aythya americana</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Ring-necked Duck*	<i>Aythya collaris</i>	0	0	0	0	0	0	0	0	0	0	0	1	38	0	0	0	39
Ruddy Duck*	<i>Oxyura jamaicensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	2	6	2	2	2	2	0	0	0	2	0	78	27	0	0	0	123
Sandhill Crane*	<i>Antigone canadensis</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Spotted Sandpiper	<i>Actitis macularius</i>	1	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	7
Sora	<i>Porzana carolina</i>	0	1	0	0	0	0	0	0	0	0	0	1	3	0	0	0	5
Unidentified Duck	---	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Wilson's Snipe	<i>Gallinago delicata</i>	0	0	0	0	0	0	0	0	0	0	1	0	20	1	0	1	23
No. Survey Visits		5	9	6	6	3	3	4	8	6	2	2	5	9	3	4	1	76
Species Richness		6	2	1	1	1	2	1	8	4	1	4	9	18	1	1	1	23
Total Individuals Detected		9	7	2	2	2	4	1	48	16	2	7	132	344	1	5	1	583
Average Abundance		1.8	0.8	0.3	0.4	0.7	1.3	0.3	6.0	2.7	1.0	3.5	26.4	38.2	0.3	1.3	1**	36.4

*Species only observed during migratory surveys.

**Value based on a single visit.

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FIGURE 5-2.
Spring Wetland Bird Average Abundance and Species Richness

LEGEND

Average Species Richness	Average Abundance
● 0 (No Birds Detected)	○ 0 (No Birds Detected)
● 0.1 - 1.9 (Lowest)	○ 0.1 - 9.9 (Lowest)
● 2 - 3.9	○ 10 - 19.9
● 4 - 5.9	○ 20 - 29.9
● 6 - 7.9 (Highest)	○ 30 - 39.9 (Highest)

▭ Terrestrial Local Study Area	▭ Project Footprint
▬ Highways	▬ Arterial Roads
▬ Local/Resource Roads	▬ Railway (Canadian Pacific)
▬ Watercourse	▬ Waterbody
▬ Wetland	▬ Watershed
▬ BC/Alberta Border	



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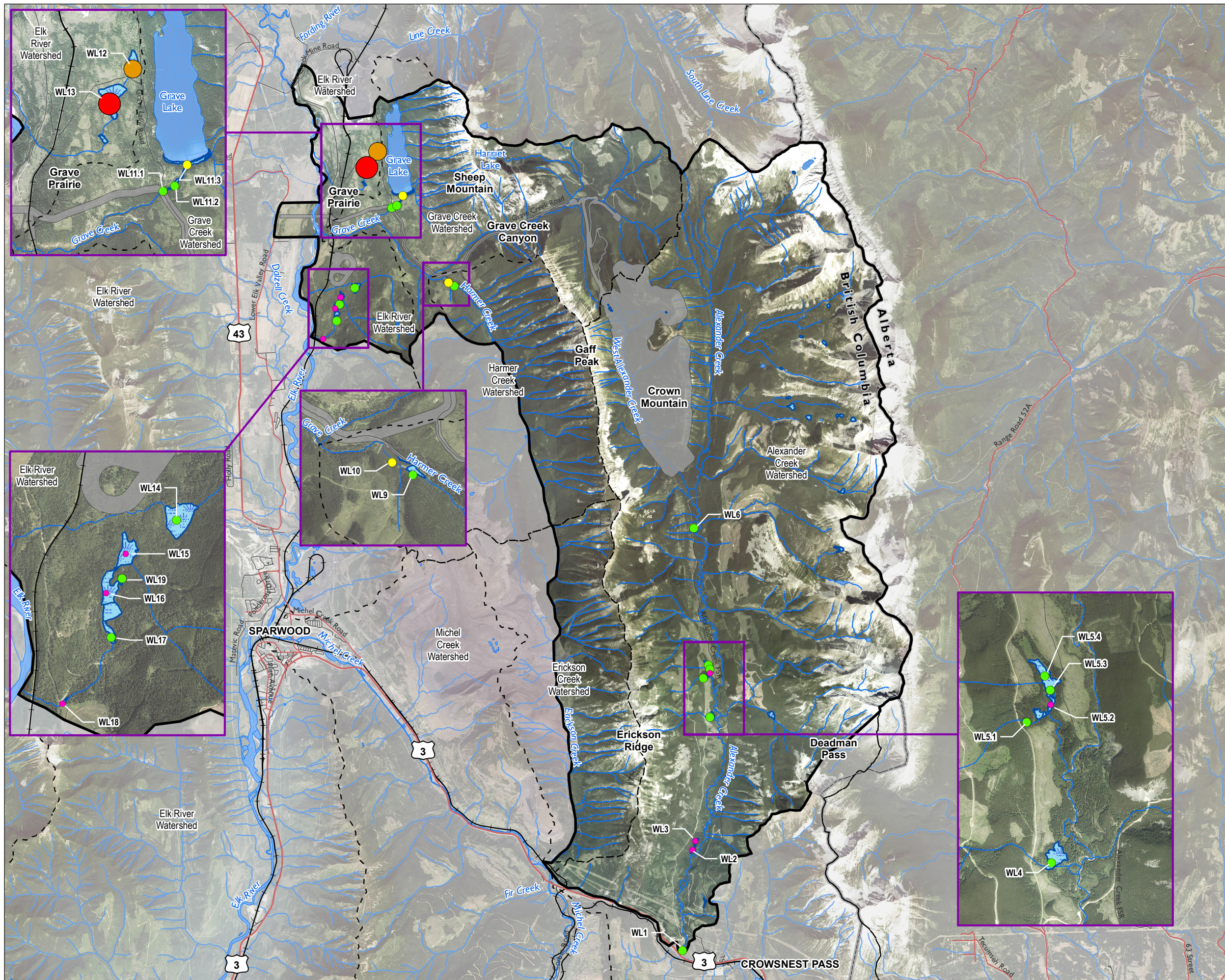




Photo 5-1: Waterfowl on Wetland Survey Site WL13 (April 24, 2018)



Photo 5-2: Wetland Survey Site WL12 (May 7, 2019)

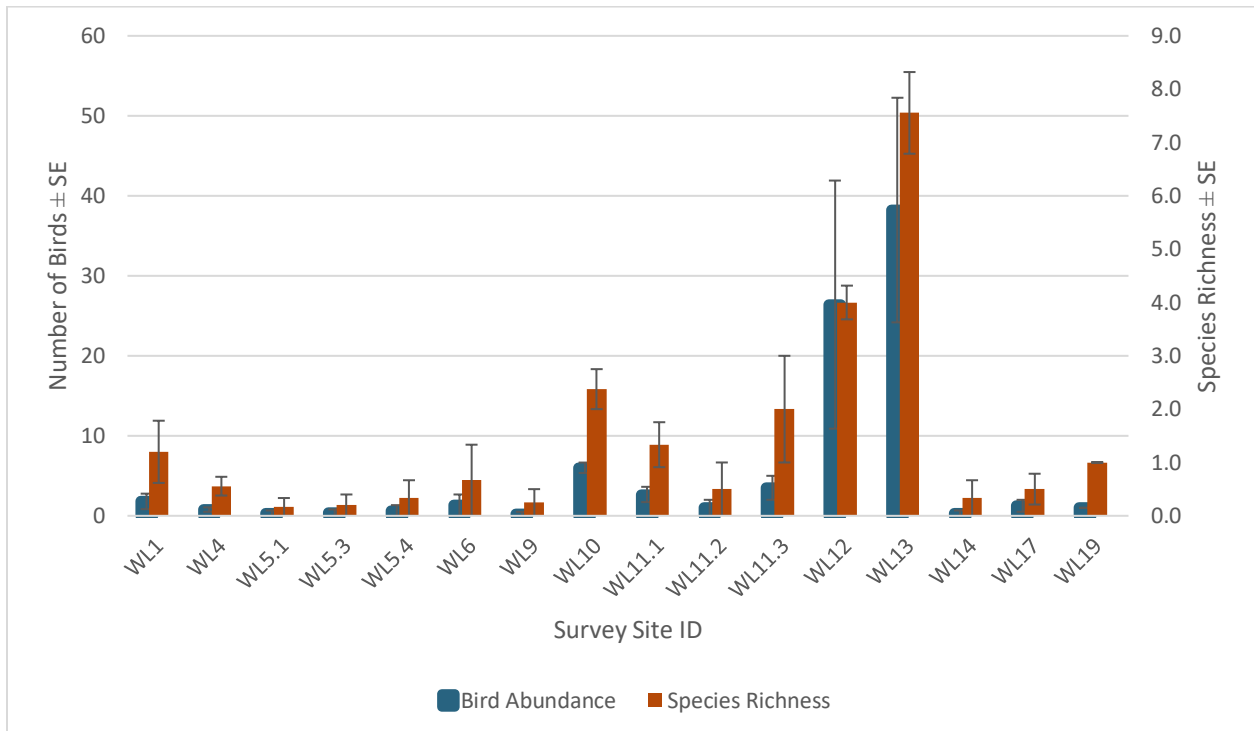


Figure 5-3: Average Bird Abundance and Species Richness of Survey Sites in the LSA with Replicate Visits. Sites without Error Bars were Visited Once

In general, the wetlands with greater average abundances also had the greatest species richness (**Figure 5-2; Figure 5-3; Appendix D3**). Site WL13 had the highest average species richness with 7.6 ± 0.8 species observed per visit, followed by WL12 (4.0 ± 0.3 species (**Figure 5-2; Figure 5-3; Appendix D3**)). Sites WL10 (2.4 ± 0.4 species) and WL11.3 (2.0 ± 1.0 species) were the only other wetlands that contained, on average, more than one species per visit. The average Shannon-Weiner Diversity Index at each site ranged from 0.00 - 1.60 (**Figure 5-4; Appendix D3**). In addition to having the highest species richness, WL13 was the most diverse (1.60 ± 0.10), followed by WL12 (1.10 ± 0.20). The Shannon-Weiner Diversity Indices were less than 1.00 for all other survey sites. For wetlands where only 1 species was observed, the diversity was found to be zero (**Appendix D3**).

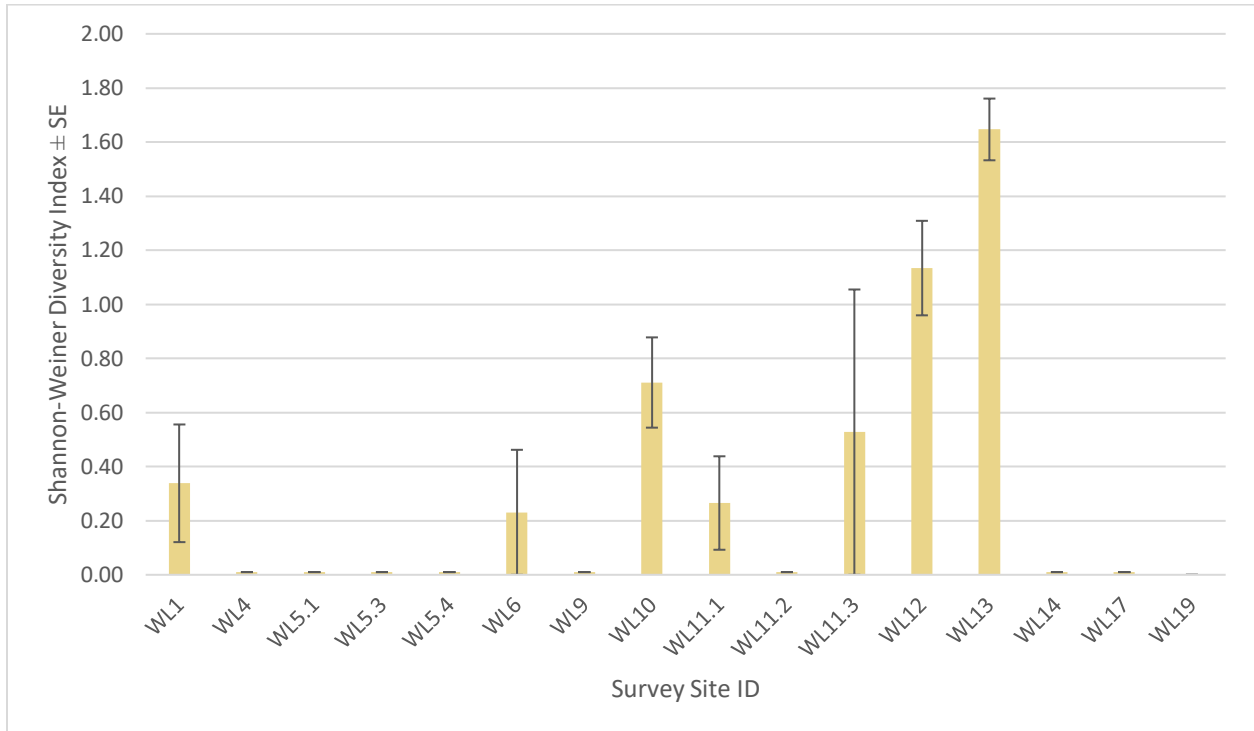


Figure 5-4: Average Shannon-Weiner Diversity Index of Survey Sites in the LSA with Replicate Visits. Sites without Error Bars were Visited Once

During the spring wetland surveys, wetland birds were observed across four of the six primary wetland classifications documented within the LSA; marsh, swamp, transitional marsh-fen, and shallow water (Figure 5-5). No birds were observed in the fens surveyed. Wetland birds were also observed in floodplain ecosystems (Figure 5-5). Over half (346) of the observations were in swamps, 132 observations were in transitional marsh-fens, 102 observations were in marshes, and 2 were in shallow water wetlands. One bird was observed in a floodplain ecosystem. Wetland bird density was greatest in the transitional marsh-fen site WL12 (approximately 54 birds/ha; Figure 5-5), followed by swamps, marshes, shallow water wetlands, and floodplain ecosystems.

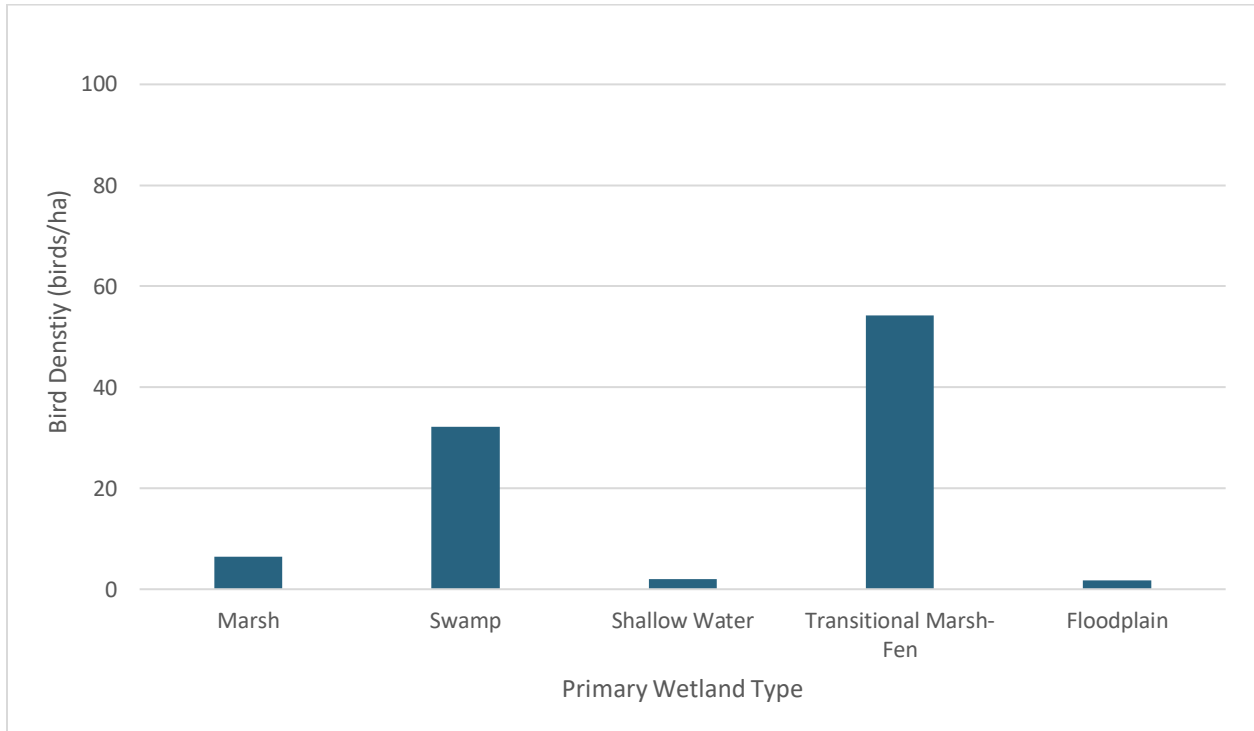


Figure 5-5: Density (birds/ha) of Wetland Birds Observed per Wetland Type and Floodplain Ecosystem

5.1.3.2

Summer Wetland Surveys

A total of 259 individual wetland birds of fourteen species were recorded in the LSA during the summer wetland and ephemeral area surveys in June and July 2014 and 2017 to 2019 (**Table 5-3**). Mallard, Spotted Sandpiper, Red-winged Blackbird, Hooded Merganser (*Lophodytes cucullatus*), Harlequin Duck, and Sora (*Porzana carolina*) were the most abundant species in wetlands across the LSA (**Table 5-3**). Observations from each survey are provided in **Appendix D4**.

Five wetland survey sites yielded greater than 15 bird observations (**Table 5-3**), including: WL1 in the Alexander Creek watershed; WL9 and WL10 in the Harmer Creek watershed, and WL12 and WL13 in the Elk River watershed west of Grave Lake. Locations with relatively high survey effort (replicate visits and/or hours) and few to no wetland bird (0-10) observations include wetland survey sites WL4, WL11.1, WL8.1, and WL17 (**Table 5-3**). No wetland birds were observed at wetland survey sites WL2, WL3, WL4, WL5.1, WL6.2, WL21, WL22, or EPH103 in the central and southern Alexander Creek watershed; at site WL8.3 near the headwaters of West Alexander Creek; at sites WL14, WL16, WL17, and WL18 southwest of Grave Lake in the Elk River watershed; or at WL20 in the Elk River watershed west of Grave Lake (**Table 5-2**).

Wetland survey site WL12 had the highest abundance, with an average of 8.0 ± 5.0 wetland birds encountered per survey (**Figure 5-6; Figure 5-7; Appendix D4**). Wetland survey site WL13, with an average abundance of 6.8 ± 1.8 wetland birds, was the site with the second highest abundance. Both WL12 and WL13 are located west of Grave Lake in the Elk River watershed. Other wetland sites with

moderate bird abundances include WL9 and WL10 in the Harmer Creek watershed (6.8 ± 2.0 and 4.7 ± 1.1 birds, respectively); WL1 in southern Alexander Creek (4.3 ± 1.3 birds), and WL11.3 along of the southern shore of Grave Lake (4 birds; visited once only). Wetland sites containing less than 2 birds, on average, included: sites WL5.2, WL5.3, WL6, and EPH106 along central Alexander Creek; WL8.1 and WL8.2 near the headwaters of West Alexander Creek; and WL11.1 and WL11.2 south of Grave Lake (**Figure 5-6; Figure 5-7; Appendix D5**). One incidental observation of a Wilson's Snipe was recorded in WL19 (**Appendix D4**).

Table 5-3: Birds Species Observed During Summer Wetland Bird Surveys

Common Name	Scientific Name	WL1 ¹	WL5.2	WL5.3 ²	WL6	WL8.1	WL8.2	WL9	WL10	WL11.1	WL11.2	WL11.3	WL12 ³	WL13 ¹	WL15	EPH106	Total
American Coot	<i>Fulica americana</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
American Wigeon	<i>Mareca americana</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Barrow's Goldeneye	<i>Bucephala islandica</i>	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Bufflehead	<i>Bucephala albeola</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Common Loon	<i>Gavia immer</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Common Merganser	<i>Mergus merganser</i>	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
Harlequin Duck	<i>Histrionicus histrionicus</i>	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	14
Hooded Merganser	<i>Lophodytes cucullatus</i>	0	1	1	0	1	0	12	1	0	0	0	0	0	0	0	16
Mallard	<i>Anas platyrhynchos</i>	1	0	0	0	0	0	33	20	2	0	0	1	11	0	0	68
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	1	0	0	5	0	0	0	0	1	3	0	15	27	0	0	52
Solitary Sandpiper	<i>Tringa solitaria</i>	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Sora	<i>Porzana carolina</i>	0	0	0	2	0	0	0	1	0	0	0	0	9	0	0	12

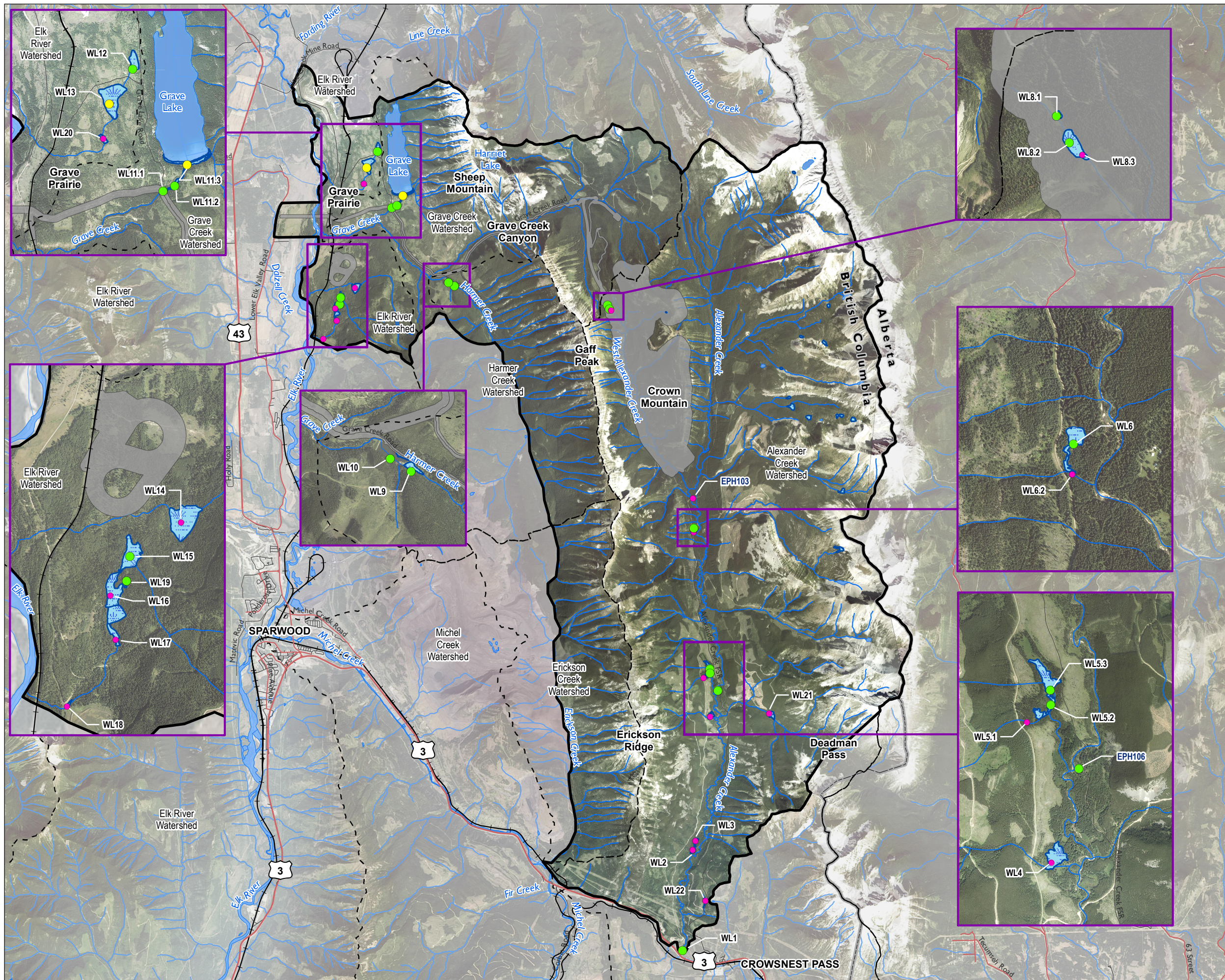
Common Name	Scientific Name	WL1 ¹	WL5.2	WL5.3 ²	WL6	WL8.1	WL8.2	WL9	WL10	WL11.1	WL11.2	WL11.3	WL12 ³	WL13 ¹	WL15	EPH106	Total
Spotted Sandpiper	<i>Actitis macularius</i>	27	0	0	5	2	2	15	13	1	0	0	0	0	0	1	66
Unidentified Duck	---	0	0	0	0	0	0	0	0	0	0	1	0	9	0	0	10
Wilson's Snipe	<i>Gallinago delicata</i>	0	0	1	0	0	0	0	0	0	1	2	0	1	1	0	6
No. Survey Visits		7	2	3	7	5	3	9	11	9	3	1	2	9	2	3	76
Species Richness		4	1	3	3	2	1	4	6	4	2	2	2	6	1	1	14
Total Individuals Detected		30	1	3	12	3	2	61	52	8	4	4	16	61	1	1	259
Average Abundance		4.29	0.50	1.00	1.71	0.60	0.67	6.78	4.73	0.89	1.33	44	8.00	6.78	0.50	0.33	17.3

¹ Two Red-winged Blackbird nests observed in wetland.

² Unidentified bird egg found in wetland, possibly Wilson's Snipe.

³ One dead Mallard duckling found.

⁴ Value based on a single visit.



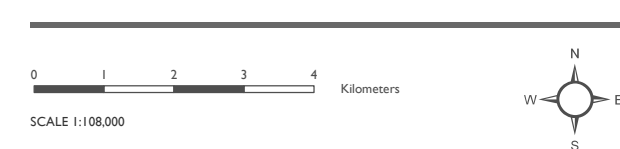
Crown Mountain Coking Coal Project

FIGURE 5-6.
Summer Wetland Bird Average Abundance and Species Richness

LEGEND

Average Species Richness	Average Abundance
● 0 (No Birds Detected)	○ 0 (No Birds Detected)
● 0.1 - 1.9 (Lowest)	○ 0.1 - 9.9 (Lowest)
● 2 - 3.9	○ 10 - 19.9
● 4 - 5.9	○ 20 - 29.9
● 6 - 7.9 (Highest)	○ 30 - 39.9 (Highest)

■ Terrestrial Local Study Area
 ■ Project Footprint
 — Highways
 — Arterial Roads
 — Local/Resource Roads
 — Railway (Canadian Pacific)
 — Watercourse
 ■ Waterbody
 ■ Wetland
 - - - Watershed
 ■ BC/Alberta Border



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In general, the wetlands with greater average abundances also had greater species richness (Figure 5-6; Figure 5-7; Appendix D5). Site WL11.3 had the highest species richness overall (3); however, this site was only surveyed once. Site WL13 had the highest average species richness with 2.1 ± 0.5 species observed per visit, closely followed by WL10, WL9, and WL12 (1.6 ± 0.2 , 1.6 ± 0.4 , and 1.5 ± 0.5 species, respectively; Figure 5-7; Appendix D5). Site WL11.3 had the second highest species richness overall (2); however, this site was only surveyed once. The average Shannon-Weiner Diversity Index at each site ranged from 0.0 to 0.60 (Figure 5-8; Appendix D5). Site WL11.3 had the highest diversity overall (1.04); however, this site was only surveyed once. In addition to having the second highest species richness, WL13 was the second most diverse (0.60 ± 0.17), closely followed by WL10 and WL9 (0.41 ± 0.10 and 0.39 ± 0.13 , respectively). For wetlands where only one species was observed, the diversity was found to be zero (Appendix D5).

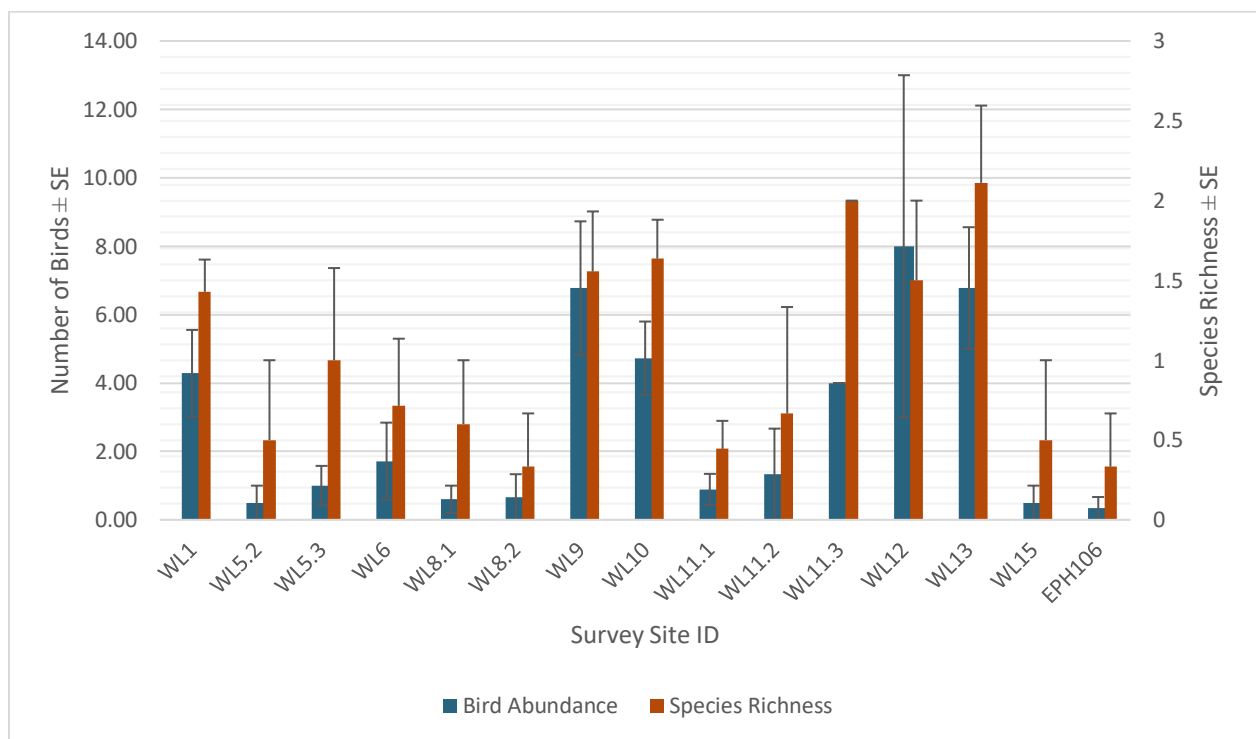


Figure 5-7: Average Bird Abundance and Species Richness per visit of Wetland Survey Sites in the LSA. Sites without Error Bars were Visited Once

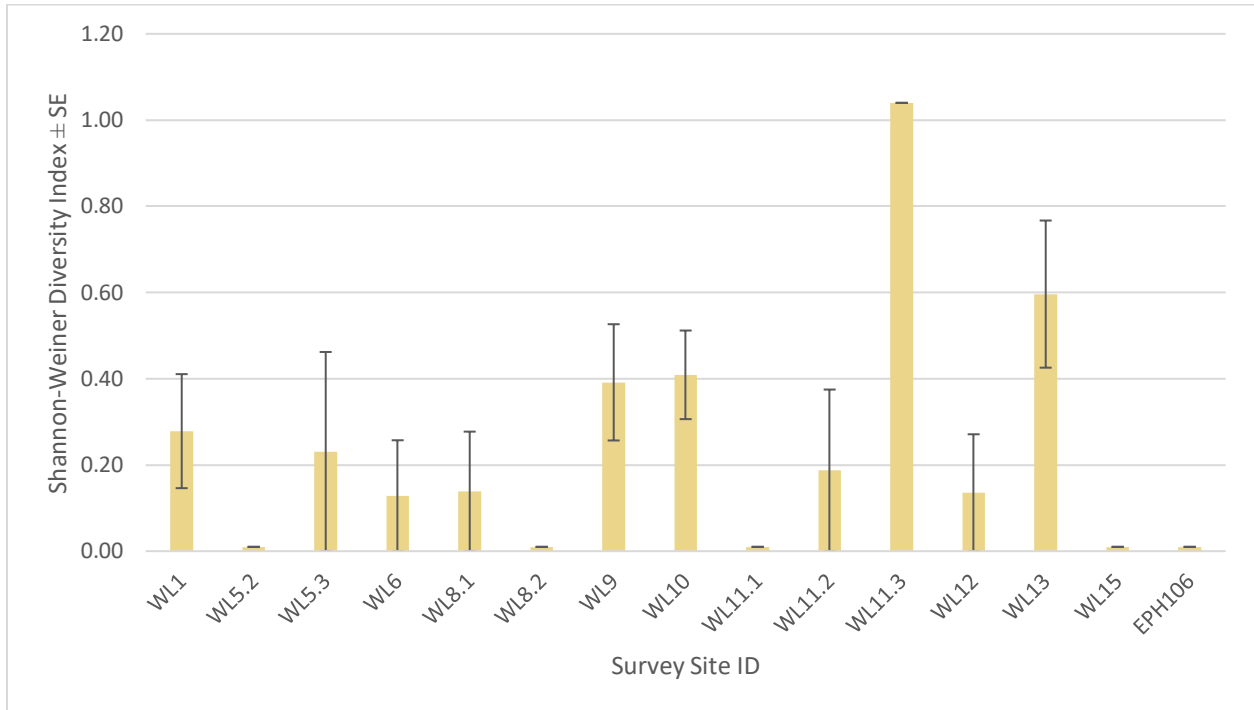


Figure 5-8: Average Shannon-Weiner Diversity Index of Survey Sites in the LSA with Replicate Visits. Sites without Error Bars were Visited Once

During the summer wetland surveys, wetland birds were observed across four of the six primary wetland classifications documented within the LSA; marsh, swamp, transitional marsh-fen, and shallow water (**Figure 5-9**). No birds were observed in the fens surveyed. Nearly half (115) of the observations were in marshes, 61 observations were in swamps, 16 observations in transitional marsh-fens, and 6 observations in shallow water wetlands. Birds were observed 62 times in floodplain ecosystems. Wetland birds were also observed in floodplain ecosystems (**Figure 5-9**). Wetland bird density was greatest in floodplain ecosystems (approximately 102 birds/ha; **Figure 5-9**). Bird density was similar in marshes, swamps, and the transitional marsh-fen site, and was lowest in shallow water wetlands.

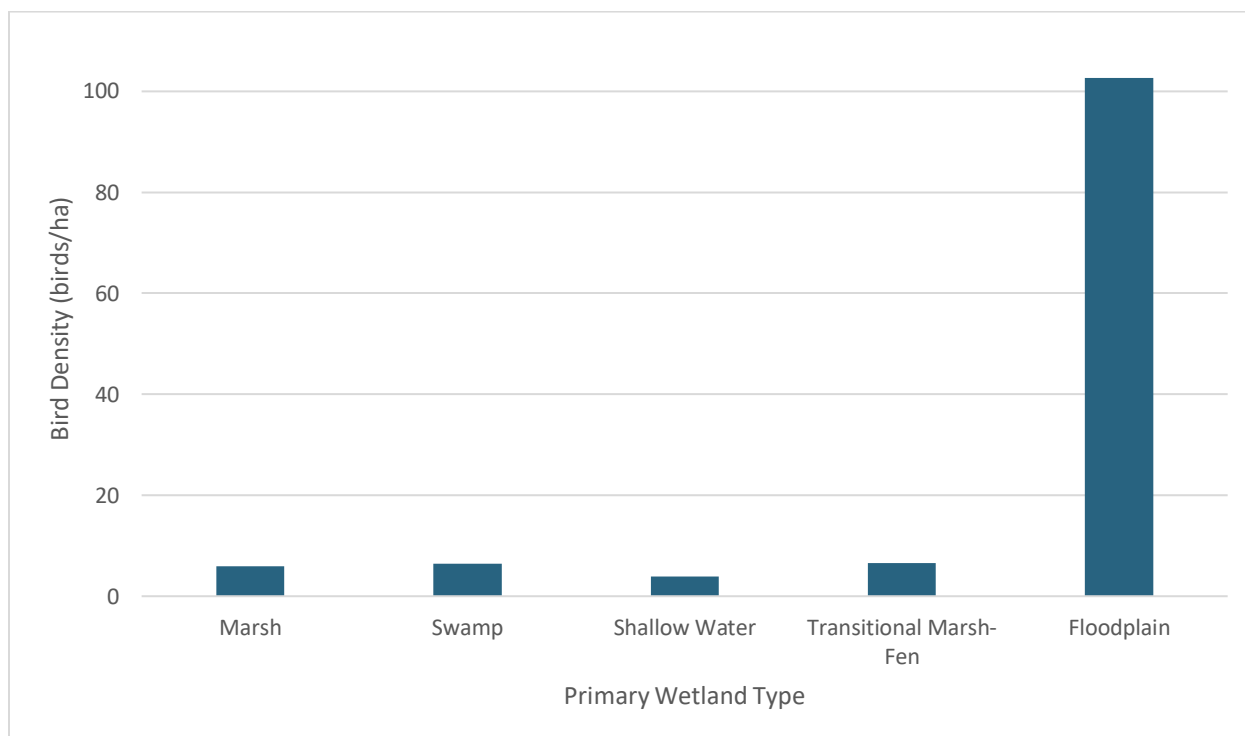


Figure 5-9: Density (birds/ha) of Wetland Birds Observed per Wetland Type and Floodplain Ecosystem

5.1.3.3

Fall Wetland Surveys

A total of six birds were recorded in the LSA during the wetland surveys in early October 2018, and mid-September 2019 (**Table 5-4**). Two wetland bird species were observed during the spring surveys; five Mallard and one Hooded Merganser (**Table 5-4**). Wetland birds were observed in sites WL4 and WL5.1 in the Alexander Creek watershed; WL10 in the Harmer Creek watershed; and WL18 in the Elk River watershed. Due to low survey detections, it was not possible to determine fall wetland bird average abundance, species richness, or Shannon-Weiner Diversity. During the fall wetland surveys, five wetland birds were observed in marshes and two birds were observed in shallow water wetlands (**Table 5-1; Table 5-4**).

Table 5-4: Birds Species Observed During Fall Wetland Bird Surveys

Wetland Survey Site ID	Mallard	Hooded Merganser	Total
WL1	0	0	0
WL4	1	0	1
WL5.1	1	0	1
WL5.2	0	0	0
WL5.3	0	0	0
WL6	0	0	0

Wetland Survey Site ID	Mallard	Hooded Merganser	Total
WL6.2	0	0	0
WL9	0	0	0
WL10	2	0	2
WL11.1	0	0	0
WL11.2	0	0	0
WL13	0	0	0
WL17	0	0	0
WL18	1	1	2
WL21	0	0	0
Totals	5	1	6

5.1.4 Discussion

5.1.4.1 Spring and Fall Wetland Surveys

Twenty-four species of wetland birds were documented within the LSA during the 2018 and 2019 spring wetland surveys (Great Blue Heron was observed incidentally only). Red-winged Blackbird, Mallard, Northern Shoveler, Bufflehead, and Ring-Necked Duck were the most abundant species observed over the course of the 86 spring wetland visits. Ten species observed may only use wetlands within the LSA as migration stopover locations as these species were not observed during the summer wetland surveys.

Wetland survey sites WL13, WL12, and WL10 contained the greatest total number of birds observed, and sites WL13 and WL12, and to a lesser extent, WL10, WL11.3, and WL11.1 contained the highest average abundances of birds. In general, the wetlands with greater average abundances also had the greatest species richness. Wetland site WL13 had the highest average species richness at 7.6 species observed and was found to be the most diverse, followed by site WL12. The Shannon-Weiner Diversity Index was below the typical range of 1.5-3.5 in all areas surveyed except site WL13, suggesting that overall wetland bird diversity was low and that numbers of individuals are not evenly distributed between all the species (Gaines et al., 1999). However, not all species share the same migration window. Depending on the timing of the surveys in relation to migration phenology, the surveys likely captured the migration peak of some species and only the beginning or end of the migration of others.

Of the 22 wetland sites visited as part of the spring wetland bird surveys, six areas did not contain any wetland birds during the spring surveys. These areas may not provide suitable spring wetland bird habitat. Ten of the areas surveyed in spring had low average abundances (less than two individuals per visit) of wetland birds. Since site WL19 was only surveyed once, it is possible that species migrating earlier or later than the one survey visit would use this wetland. The five remaining wetland sites (WL10,

WL11.1, WL11.3, WL12, and WL13) are located in the Harmer Creek, Grave Creek, and Elk River watersheds in the northwestern part of the LSA. It is possible that these wetlands are closer to a preferred movement corridor of the migratory species and are therefore a more convenient stopover location, or simply contain more suitable early spring habitat for migrating individuals (e.g., more nutrients available; more open water; less snow cover, etc.). Information pertaining to habitat use by wetland birds in East Kootenay is limited, however.

Wetland birds were observed in four primary wetland classifications: marsh, swamp, transitional marsh-fen, and shallow water. The majority of observations were in swamps, followed by transitional marsh-fens and marshes. This difference can most likely be attributed to the high number of observations in site WL13 (a swamp), which is also the largest wetland in the LSA and therefore likely supports the greatest number of wetland birds. Bird density was greatest in transitional marsh-fens, followed by swamps, marshes, shallow water wetlands, and the non-wetland floodplain ecosystem.

The total number of wetland birds observed in spring 2019 was 160% higher than in 2018, despite comparable survey effort. Surveys were conducted from April 22-24 and May 4-7 in 2018, and from May 7-9 and May 22-24, 2019. This difference in timing could explain the higher abundance of birds observed in 2018. Other migratory bird surveys conducted in the Rocky Mountains, such as the Columbia Wetlands Waterbird Survey are conducted in mid-April (Columbia Wetlands Waterbird Survey, 2019), suggesting that the majority of birds passing through the Rockies do so earlier in the year.

At the Important Bird Area (IBA) in Skookumchuck Prairie approximately 70 km west of the LSA, Northern Shoveler, Ring-necked Duck, Green-winged Teal, Bufflehead, and Canada Goose are most abundant from late April to early May; Mallard are abundant from mid-March to early-mid May; and Red-winged Blackbird are abundant throughout May (IBA Canada, 2019). Similarly to the Columbia Wetlands, this timing coincides with the trip in 2018 and again suggests that timing was the main factor influencing the number of birds observed in the two survey years. Additionally, annual variation in the bird migration may have influenced the results; for example, the spring surveys in the Columbia Wetlands yielded almost 50,000 observations in 2018 and only 25,000 individuals in 2019 during the same time frames, despite similar levels of effort (Columbia Wetlands Waterbird Survey, 2019).

There are a number of factors that may have resulted in the low number of observations made in the LSA during the fall wetland surveys. The surveys were conducted from October 4-5 in 2018 and September 10-13 in 2019. It is possible these surveys were conducted too early (2019) and too late (2018) to capture the peak of migration, although surveys were conducted in the Columbia Wetlands from late September to mid-October in both years (Columbia Wetlands Waterbird Survey, 2019). It is also possible that fall migratory routes veer closer to the coast or east of the Rockies, and therefore have minimal overlap with the LSA.

Spring and fall wetland surveys were not completed for nearby projects such as Teck's Elkview Operations or Line Creek Operations; therefore, results from the current study cannot be compared to other baseline programs in the area.

5.1.4.2

Summer Wetland Surveys

Fourteen species of wetland birds were documented within the LSA during the 2014 and 2017 to 2019 summer wetland surveys. Mallard and Red-winged Blackbird were the most abundant species observed over the course of the 112 summer wetland visits.

Wetland survey sites WL13, WL9, WL10, and WL1 contained the greatest total number of birds observed, and sites WL11.3, WL12, WL13, WL10, and WL1 contained the highest average abundances of birds. Wetland sites WL11.3 and WL12 were only visited once and twice, respectively, and as such it is difficult to determine if these sites experienced higher bird abundances. In general, the wetlands with greater average abundances also had the greatest species richness. Wetland site WL13 had the highest average species richness at 2.1 species observed and was found to be the most diverse, followed by sites WL11.3, WL10, and WL9. The Shannon-Weiner Diversity Index was below the typical range of 1.50 to 3.50 in all areas surveyed, suggesting that overall wetland bird diversity was low and that numbers of individuals are not evenly distributed between all the species (Gaines et al., 1999).

Mallard and Red-winged Blackbird were observed throughout the LSA, with each species observed in six areas (Mallard at WL1, WL9, WL10, WL11.1, WL12, and WL13; Red-winged Blackbird at WL1, WL6, WL11.1, WL11.2, 12, and 13). Wetland sites WL9, WL10, and WL13 had the most observations of Mallard, and sites WL12 and WL13 had the most observations of Red-winged Blackbird. WL12 had abundant cattails, which is one of the preferred nesting materials for Red-winged Blackbird (BC CDC, 2010). Cattails were absent at site WL13, but Red-winged Blackbird were observed to nest using grassy tufts in this location. Site WL13 appears to be relatively more productive (i.e., abundant vegetation) and contain more diverse habitat and cover than other wetlands in the LSA, and as such, it is anticipated that this wetland site has the potential to provide wetland bird breeding habitat.

Of the 28 wetland and 2 ephemeral areas visited as part of the summer wetland bird surveys, 14 sites did not contain any wetland birds during the summer surveys. These areas may not provide suitable summer wetland bird habitat. Ten of the wetland areas surveyed had low abundances (less than two individuals per visit) of summer wetland birds. Since site WL11.3 was only surveyed once, its overall significance relative to other wetland sites is not clear.

Within the Alexander Creek watershed, only wetland site WL1 contained notable abundances of wetland birds. Wetland site WL1 is a medium sized marsh with a shallow water area consisting of a clear, active beaver pond with sparse aquatic macrophytes and an extensive dam (Dillon, 2020). The marsh area is dominated by sedges and lacks the thick growth of cattails and bulrushes characteristic to preferred Red-winged Blackbird habitat, although two nests were observed on the edge of this wetland.

Spotted Sandpiper were also frequently observed on the shoreline of WL1. Survey site WL1 is situated less than 100 m from the Sparwood Rifle Range. Despite this, this wetland has the highest abundance of birds within the Alexander Creek watershed and in the central and southern LSA.

Within the Elk River watershed, wetlands sites WL12 and WL13 west of Grave Lake both contained a notable abundance of wetland birds. Wetland site WL13 is the largest wetland in the LSA and is a complex of swamp, transitional marsh-fen, and shallow water areas arranged concentrically (**Photo 5-3**; Dillon, 2020). It appears to have been created in part by humans, and an old wire fence surrounds the inner marsh-fen and shallow water wetland, which hindered survey access. The shallow water wetland within WL13 represents the largest area of this wetland type in the LSA and was found to contain yellow pond-lily and pondweed, which are important food sources to waterfowl, such as Mallard (BC CDC, 2000). Red-winged Blackbird were observed to be nesting in grassy tufts within this wetland as well. Wetland sites WL11.3 and WL12 were not surveyed as many times as WL13, but supported the greatest wetland bird abundance and diversity observed during a single survey and therefore are likely valuable to wetland birds. Wetland site WL12 is a large wetland complex with small shallow water wetlands and associated marsh (Dillon, 2020). It is bordered by tall cattails and abundant Red-winged Blackbird were observed at this site, along with Mallard. Site WL11.3 is a moderate-sized marsh on the edge of Grave Lake.



Photo 5-3: Wetland Survey Site WL13 (May 7, 2019)

Both wetland areas surveyed in the Harmer Creek watershed, survey sites WL9 and WL10, contained notable abundances of Mallard and moderate abundances of staging Harlequin Duck and Hooded Merganser (**Table 5-3**). Site WL9 occurs in a wider section of Harmer Creek where it flows into the Harmer Creek reservoir. Survey site WL9 is a floodplain complex with channels and a large shallow water wetland created by beavers (Dillon, 2020). Mallard are suspected to nest along the edges of this wetland, and a brood of Mallard was nearly always observed in this area each survey year. Adjacent to WL10 is a large, human-created reservoir formed by damming Harmer Creek. The reservoir is bordered by a narrow marsh along its north edge, which forms survey site WL10. Mallard were frequently observed in the open water area of the reservoir.

The majority of wetland bird observations were in marshes, followed by swamps and the non-wetland floodplain ecosystem. Wetland bird density was greatest in the non-wetland floodplain ecosystem, followed by marshes, swamps, and transitional marsh-fens. Floodplains are important waterbird habitat year-round, and breeding waterfowl are attracted to the lush vegetation these ecosystems support throughout the summer (Upper Midwest Environmental Sciences Center, 2016). Marsh wetlands are flooded permanently or seasonally and are often dominated by cattails, which are preferred nesting materials for Red-winged Blackbird (BC CDC, 2010). Swamps are nutrient-medium to nutrient-rich wetlands with well-developed vegetation that support diverse bird communities (Stewart, 1996).

In the local area surrounding the Project, Red-winged Blackbirds (two individuals) were observed incidentally during breeding bird studies in 2012 and 2013 completed for Teck's Elkview Operations (Golder Associates, 2015a). Mallards were also observed for this study; however, specific numbers were not provided (Golder Associates, 2015a). To the north of the Project, baseline surveys conducted for the Line Creek Operations noted that wetlands within the study area evaluated accounted for less than 1% of the land cover (Teck Coal Ltd. 2011), and wetland bird observations during the baseline program were sparse.

5.2 Riverine Birds

5.2.1 Introduction and Objectives

Riverine bird surveys targeted birds that depend on lotic habitats such as rivers, streams, and creeks. Surveys were conducted to document the occurrence and relative abundance of riverine birds within the LSA and to document riverine bird habitat availability and distribution. Riverine birds encountered during surveys were documented, with particular attention to Harlequin Duck, Spotted Sandpiper, and American Dipper. Other riverine birds in East Kootenay include Belted Kingfisher (*Megaceryle alcyon*) and Osprey, which are also discussed in this section. Osprey are a raptor species that depend on rivers and lakes for habitat and are discussed in **Section 4.0**.

Spotted Sandpiper were targeted for tissue collection to provide a baseline measure of metal concentrations in bird tissues within the LSA. These samples will also be used to support the Human Health and Ecological Risk Assessment (HHERA) for the Project.

5.2.2 Methods

5.2.2.1 Study Design

Riverine bird surveys followed the river shoreline ground survey methods outlined in the RISC *Inventory Methods for Riverine Birds: Harlequin Duck, Belted Kingfisher and American Dipper Version 2.0* (Ministry of Environment, Lands and Parks, 1998b). With the exception of Spotted Sandpiper and Osprey, all other birds encountered were considered incidental and are discussed in other sections of the report (i.e., **Section 5.1**).

Notable watercourses of the LSA in which riverine birds were expected to occur include: the Elk River; Alexander Creek; West Alexander Creek; the unnamed Creek in Deadman Pass; Grave Creek; Erickson Creek; and Harmer Creek (**Figure 5-10**). The Kootenay Boundary Water Tool (KBWT; Foundry Spatial, 2019) and ArcGIS were used to calculate the length of potential tributaries to survey. Due to limited access, the entire length of each watercourse was not surveyed. Specific watercourse sections were surveyed based on their potential to provide habitat to one or more of the target species (**Table 5-5**).

Table 5-5: Tributaries in the LSA Targeted for Riverine Bird Surveys (Foundry Spatial, 2019)

Formal Name	WFI ¹	Drainage	Catchment (km ²)	Dominant Drainage Direction	Location Description
Alexander Creek	8882825	Elk River	184.9	South	Largest drainage within LSA, located in the center of the LSA;
West Alexander Creek	8894415	Alexander Creek	14.7	South	More than half of this creek is within the Project footprint in the centre of the LSA
Unnamed Creek in Deadman Pass	8886958	Alexander Creek	16.8	West	Flows from the BC - Alberta border to Alexander Creek in the south of the LSA
Grave Creek	881190	Elk River	80.9	North/East	Flows along the proposed access route into the Project area in the north of the LSA
Harmer Creek	8169445	Grave Creek	39.0	North	Flows north from Teck's Elkview Operations through wetland sites WL9 and WL10

¹ The WFI number is the watershed feature identifier as classified by the BC Freshwater Atlas, which provides a unique code for each watershed in BC (Foundry Spatial, 2019).

Within the LSA, 25.2 km of creek habitat were surveyed from 2017 to 2019. (**Table 5-6**). In July 2017, an initial 18.6 km of creek were covered, including Alexander, West Alexander, Grave, and Harmer Creeks. In 2018, approximately 17% (3.1 km) of the original distance was repeated, along with an additional 0.5 km in Alexander, Grave, and Harmer Creeks. In 2019, an additional 6.1 km were added across West Alexander Creek, Grave Creek, and the unnamed tributary in Deadman Pass.

Table 5-6: Summary of Creeks Surveyed in the LSA

Creek	2017 Length Surveyed (km)	2018 Length Surveyed (km)	2019 Length Surveyed (km)	Total Length Surveyed (km)
Alexander Creek (mainstem)	9.2	0.2	1.7	11.2
Unnamed Creek in Deadman Pass	0.0	0.0	1.5	1.5
West Alexander Creek	1.3	0.0	2.9	2.9
Grave Creek	5.1	0.2	0.05	5.3
Harmer Creek	3.0	0.1	0.0	3.1
Total	18.6	0.5	6.1	25.2

Five creeks were surveyed for riverine birds: Grave Creek, Harmer Creek, Alexander Creek (mainstem), West Alexander Creek, and the unnamed tributary to Alexander Creek located in Deadman Pass (**Figure 5-10**). Erickson Creek was not surveyed due to access restrictions and active mining. The Elk River was not surveyed as only approximately 10 km of river passes along the border of the LSA. Access to all creeks was limited and uncertain; as such, it was not possible to predetermine transect locations along creeks prior to field work. Biologists attempted to cover the entire length of each of the largest creeks and main tributaries using maps, imagery, and reconnaissance efforts to determine where creeks came close to roads in order to identify the start point of transect locations.

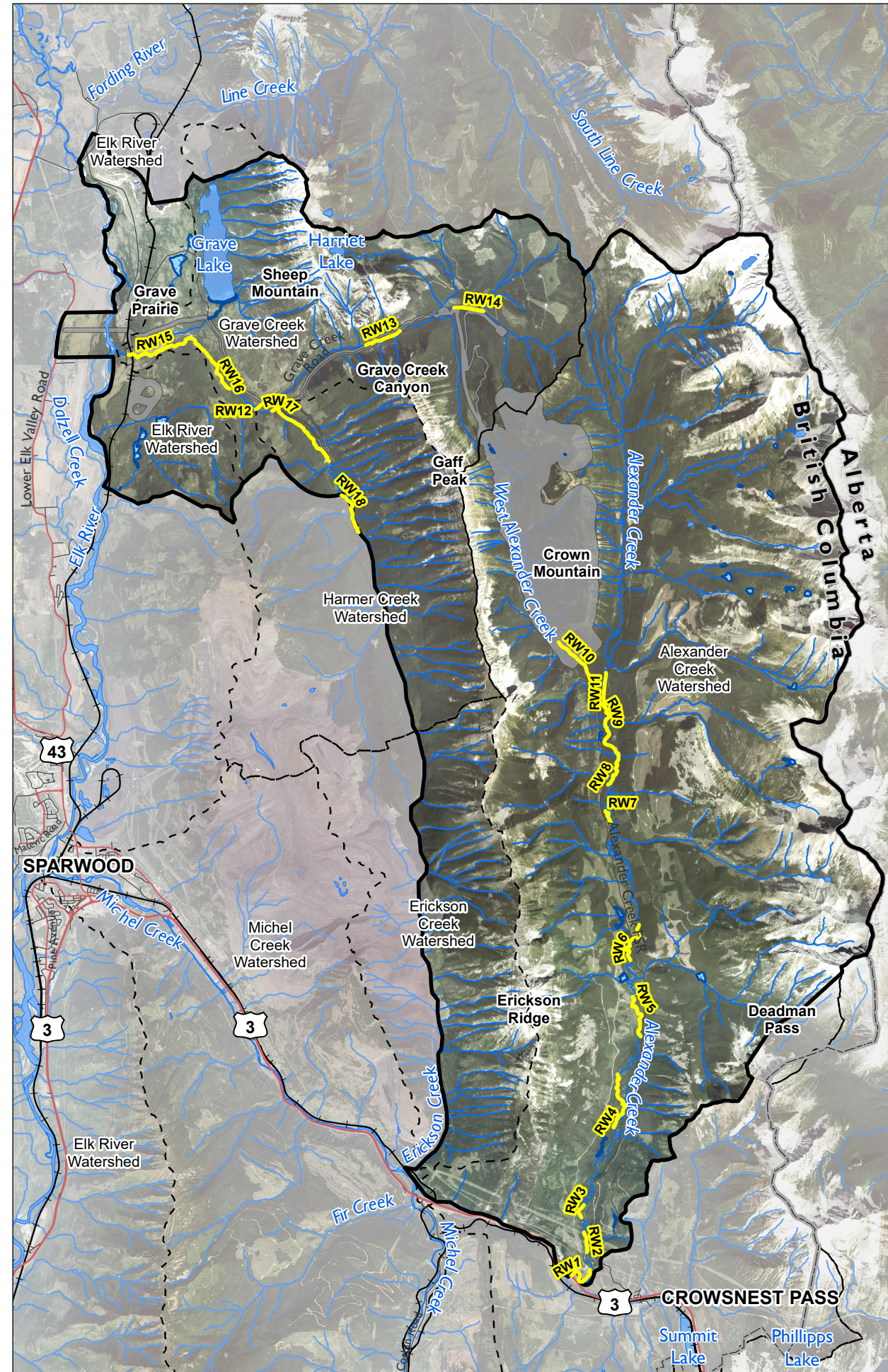
Surveyed creek segments were assigned an identification number (RWX) in sequential order. Surveys were conducted in late June and late July 2017, and approximately 30% of the segments were repeated in July 2018. In mid-July 2019, additional creek segments were surveyed to increase survey coverage within the LSA. Surveyed creek segments within the LSA and their designated identification numbers are shown in **Figure 5-10** and the coordinates of each transect segment and the year each survey was conducted are provided in **Appendix D6**.

Surveys were conducted during the summer period (June 29-July 3 and July 25-28, 2017; June 30-July 8 and July 26-30, 2018; and July 6-8, 2019) to capture the late breeding season when chicks had hatched

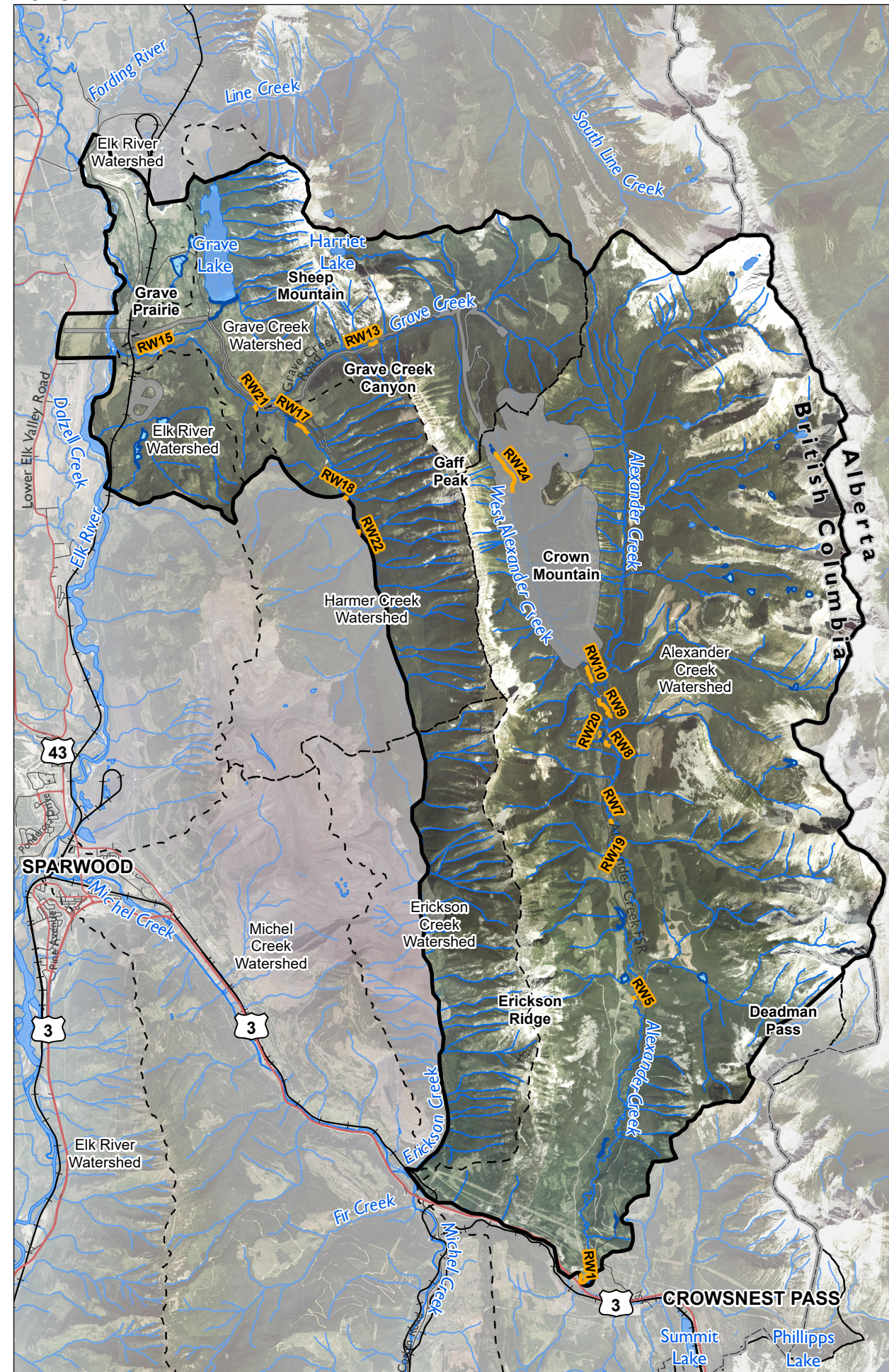
and family groups were more visible. All surveys were conducted by a team of two experienced biologists during daylight hours and only in periods of clear weather. As per RISC survey methods, birds were detected by visually scanning the creek and adjacent areas including trees, boulders, riparian vegetation, gravel bars, and banks. The biologists maintained a slow pace and stopped frequently to listen for vocalizations.

At locations with clear upstream and downstream views, biologists stopped for 10 minutes to increase the likelihood of encountering cryptic birds. The approximate locations of encountered target species were marked using a handheld GPS unit. The species, number of individuals, gender (if possible), behaviour type (e.g., feeding, flyby, nesting, signing, and resting), and incidental observations were recorded. When broods were observed, the number of young and the brood class were also noted, where possible. In addition, qualitative habitat characteristics, including vegetation cover, steepness, stream velocity, visibility of the creek (as prevented by logs and shrubs), presence of coarse woody debris, and water turbidity were noted. Semi-quantitative characteristics including creek width and estimated visibility length were recorded to estimate the distance to each bird observation from the biologists' location.

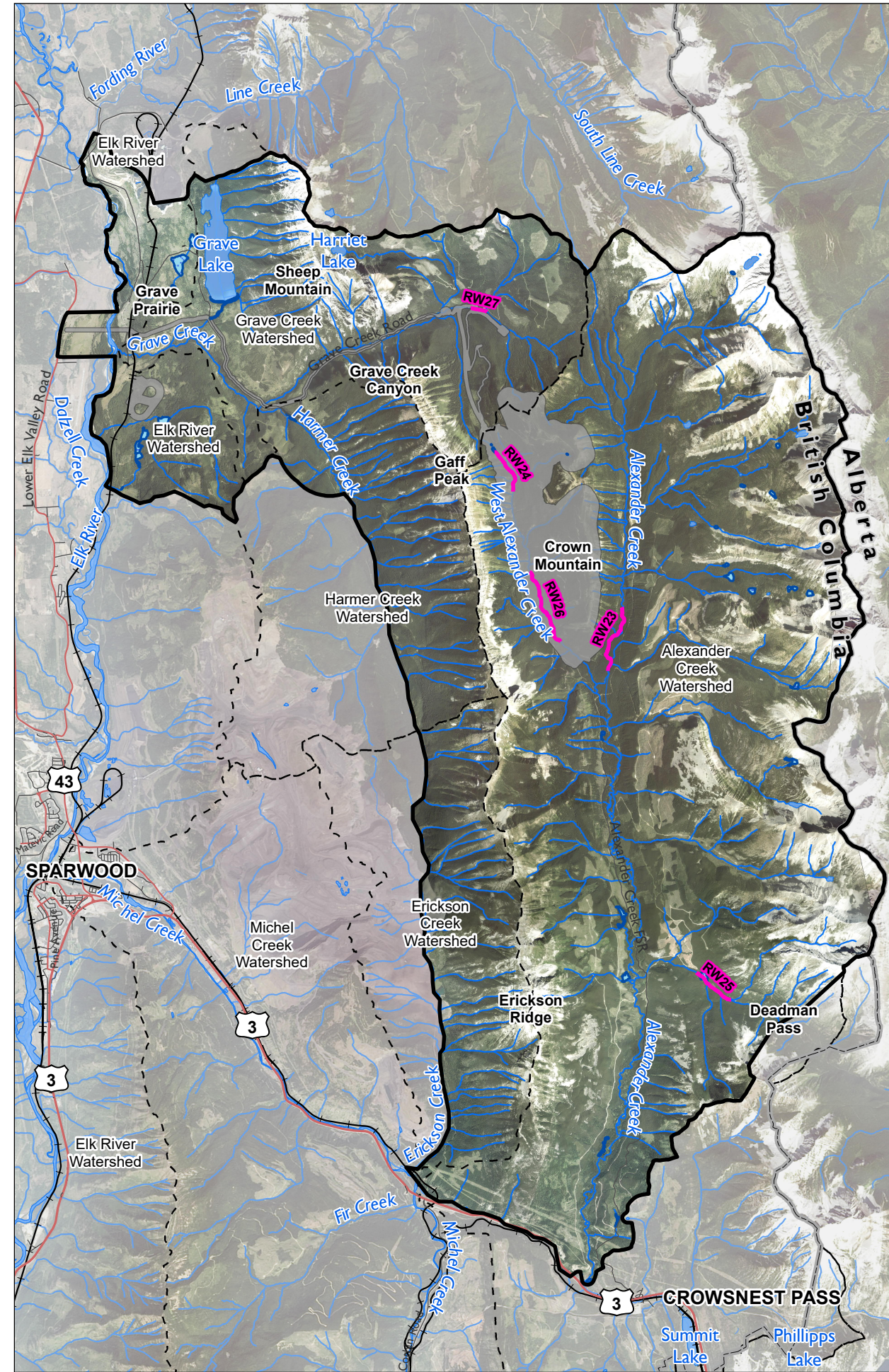
2017



2018



2019



Crown Mountain Coking Coal Project

FIGURE 5-10. Riverine Bird Survey Locations

LEGEND

- 2017
- 2018
- 2019
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border



Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-17

File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Bird\126231 Baseline Bird Riverine Bird Survey Locations.mxd

5.2.2.2

Spotted Sandpiper Tissue Collection

A scientific collection permit (BC-18-0022) was obtained from Environment Canada under Section 4(1) of the *MBCA* (1994) in 2017 and 2018 for the collection of Spotted Sandpiper eggs. To limit impacts on the Spotted Sandpiper population in the LSA, annual tissue sample collection was limited to one egg from clutches of four or more up to a collective total of ten samples per permit year.

Four bird egg tissue samples were collected in the summers of 2017 and 2018 (**Figure 5-11**). In June and July 2017, two Spotted Sandpiper egg samples were collected from the banks of Alexander Creek, and one from Harmer Creek near wetland survey site WL10 (**Figure 5-11**). In July 2018, one Spotted Sandpiper egg sample was collected from the banks of wetland survey site WL6 along Alexander Creek (**Figure 5-11**). Biologists walked rivers as per the methods outlined above, and once adult Spotted Sandpipers were encountered, their movements were carefully followed until nests could be located. Once the nests were located and eggs were confirmed, the biologists waited for the parent to leave in order to reduce stress to the parent and the potential for nest abandonment. The nest location was marked with a handheld GPS unit, photographed, and the egg was collected while wearing nitrile gloves. The egg mass was measured and the egg was placed into a glass jar and immediately put on ice in a cooler. Eggs were frozen within five hours of collection.

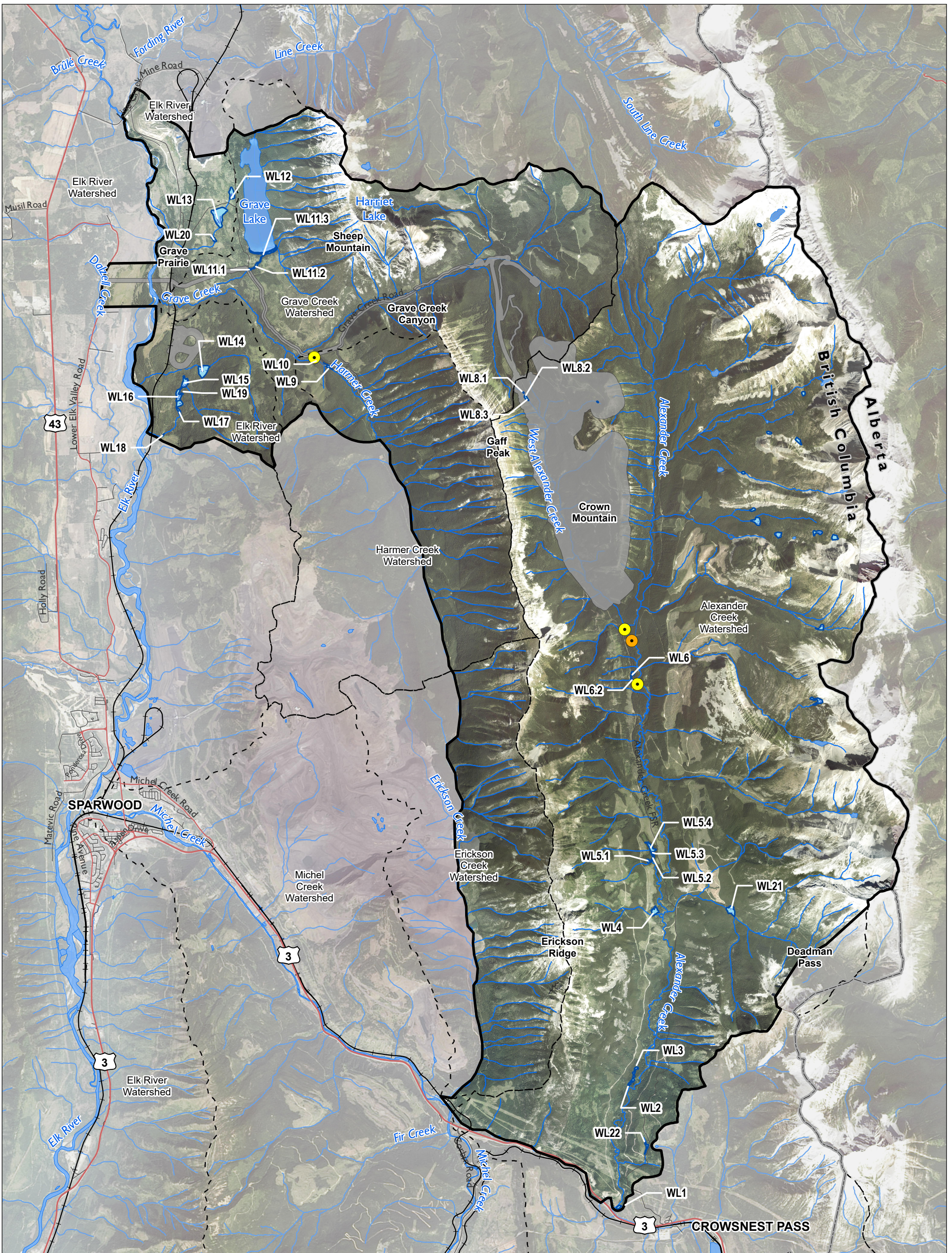


FIGURE 5-11.
Spotted Sandpiper Egg Collection Locations

LEGEND

● 2017 Collection Location	 Waterbody
● 2018 Collection Location	 Wetland
 Terrestrial Local Study Area	 Watershed
 Project Footprint	 BC/Alberta Border
— Highways	— Arterial Roads
— Local/Resource Roads	— Railway (Canadian Pacific)
— Watercourse	

0 1 2 3 4 Kilometers

SCALE 1:82,000

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5.2.2.3 Data Analysis

Riverine bird observations from each survey year were summarized by creek and across all survey years. The total number of riverine birds detected were divided by the length of creek surveyed as a measure of relative abundance for each creek (total birds/km sampled) as per the RISC *Inventory Methods for Riverine Birds: Harlequin Duck, Belted Kingfisher and American Dipper Version 2.0* (Ministry of Environment, Lands and Parks, 1998b). Riverine bird species richness, the number of bird species present in a given area, was estimated for each creek based on the portion of the creek sampled. The Shannon-Weiner Diversity Index was used to consider both the richness and evenness of the species present (Rosenzweig, 1995). The Shannon-Weiner Diversity Index was calculated using the methods described in **Section 3.1.2.2**.

Spotted Sandpiper egg metal concentrations analysed by the laboratory (ALS Environmental, Burnaby, BC) were converted to dry weight (dw) from wet weight (wt) using the laboratory-determined percent moisture content for each sample. Concentrations were compared to the provincial guideline for selenium in bird eggs (BC MOE, 2014) and the regionally-specific benchmark tissue concentration for selenium in bird eggs from the Elk Valley Water Quality Plan (Teck Resources Limited, 2015). Both guidelines are discussed in **Section 1.3.3**.

5.2.3 Results

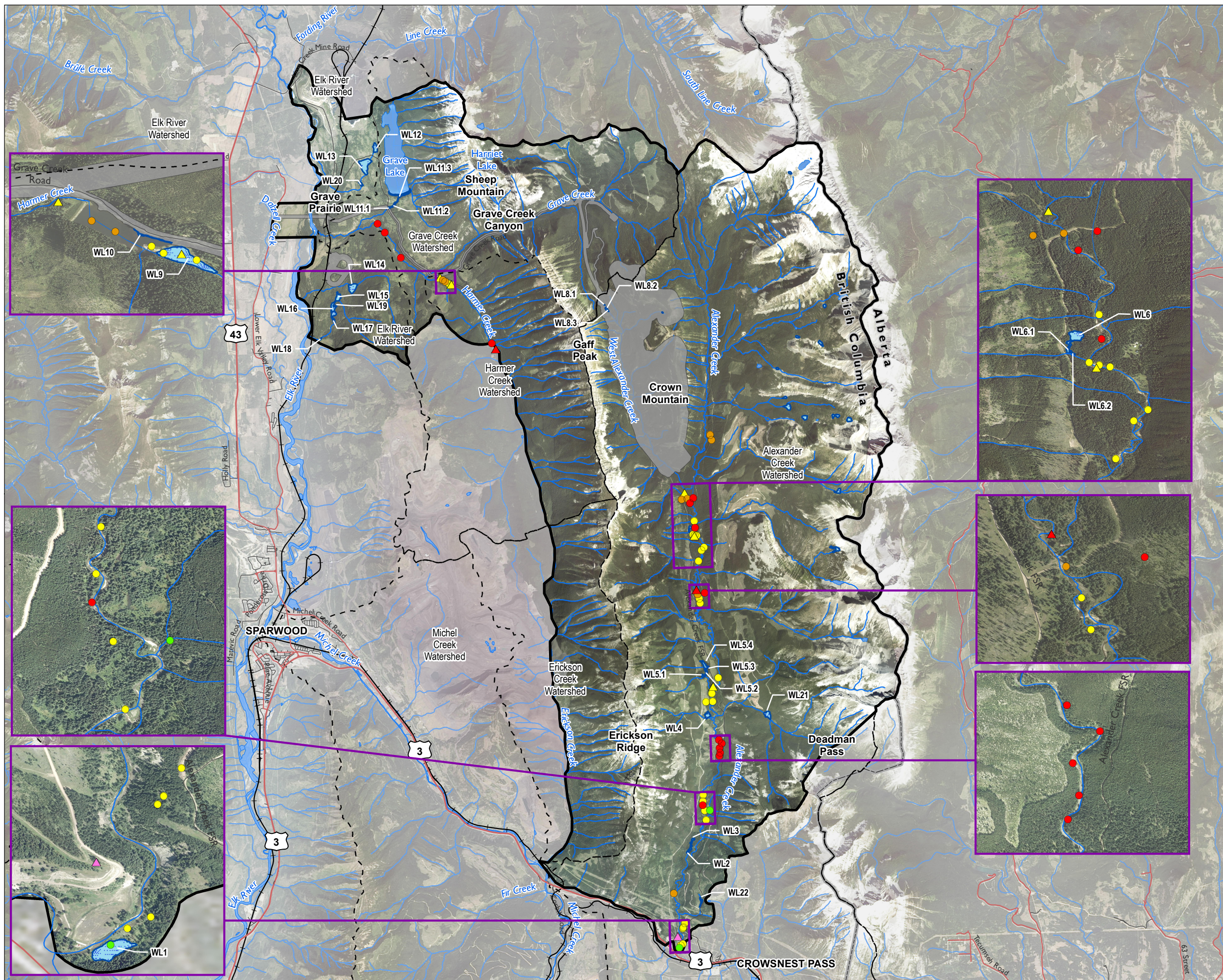
5.2.3.1 Riverine Bird Populations

Eighty-three (83) riverine birds and eleven (11) nests were observed in the LSA across 28.3 km of creek habitat assessed over the surveys years (**Table 5-7; Figure 5-12 - Figure 5-14**). Observations of birds from each survey, including sex, age, and behaviour, are provided in **Appendix D7**. Spotted Sandpiper were the most abundant riverine bird species observed in the LSA (44), followed by American Dipper (23), Harlequin Duck (12), and Belted Kingfisher and Osprey (2 each; **Table 5-7; Figure 5-12 - Figure 5-14**). The majority of observations (56 of 83 or 67%) were in Alexander Creek, followed by Harmer Creek (13), West Alexander Creek (8), and Grave Creek (6; **Table 5-7; Figure 5-12 - Figure 5-14**). No birds were observed in the unnamed creek in Deadman Pass. American Dipper nests were observed in Alexander, Harmer, and West Alexander Creeks. Spotted Sandpiper nests were observed in Alexander and Harmer Creeks and one Osprey nest was observed in Alexander Creek (referred to in **Section 4.4; Figure 5-12 - Figure 5-13**). No Belted Kingfisher nests were observed in the LSA over the course of the survey years.

Table 5-7: Results of the Riverine Bird Surveys, 2017-2019

Creek Name	Year	Length Surveyed (km)	No. Observed				Total No. Observed	Comments	
			American Dipper	Belted Kingfisher	Harlequin Duck	Osprey			Spotted Sandpiper
Alexander Creek	2017	9.2	10	2	4	0	19	35	1 American Dipper and 3 Spotted Sandpiper nests observed; 1 Osprey nest observed; 2 Spotted Sandpiper nests suspected; 1 Spotted Sandpiper brood observed
	2018	2.0	2	0	3	2	12	19	1 Spotted Sandpiper nest with 4 eggs observed; 1 Osprey nest observed
	2019	1.7	2	0	0	0	0	2	1 American Dipper nest observed
Alexander Creek Total		12.9	14	2	7	2	31	56	-
West Alexander Creek	2017	1.3	0	0	0	0	0	0	-
	2018	0.4	0	0	0	0	3	3	-
	2019	2.9	2	0	3	0	0	5	1 American Dipper nest observed
West Alexander Creek Total		4.6	2	0	3	0	3	8	-
Grave Creek	2017	5.1	3	0	0	0	0	3	-
	2018	0.5	1	0	0	0	2	3	-
	2019	0.05	0	0	0	0	0	0	-
Grave Creek Total		5.7	4	0	0	0	2	6	-
Harmer Creek	2017	3.0	1	0	0	0	0	1	1 American Dipper and 2 Spotted Sandpiper nests observed
	2018	0.7	2	0	2	0	8	12	-
Harmer Creek Total		3.7	3	0	2	0	8	13	-
Unnamed Creek in Deadman Pass	2019	1.5	0	0	0	0	0	0	-
Total		28.3	23	2	12	2	44	83	-

FIGURE 5-12.
2017 Riverine Bird Observations



LEGEND

- American Dipper
- ▲ American Dipper Nest
- Belted Kingfisher
- Harlequin Duck
- ▲ Osprey Nest
- Spotted Sandpiper
- ▲ Spotted Sandpiper Nest
- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- ▭ BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000



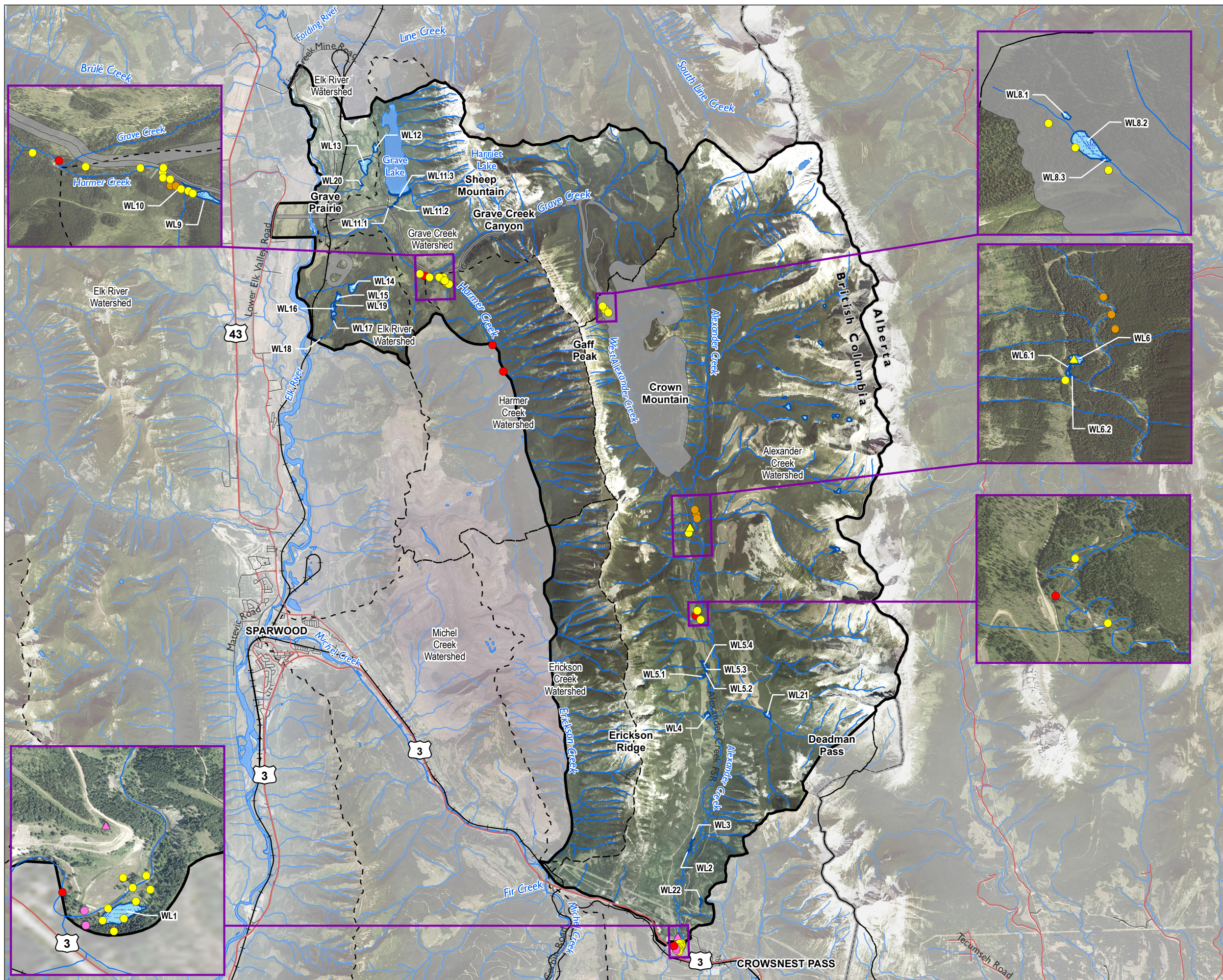
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FIGURE 5-13.
2018 Riverine Bird Observations



LEGEND

- American Dipper
- Harlequin Duck
- Osprey
- ▲ Osprey Nest
- Spotted Sandpiper
- ▲ Spotted Sandpiper Nest
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border



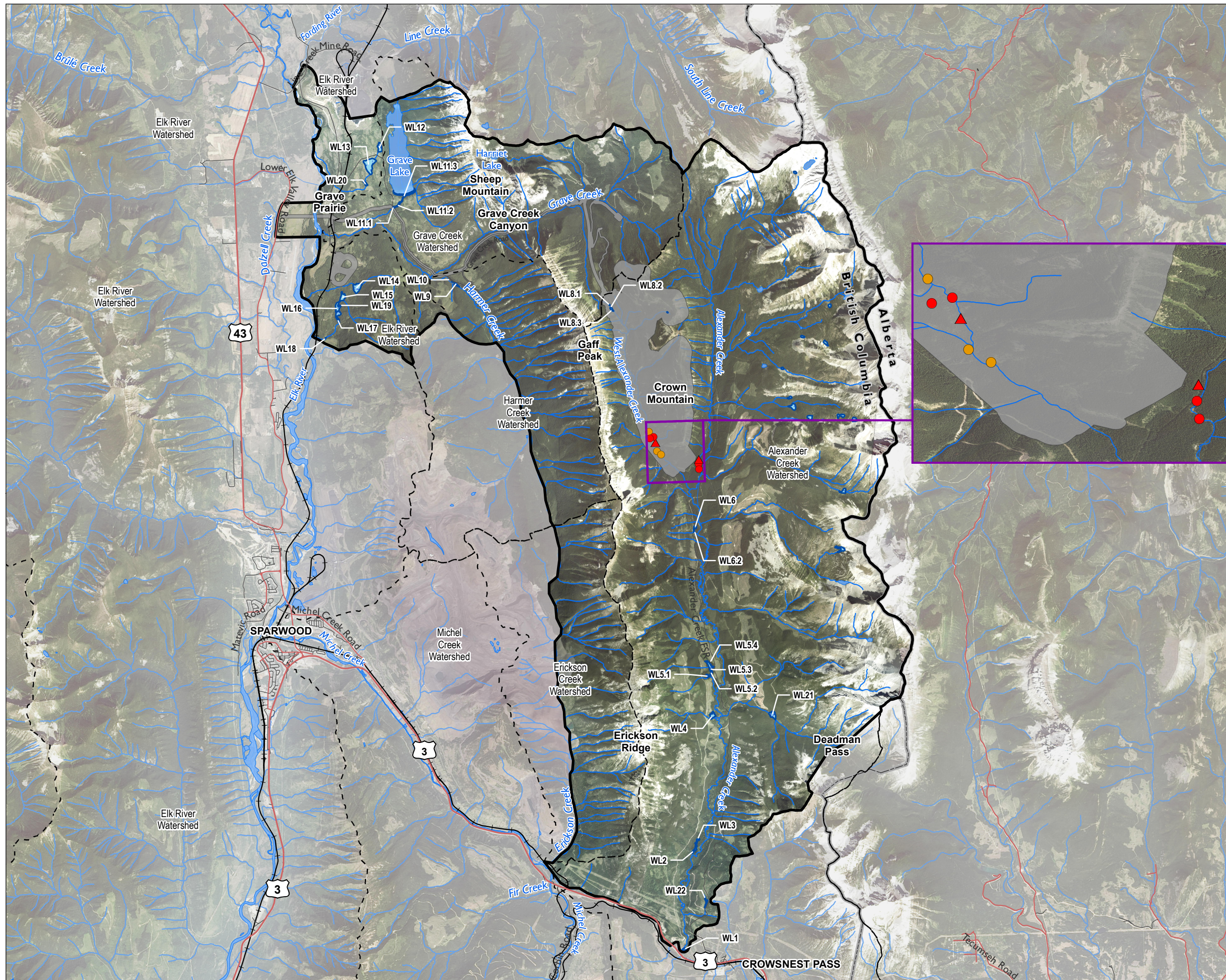
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DATE: 2021-08-16

FIGURE 5-14.
2019 Riverine Bird Observations



LEGEND

- American Dipper
- ▲ American Dipper Nest
- Harlequin Duck
- ▭ Terrestrial Local Study Area
- ▭ Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- - - Watershed
- ▭ BC/Alberta Border

0 1 2 3 4 Kilometers
SCALE 1:108,000



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Map Created By: JFC/RBB
Map Checked By: HEB
Map Projection: NAD 1983 UTM Zone 11N



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Riverine bird relative abundance (#/km surveyed) ranged from 0.0 to 17.1 birds/km (**Table 5-8; Appendix D8**). Across the three survey years, Alexander Creek had the highest relative abundance (4.3 birds/km), followed by Harmer Creek (3.5 birds/km), West Alexander Creek (1.7 birds/km), and Grave Creek (1.1 birds/km; **Table 5-8**). Overall, 2.9 birds were observed/km across all survey years and creeks.

Species richness ranged from 0 to 5 per creek across the LSA (**Table 5-8; Appendix D8**). Alexander Creek was the only creek in which all five documented riverine bird species were observed; Belted Kingfisher and Osprey were not observed in the other creeks surveyed (**Table 5-7; Table 5-8**). Species richness was 3 in both Harmer and West Alexander Creeks, and 2 in Grave Creek (**Table 5-8**).

Shannon-Weiner Diversity Index ranged from 0.00 to 1.10 in creeks where riverine birds were observed (**Table 5-8; Appendix D8**). Alexander Creek had the highest diversity (1.17) across the 3 survey years, followed by West Alexander Creek (1.08), Harmer Creek (0.93) and Grave Creek (0.64; **Table 5-8**). The riverine bird diversity across all creeks surveyed was 1.15 (**Table 5-8**).

Table 5-8: Riverine Bird Population Metrics for Surveyed Creeks

Creek Name	Year	Length Surveyed (km)	Total No. Observed	Relative Abundance (birds/km surveyed)	Species Richness	Shannon-Weiner Diversity Index
Alexander Creek	2017	9.2	35	3.8	4	1.10
	2018	2	19	9.5	4	1.06
	2019	1.7	2	1.2	1	0.00
Alexander Creek Total		12.9	56	4.3	5	1.17
West Alexander Creek	2017	1.3	0	0.0	0	-
	2018	0.4	3	7.5	1	0.00
	2019	2.9	5	1.7	2	0.67
West Alexander Creek Total		4.6	8	1.7	3	1.08
Grave Creek	2017	5.1	3	0.6	1	0.00
	2018	0.5	3	6.0	2	0.64
	2019	0.05	0	0.0	0	-
Grave Creek Total		5.7	6	1.1	2	0.64
Harmer Creek	2017	3	1	0.3	1	0.00
	2018	0.7	12	17.1	3	0.87
Harmer Creek Total		3.7	13	3.5	3	0.93
Unnamed Creek in Deadman Pass	2019	1.5	0	0.0	0	-
Total		28.3	83	2.9	5	1.15

5.2.3.2

Riverine Bird Habitat

Creek habitat characteristics (i.e., gradient, channel features, and riparian vegetation) were qualitatively described for each creek section surveyed (**Table 5-9**). Alexander Creek contained the most diverse creek habitat surveyed and features canyons, steep and mellow rapids, meandering floodplains, and smaller headwaters (**Table 5-9**). The upper reaches contain suitable American Dipper nesting habitat (i.e., boulders near fast-flowing water; **Photo 5-4**). Downstream of the confluence with West Alexander Creek, Alexander Creek widens, meanders, and fans out into a floodplain where abundant nesting habitat for Spotted Sandpiper was observed (i.e., broad-leaved vegetation shoreline cover; **Photo 5-5**). The upper reaches of West Alexander creek offer little habitat for riverine birds, as they are narrow and lack streamside vegetation and forest cover (**Table 5-9**); however, a family of Spotted Sandpiper were observed in wetland site WL8.1 near the headwaters of West Alexander Creek in 2018 (**Figure 5-13**). The middle section of West Alexander Creek near the north end of RW26 (**Figure 5-10**) supports American Dipper (including nesting) and Harlequin Duck (**Figure 5-12** and **Figure 5-14**). The unnamed creek in Deadman Pass is a small alpine headwater creek and a tributary to Alexander Creek. The section surveyed was a low gradient channel and lacked channel features such as coarse woody debris and boulders.

Upstream of the confluence with Harmer Creek, Grave Creek is shallow, narrow, and characterized by steep, continuous rapids with few pools, abundant coarse woody debris, large boulders, and frequent steep drops, and is surrounded by thick forest and shrubs (**Table 5-9**). Downstream of the confluence with Harmer Creek, Grave Creek widens and is dominated by riffles and runs with a few large rapids. The creek contains some pools and abundant coarse woody debris and log jams. Harmer Creek is dominated by riffles and runs with limited rapids and pools and runs through a steep valley with abundant overhanging vegetation. Both American Dipper and Spotted Sandpiper nest in Harmer Creek.



Photo 5-4: American Dipper Nest Observed in a Steep Rapid in the Upper Reaches of Alexander Creek (July 8, 2019)



Photo 5-5: Spotted Sandpiper Nest Observed in Central Alexander Creek (July 1, 2017)

Table 5-9: Habitat Characteristics of Creeks Surveyed for Riverine Birds*

Creek Name	Creek Section	Gradient	Channel Features	Fish Bearing?	Riparian Vegetation	Riverine Bird Species Observed
Alexander Creek	Upper (RW9, RW23)	Steep	<ul style="list-style-type: none"> Frequent riffles and rapids Canyons Large boulders Abundant coarse woody debris 	Yes	<ul style="list-style-type: none"> Mature coniferous forest Abundant moss and vegetation up to creek edge 	<ul style="list-style-type: none"> American Dipper (nesting) Harlequin Duck Spotted Sandpiper
	Middle (RW4-RW8; RW19-RW20)	Moderate	<ul style="list-style-type: none"> Riffles and runs, deep pools Abundant channels, eddies, and back channels Abundant coarse woody debris 	Yes	<ul style="list-style-type: none"> Mature coniferous forest Moss and vegetation up to creek edge Surrounded by floodplain 	<ul style="list-style-type: none"> American Dipper (nesting) Belted Kingfisher Harlequin Duck Spotted Sandpiper (nesting)
	Lower (RW1-RW3)	Moderate	<ul style="list-style-type: none"> Drop-pool structure Distinct long rapids and riffles Steep canyon walls Sedimentary cliffs and banks 	Yes	<ul style="list-style-type: none"> Second or third growth Montane forest 	<ul style="list-style-type: none"> American Dipper Belted Kingfisher Harlequin Duck Spotted Sandpiper (nesting) Osprey (nesting)
West Alexander Creek	Upper (RW24)	Steep	<ul style="list-style-type: none"> Narrow, steep Wetland sites WL8.1-WL8.3 in line with creek Intersected by several avalanche chutes 	No	<ul style="list-style-type: none"> Lacks streamside vegetation and forest cover 	<ul style="list-style-type: none"> Spotted Sandpiper
	Middle/Lower (RW10, RW26)	Moderate	<ul style="list-style-type: none"> Large boulders Boulders and undercut banks 	Yes	<ul style="list-style-type: none"> Dense moss Vegetation up to the stream bank 	<ul style="list-style-type: none"> American Dipper (nesting) Harlequin Duck Spotted Sandpiper

Creek Name	Creek Section	Gradient	Channel Features	Fish Bearing?	Riparian Vegetation	Riverine Bird Species Observed
Grave Creek	Upstream of Harmer Creek (RW12-RW14)	Steep	<ul style="list-style-type: none"> Abundant coarse woody debris Narrow, shallow with steep, continuous rapids and infrequent pools Large boulders Intersected by avalanche chutes Abundant coarse woody debris 	Yes	<ul style="list-style-type: none"> Dense, mature coniferous forest Dense, tall overhanging shrubs in some areas 	<ul style="list-style-type: none"> No riverine birds observed
	Downstream of Harmer Creek (RW15-RW16, RW21)	Moderate	<ul style="list-style-type: none"> Dominated by riffles and runs with a few large rapids and pools No boulders Abundant coarse woody debris Dominated by riffles and runs with infrequent rapids and pools 	Yes	<ul style="list-style-type: none"> Coniferous forest (active logging) 	<ul style="list-style-type: none"> American Dipper Spotted Sandpiper
Harmer Creek	Middle/Lower (RW17-RW18, RW22)	Moderate	<ul style="list-style-type: none"> Some boulders and avalanche chutes Northern end runs through wetland site WL9 and spills into a deep man-made reservoir 	Yes	<ul style="list-style-type: none"> Abundant overhanging vegetation Mature forest (active logging) 	<ul style="list-style-type: none"> American Dipper (nesting) Harlequin Duck Spotted Sandpiper (nesting)
Unnamed Creek in Deadman Pass	Middle (RW25)	Low	<ul style="list-style-type: none"> Riffles and runs Few significant rapids 	Unknown	<ul style="list-style-type: none"> Dense willows and other shrubs 	<ul style="list-style-type: none"> No riverine birds observed

Creek Name	Creek Section	Gradient	Channel Features	Fish Bearing?	Riparian Vegetation	Riverine Bird Species Observed
			<ul style="list-style-type: none"> No canyons or boulders Runs through wetland site WL21 (beaver pond) 			

*Habitat characteristics are based on creek segments surveyed for riverine birds only.



5.2.3.3 Spotted Sandpiper Tissue Collection

Results for the laboratory analysis of metals in Spotted Sandpiper egg tissues and summary statistics (minimum, maximum, geometric mean, and standard deviation) are provided in **Appendix D9**. Selenium was detected in all four Spotted Sandpiper egg tissue samples collected (**Table 5-10**). The mean concentration of selenium in bird egg tissues collected in the LSA was 4.6 mg/kg dw, with samples ranging in concentration from 2.8 to 14 mg/kg dw. Only one bird egg sample from Harmer Creek near wetland survey site WL10 (**Figure 5-11**) had a selenium concentration exceeding the BC guideline (6 mg/kg dw), with a concentration of 14 mg/kg dw. The selenium concentration in this sample fell between the 10% to 20% effect sizes from the EVWQP (Teck Resources Limited, 2015). The other three Spotted Sandpiper egg tissue samples collected from Alexander Creek and wetland survey site WL6 had selenium concentrations below the guideline values (**Table 5-10**).

Table 5-10. Spotted Sandpiper Egg Tissue Selenium Concentrations Compared to BC MOE Guideline and Elk Valley Benchmark Values

Creek	Location	Date	Selenium (mg/kg dw)			
			Result	BC WQG 2014 ^a	EVWQP 2015 (~10% Effect Size) ^b	EVWQP 2015 (~20% Effect Size) ^c
Guideline/Benchmark Value (mg/kg dw)			-	6	12	16
Harmer Creek	Creekside near WL10	July 4, 2017	14	>	>	<
Alexander Creek	Creekside	June 30, 2017	2.8	<	<	<
Alexander Creek	Creekside	July 6, 2017	3.1	<	<	<
Alexander Creek	WL6	July 4, 2018	3.8	<	<	<

^a BC MOE (2014) guideline for bird egg tissue.

^b Elk Valley Water Quality Plan (2015) benchmark selenium concentrations in bird egg tissue resulting in a critical effect size of ~10% (Level 1; quantified according to dose-response curve) representing negligible potential for population-level effects if <10% and representing a possibility of population-level effects if between 10% to 20%.

^c Elk Valley Water Quality Plan (2015) benchmark selenium concentrations in bird egg tissue resulting in a critical effect size of ~20% (Level 2; quantified according to dose-response curve) representing a possibility of population-level effects if between 10% to 20% and representing a potential for measurable and ecologically meaningful population-level effects if >20%.

5.2.4 Discussion

Riverine birds were observed throughout the LSA. Spotted Sandpiper were the most abundant species, followed by American Dipper, Harlequin Duck, and Belted Kingfisher and Osprey. The majority of observations were in Alexander Creek, followed by Harmer Creek, West Alexander Creek, and Grave Creek. No riverine birds were observed in the unnamed tributary in Deadman Pass. Alexander Creek had the highest relative abundance, species richness, and diversity of the creeks surveyed for riverine birds and all five target species were observed in Alexander Creek. Riverine birds were observed throughout Alexander Creek; however, the middle and lower reaches in the central-southern portion of the LSA had

higher abundances and were more species-rich. Based on the sections surveyed, Alexander Creek appears to support the most abundant and diverse riverine bird habitat in the LSA.

Spotted Sandpiper were the most frequently observed species in Alexander Creek and were seen from the southern reaches up to the confluence with West Alexander Creek (**Figure 5-12** to **Figure 5-14**). The abundance of Spotted Sandpiper upstream of the confluence of these creeks was low, which may be due to lack of suitable habitat. Upper Alexander Creek is not considered fish bearing and therefore may not support piscivorous species like Osprey and Belted Kingfisher; all other creeks where riverine birds were detected are considered fish bearing. Spotted Sandpiper prefer shorelines with semi-open areas like gravel patches and pockets of dense vegetation for sheltering chicks (Cornell University, 2019d); however, Alexander Creek upstream of West Alexander Creek contained limited open areas and vegetation was tall, dense, and overhung the creek.

American Dipper were the second most frequently observed species in Alexander Creek and were the most abundant species in the smaller and steeper reaches upstream of the confluence with West Alexander Creek. The upper reaches of Alexander Creek appear to be well suited to American Dipper and Harlequin Duck, with steep canyon walls and large boulders, abundant mosses and overhanging trees, root-wads, and logs and log jams for cover. Harlequin Duck prefer fast-flowing streams and nest under roots along banks, on cliffs among boulders, and in large tree cavities (Ministry of Environment, Lands and Parks, 1998b). American Dipper prefer fast-flowing streams with boulder-strewn rapids, riffles, and canyons, and nest in rock crevices or cutbanks (Ministry of Environment, Lands and Parks, 1998b). Harlequin Duck were also observed in Alexander Creek near the confluence with West Alexander Creek. These creek sections likely support Harlequin Duck nesting as observations were made in June and July during the breeding season.

Osprey and Belted Kingfisher were only observed in the southern reaches of Alexander Creek. An Osprey nest was observed on a hilltop along the Alexander Forest Service Road in the southern portion of the LSA (**Figure 5-12**; **Figure 5-13**). Osprey adults were observed a limited number of times, flying and foraging along Alexander Creek in the southern portion of the LSA. Multiple sedimentary cliffs and banks throughout the lower reaches of Alexander Creek may support Belted Kingfisher nesting (Ministry of Environment, Lands and Parks, 1998b); however, this was not confirmed during the riverine surveys. The upper reaches of Alexander Creek may not be suitable to Belted Kingfisher as no soft sediment cliffs were observed.

Harlequin Duck were primarily observed in the lower reaches of West Alexander Creek and in Alexander Creek near the confluence with West Alexander Creek. These creek sections likely support Harlequin Duck nesting as observations were made in June and July during the breeding season. American Dipper were the second most frequently observed species in West Alexander Creek and were the most widespread species in the smaller and steeper higher reaches surveyed upstream of the confluence with

Alexander Creek. In 2018, a Spotted Sandpiper adult and chicks were observed in wetland site WL8.1 near the headwaters of West Alexander Creek.

Harmer Creek and the section of Grave Creek downstream of the confluence with Harmer Creek also contain suitable riverine bird habitat. Three species were observed in these reaches: American Dipper, Harlequin Duck, and Spotted Sandpiper. Similar to Alexander Creek, American Dipper were found throughout both Harmer Creek and the downstream section of Grave Creek in both the narrow and steeper upper reaches and in the lower reaches where the creek widens and the gradient decreases. Spotted Sandpiper were only observed around the banks of the Harmer Creek reservoir and along the creek edge in wetland site WL9. Two Spotted Sandpiper nests were observed near the Harmer Creek reservoir, and based on observed bird behaviour and annual timing, more were suspected. Harlequin Duck were observed on the reservoir in early July, but were not suspected to nest there as suitable breeding habitat for this species is limited. Harmer Creek and the downstream portion of Grave Creek may not contain suitable habitat for Belted Kingfisher, as no soft sediment cliffs for nesting were observed.

No riverine birds were observed along the upper reaches of Grave Creek upstream of the confluence with Harmer Creek. In this upper section, Grave Creek is narrow (approximately 2.5 to 3 m wide) and may not provide adequate riverine bird habitat. Riverine birds were also not observed within the unnamed creek in Deadman Pass. The lack of bird detections in these two creeks may also be due to the distances that were walked, as the steep terrain limited access. Both creeks are characterized by dense, overhanging vegetation, sharp turns, and in some areas, steep gradients, resulting in low visibility. Such low-visibility conditions may have limited observations of riverine birds that were potentially present during the surveys.

No field surveys were conducted in Erickson Creek or the Elk River; however, surveys conducted in 2013 for Teck's Elkview Operations baseline program found American Dipper and Spotted Sandpiper along the Elk River and Spotted Sandpiper in Erickson Creek (Golder Associates, 2015a). In addition, American Dipper, Spotted Sandpiper, and Harlequin Duck were observed in Harmer, Dry, and Michel Creeks so these species are known to occur in other regional watercourses. Similar to the riverine bird surveys completed for the bird community baseline program, Spotted Sandpiper were the most frequently observed species for other baseline surveys in the area (Golder Associates, 2015a). No riverine birds were observed during the targeted surveys conducted during the Line Creek Operations baseline program in 2010; however, American Dipper and Harlequin Duck have been recorded at the site during other surveys (Teck Coal Ltd., 2011).

In three of the four samples analyzed, selenium concentrations measured in the Spotted Sandpiper egg samples collected during the riverine bird surveys were below provincial guidelines (BC MOE, 2014) and regional benchmark values (Teck Resources Limited, 2015), and are within the normal range for birds in natural environments as selenium is also an essential micronutrient (Ohlendorf and Heinz, 2011). The

sample from Harmer Creek near wetland survey site WL10 had a selenium concentration above the provincial guideline. The selenium concentration in this sample fell between the 10% to 20% effect sizes for the regional benchmark (Teck Resources Ltd., 2015).

The selenium concentrations measured in the majority of the Spotted Sandpiper egg samples from the LSA were similar to those from sites north of the LSA in the Elk Valley. Concentrations of selenium in Spotted Sandpiper eggs ranged from 3.0 to 4.2 mg/kg dw at reference sites for Teck's Line Creek Operations baseline program (Teck Coal Ltd., 2011). Spotted Sandpiper egg samples from mine-exposed areas in the Elk Valley generally showed higher selenium concentrations, with ranges from 3.3 to 9.0 mg/kg dw measured during the Line Creek Operations baseline program (Teck Coal Ltd., 2011) and 3.6 to 9.1 mg/kg dw measured during the Elkview Operations baseline program (Golder Associates, 2015b). A similar selenium concentration to the egg collected in Harmer Creek was measured during the Elkview Operations baseline program in a lentic exposed site in the Harmer Sediment Pond (range of 7.16 to 14.1 mg/kg dw; Golder Associates, 2015b), which is within the Harmer Creek watershed. Portions of the Harmer Creek watershed contain active coal mining (i.e., Teck's Elkview Operations), which likely contributes to elevated selenium levels in Harmer Creek.

Summary

Bird community baseline surveys were conducted in the LSA in 2014, 2017, 2018, and 2019. The baseline program included landbird breeding and migration point count and transect surveys; Common Nighthawk surveys; raptor migration standwatch surveys; Northern Goshawk call-playback and habitat assessment surveys; nocturnal owl surveys; wetland bird breeding and migration season standwatch surveys; riverine bird surveys; and riverine bird egg tissue collection.

The breeding landbird and Common Nighthawk surveys documented 80 species within the LSA over four survey years. The most frequently encountered species included Swainson's Thrush, Pine Siskin, Yellow-rumped Warbler, Dark-eyed Junco, Townsend's Warbler, and Warbling Vireo. Two SARA-listed (threatened) and provincially blue-listed species were observed, Barn Swallow and Olive-sided Flycatcher. SARA-listed Common Nighthawk (threatened) and Evening Grosbeak (special concern) were also observed, as were provincially blue-listed Great Blue Heron. The highest average relative abundance, species richness, and diversity of breeding landbirds was documented within the Grave Prairie area, west of Grave Lake, and along the mainstem of Alexander Creek. Within the LSA, breeding landbird communities were found to be the most abundant, species-rich, and diverse in grasslands, mixed shrub forests, and wetlands.

Landbird migration surveys documented 51 species within the LSA in the spring and 33 species in the fall over two survey years. The most frequently encountered species included Dark-eyed Junco, American Robin, and Pine Siskin. SARA-listed Evening Grosbeak (special concern) and Olive-sided Flycatcher (threatened and provincially blue-listed) were also observed. The highest average relative abundance, species richness, and diversity of landbirds during the spring and fall occurred within the Grave Prairie area, west of Grave Lake, and along Alexander Creek south of the confluence with West Alexander Creek. Landbird communities were found to be the most abundant, species-rich, and diverse in mixed shrub forests in the spring and in wetlands in the fall.

The raptor migration surveys documented 13 raptor species in the spring and 10 species in the fall over two survey years. The only known migrant species was a Broad-winged Hawk observed in fall 2019. Red-tailed Hawk were the most frequently observed resident species in the spring and Golden Eagle were the mostly frequently observed resident species in the fall. The highest average raptor abundance and species richness was observed at Alexander Creek in the southern portion of the LSA in the spring and in the upper reaches of Grave Creek in the northwestern portion of the LSA in the fall.

Ten Northern Goshawk were documented in the LSA over four survey years. Northern Goshawk were distributed throughout the LSA but were primarily observed in the mainstem of Alexander Creek, followed by West Alexander Creek, the Elk River, the Grave Prairie area, upper Grave Creek, and Deadman Pass. Most Goshawk observations occurred in forested areas; however, Goshawk were also

observed in areas with edge habitats between forests and grasslands, rivers, and wetlands. No Goshawk nests were observed during the habitat assessments. The habitat assessment stations with the highest overall habitat ratings were located near Alexander Creek (mainstem), West Alexander Creek, and upper Alexander Creek. The results of the habitat surveys suggests that the LSA offers primarily low to moderate quality Goshawk habitat.

No owls were observed during the nocturnal owl surveys; however, five Great Horned Owl and three Barred Owl were incidentally observed during other bird surveys conducted within the LSA. Great Horned Owl and Barred Owl are two of the most widespread owl species in BC and occupy a wide variety of habitats. Both are active during the day and night, which may have increased the likelihood of incidental observation of these species, as most bird surveys were conducted during daylight hours.

The wetland bird surveys documented 23 species in the spring, 14 species in the summer, and two species in the fall. Red-winged Blackbird, Mallard, and Northern Shoveler were the most abundant species in the spring, while Mallard, Spotted Sandpiper, and Red-winged Blackbird were the most abundant species in the summer. In the fall, only Mallard and Hooded Merganser were observed. Higher abundance areas in the spring occurred at two wetlands near the Elk River, two wetlands near Grave Creek, and one wetland along Harmer Creek. Higher abundance areas in the summer occurred at two wetlands near the Elk River, one wetland on the shore of Grave Lake, two wetlands along Harmer Creek, and one wetland along Alexander Creek. Few waterbirds were seen in the LSA during the fall.

Five riverine bird species were observed in the LSA. Spotted Sandpiper were the most frequently observed species, followed by American Dipper and Harlequin Duck. Riverine bird species were observed in four of the five creeks surveyed: Alexander Creek; West Alexander Creek; Grave Creek; and Harmer Creek. Alexander Creek had the highest bird abundance, species richness, and diversity in the LSA, particularly the middle and lower reaches in the southern portion of the LSA. No riverine birds were observed in Grave Creek upstream of the confluence with Harmer Creek or in the unnamed creek in Deadman Pass. Based on the survey locations evaluated, sections surveyed in Alexander Creek contained the most abundant and diverse riverine bird habitat in the LSA.

Selenium was detected in all four Spotted Sandpiper egg tissue samples collected during the riverine bird surveys. The selenium concentrations measured in the Spotted Sandpiper egg samples were below provincial guidelines and regional benchmark values in three of the four samples analyzed. The 2017 sample from Harmer Creek near wetland site WL10 had a selenium concentration above the provincial guideline and the 10% effect size for the regional benchmark. Portions of the Harmer Creek watershed contain active coal mining (i.e., Teck Elkview Operations), which may have contributed to the higher concentration of selenium observed in this sample.

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Appendix A

Breeding Landbird Field Data and Results

Point Count Form-Songbirds

Page ___/___

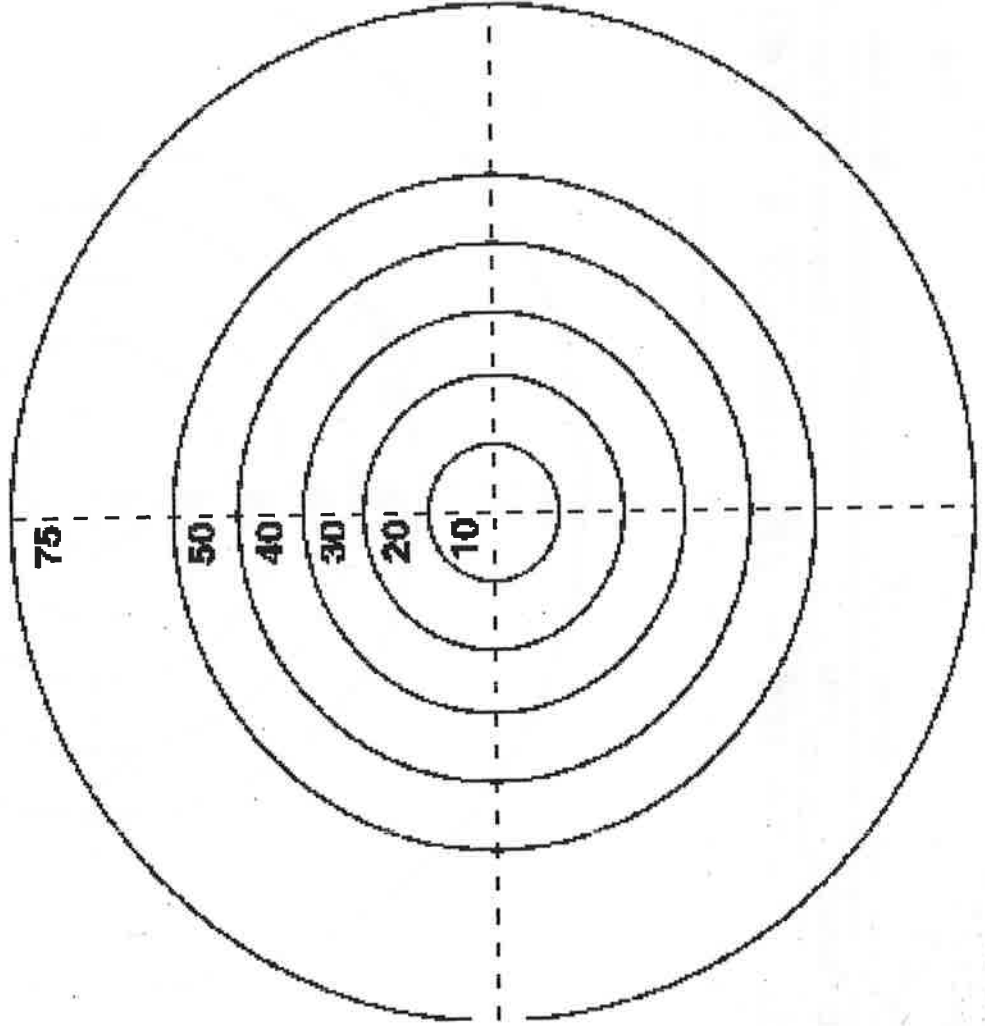
Project _____ Survey _____ Study Area _____

Pt Cnt Sta Label _____ Stratum _____ UTM _____/_____/_____ Ecosystem Form Type / # _____/_____/_____ [Trans Label _____]

Obs Date _____/_____/_____ Time: Start _____ End _____ Ceiling _____ CC _____ Wind _____ Precip _____ Temp _____

Surveyors _____

Time Interval: 5 minutes





Point Count Name	Survey Type	Year of First Visit	Date of First Survey	Easting	Northing	Total Visits	BEC ¹	Structural Stage ²	Stand Type ³	Dominant Land Cover
BBS1	BBS	2014	5-Jun-14	654329.02	5523809.2	3	MSdw	5	b	Forest
BBS2	BBS	2014	5-Jun-14	654911.62	5524027.3	3	MSdw	6	c	Forest
BBS3	BBS	2014	5-Jun-14	655616.59	5523711.1	3	MSdw	3	m	Cutblock
BBS4	BBS	2014	5-Jun-14	655821.13	5523024.8	3	MSdw	7	c	Forest
BBS5	BBS	2014	5-Jun-14	656954.98	5522520.2	3	MSdw	3	c	Cutblock
BBS6	BBS	2014	5-Jun-14	658488.9	5523343.2	3	MSdw	6	c	Forest
BBS7	BBS	2014	5-Jun-14	661433.55	5524581.4	4	MSdw	5	c	Forest
BBS8	BBS	2014	6-Jun-14	657349.11	5521936.7	4	MSdw	3	m	Wetland
BBS9	BBS	2014	6-Jun-14	658312.66	5521045.9	3	MSdw	6	c	Forest
BBS10	BBS	2014	6-Jun-14	658479.18	5520653.4	3	MSdw	6	c	Forest
BBS11	BBS	2014	6-Jun-14	658830.36	5520120.3	3	MSdw	3	m	Avalanche
BBS12	BBS	2014	6-Jun-14	659406.49	5518799.9	3	MSdw	7	m	Forest
BBS12B	BBS	2017	9-Jun-17	659608.99	5517628.8	2	MSdw	5	m	Forest
BBS13	BBS	2014	6-Jun-14	660101.88	5517083.8	1	MSdw	6	m	Forest
BBS14	BBS	2014	6-Jun-14	659364.43	5523750.5	4	MSdw	6	m	Forest
BBS15	BBS	2014	7-Jun-14	664995.42	5519390.1	3	ESSFdk1	6	c	Forest
BBS16	BBS	2014	7-Jun-14	664987.61	5518706.1	3	ESSFdk1	7	c	Forest
BBS17	BBS	2014	7-Jun-14	664276.57	5515799.4	3	ESSFdk1	6	c	Forest
BBS18	BBS	2014	7-Jun-14	664266.03	5514901.9	1	ESSFdk1	2	c	Wetland
BBS19	BBS	2014	7-Jun-14	664474.99	5513895	3	MSdw	2	c	Wetland
BBS20	BBS	2014	7-Jun-14	664221.91	5512646.4	3	MSdw	6	m	Forest
BBS21	BBS	2014	8-Jun-14	663521.66	5504028.8	3	MSdw	3	c	Forest
BBS22	BBS	2014	8-Jun-14	663291.34	5504390.9	3	MSdw	6	m	Cutblock
BBS23	BBS	2014	8-Jun-14	664006.18	5505760.8	3	MSdw	6	c	Forest
BBS24	BBS	2014	8-Jun-14	664941.47	5510075	3	MSdw	6	c	Forest
BBS25	BBS	2014	8-Jun-14	664737.19	5509363.6	3	MSdw	2	c	Wetland
BBS26	BBS	2014	8-Jun-14	664388.59	5510538.2	3	MSdw	6	c	Forest
BBS27	BBS	2014	8-Jun-14	664585.46	5515744	3	ESSFdk1	6	c	Forest
BBS28	BBS	2014	9-Jun-14	661806.08	5521593	1	ESSFdk1	7	c	Forest
BBS28B	BBS	2017	4-Jul-17	661482.1	5522212.5	1	ESSFdk1	3	c	Forest
BBS28C	BBS	2017	4-Jul-17	661826.66	5521415.7	1	ESSFdk1	7	c	Forest
BBS28D	BBS	2017	4-Jul-17	661966.79	5521807.1	1	ESSFdk1	7	c	Forest
BBS29	BBS	2014	9-Jun-14	661733.04	5523148.8	2	ESSFdk1	6	c	Forest
BBS30	BBS	2014	10-Jun-14	663738.93	5516067.5	2	ESSFdk1	3	m	Avalanche
BBS30A	BBS	2017	5-Jul-17	664070.39	5516281.4	1	ESSFdk1	7	c	Forest
BBS30B	BBS	2017	5-Jul-17	663969.45	5516553.7	2	ESSFdk1	6	c	Rocky Outcrop
BBS30C	BBS	2017	5-Jul-17	663719.99	5516768.1	1	ESSFdk1	6	c	Forest
BBS30D	BBS	2017	5-Jul-17	664010.73	5516845.7	1	ESSFdk1	6	c	Forest
BBS30E	BBS30E	2017	4-Jul-19	663670	5517065	1	ESSFdk1	6	c	Forest
BBS30F	BBS	2017	5-Jul-17	663420.16	5517433.4	1	ESSFdk1	6	c	Forest



Point Count Name	Survey Type	Year of First Visit	Date of First Survey	Easting	Northing	Total Visits	BEC ¹	Structural Stage ²	Stand Type ³	Dominant Land Cover
BBS31	BBS	2014	10-Jun-14	663301.68	5516544.3	3	ESSFdk1	6	c	Forest
BBS32	BBS	2014	10-Jun-14	663099.09	5516784.4	3	ESSFdk1	6	c	Forest
BBS33	BBS	2014	10-Jun-14	664009.33	5511574.8	3	MSdw	6	c	Forest
BBS34	BBS	2014	29-Jun-14	653921.9	5523649.9	4	MSdw	5	b	Forest
BBS35	BBS	2014	29-Jun-14	653820.01	5522629.6	1	MSdw	3	m	Mixed Shrub Forest
BBS35B	BBS		11-Jun-17	653802.9	5523029.9	2	MSdw	3	m	Mixed Shrub Forest
BBS36	BBS	2014	29-Jun-14	653754.05	5522273	1	MSdw	6	m	Mixed Shrub Forest
BBS36B	BBS	2014	11-Jun-17	653763.97	5522717.3	2	MSdw	6	m	Mixed Shrub Forest
BBS37	BBS	2014	29-Jun-14	653785.11	5522011.8	3	MSdw	6	m	Mixed Shrub Forest
BBS38	BBS	2014	29-Jun-14	653272.8	5522175.3	1	MSdw	6	m	Mixed Shrub Forest
BBS38B	BBS	2014	3-Jul-17	653680.62	5522882.1	1	MSdw	2	m	Grassland
BBS39	BBS	2014	11-Jun-14	664623.15	5510560	2	MSdw	3	c	Wetland
BBS40	BBS	2014	29-Jun-14	653876.8	5520826.7	3	MSdw	5	c	Wetland
BBS41	BBS	2014	29-Jun-14	654407.65	5521285.4	3	MSdw	6	c	Forest
BBS42	BBS	2014	30-Jun-14	661936.82	5521889.3	1	ESSFdk1	7	c	Forest
BBS43	BBS	2014	30-Jun-14	662343.43	5521688.5	1	ESSFdk1	7	c	Forest
BBS44	BBS	2014	30-Jun-14	662513.14	5521350.4	1	ESSFdk1	7	c	Forest
BBS45	BBS	2014	30-Jun-14	662886.56	5521137.6	1	ESSFdkw	7	c	Forest
BBS46	BBS	2014	30-Jun-14	662725.58	5521576.5	2	ESSFdkw	7	c	Forest
BBS47	BBS	2014	30-Jun-14	663097.23	5521445.9	1	ESSFdkw	5	c	Forest
BBS48	BBS	2014	30-Jun-14	662932.77	5521675.8	1	ESSFdkw	7	c	Forest
BBS49	BBS	2014	1-Jul-14	663602.55	5502839	3	MSdw	6	m	Mixed Shrub Forest
BBS50	BBS	2014	1-Jul-14	664497.6	5502589.4	3	MSdw	6	c	Mixed Shrub Forest
BBS51	BBS	2014	1-Jul-14	664367.01	5502896.1	3	MSdw	5	m	Forest
BBS52	BBS	2014	1-Jul-14	664120.24	5503390.8	3	MSdw	6	m	Forest
BBS53	BBS	2014	1-Jul-14	664422.61	5503444.5	3	MSdw	3	m	Grassland
BBS54	BBS	2014	1-Jul-14	664630.39	5503637.7	3	MSdw	3	m	Grassland
BBS55	BBS	2014	1-Jul-14	664615.44	5503954.1	3	MSdw	3	c	Forest
BBS56	BBS	2014	1-Jul-14	664453.81	5504308.9	3	MSdw	3	c	Cutblock
BBS57	BBS	2014	1-Jul-14	664609.58	5504705.8	3	MSdw	5	c	Forest
BBS58	BBS	2014	1-Jul-14	663103.36	5504139.8	1	MSdw	3	c	Forest
BBS59	BBS	2014	1-Jul-14	662964.13	5504358.4	2	MSdw	6	c	Forest
BBS60	BBS	2014	2-Jul-14	664788.59	5516153.2	2	ESSFdk1	5	c	Forest
BBS61	BBS	2014	2-Jul-14	664799.71	5515812.4	1	ESSFdk1	7	c	Forest
BBS62	BBS	2014	2-Jul-14	665680.46	5515770.5	1	ESSFdk1	4	c	Cutblock
BBS63	BBS	2014	2-Jul-14	665494.2	5516639.4	1	ESSFdk1	6	c	Forest
BBS64	BBS	2014	2-Jul-14	665741.84	5516932.9	1	ESSFdk1	6	c	Forest
BBS65	BBS	2014	2-Jul-14	665136.86	5517250.7	1	ESSFdk1	6	c	Forest
BBS66	BBS	2014	2-Jul-14	665280.79	5517966.2	1	ESSFdk1	6	c	Forest
BBS67	BBS	2014	2-Jul-14	665757.52	5519166.7	1	ESSFdk1	7	c	Forest



Point Count Name	Survey Type	Year of First Visit	Date of First Survey	Easting	Northing	Total Visits	BEC ¹	Structural Stage ²	Stand Type ³	Dominant Land Cover
BBS68	BBS	2017	3-Jul-14	654781.24	5525594.7	3	MSdw	6	b	Wetland
BBS69	BBS	2017	4-Jul-14	663743.02	5503356.6	2	MSdw	6	c	Grassland
BBS70	BBS	2018	5-Jul-18	663740.03	5520577	1	ESSFdkw	2	c	Alpine
BBS71	BBS	2018	5-Jul-18	663846.06	5520307.8	1	ESSFdkw	2	c	Alpine
BBS72	BBS	2018	5-Jul-18	663693.75	5519786.8	2	ESSFdkw	7	c	Forest
BBS73	BBS	2018	5-Jul-18	663648.63	5519531.6	2	ESSFdkw	7	c	Forest
BBS74	BBS	2018	5-Jul-18	663713.98	5519262.4	1	ESSFdkw	7	c	Forest
BBS75	BBS	2018	5-Jul-18	663761.37	5518982.3	1	ESSFdkw	7	c	Forest
BBS76	BBS	2018	5-Jul-18	663678.02	5518724.4	1	ESSFdkw	7	c	Forest
BBS77	BBS	2018	5-Jul-18	663444.5	5518817.9	2	ESSFdkw	7	c	Forest
BBS78	BBS	2018	5-Jul-18	663424.08	5518562.1	1	ESSFdkw	7	c	Forest
BBS79	BBS	2018	5-Jul-18	663430.94	5518307.3	2	ESSFdkw	7	c	Forest
BBS80	BBS	2018	5-Jul-18	663429.36	5518055.1	1	ESSFdk1	7	c	Forest
BBS81	BBS	2018	5-Jul-18	663508.18	5517816.5	2	ESSFdk1	6	c	Forest
BBS82	BBS	2018	5-Jul-18	663690.18	5518470.7	1	ESSFdkw	7	c	Forest
BBS83	BBS	2019	6-Jul-19	664397	5516690	1	ESSFdk1	7	c	Forest
BBS84	BBS	2019	6-Jul-19	664491	5517006	1	ESSFdk1	7	c	Forest
BBS85	BBS	2019	6-Jul-19	664771	5517352	1	ESSFdk1	6	c	Forest
BBS86	BBS	2019	6-Jul-19	664781	5517706	1	ESSFdk1	7	c	Forest
BBS87	BBS	2019	7-Jul-19	654001	5525810	1	MSdw	7	m	Forest
BBS88	BBS	2019	7-Jul-19	654379	5525234	1	MSdw	7	b	Forest
BBS89	BBS	2019	7-Jul-19	654717	5524853	1	MSdw	5	b	Forest
BBS90	BBS	2019	7-Jul-19	655250	5524504	1	MSdw	6	m	Forest
BBS91	BBS	2019	7-Jul-19	654295	5524641	1	MSdw	6	m	Forest
BBS92	BBS	2019	7-Jul-19	661968	5524386	1	MSdw	6	c	Forest
BBS93	BBS	2019	7-Jul-19	663012	5523972	1	ESSFdk1	5	c	Forest
bbs94	BBS	2019	7-Jul-19	663716	5524477	1	ESSFdkw	7	c	Forest
BBS95	BBS	2019	8-Jul-19	663201	5517216	1	ESSFdk1	7	c	Forest
BBS96	BBS	2019	8-Jul-19	663086	5517500	1	ESSFdk1	7	c	Forest
BBS97	BBS	2019	8-Jul-19	662905	5517729	1	ESSFdk1	7	c	Forest
BBS98	BBS	2019	8-Jul-19	662872	5518048	1	ESSFdk1	7	c	Forest
BBS99	BBS	2019	8-Jul-19	662732	5518422	1	ESSFdk1	3	c	Wetland
BBS100	BBS	2019	9-Jul-19	666483	5509484	1	MSdw	2	c	Wetland
BBS101	BBS	2019	9-Jul-19	666763	5509454	1	MSdw	6	c	Forest
BBS102	BBS	2019	9-Jul-19	667089	5509337	1	ESSFdk1	6	c	Forest
BBS103	BBS	2019	9-Jul-19	667577	5509162	1	ESSFdk1	5	c	Forest
BBS104	BBS	2019	9-Jul-19	668043	5509003	1	ESSFdk1	3	c	Avalanche
BBS105	BBS	2019	9-Jul-19	668267	5508772	1	ESSFdk1	7	c	Forest
BBS106	BBS	2019	9-Jul-19	668509	5508517	1	ESSFdk1	7	c	Forest
BBS107	BBS	2019	9-Jul-19	667350	5509013	1	MSdw	6	m	Forest

Point Count Name	Survey Type	Year of First Visit	Date of First Survey	Easting	Northing	Total Visits	BEC ¹	Structural Stage ²	Stand Type ³	Dominant Land Cover
BBS108	BBS	2019	10-Jul-19	661830	5521182	1	ESSFdk1	7	c	Wetland
BBS109	BBS	2019	10-Jul-19	662068	5520917	-	ESSFdk1	3	c	Avalanche
BBS110	BBS	2019	10-Jul-19	662312	5520374	1	ESSFdk1	7	c	Forest
BBS111	BBS	2019	10-Jul-19	662561	5520380	1	ESSFdk1	7	c	Forest
BBS112	BBS	2019	6-Jul-19	664487	5516442	1	ESSFdk1	7	c	Forest
RSS1	RSS	2014	11-Jun-14	663830	5503196	1	MSdw	6	c	Forest
RSS2	RSS	2014	11-Jun-14	663672	5504326	1	MSdw	6	m	Forest
RSS3	RSS	2014	11-Jun-14	663717	5504898	1	MSdw	3	c	Cutblock
RSS4	RSS	2014	11-Jun-14	664004	5505624	1	MSdw	6	c	Forest
RSS5	RSS	2014	11-Jun-14	664377	5506347	1	MSdw	3	c	Cutblock
RSS6	RSS	2014	11-Jun-14	664593	5507640	1	MSdw	5	c	Cutblock
RSS7	RSS	2014	11-Jun-14	664597	5510071	1	MSdw	3	c	Cutblock
RSS8	RSS	2014	11-Jun-14	664411	5511596	1	MSdw	3	c	Cutblock
RSS9	RSS	2014	11-Jun-14	664411	5512281	1	MSdw	6	c	Forest
RSS10	RSS	2014	11-Jun-14	664285	5513157	1	MSdw	6	c	Forest
RSS11	RSS	2014	11-Jun-14	664203	5514777	1	ESSFdk1	6	m	Wetland
RSS12	RSS	2014	11-Jun-14	664653	5516425	1	ESSFdk1	7	c	Forest
RSS13	RSS	2014	11-Jun-14	664857	5517314	1	ESSFdk1	7	c	Forest
RSS14	RSS	2014	11-Jun-14	664921	5518219	1	ESSFdk1	3	c	Cutblock

¹ BEC: Biogeoclimatic Ecosystem Classification (BEC) system developed in British Columbia to classify and manage sites based on ecosystem features

² Structural Stage: Structural stages are used to describe the appearance of an ecosystem based on dominant life forms often reflecting disturbance history created by the Ecosystems Working Group, 1998.

³ Stand Type: Identify conifer-dominated stands (C), broadleaf-dominated stands (B) or mixed stands (M)

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Breeding Bird Point Count Survey Data, June 5-10, 2014



Survey Point Name	BBS01	BBS02	BBS03	BBS04	BBS05	BBS06	BBS07	BBS08	BBS09	BBS10	BBS11	BBS12	BBS13	BBS14	BBS15	BBS16	BBS17
BBS Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time Start	6:06	6:51	7:32	8:09	8:32	9:28	10:25	5:41	6:18	6:47	7:28	8:27	9:36	10:35	5:53	6:28	7:10
Time End	6:13	6:58	7:39	8:16	8:39	9:35	10:32	5:48	6:25	6:54	7:35	8:34	9:43	10:42	6:00	6:35	7:17
Ceiling ¹	M	H	H	H	H	H	H	M	H	H	H	H	H	H	0	0	H
Cloud Cover (%)	100	100	100	40	30	60	70	80	20	10	5	5	15	35	0	0	30
Wind ²	1	0-1	0-1	1	4	3	3	2	1	1	1	2	1	1	1	1	1
Precipitation ³	Drizzle	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	9	10	10	11	11	7	7	2	3	2	2	3	4	8	-1	-1	1
Date	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	07-Jun-14	07-Jun-14	07-Jun-14
American Robin	1							1		1		1					
Boreal Chickadee							2						1		1		
Cassin's Vireo						1											
Chipping Sparrow			2														
Common Raven				1													
Dark-eyed Junco	1									1				1	1		
Downy Woodpecker			1														
Evening Grosbeak					1												
Golden-crowned Kinglet			1			1		1			1	1					
Hammond's Flycatcher	1				1			1									
Hermit Thrush									3		1	2	1		1		1
Lincoln's Sparrow								1									
MacGillivray's Warbler	1	1	1		1			1			1	1					
Mountain Chickadee	1																
Northern Waterthrush				1				1									
Olive-sided Flycatcher			2														
Orange-crowned Warbler		1			1												
Pacific Wren																	1
Pine Grosbeak													1				
Pine Siskin				1													1
Purple Finch							1										
Red Crossbill				1													
Red-breasted Nuthatch																	1
Red-naped Sapsucker		1	1														
Ruby-crowned Kinglet		1										1	1				
Ruffed Grouse									1								
Song Sparrow																	
Spotted Sandpiper																	
Swainson's Thrush								2									1
Tennessee Warbler																	
Townsend's Warbler							1	2	3	1	1		2		2		
Tree Swallow																	
Varied Thrush			1					1					1				3
Warbling Vireo	2	1	2		1	1		1									
Western Tanager				1	1												
Willow Flycatcher								2									
Wilson's Warbler										1				2			
Yellow-Rumped Warbler		1			1	1						1	1				

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Breeding Bird Point Count Survey Data, June 5-10, 2014



Survey Point Name	BBS18	BBS19	BBS20	BBS21	BBS22	BBS23	BBS24	BBS25	BBS26	BBS27	BBS28	BBS29	BBS30	BBS31	BBS32	BBS33	BBS39
BBS Number	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	39
Time Start	8:00	8:45	9:30	5:18	6:06	6:37	7:28	8:20	9:06	10:11	7:56	9:00	5:59	6:53	7:40	9:40	9:41
Time End	8:07	8:52	9:37	5:25	6:13	6:44	7:35	8:27	9:13	10:18	8:03	9:07	6:06	7:00	7:47	9:47	9:48
Ceiling ¹	H	H	H	0	0	0	0	0	0	0	M	M	H	M	H	H	H
Cloud Cover (%)	10	0	0	0	0	0	0	0	0	0	70	80	20	60	70	75	10
Wind ²	1	1	1	1	1	1	1	1	2	2	1	3	1	1	1	1	2.5
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	1	4	6	0	1	2	0	3	7	4	8	8	0	2	4	4	6
Date	07-Jun-14	07-Jun-14	07-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	11-Jun-14
American Robin	1			1				1									
Boreal Chickadee																	
Cassin's Vireo						1				1							
Chipping Sparrow			1	4													
Common Raven																	
Dark-eyed Junco			1			2						1		1			
Downy Woodpecker				1													
Evening Grosbeak																	
Golden-crowned Kinglet			1	1			1		1		1			1	1		
Hammond's Flycatcher						1								2			
Hermit Thrush												1		1	2		
Lincoln's Sparrow																	1
MacGillivray's Warbler						2			1					1			1
Mountain Chickadee																	
Northern Waterthrush	1								1								2
Olive-sided Flycatcher			1	1	1					1	1						
Orange-crowned Warbler																	
Pacific Wren												1		1			1
Pine Grosbeak																	
Pine Siskin	1																
Purple Finch						1											
Red Crossbill												1					
Red-breasted Nuthatch																	
Red-naped Sapsucker																	
Ruby-crowned Kinglet			1	1	1	1	1	1	1		1		1		1		1
Ruffed Grouse	1					1								1			1
Song Sparrow								1	1								
Spotted Sandpiper								1									
Swainson's Thrush		2		2	1	1				1		1	1	1	1		
Tennessee Warbler	1																
Townsend's Warbler		1	1				1	2		1	1			1	1		1
Tree Swallow	1								1								
Varied Thrush												1					
Warbling Vireo	1		1	2	1	1			1			1		2			
Western Tanager				1													
Willow Flycatcher									2								
Wilson's Warbler	1		1			1		1	1				1	2			
Yellow-Rumped Warbler			1	1		2		2		1	1	2	1				1

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Breeding Bird Point Count Survey Data, June 5-10, 2014



Survey Point Name	BBS01	BBS02	BBS03	BBS04	BBS05	BBS06	BBS07	BBS08	BBS9	BBS10	BBS11	BBS12	BBS13	BBS14	BBS15	BBS16	BBS17
BBS Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time Start	6:06	6:51	7:32	8:09	8:32	9:28	10:25	5:41	6:18	6:47	7:28	8:27	9:36	10:35	5:53	6:28	7:10
Time End	6:13	6:58	7:39	8:16	8:39	9:35	10:32	5:48	6:25	6:54	7:35	8:34	9:43	10:42	6:00	6:35	7:17
Ceiling ¹	M	H	H	H	H	H	H	M	H	H	H	H	H	H	0	0	H
Cloud Cover (%)	100	100	100	40	30	60	70	80	20	10	5	5	15	35	0	0	30
Wind ²	1	0-1	0-1	1	4	3	3	2	1	1	1	2	1	1	1	1	1
Precipitation ³	Drizzle	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	9	10	10	11	11	7	7	2	3	2	2	3	4	8	-1	-1	1
Date	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	05-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	06-Jun-14	07-Jun-14	07-Jun-14	07-Jun-14
Incidental Observations																	
American Robin			1														
Black-capped Chickadee																	1
Boreal Chickadee																	
Brown-headed Cowbird																	
Calliope Hummingbird																	
Canada Goose																	
Cassin's Vireo	1	1															
Chipping Sparrow							1										
Common Raven	1																
Dark-eyed Junco																	
Golden-crowned Kinglet																	
Gray Jay							1										
Hammond's Flycatcher			1												1		
Harry Woodpecker							1										
Hermit Thrush																	
Mountain Chickadee																	
Northern Flicker													1				
Northern Waterthrush																	
Olive-sided Flycatcher			1														
Orange-crowned Warbler	1																
Pacific Wren																	1
Red Crossbill																	
Red-breasted Nuthatch	1	1															
Red-naped Sapsucker																	
Ruby-crowned Kinglet	1						1										
Song Sparrow								1									
Swainson's Thrush		1	1													1	
Townsend's Solitaire						1											1
Townsend's Warbler							1							1			
Varied Thrush							1			1							1
Western Tanager	1																
White-winged Crossbill														1			
Yellow-Rumped Warbler																	

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None n/a = not applicable; nd = no data; N=no precipitation

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
 Breeding Bird Point Count Survey Data, June 5-10, 2014



Survey Point Name	BBS18	BBS19	BBS20	BBS21	BBS22	BBS23	BBS24	BBS25	BBS26	BBS27	BBS28	BBS29	BBS30	BBS31	BBS32	BBS33	BBS39
BBS Number	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	39
Time Start	8:00	8:45	9:30	5:18	6:06	6:37	7:28	8:20	9:06	10:11	7:56	9:00	5:59	6:53	7:40	9:40	9:41
Time End	8:07	8:52	9:37	5:25	6:13	6:44	7:35	8:27	9:13	10:18	8:03	9:07	6:06	7:00	7:47	9:47	9:48
Ceiling ¹	H	H	H	0	0	0	0	0	0	0	M	M	H	M	H	H	H
Cloud Cover (%)	10	0	0	0	0	0	0	0	0	0	70	80	20	60	70	75	10
Wind ²	1	1	1	1	1	1	1	1	2	2	1	3	1	1	1	1	2.5
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	1	4	6	0	1	2	0	3	7	4	8	8	0	2	4	4	6
Date	07-Jun-14	07-Jun-14	07-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	08-Jun-14	11-Jun-14

Incidental Observations																	
American Robin			1										1				
Black-capped Chickadee																	
Boreal Chickadee			1														
Brown-headed Cowbird				1													
Calliope Hummingbird														1			
Canada Goose												1					
Cassin's Vireo																	
Chipping Sparrow				1					1								
Common Raven																	
Dark-eyed Junco		1							1								
Golden-crowned Kinglet								1		1							1
Gray Jay											1		2				
Hammond's Flycatcher																	
Harry Woodpecker																	
Hermit Thrush												1					
Mountain Chickadee													1				
Northern Flicker																	
Northern Waterthrush			1				1										
Olive-sided Flycatcher																	
Orange-crowned Warbler																	
Pacific Wren											1						
Red Crossbill					1												
Red-breasted Nuthatch						1											
Red-naped Sapsucker						1											1
Ruby-crowned Kinglet																	
Song Sparrow																	
Swainson's Thrush								1									
Townsend's Solitaire									1								
Townsend's Warbler																	
Varied Thrush																	
Western Tanager				1													
White-winged Crossbill												1					
Yellow-Rumped Warbler		1						1		1						1	

¹ Ceiling: H=High, M=Medium, L=Low, 0=None
² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze
³ Precipitation: N=None n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS07	BBS08	BBS14	BBS34	BBS35	BBS36	BBS37	BBS38	BBS39	BBS40	BBS41	BBS42	BBS43	BBS44	BBS45	BBS46	BBS47	BBS48
BBS Number	7	8	14	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Time Start	7:01	6:05	6:41	5:49	6:27	6:53	7:32	8:15	8:44	9:23	9:52	7:10	7:45	8:19	8:55	9:39	10:01	10:29
Time End	7:08	6:12	6:48	5:56	6:34	7:00	7:39	8:22	8:51	9:30	9:59	7:17	7:52	8:26	9:02	9:46	10:08	10:36
Ceiling ¹	H	H	H	H	H	H	H	H	M	H	M	M	H	H	H	H	H	H
Cloud Cover (%)	60	50	20	10	60	25	20	30	50	40	75	95	95	60	50	30	50	20
Wind ²	1	1	0	0	1	0	0	0	1	0	1	1	1	1	0	1	2	2
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	10	9	10	7	7	7	8	9	9	10	12	9	9	10	11	11	10	13
Date	3-Jul-14	3-Jul-14	3-Jul-14	29-Jun-14	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19
American Robin							1					2						
Black-capped Chickadee																		
Boreal Chickadee										1							1	
Brown-headed Cowbird							1											
Cassin's Vireo																		
Cedar Waxwing		2				1												
Chipping Sparrow																		1
Common Raven							1	1				1						
Common Yellowthroat																		
Dark-eyed Junco		1					1		1	1			1	1		1		1
Evening Grosbeak							1											
Fox Sparrow														1				1
Golden-crowned Kinglet						1	1		1									
Hammond's Flycatcher					1			1										
Hermit Thrush														3		1	3	1
House Wren																		
Least Flycatcher																		
Lincoln's Sparrow											1							
MacGillivray's Warbler		1		1							1							
Mountain Chickadee										1								
Northern Flicker							1											
Northern Waterthrush		2										1						
Olive-sided Flycatcher														1				
Orange-crowned Warbler					2	2	1	1		3		1						
Pacific Wren			1															
Pine Grosbeak																1		2
Pine Siskin		1															1	
Red Crossbill								1						1				
Red-breasted Nuthatch					1	2					1	1				1		
Red-naped Sapsucker					1			1										
Red-winged Blackbird																		
Ruby-crowned Kinglet						1	1	1					1	1				
Song Sparrow		1																
Sora																		
Swainson's Thrush	1	2	1	1	2	3	3	1		3	1							
Tennessee Warbler		1					1											
Townsend's Warbler	1				1					2	2				1			
Tree Swallow																		
Varied Thrush	1												1	2	1	1		1
Vesper's Sparrow																		
Warbling Vireo					2				1	1								
Western Tanager								1										
White-crowned Sparrow																		
Willow Flycatcher																		
Wilson's Warbler												1						
Yellow-Rumped Warbler		1											1	2				1

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Breeding Bird Point Count Survey Data, June 29-July 3, 2014



Survey Point Name	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS58	BBS59	BBS60	BBS61	BBS62	BBS63	BBS64	BBS65	BBS66	BBS67	BBS68
BBS Number	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
Time Start	5:10	5:35	5:59	6:22	6:44	7:06	7:31	8:00	8:38	9:19	9:53	6:09	6:38	7:11	7:41	8:08	8:57	9:34	10:03	5:32
Time End	5:17	5:42	6:06	6:29	6:51	7:13	7:38	8:07	8:45	9:26	10:00	6:16	6:45	7:18	7:48	8:15	9:05	9:41	10:10	5:39
Ceiling ¹	H	H	H	H	H	H	H	H	H	H	0	0	0	0	0	0	0	0	0	0
Cloud Cover (%)	10	15	15	20	30	25	10	10	0	0	0	0	0	0	0	0	0	0	0	10
Wind ²	2	1	1	1	1	1	1	1	0	1	2	1	0	1	0	0	0	0	1	0
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	7	7	7	7	7	7	7	9	9	12	15	7	8	9	9	10	12	12	15	9
Date	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	3-Jul-14
American Robin			1			2						1			2					
Black-capped Chickadee		1																		
Boreal Chickadee								1				1							1	
Brown-headed Cowbird							1													
Cassin's Vireo		1									1									
Cedar Waxwing																				1
Chipping Sparrow		1			1		1	2	2											
Common Raven																				
Common Yellowthroat																				1
Dark-eyed Junco					1						1				1					
Evening Grosbeak																				
Fox Sparrow																				
Golden-crowned Kinglet				2		1	1			1		1	1							
Hammond's Flycatcher	2																			
Hermit Thrush															2	1				
House Wren																				1
Least Flycatcher																				2
Lincoln's Sparrow						1														
MacGilliver's Warbler													1							
Mountain Chickadee																				
Northern Flicker																				
Northern Waterthrush	2																			
Olive-sided Flycatcher							1	1	1	1										
Orange-crowned Warbler								2												1
Pacific Wren													1							
Pine Grosbeak																				
Pine Siskin															1				1	
Red Crossbill													1							
Red-breasted Nuthatch				1	1	1				1										
Red-naped Sapsucker																				
Red-winged Blackbird																				3
Ruby-crowned Kinglet			1		1						1									
Song Sparrow																				
Sora																				2
Swainson's Thrush	2	2	3	2	2	2	4	2	1	2	1	2	3		3	1	2		1	
Tennessee Warbler																				
Townsend's Warbler												2	2	1						
Tree Swallow																				3
Varied Thrush										2		2	1						2	
Vesper's Sparrow															1					
Warbling Vireo	1	1	1	1	1		1	1		1	1			1						
Western Tanager					2															
White-crowned Sparrow					1															
Willow Flycatcher																				1
Wilson's Warbler						1	1			1			1							
Yellow-Rumped Warbler		1	1	2			1						1	1		1		1	1	1

Survey Point Name	BBS07	BBS08	BBS14	BBS34	BBS35	BBS36	BBS37	BBS38	BBS39	BBS40	BBS41	BBS42	BBS43	BBS44	BBS45	BBS46	BBS47	BBS48
BBS Number	7	8	14	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Time Start	7:01	6:05	6:41	5:49	6:27	6:53	7:32	8:15	8:44	9:23	9:52	7:10	7:45	8:19	8:55	9:39	10:01	10:29
Time End	7:08	6:12	6:48	5:56	6:34	7:00	7:39	8:22	8:51	9:30	9:59	7:17	7:52	8:26	9:02	9:46	10:08	10:36
Ceiling ¹	H	H	H	H	H	H	H	H	M	H	M	M	H	H	H	H	H	H
Cloud Cover (%)	60	50	20	10	60	25	20	30	50	40	75	95	95	60	50	30	50	20
Wind ²	1	1	0	0	1	0	0	0	1	0	1	1	1	1	0	1	2	2
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	10	9	10	7	7	7	8	9	9	10	12	9	9	10	11	11	10	13
Date	3-Jul-14	3-Jul-14	3-Jul-14	29-Jun-14	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19	30-Jun-19
Incidental Observations																		
American Robin						1												
Boreal Chickadee																		
Cedar Waxwing												1						
Chipping Sparrow						1				1		1						
Common Nighthawk					1													
Dark-eyed Junco										1								
Golden-crowned Kinglet	1																	
Gray Jay																		
Great Horned Owl										1								
Hammond's Flycatcher						1												
MacGillivray's Warbler												1						
Orange-crowned Warbler																		
Red-breasted Nuthatch																		
Red-breasted Sapsucker																		
Red-naped Sapsucker																		
Red-tailed Hawk																		
Rufous Hummingbird							1			1								
Townsend's Solitaire							1											
Warbling Vireo						1						1						
Western Tanager																		
Willow Flycatcher			1															
Wilson's Warbler								1										
Yellow-Rumped Warbler																		

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation



Survey Point Name	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS58	BBS59	BBS60	BBS61	BBS62	BBS63	BBS64	BBS65	BBS66	BBS67	BBS68
BBS Number	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
Time Start	5:10	5:35	5:59	6:22	6:44	7:06	7:31	8:00	8:38	9:19	9:53	6:09	6:38	7:11	7:41	8:08	8:57	9:34	10:03	5:32
Time End	5:17	5:42	6:06	6:29	6:51	7:13	7:38	8:07	8:45	9:26	10:00	6:16	6:45	7:18	7:48	8:15	9:05	9:41	10:10	5:39
Ceiling ¹	H	H	H	H	H	H	H	H	H	H	0	0	0	0	0	0	0	0	0	0
Cloud Cover (%)	10	15	15	20	30	25	10	10	0	0	0	0	0	0	0	0	0	0	0	10
Wind ²	2	1	1	1	1	1	1	1	0	1	2	1	0	1	0	0	0	0	1	0
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	7	7	7	7	7	7	7	9	9	12	15	7	8	9	9	10	12	12	15	9
Date	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	1-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	2-Jul-14	3-Jul-14
Incidental Observations																				
American Robin																				
Boreal Chickadee																	1			
Cedar Waxwing																				
Chipping Sparrow																				
Common Nighthawk																				
Dark-eyed Junco																				
Golden-crowned Kinglet						1														
Gray Jay							1				1									
Great Horned Owl																				
Hammond's Flycatcher																				
MacGillivray's Warbler																				
Orange-crowned Warbler						1														
Red-breasted Nuthatch								1												
Red-breasted Sapsucker																				1
Red-naped Sapsucker								1												
Red-tailed Hawk								1												
Rufous Hummingbird													1							
Townsend's Solitaire										1		1								
Warbling Vireo																				
Western Tanager													1							
Willow Flycatcher																				
Wilson's Warbler																				
Yellow-Rumped Warbler						1											1			

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS01	BBS02	BBS03	BBS04	BBS05	BBS06	BBS07	BBS08	BBS09	BBS10	BBS11	BBS12	BBS14	BBS15	BBS16	BBS17	BBS19	BBS21	BBS22	BBS23	BBS24	BBS25	BBS26	BBS27
BBS Number	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	19	21	22	23	24	25	26	27
Time Start	6:15	5:52	6:39	7:00	7:24	8:26	9:11	7:48	6:16	6:30	6:53	7:23	8:46	9:07	8:45	9:29	7:09	7:02	5:13	7:38	8:25	9:06	9:49	9:50
Time End	6:22	5:59	6:46	7:07	7:31	8:33	9:18	7:55	6:23	6:37	7:00	7:30	8:53	9:14	8:52	9:36	7:16	7:09	5:20	8:45	8:32	9:13	9:56	9:57
Ceiling ¹	H	H	H	H	H	H	H	0	0	H	H	L	0	0	M	0	0	0	0	0	0	0	0	0
Cloud Cover (%)	20	20	20	20	0	0	100	0	10	10	100	100	0	50	70	0	0	0	0	0	0	0	0	0
Wind ²	0	0	0	0	0	0	1	0	3.5	1.5	3	3.5	0	3	2.5	0	0	0	0	0	0	1	1	1
Precipitation ³	N	N	N	N	N	N	N	N	N	N	Intermittent light drizzle	Intermittent light drizzle	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	7	8	9	10	10	12	12	12	9	9	10	10	12	8	8	8	6	4	6	5	2	3	8	9
Date	8-Jun-17	8-Jun-17	8-Jun-17	8-Jun-17	8-Jun-17	8-Jun-17	8-Jun-17	8-Jun-17	9-Jun-17	9-Jun-17	9-Jun-17	9-Jun-17	8-Jun-17	10-Jun-19	10-Jun-19	7-Jun-17	7-Jun-17	6-Jun-17	7-Jun-17	6-Jun-17	6-Jun-17	6-Jun-17	6-Jun-17	7-Jun-17
American Robin		1	1	1		1				1		1		1										
Black-headed Grosbeak																								
Boreal Chickadee										1	1													
Brown Creeper																								1
Brown-headed Cowbird						1															1	1		
Canada Goose																								
Cassin's Finch																								
Cassin's Vireo			1																					
Chipping Sparrow				1			1											1	1		1			
Common Loon																			1					
Common Raven								1							1									
Common Yellowthroat																								1
Dark-eyed Junco						2					1		1				1							
Golden-crowned Kinglet								1	1			1		1										
Gray Jay																								
Great Blue Heron																								
Hammond's Flycatcher		1																						
Hermit Thrush							1								1									
House Wren																								
Least Flycatcher		1																						
Lincoln's Sparrow				1																			1	1
MacGillivray's Warbler						1			1			1	1										1	1
Marsh Wren																								
Mountain Chickadee			1																					
Northern Flicker																								
Northern Waterthrush									1									1						1
Olive-sided Flycatcher		1		2	1														1	2				1
Orange-crowned Warbler				1																				
Pacific Wren				1																				
Pileated Woodpecker																								
Pine Siskin							1	1	2		1												1	1
Red Crossbill																								
Red-breasted Nuthatch			1					1		1	1				1									1
Red-breasted Sapsucker																								
Red-naped Sapsucker				1																				
Red-tailed Hawk																								1
Red-winged Blackbird																								
Ruby-crowned Kinglet		1		1						1								1	1		1	1	1	1
Ruffed Grouse																		1	1	1				
Sora																								
Spotted Sandpiper																								
Spruce Grouse																								
Swainson's Thrush		2			1		2		1															1
Tennessee Warbler																								
Townsend's Warbler					1	2	1	1	2	1			1			1	1	1			1	2	1	1
Tree Swallow																								
Unid Chickadee																								
Unid Hummingbird																								
Unid Songbird																								
Varied Thrush									2				1											
Warbling Vireo				2	1	2	1		1			1								1	1	1		2
Western Tanager			2		1																			
Western-wood Pewee					1																			
White-crowned Sparrow																								
Willow Flycatcher																								2
Wilson's Warbler																								1
Yellow Warbler																								
Yellow-Rumped Warbler		1	2	1	2	2	1		2	1	1	1			1	1	1					1	1	

Survey Point Name	BBS31	BBS32	BBS33	BBS34	BBS37	BBS40	BBS41	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS68	BBS69	BBS12B	BBS20	BBS30B	BBS34C	BBS35B	BBS36B	
BBS Number	31	32	33	34	37	40	41	49	50	51	52	53	54	55	56	57	68	69	12.2	20	30.2	34.3	35.2	36.2	
Time Start	7:22	8:34	6:11	5:38	9:20	7:00	7:39	6:09	5:17	5:33	7:37	7:19	6:00	6:15	6:58	6:34	5:23	6:35	7:53	6:39	7:43	5:38	6:03	6:24	
Time End	7:29	8:41	6:18	5:45	9:27	7:07	7:46	6:16	5:24	5:40	7:44	7:26	6:07	6:22	7:05	6:41	5:30	6:42	8:00	6:46	7:50	5:45	6:10	6:31	
Ceiling ¹	0	0	0	L	L	H	M	0	H	0	M	H	L	M	0	H	H	0	L	0	0	L	L	L	
Cloud Cover (%)	0	0	0	90	100	60	30	0	50	100	50	20	60	80	20	90	50	0	100	0	0	90	30	50	
Wind ²	1	1	1	0	3.5	0	0	0	2	3.5	4	3	3	3.5	2	3	0	0	2	0	1	0	1	1	
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Temperature (°C)	5	8	6	8	10	9	9	4	8	8	10	9	8	8	8	8	7	4	11	6	5	8	8	8	
Date	7-Jun-17	7-Jun-17	7-Jun-17	11-Jun-19	9-Jun-17	11-Jun-17	11-Jun-19	6-Jun-17	9-Jun-17	10-Jun-17	10-Jun-19	10-Jun-19	10-Jun-17	10-Jun-17	10-Jun-17	10-Jun-17	8-Jun-17	6-Jun-17	9-Jun-17	7-Jun-17	7-Jun-17	9-Jun-17	11-Jun-17	11-Jun-17	
American Robin		1			1						2			1		4							2		1
Black-headed Grosbeak							1																		
Boreal Chickadee														1											
Brown Creeper																									
Brown-headed Cowbird							1			1			1	1					1				1		2
Canada Goose										1															
Cassin's Finch																			1						
Cassin's Vireo																									
Chipping Sparrow								1																1	
Common Loon																									
Common Raven				1	2	1		1				1								1	1		1	1	1
Common Yellowthroat																									
Dark-eyed Junco				1	2	1				1	1	1					2	1						2	
Golden-crowned Kinglet	1	1	2	1		1																			
Gray Jay																		1							
Great Blue Heron								1																	
Hammond's Flycatcher				1																				1	
Hermit Thrush																									
House Wren																								1	
Least Flycatcher																		1							
Lincoln's Sparrow							1						1												
MacGillivray's Warbler					2		1	1						2	1				1	1	1	1			1
Marsh Wren																		1							
Mountain Chickadee								1																	
Northern Flicker														1											
Northern Waterthrush								1																	
Olive-sided Flycatcher											1	1		1	2	1			1					1	
Orange-crowned Warbler				1	1							1			1				1					1	1
Pacific Wren	1		1																						
Pileated Woodpecker														1											
Pine Siskin	2		1	1		1	1	11			1					1	1		11	4	14		1	31	
Red Crossbill			1													1	1								
Red-breasted Nuthatch				1			1				1							1							
Red-breasted Sapsucker																									
Red-naped Sapsucker															1										
Red-tailed Hawk												1													
Red-winged Blackbird																			5						
Ruby-crowned Kinglet					2	1		1	1	1	1	1	1	1	1	1			1				2		1
Ruffed Grouse						1										1				1					
Sora																									
Spotted Sandpiper																									
Spruce Grouse																									
Swainson's Thrush							2	1	1	1															1
Tennessee Warbler							1																		
Townsend's Warbler	1	1	1			1	3						1	2						2	1	1			
Tree Swallow																									
Unid Chickadee								1						1											
Unid Hummingbird																									1
Unid Songbird																									
Varied Thrush		1		1																					
Warbling Vireo	1				1	2	2		1	3	1	1	2	2	1				2	1	2	2		1	1
Western Tanager				1			1																		
Western-wood Pewee																									
White-crowned Sparrow												1													
Willow Flycatcher																									
Wilson's Warbler	1						1																		
Yellow Warbler																									
Yellow-rumped Warbler			1	1								1	1		1						1	1			1

Survey Point Name	BBS01	BBS02	BBS03	BBS04	BBS05	BBS06	BBS07	BBS08	BBS09	BBS10	BBS11	BBS12	BBS14	BBS15	BBS16	BBS17	BBS19	BBS21	BBS22	BBS23	BBS24	BBS25	BBS26	BBS27	
BBS Number	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	19	21	22	23	24	25	26	27	
Time Start	6:15	5:52	6:39	7:00	7:24	8:26	9:11	7:48	6:16	6:30	6:53	7:23	8:46	9:07	8:45	9:29	7:09	7:02	5:13	7:38	8:25	9:06	9:49	9:50	
Time End	6:22	5:59	6:46	7:07	7:31	8:33	9:18	7:55	6:23	6:37	7:00	7:30	8:53	9:14	8:52	9:36	7:16	7:09	5:20	8:45	8:32	9:13	9:56	9:57	
Ceiling ¹	H	H	H	H	H	H	H	0	0	H	H	L	0	0	M	0	0	0	0	0	0	0	0	0	
Cloud Cover (%)	20	20	20	20	0	0	100	0	10	10	100	100	0	50	70	0	0	0	0	0	0	0	0	0	
Wind ²	0	0	0	0	0	0	1	0	3.5	1.5	3	3.5	0	3	2.5	0	0	0	0	0	0	1	1	1	
Precipitation ³	N	N	N	N	N	N	N	N	N	N	Intermittent light drizzle	Intermittent light drizzle	N	N	N	N	N	N	N	N	N	N	N	N	
Temperature (°C)	7	8	9	10	10	12	12	12	9	9	10	10	12	8	8	8	6	4	6	5	2	3	8	9	
Incidental Observations																									
Cassin's Vireo																									
Common Raven																									
Golden-crowned Kinglet																									
Hammond's Flycatcher									1																
Harequin Duck									1																
Harry Woodpecker																									
Hermit Thrush																									
Mountain Chickadee									1																
Pacific Wren																									
Red-breasted Nuthatch																									
Red-naped Sapsucker																									
Ruby-crowned Kinglet																									
Ruffed Grouse		1																							
Spotted Sandpiper																									
Swainson's Thrush																									
Townsend's Solitaire									1																
Varied Thrush																									
White-crowned Sparrow																									
Wilson's Warbler																									
Yellow-Rumped Warbler																									

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS31	BBS32	BBS33	BBS34	BBS37	BBS40	BBS41	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS68	BBS69	BBS12B	BBS20	BBS30B	BBS34C	BBS35B	BBS36B
BBS Number	31	32	33	34	37	40	41	49	50	51	52	53	54	55	56	57	68	69	12.2	20	30.2	34.3	35.2	36.2
Time Start	7:22	8:34	6:11	5:38	9:20	7:00	7:39	6:09	5:17	5:33	7:37	7:19	6:00	6:15	6:58	6:34	5:23	6:35	7:53	6:39	7:43	5:38	6:03	6:24
Time End	7:29	8:41	6:18	5:45	9:27	7:07	7:46	6:16	5:24	5:40	7:44	7:26	6:07	6:22	7:05	6:41	5:30	6:42	8:00	6:46	7:50	5:45	6:10	6:31
Ceiling ¹	0	0	0	L	L	H	M	0	H	0	M	H	L	M	0	H	H	0	L	0	0	L	L	L
Cloud Cover (%)	0	0	0	90	100	60	30	0	50	100	50	20	60	80	20	90	50	0	100	0	0	90	30	50
Wind ²	1	1	1	0	3.5	0	0	0	2	3.5	4	3	3	3.5	2	3	0	0	2	0	1	0	1	1
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	5	8	6	8	10	9	9	4	8	8	10	9	8	8	8	8	7	4	11	6	5	8	8	8
Incidental Observations																								
Cassin's Vireo																								
Common Raven																								
Golden-crowned Kinglet																								
Hammond's Flycatcher																								
Harequin Duck																								
Harry Woodpecker																								1
Hermit Thrush	1																							
Mountain Chickadee							1																	1
Pacific Wren								1																
Red-breasted Nuthatch											1													
Red-naped Sapsucker								1																
Ruby-crowned Kinglet																								
Ruffed Grouse											1													
Spotted Sandpiper																								
Swainson's Thrush							1														1			
Townsend's Solitaire																								
Varied Thrush																								
White-crowned Sparrow																								
Wilson's Warbler																						1		
Yellow-Rumped Warbler								1																

1 Ceiling: H=High, M=Medium, L=Low, 0=None
 2 Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze
 3 Precipitation: N=None
 n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS41	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS59	BBS60	BBS68	BBS69	BBS12B	BBS20B	BBS28B	BBS28C	BBS28D	BBS30a	BBS30B	BBS30C	BBS30D	BBS30E	BBS30F	BBS35B	BBS36B	BBS38B	
BBS Number	41	49	50	51	52	53	54	55	56	57	59	60	68	69	12B	20B	28B	28C	28D	30a	30B	30C	30D	30E	30F	35B	36B	38B	
Time Start	5:28	8:18	5:37	5:55	6:49	6:27	6:42	6:57	7:14	7:44	6:42	6:57	6:30	8:35	8:10	8:06	8:13	8:47	9:12	8:06	8:19	8:42	8:58	9:19	9:38	6:32	6:48	6:07	
Time End	5:35	8:23	5:44	6:00	6:56	6:34	6:49	7:04	7:21	7:51	6:49	6:58	6:37	8:42	8:17	8:13	8:20	8:54	9:19	8:13	8:26	8:49	9:05	9:26	9:45	6:39	6:55	6:14	
Ceiling ¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	
Wind ²	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	0	2	0	0	0	0	0	0	0	
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Temperature (°C)	10	10	7	7	7	7	7	8	9	9	10	11	6	12	10	10	7	9	9	8	8	8	9	8	8	9	9	9	
Date	03-Jul-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	06-Jul-17	07-Jul-17	04-Jul-17	30-Jun-17	02-Jul-17	01-Jul-17	04-Jul-17	04-Jul-17	04-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	03-Jul-17	03-Jul-17	03-Jul-17	
American Robin				1	3	2	1	1	1	1				1		1												1	
Boreal Chickadee														1															
Brown-headed Cowbird							1		2																	1	1		
Cassin's Vireo								1			1			1															
Cedar Waxwing													1																
Chipping Sparrow			1																										
Common Raven																											1	2	
Common Yellowthroat																													
Dark-eyed Junco				1		1	1		2			1		1	1	2		3	2	1	1		1		1	2	1	2	
Fox Sparrow																		1											
Golden-crowned Kinglet																1													
Gray Jay							1		1																				
Great Blue Heron																													
Hammond's Flycatcher		1																										1	
Harry Woodpecker							1																						
Hermit Thrush															1		1	3	3		1	2		2					
Lincoln's Sparrow							1							1	1												1		
MacGillivray's Warbler		1						1																			1	1	
Mountain Chickadee	1				1				1										1										
Northern Flicker											1																	1	
Northern Waterthrush																													
Olive-sided Flycatcher								1	1							1	1												
Orange-crowned Warbler									1																		1		
Pacific Wren	1																		1	1									
Pine Siskin									2	1				1		1	1		1									1	
Red Crossbill					1	1		2						4															
Red-breasted Nuthatch				1		1			1		1			1	1												1		
Red-naped Sapsucker								1																				1	
Red-tailed Hawk	1			1																									
Red-winged Blackbird														5															
Ruby-crowned Kinglet			1	1	1	1	1	1	1											1					1	1		2	1
Song Sparrow		2																											
Sora														2															
Spotted Sandpiper																													
Swainson's Thrush	3	1			1	3	1	1	2	1	2	1	1	2	2	1	1	2			1	2			1	2	2		
Townsend's Warbler											1	2			2										1				
Tree Swallow													2																
Unid Chickadee				1																									
Unid Flycatcher													1																
Unid Hummingbird													1																
Unid Songbird								1																					
Unid woodpecker																													
Varied Thrush												1							2										
Vesper's Sparrow																											1	1	
Violet-Green Swallow		5																											
Warbling Vireo			2		1		2		1	1	1					1										1	1	1	
Western Tanager									1	1																1			
Western-wood Pewee						2	1	1					2															1	
White-crowned Sparrow					1		1							1															
Willow Flycatcher																													
Wilson's Warbler	1																									1	1		
Yellow Warbler			2											1															
Yellow-Rumped Warbler		1		1	2					2					1				1	1	1	2	1		1			1	

Survey Point Name	BBS01	BBS02	BBS03	BBS04	BBS05	BBS06	BBS07	BBS08	BBS09	BBS10	BBS11	BBS12	BBS14	BBS15	BBS16	BBS17	BBS19	BBS21	BBS22	BBS23	BBS24	BBS25	BBS26	BBS27	BBS29	BBS30	BBS31	BBS32	BBS33	BBS34	BBS37	BBS40				
BBS Number	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	19	21	22	23	24	25	26	27	29	30	31	32	33	34	37	40				
Time Start	7:54	8:16	5:34	5:59	8:45	7:21	9:31	6:21	6:46	7:04	7:24	7:48	9:07	9:25	9:06	5:47	8:33	8:59	9:21	5:34	6:00	6:37	6:59	9:59	10:34	6:23	6:54	7:14	7:32	7:34	7:07	4:47				
Time End	8:01	8:23	5:41	6:06	8:52	7:28	9:38	6:28	6:53	7:11	7:32	7:55	9:14	9:32	9:13	5:54	8:40	9:06	9:28	5:41	6:07	6:44	7:06	10:06	10:41	6:30	7:01	7:21	7:39	7:41	7:14	5:54				
Ceiling ¹	0	0	0	0	0	0	0	0	0	0	0	0	0	H	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	10	30	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Wind ²	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0					
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
Temperature (°C)	12	12	8	8	13	7	12	7	8	9	10	10	11	10	10	7	10	14	16	10	10	9	10	10	9	7	8	9	11	11	9	10				
Date	03-Jul-17	03-Jul-17	02-Jul-17	02-Jul-17	03-Jul-17	04-Jul-17	02-Jul-17	02-Jul-17	02-Jul-17	02-Jul-17	02-Jul-17	02-Jul-17	02-Jul-17	01-Jul-17	01-Jul-17	05-Jul-17	01-Jul-17	30-Jun-17	30-Jun-17	01-Jul-17	01-Jul-17	01-Jul-17	01-Jul-17	01-Jul-17	01-Jul-17	04-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	01-Jul-17	03-Jul-17	03-Jul-17	03-Jul-17			
Incidental Observations																																				
American Robin																																		1		
Boreal Chickadee			1																																	
Calliope Hummingbird																																				
Cedar Waxwing				1																																
Chipping Sparrow																																				
Common Raven																																				
Evening Grosbeak																																			1	
Fox Sparrow																																				
Least Flycatcher																																				
Lincoln's Sparrow																																				
MacGillivray's Warbler																																				
Mountain Bluebird																																				
Mountain Chickadee																																				
Northern Flicker																																				
Norther Waterthrush																																				
Olive-sided Flycatcher																																				
Pileated Woodpecker																																				
Pine Grosbeak				1																																
Pine Siskin				1																																
Red-naped Sapsucker																																				
Ruffed Grouse																																				
Rufous Hummingbird																																				
Townsend's Solitaire																																				
Violet-Green Swallow																																				
Warbling Vireo																																				
Western Tanager																																				
Yellow-Rumped Warbler																																				

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS41	BBS49	BBS50	BBS51	BBS52	BBS53	BBS54	BBS55	BBS56	BBS57	BBS59	BBS60	BBS68	BBS69	BBS12B	BBS20B	BBS28B	BBS28C	BBS28D	BBS30a	BBS30B	BBS30C	BBS30D	BBS30E	BBS30F	BBS35B	BBS36B	BBS38B	
BBS Number	41	49	50	51	52	53	54	55	56	57	59	60	68	69	12B	20B	28B	28C	28D	30a	30B	30C	30D	30E	30F	35B	36B	38B	
Time Start	5:28	8:18	5:37	5:55	6:49	6:27	6:42	6:57	7:14	7:44	6:42	6:57	6:30	8:35	8:10	8:06	8:13	8:47	9:12	8:06	8:19	8:42	8:58	9:19	9:38	6:32	6:48	6:07	
Time End	5:35	8:23	5:44	6:00	6:56	6:34	6:49	7:04	7:21	7:51	6:49	6:58	6:37	8:42	8:17	8:13	8:20	8:54	9:19	8:13	8:26	8:49	9:05	9:26	9:45	6:39	6:55	6:14	
Ceiling ¹	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	
Wind ²	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	0	2	0	0	0	0	0	0	0	
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Temperature (°C)	10	10	7	7	7	7	7	8	9	9	10	11	6	12	10	10	7	9	9	8	8	8	9	8	8	9	9	9	
Date	03-Jul-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	30-Jun-17	06-Jul-17	07-Jul-17	04-Jul-17	30-Jun-17	02-Jul-17	01-Jul-17	04-Jul-17	04-Jul-17	04-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	05-Jul-17	03-Jul-17	03-Jul-17	03-Jul-17
Incidental Observations																													
American Robin																													
Boreal Chickadee																													
Calliope Hummingbird										1																			
Cedar Waxwing																													
Chipping Sparrow																													
Common Raven	1																												
Evening Grosbeak												1																	
Fox Sparrow															1														
Least Flycatcher	1																					1							
Lincoln's Sparrow																													
MacGillivray's Warbler												1																	
Mountain Bluebird																													
Mountain Chickadee																													
Northern Flicker																							1						
Norther Waterthrush											1																		
Olive-sided Flycatcher																													
Pileated Woodpecker										5																			
Pine Grosbeak																													
Pine Siskin															1														
Red-naped Sapsucker																													
Ruffed Grouse																													
Rufous Hummingbird										1																			
Townsend's Solitaire			5																										
Violet-Green Swallow																													
Warbling Vireo																													
Western Tanager												1																	
Yellow-Rumped Warbler																													

1 Ceiling: H=High, M=Medium, L=Low, 0=None
 2 Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze
 3 Precipitation: N=None
 n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS70	BBS71	BBS72	BBS73	BBS74	BBS75	BBS76	BBS77	BBS78	BBS79	BBS80	BBS81	BBS82
BBS Survey Number	70	71	72	73	74	75	76	77	78	79	80	81	82
Time Start	6:43	6:58	7:12	7:25	7:37	7:49	8:01	8:20	8:32	8:40	8:57	9:14	10:00
Time End	6:50	7:05	7:19	7:32	7:44	7:56	8:08	8:27	8:39	8:47	9:04	9:21	10:07
Ceiling ¹	0	0	0	0	0	0	0	0	0	0	0	0	0
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind ²	1	1	1	1	2	0	0	0	0	0	0	0	0
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	6	6	6	6	6	6	6	6	6	6	6	7	7
Date	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18	05-Jul-18
American Three-toed Woodpecker												1	
Chipping Sparrow					1								
Dark-eyed Junco			1	1	1							1	
Harry Woodpecker								1	1				
Hermit Thrush			1	1	1	2	2			1	1	1	2
Mountain Chickadee						1			1				
Pacific Wren								1	1				
Pine Siskin	1	1	1	1				1	1		2	1	1
Red-breasted Nuthatch			1	1				1	1		1		
Ruby-crowned Kinglet									1	1			1
Rufous Hummingbird				1									
Swainson's Thrush										1	1	1	
Townsend's Solitaire				1									
Yellow-Rumped Warbler							1		1				2
Incidental Observations													
Dark-eyed Junco										1	1		
Harry Woodpecker												1	
Hermit Thrush			2		1	2	2	2	1	1	1	1	1
Mountain Chickadee			1	1	1		1	1					1
Pine Siskin				1									
Red-breasted Nuthatch				1									
Ruby-crowned Kinglet	1										1		
Swainson's Thrush										1			
Varied Thrush	1												1
White-crowned Sparrow	1												
Yellow-Rumped Warbler	1												

¹ Ceiling: H=High, M=Medium, L=Low, 0=None ² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze
³ Precipitation: N=None n/a = not applicable; nd = no data; N=no precipitation

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Breeding Bird Point Count Survey Data, July 4- July 11, 2019



Survey Point Name	BBS73	BBS46	BBS72	BBS77	BBS79	BBS81	BBS112	BBS83	BBS84	BBS85	BBS86	BBS87	BBS88	BBS89	BBS90	BBS91	BBS92	BBS93	BBS94	BBS95	BBS96	
BBS Survey Number	73	46	72	77	79	81	112	83	84	85	86	87	88	89	90	91	92	93	94	95	96	
Time Start	7:07	7:27	6:54	7:35	7:57	8:10	8:23	8:46	9:12	9:49	10:25	6:12	6:41	7:14	7:47	8:22	9:38	10:02	11:17	7:58	8:27	
Time End	7:14	7:34	7:01	7:43	8:04	8:17	8:30	8:53	9:19	9:56	10:32	6:19	6:48	7:21	7:54	8:29	9:45	10:09	11:24	8:05	8:34	
Ceiling ¹	H	L	H	H	H	H	0	0	0	H	H	L	L	L	M	L	0	0	H	0	0	
Cloud Cover (%)	80	100	50	90	90	90	0	0	0	70	100	100	100	100	100	100	0	0	5	0	0	
Wind ²	2	1	3	3	3	3	0	0	0	1	0	0	0	0	0	1-2	0	0	2	0	1	
Precipitation ³	N	Drizzle	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Temperature (°C)	8	7	8	9	10	10	8	8	8	9	10	10	10	12	12	12	10	12	12	5	5	
Date	11-Jul-19	04-Jul-19	11-Jul-19	11-Jul-19	11-Jul-19	11-Jul-19	06-Jul-19	06-Jul-19	06-Jul-19	06-Jul-19	06-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	08-Jul-19	08-Jul-19	
American Dipper																						1
American Robin								1				1	2		1	1						
Brown-headed Cowbird																						
Cassin's finch			1																			
Chipping Sparrow													1	1								
Clark's nuthatch	1																					
Common Raven													1						1			
Dark-eyed Junco	1	1	2	1		1			1			1				1						
Fox Sparrow			1																			
Golden-crowned Kinglet							1	1			1											1
Gray Jay																						
Hammond's Flycatcher														1		1						
Harry Woodpecker														1								
Hermit Thrush	2	2		3	1	1	1			1									1	1	1	
Lincoln's Sparrow														1	1							
MacGillivray's Warbler																						1
Mountain Chickadee	1													1	1				2			
Northern Flicker												2					1					
Northern Waterthrush																	1					
Orange-crowned Warbler																						
Pacific Wren								1	1	1	1											1
Pacific-slope Flycatcher								1														
Pine Grosbeak		1		1																		
Pine Siskin	1	2	2	5		3	1	1	2	1	1				2				3			
Red-breasted Nuthatch				1	1	1							1				1	1				
Red-winged Blackbird													3									
Ruby-crowned Kinglet												1	1			1						
Rufous Hummingbird																						
Song Sparrow								1														
Swainson's Thrush						1						1		1	2	3		1				
Townsend's Solitaire						1																
Townsend's Warbler							1	1									1	1				
Varied Thrush	1	1						1	1													1
Warbling Vireo												1		2								
Western Tanager																1						
Western-wood Pewee														1								
White-winged Crossbill		1																				
Willow Flycatcher														2								
Wilson's Warbler					1									1								
Yellow-Rumped Warbler			1			1	2		1				1						1			
Incidental Observations																						
Golden-crowned Kinglet																						
Tree Swallow																						

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	BBS97	BBS98	BBS99	BBS100	BBS101	BBS102	BBS103	BBS104	BBS105	BBS106	BBS107	BBS108	BBS110	BBS111
BBS Survey Number	97	98	99	100	101	102	103	104	105	106	107	108	110	111
Time Start	9:04	9:37	10:11	6:38	7:34	7:53	8:13	8:32	8:51	9:11	10:18	7:16	8:26	9:17
Time End	9:11	9:44	10:18	6:45	7:41	8:00	8:20	8:49	8:58	9:18	10:25	7:23	8:30	9:24
Ceiling ¹	0	0	H	H	H	H	0	0	0	0	0	H	H	H
Cloud Cover (%)	0	0	30	30	40	10	0	0	0	0	0	60	100	100
Wind ²	0	0	2	0	0	0	0	0	0	0	2-3	2 (4)	1	1
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	6	7	10	5	5	7	7	10	10	10	15	10	10	13
Date	08-Jul-19	08-Jul-19	08-Jul-19	09-Jul-19	08-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	10-Jul-19	10-Jul-19	10-Jul-19
American Dipper														
American Robin														
Brown-headed Cowbird				1										
Cassin's finch														
Chipping Sparrow							1							
Clark's nuthatch														
Common Raven														
Dark-eyed Junco									1	2	1		1	1
Fox Sparrow												1		
Golden-crowned Kinglet	1		1										1	
Gray Jay												1		
Hammond's Flycatcher														
Harry Woodpecker														
Hermit Thrush			2	1									2	2
Lincoln's Sparrow				2										
MacGillvery's Warbler			1									1		
Mountain Chickadee								2						
Northern Flicker														
Northern Waterthrush				2										
Orange-crowned Warbler														
Pacific Wren														
Pacific-slope Flycatcher														
Pine Grosbeak														
Pine Siskin				1		1					1	23		1
Red-breasted Nuthatch								2				1	1	
Red-winged BlackBird														
Ruby-crowned Kinglet				1					2					
Rufous Hummingbird					1			2						
Song Sparrow				1										
Swainson's Thrush	2	1	2	2		1	2	1	1	2	2			
Townsend's Solitaire							1		1					
Townsend's Warbler	1	1												
Varied Thrush							1						1	1
Warbling Vireo														
Western Tanager														
Western-wood Pewee														
White-winged Crossbill						1			6					
Willow Flycatcher				1										
Wilson's Warbler														
Yellow-Rumped Warbler				1	4	2	1	2				1		
Incidental Observations														
Golden-crowned Kinglet		1												
Tree Swallow				1										

1 Ceiling: H=High, M=Medium, L=Low, 0=None

2 Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

3 Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Appendix A3: Breeding Bird Point Count and Roadside Survey Data
Roadside Survey Data, 2014



Survey Type	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside	Roadside
Time Start	5:59	6:08	6:17	6:26	6:35	6:45	6:59	7:11	7:20	7:38	7:54	8:13	8:24	8:38
Time End	6:02	6:15	6:20	6:29	6:38	6:52	7:06	7:18	7:25	7:41	7:57	8:16	8:27	8:41
Ceiling ¹	M	M	M	M	H	H	H	M	M	M	H	H	H	H
Cloud Cover (%)	80	80	80	80	50	50	50	50	50	50	20	20	10	10
Wind ²	1	1	1	1	2-3	2-3	2-3	2	3	3	1	1	1	1
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	4	4	4	4	4	2	2	3	2	2	4	4	4	4
Date	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14	11-Jun-14
General Location	RS1	RS2	RS3	RS4	RS5	RS6	RS7	RS8	RS9	RS10	RS11	RS12	RS13	RS14
American Robin			2				1	3	1	1				
Boreal Chickadee		1						1						
Brown-headed Cowbird								1						
Chipping Sparrow					1	1		2			1			3
Common Raven														1
Dark-eyed Junco							1			2				1
Golden-crowned Kinglet				6							1	1	3	
Hammond's Flycatcher								1		1				
Hermit Thrush						1	1						1	2
Lincoln's Sparrow							1							
MacGillivray's Warbler	1							3			1			
Mountain Chickadee										1				2
Northern Waterthrush				1	1		2			1	1			
Olive-sided Flycatcher	1							1						
Orange-crowned Warbler		1												
Red-breasted Nuthatch			1					1						
Red-naped Sapsucker														1
Ruby-crowned Kinglet	1	1		1						1	1			
Ruffed Grouse									1		1	1		
Swainson's Thrush			1											1
Townsend's Warbler				1	1						3	1		
Varied Thrush					1									1
Warbling Vireo		1				1		1	2	1	1			
Western-wood Pewee								3						
White-crowned Sparrow	1													
Willow Flycatcher							1		1					
Wilson's Warbler														1
Yellow-Rumped Warbler	2	1			1	1	1	3	2				1	1

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Appendix A4: Breeding Bird Population Metrics



Breeding Bird Population Metrics per Survey

Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 1 2014	BBS01	7	6	1.75
Trip 3 2017	BBS01	8	7	1.91
Trip 4 2017	BBS01	7	7	1.95
Trip 1 2014	BBS02	6	6	1.79
Trip 3 2017	BBS02	8	6	1.73
Trip 4 2017	BBS02	5	4	1.33
Trip 1 2014	BBS03	11	8	2.02
Trip 3 2017	BBS03	11	9	2.15
Trip 4 2017	BBS03	11	9	2.15
Trip 1 2014	BBS04	5	5	1.61
Trip 3 2017	BBS04	8	7	1.91
Trip 4 2017	BBS04	8	7	1.91
Trip 1 2014	BBS05	7	7	1.95
Trip 3 2017	BBS05	10	7	1.89
Trip 4 2017	BBS05	11	9	2.15
Trip 1 2014	BBS06	4	4	1.39
Trip 3 2017	BBS06	9	7	1.89
Trip 4 2017	BBS06	9	8	2.04
Trip 1 2014	BBS07	4	3	1.04
Trip 2 2014	BBS07	5	5	1.61
Trip 3 2017	BBS07	5	5	1.61
Trip 4 2017	BBS07	5	4	1.33
Trip 1 2014	BBS08	14	11	2.34
Trip 2 2014	BBS08	10	7	1.89
Trip 3 2017	BBS08	15	12	2.43
Trip 4 2017	BBS08	16	11	2.34
Trip 1 2014	BBS09	7	3	1.00
Trip 3 2017	BBS10	6	5	1.56
Trip 4 2017	BBS11	8	6	1.73
Trip 1 2014	BBS10	4	4	1.79
Trip 3 2017	BBS10	7	7	1.95
Trip 4 2017	BBS10	10	8	2.03
Trip 1 2014	BBS11	4	4	1.39
Trip 3 2017	BBS11	6	6	1.79
Trip 4 2017	BBS11	8	7	1.91
Trip 1 2014	BBS12	7	6	1.75
Trip 3 2017	BBS12	5	5	1.61
Trip 4 2017	BBS12	9	7	1.89
Trip 1 2014	BBS13	8	7	1.91
Trip 1 2014	BBS14	3	2	0.64
Trip 2 2014	BBS14	3	3	1.10
Trip 3 2017	BBS14	2	2	0.69
Trip 4 2017	BBS14	1	1	0.00
Trip 1 2014	BBS15	5	4	1.33
Trip 3 2017	BBS15	3	3	1.10
Trip 4 2017	BBS15	5	4	1.33

Appendix A4: Breeding Bird Population Metrics



Breeding Bird Population Metrics per Survey

Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 1 2014	BBS16	3	3	1.10
Trip 3 2017	BBS16	4	4	1.39
Trip 4 2017	BBS16	5	4	1.33
Trip 1 2014	BBS17	5	3	0.95
Trip 3 2017	BBS17	3	3	1.10
Trip 4 2017	BBS17	6	6	1.79
Trip 1 2014	BBS18	8	8	2.08
Trip 1 2014	BBS19	6	5	1.56
Trip 3 2017	BBS19	5	5	1.61
Trip 4 2017	BBS19	10	8	2.03
Trip 1 2014	BBS20	9	9	2.20
Trip 3 2017	BBS21	29	14	2.00
Trip 4 2017	BBS22	8	7	1.91
Trip 1 2014	BBS21	12	7	1.79
Trip 3 2017	BBS21	11	11	2.40
Trip 4 2017	BBS21	14	9	2.11
Trip 1 2014	BBS22	15	12	2.43
Trip 3 2017	BBS22	13	10	2.25
Trip 4 2017	BBS22	14	11	2.34
Trip 1 2014	BBS23	5	5	1.61
Trip 3 2017	BBS23	5	5	1.61
Trip 4 2017	BBS23	9	7	1.89
Trip 1 2014	BBS24	8	6	1.73
Trip 3 2017	BBS24	6	5	1.56
Trip 4 2017	BBS24	11	10	2.27
Trip 1 2014	BBS25	11	10	2.27
Trip 3 2017	BBS25	16	14	2.60
Trip 4 2017	BBS25	15	12	2.40
Trip 1 2014	BBS26	2	2	0.69
Trip 3 2017	BBS26	2	2	0.69
Trip 4 2017	BBS26	3	2	0.64
Trip 1 2014	BBS27	6	6	1.79
Trip 3 2017	BBS27	6	5	1.56
Trip 4 2017	BBS27	5	4	1.33
Trip 1 2014	BBS28	6	5	1.56
Trip 1 2014	BBS29	7	7	1.95
Trip 4 2017	BBS29	3	2	0.64
Trip 1 2014	BBS30	12	9	2.14
Trip 4 2017	BBS30	8	6	1.73
Trip 1 2014	BBS31	6	6	1.79
Trip 3 2017	BBS31	8	7	1.91
Trip 4 2017	BBS31	5	4	1.33
Trip 1 2014	BBS32	3	2	0.64
Trip 3 2017	BBS32	5	5	1.61
Trip 4 2017	BBS32	7	7	1.95
Trip 1 2014	BBS33	1	1	0.00

Appendix A4: Breeding Bird Population Metrics



Breeding Bird Population Metrics per Survey

Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 3 2017	BBS33	7	6	1.75
Trip 4 2017	BBS33	7	7	1.95
Trip 2 2014	BBS34	8	6	1.73
Trip 3 2017	BBS34	10	10	2.30
Trip 4 2017	BBS34	10	4	1.31
Trip 2 2014	BBS35	10	7	1.89
Trip 2 2014	BBS36	13	11	2.31
Trip 2 2014	BBS37	9	7	1.83
Trip 3 2017	BBS37	10	6	1.75
Trip 4 2017	BBS37	11	8	1.89
Trip 2 2014	BBS38	5	5	1.61
Trip 1 2014	BBS39	8	7	1.91
Trip 2 2014	BBS39	6	4	1.24
Trip 2 2014	BBS40	9	6	1.68
Trip 3 2017	BBS40	13	12	2.46
Trip 4 2017	BBS40	10	7	1.83
Trip 2 2014	BBS41	10	8	2.03
Trip 3 2017	BBS41	13	9	2.10
Trip 4 2017	BBS41	7	5	1.48
Trip 2 2014	BBS42	4	4	1.39
Trip 2 2014	BBS43	7	6	1.75
Trip 2 2014	BBS44	7	4	1.28
Trip 2 2014	BBS45	5	5	1.61
Trip 2 2014	BBS46	5	3	0.95
Trip 6 2019	BBS46	9	7	1.89
Trip 2 2014	BBS47	5	4	1.33
Trip 2 2014	BBS48	3	3	1.10
Trip 2 2014	BBS49	7	4	1.35
Trip 3 2017	BBS49	19	9	1.56
Trip 4 2017	BBS49	14	8	1.87
Trip 2 2014	BBS50	8	7	1.91
Trip 3 2017	BBS50	7	7	1.95
Trip 4 2017	BBS50	4	3	1.04
Trip 2 2014	BBS51	6	4	1.24
Trip 3 2017	BBS51	8	5	1.49
Trip 4 2017	BBS51	6	6	1.79
Trip 2 2014	BBS52	8	5	1.56
Trip 3 2017	BBS52	8	8	2.08
Trip 4 2017	BBS52	11	8	1.97
Trip 2 2014	BBS53	12	9	2.14
Trip 3 2017	BBS53	12	12	2.48
Trip 4 2017	BBS53	14	10	2.21
Trip 2 2014	BBS54	8	7	1.91
Trip 3 2017	BBS54	12	7	0.00
Trip 4 2017	BBS54	10	9	2.16
Trip 2 2014	BBS55	10	7	1.75

Appendix A4: Breeding Bird Population Metrics



Breeding Bird Population Metrics per Survey

Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 3 2017	BBS55	9	7	1.89
Trip 4 2017	BBS55	11	10	2.27
Trip 2 2014	BBS56	8	5	1.56
Trip 3 2017	BBS56	14	12	2.44
Trip 4 2017	BBS56	16	12	2.43
Trip 2 2014	BBS57	5	4	1.33
Trip 3 2017	BBS57	7	6	1.75
Trip 4 2017	BBS57	6	5	1.56
Trip 2 2014	BBS58	11	9	2.15
Trip 2 2014	BBS59	7	6	1.75
Trip 4 2017	BBS59	7	6	1.75
Trip 2 2014	BBS60	9	6	1.74
Trip 4 2017	BBS60	9	5	1.43
Trip 2 2014	BBS61	8	6	1.67
Trip 2 2014	BBS62	6	5	1.56
Trip 2 2014	BBS63	6	3	1.01
Trip 2 2014	BBS64	3	3	1.10
Trip 2 2014	BBS65	2	1	0.00
Trip 2 2014	BBS66	5	4	1.33
Trip 2 2014	BBS67	2	2	0.69
Trip 2 2014	BBS68	15	9	2.08
Trip 3 2017	BBS68	14	8	1.87
Trip 4 2017	BBS68	17	10	2.12
Trip 3 2017	BBS69	20	9	1.61
Trip 4 2017	BBS69	10	9	2.16
Trip 5 2018	BBS70	1	1	0.00
Trip 5 2018	BBS71	4	4	1.39
Trip 5 2018	BBS72	6	6	1.79
Trip 6 2019	BBS72	6	4	1.33
Trip 5 2018	BBS73	4	4	1.39
Trip 6 2019	BBS73	7	6	1.75
Trip 5 2018	BBS74	3	2	0.64
Trip 5 2018	BBS75	3	2	0.64
Trip 5 2018	BBS76	4	4	1.39
Trip 5 2018	BBS77	7	7	1.95
Trip 6 2019	BBS77	11	5	1.37
Trip 5 2018	BBS78	3	3	1.10
Trip 5 2018	BBS79	5	4	1.33
Trip 6 2019	BBS79	3	3	1.10
Trip 5 2018	BBS80	5	5	1.61
Trip 5 2018	BBS81	3	2	0.64
Trip 6 2019	BBS81	9	7	1.83
Trip 5 2018	BBS82	8	4	1.21
Trip 6 2019	BBS83	8	8	2.08
Trip 6 2019	BBS84	6	5	1.56
Trip 6 2019	BBS85	3	3	1.10

Appendix A4: Breeding Bird Population Metrics



Breeding Bird Population Metrics per Survey

Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 6 2019	BBS86	3	3	1.10
Trip 6 2019	BBS87	7	6	1.75
Trip 6 2019	BBS88	14	11	2.30
Trip 6 2019	BBS89	10	8	2.03
Trip 6 2019	BBS90	5	3	1.05
Trip 6 2019	BBS91	10	8	1.97
Trip 6 2019	BBS92	2	2	0.69
Trip 6 2019	BBS93	7	5	1.48
Trip 6 2019	BBS94	4	3	1.04
Trip 6 2019	BBS95	4	4	1.39
Trip 6 2019	BBS96	3	3	1.10
Trip 6 2019	BBS97	4	3	1.04
Trip 6 2019	BBS98	2	2	0.69
Trip 6 2019	BBS99	6	4	1.33
Trip 6 2019	BBS100	13	10	2.25
Trip 6 2019	BBS101	5	2	0.50
Trip 6 2019	BBS102	5	4	1.33
Trip 6 2019	BBS103	6	5	1.56
Trip 6 2019	BBS104	9	5	1.58
Trip 6 2019	BBS105	11	5	1.29
Trip 6 2019	BBS106	4	2	0.69
Trip 6 2019	BBS107	4	3	1.04
Trip 6 2019	BBS108	28	6	0.76
Trip 6 2019	BBS110	6	5	1.56
Trip 6 2019	BBS111	5	4	1.33
Trip 6 2019	BBS112	6	5	1.56
Trip 1 2014	RS1	6	5	1.56
Trip 1 2014	RS2	5	5	1.61
Trip 1 2014	RS3	4	3	1.04
Trip 1 2014	RS4	9	4	1.00
Trip 1 2014	RS5	5	5	1.61
Trip 1 2014	RS6	3	3	1.10
Trip 1 2014	RS7	9	8	2.04
Trip 1 2014	RS8	18	11	2.26
Trip 1 2014	RS9	8	5	1.49
Trip 1 2014	RS10	10	8	2.03
Trip 1 2014	RS11	10	8	1.97
Trip 1 2014	RS12	2	2	0.69
Trip 1 2014	RS13	8	6	1.67
Trip 1 2014	RS14	11	7	1.85
Trip 3 2017	BBS12B	9	5	1.43
Trip 4 2017	BBS12B	8	6	1.73
Trip 4 2017	BBS28B	4	4	1.39
Trip 4 2017	BBS28C	14	8	1.97
Trip 4 2017	BBS28D	8	5	1.49
Trip 4 2017	BBS30A	2	2	0.69

Appendix A4: Breeding Bird Population Metrics

Breeding Bird Population Metrics per Survey



Trip	Location	Abundance	Species Richness	Shannon-Weiner Diversity Index
Trip 1 2014	BBS30B	8	6	1.73
Trip 3 2017	BBS30B	4	4	1.39
Trip 4 2017	BBS30C	7	4	1.35
Trip 4 2017	BBS30D	2	2	0.69
Trip 4 2017	BBS30E	4	3	1.04
Trip 4 2017	BBS30F	5	5	1.61
Trip 3 2017	BBS34C	6	4	1.33
Trip 3 2017	BBS35B	10	10	2.30
Trip 4 2017	BBS35B	10	8	2.03
Trip 3 2017	BBS36B	39	8	0.90
Trip 4 2017	BBS36B	11	9	2.15
Trip 4 2017	BBS38B	14	12	2.44

Appendix A4: Breeding Bird Population Metrics
 Summary Statistics for Breeding Bird Population Metrics



Location	Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Shannon	Shannon StDev	Shannon SE
BBS01	3	7.3	0.6	0.3	6.7	0.6	0.3	1.87	0.10	0.06
BBS02	3	6.3	1.5	0.9	5.3	1.2	0.7	1.62	0.25	0.14
BBS03	3	11.0	0.0	0.0	8.7	0.6	0.3	2.10	0.07	0.04
BBS04	3	7.0	1.7	1.0	6.3	1.2	0.7	1.81	0.17	0.10
BBS05	3	9.3	2.1	1.2	7.7	1.2	0.7	1.99	0.14	0.08
BBS06	3	7.3	2.9	1.7	6.3	2.1	1.2	1.77	0.34	0.20
BBS07	4	4.8	0.5	0.3	4.3	1.0	0.5	1.40	0.27	0.14
BBS08	4	13.8	2.6	1.3	10.3	2.2	1.1	2.25	0.25	0.12
BBS09	3	7.0	1.0	0.6	4.7	1.5	0.9	1.43	0.38	0.22
BBS10	3	7.0	3.0	1.7	6.3	2.1	1.2	1.92	0.12	0.07
BBS11	3	6.0	2.0	1.2	5.7	1.5	0.9	1.69	0.27	0.16
BBS12	3	7.0	2.0	1.2	6.0	1.0	0.6	1.75	0.14	0.08
BBS13	1	8.0	-	-	7.0	-	-	1.91	-	-
BBS14	4	2.3	1.0	0.5	2.0	0.8	0.4	0.61	0.45	0.23
BBS15	3	4.3	1.2	0.7	3.7	0.6	0.3	1.25	0.13	0.08
BBS16	3	4.0	1.0	0.6	3.7	0.6	0.3	1.27	0.15	0.09
BBS17	3	4.7	1.5	0.9	4.0	1.7	1.0	1.28	0.45	0.26
BBS18	1	8.0	-	-	8.0	-	-	2.08	-	-
BBS19	3	7.0	2.6	1.5	6.0	1.7	1.0	1.73	0.26	0.15
BBS20	3	15.3	11.8	6.8	10.0	3.6	2.1	2.03	0.15	0.09
BBS21	3	12.3	1.5	0.9	9.0	2.0	1.2	2.10	0.30	0.18
BBS22	3	14.0	1.0	0.6	11.0	1.0	0.6	2.34	0.09	0.05
BBS23	3	6.3	2.3	1.3	5.7	1.2	0.7	1.70	0.16	0.09
BBS24	3	8.3	2.5	1.5	7.0	2.6	1.5	1.86	0.37	0.21
BBS25	3	14.0	2.6	1.5	12.0	2.0	1.2	2.42	0.17	0.10
BBS26	3	2.3	0.6	0.3	2.0	0.0	0.0	0.67	0.03	0.02
BBS27	3	5.7	0.6	0.3	5.0	1.0	0.6	1.56	0.23	0.13
BBS28	1	6.0	-	-	5.0	-	-	1.56	-	-
BBS29	2	5.0	2.8	2.0	4.5	3.5	2.5	1.29	0.93	0.65
BBS30	2	10.0	2.8	2.0	7.5	2.1	1.5	1.94	0.29	0.20
BBS31	3	6.3	1.5	0.9	5.7	1.5	0.9	1.68	0.30	0.18
BBS32	3	5.0	2.0	1.2	4.7	2.5	1.5	1.40	0.68	0.39
BBS33	3	5.0	3.5	2.0	4.7	3.2	1.9	1.23	1.07	0.62
BBS34	4	8.5	1.9	1.0	6.0	2.8	1.4	1.67	0.46	0.23
BBS35	1	10.0	-	-	7.0	-	-	1.89	-	-
BBS36	1	13.0	-	-	11.0	-	-	2.31	-	-
BBS37	3	10.0	1.0	0.6	7.0	1.0	0.6	1.82	0.07	0.04
BBS38	1	5.0	-	-	5.0	-	-	1.61	-	-
BBS39	2	7.0	1.4	1.0	5.5	2.1	1.5	1.57	0.47	0.33
BBS40	3	10.7	2.1	1.2	8.3	3.2	1.9	1.99	0.41	0.24
BBS41	3	10.0	3.0	1.7	7.3	2.1	1.2	1.87	0.34	0.20
BBS42	1	4.0	-	-	4.0	-	-	1.39	-	-
BBS43	1	7.0	-	-	6.0	-	-	1.75	-	-
BBS44	1	7.0	-	-	4.0	-	-	1.28	-	-
BBS45	1	5.0	-	-	5.0	-	-	1.61	-	-
BBS46	2	7.0	2.8	2.0	5.0	2.8	2.0	1.42	0.66	0.47

Appendix A4: Breeding Bird Population Metrics
 Summary Statistics for Breeding Bird Population Metrics



Location	Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Shannon	Shannon StDev	Shannon SE
BBS47	1	5.0	-	-	4.0	-	-	1.33	-	-
BBS48	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS49	3	13.3	6.0	3.5	7.0	2.6	1.5	1.59	0.26	0.15
BBS50	3	6.3	2.1	1.2	5.7	2.3	1.3	1.63	0.51	0.30
BBS51	3	6.7	1.2	0.7	5.0	1.0	0.6	1.51	0.27	0.16
BBS52	3	9.0	1.7	1.0	7.0	1.7	1.0	1.87	0.27	0.16
BBS53	3	12.7	1.2	0.7	10.3	1.5	0.9	2.28	0.18	0.11
BBS54	3	10.0	2.0	1.2	7.7	1.2	0.7	1.36	1.18	0.68
BBS55	3	10.0	1.0	0.6	8.0	1.7	1.0	1.97	0.27	0.16
BBS56	3	12.7	4.2	2.4	9.7	4.0	2.3	2.14	0.50	0.29
BBS57	3	6.0	1.0	0.6	5.0	1.0	0.6	1.55	0.21	0.12
BBS58	1	11.0	-	-	9.0	-	-	2.15	-	-
BBS59	2	7.0	0.0	0.0	6.0	0.0	0.0	1.75	0.00	0.00
BBS60	2	9.0	0.0	0.0	5.5	0.7	0.5	1.58	0.22	0.15
BBS61	1	8.0	-	-	6.0	-	-	1.67	-	-
BBS62	1	6.0	-	-	5.0	-	-	1.56	-	-
BBS63	1	6.0	-	-	3.0	-	-	1.01	-	-
BBS64	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS65	1	2.0	-	-	1.0	-	-	0.00	-	-
BBS66	1	5.0	-	-	4.0	-	-	1.33	-	-
BBS67	1	2.0	-	-	2.0	-	-	0.69	-	-
BBS68	3	15.3	1.5	0.9	9.0	1.0	0.6	2.02	0.14	0.08
BBS69	2	15.0	7.1	5.0	9.0	0.0	0.0	1.89	0.39	0.28
BBS70	1	1.0	-	-	1.0	-	-	0.00	-	-
BBS71	1	4.0	-	-	4.0	-	-	1.39	-	-
BBS72	2	6.0	0.0	0.0	5.0	1.4	1.0	1.56	0.33	0.23
BBS73	2	5.5	2.1	1.5	5.0	1.4	1.0	1.57	0.26	0.18
BBS74	1	3.0	-	-	2.0	-	-	0.64	-	-
BBS75	1	3.0	-	-	2.0	-	-	0.64	-	-
BBS76	1	4.0	-	-	4.0	-	-	1.39	-	-
BBS77	2	9.0	2.8	2.0	6.0	1.4	1.0	1.66	0.41	0.29
BBS78	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS79	2	4.0	1.4	1.0	3.5	0.7	0.5	1.22	0.17	0.12
BBS80	1	5.0	-	-	5.0	-	-	1.61	-	-
BBS81	2	6.0	4.2	3.0	4.5	3.5	2.5	1.23	0.84	0.60
BBS82	1	8.0	-	-	4.0	-	-	1.21	-	-
BBS83	1	8.0	-	-	8.0	-	-	2.08	-	-
BBS84	1	6.0	-	-	5.0	-	-	1.56	-	-
BBS85	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS86	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS87	1	7.0	-	-	6.0	-	-	1.75	-	-
BBS88	1	14.0	-	-	11.0	-	-	2.30	-	-
BBS89	1	10.0	-	-	8.0	-	-	2.03	-	-
BBS90	1	5.0	-	-	3.0	-	-	1.05	-	-
BBS91	1	10.0	-	-	8.0	-	-	1.97	-	-
BBS92	1	2.0	-	-	2.0	-	-	0.69	-	-

Appendix A4: Breeding Bird Population Metrics
 Summary Statistics for Breeding Bird Population Metrics



Location	Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Shannon	Shannon StDev	Shannon SE
BBS93	1	7.0	-	-	5.0	-	-	1.48	-	-
BBS94	1	4.0	-	-	3.0	-	-	1.04	-	-
BBS95	1	4.0	-	-	4.0	-	-	1.39	-	-
BBS96	1	3.0	-	-	3.0	-	-	1.10	-	-
BBS97	1	4.0	-	-	3.0	-	-	1.04	-	-
BBS98	1	2.0	-	-	2.0	-	-	0.69	-	-
BBS99	1	6.0	-	-	4.0	-	-	1.33	-	-
BBS100	1	13.0	-	-	10.0	-	-	2.25	-	-
BBS101	1	5.0	-	-	2.0	-	-	0.50	-	-
BBS102	1	5.0	-	-	4.0	-	-	1.33	-	-
BBS103	1	6.0	-	-	5.0	-	-	1.56	-	-
BBS104	1	9.0	-	-	5.0	-	-	1.58	-	-
BBS105	1	11.0	-	-	5.0	-	-	1.29	-	-
BBS106	1	4.0	-	-	2.0	-	-	0.69	-	-
BBS107	1	4.0	-	-	3.0	-	-	1.04	-	-
BBS108	1	28.0	-	-	6.0	-	-	0.76	-	-
BBS109	1	6.0	-	-	5.0	-	-	1.56	-	-
BBS110	1	5.0	-	-	4.0	-	-	1.33	-	-
BBS111	1	6.0	-	-	5.0	-	-	1.56	-	-
RSS1	1	6.0	-	-	5.0	-	-	1.56	-	-
RSS2	1	5.0	-	-	5.0	-	-	1.61	-	-
RSS3	1	4.0	-	-	3.0	-	-	1.04	-	-
RSS4	1	9.0	-	-	4.0	-	-	1.00	-	-
RSS5	1	5.0	-	-	5.0	-	-	1.61	-	-
RSS6	1	3.0	-	-	3.0	-	-	1.10	-	-
RSS7	1	9.0	-	-	8.0	-	-	2.04	-	-
RSS8	1	18.0	-	-	11.0	-	-	2.26	-	-
RSS9	1	8.0	-	-	5.0	-	-	1.49	-	-
RSS10	1	10.0	-	-	8.0	-	-	2.03	-	-
RSS11	1	10.0	-	-	8.0	-	-	1.97	-	-
RSS12	1	2.0	-	-	2.0	-	-	0.69	-	-
RSS13	1	8.0	-	-	6.0	-	-	1.67	-	-
RSS14	1	11.0	-	-	7.0	-	-	1.85	-	-
BBS12B	2	8.5	0.7	0.5	5.5	0.7	0.5	1.58	0.22	0.15
BBS28B	1	4.0	-	-	4.0	-	-	1.39	-	-
BBS28C	1	14.0	-	-	8.0	-	-	1.97	-	-
BBS28D	1	8.0	-	-	5.0	-	-	1.49	-	-
BBS30A	1	2.0	-	-	2.0	-	-	0.69	-	-
BBS30B	2	6.0	2.8	2.0	5.0	1.4	1.0	1.56	0.25	0.17
BBS30C	1	7.0	-	-	4.0	-	-	1.35	-	-
BBS30D	1	2.0	-	-	2.0	-	-	0.69	-	-
BBS30E	1	4.0	-	-	3.0	-	-	1.04	-	-
BBS30F	1	5.0	-	-	5.0	-	-	1.61	-	-
BBS35B	2	10.0	0.0	0.0	9.0	1.4	1.0	2.16	0.20	0.14
BBS36B	2	25.0	19.8	14.0	8.5	0.7	0.5	1.52	0.88	0.62
BBS38B	1	14.0	-	-	12.0	-	-	2.44	-	-

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS01	7	6	1.75	MSdw	Forest
BBS01	8	7	1.91	MSdw	Forest
BBS01	7	7	1.95	MSdw	Forest
BBS02	6	6	1.79	MSdw	Forest
BBS02	8	6	1.73	MSdw	Forest
BBS02	5	4	1.33	MSdw	Forest
BBS03	11	8	2.02	MSdw	Cutblock
BBS03	11	9	2.15	MSdw	Cutblock
BBS03	11	9	2.15	MSdw	Cutblock
BBS04	5	5	1.61	MSdw	Forest
BBS04	8	7	1.91	MSdw	Forest
BBS04	8	7	1.91	MSdw	Forest
BBS05	7	7	1.95	MSdw	Cutblock
BBS05	10	7	1.89	MSdw	Cutblock
BBS05	11	9	2.15	MSdw	Cutblock
BBS06	4	4	1.39	MSdw	Forest
BBS06	9	7	1.89	MSdw	Forest
BBS06	9	8	2.04	MSdw	Forest
BBS07	4	3	1.04	MSdw	Forest
BBS07	5	5	1.61	MSdw	Forest
BBS07	5	5	1.61	MSdw	Forest
BBS07	5	4	1.33	MSdw	Forest
BBS08	14	11	2.34	MSdw	Wetland
BBS08	10	7	1.89	MSdw	Wetland
BBS08	15	12	2.43	MSdw	Wetland
BBS08	16	11	2.34	MSdw	Wetland
BBS09	6	5	1.56	MSdw	Forest
BBS09	8	6	1.73	MSdw	Forest
BBS10	4	4	1.79	MSdw	Forest
BBS10	7	7	1.95	MSdw	Forest
BBS10	10	8	2.03	MSdw	Forest
BBS100	13	10	2.25	MSdw	Wetland
BBS101	5	2	0.50	MSdw	Forest
BBS102	5	4	1.33	ESSFdk1	Forest
BBS103	6	5	1.56	ESSFdk1	Forest
BBS104	9	5	1.58	ESSFdk1	Avalanche
BBS105	11	5	1.29	ESSFdk1	Forest
BBS106	4	2	0.69	ESSFdk1	Forest
BBS107	4	3	1.04	MSdw	Forest
BBS108	28	6	0.76	ESSFdk1	Wetland
BBS11	4	4	1.39	MSdw	Avalanche
BBS11	6	6	1.79	MSdw	Avalanche
BBS11	8	7	1.91	MSdw	Avalanche
BBS110	6	5	1.56	ESSFdk1	Forest
BBS111	5	4	1.33	ESSFdk1	Forest

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS112	6	5	1.56	ESSFdk1	Forest
BBS12	7	6	1.75	MSdw	Forest
BBS12	5	5	1.61	MSdw	Forest
BBS12	9	7	1.89	MSdw	Forest
BBS12B	9	5	1.43	MSdw	Forest
BBS12B	8	6	1.73	MSdw	Forest
BBS13	8	7	1.91	MSdw	Forest
BBS14	3	2	0.64	MSdw	Forest
BBS14	3	3	1.10	MSdw	Forest
BBS14	2	2	0.69	MSdw	Forest
BBS14	1	1	0.00	MSdw	Forest
BBS15	5	4	1.33	ESSFdk1	Forest
BBS15	3	3	1.10	ESSFdk1	Forest
BBS15	5	4	1.33	ESSFdk1	Forest
BBS16	3	3	1.10	ESSFdk1	Forest
BBS16	4	4	1.39	ESSFdk1	Forest
BBS16	5	4	1.33	ESSFdk1	Forest
BBS17	5	3	0.95	ESSFdk1	Forest
BBS17	3	3	1.10	ESSFdk1	Forest
BBS17	6	6	1.79	ESSFdk1	Forest
BBS18	8	8	2.08	ESSFdk1	Wetland
BBS19	6	5	1.56	MSdw	Wetland
BBS19	5	5	1.61	MSdw	Wetland
BBS19	10	8	2.03	MSdw	Wetland
BBS20	9	9	2.20	MSdw	Forest
BBS21	29	14	2.00	MSdw	Forest
BBS21	12	7	1.79	MSdw	Forest
BBS21	11	11	2.40	MSdw	Forest
BBS21	14	9	2.11	MSdw	Forest
BBS22	8	7	1.91	MSdw	Cutblock
BBS22	15	12	2.43	MSdw	Cutblock
BBS22	13	10	2.25	MSdw	Cutblock
BBS22	14	11	2.34	MSdw	Cutblock
BBS23	5	5	1.61	MSdw	Forest
BBS23	5	5	1.61	MSdw	Forest
BBS23	9	7	1.89	MSdw	Forest
BBS24	8	6	1.73	MSdw	Forest
BBS24	6	5	1.56	MSdw	Forest
BBS24	11	10	2.27	MSdw	Forest
BBS25	11	10	2.27	MSdw	Wetland
BBS25	16	14	2.60	MSdw	Wetland
BBS25	15	12	2.40	MSdw	Wetland
BBS26	2	2	0.69	MSdw	Forest
BBS26	2	2	0.69	MSdw	Forest
BBS26	3	2	0.64	MSdw	Forest

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS27	6	6	1.79	ESSFdk1	Forest
BBS27	6	5	1.56	ESSFdk1	Forest
BBS27	5	4	1.33	ESSFdk1	Forest
BBS28	6	5	1.56	ESSFdk1	Forest
BBS28B	4	4	1.39	ESSFdk1	Forest
BBS28C	14	8	1.97	ESSFdk1	Forest
BBS28D	8	5	1.49	ESSFdk1	Forest
BBS29	7	7	1.95	ESSFdk1	Forest
BBS29	3	2	0.64	ESSFdk1	Forest
BBS30	12	9	2.14	ESSFdk1	Avalanche
BBS30	8	6	1.73	ESSFdk1	Avalanche
BBS30a	2	2	0.69	ESSFdk1	Forest
BBS30B	8	6	1.73	ESSFdk1	Rocky Outcrop
BBS30B	4	4	1.39	ESSFdk1	Rocky Outcrop
BBS30C	7	4	1.35	ESSFdk1	Forest
BBS30D	2	2	0.69	ESSFdk1	Forest
BBS30E	4	3	1.04	ESSFdk1	Forest
BBS30F	5	5	1.61	ESSFdk1	Forest
BBS31	6	6	1.79	ESSFdk1	Forest
BBS31	8	7	1.91	ESSFdk1	Forest
BBS31	5	4	1.33	ESSFdk1	Forest
BBS32	3	2	0.64	ESSFdk1	Forest
BBS32	5	5	1.61	ESSFdk1	Forest
BBS32	7	7	1.95	ESSFdk1	Forest
BBS33	1	1	0.00	MSdw	Forest
BBS33	7	6	1.75	MSdw	Forest
BBS33	7	7	1.95	MSdw	Forest
BBS34	8	6	1.73	MSdw	Forest
BBS34	10	10	2.30	MSdw	Forest
BBS34	10	4	1.31	MSdw	Forest
BBS34C	6	4	1.33	MSdw	Forest
BBS35	10	7	1.89	MSdw	Mixed Shrub Forest
BBS35B	10	10	2.30	MSdw	Mixed Shrub Forest
BBS35B	10	8	2.03	MSdw	Mixed Shrub Forest
BBS36	13	11	2.31	MSdw	Mixed Shrub Forest
BBS36B	39	8	0.90	MSdw	Mixed Shrub Forest
BBS36B	11	9	2.15	MSdw	Mixed Shrub Forest
BBS37	9	7	1.83	MSdw	Mixed Shrub Forest
BBS37	10	6	1.75	MSdw	Mixed Shrub Forest
BBS37	11	8	1.89	MSdw	Mixed Shrub Forest
BBS38	5	5	1.61	MSdw	Mixed Shrub Forest
BBS38B	7 to 12	12	2.44	MSdw	Grassland
BBS39	8	7	1.91	MSdw	Wetland
BBS39	6	4	1.24	MSdw	Wetland
BBS40	9	6	1.68	MSdw	Wetland

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS40	13	12	2.46	MSdw	Wetland
BBS40	10	7	1.83	MSdw	Wetland
BBS41	10	8	2.03	MSdw	Forest
BBS41	13	9	2.10	MSdw	Forest
BBS41	7	5	1.48	MSdw	Forest
BBS42	4	4	1.39	ESSFdk1	Forest
BBS43	7	6	1.75	ESSFdk1	Forest
BBS44	7	4	1.28	ESSFdk1	Forest
BBS45	5	5	1.61	ESSFdkw	Forest
BBS46	5	3	0.95	ESSFdkw	Forest
BBS46	9	7	1.89	ESSFdkw	Forest
BBS47	5	4	1.33	ESSFdkw	Forest
BBS48	3	3	1.10	ESSFdkw	Forest
BBS49	7	4	1.35	MSdw	Mixed Shrub Forest
BBS49	19	9	1.56	MSdw	Mixed Shrub Forest
BBS49	14	8	1.87	MSdw	Mixed Shrub Forest
BBS50	8	7	1.91	MSdw	Mixed Shrub Forest
BBS50	7	7	1.95	MSdw	Mixed Shrub Forest
BBS50	4	3	1.04	MSdw	Mixed Shrub Forest
BBS51	6	4	1.24	MSdw	Forest
BBS51	8	5	1.49	MSdw	Forest
BBS51	6	6	1.79	MSdw	Forest
BBS52	8	5	1.56	MSdw	Forest
BBS52	8	8	2.08	MSdw	Forest
BBS52	11	8	1.97	MSdw	Forest
BBS53	12	9	2.14	MSdw	Grassland
BBS53	12	12	2.48	MSdw	Grassland
BBS53	14	10	2.21	MSdw	Grassland
BBS54	8	7	1.91	MSdw	Grassland
BBS54	12	7	0.00	MSdw	Grassland
BBS54	10	9	2.16	MSdw	Grassland
BBS55	10	7	1.75	MSdw	Forest
BBS55	9	7	1.89	MSdw	Forest
BBS55	11	10	2.27	MSdw	Forest
BBS56	8	5	1.56	MSdw	Cutblock
BBS56	14	12	2.44	MSdw	Cutblock
BBS56	16	12	2.43	MSdw	Cutblock
BBS57	5	4	1.33	MSdw	Forest
BBS57	7	6	1.75	MSdw	Forest
BBS57	6	5	1.56	MSdw	Forest
BBS58	11	9	2.15	MSdw	Forest
BBS59	7	6	1.75	MSdw	Forest
BBS59	7	6	1.75	MSdw	Forest
BBS60	9	6	1.74	ESSFdk1	Forest
BBS60	9	5	1.43	ESSFdk1	Forest

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS61	8	6	1.67	ESSFdk1	Forest
BBS62	6	5	1.56	ESSFdk1	Cutblock
BBS63	6	3	1.01	ESSFdk1	Forest
BBS64	3	3	1.10	ESSFdk1	Forest
BBS65	2	1	0.00	ESSFdk1	Forest
BBS66	5	4	1.33	ESSFdk1	Forest
BBS67	2	2	0.69	ESSFdk1	Forest
BBS68	15	9	2.08	MSdw	Wetland
BBS68	14	8	1.87	MSdw	Wetland
BBS68	17	10	2.12	MSdw	Wetland
BBS69	20	9	1.61	MSdw	Grassland
BBS69	10	9	2.16	MSdw	Grassland
BBS70	1	1	0.00	ESSFdkw	Alpine
BBS71	4	4	1.39	ESSFdkw	Alpine
BBS72	6	6	1.79	ESSFdkw	Forest
BBS72	6	4	1.33	ESSFdkw	Forest
BBS73	4	4	1.39	ESSFdkw	Forest
BBS73	7	6	1.75	ESSFdkw	Forest
BBS74	3	2	0.64	ESSFdkw	Forest
BBS75	3	2	0.64	ESSFdkw	Forest
BBS76	4	4	1.39	ESSFdkw	Forest
BBS77	7	7	1.95	ESSFdkw	Forest
BBS77	11	5	1.37	ESSFdkw	Forest
BBS78	3	3	1.10	ESSFdkw	Forest
BBS79	5	4	1.33	ESSFdkw	Forest
BBS79	3	3	1.10	ESSFdkw	Forest
BBS80	5	5	1.61	ESSFdk1	Forest
BBS81	3	2	0.64	ESSFdk1	Forest
BBS81	9	7	1.83	ESSFdk1	Forest
BBS82	8	4	1.21	ESSFdkw	Forest
BBS83	8	8	2.08	ESSFdk1	Forest
BBS84	6	5	1.56	ESSFdk1	Forest
BBS85	3	3	1.10	ESSFdk1	Forest
BBS86	3	3	1.10	ESSFdk1	Forest
BBS87	7	6	1.75	MSdw	Forest
BBS88	14	11	2.30	MSdw	Forest
BBS89	10	8	2.03	MSdw	Forest
BBS9	7	3	1.00	MSdw	Forest
BBS90	5	3	1.05	MSdw	Forest
BBS91	10	8	1.97	MSdw	Forest
BBS92	2	2	0.69	MSdw	Forest
BBS93	7	5	1.48	ESSFdk1	Forest
BBS94	4	3	1.04	ESSFdkw	Forest
BBS95	4	4	1.39	ESSFdk1	Forest
BBS96	3	3	1.10	ESSFdk1	Forest

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations
Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



Location	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
BBS97	4	3	1.04	ESSFdk1	Forest
BBS98	2	2	0.69	ESSFdk1	Forest
BBS99	6	4	1.33	ESSFdk1	Wetland
RS1	6	5	1.56	MSdw	Forest
RS10	10	8	2.03	MSdw	Forest
RS11	10	8	1.97	ESSFdk1	Wetland
RS12	2	2	0.69	ESSFdk1	Forest
RS13	8	6	1.67	ESSFdk1	Forest
RS14	11	7	1.85	ESSFdk1	Cutblock
RS2	5	5	1.61	MSdw	Forest
RS3	4	3	1.04	MSdw	Cutblock
RS4	9	4	1.00	MSdw	Forest
RS5	5	5	1.61	MSdw	Cutblock
RS6	3	3	1.10	MSdw	Cutblock
RS7	9	8	2.04	MSdw	Cutblock
RS8	18	11	2.26	MSdw	Cutblock
RS9	8	5	1.49	MSdw	Forest

Appendix A5: Breeding Bird BEC Subzone and Land Cover Associations

Summary Statistics for Breeding Bird Population Metrics per BEC Subzone and Land Cover Type



BEC Subzone	Average Abundance	Abundance SE	Average Richness	Richness SE	Average Shannon	Shannon SE
MSdw	9.0	0.4	6.9	0.2	1.74	0.04
ESSFdk1	6.0	0.4	4.5	0.2	1.37	0.05
ESSFdkw	5.0	0.5	4.0	0.3	1.25	0.10
Dominant Habitat Type	Abundance	Richness	Diversity	Abundance SE	Richness SE	Diversity SE
MSdw						
Alpine	0.0	0.0	0.0	0.0	0.0	0.0
Avalanche Chute	6.0	5.7	1.7	1.2	0.9	0.2
Cutblock	10.4	8.2	2.0	1.0	0.7	0.1
Forest	7.4	5.8	1.6	0.4	0.3	0.1
Grassland	12.3	9.3	1.9	1.2	0.6	0.3
Mixed Shrub Forest	11.7	7.3	1.8	2.0	0.5	0.1
Rocky Outcrop	0.0	0.0	0.0	0.0	0.0	0.0
Wetland	11.7	8.8	2.0	0.9	0.6	0.1
ESSFdk1						
Alpine	0.0	0.0	0.0	0.0	0.0	0.0
Avalanche Chute	9.7	6.7	1.8	1.2	1.2	0.2
Cutblock	8.5	6.0	1.7	2.5	1.0	0.1
Forest	5.3	4.2	1.3	0.3	0.2	0.1
Grassland	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Shrub Forest	0.0	0.0	0.0	0.0	0.0	0.0
Rocky Outcrop	6.0	5.0	1.6	2.0	1.0	0.2
Wetland	13.0	6.5	1.5	5.1	1.0	0.3
ESSFdkw						
Alpine	2.5	2.5	0.7	1.5	1.5	0.7
Avalanche Chute	0.0	0.0	0.0	0.0	0.0	0.0
Cutblock	0.0	0.0	0.0	0.0	0.0	0.0
Forest	5.3	4.2	1.3	0.5	0.3	0.1
Grassland	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Shrub Forest	0.0	0.0	0.0	0.0	0.0	0.0
Rocky Outcrop	0.0	0.0	0.0	0.0	0.0	0.0
Wetland	0.0	0.0	0.0	0.0	0.0	0.0

Station Name	Survey Type	General Location	Station Location	Survey Date	Survey Start Time	Temp (°C)	Wind ¹	Cloud Cover ²	Moon ³	Noise ⁴	No. of Cars	No. of CONI Observed	CONI Behaviour
CS1	CONI	Grave Prarie	11 U 653460 5520374	30-Jun-18	2053	13	1	1	0	1	0	0	N/A
CS2	CONI	Grave Prarie	11 U 653206 5521960	30-Jun-18	9105	13	1	1	0	1	0	1	Foraging
CS3	CONI	Grave Prarie	11 U 653616 5523449	30-Jun-18	2116	13	2	2	0	1	0	0	N/A
CS4	CONI	Grave Prarie	11 U 655103 5524156	30-Jun-18	2129	12.5	3	3	0	0	0	0	N/A
CS5	CONI	Grave Creek	11 U 656005 5522800	30-Jun-18	2140	12.5	2	2	0	1	0	0	N/A
CS6	CONI	Harmer Creek	11 U 657397 5521978	30-Jun-18	2154	12	2	2	0	1	0	0	N/A
CS7	CONI	Grave Creek	11 U 658245 5523329	30-Jun-18	2203	12	3	3	0	1	0	0	N/A
CS8	CONI	West Alexander Creek	11 U 664105 5515659	5-Jul-18	2105	17	1	0	0	0	0	0	N/A
CS9	CONI	Alexander Creek	11 U 664295 5514079	5-Jul-18	2116	17	3	0	0	0	0	0	N/A
CS10	CONI	Alexander Creek	11 U 664295 5512882	5-Jul-18	2126	17	3	0	0	0	0	0	N/A
CS11	CONI	Alexander Creek	11 U 664452 5510886	5-Jul-18	2136	17.5	3	0	0	0	0	0	N/A
CS12	CONI	Alexander Creek	11 U 664613 5509267	5-Jul-18	2147	17.5	3	0	0	0	0	0	N/A
CS13	CONI	Alexander Creek	11 U 664601 5507660	5-Jul-18	2157	18	3	0	0	0	0	0	N/A
CS14	CONI	Alexander Creek	11 U 664300 5506060	5-Jul-18	2208	18	2	0	0	0	0	0	N/A
CS15	CONI	Alexander Creek	11 U 663640 5504603	5-Jul-18	2218	18	2	0	0	0	0	0	N/A
CS16	CONI	Alexander Creek	11 U 663888 5503024	5-Jul-18	2229	18	3	0	0	1	0	0	N/A

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

² Cloud Cover: 0 - no clouds; 1 - <25% cover; 2 - 25-50%; 3 - 50-90%; 4 - >90%

³ Moon: Absence (0); Presence (1)

⁴ Noise: 0 - None; 1 - Slight (distant traffic); 2 - Moderate (arplane, moderate traffic); 3 - Excessive (construction, frog chorus)

Appendix B

Migratory Landbird Field Data and Results

Survey Station Name	Survey Type	Latitude	Longitude	Company	First Visit	Sub Area	BEC ¹	Land Cover	Structural Stage ²	Dominant Stand Type ³	No. of Surveys Conducted Spring	No. of Surveys Conducted Fall	No. of Surveys Conducted Total
MPC01	Point Count	49.84064	-114.8648	Dillon	2018	Grave Prairie	MSdw	Grassland	2	m	4	2	6
MPC02	Point Count	49.83847	-114.8651	Dillon	2018	Grave Prairie	MSdw	Grassland	2	m	5	2	7
MPC03	Point Count	49.83847	-114.8651	Dillon	2018	Grave Prairie	MSdw	Grassland	2	m	5	2	7
MPC04	Point Count	49.83499	-114.8696	Dillon	2018	Grave Prairie	MSdw	Grassland	2	m	6	2	8
MPC05	Point Count	49.83318	-114.8714	Dillon	2018	Grave Prairie	MSdw	Grassland	2	m	6	3	9
MPC06	Point Count	49.83846	-114.8637	Dillon	2018	Grave Prairie	MSdw	Grassland	2	c	5	1	6
MPC07	Point Count	49.83848	-114.8637	Dillon	2018	Grave Escarpment	MSdw	Grassland	3	m	3	2	5
MPC08	Point Count	49.84475	-114.8521	Dillon	2018	Grave Escarpment	MSdw	Grassland	3	m	2	1	3
MPC09	Point Count	49.84667	-114.8542	Dillon	2018	Grave Prairie/forest	MSdw	Forest	5	b	3	2	5
MPC10	Point Count	49.7142	-114.7148	Dillon	2018	Wetland 4	MSdw	Wetland	2	m	4	2	6
MPC11	Point Count	49.71599	-114.7131	Dillon	2018	Wetland 4	MSdw	Wetland	2	m	3	2	5
MPC12	Point Count	49.74613	-114.7162	Dillon	2018	Middle Alexander Creek	MSdw	Forest	6	m	4	2	6
MPC13	Point Count	49.72516	-114.7158	Dillon	2018	Wetland 5	MSdw	Wetland	3	m	3	2	5
MPC14	Point Count	49.72672	-114.7145	Dillon	2018	Wetland 5	MSdw	Wetland	3	m	3	1	4
MPC15	Point Count	49.83091	-114.8621	Dillon	2018	Black Creek	MSdw	Forest	6	m	3	1	4
MPC16	Point Count	49.82924	-114.8528	Dillon	2018	Black Creek	MSdw	Grassland	2	m	2	0	2
MPC17	Point Count	49.82714	-114.8547	Dillon	2018	Black Creek	MSdw	Forest	6	m	3	0	3
MPC18	Point Count	49.82917	-114.8122	Dillon	2018	Harmer Reservoir	MSdw	Wetland	3	c	4	2	6
MPC19	Point Count	49.76426	-114.7192	Dillon	2018	Wetland 6	ESSFdk1	Wetland	2	c	3	2	5
MPC20	Point Count	49.72861	-114.7155	Dillon	2018	Wetland 5	MSdw	Wetland	3	m	2	1	3
MPC21	Point Count	49.66511	-114.7335	Dillon	2019	Hydro Lines	MSdw	Grassland	3	m	1	0	1
MPC22	Point Count	49.77267	-114.7215	Dillon	2019	West Alexander	ESSFdk1	Forest	6	c	2	0	2
MPC23	Point Count	49.77442	-114.7242	Dillon	2019	Avalanche Chute	ESSFdk1	Avalanche	3	m	2	1	3
MPC24	Point Count	49.8741	-114.8626	Dillon	2019	Line Creek Land	MSdw	Grassland	2	m	0	0	1
MPC25	Point Count	49.7147	-114.6909	Dillon	2019	Deadman Pass	MSdw	Wetland	2	c	0	2	2
MTC1-01	Transect	49.85702	-114.8569	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-02	Transect	49.85883	-114.8542	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-03	Transect	49.86075	-114.852	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-04	Transect	49.86251	-114.8501	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-05	Transect	49.86327	-114.8469	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-06	Transect	49.86379	-114.8434	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	6	1	7
MTC1-07	Transect	49.86234	-114.8406	Dillon	2018	Wetland 13 Access	MSdw	Forest	6	b	1	0	1
MTC2-01	Transect	49.84995	-114.8376	Dillon	2018	Wetland 13 Access	MSdw	Wetland	3	m	2	1	2
CM0100	Point Count	49.83064	-114.7545	KES	2018	On Branch C	-	Forest	3	c	0	1	1
CM0200	Point Count	49.86297	-114.8478	KES	2018	Near Wetland 13	MSdw	Wetland	3	m	0	1	1

¹ BEC: Dry Warm Montane Spruce (MSdw), Elk Dry Cool Engelmann Spruce-Subalpine Fir (ESSFdkw), and Dry Cool Parkland Engelmann Spruce-Subalpine Fir (ESSFdkp)

² Structural Stage: 1= Sparse/Bryoid; 2= Herb; 3= Shrub/Herb; 4= Pole/Sapling; 5= Young Forest; 6= Mature Forest; 7= Old Forest

³ Dominant Stand Type: c= coniferous, m= mixed, b= broadleaf

Appendix B2: Migratory Bird Point Count and Transect Survey Data
Migratory Bird Point Count Survey Data, April 22-26, 2018



Survey Point Name	MPC01	MPC02	MPC03	MPC04	MPC05	MPC06	MPC07	MPC08	MPC09	MPC10	MPC11	MPC12	MPC13	MPC14
Time Start	10:04	10:00	10:30	10:47	11:08	11:40	13:02	13:23	14:12	8:51	9:16	11:19	14:14	14:48
Time End	10:14	10:10	10:40	10:57	11:18	11:59	13:12	12:33	14:22	9:01	9:26	11:29	14:24	14:58
Ceiling ¹	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Cloud Cover (%)	10	10	20	50	80	80	90	100	100	100	100	100	100	100
Wind ²	2	2	2	2	2	2	2	2-3	2-3	1-2	1-2	1-2	1-2	1-2
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	6	6	6	6	7	7	7	9	9	0	1	1	1	1
Date	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	24-Apr-18	24-Apr-18	24-Apr-18	24-Apr-18	24-Apr-18
American Robin	1	2	22	5	6	4				2				
Black-capped Chickadee					2									
Dark-eyed Junco	1	15	11		2	1		1	1		1			1
European Starling		4												
Golden-crowned Kinglet											1			1
Gray Jay											1			
Harry Woodpecker										2				
Mountain Chickadee	1				2				2					
Northern Flicker	1	1			1		1							
Ruby-crowned Kinglet	1				1				1	1				1
Townsend's Solitaire	1													
Tree Swallow		2				2				1				
Varied Thrush											1			
White-winged Crossbill												1		
Incidental Observations														
American Robin			5	40	10				1	1				
Bald Eagle		1												
Black-capped Chickadee				1										
Canada Goose		1		1	4									
Common Raven						1								
Dark-eyed Junco						2		1				1		1
European Starling			3											
Mountain Bluebird					5									
Mountain Chickadee											1			
Northern Flicker	1	1	1		1	3			1					
Red-naped Sapsucker										1				
Red-tailed Hawk												1		
Ruby-crowned Kinglet				1				1						1
Savannah Sparrow								1						
Turkey Vulture								1						
Varied Thrush										1				

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Appendix B2: Migratory Bird Point Count and Transect Survey Data
Migratory Bird Point Count Survey Data, April 25-26, 2018 Duplicates



Survey Point Name	MPC04	MPC05	MPC01	MPC02	MPC03	MPC04	MPC05	MPC06
Time Start	14:10	13:52	10:32	10:13	9:55	9:18	9:00	10:52
Time End	14:20	14:02	10:42	10:23	10:05	9:28	9:10	11:02
Ceiling ¹	N	N	H	H	H	H	H	H
Cloud Cover (%)	0	0	10	10	10	10	0	10
Wind ²	4	3	2	2	2	2	0	2
Precipitation ³	N	N	N	N	N	N	N	N
Temperature (°C)	16	14	6	6	6	6	1	6
Date	25-Apr-18	25-Apr-18	26-Apr-18	26-Apr-18	26-Apr-18	26-Apr-18	26-Apr-18	26-Apr-18
American Robin			2		1		1	4
Canada Goose							2	
Common Raven			1					
Dark-eyed Junco				3	2		1	5
European Starling					1		1	
Harry Woodpecker					1			
Mountain Bluebird								2
Mountain Chickadee			1					1
Northern Flicker					1			1
Red-breasted Nuthatch								1
Red-naped Sapsucker								1
Ruby-crowned Kinglet				1				1
Tree Swallow				4	1			1
Incidental Observations								
American Robin		4		1		1	3	3
American Kestrel								1
Bald Eagle						1		
Canada Goose				1				1
Common Raven							1	
Cooper's Hawk								1
Dark-eyed Junco					1		1	
European Starling						2		7
Mountain Chickadee				1				
Northern Flicker				1	1		1	1
Red-naped Sapsucker								1
Red-tailed Hawk								1
Ruby-crowned Kinglet			1	1	1	1	1	1
Unid Duck						10		
Varied Thrush								1
Western Meadowlark					1			

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MPC02	MPC03	MPC04	MPC05	MPC06	MPC15	MPC16	MPC17	MPC18	MPC12	MPC19	MPC20	MPC10	MPC11	MPC13	MPC14	MPC12
Time Start	7:22	7:52	8:07	8:33	9:00	10:08	11:29	11:54	10:00	8:12	10:11	11:11	9:07	9:27	10:37	11:50	12:50
Time End	7:32	8:02	8:17	8:43	9:10	10:18	0:00	12:04	10:10	8:22	10:21	11:21	9:17	9:37	10:47	12:00	13:00
Ceiling ¹	H	H	H	H	H	H	H	H	N	N	N	N	N	N	N	N	N
Cloud Cover (%)	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0
Wind ²	1	1	1	1	1	4	3-5	3-5	2	0	0	0	2	2	2	3	2
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	5	5	5	5	5	12	12	12	10	6	6	6	12	12	12	12	13
Date	4-May-18	4-May-18	4-May-18	4-May-18	4-May-18	4-May-18	4-May-18	4-May-18	5-May-18	6-May-18	6-May-18	6-May-18	7-May-18	7-May-18	7-May-18	7-May-18	7-May-18
American Robin		1	2	1	1	2						1		1			
American Dipper										1							
Belted Kingfisher													1				
Canada Goose			1														
Common Raven					1												
Dark-eyed Junco					2						1						
European Starling						1											
Fox Sparrow											1			1		1	
Golden-crowned Kinglet					1		1				1	2	1	1	1	1	
Gray Jay	1																
Mountain Bluebird	1						2										
Mountain Chickadee							1		1								
Northern Waterthrush				1													
Orange-crowned Warbler							1										
Red-naped Sapsucker		2					1							1			
Ruby-crowned Kinglet				1	1	2	4	1			2		2	3	1	2	1
Ruffed Grouse											1						
Song Sparrow									1								
Townsend's Warbler												1					
Tree Swallow		5				1						2				1	1
Varied Thrush					1							1			1		
Yellow-Rumped Warbler						2					2	3		2		1	
Incidental Observations																	
American Robin	1	2	2	1	1												
American Dipper											2	1					
Brown-headed Cowbird											2						
Canada Goose	1	1															
Common Raven	1						1										
Dark-eyed Junco												1				1	
European Starling			1														
Fox Sparrow													1				
Golden-crowned Kinglet								1									
Lincoln's Sparrow																1	
Mountain Chickadee	1																
Northern Flicker		1	1		1	1											
Orange-crowned Warbler	1		1							1							
Pacific Wren			1						1	1					1		
Pileated Woodpecker							1										
Red-breasted Nuthatch							1										
Red-naped Sapsucker					1												
Red-winged Blackbird															1		
Ruby-crowned Kinglet	2	2	2	1	1	2	1		1	1	1	1		1		1	
Ruffed Grouse												1		1			1
Sora														1			
Townsend's Warbler									1								
Tree Swallow											1						
Unid Flycatcher				1													
Varied Thrush			1		2		1				1				1		
Yellow-Rumped Warbler			1	1	1				1	1							

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Appendix B2: Migratory Bird Point Count and Transect Survey Data
Migratory Bird Point Count Survey Data, May 8-9, 2018 Duplicates



Survey Point Name	MPC18	MPC10
BBS Number	18	10
Time Start	9:33	9:36
Time End	9:43	9:46
Ceiling ¹	H	H
Cloud Cover (%)	30	100
Wind ²	3	1-2
Precipitation ³	N	N
Temperature (°C)	8	7
Date	08-May-18	09-May-18
Dark-eyed Junco		2
Golden-crowned Kinglet		2
Ruby-crowned Kinglet		1
Song Sparrow		1
Townsend's Solitaire	1	
Varied Thrush	1	
Yellow-Rumped Warbler	1	1
Incidental Observations		
American Robin	1	
Ruby-crowned Kinglet		1
Ruffed Grouse		1
Song Sparrow	1	
Varied Thrush	1	1

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MPC01	MPC02	MPC03	MPC04	MPC05	MPC06	MPC07	MPC08	MPC09	MPC21	MPC10	MPC11	MPC13	MPC14	MPC20	MPC12	MPC19	MPC22	MPC23	MPC18	MPC15	MPC17
Time Start	7:05	7:27	7:53	8:10	8:30	9:00	9:49	10:11	9:32	6:53	7:37	8:02	8:36	8:53	9:14	9:50	10:17	10:39	11:00	9:34	11:06	11:39
Time End	7:15	7:37	8:03	8:20	8:40	9:10	9:50	10:21	9:42	7:03	7:47	8:12	8:37	9:03	9:24	10:00	10:27	10:49	11:10	9:44	11:16	11:49
Ceiling ¹	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	100	100	100
Wind ²	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0	0	0
Temperature (°C)	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	6	6	6
Date	7-May-19	7-May-19	7-May-19	7-May-19	7-May-19	7-May-19	7-May-19	7-May-19	7-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	8-May-19	9-May-19	9-May-19	9-May-19
American Robin	1	3		4	4	1	1			1	2			1		1		1		1		
American Three-toed Woodpecker																	2					1
Cassin's Finch							1															
Chipping Sparrow	1																					
Common Raven							1			1												1
Cooper's Hawk								1														
Dark-eyed Junco			2			1	3	1														1
European Starling			1				2															
Evening Grosbeak												1										
Fox Sparrow														1	1							
Golden-crowned Kinglet	1												1	1	1				4	1		
Gray Jay							1														2	
Hammond's Flycatcher							1	1	1	1												
Harry Woodpecker								1														
Lincoln's Sparrow											1											
Mountain Bluebird			2																			
Mountain Chickadee			1					2			1	2			2	2						
Northern Flicker			1				1															
Orange-crowned Warbler							1	1	1	1												
Pine Siskin		2	2		1	2	2	4	1	4	4	2		2	2	1	2	2		10	2	
Purple Finch																			1			
Red-breasted Nuthatch						1	1			1						1					1	1
Red-breasted Sapsucker						1										1						
Red-naped Sapsucker							1	1	1													
Red-winged BlackBird										1	2	2	2	2	2	2						
Ruby-crowned Kinglet					3	3	1	1	2	1	1	1	1		1						1	3
Savannah Sparrow			1	3																		2
Sharp-shinned Hawk						2					1											
Song Sparrow																					1	
Townsend's Warbler																					1	1
Tree Swallow	1	2					2										4					
Vesper's Sparrow				2			1															
White-winged Crossbill								1		2	4									1		
Yellow-Rumped Warbler											2						1	1	1		1	

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MPC21	MPC10	MPC11	MPC13	MPC14	MPC20	MPC12	MPC19	MPC23	MPC22	MPC05	MPC04	MPC03	MPC02	MPC01	MPC06	MPC15	MPC16	MPC17	MPC09	MPC07	MPC18
Time Start	6:37	7:11	7:49	8:26	8:44	9:08	9:39	10:07	10:38	11:05	6:36	6:55	7:15	7:30	7:52	8:11	9:09	9:43	10:17	11:05	11:32	9:34
Time End	6:47	7:21	7:59	8:36	8:54	9:18	9:49	10:17	10:48	11:15	6:46	7:05	7:25	7:40	8:02	8:21	9:19	9:53	10:27	11:15	11:42	9:44
Ceiling ¹	H	H	H	H	H	H	H	H	H	H	N	N	N	N	N	N	N	N	N	N	N	L
Cloud Cover (%)	90	90	90	85	85	85	85	60	80	80	0	0	0	0	0	0	0	0	0	0	0	100
Wind ²	0	0	0	2	2	2	2	2-3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Precipitation ³	nd	nd	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Rain light
Temperature (°C)	6	6	6	6	8	10	10	13	13	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	3
Date	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	23-May-19	24-May-19
American Robin	4										2			2		2		1				2
American Three-toed Woodpecker								1			1											
Brown-headed Cowbird			1		1		2							5			1					1
Cassin's Finch																1						1
Clay coloured sparrow																1						
Chipping Sparrow	1										1	1										
Common Raven											2			1								
Dark-eyed Junco	1	1		1		1	1										2		1		3	
European Starling														1	1							
Golden-crowned Kinglet				2																2		
Hammond's Flycatcher																				2	1	
Hermit Thrush			1																			
Lincoln's Sparrow		3			2	1					1		1				1					1
Mountain Bluebird																2						
Mountain Chickadee				1			1				2						1		2	1		
Northern Waterthrush											1											1
Pacific Wren																						
Pine Siskin	7	2	1	3	1		2	2	2		2								4	1	2	2
Red-breasted Nuthatch																					1	
Red-naped Sapsucker														2								
Ruby-crowned Kinglet						1	1	1	1								1	2		1	1	
Ruffed Grouse		1	1																			
Savannah Sparrow												2	2				1					
Townsend's Warbler			1	1			1	1												1		1
Tree Swallow					2			1						5	1							
Unid Hummingbird																1						
Vesper's Sparrow											1			2								
Warbling Vireo						1																1
White-crowned Sparrow		1			1	1	1															
White-winged Crossbill	12	3	1																			
Wilson's Warbler																						1
Yellow-Rumped Warbler		1	1	3	1		2	2							1	1			1	1		

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MPC01	MPC02	MPC03	MPC04	MPC05	MPC05	MPC06	MPC07	MPC09	MPC10a (WL4)	MPC11	MPC12	MPC13	MPC14	MPC15	MPC18	MPC19	MPC20	MPC23	MPC25 (BBS100)
Time Start	9:10	7:57	8:25	8:08	7:52	7:45	9:47	10:51	11:18	7:27	7:50	10:02	8:34	8:57	12:47	11:54	10:29	9:21	10:49	9:09
Time End	9:20	8:07	8:35	8:18	8:02	7:55	9:57	11:01	11:28	7:37	8:00	10:12	8:44	9:07	12:57	12:04	10:39	9:31	10:59	9:19
Ceiling ¹	N	N	N	N	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Cloud Cover (%)	70	70	60	70	100	70	75	85	85	40	40	30	30	30	50	60	30	20	55	100
Wind ²	0	0	0	0	0	0	2	2	1	0	0	1	0	1	2	0	2	0	2-3	2 (4)
Precipitation ³	N	N	N	N	Drizzle (light, became heavy and cancelled subsequent surveys)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	None to drizzle to rain
Temperature (°C)	9	9	5	5	6	3	10	12	12	4	4	5	3	5	5	10	7	6	11	8
Date	11-Sep-19	11-Sep-19	11-Sep-19	11-Sep-19	10-Sep-19	11-Sep-19	11-Sep-19	11-Sep-19	11-Sep-09	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	11-Sep-19	11-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	13-Sep-19
Belted Kingfisher	1																			
Black-capped Chickadee	3	2						1	2	2	2									
Cedar Waxwing								12												
Dark-eyed Junco												1					2			
Golden-crowned Kinglet										2			1				2			1
Harry Woodpecker	1	1																		
Hermit Thrush						1														
Northern Goshawk																				1
Olive-sided Flycatcher																				1
Pine Siskin	1																			
Ruby-crowned Kinglet									4											2
Sharp-shinned Hawk																				1
Song Sparrow																				1
Unid Chickadee						1														1
Unid sparrow								1												1
Unid woodpecker								1												
Yellow-Rumped Warbler									1	3							1	1		5

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None n/a = not applicable; nd = no data; N=no precipitation

Appendix B2: Migratory Bird Point Count and Transect Survey Data
Migratory Bird Transect Survey Data, April 23, 2018



Survey Point Name	MTC1-1 to MTC1-2	MTC1-2 to MTC1-3	MTC1-3 to MTC1-4	MTC1-4 to MTC1-5	MTC1-5 to MTC1-6	MTC1-6 to MTC1-7	MTC2-1 to MTC2-2
Time Start	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Time End	9:07	9:07	9:07	9:07	9:07	9:07	9:07
Ceiling ¹	N	N	N	N	N	N	N
Cloud Cover (%)	0	0	0	0	0	0	0
Wind ²	3	3	4	4	5	3	4
Precipitation ³	N	N	N	N	N	N	N
Temperature (°C)	-4	-3	-2	-2	0	1	1
Date	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18
American Robin	1	1	2	2	2	1	
Boreal Chickadee			1				
Dark-eyed Junco		3	3	1	1	1	1
Downy Woodpecker					2		
Golden-crowned Kinglet	1						
Hooded Merganser							2
Killdeer			1				
Mallard				2			
Mountain Chickadee						4	3
Northern Flicker					1	3	
Ruby-crowned Kinglet			2				
Ruffed Grouse						1	
Tree Swallow			1			1	
Unid woodpecker			1				1
Incidental Observations							
American Robin							1
Canada Goose							3
Common Raven						1	
Gadwell					2		
Mallard					10		
Northern Flicker					1	1	1
Northern Shoveler					2		
Red-winged BlackBird			1				
Ruby-crowned Kinglet	1	2					1
Sandhill Crane							1
Tree Swallow						1	
Varied Thrush			1				

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MTC1-1 to MTC1-2	MTC1-2 to MTC1-3	MTC1-3 to MTC1-4	MTC1-4 to MTC1-5	MTC1-5 to MTC1-6	MTC1-6 to MTC1-7	MTC1-1 to MTC1-2	MTC1-2 to MTC1-3	MTC1-3 to MTC1-4	MTC1-4 to MTC1-5	MTC1-5 to MTC1-6	MTC1-6 to MTC1-7
Time Start	7:40	7:40	7:40	7:40	7:40	7:40	8:06	8:06	8:06	8:06	8:06	8:06
Time End	8:25	8:25	8:25	8:25	8:25	8:25	8:50	8:50	8:50	8:50	8:50	8:50
Ceiling ¹	N	N	N	N	N	N	H	H	H	H	H	H
Cloud Cover (%)	0	0	0	0	0	0	70	70	70	70	70	70
Wind ²	0	0	0	0	0	0	0	0	0	0	0	0
Precipitation ³	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	2	2	2	2	2	2	0	0	0	0	0	0
Date	5-May-18	5-May-18	5-May-18	5-May-18	5-May-18	5-May-18	8-May-18	8-May-18	8-May-18	8-May-18	8-May-18	8-May-18
American Robin		2	5	1	4				1	2	1	
Dark-eyed Junco		1		1	1			1	1	2		4
Golden-crowned Kinglet					2	1		1	1		2	1
Hammond's Flycatcher							2	1	1		1	
Lincoln's Sparrow												1
Mountain Chickadee		1	1			1	3					
Orange-crowned Warbler	1	1	2		1	1		2	1			1
Red-breasted Sapsucker	1											
Red-naped Sapsucker										1	2	
Red-winged BlackBird					1							
Ruby-crowned Kinglet	3	2	1	1	1	3	2	1			2	
Tree Swallow				1	4	4			1	2	2	
Wilson's Warbler							1					
Yellow-Rumped Warbler					6		1	1		1		
Incidental Observations												
American Robin									1		1	
American coot				1								
Canada Goose				2								
Common Loon						1						
Dark-eyed Junco												1
Hammond's Flycatcher								1			1	1
MacGillvery's Warbler										1		
Mallard				3								
Orange-crowned Warbler			1						1		1	1
Red-breasted Nuthatch		1						1				
Red-naped Sapsucker				1								
Red-winged BlackBird				1	1	2						1
Ruby-crowned Kinglet	1	1	1			2	1	1	3		1	2
Ruffed Grouse											1	
Wilson's Snipe				1								
Yellow-Rumped Warbler								1				1

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Survey Point Name	MTC1-1-2	MTC1-2-3	MTC1-3-4	MTC1-4-5	MTC1-5-6	MTC1-6-7	MTC2-1	MTC1-1	MTC1-1 to MTC 1-2	MTC1-2	MTC1-2 to MTC1-3	MTC1-3	MTC1-3 to MTC1-4	MTC1-4	MTC1-4 to MTC1-5	MTC1-5	MTC1-5 to MTC1-6	MTC1-6	MTC6 to MTC7	MTC7
Time Start	8:00	8:00	8:00	8:00	8:00	8:00	12:48	7:07	7:09	7:18	7:20	7:27	7:30	7:37	7:40	7:49	7:51	8:01	8:04	8:11
Time End	9:07	9:07	9:07	9:07	9:07	9:07	13:00	7:09	7:18	7:20	7:27	7:30	7:37	7:40	7:49	7:51	8:01	8:04	8:11	8:13
Ceiling	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Cloud Cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind (B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Precipitation	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Temperature (°C)	-4	-3	-1	-1	0	0	10	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	1
Date	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19	9-May-19
American Robin	1		2	2	2	1				2	1		2		3			2		
Black-capped Chickadee			1																	
Brown-headed Cowbird															1	1				2
Cassin's Finch													1	1						1
Dark-eyed Junco		1	3	1	1	1	4				2	1						1		1
Downy Woodpecker					2										1					
Golden-crowned Kinglet	1							2												
Hammond's Flycatcher											2	1	1				1	1		1
Hooded Merganser							2													
Mallard				2																
Mountain Chickadee					4	3				1			2		2	1				1
Northern Flicker			1	3							1									
Pine Siskin									1	1	1		1					1		3
Red-breasted Nuthatch																1		1		1
Red-naped Sapsucker								1	1						1					
Ruby-crowned Kinglet			2					1	2	2	1		1		1	1	1	1		2
Ruffed Grouse					1															
Tree Swallow			1		1										1			1		1
Unid songbird								1												
Unid woodpecker			1				1													
Warbling Vireo									1											
White-winged Crossbill																1				

¹ Ceiling: H=High, M=Medium, L=Low, 0=None

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

³ Precipitation: N=None

n/a = not applicable; nd = no data; N=no precipitation

Station No.	Location	Date	Start	End	Cloud Cover	Wind ¹	Precipitation ²	Temperature (°C)	Species Observed	Notes
MPC01	Grave Prairie	04-Oct-18	11:04	11:14	40-60%	1	0	2.4	HAWO	-
MPC02	Grave Prairie	04-Oct-18	11:20	11:30	40-60%	1	0	2.4	RECR (2), BCCH (2), VATH (2)	-
MPC03	Grave Prairie	04-Oct-18	11:42	11:52	40-60%	1	0	4	-	No observations
MPC04	Grave Prairie	04-Oct-18	11:59	12:09	40-60%	1	0	2	-	No observations
MPC05	Grave Prairie	04-Oct-18	12:17	12:27	40-60%	1	0	5.3	CAFI (5)	-
WETLAND1	Grave Prairie	04-Oct-18	9:20	9:30	40-60%	1	0	-2	MOCH, DEJU	Frozen, 35+ cm snow cover
MTC1-1	Grave Prairie	04-Oct-18	8:12	8:22	40-60%	1	0	-5	BCCH (2), RBNU (2), RECR, GCKI	Duplicated in Transect Sheet
MCT1-2	Grave Prairie	04-Oct-18	8:31	8:41	40-60%	1	0	-5.2	RECR, CORA	
MCT1-3	Grave Prairie	04-Oct-18	8:46	8:56	40-60%	1	0	-5.2	RBNU (2), PISI (5)	
MCT1-4	Grave Prairie	04-Oct-18	9:02	9:12	40-60%	1	0	-5	BCCH (2), RBNU (2), PISI, RECR (3)	
MCT1-5	Grave Prairie	04-Oct-18	9:19	9:29	40-60%	1	0	-2.2	NOFL, MOBL, HAWO, BCCH, PISI	
MCT1-6	Grave Prairie	04-Oct-18	9:35	9:45	40-60%	1	0	-2.2	HAWO, RBNU, DOWO, MOCH, GCKI	
MCT1-END	Grave Prairie	04-Oct-18	9:51	10:01	40-60%	1	0	-2	RBNU (3), MOCH, RECR (5), PISI (10), DEJU (20), RCKI (4)	
MPC06	-	-	-	-	-	-	-	-	-	Not completed: < 250m spacing
MPC07	Grave Prairie	04-Oct-18	14:03	14:13	20-40%	2	0	2.8	MOCH (2), RECR (4), CAFI (8), CORA, AMRO	-
MPC08	Grave Prairie	04-Oct-18	14:20	14:30	20-40%	2	0	4	BCCH	-
MPC09	Grave Prairie	04-Oct-18	13:34	13:44	40-60%	2	0	5.4	CORA	-
MSW02	Alexander	05-Oct-18	9:25	9:35	80-100%	1	0	0	DEJU (2), WTSP (2)	GRJA and CLNU outside plot; no raptor stand watch, bad spot
MPC10 / MPC10A	Alexander	05-Oct-18	10:42	10:52	80-100%	1	0	1	WWCR (7), BOWA (40), BRGR, MOCH (4), BEKI, BRBL	CLNU, BRBL (female) outside plot
MPC11	Alexander	05-Oct-18	11:05	11:15	80-100%	1	0	2.1	HETH (2), WWCR, PISI (3)	WWCR (4), BEKI, BOWA, CORA outside plot
MPC12	Alexander	05-Oct-18	8:40	8:50	60-80%	1	0	-2.5	DEJU (20), YRWA (10)	VATH outside plot
MPC13	Alexander	05-Oct-18	10:04	10:14	80-100%	1	0	1.3	DEJU (3), BCCH	-
MPC13(011)	-	-	-	-	-	-	-	-	-	Not completed: < 250m spacing
MPC14	-	-	-	-	-	-	-	-	-	Not completed: < 250m spacing
MPC18	Grave Canyon	05-Oct-18	13:57	14:07	100%	1	0	3	DEJU (20), MOCH (3), AMRO (5), VATH, COHA, CORA	HOME, MALL outside plot
MPC19	Alexander	05-Oct-18	9:05	9:15	100%	1	0	-1.4	RBNU, RECR (4)	VATH, GRJA outside plot
CM01	Branch C	05-Oct-18	16:50	17:00	100%	1	0	0.6	-	RBNU, STJA outside plot; new plot (11U 661483, 5522219)

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

² Precipitation: 0=None

Appendix B3: Migratory Landbird Population Metrics
 Spring Migratory Landbird Population Metrics per Survey



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index
MPC01	2018-04-22	6	6	1.79
MPC01	2018-04-26	8	3	0.97
MPC01	2019-05-07	4	4	1.39
MPC01	2019-05-23	2	2	0.69
MPC02	2018-04-22	25	5	1.14
MPC02	2018-04-26	7	6	1.75
MPC02	2018-05-04	10	5	1.36
MPC02	2019-05-07	12	7	1.86
MPC02	2019-05-23	12	5	1.47
MPC03	2018-04-22	33	2	0.64
MPC03	2018-04-26	0	0	0.00
MPC03	2018-05-04	3	2	0.64
MPC03	2019-05-07	5	3	1.05
MPC03	2019-05-23	10	5	1.36
MPC04	2018-04-22	5	1	0.00
MPC04	2018-04-25	0	0	0.00
MPC04	2018-04-26	5	4	1.33
MPC04	2018-05-04	3	3	1.10
MPC04	2019-05-07	9	3	1.06
MPC04	2019-05-23	3	2	0.64
MPC05	2018-04-22	14	6	1.57
MPC05	2018-04-25	4	3	1.04
MPC05	2018-04-26	13	6	1.52
MPC05	2018-05-04	7	6	1.75
MPC05	2019-05-07	11	5	1.47
MPC05	2019-05-23	12	8	2.02
MPC06	2018-04-22	7	3	0.96
MPC06	2018-04-26	6	5	1.56
MPC06	2018-05-04	12	8	2.02
MPC06	2019-05-07	15	10	2.21
MPC06	2019-05-23	17	11	2.26
MPC07	2018-04-22	1	1	0.00
MPC07	2019-05-07	14	11	2.30
MPC07	2019-05-23	7	5	1.55
MPC08	2018-04-22	1	1	0.00
MPC08	2019-05-07	13	9	2.03
MPC09	2018-04-22	4	3	1.04
MPC09	2019-05-07	5	4	1.33
MPC09	2019-05-23	10	6	1.70
MPC10	2018-04-24	6	4	1.33
MPC10	2018-05-07	8	5	1.49
MPC10	2018-05-09	7	5	1.55
MPC10	2019-05-08	18	9	2.04
MPC10	2019-05-22	12	7	1.82
MPC11	2018-04-24	4	4	1.39
MPC11	2018-05-07	5	5	1.61
MPC11	2019-05-08	9	6	1.74
MPC11	2019-05-22	9	8	2.04

Appendix B3: Migratory Landbird Population Metrics
 Spring Migratory Landbird Population Metrics per Survey



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index
MPC12	2018-04-24	1	1	0.00
MPC12	2018-05-06	9	7	1.89
MPC12	2018-05-07	0	0	0.00
MPC12	2019-05-08	8	6	1.73
MPC12	2019-05-22	11	8	2.02
MPC13	2018-04-24	2	2	0.69
MPC13	2018-05-07	5	4	1.33
MPC13	2019-05-08	4	3	1.04
MPC13	2019-05-22	9	5	1.46
MPC14	2018-04-24	2	2	0.69
MPC14	2018-05-07	3	3	1.10
MPC14	2019-05-08	6	4	1.33
MPC14	2019-05-22	8	6	1.73
MPC15	2018-05-04	6	3	0.87
MPC15	2018-05-09	7	4	1.28
MPC15	2019-05-23	4	3	1.04
MPC16	2018-05-04	2	2	0.69
MPC16	2019-05-23	6	3	0.87
MPC17	2018-05-04	0	0	0.00
MPC17	2018-05-09	6	5	1.56
MPC17	2019-05-23	9	7	1.89
MPC18	2018-05-05	1	1	0.00
MPC18	2018-05-08	3	3	1.10
MPC18	2018-05-09	17	7	1.40
MPC18	2019-05-24	16	6	1.12
MPC19	2018-05-06	9	5	1.52
MPC19	2019-05-08	9	4	1.27
MPC19	2019-05-22	9	7	1.89
MPC20	2018-05-06	4	3	1.04
MPC20	2019-05-08	10	7	1.89
MPC20	2019-05-22	5	5	1.61
MPC21	2019-05-08	13	9	2.03
MPC21	2019-05-22	25	5	1.26
MPC22	2019-05-08	9	5	1.43
MPC22	2019-05-22	0	0	0.00
MPC23	2019-05-08	2	2	0.69
MPC23	2019-05-22	3	2	0.64
MTC1-1	2019-05-09	5	4	1.33
MTC1-1	2018-04-23	2	2	0.69
MTC1-1	2018-05-05	5	3	0.95
MTC1-1	2018-05-08	9	5	1.52
MTC1-1	2019-05-09	5	4	1.33
MTC1-2	2019-05-09	6	4	1.33
MTC1-2	2018-04-23	4	2	0.56
MTC1-2	2018-05-05	7	5	1.55
MTC1-2	2018-05-08	7	6	1.75
MTC1-2	2019-05-09	8	6	1.73
MTC1-3	2019-05-09	2	2	0.69

Appendix B3: Migratory Landbird Population Metrics
 Spring Migratory Landbird Population Metrics per Survey



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index
MTC1-3	2018-04-23	11	7	1.85
MTC1-3	2018-05-05	9	4	1.15
MTC1-3	2018-05-08	6	6	1.79
MTC1-3	2019-05-09	8	6	1.73
MTC1-4	2019-05-09	1	1	0.00
MTC1-4	2018-04-23	6	4	1.33
MTC1-4	2018-05-05	4	4	1.39
MTC1-4	2018-05-08	8	5	1.56
MTC1-4	2019-05-09	10	7	1.83
MTC1-5	2019-05-09	5	5	1.61
MTC1-5	2018-04-23	14	7	1.81
MTC1-5	2018-05-05	20	8	1.83
MTC1-5	2018-05-08	10	6	1.75
MTC1-5	2019-05-09	6	6	1.79
MTC1-6	2019-05-09	5	4	1.33
MTC1-6	2018-04-23	5	3	0.95
MTC1-6	2018-05-05	10	5	1.42
MTC1-6	2018-05-08	7	4	1.15
MTC1-6	2019-05-09	12	8	1.98
MTC1-7	2019-05-09	3	2	0.64
MTC2	2018-04-23	4	3	1.04

Appendix B3: Migratory Landbird Population Metrics
 Summary Statistics for Spring Migratory Landbird Population Metrics



Location	Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Shannon	Shannon StDev	Shannon SE
MPC01	4	5.0	2.6	1.3	3.8	1.7	0.9	1.21	0.48	0.24
MPC02	5	13.2	6.9	3.1	5.6	0.9	0.4	1.52	0.29	0.13
MPC03	5	10.2	13.3	5.9	2.4	1.8	0.8	0.74	0.51	0.23
MPC04	6	4.2	3.0	1.2	2.2	1.5	0.6	0.69	0.58	0.24
MPC05	6	10.2	3.9	1.6	5.7	1.6	0.7	1.56	0.33	0.13
MPC06	5	11.4	4.8	2.2	7.4	3.4	1.5	1.80	0.55	0.25
MPC07	3	7.3	6.5	3.8	5.7	5.0	2.9	1.28	1.17	0.68
MPC08	2	7.0	8.5	6.0	5.0	5.7	4.0	1.02	1.44	1.02
MPC09	3	6.3	3.2	1.9	4.3	1.5	0.9	1.36	0.33	0.19
MPC10	5	10.2	4.9	2.2	6.0	2.0	0.9	1.65	0.28	0.13
MPC11	4	6.8	2.6	1.3	5.8	1.7	0.9	1.69	0.27	0.14
MPC12	5	5.8	5.0	2.2	4.4	3.6	1.6	1.13	1.04	0.46
MPC13	4	5.0	2.9	1.5	3.5	1.3	0.6	1.13	0.34	0.17
MPC14	4	4.8	2.8	1.4	3.8	1.7	0.9	1.21	0.43	0.22
MPC15	3	5.7	1.5	0.9	3.3	0.6	0.3	1.06	0.21	0.12
MPC16	2	4.0	2.8	2.0	2.5	0.7	0.5	0.78	0.12	0.09
MPC17	3	5.0	4.6	2.6	4.0	3.6	2.1	1.15	1.01	0.58
MPC18	4	9.3	8.4	4.2	4.3	2.8	1.4	0.90	0.62	0.31
MPC19	3	9.0	0.0	0.0	5.3	1.5	0.9	1.56	0.31	0.18
MPC20	3	6.3	3.2	1.9	5.0	2.0	1.2	1.51	0.43	0.25
MPC21	2	19.0	8.5	6.0	7.0	2.8	2.0	1.65	0.55	0.39
MPC22	2	4.5	6.4	4.5	2.5	3.5	2.5	0.71	1.01	0.71
MPC23	2	2.5	0.7	0.5	2.0	0.0	0.0	0.66	0.04	0.03
MTC1-1	5	5.2	2.5	1.1	3.6	1.1	0.5	1.17	0.34	0.15
MTC1-2	5	6.4	1.5	0.7	4.6	1.7	0.7	1.38	0.49	0.22
MTC1-3	5	7.2	3.4	1.5	5.0	2.0	0.9	1.44	0.50	0.23
MTC1-4	5	5.8	3.5	1.6	4.2	2.2	1.0	1.22	0.71	0.32
MTC1-5	5	11.0	6.2	2.8	6.4	1.1	0.5	1.76	0.09	0.04
MTC1-6	5	7.8	3.1	1.4	4.8	1.9	0.9	1.37	0.39	0.17
MTC1-7	1	3.0	-	-	2.0	-	-	0.64	-	-
MTC2	1	4.0	-	-	3.0	-	-	1.04	-	-

Appendix B3: Migratory Landbird Population Metrics
 Fall Migratory Landbird Population Metrics per Survey



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index
CM01	2018-10-05	0.0	0.0	0.00
MCT1-2	2018-10-04	2.0	2.0	0.69
MCT1-3	2018-10-04	6.0	2.0	0.45
MCT1-4	2018-10-04	8.0	4.0	1.32
MCT1-5	2018-10-04	6.0	6.0	1.79
MCT1-6	2018-10-04	5.0	5.0	1.61
MCT1-END	2018-10-04	43.0	6.0	1.44
MPC01	2018-10-04	1.0	1.0	0.95
MPC01	2019-09-11	6.0	4.0	0.83
MPC02	2019-09-11	3.0	2.0	0.61
MPC02	2018-10-04	6.0	3.0	1.10
MPC03	2019-09-11	0.0	0.0	0.00
MPC03	2018-10-04	0.0	0.0	0.00
MPC04	2019-09-11	0.0	0.0	0.00
MPC04	2018-10-04	0.0	0.0	0.00
MPC05	2019-09-10	1.0	1.0	0.37
MPC05	2019-09-11	1.0	1.0	0.37
MPC05	2018-10-04	5.0	1.0	0.00
MPC06	2019-09-11	2.0	2.0	0.60
MPC07	2019-09-11	13.0	2.0	0.48
MPC07	2018-10-04	16.0	5.0	1.30
MPC08	2018-10-04	1.0	1.0	0.00
MPC09	2018-10-04	1.0	1.0	0.00
MPC09	2109-09-11	7.0	3.0	0.76
MPC10	2019-09-12	5.0	2.0	0.65
MPC10	2018-10-05	54.0	6.0	0.90
MPC11	2019-09-12	4.0	2.0	0.64
MPC11	2018-10-05	7.0	3.0	1.08
MPC12	2019-09-12	1.0	1.0	0.37
MPC12	2018-10-05	20.0	2.0	0.69
MPC13	2019-09-12	1.0	1.0	0.37
MPC13	2018-10-05	4.0	2.0	0.56
MPC14	2019-09-12	1.0	1.0	0.37
MPC15	2019-09-11	0.0	0.0	0.00
MPC18	2019-09-11	3.0	3.0	0.73
MPC18	2018-10-05	31.0	6.0	1.14
MPC19	2019-09-12	5.0	3.0	0.77
MPC19	2018-10-05	5.0	2.0	0.50
MPC20	2019-09-12	1.0	1.0	0.37
MPC23	2019-09-12	2.0	2.0	0.60
MPC25	2019-09-13	9.0	4.0	0.84
MSW02	2018-10-05	3.0	2.0	0.64
MTC1-1	2018-10-04	6.0	4.0	1.33
WETLAND1	2018-10-04	2.0	2.0	0.69

Appendix B3: Migratory Landbird Population Metrics
 Summary Statistics for Fall Migratory Landbird Population Metrics



Location	Number of Surveys	Average Abundance	Average Richness	Average Shannon	Shannon StDev	Shannon SE
CM01	1	0.0	0.0	0.00	-	-
MCT1-2	1	2.0	2.0	0.69	-	-
MCT1-3	1	6.0	2.0	0.45	-	-
MCT1-4	1	8.0	4.0	1.32	-	-
MCT1-5	1	6.0	6.0	1.79	-	-
MCT1-6	1	5.0	5.0	1.61	-	-
MCT1-END	1	43.0	6.0	1.44	-	-
MPC01	2	3.5	2.5	0.89	0.08	0.06
MPC02	2	4.5	2.5	0.85	0.35	0.25
MPC03	2	0.0	0.0	0.00	0.00	0.00
MPC04	2	0.0	0.0	0.00	0.00	0.00
MPC05	3	2.3	1.0	0.24	0.21	0.12
MPC06	1	2.0	2.0	0.60	-	-
MPC07	2	14.5	3.5	0.89	0.58	0.41
MPC08	1	1.0	1.0	0.00	-	-
MPC09	2	4.0	2.0	0.38	0.54	0.38
MPC10	1	5.0	2.0	0.65	-	-
MPC10	1	54.0	6.0	0.90	-	-
MPC11	2	5.5	2.5	0.86	0.31	0.22
MPC12	2	10.5	1.5	0.53	0.23	0.16
MPC13	2	2.5	1.5	0.46	0.14	0.10
MPC14	1	1.0	1.0	0.37	-	-
MPC15	1	0.0	0.0	0.00	-	-
MPC18	2	17.0	4.5	0.93	0.28	0.20
MPC19	2	5.0	2.5	0.64	0.19	0.14
MPC20	1	1.0	1.0	0.37	-	-
MPC23	1	2.0	2.0	0.60	-	-
MPC25	1	9.0	4.0	0.84	-	-
MSW02	1	3.0	2.0	0.64	-	-
MTC1-1	1	6.0	4.0	1.33	-	-
WETLAND1	1	2.0	2.0	0.69	-	-

Appendix B4: Migratory Landbird BEC Subzone and Land Cover Associations, 2018-2019
 Spring Migratory Landbird Population Metrics per BEC Subzone and Land Cover Type



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
MPC01	2018-04-22	6	6	1.79	MSdw	Grassland
MPC01	2018-04-26	8	3	0.97	MSdw	Grassland
MPC01	2019-05-07	4	4	1.39	MSdw	Grassland
MPC01	2019-05-23	2	2	0.69	MSdw	Grassland
MPC02	2018-04-22	25	5	1.14	MSdw	Grassland
MPC02	2018-04-26	7	6	1.75	MSdw	Grassland
MPC02	2018-05-04	10	5	1.36	MSdw	Grassland
MPC02	2019-05-07	12	7	1.86	MSdw	Grassland
MPC02	2019-05-23	12	5	1.47	MSdw	Grassland
MPC03	2018-04-22	33	2	0.64	MSdw	Grassland
MPC03	2018-04-26	0	0	0.00	MSdw	Grassland
MPC03	2018-05-04	3	2	0.64	MSdw	Grassland
MPC03	2019-05-07	5	3	1.05	MSdw	Grassland
MPC03	2019-05-23	10	5	1.36	MSdw	Grassland
MPC04	2018-04-22	5	1	0.00	MSdw	Grassland
MPC04	2018-04-25	0	0	0.00	MSdw	Grassland
MPC04	2018-04-26	5	4	1.33	MSdw	Grassland
MPC04	2018-05-04	3	3	1.10	MSdw	Grassland
MPC04	2019-05-07	9	3	1.06	MSdw	Grassland
MPC04	2019-05-23	3	2	0.64	MSdw	Grassland
MPC05	2018-04-22	14	6	1.57	MSdw	Grassland
MPC05	2018-04-25	4	3	1.04	MSdw	Grassland
MPC05	2018-04-26	13	6	1.52	MSdw	Grassland
MPC05	2018-05-04	7	6	1.75	MSdw	Grassland
MPC05	2019-05-07	11	5	1.47	MSdw	Grassland
MPC05	2019-05-23	12	8	2.02	MSdw	Grassland
MPC06	2018-04-22	7	3	0.96	MSdw	Mixed Shrub Forest
MPC06	2018-04-26	6	5	1.56	MSdw	Mixed Shrub Forest
MPC06	2018-05-04	12	8	2.02	MSdw	Mixed Shrub Forest
MPC06	2019-05-07	15	10	2.21	MSdw	Mixed Shrub Forest
MPC06	2019-05-23	17	11	2.26	MSdw	Mixed Shrub Forest
MPC07	2018-04-22	1	1	0.00	MSdw	Mixed Shrub Forest
MPC07	2019-05-07	14	11	2.30	MSdw	Mixed Shrub Forest
MPC07	2019-05-23	7	5	1.55	MSdw	Mixed Shrub Forest
MPC08	2018-04-22	1	1	0.00	MSdw	Mixed Shrub Forest
MPC08	2019-05-07	13	9	2.03	MSdw	Mixed Shrub Forest
MPC09	2018-04-22	4	3	1.04	MSdw	Forest
MPC09	2019-05-07	5	4	1.33	MSdw	Forest
MPC09	2019-05-23	10	6	1.70	MSdw	Forest
MPC10	2018-04-24	6	4	1.33	MSdw	Wetland
MPC10	2018-05-07	8	5	1.49	MSdw	Wetland
MPC10	2018-05-09	7	5	1.55	MSdw	Wetland
MPC10	2019-05-08	18	9	2.04	MSdw	Wetland
MPC10	2019-05-22	12	7	1.82	MSdw	Wetland
MPC11	2018-04-24	4	4	1.39	MSdw	Wetland
MPC11	2018-05-07	5	5	1.61	MSdw	Wetland
MPC11	2019-05-08	9	6	1.74	MSdw	Wetland

Appendix B4: Migratory Landbird BEC Subzone and Land Cover Associations, 2018-2019
 Spring Migratory Landbird Population Metrics per BEC Subzone and Land Cover Type



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
MPC11	2019-05-22	9	8	2.04	MSdw	Wetland
MPC12	2018-04-24	1	1	0.00	MSdw	Forest
MPC12	2018-05-06	9	7	1.89	MSdw	Forest
MPC12	2018-05-07	0	0	0.00	MSdw	Forest
MPC12	2019-05-08	8	6	1.73	MSdw	Forest
MPC12	2019-05-22	11	8	2.02	MSdw	Forest
MPC13	2018-04-24	2	2	0.69	MSdw	Wetland
MPC13	2018-05-07	5	4	1.33	MSdw	Wetland
MPC13	2019-05-08	4	3	1.04	MSdw	Wetland
MPC13	2019-05-22	9	5	1.46	MSdw	Wetland
MPC14	2018-04-24	2	2	0.69	MSdw	Wetland
MPC14	2018-05-07	3	3	1.10	MSdw	Wetland
MPC14	2019-05-08	6	4	1.33	MSdw	Wetland
MPC14	2019-05-22	8	6	1.73	MSdw	Wetland
MPC15	2018-05-04	6	3	0.87	MSdw	Forest
MPC15	2018-05-09	7	4	1.28	MSdw	Forest
MPC15	2019-05-23	4	3	1.04	MSdw	Forest
MPC16	2018-05-04	2	2	0.69	MSdw	Wetland
MPC16	2019-05-23	6	3	0.87	MSdw	Wetland
MPC17	2018-05-04	0	0	0.00	MSdw	Forest
MPC17	2018-05-09	6	5	1.56	MSdw	Forest
MPC17	2019-05-23	9	7	1.89	MSdw	Forest
MPC18	2018-05-05	1	1	0.00	MSdw	Wetland
MPC18	2018-05-08	3	3	1.10	MSdw	Wetland
MPC18	2018-05-09	17	7	1.40	MSdw	Wetland
MPC18	2019-05-24	16	6	1.12	MSdw	Wetland
MPC19	2018-05-06	9	5	1.52	ESSFdk1	Wetland
MPC19	2019-05-08	9	4	1.27	ESSFdk1	Wetland
MPC19	2019-05-22	9	7	1.89	ESSFdk1	Wetland
MPC20	2018-05-06	4	3	1.04	MSdw	Wetland
MPC20	2019-05-08	10	7	1.89	MSdw	Wetland
MPC20	2019-05-22	5	5	1.61	MSdw	Wetland
MPC21	2019-05-08	13	9	2.03	MSdw	Grassland
MPC21	2019-05-22	25	5	1.26	MSdw	Grassland
MPC22	2019-05-08	9	5	1.43	ESSFdk1	Forest
MPC22	2019-05-22	0	0	0.00	ESSFdk1	Forest
MPC23	2019-05-08	2	2	0.69	ESSFdk1	Avalanche
MPC23	2019-05-22	3	2	0.64	ESSFdk1	Avalanche
MTC1-1	2019-05-09	5	4	1.33	MSdw	Mixed Shrub-Forest
MTC1-1	2018-04-23	2	2	0.69	MSdw	Mixed Shrub-Forest
MTC1-1	2018-05-05	5	3	0.95	MSdw	Mixed Shrub-Forest
MTC1-1	2018-05-08	9	5	1.52	MSdw	Mixed Shrub-Forest
MTC1-1	2019-05-09	5	4	1.33	MSdw	Mixed Shrub-Forest
MTC1-2	2019-05-09	6	4	1.33	MSdw	Mixed Shrub-Forest
MTC1-2	2018-04-23	4	2	0.56	MSdw	Mixed Shrub-Forest
MTC1-2	2018-05-05	7	5	1.55	MSdw	Mixed Shrub-Forest
MTC1-2	2018-05-08	7	6	1.75	MSdw	Mixed Shrub-Forest

Appendix B4: Migratory Landbird BEC Subzone and Land Cover Associations, 2018-2019
 Spring Migratory Landbird Population Metrics per BEC Subzone and Land Cover Type



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
MTC1-2	2019-05-09	8	6	1.73	MSdw	Mixed Shrub-Forest
MTC1-3	2019-05-09	2	2	0.69	MSdw	Mixed Shrub-Forest
MTC1-3	2018-04-23	11	7	1.85	MSdw	Mixed Shrub-Forest
MTC1-3	2018-05-05	9	4	1.15	MSdw	Mixed Shrub-Forest
MTC1-3	2018-05-08	6	6	1.79	MSdw	Mixed Shrub-Forest
MTC1-3	2019-05-09	8	6	1.73	MSdw	Mixed Shrub-Forest
MTC1-4	2019-05-09	1	1	0.00	MSdw	Mixed Shrub-Forest
MTC1-4	2018-04-23	6	4	1.33	MSdw	Mixed Shrub-Forest
MTC1-4	2018-05-05	4	4	1.39	MSdw	Mixed Shrub-Forest
MTC1-4	2018-05-08	8	5	1.56	MSdw	Mixed Shrub-Forest
MTC1-4	2019-05-09	10	7	1.83	MSdw	Mixed Shrub-Forest
MTC1-5	2019-05-09	5	5	1.61	MSdw	Mixed Shrub-Forest
MTC1-5	2018-04-23	14	7	1.81	MSdw	Mixed Shrub-Forest
MTC1-5	2018-05-05	20	8	1.83	MSdw	Mixed Shrub-Forest
MTC1-5	2018-05-08	10	6	1.75	MSdw	Mixed Shrub-Forest
MTC1-5	2019-05-09	6	6	1.79	MSdw	Mixed Shrub-Forest
MTC1-6	2019-05-09	5	4	1.33	MSdw	Mixed Shrub-Forest
MTC1-6	2018-04-23	5	3	0.95	MSdw	Mixed Shrub-Forest
MTC1-6	2018-05-05	10	5	1.42	MSdw	Mixed Shrub-Forest
MTC1-6	2018-05-08	7	4	1.15	MSdw	Mixed Shrub-Forest
MTC1-6	2019-05-09	12	8	1.98	MSdw	Mixed Shrub-Forest
MTC1-7	2019-05-09	3	2	0.64	MSdw	Mixed Shrub-Forest
MTC2	2018-04-23	4	3	1.04	MSdw	Wetland

BEC Subzone and Habitat Type		Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Diversity	Diversity StDev	Diversity SE
ESSFDK1 Total		7.0	5.9	4.0	1.5	3.6	2.4	0.9	1.06	0.65	0.24
ESSFdk1	Avalanche	2.0	2.5	0.7	0.5	2.0	0.0	0.0	0.66	0.04	0.03
	Forest	2.0	4.5	6.4	4.5	2.5	3.5	2.5	0.71	1.01	0.71
	Wetland	3.0	9.0	0.0	0.0	5.3	1.5	0.9	1.56	0.31	0.18
MSdw Total		78.0	7.9	6.0	0.7	4.6	2.6	0.3	1.26	0.62	0.07
MSdw	Forest	14.0	5.7	3.6	1.0	4.1	2.6	0.7	1.17	0.72	0.19
	Grassland	28.0	9.3	7.7	1.5	4.1	2.3	0.4	1.18	0.57	0.11
	Mixed Shrub-Forest	10.0	9.3	5.7	1.8	6.4	3.9	1.2	1.49	0.89	0.28
	Wetland	26.0	7.0	4.6	0.9	4.6	2.0	0.4	1.31	0.48	0.09
Combined BEC Subzones	Avalanche	2	2.5	0.7	0.5	2.0	0.0	0.0	0.66	0.04	0.03
	Forest	16	5.6	3.8	0.9	3.9	2.6	0.7	1.11	0.74	0.18
	Grassland	28	9.3	7.7	1.5	4.1	2.3	0.4	1.18	0.57	0.11
	Mixed Shrub Forest	10	9.3	5.7	1.8	6.4	3.9	1.2	1.49	0.89	0.28
	Wetland	29	7.2	4.4	0.8	4.7	2.0	0.4	1.34	0.46	0.09

Appendix B4: Migratory Landbird BEC Subzone and Land Cover Associations, 2018-2019
 Fall Migratory Landbird Population Metrics per BEC Subzone and Land Cover Type



Location	Date	Abundance	Species Richness	Shannon-Weiner Diversity Index	BEC Subzone	Land Cover Type
CM01	2018-10-05	0.00	0.00	0.00	ESSFdk1	Forest
MPC01	2018-10-04	1.00	1.00	0.95	MSdw	Grassland
MPC01	2019-09-11	6.00	4.00	0.83	MSdw	Grassland
MPC02	2019-09-11	3.00	2.00	0.61	MSdw	Grassland
MPC02	2018-10-04	6.00	3.00	1.10	MSdw	Grassland
MPC03	2019-09-11	0.00	0.00	0.00	MSdw	Grassland
MPC03	2018-10-04	0.00	0.00	0.00	MSdw	Grassland
MPC04	2019-09-11	0.00	0.00	0.00	MSdw	Grassland
MPC04	2018-10-04	0.00	0.00	0.00	MSdw	Grassland
MPC05	2019-09-10	1.00	1.00	0.37	MSdw	Grassland
MPC05	2019-09-11	1.00	1.00	0.37	MSdw	Grassland
MPC05	2018-10-04	5.00	1.00	0.00	MSdw	Grassland
MPC06	2019-09-11	2.00	2.00	0.60	MSdw	Mixed Shrub-Forest
MPC07	2019-09-11	13.00	2.00	0.48	MSdw	Mixed Shrub-Forest
MPC07	2018-10-04	16.00	5.00	1.30	MSdw	Mixed Shrub-Forest
MPC08	2018-10-04	1.00	1.00	0.00	MSdw	Mixed Shrub-Forest
MPC09	2018-10-04	1.00	1.00	0.00	MSdw	Forest
MPC09	2019-09-11	7.00	3.00	0.76	MSdw	Forest
MPC10	2019-09-12	5.00	2.00	0.65	MSdw	Wetland
MPC10	2018-10-05	54.00	6.00	0.90	MSdw	Wetland
MPC11	2019-09-12	4.00	2.00	0.64	MSdw	Wetland
MPC11	2018-10-05	7.00	3.00	1.08	MSdw	Wetland
MPC12	2019-09-12	1.00	1.00	0.37	MSdw	Forest
MPC12	2018-10-05	20.00	2.00	0.69	MSdw	Forest
MPC13	2019-09-12	1.00	1.00	0.37	MSdw	Wetland
MPC13	2018-10-05	4.00	2.00	0.56	MSdw	Wetland
MPC14	2019-09-12	1.00	1.00	0.37	MSdw	Wetland
MPC15	2019-09-11	0.00	0.00	0.00	MSdw	Forest
MPC18	2019-09-11	3.00	3.00	0.73	MSdw	Wetland
MPC18	2018-10-05	31.00	6.00	1.14	MSdw	Wetland
MPC19	2019-09-12	5.00	3.00	0.77	ESSFdk1	Wetland
MPC19	2018-10-05	5.00	2.00	0.50	ESSFdk1	Wetland
MPC20	2019-09-12	1.00	1.00	0.37	MSdw	Wetland
MPC23	2019-09-12	2.00	2.00	0.60	ESSFdk1	Avalanche
MPC25	2019-09-13	9.00	4.00	0.84	MSdw	Wetland
MSW02	2018-10-05	3.00	2.00	0.64	ESSFdk1	Forest
WETLAND1	2018-10-04	2.00	2.00	0.69	MSdw	Wetland

BEC Subzone and Habitat Type	Number of Surveys	Average Abundance	Abundance StDev	Abundance SE	Average Richness	Richness StDev	Richness SE	Average Diversity	Diversity StDev	Diversity SE
ESSFDK1 Total	5	3.0	2.1	0.9	1.8	1.1	0.5	0.50	0.30	0.13
ESSFdk1	Avalanche	1	2.0	-	-	2.0	-	0.60	-	-
	Forest	2	1.5	2.1	1.5	1.0	1.4	1.0	0.45	0.32
	Wetland	2	5.0	0.0	0.0	2.5	0.7	0.5	0.64	0.19
MSdw Total	32	6.4	11.0	1.9	2.0	1.6	0.3	0.52	0.39	0.07
MSdw	Forest	5	5.8	8.4	3.8	1.4	1.1	0.5	0.36	0.36
	Grassland	11	2.1	2.5	0.7	1.2	1.3	0.4	0.38	0.43
	Mixed Shrub-Forest	4	8.0	7.6	3.8	2.5	1.7	0.9	0.59	0.54
	Wetland	12	10.2	16.1	4.6	2.8	1.8	0.5	0.69	0.26
Combined BEC Subzones	Avalanche	1	2.0	-	-	2.0	-	0.60	-	-
	Forest	7	4.5	7.2	2.7	1.3	1.1	0.4	0.35	0.35
	Grassland	11	2.1	2.5	0.7	1.2	1.3	0.4	0.38	0.43
	Mixed Shrub Forest	4	8.0	7.6	3.8	2.5	1.7	0.9	0.59	0.54
	Wetland	14	9.4	14.9	4.0	2.7	1.6	0.4	0.69	0.25

Appendix C

Raptor Field Data and Results

Survey Location Name	General Location	GPS Location		Habitat Notes
		x	y	
MSW01	Grave Prarie	49.844978	-114.851515	Shrub/Herb
MSW02	Alexander Creek	49.77110105	-114.7205249	Mature Forest
MSW03	Alexander Creek	49.67852649	-114.7299577	Pole/Sapling
MSW04	Grave Creek	49.84218856	-114.7957868	Young Forest
MSW05	Grave Creek	49.83408808	-114.8084756	Mature Forest
MSW06	Alexander	49.74612354	-114.7178141	Young Forest

Survey Location Name	Survey Date	Survey Start Time	Survey End Time	Temp (°c)	Wind ¹	Cloud Cover (%)	Species Observed	Life Stage	Distance (m)	Height	Behaviour	Direction
Spring Migration												
MSW01	23-Apr-18	1500	1600	13	4.5	0	Red-tailed hawk	Adult	-	-	-	-
							Bald Eagle	Adult	-	-	-	-
MSW02	24-Apr-18	1121	1221	5	4	0	Golden Eagle	-	-	-	-	-
							Red-tailed hawk	Adult	-	-	-	-
							Red-tailed hawk	Adult	-	-	-	-
MSW03	24-Apr-18	1600	1700	5	4	0	Bald Eagle	Adult	-	-	-	-
							Red-tailed hawk	Adult	-	-	-	-
							Red-tailed hawk	Adult	-	-	-	-
							Turkey Vulture	Adult	500	40	Circling	-
MSW01	04-May-18	1453	1553	15	1	0	Turkey Vulture	Adult	500	200	Circling	-
							Red-tailed hawk	Adult	500	500	Flying	-
MSW05	05-May-18	1159	1259	14	3.5	0	Golden Eagle	Adult	>5000	>1000	Circling	South
							Golden Eagle	Adult	>5000	>1000	Circling	South
							Golden Eagle	Adult	>5000	>1000	Circling	South
							Osprey	Adult	>5000	>1000	Circling	South
MSW03	06-May-18	950	1050	6	1	50	Unidentified Raptor	-	-	-	Flying	North
							Unidentified Raptor	-	-	-	Flying	East
							Unidentified Eagle	-	1000	400	Circling	West
MSW02	06-May-18	1306	1406	15	1	0	Unidentified Raptor	-	-	-	Flying	North
							Unidentified Raptor	-	-	-	Flying	North
							Golden Eagle	-	1000	1000	Flying	North
MSW05	08-May-18	1119	1319	13	1	30	Unidentified Eagle	-	-	-	-	South
							Unidentified Raptor	-	200	60	Flying	West
							Unidentified Eagle	Adult	1000	2000	Flying	North
							Bald Eagle	-	1000	500	Flying	South
MSW01	08-May-18	1530	1630	14	3.5	60	Red-tailed hawk	Adult	-	-	Circling	Southwest
							Red-tailed hawk	Adult	1000	500	Circling	East
MSW01	07-May-19	1023	1123	10	3	40	Red-tailed hawk	Adult	400	90	Flying	Northeast
							Northern Goshawk	Juvenile	200	75	Flying	Southeast
MSW05	07-May-19	1310	1410	12	4	100	Bald Eagle	Adult	2000	400	Flying	South
							Unidentified Raptor	Unknown	1000	300	Flying	West
MSW03	22-May-19	1536	1636	11	3.5	100	Red-tailed hawk	Unknown	500	500	Flying	North
MSW01	23-May-19	1619	1719	15	2	0	Unidentified Raptor	Unknown	2500	500	Flying	East
Fall Migration												
MSW04	05-Oct-18	1525	1625	1	1	90	Golden Eagle	-	-	-	Flying	-
							Cooper's Hawk	-	-	-	Flying	South
MSW05	05-Oct-18	1428	1528	1	1	90	Golden Eagle	-	-	-	Flying	-
							Golden Eagle	-	-	-	Flying	-
MSW02	12-Sep-19	1208	1308	15	3.5	30	Possible Northern Goshawk	Adult	100	20	Flying	West

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Station No.	Location	Date	Start	End	Cloud Cover	Wind ¹	Precipitation ²	Temperature (°C)	Species Observed	Notes
MRW01	Grave Prairie	04-Oct-18	14:20	15:20	20-40%	2	0	4	-	No observations
MRW02	-	-	-	-	-	-	-	-	-	Changed to MPC station, bad raptor watch location
MSW03	Alexander	05-Oct-18	11:50	12:50	80-100%	1	0	2.9	No raptor observations	RBNU (3), PISI (12), DEJU (2), GRJA (3), CORA, WWCR (5)
MRW04	Grave Canyon	05-Oct-18	15:25	16:25	80-100%	1	0	1.4	GOEA - soaring against cliff to North	TOSO, CLNU, RBNU, GCKI, VATH, WWCR; new location slightly east with better sight lines (11U, 658763, 5523440)
MRW05	Grave Canyon	05-Oct-18	14:18	15:18	80-100%	1	0	1.5	GOEA - flying high @ 160°, GOEA - coaring, circling, COHA - flying high @ 160°	CLNU, STJA, WWCR, CORA, TOSO, PISI, RBNU, VATH

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze
² Precipitation: 0=None

Appendix C1: Migratory Raptor Survey Details, 2018-2019
 Incidental Observations of Migratory Raptors, 2018-2019



Location Name	General Location	Observation Location		Year	Month	Day	Species
		x	y				
Incidental	Grave	49.876614	-114.864106	2018	April	22	Turkey Vulture
Incidental	Grave	49.876614	-114.864106	2018	April	22	Turkey Vulture
Incidental	Grave	49.876614	-114.864106	2018	April	22	Turkey Vulture
Incidental	Grave	49.876614	-114.864106	2018	April	22	Turkey Vulture
Incidental	Grave	49.876614	-114.864106	2018	April	22	Turkey Vulture
MPC08	Grave	49.844754	-114.852112	2018	April	22	Turkey Vulture
NOGO 18	Alexander Main and Lower West Alexander	49.678488	-114.729647	2018	April	24	Turkey Vulture
MPC03	Grave	49.838465	-114.865061	2018	April	26	Bald Eagle
WL13	Grave	---	---	2018	April	23	Red-tailed Hawk
WL12	Grave	---	---	2018	April	23	Red-tailed Hawk
WL1	Alexander Main and Lower West Alexander	49.654324	-114.728124	2018	April	23	Red-tailed Hawk
WL1	Alexander Main and Lower West Alexander	49.656937	-114.729098	2018	April	23	Osprey
MPC12	Alexander Main and Lower West Alexander	49.657025	-114.729043	2018	April	24	Osprey
MPC12	Alexander Main and Lower West Alexander	49.746129	-114.7161597	2018	April	24	Sharp-shinned Hawk
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2018	April	24	Red-tailed Hawk
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2018	April	24	Barred Owl
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2018	April	24	Red-tailed Hawk
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2018	April	24	Barred Owl
Incidental	Grave Prairie	49.86296849	-114.8465717	2018	April	25	Red-tailed Hawk
S14	Alexander	49.7068	-114.714	2018	May	3	Northern Goshawk
MSW05	Grave	49.83408808	-114.8084756	2018	May	8	Red-tailed Hawk
MPC01	Grave	49.84064317	-114.8648279	2018	May	4	Red-tailed Hawk
MPC01	Grave	49.84064317	-114.8648279	2018	May	4	Turkey Vulture
MPC06	Grave	49.83845941	-114.8636509	2018	May	4	Red-tailed Hawk
MPC06	Grave	49.83845941	-114.8636509	2018	May	4	American Kestrel
MPC13	Alexander Main and Lower West Alexander	49.72514351	-114.7157611	2018	May	6	Red-tailed Hawk
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2018	May	3	Osprey
WL10	Harmer	49.82989009	-114.8152091	2018	May	8	Turkey Vulture
Incidental	Grave Prairie	49.87953956	-114.8726481	2018	May	4	Red-tailed Hawk
Incidental	Grave Prairie	49.87953956	-114.8726481	2018	May	4	Turkey Vulture
Incidental	Grave Prairie	49.81841763	-114.8658015	2018	May	4	Great Horned Owl
Incidental	Grave Prairie	49.83680483	-114.865218	2018	May	4	Sharp-shinned Hawk
Incidental	Alexander Main and Lower West Alexander	49.73813259	-114.7180104	2018	May	6	Red-tailed Hawk
Incidental	Grave Prairie	49.87342164	-114.8627549	2018	May	4	Red-tailed Hawk
Incidental	Grave Prairie	49.86376332	-114.8434216	2018	May	4	Northern Harrier
Nest	Alexander Main and Lower West Alexander	49.657051	-114.729017	2018	May	3	Osprey
MPC18	Harmer	49.82916647	-114.8121814	2018	Oct	5	Cooper's Hawk
Nest	Alexander Main and Lower West Alexander	49.657051	-114.729017	2018	Sept	12	Osprey

Appendix C1: Migratory Raptor Survey Details, 2018-2019
 Incidental Observations of Migratory Raptors, 2018-2019



Location Name	General Location	Observation Location		Year	Month	Day	Species
		x	y				
MPC04	Grave	49.70683011	-114.714464	2019	May	4	Northern Goshawk
Incidental	Alexander Main and Lower West Alexander	49.76432692	-114.7196721	2019	May	21 to 25	Red-tailed Hawk
Incidental	Alexander Main and Lower West Alexander	49.77445854	-114.7252086	2019	May	21 to 25	Sharp-shinned Hawk
Incidental	Grave Prairie	49.84659947	-114.8499514	2019	May	21 to 25	Sharp-shinned Hawk
Incidental	Harmer	49.83023444	-114.8080217	2019	May	21 to 25	Red-tailed Hawk
Incidental	Harmer	49.8316456	-114.805707	2019	May	21 to 25	Red-tailed Hawk
MPC19	Alexander Main and Lower West Alexander	49.76425897	-114.7192183	2019	May	21 to 25	Red tailed Hawk
MPC23	Alexander Main and Lower West Alexander	49.77441514	-114.7241522	2019	May	21 to 25	Sharp-shinned Hawk
Incidental	Grave Prairie	49.84356964	-114.8509835	2019	May	7	Cooper's Hawk
Incidental	Grave Prairie	49.83546834	-114.8719364	2019	May	7	Peregrine Falcon
Incidental	Alexander Main and Lower West Alexander	49.74610554	-114.7179265	2019	May	8	Red-tailed Hawk
MTC1-4	Grave	49.8625064	-114.8501078	2019	may	7	Northern Harrier
Nest	Alexander Main and Lower West Alexander	49.657051	-114.729017	2019	May	8	Osprey
MPC23	Alexander Main and Lower West Alexander	49.77441514	-114.7241522	2019	Sept	12	Sharp-shinned Hawk
MPC01	Grave	49.84064317	-114.8648279	2019	Sept	11	Red tailed Hawk
MPC01	Grave	49.84064317	-114.8648279	2019	Sept	11	Sharp-shinned Hawk
MPC06	Grave	49.83845941	-114.8636509	2019	Sept	11	Merlin
MPC06	Grave	49.83845941	-114.8636509	2019	Sept	11	Osprey
MPC15	Grave Prairie	49.83091213	-114.862121	2019	Sept	11	Sharp-shinned Hawk
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2019	Sept	12	Osprey
WL1	Alexander Main and Lower West Alexander	49.65351256	-114.7286499	2019	Sept	12	Osprey
WL1	Alexander Main and Lower West Alexander	49.657051	-114.729017	2019	Sept	12	Osprey
Incidental	Grave Prairie	49.83257224	-114.8702365	2019	Sept	10	Sharp-shinned hawk
Incidental	Grave Prairie	49.83300774	-114.8710605	2019	Sept	10	Northern Harrier
Incidental	Grave Prairie	49.83318205	-114.8706773	2019	Sept	10	Northern Harrier
Incidental	Grave Prairie	49.8330426	-114.8695644	2019	Sept	10	Merlin
Incidental	Grave Prairie	49.84071962	-114.8647523	2019	Sept	10	Red-tailed Hawk
Incidental	Grave Prairie	49.84071731	-114.8647443	2019	Sept	10	Merlin
Incidental	Grave Prairie	49.83848711	-114.8636852	2019	Sept	10	Osprey
Incidental	Grave	49.83096587	-114.8618144	2019	Sept	11	Sharp-shinned hawk
Incidental	Grave	49.85742354	-114.8490265	2019	Sept	11	Red-tailed Hawk
Incidental	Grave	49.85742354	-114.8490265	2019	Sept	11	Red-tailed Hawk
Incidental	Grave	49.85742354	-114.8490265	2019	Sept	11	Red-tailed Hawk
Incidental	Grave	49.85742354	-114.8490265	2019	Sept	11	Red-tailed Hawk
Incidental	Grave	49.85742354	-114.8490265	2019	Sept	11	Red-tailed Hawk
MPC25/WL21	Deadman's Pass	49.71487	-114.691111	2019	Sept	13	Northern Goshawk
Incidental	Upper Grave	49.85697201	-114.7335512	2019	Sept	10	Northern Goshawk
Incidental	Alexander Forest Service Road	49.71008	-114.716225	2019	Sept	12	Broad-winged Hawk

Location Name	Number	Year	Month	Day	Time	End Time	Duration (Hours)	Observations	Bird Abundance	Species Richness	Temp	Wind	Cloud Cover
MSW01	1	2018	April	23	1500	1600	1	Yes	1	1	13	4.5	0
MSW01	1	2018	May	4	1414	1514	1	Yes	2	2	10	5	15
MSW01	1	2018	May	8	1431	1531	1	Yes	2	1	12	3.5	60
MSW01	1	2019	May	7	1023	1123	1	Yes	2	2	10	3	40
MSW01	1	2019	May	23	1619	1719	1	Yes	1	1	15	2	0
MSW01	1	2018	October	4	1420	1520	1	None	0	0	4	2	30
MSW01	1	2019	September	11	1728	1828	1	None	0	0	15	0	50
MSW02	2	2018	April	24	1121	1221	1	Yes	4	3	5	4	0
MSW02	2	2018	May	6	955	1055	1	Yes	3	2	6	0	0
MSW02	2	2018	May	7	1206	1306	1	None	0	0	12	2	0
MSW02	2	2019	May	7	1125	1155	0.5	None	0	0	13	3	50
MSW02	2	2019	May	22	1120	1220	1	None	0	0	11	3.5	100
MSW02	2	2018	October	5	925	935	0.17	None	0	0	0	1	0
MSW02	2	2019	September	12	1208	1308	1	Yes	1	1	15	3.5	30
MSW03	3	2018	April	24	1600	1700	1	Yes	4	3	5	4	0
MSW03	3	2018	May	6	1502	1602	1	Yes	3	2	15	0	0
MSW03	3	2019	May	22	1536	1636	1	Yes	1	1	11	3.5	100
MSW03	3	2018	October	5	1150	1250	1	None	0	0	3	1	90
MSW04	4	2018	April	15	1000	1100	1	None	0	0	3	3	0
MSW04	4	2018	May	5	1045	1145	1	None	0	0	12	3.5	0
MSW04	4	2019	May	24	1057	1157	1	None	0	0	10	0	20
MSW04	4	2018	October	5	1525	1625	1	Yes	1	1	1	1	90
MSW04	4	2019	September	10	1555	1625	0.5	None	0	0	8	1	100
MSW05	5	2018	May	5	1159	1259	1	Yes	4	2	14	3.5	0
MSW05	5	2018	May	8	1025	1125	1	Yes	4	3	12	3.5	60
MSW05	5	2019	May	7	1310	1410	1	Yes	2	2	12	4	100
MSW05	5	2019	May	23	1256	1356	1	None	0	0	15	2	0
MSW05	5	2018	October	5	1418	1518	1	Yes	3	2	2	1	90
MSW06	6	2019	May	7	1240	1340	1	None	0	0	12	4	100
MSW06	6	2019	May	22	1230	1256	0.43	None	0	0	11	3.5	100

Appendix C3: Northern Goshawk Habitat Survey Form



Dillon / Strix Northern Goshawk Habitat Assessment Form

Date: _____ Location _____ Wpt. _____ UTM _____

Surveyors: _____

Survey Type: _____

Stand (visual) Plot: (m radius: 25 50 other _____)

A. Open Understory / Sub-canopy Flyway 0 1 2 3 4

B. Canopy Cover <40% ≥ 40% (est. _____%)

C. Structural Stage 4 5 6 7

D. # of Large Diameter Trees (>40cm dbh) <10% ≥10% (est. _____%)

E. Stand Density (large trees - >25 cm dbh) 0 1 2 3 4 (est. avg. spacing: _____ m)

F. Suitable Nest Trees* (abundance) 0 1 2 3 4 (est. number _____)

G. Nest Present None observed Yes Descr.: _____

H. Goshawk Present (living or sign) None observed Yes Descr.: _____

I. Stand Height (average) <24 m >24 m (est. _____%)

J. Slope >60% <60% (31°) (_____%)

K. Aspect N E S W

L. Insularity (with > 200 m from hard edge) No Yes

M. Species composition (main trees) (i.e. relative abundance)

_____ %
 _____ %
 _____ %
 _____ %

Notes: _____

Definitions and explanations

General 0-4 Ratings: 0 = lowest/nil rating and 4=highest/greatest.

(These are subjective ratings and estimations designed to give a general, reliable but not infallible impression/assessment.)

- A. 0 = closed/no flyway; 1=closed/few spaces; 2=some spaces/flyways; 3= sparse understory/flyways present; 4=no understory/unobstructed flyways
- B. Percentage foliage/canopy cover (in contrast to open space/sky) projected onto the ground
- C. Structural Stage: 4 = pole/sapling; 5 = young forest; 6 = mature forest; 7 = old forest (see below)
- D. Large diameter trees. What percent of trees are greater than 40 cm dbh?
- E. 0 = trees sparse/far apart; 1= trees well-spaced/some large gaps; 2=trees moderately and somewhat evenly spaced; 3= trees close together; 4=trees very close together/dense
- F. 0=no large trees, branches; 1=very few large trees; 2= a few large trees; 3=large trees abundant; 4=large trees abundant or comprising majority of trees
Branch suitability of largest trees in forest. Large branches. Smaller trees with suitable nest platforms: mistletoe, multiple leaders, deformities. Trembling Aspen, Douglas-fir, spruce, Black Cottonwood (B.C.). 6-18 m. Lodgepole Pine (Wyoming).
- L. Is there some portion of the forest > 200 m from a hard edge. That is, forest is at least 400 m dia. or square.

4 Pole/Sapling

Trees >10 m tall, typically densely stocked, have overtopped shrub and herb layers; younger stands are vigorous (usually >10–15 years old); older stagnated stands (up to 100 years old) are also included; self-thinning and vertical structure not yet evident in the canopy – this often occurs by age 30 in vigorous broadleaf stands, which are generally younger than coniferous stands at the same structural stage; time since disturbance is usually <40 years for normal forest succession; up to 100+ years for dense (5000–15 000+ stems per hectare) stagnant stands.

5 Young Forest

Self-thinning has become evident and the forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the pole/sapling stage; time since disturbance is generally 40–80 years but may begin as early as age 30, depending on tree species and ecological conditions.

6 Mature Forest: Understorey re-initiation stage

Trees established after the last disturbance have matured; a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up; time since disturbance is generally 80–140 years for biogeoclimatic group A (**ESSFdk and MS**)* and 80–250 years for group B.

7 Old Forest: Old-growth stage

Old, structurally complex stands composed mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition typical, as are patchy understories; understories may include tree species uncommon in the canopy, due to inherent limitations of these species under the given conditions; time since disturbance generally >140 years for biogeoclimatic group A (**ESSFdk and MS**)* and >250 years for group B (all other BECs)*.

* and all subzones

Form development, NOGO habitat characteristics

The Northern Goshawk Habitat Assessment Form and the accompanying Definitions and Explanations were created from a review of the following primary references. Structural aspects of Northern Goshawk habitat form the basis of these forms and the subjective evaluation of habitat. These attributes were chosen because they are discernable and measurable (or at least can be readily estimated) in the field and are considered important features by various researchers. However, as Reynold et al. (2008) point out, Northern Goshawk habitat is variable, individuals will occupy areas beyond those defined by a narrow set of structural elements and we should not underestimate or discount the importance of its preys' habitat in influencing site occupancy and use. In other words, the attributes defined by the assessment form and their resultant "assessment" may suggest but not indicate ideal conditions and occupancy.

References

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Station Number	Purpose of First Survey	Date of First Survey	Location (General)	GPS Coordinates		Structural Stage Type	Overall Subjective	Flyways ²	Canopy Cover ³	Structural Stage ⁴	# of Large Diameter Trees	Stand Density ⁶	Suitable Nest tree	Nest Present ⁸	Goshawk Present ⁹	Stand Height ¹⁰	Slope ¹¹	Aspect ¹²	Insularity ¹³
				x	y														
1	Call-playback	6-Jun-14	Grave Creek	49.85180935	-114.737633	Cutblock	1.5	1	2	6	1	3	1	0	0	1	2	W	N
2	Call-playback	6-Jun-14	Grave Creek	49.85153935	-114.747371	Mature Forest	1.5	0	2	6	1	4	1	0	0	1	2	W	N
3	Call-playback	6-Jun-14	Grave Creek	49.8479	-114.774	Cut block	Habitat Assessment Survey Not Completed												
4	Call-playback	6-Jun-14	Grave Creek	49.8423	-114.796	Mature Forest	Habitat Assessment Survey Not Completed												
5	Call-playback	6-Jun-14	Grave Creek	49.839	-114.804	Mature Forest	Habitat Assessment Survey Not Completed												
6	Call-playback	6-Jun-14	Harmer	49.8251	-114.804	At Harmer reservoir	Habitat Assessment Survey Not Completed												
7	Call-playback	6-Jun-14	Grave Creek	49.8318	-114.821	Cutblock	Habitat Assessment Survey Not Completed												
8	Call-playback	6-Jun-14	Grave Prairie	49.8499	-114.841	Cutblock	4	2	1	6	1	2	2	0	0	2	2	S	N
9	Call-playback	8-Jun-14	Alexander (East fork)	49.7722	-114.715	Mature Forest	4.5	1	1	5	2	2	2	0	0	2	2	SW	Y
10	Call-playback	8-Jun-14	Grave Prairie	49.76647636	-114.719933	Mature Forest	3.5	2	1	6	2	1	2	0	0	2	2	S	N
11	Call-playback	8-Jun-14	Alexander Creek	49.74640236	-114.716236	Mature Forest	2	3	1	6	2	1	2	0	0	2	2	E	N
12	Call-playback	8-Jun-14	Alexander Creek	49.72665836	-114.717981	Mature Forest	3	2	1	6	2	2	3	0	0	2	2	E	N
13	Call-playback	8-Jun-14	Alexander Creek	49.71823736	-114.716309	Mature Forest	2	1	1	5.5	1	3	1	0	0	1	2	E	N
14	Call-playback	8-Jun-14	Alexander Creek	49.70822636	-114.716517	Mature Forest	6	3	2	6	2	2	2	0	1	2	2	SE	N
15	Call-playback	9-Jun-19	Crown Mountain	49.83877536	-114.750766	Pole Sapling	Habitat Assessment Survey Not Completed												
16	Call-playback	9-Jun-19	Alexander Creek	49.69994436	-114.716335	Pole Sapling	1	1	2	5.5	1	4	1	0	0	1	1	E	N
17	Call-playback	10-Jun-14	Alexander Creek	49.68791936	-114.721154	Pole Sapling	2	1	2	6	1	3	1	0	0	2	1	E	Y
18	Call-playback	10-Jun-14	Alexander Creek	49.67848836	-114.729647	Young Forest	5.5	1	2	6	2	2.5	3	0	0	2	2	W	Y
19	Call-playback	29-Jun-14	Black Creek	49.82403	-114.854299	Mature Forest	Habitat Assessment Survey Not Completed												
20	Call-playback	29-Jun-14	Grave Prairie	49.829254	-114.84638	Mature Forest	Habitat Assessment Survey Not Completed												
21	Call-playback	30-Jun-14	Grave Creek	49.84990036	-114.756284	Mature Forest	3	1	1	6	1	3	2	0	0	2	2	SW	N
21	Habitat	29-Jul-14																	
22	Habitat	29-Jul-18	West Alexander	49.778452	-114.722865	Mature Forest	6	2	1	6	2	3	3	0	0	2	2	NA	Y
	22	Call-playback		1-Jul-19	49.7753967														
23	Habitat	29-Jul-18	West Alexander	49.791395	-114.736586	Mature Forest	4	1	1	6	2	2	3	0	0	2	2	W	Y
24	Habitat	29-Jul-18	Alexander Creek	49.68195601	-114.720732	Mature Forest	3	1	2	6	1	3	2	0	0	2	2	NA	Y
25	Habitat	29-Jul-18	Alexander Creek	49.73440502	-114.723888	Mature Forest	4.5	2	1	6	1	2	2	0	0	2	2	NE	N
26	Habitat	29-Jul-18	Alexander Creek	49.723716	-114.718081	Mature Forest	2.5	2	1	6	1	2	1	0	0	2	2	W	Y
27	Habitat	29-Jul-18	Alexander Creek	49.71254602	-114.71619	Young Forest	3	3	1	5	1	2	1	0	0	2	2	W	N
28	Habitat	29-Jul-18	Alexander Creek	49.69652602	-114.718329		3	2.5	2	6	1	3	1	0	0	2	2	W	Y
29	Habitat	30-Jul-18	Harmer	49.81218698	-114.797075	Mature Forest	2.5	0	2	5	1	3	1	0	0	1	1	E	N
30	Habitat	30-Jul-18	Grace Prairie	49.83220699	-114.869843	Mature Forest	2	1	1	5	1	2	1	0	0	1	2	SW	Y
31	Habitat	29-Jul-18	Alexander Creek	49.758217	-114.717281	Mature Forest	4	1	1	6	1	2	1	0	0	2	2	NA	Y
32	Habitat	29-Jul-18	Alexander Creek	49.6786	-114.73		5.5	1	2	6	2	2.5	3	0	0	2	2	W	Y
33	Both	5-Jul-19	Black Creek	49.81623089	-114.866667	Mature Forest	3	3	1	6	1	0	1	0	0	1	2	W	N
34	Both	5-Jul-19	Grave Prairie	49.82862719	-114.86847	Mature Forest	4	2	1	6	1	3	2	0	0	1	2	W	N
35	Both	6-Jul-19	Alexander (East fork)	49.78916583	-114.71067	Mature Forest	6.5	2	2	6	2	2	2	0	0	2	1	N/A	N
36	Both	6-Jul-19	Alexander (East fork)	49.78403618	-114.713648	Mature Forest	3.5	1	1	6	1	3	2	0	0	1	2	N/A	N
37	Both	6-Jul-19	Alexander (East fork)	49.78085998	-114.716212	Mature Forest	6.5	2	2	6	2	2	2	0	0	2	2	N/A	N
38	Call-playback	6-Jul-19	Alexander Creek	49.73533648	-114.718524	Cutblock	Habitat Assessment Survey Not Completed												
39	Both	7-Jul-19	Grave Creek	49.850297	-114.722548	Mature Forest	4	3	1	6	2	2	2	0	0	2	1	W	N
40	Both	7-Jul-19	Harmer	49.828663	-114.811122	Mature Forest	4	2	1	6	1	2	2	0	0	1	1	N	N
41	Both	8-Jul-19	West Alexander	49.796194	-114.738825	Mature Forest	1	1	1	6	1	1	1	0	0	1	2	W	N
42	Both	9-Jul-19	Racehorse pass	49.710151	-114.669061	Pole Sapling	1	1	1	5	1	3	0	0	0	1	2	S	N
43	Both	9-Jul-19	Racehorse pass	49.71873606	-114.698762	Young Forest	3	1	2	5	1	3	1	0	0	1	2	S	N
44	Both	10-Jul-19	West Alexander	49.813896	-114.740326	Mature Forest	3	3	1	6	2	1	2	0	0	2	2	N	N

Station Number	Purpose of First Survey	Date of First Survey	Location (General)	GPS Coordinates		Structural Stage Type	Overall Subjective	Flyways ²	Canopy Cover ³	Structural Stage ⁴	# of Large Diameter Trees	Stand Density ⁶	Suitable Nest tree	Nest Present ⁸	Goshawk Present ⁹	Stand Height ¹⁰	Slope ¹¹	Aspect ¹²	Insularity ¹³
				x	y														
45	Both	10-Jul-19	West Alexander	49.6633308	-114.731791	Old Forest	2	1	2	6	1	3	2	0	0	2	2	S	N
46	Both	10-Jul-19	Alexander Creek	49.65606709	-114.734314	Mature Forest	1.5	3	1	5.5	1	1	2	0	0	1	2	W	N
47	Both	11-Jul-19	Crown Mountain	49.79717665	-114.729104	Mature Forest	1	1	1	6	1	4	1	0	0	1	1	W	Y
48	Both	11-Jul-19	Crown Mountain	49.81906886	-114.725237	Mature Forest	2.5	1	1	6	1	3	2	0	0	1	1	W	N
49	Both	11-Jul-19	Crown Mountain	49.82552981	-114.742173	Mature Forest	1.5	1	1	6	1	2	1	0	0	1	1	W	N
50	Both	11-Jul-19	West Alexander	49.821204	-114.749659	Mature Forest	6	2	2	6	2	3	2.5	0	0	2	1	E	Y
51	Both	10-Jul-19	Alexander Creek	49.668487	-114.730309	Mature Forest	5.5	2	2	6	2	2	3	0	0	2	2	E	N

¹ Overall Subjectivity Rating: 0-10 Ratings: 0 = lowest/nil rating and 10=highest/greatest.

(These are subjective ratings and estimations designed to give a general, reliable but not infallible impression/assessment.)

² Flyaways: 0 = closed/no flyway; 1=closed/few spaces; 2=some spaces/flyways; 3= sparse understory/flyways present; 4=no understory/unobstructed flyways

³ Canopy Cover: Percentage foliage/canopy cover (in contrast to open space/sky) projected onto the ground 1 for <40% and 2 for >40%;

⁴ Structural Stage: 4 = pole/sapling; 5 = young forest; 6 = mature forest; 7 = old forest

⁵ # of Large Diameter Trees (DBH>40cm): 1=<10% or 2=>10%

⁶ Stand Density: 0 = trees sparse/far apart; 1= trees well-spaced/some large gaps; 2=trees moderately and somewhat evenly spaced; 3= trees close together; 4=trees very close together/dense

⁷ Suitable Nest Tree Abundance: 0=no large trees, branches; 1=very few large trees; 2= a few large trees; 3=large trees abundant; 4=large trees abundant or comprising majority of trees

⁸ Nest Present: 0=no nests; 1=nest observed

⁹ Goshawk Present: 0 = No Goshawk observed 1 = Goshawk Observed

¹⁰ Stand Height: 1=<24m and 2=>24m

¹¹ Slope: 1=<60%; 2=>60%

¹² Aspect: N= North; S= South; E= East; W=West;

¹³ Insularity: Is there some portion of the forest > 200 m from a hard edge. That is, forest is at least 400 m dia. or square. N= No; Y=Yes
Refer to the Dillon/Strix Northern Goshawk Habitat Assessment Form in Appendix C3 for further details.

Station Number	Purpose of First Survey	Date of First Survey	Location (General)	GPS Coordinates		% Dominance of trees								Notes
				x	y	Picea Engelmannii (engelman spruce)	Abies lasiocarpa (subalpine fir)	Pinus contorta (lodgepole pine)	Picea Glauca (white spruce)	Pseudotsuga menziesii (Douglas fir)	Populus trichocarpa (black cottonwood)	Larix occidentalis (Western larch)	Populus tremuloides (trembling aspen)	
1	Call-playback	6-Jun-14	Grave Creek	49.85180935	-114.73763	50	50	-	-	-	-	-	-	West facing slope, near small headwaters stream, good view
2	Call-playback	6-Jun-14	Grave Creek	49.85153935	-114.74737	45	45	10	-	-	-	-	-	West facing slope, some large spruce to the NW
3	Call-playback	6-Jun-14	Grave Creek	49.8479	-114.774	Habitat Assessment Survey Not Completed								South facing, along Grave Creek, in the Pass, steep mountains to north and south
4	Call-playback	6-Jun-14	Grave Creek	49.8423	-114.796	Habitat Assessment Survey Not Completed								North facing, along Grave Creek, in the Pass, steep mountains to north and south
5	Call-playback	6-Jun-14	Grave Creek	49.839	-114.804	Habitat Assessment Survey Not Completed								North facing, along Grave Creek, in the Pass, steep mountains to north and south
6	Call-playback	6-Jun-14	Harmer	49.8251	-114.804	Habitat Assessment Survey Not Completed								Cut block
7	Call-playback	6-Jun-14	Grave Creek	49.8318	-114.821	Habitat Assessment Survey Not Completed								Mixed cut block, mature forest, open grassy slope, camp site
8	Call-playback	6-Jun-14	Grave Prairie	49.8499	-114.841	25	-	25	-	25	-	25	-	
9	Call-playback	8-Jun-14	Alexander (East fork)	49.7722	-114.715	47.5	47.5	-	-	-	5	-	-	
10	Call-playback	8-Jun-14	Grave Prairie	49.76647636	-114.71993	60	40	-	-	-	-	-	-	
11	Call-playback	8-Jun-14	Alexander Creek	49.74640236	-114.71624	35	-	15	-	-	15	-	35	Majority of plot flat (60%) and 40% of plot sloped at 15%
12	Call-playback	8-Jun-14	Alexander Creek	49.72665836	-114.71798	10	-	80	-	-	-	-	10	Riparian, proximity to road and clearing detract from potential value
13	Call-playback	8-Jun-14	Alexander Creek	49.71823736	-114.71631	10	-	90	-	-	-	-	-	Dense pine fur spruce stand
14	Call-playback	8-Jun-14	Alexander Creek	49.70822636	-114.71652	40	-	40	-	-	-	-	20	Spruce-fir stand on east facing slope
15	Call-playback	9-Jun-19	Crown Mountain	49.83877536	-114.75077	Habitat Assessment Survey Not Completed								
16	Call-playback	9-Jun-19	Alexander Creek	49.69994436	-114.71634	30	-	50	-	-	-	-	20	Pine spruce fir stands
17	Call-playback	10-Jun-14	Alexander Creek	49.68791936	-114.72115	50	50	-	-	-	-	-	-	Dense young pine and fir stands, value likely increases downslope, upslope area appears poorer with increased density and no flyaways
18	Call-playback	10-Jun-14	Alexander Creek	49.67848836	-114.72965	10	-	40	-	40	-	-	10	
19	Call-playback	29-Jun-14	Black Creek	49.82403	-114.8543	Habitat Assessment Survey Not Completed								Habitat data not collected
20	Call-playback	29-Jun-14	Grave Prairie	49.829254	-114.84638	Habitat Assessment Survey Not Completed								Habitat data not collected
21	Call-playback	30-Jun-14	Grave Creek	49.84990036	-114.75628	50	50	-	-	-	-	-	-	North facing slope near Grave Creek
22	Habitat	29-Jul-18	West Alexander	49.778452	-114.72286	50	50	-	-	-	-	-	-	Mature spruce fir stand on bench
23	Habitat	29-Jul-18	West Alexander	49.791395	-114.73659	50	50	-	-	-	-	-	-	Riparian bench mature to old forest
24	Habitat	29-Jul-18	Alexander Creek	49.68195601	-114.72073	70	-	10	-	-	-	-	20	Riparian bench at base of valley along Alexander Creek, near Wetlands 2 and 3
25	Habitat	29-Jul-18	Alexander Creek	49.73440502	-114.72389	5	-	-	95	-	-	-	-	East facing slope; many forestry cutblocks nearby
26	Habitat	29-Jul-18	Alexander Creek	49.723716	-114.71808	10	-	90	-	-	-	-	-	Spruce stand mature dense little understory
27	Habitat	29-Jul-18	Alexander Creek	49.71254602	-114.71619	5	-	94	-	-	-	-	-	Cut blocks saplings young pine stands
28	Habitat	29-Jul-18	Alexander Creek	49.69652602	-114.71833	20	-	20	-	-	-	-	-	
29	Habitat	30-Jul-18	Harmer	49.81218698	-114.79707	50	45	-	-	5	-	-	-	Riparian bench mixed age
30	Habitat	30-Jul-18	Grave Prairie	49.83220699	-114.86984	60	-	10	-	-	-	-	60	
31	Habitat	29-Jul-18	Alexander Creek	49.758217	-114.71728	-	95	-	-	-	5	-	-	
32	Habitat	29-Jul-18	Alexander Creek	49.6786	-114.73	10	-	40	-	40	-	-	10	

Station Number	Purpose of First Survey	Date of First Survey	Location (General)	GPS Coordinates		% Dominance of trees								Notes
				x	y	Picea Engelmannii (engelman spruce)	Abies lasiocarpa (subalpine fir)	Pinus contorta (lodgepole pine)	Picea Glauca (white spruce)	Pseudotsuga menziesii (Douglas fir)	Populus trichocarpa (black cottonwood)	Larix occidentalis (Western larch)	Populus tremuloides (trembling aspen)	
33	Both	5-Jul-19	Black Creek	49.81623089	-114.86667	10	30	-	-	-	60	-	-	Mixed forest; near creek, highly disturbed area surrounded by variable forest. Chose adjacent forest that seemed to characterize the main forest of the area (mixed deciduous-coniferous)
34	Both	5-Jul-19	Grave Prairie	49.82862719	-114.86847	40	-	-	-	-	50	-	10	Mixed forest; some cut blocks
35	Both	6-Jul-19	Alexander (East fork)	49.78916583	-114.71067	60	40	-	-	-	-	-	-	Riparian bench
36	Both	6-Jul-19	Alexander (East fork)	49.78403618	-114.71365	50	50	-	-	-	-	-	-	Riparian forest bench near river and west facing slope
37	Both	6-Jul-19	Alexander (East fork)	49.78085998	-114.71621	30	70	-	-	-	-	-	-	Riparian bench, 60% of area is flat; 40% is sloped at 30%
38	Call-playback	6-Jul-19	Alexander Creek	49.73533648	-114.71852	Habitat Assessment Survey Not Completed								Call playback conducted at separate locations; NH05 is habitat for both
39	Both	7-Jul-19	Grave Creek	49.850297	-114.72255	45	45	10	-	-	-	-	-	West facing slope
40	Both	7-Jul-19	Harmer	49.828663	-114.81112	40	60	-	-	-	-	-	-	Wetland beaver flood adjacent to west and east facing forested slopes, edge of clearing, trees scattered in groups, large openings
41	Both	8-Jul-19	West Alexander	49.796194	-114.73883	50	50	-	-	-	-	-	-	Open avalanche shoot adjacent to river and spruce stand
42	Both	9-Jul-19	Racehorse pass	49.710151	-114.66906	-	-	100	-	-	-	-	-	Pine stand; South facing slope
43	Both	9-Jul-19	Racehorse pass	49.71873606	-114.69876	-	-	80	-	-	20	-	-	Cutblocks and dense young pine spruce stands
44	Both	10-Jul-19	West Alexander	49.813896	-114.74033	37.5	57.5	5	-	-	-	-	-	Mature stand fir and spruce abundant snags
45	Both	10-Jul-19	West Alexander	49.6633308	-114.73179	60	-	-	-	20	-	-	20	Mixed aspen spruce stand west facing; dense
46	Both	10-Jul-19	Alexander Creek	49.65606709	-114.73431	20	-	26.7	-	-	26.7	-	26.7	Mixed open forest; adjacent to highway; gun club: river
47	Both	11-Jul-19	Crown Mountain	49.79717665	-114.7291	50	50	-	-	-	-	-	-	Spruce fir dense forest
48	Both	11-Jul-19	Crown Mountain	49.81906886	-114.72524	50	50	-	-	-	-	-	-	High elevation spruce fir stand; dense
49	Both	11-Jul-19	Crown Mountain	49.82552981	-114.74217	50	50	-	-	-	-	-	-	Spruce fir
50	Both	11-Jul-19	West Alexander	49.821204	-114.74966	45	45	10	-	-	-	-	-	Headwaters at foot of avalanche shoot; downstream of Wetland complex 8 along river
51	Both	10-Jul-19	Alexander Creek	49.668487	-114.73031	95	5	-	-	-	-	-	-	East side of road; west side of river; top of embankment
	Call-playback	1-Jul-19		49.7753967	-114.72497									Purpose of site was to repeat calls where NOGO2 was observed

Station Number	Purpose of First Survey	Date of First Survey	Location (General)	GPS Coordinates		% Dominance of trees							Notes
				x	y	Picea Engelmannii (engelman spruce)	Abies lasiocarpa (subalpine fir)	Pinus contorta (lodgepole pine)	Picea Glauca (white spruce)	Pseudotsuga menziesii (Douglas fir)	Populus trichocarpa (black cottonwood)	Larix occidentalis (Western larch)	

¹ Overall Subjectivity Rating: 0-10 Ratings: 0 = lowest/nil rating and 10=highest/greatest.

(These are subjective ratings and estimations designed to give a general, reliable but not infallible impression/assessment.)

² Flyaways: 0 = closed/no flyway; 1=closed/few spaces; 2=some spaces/flyways; 3= sparse understory/flyways present; 4=no understory/unobstructed flyways

³ Canopy Cover: Percentage foliage/canopy cover (in contrast to open space/sky) projected onto the ground 1 for <40% and 2 for >40%;

⁴ Structural Stage: 4 = pole/sapling; 5 = young forest; 6 = mature forest; 7 = old forest

⁵ # of Large Diameter Trees (DBH>40cm): 1=<10% or 2=>10%

⁶ Stand Density: 0 = trees sparse/far apart; 1= trees well-spaced/some large gaps; 2=trees moderately and somewhat evenly spaced; 3= trees close together; 4=trees very close together/dense

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⁸ Nest Present: 0=no nests; 1=nest observed

⁹ Goshawk Present: 0 = No Goshawk observed 1 = Goshawk Observed

¹⁰ Stand Height: 1=<24m and 2=>24m

¹¹ Slope: ¹² Aspect: N= North; S= South; E= East; W=West;

¹³ Insularity: Is there some portion of the forest > 200 m from a hard edge. That is, forest is at least 400 m dia. or square. N= No; Y=Yes

"-" = Not Observed

Refer to the Dillon/Strix Northern Goshawk Habitat Assessment Form in Section 4.2 of the report for further detail.s

Station Number	Survey Type	Date	New/Repeat Survey	Survey Start Time	Clarity	Temp (°C)	Wind ¹	Cloud Cover (%)	Call-playback Results	Notes
1	Call-playback	5-Jun-14	New	1200	Sunny	10	2	20	No Response	
1	Call-playback	6-Jun-14	Repeat	1140	Sunny	8	2	20	No Response	
2	Call-playback	6-Jun-14	New	1212	Sunny	11.5	2.5	25	No Response	
3	Call-playback	6-Jun-14	New	1234	Sunny	4	1.5	15	No Response	
4	Call-playback	6-Jun-14	New	1554	Sunny	15	2.5	15	No Response	Poor visibility (topography)
5	Call-playback	6-Jun-14	New	1307	Sunny	15	2.5	15	No Response	
6	Call-playback	6-Jun-14	New	1329	Sunny	17	2	20	No Response	
7	Call-playback	6-Jun-14	New	1353	Sunny	18	2.5	25	No Response	
8	Call-playback	6-Jun-14	New	1416	Sunny	20	1.5	5	No Response	
9	Call-playback	8-Jun-14	New	1038	Sunny	8	2	5	No Response	
10	Call-playback	8-Jun-14	New	1057	Sunny	8	2	5	No Response	
11	Call-playback	8-Jun-14	New	1251	Sunny	15	2.5	60	No Response	
12	Call-playback	8-Jun-14	New	1314	Sunny	16	3.5	75	No Response	
13	Call-playback	8-Jun-14	New	1330	Sunny	2.5	3	75	No Response	Gusts up to 6-7
14	Call-playback	8-Jun-14	New	1350	Sunny	16	3	75	NOGO1 observed	Adult; Soaring between NOGO 13 and 14 station; gusts up to 6
14	Call-playback	10-Jun-14	Repeat	1043	Overcast	10	2.5	75	No Response	No response
15	Call-playback	9-Jun-14	New	918	Overcast	8	2	95	No Response	Same location as BBS29
16	Call-playback	9-Jun-14	New	955	Sunny	8	2	25	No Response	
16	Call-playback	10-Jun-14	Repeat	1100	Sunny	10	3	80	No Response	
17	Call-playback	10-Jun-14	New	1119	Sunny	10	3	80	No Response	Gusts to 5-6
18	Call-playback	10-Jun-14	New	1138	Sunny	14	2.5	80	No Response	
19	Call-playback	29-Jun-14	New	1035	Sunny	14	2	40	No Response	
20	Call-playback	29-Jun-14	New	1058	Sunny	14	1.5	40	No Response	
21	Call-playback	30-Jun-14	New	114	Sunny	18	1.5	30	No Response	
3	Call-playback	30-Jun-14	Repeat	1417	Sunny	21	2.5	15	No Response	
4	Call-playback	30-Jun-14	Repeat	1437	Sunny	21	2	15	No Response	
5	Call-playback	30-Jun-14	Repeat	1504	Sunny	15	3.5	15	No Response	
6	Call-playback	30-Jun-14	Repeat	1520	Sunny	21	3	20	No Response	
7	Call-playback	30-Jun-14	Repeat	1536	Sunny	22	2	30	No Response	Stream is loud
21	Call-playback	1-Jul-14	Repeat	1050	Sunny	21	2	7	No Response	
18	Call-playback	1-Jul-14	Repeat	1112	Sunny	21	3.5	7	No Response	
17	Call-playback	1-Jul-14	Repeat	1125	Sunny	21	3	10	No Response	
16	Call-playback	1-Jul-14	Repeat	1139	Sunny	21	3	10	No Response	
14	Call-playback	1-Jul-14	Repeat	1145	Sunny	22	2.5	30	No Response	
13	Call-playback	1-Jul-14	Repeat	1205	Sunny	22	3	30	No Response	
12	Call-playback	1-Jul-14	Repeat	1217	Sunny	22	4	30	No Response	Gusts 5-7 near end
22	Call-playback	2-Jul-14	New	1140	Sunny	22	2	30	No Response	Only played half of response as juvenile NOGO2 was incidentally observed nearby and decided not to disturb after survey already started (half complete); walked around forest to search for possible nests - none found
1	Call-playback	3-Jul-14	Repeat	1110	Overcast	15	4.5	100	No Response	

Station Number	Survey Type	Date	New/Repeat Survey	Survey Start Time	Clarity	Temp (°C)	Wind ¹	Cloud Cover (%)	Call-playback Results	Notes
11	Call-playback	3-Jul-14	Repeat	1042	Sunny	19	2	10	No Response	
10	Call-playback	4-Jul-14	Repeat	1045	Sunny	20	3	5	No Response	
23	Call-playback	4-Jul-14	-	1111	Sunny	20	2	5	No Response	Not sure if this is the first time this survey was established or not. Suspect it's the first.
12	Call-playback	4-Jul-14	Repeat	1120	Sunny	20	5	5	No Response	Gusts to 5
13	Call-playback	4-Jul-14	Repeat	1139	Sunny	20	4	5	No Response	Gusts to 6
8	Call-playback	4-Jul-14	Repeat	1443	Sunny	23	3	5	No Response	
7	Call-playback	4-Jul-14	Repeat	1456	Sunny	23	3.5	5	No Response	
5	Call-playback	4-Jul-14	Repeat	1516	Sunny	25	3	5	No Response	
4	Call-playback	4-Jul-14	Repeat	1626	Sunny	25	4	5	No Response	
2	Call-playback	4-Jul-14	Repeat	1544	Sunny	26	4	10	No Response	
16	Call-playback	4-Jul-14	Repeat	1559	Sunny	26	4	15	No Response	
3	Call-playback	4-Jul-14	Repeat	1410	Sunny	26	4	15	No Response	Creel noisy
6	Call-playback	4-Jul-14	Repeat	1625	Sunny	26	3	10	No Response	At reservoir
12	Call-playback	5-Jul-14	Repeat	839	Sunny	9	3	10	No Response	
14	Call-playback	5-Jul-14	Repeat	855	Sunny	10	3	10	No Response	Gusts of 5
16	Call-playback	5-Jul-14	Repeat	905	Sunny	10	3	20	No Response	
17	Call-playback	5-Jul-14	Repeat	915	Sunny	12	3	30	No Response	
8	Call-playback	11-Jun-17	Repeat	1305	Mixed	17	3.5	60	No Response	Gusts to 4
18	Call-playback	5-Jul-14	Repeat	926	Sunny	13	2	45	No Response	
3	Call-playback	11-Jun-17	Repeat	919	Sunny	8	3	0	No Response	
4	Call-playback	11-Jun-17	Repeat	940	Sunny	8	2	0	No Response	
5	Call-playback	11-Jun-17	Repeat	855	Sunny	8	1	0	No Response	
6	Call-playback	11-Jun-17	Repeat	830	Sunny	8	3	0	No Response	
7	Call-playback	11-Jun-17	Repeat	826	Sunny	9	0	0	No Response	
8	Call-playback	11-Jun-17	Repeat	810	Sunny	9	0	0	No Response	
19	Call-playback	11-Jun-17	Repeat	740	Sunny	8	0	0	No Response	
20	Call-playback	11-Jun-17	Repeat	726	Sunny	8	0	0	No Response	
10	Call-playback	6-Jun-17	Repeat	1321	Overcast	22	2	100	No Response	
11	Call-playback	6-Jun-17	Repeat	1249	Overcast	20	3	100	No Response	
12	Call-playback	6-Jun-17	Repeat	1237	Overcast	20	3	100	No Response	
13	Call-playback	6-Jun-17	Repeat	1030	Overcast	14	3	100	No Response	
14	Call-playback	6-Jun-17	Repeat	1047	Overcast	14	3	100	No Response	
16	Call-playback	6-Jun-17	Repeat	1114	Overcast	15	3	100	No Response	
17	Call-playback	6-Jun-17	Repeat	1130	Overcast	15	3	100	NOGO3 observed	Adult; called 3 times; circles area; flew over spruce/pine stand to east
18	Call-playback	6-Jun-17	Repeat	1155	Overcast	20	2	100	No Response	
1	Call-playback	8-Jun-17	Repeat	951	Sunny	16	0	0	No Response	
2	Call-playback	8-Jun-17	Repeat	940	Sunny	16	0	0	No Response	11-Jun-17
16	Call-playback	8-Jun-17	Repeat	1041	Mixed	15	2.5	50	No Response	
10	Call-playback	30-Jun-17	Repeat	1343	Sunny	20	3	0	No Response	Gusts of 4 and 5
11	Call-playback	30-Jun-17	Repeat	1357	Sunny	20	3	0	No Response	Gusts of 4 and 5
12	Call-playback	30-Jun-17	Repeat	1409	Sunny	20	3	0	No Response	Gusts of 4 and 5

Station Number	Survey Type	Date	New/Repeat Survey	Survey Start Time	Clarity	Temp (°C)	Wind ¹	Cloud Cover (%)	Call-playback Results	Notes
13	Call-playback	30-Jun-17	Repeat	1420	Sunny	20	3	0	No Response	Gusts of 4 and 5
14	Call-playback	30-Jun-17	Repeat	1429	Sunny	20	3	0	No Response	Gusts of 4 and 5
16	Call-playback	30-Jun-17	Repeat	1441	Sunny	20	3	0	No Response	Gusts of 4 and 5
17	Call-playback	30-Jun-17	Repeat	-	-	-	-	-	No Response	Skipped this location as NOGO previously observed here and did not want to disturb nesting
18	Call-playback	30-Jun-17	Repeat	1506	Sunny	20	3	0	No Response	
1	Call-playback	Jul 2 2017	Repeat	1000	Sunny	11	1	0	No Response	
2	Call-playback	Jul 2 2017	Repeat	1012	Sunny	11	1	0	No Response	
16	Call-playback	Jul 2 2017	Repeat	1021	Sunny	12	1	0	No Response	
15	Call-playback	Jul 2 2017	Repeat	1100	Sunny	12	3	0	No Response	
3	Call-playback	Jul 2 2017	Repeat	1134	Sunny	13	2.5	0	No Response	
4	Call-playback	Jul 2 2017	Repeat	1144	Sunny	15	2.5	0	No Response	
5	Call-playback	Jul 2 2017	Repeat	1155	Sunny	16	1	0	No Response	
6	Call-playback	Jul 2 2017	Repeat	1211	Sunny	17	2	0	No Response	
7	Call-playback	Jul 2 2017	Repeat	1222	Sunny	17	2	0	No Response	
8	Call-playback	Jul 2 2017	Repeat	1236	Sunny	17	2	0	No Response	
20	Call-playback	Jul 2 2017	Repeat	1259	Sunny	18	2	0	No Response	
21	Call-playback	6-Jul-17	Repeat	630	Sunny	20	2	0	No Response	
23	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
25	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
8	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
24	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
31	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
32	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
9	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
30	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
22	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
26	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
27	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
28	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	

Station Number	Survey Type	Date	New/Repeat Survey	Survey Start Time	Clarity	Temp (°C)	Wind ¹	Cloud Cover (%)	Call-playback Results	Notes
29	Habitat Survey	1-Jun-18	New	-	-	-	-	-	not applicable; no calling conducted	
33	Call-playback	5-Jul-19	New	1332	Overcast	15	1	100	No Response	
34	Call-playback	5-Jul-19	New	1645	Sunny	20	2	0	No Response	
35	Call-playback	6-Jul-19	New	1035	Sunny	15	0	80	No Response	River noise; habitat survey complete
36	Call-playback	6-Jul-19	New	1204	Sunny	15	2	10	No Response	
37	Call-playback	6-Jul-19	New	1252	Sunny	17	2	0	No Response	
8	Call-playback	6-Jul-19	Repeat	1308	Mixed	21	1	50	No Response	
10	Call-playback	6-Jul-19	Repeat	1432	Sunny	24	0	50	No Response	Hhabitat survey also completed; RUHU; DEJU; PAWR
12	Call-playback	6-Jul-19	Repeat	1510	Sunny	24	3	50	No Response	Adding call playback;
11	Call-playback	6-Jul-19	Repeat	1530	Sunny	24	2	75	No Response	
11	Call-playback	6-Jul-19	New	1600	Sunny	24	2	75	No Response	
38	Call-playback	6-Jul-19	New	1556	Sunny	24	2	30	No Response	
25	Call-playback	6-Jul-19	New	1615	Sunny	24	2	30	No Response	
5	Call-playback	6-Jul-19	New	1630	Sunny	23	3	0	No Response	Thunder
39	Call-playback	7-Jul-19	New	1135	Sunny	15	2.5	30	No Response	
1	Call-playback	7-Jul-19	Repeat	1300	Sunny	15	2.5	0	No Response	
2	Call-playback	7-Jul-19	Repeat	1313	Sunny	17	3	20	No Response	
21	Call-playback	7-Jul-19	Repeat	1349	Sunny	17	3	20	No Response	Habitat added; creek loud; no birds heard
29	Call-playback	7-Jul-19	New	1520	Overcast	20	3	70	No Response	Music festival music in background
40	Call-playback	7-Jul-19	New	1550	Sunny	24	3	0	No Response	
10	Call-playback	7-Jul-19	Repeat	1620	Overcast	20	2	100	No Response	Habitat added
41	Call-playback	8-Jul-19	New	1030	Sunny	18	2	0	No Response	
23	Call-playback	8-Jul-19	Repeat	1135	Sunny	18	1	10	No Response	No birds
22	Call-playback	8-Jul-19	Repeat	1400	Mixed	20	2	50	No Response	Looks like good habitat
22B	Call-playback	8-Jul-19	Repeat	1511	Sunny	20	2	0	No Response	
42	Call-playback	9-Jul-19	New	930	Sunny	15	0	0	No Response	
43	Call-playback	9-Jul-19	New	1308	Sunny	20	3.5	0	No Response	
27	Call-playback	9-Jul-19	Repeat	1503	Sunny	25	4	0	No Response	Adding call play back
14	Call-playback	9-Jul-19	Repeat	1509	Sunny	25	4	0	NOGO7 Observed	NOGO Response; Perched, then flew away just above canopy, soaring; checked for nest trees, none found.
44	Call-playback	10-Jul-19	New	926	Overcast	15	3	100	No Response	
12	Call-playback	10-Jul-19	Repeat	1541	Overcast	15	4	100	No Response	Wind 3 with gust to 5
26	Call-playback	10-Jul-19	Repeat	1459	Overcast	15	4	100	No Response	Wind 3 with gust to 5
13	Call-playback	10-Jul-19	Repeat	1613	Overcast	15	4	100	No Response	Wind 3 with gust to 5
14	Call-playback	10-Jul-19	Repeat	1630	Overcast	15	3	100	No Response	Wind 2 with gusts of 3
16	Call-playback	10-Jul-19	Repeat	1635	Overcast	15	3	100	No Response	Wind 2 with gusts of 3
17	Call-playback	10-Jul-19	Repeat	1648	Overcast	15	3	100	No Response	Wind 2 with gusts of 3
18	Call-playback	10-Jul-19	Repeat	1602	Overcast	15	2	100	No Response	Wind 1 with gusts up to 3
45	Call-playback	10-Jul-19	New	1718	Mixed	15	2	50	No Response	
46	Call-playback	10-Jul-19	New	1635	Sunny	17	2	50	No Response	Loud traffic noise; near highway

Station Number	Survey Type	Date	New/Repeat Survey	Survey Start Time	Clarity	Temp (°C)	Wind ¹	Cloud Cover (%)	Call-playback Results	Notes
47	Call-playback	11-Jul-19	New	840	Sunny	14	3	0	No Response	Wind 2 gusts to 4
48	Call-playback	11-Jul-19	New	935	Sunny	14	3	0	No Response	Wind 3 gusts to 4
49	Call-playback	11-Jul-19	New	1002	Sunny	15	2	0	No Response	Wind 0 gusts to 3
50	Call-playback	11-Jul-19	New	1100	Overcast	15	2	70	No Response	

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Transect number	Survey Type	Location		Survey Date	Survey Start Time	Survey End Time	General Weather	Temperature (°C)	Wind ¹	Ceiling	Owl Species Observed?	Habitat Description	Structural Stage	Notes
		Easting	Northing											
OT1-1	Owl Survey	653457.6517	5520375.076	23-Apr-18	2040	2045	Overcast	5	1	High	No	Road side; small 2m wide creek; openfield(teck site); wetlands; young pine plantation; mature mixed forest	Other (lake, urban, etc.)	Noisey creek nearby
OT1-1	Owl Survey	653350.5571	5521141.52	23-Apr-18	852	857	Overcast	6	1	High	No	Road side; Mixed aspen and spruce; east facing slo	Young Forest (40-80 yrs; self thinning)	Ruffed Grouse; possible hooting?
OT1-3	Owl Survey	653224.4196	5521926.962	23-Apr-18	2110	2115	Overcast	6	1	High	No	Mature mixed standroad side	Mature Forest (80-20 yrs; developed under-story)	n/a
OT1-4	Owl Survey	653398.2061	5522611.918	23-Apr-18	2018	2023	Overcast	6	1	High	No	Grave prairie; open; shrub and grass dominated	Herb (avalanche tracks/wetlands/grasslands/floodplains/grazing)	n/a
OT1-5	Owl Survey	653623.9403	5523428.536	23-Apr-18	2026	2031	Clear with half moon	6	1	n/a	No	Grave creek bridge with clearing and then mature forest	Mature Forest (80-20 yrs; developed under-story)	n/a
OT1-6	Owl Survey	653497.6599	5524239.085	23-Apr-18	2035	2040	Clear with half moon	6	1	n/a	No	Cutblock	Shrub/Herb (10% trees + avalanche tracks/wetlands/grasslands/floodplains/grazing)	n/a
OT1-7	Owl Survey	653782.2509	5524944.111	23-Apr-18	2043	2048	Clear with half moon	6	1	n/a	No	Cutblock	Shrub/Herb (10% trees + avalanche tracks/wetlands/grasslands/floodplains/grazing)	n/a
OT1-8	Owl Survey	653888.281	5525728.639	23-Apr-18	2055	2300	Clear with half moon	6	1	n/a	No	Cutblock	Shrub/Herb (10% trees + avalanche tracks/wetlands/grasslands/floodplains/grazing)	Unid. call
OT1-9	Owl Survey	653655.8221	5526470.565	23-Apr-18	2105	2110	Clear with half moon	6	1	n/a	No	Adjacent to line creek grass/slag slopes to east riparian elk river forest mature to west	Young Forest (40-80 yrs; self thinning)	Elk nearby
OT2-1	Owl Survey	663614.334	5502844.613	24-Apr-18	752	802	clear	0	0	n/a	No	gravel parking lot	Shrub/Herb (10% trees + avalanche tracks/wetlands/grasslands/floodplains/grazing)	4min; one site only
OTS3-1	Owl Survey	664203.7673	5514898.458	25-Apr-18	1941	1946	Clear skies	-1	1	n/a	No		Mature Forest (80-20 yrs; developed under-story)	1 min silence 4 min listening
OTS3-2	Owl Survey	664262.742	5513235.187	25-Apr-18	2003	2008	Clear skies	-1	1	n/a	No	SAP	Young Forest (40-80 yrs; self thinning)	n/a
OTS3-3	Owl Survey	664400.2022	5511622.328	25-Apr-18	2033	2038	Clear skies	-1	1	n/a	No	Replanted forested	Pole/Sapling (10-15 yrs; 10 m tall; dense)	n/a
OT3-4	Owl Survey	664601.9921	5510033.181	25-Apr-18	2047	2052	Clear skies	-1	1	n/a	No		Shrub/Herb (10% trees + avalanche tracks/wetlands/grasslands/floodplains/grazing)	n/a
OTS3-5	Owl Survey	664558.5976	5508420.23	25-Apr-18	2101	2106	Clear skies	-1	1	n/a	No		Mature Forest (80-20 yrs; developed under-story)	n/a

¹ Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze; n/a = not applicable

Appendix D

Waterbird Field Data and Results

Appendix D1: Wetland Bird Survey Locations



Wetland Survey Site ID	GPS Coordinates		Primary Wetland Classification	Wetland Size (ha)	Spring Surveys		Summer Surveys		Fall Surveys		Watershed
	Eastings	Northing			No. Surveys	Survey Effort (Hours)	No. Surveys	Survey Effort (Hours)	No. Surveys	Survey Effort (Hours)	
WL1	663941	5502585	Marsh	0.55	5	1.5	7	2.71	1	0.17	Alexander Creek
WL2	664229	5505500	Fen	0.51	1	0.55	2	0.67	0	-	Alexander Creek
WL3	664310	5505768	Fen	0.76	1	0.17	2	0.25	0	-	Alexander Creek
WL4	664742	5509372	Marsh	2.12	9	3.47	7	3.17	3	2.35	Alexander Creek
WL5.1	664626	5510566	Marsh	0.41	6	1.05	2	0.42	2	0.73	Alexander Creek
WL5.2	664736	5510647	Marsh	0.59	1	0.47	2	0.67	1	0.42	Alexander Creek
WL5.3	664733	5510766	Marsh	0.14	6	0.83	3	0.92	2	0.3	Alexander Creek
WL5.4	664688	5510880	Swamp	1.92	3	0.5	0	-	0	-	Alexander Creek
WL6	664264	5514861	Marsh	0.45	3	0.67	7	1.8	2	0.8	Alexander Creek
WL6.2	664259	5514736	Shallow Water	0.02	0	-	2	0.28	1	0.47	Alexander Creek
WL8.1	661756	5521351	Marsh	0.04	0	-	5	0.32	0	-	Alexander Creek
WL8.2	661807	5521243	Shallow Water	0.55	0	-	3	0.5	0	-	Alexander Creek
WL8.3	661860	5521194	Marsh	0.03	0	-	3	0.17	0	-	Alexander Creek
WL9	657290	5521906	n/a (floodplain; secondary classification shallow water)	0.57	4	0.83	9	1.42	0	0.43	Harmer Creek
WL10	657123	5522007	Marsh	0.03	8	1.42	11	1.8	1	0.52	Harmer Creek
WL11.1	655465	5524177	Marsh	0.21	6	1.42	9	4.03	1	0.15	Grave Creek
WL11.2	655622	5524247	Shallow Water	0.88	2	0.42	3	2.18	1	0.07	Grave Creek
WL11.3	655790	5524528	Marsh	0.78	2	0.58	1	0.35	0	-	Grave Creek
WL12	655054	5525819	Transitional Marsh-Fen	2.44	5	3.1	2	1.18	0	-	Elk River
WL13	654738	5525349	Swamp	8.84	9	5.12	9	3.57	1	0.28	Elk River
WL14	654394	5521844	Marsh	4.79	3	2.12	1	-	0	-	Elk River
WL15	653981	5521570	Marsh	2.59	2	1.42	2	1	0	-	Elk River
WL16	653822	5521252	Marsh	2.44	3	2.3	3	3.28	0	-	Elk River
WL17	653864	5520896	Marsh	0.67	4	1.78	7	4.03	1	0.35	Elk River
WL18	653471	5520358	Shallow Water	0.1	2	0.32	2	0.58	3	0.67	Elk River
WL19	653953.5	5521371	Marsh	0.02	1	0.08	1	-	0	-	Elk River
WL20	654656.3	5524876	Marsh	0.61	0	-	1	0.17	0	-	Elk River
WL21	666454.3	5509468	Marsh	2.82	0	-	1	0.9	2	1.43	Alexander Creek
WL22	664602	5504023	Swamp	0.69	0	-	1	1.5	0	-	Alexander Creek
EPH103	664240.8	5515728	n/a (Floodplain)	0.02	0	-	1	-	0	-	Alexander Creek
EPH106	664964	5510133	n/a (Floodplain)	0.01	0	-	3	0.58	0	-	Alexander Creek
Total					86	30.1	112	38.5	22	9.1	-

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2018



Wetland Location	WL4.1	WL5.1	WL5.3	WL11.1	WL11.2	WL11.3	WL1	WL12	WL13	WL11.1	WL10	WL10	WL13	WL12	WL13	WL1
Date	24-Apr-18	24-Apr-18	24-Apr-18	21-Apr-18	21-Apr-18	21-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	26-Apr-18	03-May-18
Survey Start Time	847	1313	1347	1630	1645	1700	1503	921	1015	1350	1515	1113	1500	1545	1207	1400
Survey End Time	857	1323	1357	1645	1700	1715	1515	1000	1050	1400	1530	1123	1530	1615	1230	1430
Notes																
Survey Type ¹	MPC	MPC	MPC	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	0	0	0	0	0	0	100	10	10	10	10	10	10	10	0	15
Temperature (°C)	0	5	5	0	0	0	-5	5	5	5	5	5	5	8	10	15
Wind ²	1	2.5	2.5	2	2	2	2	1	1	1	1	3	3	3	1	0
Total Waterbirds Observed	0	0	0	2	0	2	5	8	22	2	4	6	150	28	18	1
American Wigeon													12	4		
Buffelhead								2				6	12	4	2	
Cinamon Teal																
Mallard								4	14				16	10	2	1
Common Merganser							2									
Harelequin Duck																
Hooded Merganser				2						2			4			
Green-winged teal							1		4		2		7	4		
Northern Pintail													2			
Northern Shoveler									2				72	6	10	
Red Head													2			
Ring-necked Duck								1	1				20		4	
Ruddy Duck																
Unid. Duck																
Sandhill Crane						2										
American Coot																
Canada Goose							2				2		1			
Spotted Sandpiper																
Sora									1							
Wilson's snipe																
Red-winged Blackbird								1					2			
	¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey ² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze															

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2018



Wetland Location	WL11.1	WL14	WL13	WL9	WL13	WL10	WL15	WL16	WL17	WL11.1	WL6	WL5.1	WL4.1	WL4.1	WL5.1	WL5.3
Date	04-May-18	04-May-18	04-May-18	05-May-18	05-May-18	05-May-18	05-May-18	05-May-18	05-May-18	05-May-18	06-May-18	06-May-18	07-May-18	07-May-18	07-May-18	07-May-18
Survey Start Time	1630	100	1700	1000	830	1105	1215	1240	1700	1130	1010	1503	1323	1330	1100	1115
Survey End Time	1640	1130	1715	1020	900	1115	1240	1300	1720	1140	1030	1530	1330	1340	1110	1126
Notes																
Survey Type ¹	WLS	MPC	WLS	MPC	WLS	WLS	WLS	WLS	WLS	WLS	MPC	WLS	MPC	MPC	MPC	MPC
Precipitation	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	60	60	60	10	20	20	40	40	50	60	40	0	10	10	10	10
Temperature (°C)	12	12	13	8	5	8	13	13	13	13	0	8	5	5	0	0
Wind ²	1	1	1	1	2	2	1	2	1	1	0	3	2	2	0	0
Total Waterbirds Observed	2	0	26	0	21	6	0	0	3	7	0	0	1	1	0	0
American Wigeon			1													
Buffelhead			1		2											
Cinamon Teal			2													
Mallard	2		4		3	2			3	4						
Common Merganser																
Harelequin Duck						2										
Hooded Merganser										2						
Green-winged teal			4													
Northern Pintail																
Northern Shoveler																
Red Head																
Ring-necked Duck			4		3											
Ruddy Duck			6													
Unid. Duck					1											
Sandhill Crane																
American Coot																
Canada Goose			3		1	2										
Spotted Sandpiper										1						
Sora					1								1			
Wilson's snipe			1		2											
Red-winged Blackbird					8									1		
	¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey ² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze															

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2018



Wetland Location	None	WL1	WL13	WL9	WL10	WL1	WL13	WL18
Date	07-May-18	07-May-18	08-May-18	08-May-18	08-May-18	09-May-18	04-Oct-18	05-Oct-18
Survey Start Time	1200	1505	900	1030	1100	800	920	1357
Survey End Time	1210	1530	1000	1040	1110	810	930	1407
Notes	Fly by over creek							
Survey Type ¹	Incidental/MPC	WLS	WLS	MPC	WLS	WLS	WLS	MPC
Precipitation	None	None	None	None	None	None	none	none
Cloud Cover (%)	10	80	10	10	30	30	50	100
Temperature (°C)	0	10	0	1	8	2	-5	3
Wind ²	1	3	1	1	2	2	1	0
Total Waterbirds Observed	1	0	33	0	10	0	0	2
American Wigeon			2					
Buffelhead			3		6			
Cinamon Teal								
Mallard	1		10		1			1
Common Merganser					1			
Harelequin Duck					2			
Hooded Merganser			1					1
Green-winged teal								
Northern Pintail			1					
Northern Shoveler								
Red Head								
Ring-necked Duck								
Ruddy Duck								
Unid. Duck								
Sandhill Crane								
American Coot			1					
Canada Goose			6					
Spotted Sandpiper								
Sora			1					
Wilson's snipe			5					
Red-winged Blackbird			3					
	¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey ² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze							

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2019



Trip	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19
Wetland Location	WL12	WL10	WL10	WL13	WL12	WL11.1	WL4.1	WL4.1	WL5.1	WL5.3	WL5.4	WL6	WL5.3	WL5.2
Date	06-May-19	06-May-19	07-May-19	07-May-19	07-May-19	07-May-19	08-May-19	08-May-19	08-May-19	08-May-19	08-May-19	08-May-19	08-May-19	08-May-19
Survey Start Time	1618	1652	1430	1500	1630	1450	737	802	836	853	914	1205	1410	1425
Survey End Time	1628	1702	1440	1630	1800	1500	747	812	837	903	924	1215	1419	1453
Notes														
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	MPC	MPC	MPC	MPC	MPC	MPC	WLS	WLS
Precipitation	None	None	Light	Light	Light	WLS	None	None	None	None	None	None	None	None
Cloud Cover (%)	50	50	100	100	100	100	50	50	50	50	50	50	50	50
Temperature (°C)	14	14	10	10	10	10	10	18	18	18	18	18	18	18
Wind ²	3	2.5	2	2	2	2	0	1	1	1	1	1	1	1
Total Waterbirds Observed	4	7	5	24	6	0	2	2	2	2	2	4	0	0
Barrow's Goldeneye		2		2										
Blue winged teal														
Buffelhead	1			6										
Mallard	1	3	3		3							2		
Green-winged teal														
Northern Shoveler				1										
Ring-necked Duck				1										
Ruddy Duck				1										
Great Blue heron														
Common loon														
American Coot	1			1	1									
Canada Goose		2	2											
Spotted Sandpiper														
Sora														
Wilson's snipe				5										
Red-winged Blackbird	1			7	2		2	2	2	2	2	2		

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2019



Trip	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Jan-19	Feb-19
Wetland Location	WL5.1	WL4.1	WL3	WL2	WL13	WL9	WL10	WL14	WL15	WL16	WL19	WL17	WL12	WL5.4
Date	08-May-19	08-May-19	08-May-19	08-May-19	09-May-19	09-May-19	09-May-19	09-May-19	09-May-19	09-May-19	09-May-19	09-May-19	09-May-19	22-May-19
Survey Start Time	1454	1522	1702	1712	826	934	950	1253	1318	1420	1500	1603	1228	637
Survey End Time	1459	1630	1712	1745	836	944	1000	1305	1418	1500	1505	1647	1245	647
Notes														
Survey Type ¹	WLS	WLS	WLS	WLS	MPC	MPC	MPC	MPC	MPC	MPC	MPC	MPC	MPC	MPC
Precipitation	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	50	50	50	50	0	0	0	0	0	0	0	0	0	90
Temperature (°C)	18	18	18	18	-1	8	8	8	14	14	16	16	16	6
Wind ²	1	1	1	1	0	1	1	1	1	1	1	1	1	0
Total Waterbirds Observed	0	0	0	0	25	1	5	1	0	0	1	2	86	0
Barrow's Goldeneye							1							
Blue winged teal														
Buffelhead					4									
Mallard					7	1	2					2	4	
Green-winged teal													7	
Northern Shoveler														
Ring-necked Duck					2									
Ruddy Duck														
Great Blue heron														
Common loon														
American Coot					2									
Canada Goose					2		2							
Spotted Sandpiper														
Sora													1	
Wilson's snipe					4			1			1			
Red-winged Blackbird					4								74	

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2019



Trip	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19
Wetland Location	WL4.1	WL4.1	WL5.1	WL5.3	WL5.4	WL6	WL4.1	WL14	WL11.1	WL11.2	WL11.3	WL13	WL17	WL17
Date	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	22-May-19	23-May-19	23-May-19	23-May-19	23-May-19	24-May-19	23-May-19	23-May-19
Survey Start Time	711	749	826	844	908	1007	1400	940	1440	1500	1510	1329	1422	1620
Survey End Time	721	759	836	854	918	1017	1430	1005	1500	1510	1530	1343	1450	1635
Notes													Very windy	
Survey Type ¹	MPC	MPC	MPC	MPC	MPC	MPC	WLS	MPC	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	90	90	85	95	95	95	90	0	0	0	0	0	0	0
Temperature (°C)	6	6	7	7	7	7	15	0	10	10	10	15	9	10
Wind ²	0	0	2	2	2	2	0	0	0	0	2	0	7	2.5
Total Waterbirds Observed	1	0	0	0	0	0	0	0	3	2	5	25	0	0
Barrow's Goldeneye														
Blue winged teal												2		
Buffelhead														
Mallard									2			13		
Green-winged teal												1		
Northern Shoveler														
Ring-necked Duck												3		
Ruddy Duck														
Great Blue heron														
Common loon											2			
American Coot											2			
Canada Goose									1					
Spotted Sandpiper														
Sora														
Wilson's snipe											1	3		
Red-winged Blackbird	1									2		3		

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2019



Trip	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Feb-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19
Wetland Location	WL16	WL18	Elk River	WL9	WL10	WL18	WL1	WL18	WL11.1	WL11.2	WL18	WL10	WL9	WL17
Date	23-May-19	23-May-19	24-May-19	24-May-19	24-May-19	24-May-19	25-May-19	10-Sep-19	10-Sep-19	10-Sep-19	10-Sep-19	10-Sep-19	10-Sep-19	10-Sep-19
Survey Start Time	1500	934	605	948	936	1728	627	826	1135	1144	1200	1254	1331	1817
Survey End Time	1618	944	605	958	946	1737	640	836	1144	1148	1220	1325	1357	1838
Notes														
Survey Type ¹	WLS	WLS	Incidental	MPC	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	None	None	None	None	None	None	None	Rain	Rain	Rain	Rain	Rain	Rain	Rain
Cloud Cover (%)	0	0	60	60	60	0	0	100	100	100	100	100	100	90
Temperature (°C)	10	2	5	5	5	10	10	5	7	7	7	9	10	11
Wind ²	2	2	0	0	0	0	0	0.5	0	0	0	0	1	0
Total Waterbirds Observed	0	0	1	0	5	0	3	0	0	0	0	2	0	0
Barrow's Goldeneye														
Blue winged teal														
Buffelhead														
Mallard												2		
Green-winged teal														
Northern Shoveler														
Ring-necked Duck														
Ruddy Duck														
Great Blue heron			1											
Common loon														
American Coot														
Canada Goose														
Spotted Sandpiper					5		1							
Sora														
Wilson's snipe														
Red-winged Blackbird							2							

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D2: Spring and Fall Wetland Bird Survey Data
 Spring and Fall Wetland Bird Survey Observation Data, 2019



Trip	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19	Apr-19
Wetland Location	WL4.1	WL5.1	WL5.3	WL6	WL6	WL6.2	WL5.3	WL5.2	WL5.1	WL21	WL4.1	WL1	WL21	WL4.1
Date	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	12-Sep-19	13-Sep-19	13-Sep-19	13-Sep-19
Survey Start Time	727	834	857	1029	1340	1437	1606	1615	1641	906	1100	740	823	1100
Survey End Time	738	844	907	1040	1417	1505	1614	1640	1715	1022	1205	750	833	1205
Notes														
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	None	None	None	None	None	None	None	None	None	None	None	Light	Light	Light
Cloud Cover (%)	40	30	30	30	30	30	30	30	30	30	95	40	40	60
Temperature (°C)	3	3	4	7	12	14	15	13	13	10	10	10	10	10
Wind ²	0	0	0	1	3	2	3	3	3	4	4	4	4	4
Total Waterbirds Observed	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Barrow's Goldeneye														
Blue winged teal														
Buffelhead														
Mallard											1			
Green-winged teal														
Northern Shoveler														
Ring-necked Duck														
Ruddy Duck														
Great Blue heron														
Common loon														
American Coot														
Canada Goose														
Spotted Sandpiper														
Sora														
Wilson's snipe														
Red-winged Blackbird														

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; MPC= Migratory Point Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D3: Spring Wetland Bird Population Metrics
 Spring Wetland Bird Population Metrics per Survey



Trip	Wetland Survey Site ID	Abundance	Species Richness	Shannon-Weiner Diversity Index
2018-1	WL1	5	3	1.05
2018-2	WL1	1	1	0.00
2018-2	WL1	0	0	0.00
2018-2	WL1	0	0	0.00
2019-2	WL1	3	2	0.64
2019-1	WL2	0	0	0.00
2019-1	WL3	0	0	0.00
2018-1	WL4.1	0	0	0.00
2018-2	WL4.1	1	1	0.00
2018-2	WL4.1	1	1	0.00
2019-1	WL4.1	2	1	0.00
2019-1	WL4.1	2	1	0.00
2019-1	WL4.1	0	0	0.00
2019-2	WL4.1	1	1	0.00
2019-2	WL4.1	0	0	0.00
2019-2	WL4.1	0	0	0.00
2018-1	WL5.1	0	0	0.00
2018-2	WL5.1	0	0	0.00
2018-2	WL5.1	0	0	0.00
2019-1	WL5.1	2	1	0.00
2019-1	WL5.1	0	0	0.00
2019-2	WL5.1	0	0	0.00
2019-1	WL5.2	0	0	0.00
2018-1	WL5.3	0	0	0.00
2018-2	WL5.3	0	0	0.00
2019-1	WL5.3	2	1	0.00
2019-1	WL5.3	0	0	0.00
2019-2	WL5.3	0	0	0.00
2019-1	WL5.4	2	1	0.00
2019-2	WL5.4	0	0	0.00
2019-2	WL5.4	0	0	0.00
2018-2	WL6	0	0	0.00
2019-1	WL6	4	2	0.69
2019-2	WL6	0	0	0.00
2018-2	WL9	0	0	0.00
2018-2	WL9	0	0	0.00
2019-1	WL9	1	1	0.00
2019-2	WL9	0	0	0.00
2018-1	WL10	4	2	0.69
2018-1	WL10	6	1	0.00
2018-2	WL10	6	3	1.10
2018-2	WL10	10	4	1.09
2019-1	WL10	7	3	1.08

Appendix D3: Spring Wetland Bird Population Metrics
 Spring Wetland Bird Population Metrics per Survey



Trip	Wetland Survey Site ID	Abundance	Species Richness	Shannon-Weiner Diversity Index
2019-1	WL10	5	2	0.67
2019-1	WL10	5	3	1.05
2019-2	WL10	5	1	0.00
2018-1	WL11.1	2	1	0.00
2018-1	WL11.1	2	1	0.00
2018-2	WL11.1	2	1	0.00
2018-2	WL11.1	7	3	0.96
2019-1	WL11.1	0	0	0.00
2019-2	WL11.1	3	2	0.64
2018-1	WL11.2	0	0	0.00
2019-2	WL11.2	2	1	0.00
2018-1	WL11.3	2	1	0.00
2019-2	WL11.3	5	3	1.05
2018-1	WL12	8	4	1.21
2018-1	WL12	28	5	1.53
2019-1	WL12	4	4	1.39
2019-1	WL12	6	3	1.01
2019-1	WL12	86	4	0.53
2018-1	WL13	22	5	1.10
2018-1	WL13	150	11	1.71
2018-1	WL13	18	4	1.15
2018-2	WL13	26	9	2.02
2018-2	WL13	21	8	1.81
2018-2	WL13	33	10	1.99
2019-1	WL13	24	8	1.77
2019-1	WL13	25	7	1.84
2019-2	WL13	25	6	1.43
2018-2	WL14	0	0	0.00
2019-1	WL14	1	1	0.00
2019-2	WL14	0	0	0.00
2018-2	WL15	0	0	0.00
2019-1	WL15	0	0	0.00
2018-2	WL16	0	0	0.00
2019-1	WL16	0	0	0.00
2019-2	WL16	0	0	0.00
2018-2	WL17	3	1	0.00
2019-1	WL17	2	1	0.00
2019-2	WL17	0	0	0.00
2019-2	WL17	0	0	0.00
2019-2	WL18	0	0	0.00
2019-2	WL18	0	0	0.00
2019-1	WL19	1	1	0.00

Appendix D3: Spring Wetland Bird Population Metrics
 Summary Statistics for Spring Wetland Bird Population Metrics



Wetland Survey Site ID	Abundance		Species Richness		Shannon-Weiner Diversity Index	
	Average	SE	Average	SE	Average	SE
WL1	1.8	1.0	1.2	0.6	0.30	0.20
WL4	0.8	0.3	0.6	0.2	0.00	0.00
WL5.1	0.3	0.3	0.2	0.2	0.00	0.00
WL5.3	0.4	0.4	0.2	0.2	0.00	0.00
WL5.4	0.7	0.7	0.3	0.3	0.00	0.00
WL6.1	1.3	1.3	0.7	0.7	0.20	0.20
WL9	0.3	0.3	0.3	0.3	0.00	0.00
WL10	6.0	0.7	2.4	0.4	0.70	0.20
WL11.1	2.7	1.0	1.3	0.4	0.30	0.20
WL11.2	1.0	1.0	0.5	0.5	0.00	0.00
WL11.3	3.5	1.5	2.0	1.0	0.50	0.50
WL12	26.4	15.5	4.0	0.3	1.10	0.20
WL13	38.2	14.0	7.6	0.8	1.60	0.10
WL14	0.3	0.3	0.3	0.3	0.00	0.00
WL17	1.3	0.8	0.5	0.3	0.00	0.00

Wetland Location	WL10	WL11.1	WL11.2	WL9	WL6	WL106	WL103	WL4.1	WL6.2	WL5.1	WL17	WL13	WL5.3	WL13	WL10	WL11.1	WL11.2	WL17	WL1
Date	04-Jun-14	05-Jun-14	05-Jun-14	06-Jun-14	07-Jun-14	07-Jun-14	07-Jun-14	08-Jun-14	08-Jun-14	11-Jun-14	29-Jun-14	29-Jun-14	02-Jul-14	03-Jul-14	03-Jul-14	03-Jul-14	03-Jul-14	03-Jul-14	04-Jul-14
Survey Start Time	745	1245	1300	550	840	1000	morning	820	1315	948	1153	1240	1330	530	1201	1218	1400	1434	1202
Survey End Time	800	1300	1315	600	855	1015	-	830	1325	958	1230	1320	1345	545	1211	1400	1430	1504	1240
Notes			Fish observed												Fish observed				Appears high in calicum; Fish observed at edge of pond
Survey Type ¹	WLS	WLS	WLS	BBS	BBS	BBS	BBS	BBS	WLS	BBS	BBS	WLS	WLS	BBS	WLS	WLS	WLS	WLS	WLS
Precipitation	None	None	None	None	None	None	None	None	None	None	None	None	None	None	Light	Light	Light	None	None
Cloud Cover (%)	40	70	70	100	0	0	0	0	0	100	40	40	0	0	100	100	100	50	0
Temperature (°c)	11	10	10	1	0	0	0	3	3	6			30	9	10	10	10	20	25
Wind ²	1	3	3	2	0	1	1	1	1	2	2	2	2	0	2.5	2.5	2.5	0	
Total Waterbirds Observed	8	0	0	0	0	0	0	0	0	0	0	14	0	5	4	0	0	0	2
Barrow's Goldeneye	2																		
Harelequin Duck	6														3				
Unid. Duck												6							
Spotted Sandpiper																			2
Sora												2		2	1				
Red-winged Blackbird												6		3					
¹ Survey Type: BBS = Breeding Bird Survey; WLS = Wetland Bird Survey; S ² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze																			

Wetland Location	WL4.1	WL106	WL6	WL5.1	WL5.3	WL5.2	WL4.1	WL13	WL10	WL11.1	WL13	WL17	WL11.1
Day	6	6	6	7	7	7	7	8	8	8	8	9	9
Survey Start Time	900	824	1330	1000	1040	1100	1214	520	735	1121	1250	1015	-
Survey End Time	915	834	1345	1015	11	1120	1340	530	748	1131	1345	1100	-
Notes													
Survey Type ¹	BBS	BBS	WLS	WLS	WLS	WLS	WLS	BBS	WLS	WLS	WLS	BBS	BBS
Precipitation	None	None	None	None	None	None	None	None	None	None	None	Light	Light
Cloud Cover (%)	0	0	0	0	0	0	0	50	50	50	50	50	50
Temperature (°c)	3	3	3	9	3	3	3	7	7	7	7	8	8
Wind ²	1	1	1	1	1	1	1	0	0	0	0	2	2
Toal Waterbirds Observed	0	1	0	0	2	0	0	6	2	0	14	0	0
American Wigeon											2		
Mallard											2		
Harlequin Duck									1				
Spotted Sandpiper		1							1				
Sora								2			2		
Wilson's snipe					1						1		
Red-winged Blackbird								4			5		
Red-windged Blackbird nest											2		
Unid bird egg, possible Wilson's snipe					1								

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Wetland Location	WL18	WL1	WL10	WL17	WL6	WL6.2	WL4.1	EPH106	WL4.1	WL6	WL10	WL17	WL13
Day	9	9	10	11	30	30	30	1	1	2	2	3	3
Survey Start Time	1115	1240	afternoon	700	1100	1128	1311	607	742	620	1440	547	941
Survey End Time	1130	1315		710	1118	1135	1330	617	752	630	1450	557	1015
Notes													
Survey Type ¹	WLS	WLS	WLS	BBS	WLS	WLS	WLS	BBS	BBS	BBS	WLS	BBS	WLS
Precipitation	Light	Light	None	Moderate	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	50	50	50	0	0	0	0	0	0	0	0	0	0
Temperature (°c)	8	15		9	20	20	20			10	20	20	30
Wind ²	2	2	3	0	0	0	0			0	0	0	0
Toal Waterbirds Observed	0	2	5	0	0		0	0	0	8	2	0	6
American Wigeon													
Mallard													
Harelequin Duck			2										
Spotted Sandpiper		1	3							1	2		
Sora										2			
Wilson's snipe													
Red-winged Blackbird		1								5			6
Red-windged Blackbird nest													
Unid bird egg, possible Wilson's snipe													

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Wetland Location	WL13	WL1	WL11.1	WL17	WL16	WL1
Day	4	6	6	25	25	28
Survey Start Time	600	705	1630	1200	1036	745
Survey End Time	610	745	1700	1230	1150	820
Notes						
Survey Type ¹	BBS	WLS	WLS	WLS	WLS	RWS
Precipitation	None	None	None	None	None	None
Cloud Cover (%)	0	0	0	0	0	0
Temperature (°c)	10	10	10	30	30	30
Wind ²	0	0	0	0	0	0
Toal Waterbirds Observed	0	8	0	0	0	2
American Wigeon						
Mallard						1
Harelequin Duck						
Spotted Sandpiper		8				1
Sora						
Wilson's snipe						
Red-winged Blackbird						
Red-windged Blackbird nest						
Unid bird egg, possible Wilson's snipe						

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D4: Summer Wetland Bird Survey Data
 Summer Wetland Bird Survey Observation Data, 2018



Wetland Location	WL10	WL10	WL10	WL13	WL9	WL10	WL11.1	WL6	WL1	WL10	WL8.1	WL8.1	WL8.3	WL14	WL15	WL16	WL19	WL4.1
Date	30-Jun-18	1-Jul-18	1-Jul-18	1-Jul-18	2-Jul-18	2-Jul-18	2-Jul-18	3-Jul-18	3-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	4-Jul-18	5-Jul-18
Start Time	2100	830	1500	1530	1400	1410	1530	1215	1600	845	-	-	-	-	-	-	-	1720
End Time	2110	840	1510	1600	1410	1420	1540	1230	1615	855	-	-	-	-	-	-	-	1740
Notes																		
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	-	-	None	None	-	-	-	-	Light	-	-	-	-	-	-	-	-	None
Cloud Cover (%)	-	-	50	50	-	-	-	-	100	-	-	-	-	-	-	-	-	0
Temperature (°c)	-	-	18	18	-	-	-	-	11	-	-	-	-	-	-	-	-	25
Wind ²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Toal Waterbirds Observed	2	10	5	2	1	0	1	1	11	11	0	2	0	0	0	0	1	0
Mallard		6	5							9								
Harelequin Duck	2																	
Hooded Merganser		1										1						
Unid. Duck																		
American Coot																		
Solitary Sandpiper																		
Spotted Sandpiper		3			1			1	10	2		1						
Sora				1														
Wilson's snipe																	1	
Red-winged Blackbird				1			1											
Red-windged Blackbird nest									1									

¹ Survey Type: BBS = Breeding Bird Survey, WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D4: Summer Wetland Bird Survey Data
 Summer Wetland Bird Survey Observation Data, 2018



Wetland Location	WL1	WL9	WL8.1	WL8.2	WL8.3	WL9	WL6	WL9	WL9	WL11.1	WL2	WL3	WL13	WL9	WL1
Date	6-Jul-18	26-Jul-18	26-Jul-18	26-Jul-18	26-Jul-18	26-Jul-18	27-Jul-18	28-Jul-18	28-Jul-18	28-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18
Start Time	-	830				1750	1617	900	1914	1930			908		
End Time	-	840				1800	1627	910	1924	1940			918		
Notes															
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	-	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Cloud Cover (%)	-	-	-	-	-	-	-	0	0	0	0	0	0	-	-
Temperature (°c)	-	-	-	-	-	-	-	14	14	14	14	14	10	-	-
Wind ²	-	-	-	-	-	-	-	0	0	0	0	0	0	-	-
Toal Waterbirds Observed	5	17	1	2	0	8	3	6	13	1	0	0	14	8	2
Mallard		9							9				9	8	
Harelequin Duck															
Hooded Merganser		3				3		3	3						
Unid. Duck													3		
American Coot													2		
Solitary Sandpiper	1														
Spotted Sandpiper	3	5	1	2		5	3	3	1	1					2
Sora															
Wilson's snipe															
Red-winged Blackbird															
Red-windged Blackbird nest	1														

¹ Survey Type: BBS = Breeding Bird Survey, WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D4: Summer Wetland Bird Survey Data
 Summer Wetland Bird Survey Observation Data, 2019



Wetland Location	WL9	WL10	WL11.1	WL11.2	WL11.3	WL13	WL12	WL16	WL15	WL17	WL18	WL6	WL20	WL9	WL11.1	WL12
Date	04-Jul-19	04-Jul-19	04-Jul-19	04-Jul-19	04-Jul-19	04-Jul-19	04-Jul-19	05-Jul-19	05-Jul-19	05-Jul-19	05-Jul-19	06-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19	07-Jul-19
Survey Start Time	847	906	1003	1055	1224	1410	1642	727	940	1210	1500	1435	640	1615	1515	1650
Survey End Time	857	916	1053	1221	1245	1420	1743	930	1040	1330	1520	1500	650	1630	1530	1700
Notes							Found 1 dead mallard duckling									
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS	WLS
Precipitation	Light	Light	Light	Light	Light	Heavy	Heavy	rain	rain	rain	rain	none	none	none	none	none
Cloud Cover (%)	100	100	100	100	100	100	100	10	10	10	10	15	100	100	100	100
Temperature (°c)	5	5	5	5	5	5	5	6	8	10	12	12	10	15	15	15
Wind ²	2	2	2	2	2	4	4	1	1	2	0	2	2	3	3	3
Toal Waterbirds Observed	0	3	4	4	4	2	13	0	1	0	0	0	0	8	2	3
Barrow's Goldeneye		1														
Buffelhead																
Mallard							1							7	2	
Common Merganser			4													
Hooded Merganser																
Unid. Duck					1											
Common loon					1											
Solitary Sandpiper														1		
Spotted Sandpiper		2														
Wilson's snipe				1	2				1							
Red-winged Blackbird				3		2	12									3

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D4: Summer Wetland Bird Survey Data
 Summer Wetland Bird Survey Observation Data, 2019



Wetland Location	WL5.2	WL5.3	WL21	WL4.1	WL2	WL3	WL22	WL8.1	WL8.2	WL8.3	WL8.1	WL8.2
Date	08-Jul-19	08-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	10-Jul-19	10-Jul-19	10-Jul-19	11-Jul-19	11-Jul-19
Survey Start Time	1650	1730	1106	1330	1630	1715	1315	730	730	730	1034	1040
Survey End Time	1710	1750	1200	1400	1710	1730	1445	740	740	740	1043	1100
Notes												
Survey Type ¹	WLS	WLS	WLS	WLS	WLS	WLS	WLS	BBS	BBS	BBS	WLS	WLS
Precipitation	none	none	none	none	none	none	light	light	light	light	none	none
Cloud Cover (%)	0	0	0	0	0	0	0	100	100	100	0	0
Temperature (°c)	15	15	15	15	15	15	10	8	8	8	10	10
Wind ²	3	3	3	3	3	1	3	1	1	1	4	4
Toal Waterbirds Observed	1	2	0	0	0	0	0	0	0	0	0	0
Barrow's Goldeneye												
Buffelhead		1										
Mallard												
Common Merganser												
Hooded Merganser	1	1										
Unid. Duck												
Common loon												
Solitary Sandpiper												
Spotted Sandpiper												
Wilson's snipe												
Red-winged Blackbird												

¹ Survey Type: BBS = Breeding Bird Survey; WLS= Wetland Bird Survey; RWS=River Walk Survey

² Beaufort Scale: 0 - Calm - Smoke rises vertically; 1 - Light air; 2 - Light breeze; 3 - Gentle breeze; 4 - Moderate breeze; 5 - Fresh breeze

Appendix D5: Summer Wetland Bird Population Metrics
 Summer Wetland Bird Population Metrics per Survey



Trip	Wetland Survey Site ID	Abundance	Species Richness	Shannon-Weiner Diversity Index
2014-2	WL1	2	1	0.00
2017-1	WL1	2	2	0.69
2017-2	WL1	8	1	0.00
2017-3	WL1	2	2	0.69
2018-3	WL1	10	1	0.00
2018-3	WL1	4	2	0.56
2018-4	WL1	2	1	0.00
2018-4	WL2	0	0	0.00
2019-3	WL2	0	0	0.00
2018-4	WL3	0	0	0.00
2019-3	WL3	0	0	0.00
2014-1	WL4.1	0	0	0.00
2017-1	WL4.1	0	0	0.00
2017-1	WL4.1	0	0	0.00
2017-2	WL4.1	0	0	0.00
2017-2	WL4.1	0	0	0.00
2018-3	WL4.1	0	0	0.00
2019-3	WL4.1	0	0	0.00
2014-1	WL5.1	0	0	0.00
2017-1	WL5.1	0	0	0.00
2017-1	WL5.2	0	0	0.00
2019-3	WL5.2	1	1	0.00
2014-2	WL5.3	0	0	0.00
2017-1	WL5.3	1	1	0.00
2019-3	WL5.3	2	2	0.69
2014-1	WL6	0	0	0.00
2017-1	WL6	0	0	0.00
2017-2	WL6	0	0	0.00
2017-2	WL6	8	3	0.90
2018-3	WL6	1	1	0.00
2018-4	WL6	3	1	0.00
2019-3	WL6	0	0	0.00
2014-1	WL6.2	0	0	0.00
2017-2	WL6.2	0	0	0.00
2018-3	WL8.1	0	0	0.00
2018-3	WL8.1	2	2	0.69
2018-4	WL8.1	1	1	0.00
2019-3	WL8.1	0	0	0.00
2019-3	WL8.1	0	0	0.00
2018-4	WL8.2	2	1	0.00
2019-3	WL8.2	0	0	0.00
2019-3	WL8.2	0	0	0.00

Appendix D5: Summer Wetland Bird Population Metrics
 Summer Wetland Bird Population Metrics per Survey



Trip	Wetland Survey Site ID	Abundance	Species Richness	Shannon-Weiner Diversity Index
2018-3	WL8.3	0	0	0.00
2018-4	WL8.3	0	0	0.00
2019-3	WL8.3	0	0	0.00
2014-1	WL9	0	0	0.00
2018-3	WL9	1	1	0.00
2018-4	WL9	17	3	1.00
2018-4	WL9	8	2	0.66
2018-4	WL9	6	2	0.69
2018-4	WL9	13	3	0.79
2018-4	WL9	8	1	0.00
2019-3	WL9	0	0	0.00
2019-3	WL9	8	2	0.38
2014-1	WL10	8	2	0.56
2014-2	WL10	4	2	0.56
2017-1	WL10	2	2	0.69
2017-1	WL10	5	2	0.67
2017-2	WL10	2	1	0.00
2018-3	WL10	2	1	0.00
2018-3	WL10	10	3	0.90
2018-3	WL10	5	1	0.00
2018-3	WL10	0	0	0.00
2018-3	WL10	11	2	0.47
2019-3	WL10	3	2	0.64
2014-1	WL11.1	0	0	0.00
2014-2	WL11.1	0	0	0.00
2017-1	WL11.1	0	0	0.00
2017-1	WL11.1	0	0	0.00
2017-2	WL11.1	0	0	0.00
2018-3	WL11.1	1	1	0.00
2018-4	WL11.1	1	1	0.00
2019-3	WL11.1	4	1	0.00
2019-3	WL11.1	2	1	0.00
2014-1	WL11.2	0	0	0.00
2014-2	WL11.2	0	0	0.00
2019-3	WL11.2	4	2	0.56
2019-3	WL11.3	4	3	1.04
2019-3	WL12	13	2	0.27
2019-3	WL12	3	1	0.00
2014-2	WL13	14	3	1.00
2014-2	WL13	5	2	0.67
2017-1	WL13	6	2	0.64
2017-1	WL13	12	5	1.47

Appendix D5: Summer Wetland Bird Population Metrics
 Summer Wetland Bird Population Metrics per Survey



Trip	Wetland Survey Site ID	Abundance	Species Richness	Shannon-Weiner Diversity Index
2017-2	WL13	6	1	0.00
2017-2	WL13	0	0	0.00
2018-3	WL13	2	2	0.69
2018-4	WL13	14	3	0.89
2019-3	WL13	2	1	0.00
2018-3	WL14	0	0	0.00
2018-3	WL15	0	0	0.00
2019-3	WL15	1	1	0.00
2017-3	WL16	0	0	0.00
2018-3	WL16	0	0	0.00
2019-3	WL16	0	0	0.00
2014-2	WL17	0	0	0.00
2014-2	WL17	0	0	0.00
2017-1	WL17	0	0	0.00
2017-1	WL17	0	0	0.00
2017-2	WL17	0	0	0.00
2017-3	WL17	0	0	0.00
2019-3	WL17	0	0	0.00
2017-1	WL18	0	0	0.00
2019-3	WL18	0	0	0.00
2018-3	WL19	1	1	0.00
2019-3	WL20	0	0	0.00
2019-3	WL21	0	0	0.00
2019-3	WL22	0	0	0.00
2014-1	EPH103	0	0	0.00
2014-1	EPH106	0	0	0.00
2017-1	EPH106	1	1	0.00
2017-2	EPH106	0	0	0.00

Appendix D5: Summer Wetland Bird Population Metrics
 Summer Wetland Bird Population Metrics per Survey



Wetland Survey Site ID	Abundance		Species Richness		Shannon-Weiner Diversity Index	
	Average	SE	Average	SE	Average	SE
WL1	4.3	1.3	1.4	0.2	0.28	0.13
WL5.2	0.5	0.5	0.5	0.5	0.00	0.00
WL5.3	1.0	0.6	1.0	0.6	0.23	0.23
WL6.1	1.7	1.1	0.7	0.4	0.13	0.13
WL8.1	0.6	0.4	0.6	0.4	0.14	0.14
WL8.2	0.7	0.7	0.3	0.3	0.00	0.00
WL9	6.8	2.0	1.6	0.4	0.39	0.13
WL10	4.7	1.1	1.6	0.2	0.41	0.1
WL11.1	0.9	0.5	0.4	0.2	0.00	0.00
WL11.2	1.3	1.3	0.7	0.7	0.19	0.19
WL12	8.0	5.0	1.5	0.5	0.14	0.14
WL13	6.8	1.8	2.1	0.5	0.60	0.17
WL15	0.5	0.5	0.5	0.5	0.00	0.00
EPH106	0.3	0.3	0.3	0.3	0.00	0.00



Transect ID	General Location	GPS Location, Transect Start		GPS Location, Transect End		Survey Year
		Latitude	Longitude	Latitude	Longitude	
RW1	Alexander Creek (mainstem)	49.65612652	-114.7273101	49.65499113	-114.7332014	2017
RW2	Alexander Creek (mainstem)	49.66368429	-114.7288698	49.65966439	-114.7281135	2017
RW3	Alexander Creek (mainstem)	49.66920143	-114.7285401	49.66665372	-114.7294721	2017
RW4	Alexander Creek (mainstem)	49.69529015	-114.7168369	49.68458936	-114.7185795	2017
RW5	Alexander Creek (mainstem)	49.70839778	-114.710293	49.70280284	-114.7093389	2017
RW6	Alexander Creek (mainstem)	49.72529431	-114.708819	49.71817411	-114.711842	2017
RW7	Upper Alexander Creek	49.74842018	-114.7182019	49.74597431	-114.7165035	2017
RW8	Alexander Creek (mainstem)	49.76181778	-114.7174936	49.75366773	-114.717163	2017
RW9	Alexander Creek (mainstem)	49.76202943	-114.7177903	49.77397997	-114.7202582	2017
RW11	Alexander Creek (mainstem)	49.76917896	-114.7172458	49.77623429	-114.7166966	2017
RW10	West Alexander Creek	49.77397997	-114.7202582	49.78269329	-114.7311442	2017
RW12	Grave Creek - upper	49.83139412	-114.823401	49.83307813	-114.8191442	2017
RW13	Grave Creek - upper	49.84633977	-114.7776586	49.84366653	-114.7884519	2017
RW14	Grave Creek - upper	49.84982767	-114.7514421	49.85069045	-114.7606464	2017
RW15	Grave Creek below Harmer	49.84303561	-114.8626184	49.84385013	-114.8520437	2017
RW16	Grave Creek below Harmer	49.83563257	-114.831208	49.84385013	-114.8520437	2017
RW17	Harmer Creek	49.82046474	-114.8010486	49.83091132	-114.8183468	2017
RW18	Harmer Creek	49.81358952	-114.79746	49.80603341	-114.7924295	2017
RW19	Alexander Creek (mainstem)	49.741287	-114.716974	49.740309	-114.716928	2018
RW20	Alexander Creek (mainstem)	49.764291	-114.71947	49.763652	-114.719949	2018
RW22	Harmer Creek	49.80678	-114.792744	49.805922	-114.792186	2018
RW23	Upper Alexander Creek	49.78927301	-114.7114061	49.77651859	-114.716757	2018
RW27	Grave Creek - upper	49.850379	-114.756053	49.849667	-114.750807	2019
RW24	Upper West Alexander Creek	49.821309	-114.749985	49.81322045	-114.7445608	2019
RW26	Lower West Alexander Creek	49.79698	-114.740157	49.776972	-114.722749	2019
RW25	Deadman Pass Creek - middle	49.709585	-114.681478	49.715155	-114.692111	2019
Repeat sites in 2018						
RW1	Alexander Creek (mainstem)	49.65563099	-114.7307149	49.65457098	-114.727801	2018
RW5	Alexander Creek (mainstem)	49.711158	-114.711725	49.710361	-114.711047	2018
RW7	Upper Alexander Creek	49.746992	-114.717247	49.745798	-114.716345	2018
RW8	Alexander Creek (mainstem)	49.76278	-114.717575	49.761585	-114.716338	2018
RW9	Alexander Creek (mainstem)	49.771366	-114.719612	49.767287	-114.71634	2018
RW19	Alexander Creek (mainstem)	49.741287	-114.716974	49.740309	-114.716928	2018
RW20	Alexander Creek (mainstem)	49.764291	-114.71947	49.763652	-114.719949	2018
RW10	West Alexander Creek	49.774455	-114.721373	49.777953	-114.723131	2018
RW13	Grave Creek - upper	49.844703	-114.78498	49.843851	-114.788059	2018
RW21	Grave Creek below Harmer	49.831267	-114.823122	49.832341	-114.824415	2018
RW15	Grave Creek below Harmer	49.843779	-114.852448	49.843612	-114.853203	2018
RW17	Harmer Creek	49.826461	-114.807425	49.828512	-114.811322	2018
RW18	Harmer Creek	49.81351	-114.797259	49.813056	-114.796115	2018
RW22	Harmer Creek	49.80678	-114.792744	49.805922	-114.792186	2018

RW no.	Watershed	Creek	Year	Month	Day	Observation Location		Species	Sightline ¹	Est. River Width	Age Class ²	Sex ³	Behavioral Notes
						Latitude	Longitude						
RW17	Grave Creek	Harmer Creek	2017	July	2	49.82938	-114.812813	Nest Spotted Sandpiper	0	1	N	U	
RW17	Grave Creek	Harmer Creek	2017	July	2	49.8296	-114.8145	Spotted Sandpiper	0	1	A	U	incidental (not observed during regular RW)
RW17	Grave Creek	Harmer Creek	2017	July	2	49.8296	-114.81421	Spotted Sandpiper	0	1	A	U	incidental (not observed during regular RW)
RW18	Grave Creek	Harmer Creek	2017	July	4	49.81319	-114.796478	American Dipper	1	0	A	U	
RW18	Grave Creek	Harmer Creek	2017	July	4	49.81272	-114.796062	Nest American Dipper	1	0	N	U	
RW17	Grave Creek	Harmer Creek	2017	July	4	49.83128	-114.817316	Nest Spotted Sandpiper	0	1	N	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.75509	-114.715989	Spotted Sandpiper	3	3	A	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.75786	-114.714669	Spotted Sandpiper	3	3	A	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.75866	-114.71363	Spotted Sandpiper	3	3	A	U	
RW7	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.74638	-114.716731	Harlequin Duck	2	1	A	F	
RW6	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.72103	-114.711782	Spotted Sandpiper	3	2	A	U	
RW6	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.72175	-114.712005	Nest Spotted Sandpiper	3	2	N	U	
RW6	Alexander Creek	Alexander Creek (mainstem)	2017	July	5	49.72438	-114.709448	Spotted Sandpiper	3	2	A	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.65385	-114.729166	Spotted Sandpiper Adult	3	2	A	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.65385	-114.729166	SPSA Brood	3	2	J	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.65412	-114.728733	Belted Kingfisher	3	2	A	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.6542	-114.729089	Spotted Sandpiper	3	2	A	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.6542	-114.729089	Spotted Sandpiper	3	2	J	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.654	-114.72932	Spotted Sandpiper	3	2	A	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.654	-114.72932	Spotted Sandpiper	3	2	A	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.654	-114.72932	Spotted Sandpiper	3	2	A	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.654	-114.72932	Spotted Sandpiper	3	2	J	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.6544	-114.728815	Spotted Sandpiper	3	2	A	U	incidental (not observed during regular RW)
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	July	6	49.6544	-114.728815	Spotted Sandpiper	3	2	J	U	incidental (not observed during regular RW)
RW5	Alexander Creek	Alexander Creek (mainstem)	2017	July	7	49.70395	-114.709967	American Dipper	3	1	A	U	
RW5	Alexander Creek	Alexander Creek (mainstem)	2017	July	7	49.70482	-114.709559	American Dipper	3	1	A	U	
RW5	Alexander Creek	Alexander Creek (mainstem)	2017	July	7	49.70599	-114.709785	American Dipper	3	1	A	U	
RW5	Alexander Creek	Alexander Creek (mainstem)	2017	July	7	49.70716	-114.708801	American Dipper	3	1	A	U	
RW5	Alexander Creek	Alexander Creek (mainstem)	2017	July	7	49.70723	-114.709286	American Dipper	3	1	A	U	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.77312	-114.720908	Nest Spotted Sandpiper	1	2	N	NA	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.76558	-114.717206	Spotted Sandpiper	1	2	A	U	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.76381	-114.717028	American Dipper	1	2	A	U	
RW7	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.74634	-114.716972	Spotted Sandpiper	2	1	A	U	
RW7	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.74696	-114.717337	Spotted Sandpiper	2	1	A	U	
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.6939	-114.716971	Spotted Sandpiper	3	2	A	U	
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.6922	-114.717155	Spotted Sandpiper	3	2	A	U	

RW no.	Watershed	Creek	Year	Month	Day	Observation Location		Species	Sightline ¹	Est. River Width	Age Class ²	Sex ³	Behavioral Notes
						Latitude	Longitude						
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.69115	-114.717299	American Dipper	3	2	A	U	
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.68983	-114.7156	Spotted Sandpiper	3	2	A	U	
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.68975	-114.715387	Belted Kingfisher	3	2	A	F	
RW4	Alexander Creek	Alexander Creek (mainstem)	2017	July	26	49.68726	-114.716083	Spotted Sandpiper	3	2	A	U	
RW16	Grave Creek	Grave Creek	2017	July	27	49.83675	-114.832925	American Dipper	1	1	A	U	
RW16	Grave Creek	Grave Creek	2017	July	27	49.84341	-114.839118	American Dipper	1	1	A	U	
RW16	Grave Creek	Grave Creek	2017	July	27	49.84586	-114.84193	American Dipper	1	1	A	U	
RW3	Alexander Creek	Alexander Creek (mainstem)	2017	July	28	49.66831	-114.730	Harlequin Duck	3	1	J	U	8 ducklings
RW3	Alexander Creek	Alexander Creek (mainstem)	2017	July	28	49.66831	-114.730	Harlequin Duck	3	1	A	F	Female + 8 ducklings
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.77149	-114.71978	Harlequin Duck	1	2	A	F	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.77149	-114.71978	Harlequin Duck	1	2	A	F	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.7715	-114.719697	American Dipper	1	2	A	U	
RW9	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.7715	-114.719697	American Dipper	1	2	A	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.7619	-114.7172	Spotted Sandpiper	3	3	A	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.7619	-114.7172	Spotted Sandpiper	3	3	A	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.76172	-114.717411	Nest Spotted Sandpiper	3	3	N	U	
RW8	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.76172	-114.717411	Spotted Sandpiper	3	3	A	U	
RW7	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.74649	-114.716904	Nest American Dipper	2	1	N	U	
RW7	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.74649	-114.716904	American Dipper	2	1	A	U	
RW6	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.71823	-114.711954	Spotted Sandpiper	3	2	A	U	
RW6	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.71823	-114.711954	Spotted Sandpiper	3	2	A	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.65463	-114.727877	Spotted Sandpiper	3	2	-	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2017	June	10	49.65463	-114.727877	Spotted Sandpiper	3	2	-	U	
RW17	Grave Creek	Harmer Creek	2017	June	10	49.8296	-114.8145	Spotted Sandpiper	0	1	A	U	incidental (not observed during regular RW)
RW17	Grave Creek	Harmer Creek	2017	June	10	49.8296	-114.81421	Spotted Sandpiper	0	1	A	U	incidental (not observed during regular RW)
RW17	Grave Creek	Harmer Creek	2017	June	10	49.8297	-114.813899	Spotted Sandpiper	0	1	A	U	incidental (not observed during regular RW)
RW17	Grave Creek	Harmer Creek	2017	June	10	49.8302	-114.81523	Harlequin Duck	0	1	A	M	incidental (not observed during regular RW)
RW17	Grave Creek	Harmer Creek	2017	June	10	49.8302	-114.81523	Harlequin Duck	0	1	A	M	incidental (not observed during regular RW)
NA	Alexander Creek	Alexander Creek (mainstem)	2017	June	-	49.65748	-114.72952	Osprey nest	Not Applicable	Not Applicable	N	U	Nest located along power lines, 110m from river
RW17	Grave Creek	Harmer Creek	2018	July	1	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	1	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	1	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW22	Grave Creek	Harmer Creek	2018	July	2	49.80629	-114.792748	American Dipper	0	2	A	U	
RW18	Grave Creek	Harmer Creek	2018	July	2	49.81318	-114.79669	American Dipper	0	2	A	U	
RW21	Grave Creek	Grave Creek	2018	July	2	49.83187	-114.823486	American Dipper	2	2	A	U	
RW21	Grave Creek	Grave Creek	2018	July	2	49.83187	-114.823486	Spotted Sandpiper	0	2	A	U	
RW21	Grave Creek	Grave Creek	2018	July	2	49.83187	-114.823486	Spotted Sandpiper	0	2	A	U	
RW9	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664447	5515263	Harlequin Duck	1	2	A	F	
RW9	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664447	5515263	Harlequin Duck	1	2	A	F	
RW9	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664447	5515263	Harlequin Duck	1	2	A	F	

RW no.	Watershed	Creek	Year	Month	Day	Observation Location		Species	Sightline ¹	Est. River Width	Age Class ²	Sex ³	Behavioral Notes
						Latitude	Longitude						
Wetland survey	Alexander Creek	WL6	2018	July	3	49.76411	-114.719057	Spotted Sandpiper	0	4	A	F	
Wetland survey	Alexander Creek	WL6	2018	July	3	49.76411	-114.719057	Nest Spotted Sandpiper	0	4	N	-	4 eggs
RW19	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664432	5512307	American Dipper	3	2	A	U	
RW19	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664432	5512307	Spotted Sandpiper	2	2	A	U	
RW19	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	664432	5512307	Spotted Sandpiper	2	2	A	U	
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.65479	-114.728041	Spotted Sandpiper	3	11	A	U	Gun club area
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.65469	-114.728207	Spotted Sandpiper	3	3	A	U	Gun club area
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.65469	-114.728207	Spotted Sandpiper	3	3	J	U	Gun club area
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.65469	-114.728207	Spotted Sandpiper	3	3	J	U	Gun club area
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.65469	-114.728207	Spotted Sandpiper	3	3	J	U	Gun club area
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.6536	-114.729137	Spotted Sandpiper	3	4	A	U	WL1 Adults on beaver dam
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.6536	-114.729137	Spotted Sandpiper	3	4	A	U	WL1 Adults on beaver dam
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.6536	-114.729137	Spotted Sandpiper	3	4	J	U	WL1 Adults on beaver dam
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	3	49.6536	-114.729137	Spotted Sandpiper	3	4	J	U	WL1 Adults on beaver dam
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	5	663911	5502600	Osprey	2	3	A	U	Flying above gun club/WL1
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	5	663911	5502600	Osprey	2	3	A	U	Flying above gun club/WL1
RW1	Alexander Creek	Alexander Creek (mainstem)	2018	July	6	49.65454	-114.730884	American Dipper	3	4	A	U	Downstream of Gun club area
RW17	Grave Creek	Harmer Creek	2018	July	26	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	26	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	26	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	26	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW17	Grave Creek	Harmer Creek	2018	July	26	49.83004	-114.815365	Spotted Sandpiper	2	4	A	U	Reservoir
RW24	Alexander Creek	West Alexander Creek	2018	July	26	49.82157	-114.750525	Spotted Sandpiper	3	4	A	U	WL8.3
RW24	Alexander Creek	West Alexander Creek	2018	July	26	49.82157	-114.750525	Spotted Sandpiper	3	4	A	U	WL8.3
RW24	Alexander Creek	West Alexander Creek	2018	July	26	49.82157	-114.750525	Spotted Sandpiper	3	4	J	U	WL8.3
RW17	Grave Creek	Harmer Creek	2018	June	30	49.83004	-114.815365	Harlequin Duck	2	4	A	F	Reservoir
RW17	Grave Creek	Harmer Creek	2018	June	30	49.83004	-114.815365	Harlequin Duck	2	4	A	F	Reservoir
NA	Alexander Creek	Alexander Creek (mainstem)	2018	June	-	49.65748	-114.72952	Osprey nest	Not Applicable	Not Applicable	N	U	Nest located along power lines, 110m from river
RW19	Alexander Creek	Upper Alexander Creek	2019	July	6	49.78048	-114.716719	American Dipper	2	2	A	M	Nest present; parents flushed
RW19	Alexander Creek	Upper Alexander Creek	2019	July	6	49.78045	-114.716821	American Dipper	2	2	A	Y	Nest present; parents flushed
RW19	Alexander Creek	Upper Alexander Creek	2019	July	6	49.78045	-114.716821	Nest American Dipper	2	2	N	-	Nest
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78933	-114.736412	Harlequin Duck	1	1	J	F	Swimming under bank
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78646	-114.733998	Nest American Dipper	1	1	N	-	Nest; no birds observed;
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78795	-114.73462	American Dipper	1	1	A	F	
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78795	-114.73462	American Dipper	1	1	A	M	
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78418	-114.733436	Harlequin Duck	2	1	J	F	
RW21	Alexander Creek	West Alexander Creek	2019	July	8	49.78401	-114.733307	Harlequin Duck	2	1	J	F	
NA	Alexander Creek	Alexander Creek (mainstem)	2019	July	-	49.65748	-114.72952	Osprey nest	Not Applicable	Not Applicable	N	U	Nest located along power lines, 110m from river

¹ Sightline: 0 <25m; 1 <50m; 2 <100m; 3 >100m

² Estimated River Width: 0 <5m; 1 <10m; 2 <20m; 3 >21; 4 - other (reservoir/wetland)

³ Age Class: A=Adult; J=Juvenile; N=Nest

⁴ Sex: M=Male; F=Female; U=Unidentified

Chemical Group	Chemical Name	Units	EQL	BC WQG 2014 (mg/kg dw)	EVWQP 2015 -10% effect size (mg/kg dw)	EVWQP 2015 -20% effect size (mg/kg dw)	Sample ID	SPSA-E-HCR	SPSA-E-MACR	SPSA-E-VACR	WL1	Minimum	Maximum
							Sample Date	2017-07-04	2017-06-30	2017-07-06	2018-07-04		
							Lab Report Number	L1955497	L1955497	L1955497	L2125502		
General Chemistry	Phosphorus	mg/kg	2				10236	9936	11393	9033		9033	11393
Metals	Aluminium	mg/kg	0.4				9.4	3.8	4.3	<DL		3.8	9.4
	Antimony	mg/kg	0.002				<DL	<DL	<DL	<DL		<DL	-
	Arsenic	mg/kg	0.004				0.023	0.023	0.033	0.026		0.023	0.033
	Barium	mg/kg	0.01				16	63	55	8		8	63
	Beryllium	mg/kg	0.002				<DL	<DL	<DL	<DL		<DL	-
	Bismuth	mg/kg	0.002				<DL	<DL	<DL	<DL		<DL	-
	Boron	mg/kg	0.2				<DL	<DL	<DL	<DL		<DL	-
	Cadmium	mg/kg	0.001				<DL	<DL	<DL	<DL		<DL	-
	Calcium	mg/kg	4				67340	88217	75357	3275		3275	88217
	Cesium	mg/kg	0.001				<DL	0.004	0.004	<DL		<DL	0.004
	Chromium Total (III+VI)	mg/kg	0.01				<DL	<DL	<DL	<DL		<DL	-
	Cobalt	mg/kg	0.004				0.077	0.131	0.227	0.203		0.077	0.227
	Copper	mg/kg	0.02				3.7	3.5	4.4	4.6		3.5	4.6
	Iron	mg/kg	0.6				77	82	116	110		77	116
	Lead	mg/kg	0.004				<DL	<DL	<DL	<DL		<DL	-
	Lithium	mg/kg	0.1				<DL	<DL	<DL	<DL		<DL	-
	Magnesium	mg/kg	0.4				872	984	1143	367		367	1143
	Manganese	mg/kg	0.01				3.6	2.3	2.0	2.1		2.0	3.6
	Mercury	mg/kg	0.001				0.087	0.099	0.155	0.098		0.087	0.155
	Molybdenum	mg/kg	0.004				0.092	0.088	0.117	0.137		0.088	0.137
	Nickel	mg/kg	0.04				<DL	<DL	<DL	<DL		<DL	-
	Potassium	mg/kg	4				5387	5255	5571	6283		5255	6283
	Rubidium	mg/kg	0.01				1.7	1.6	1.78	1.7		1.6	1.8
	Selenium	mg/kg	0.01		6	12	16	14	2.8	3.1	3.8	2.8	14.0
	Silver	mg/kg	0.001				0.010	0.024	0.035	0.026		0.010	0.035
	Sodium	mg/kg	4				5253	4904	6679	5948		4904	6679
	Strontium	mg/kg	0.01				35	160	121	3.7		3.7	160
	Tellurium	mg/kg	0.004				<DL	<DL	0.018	<DL		<DL	0.018
	Thallium	mg/kg	0.0004				0.046	0.056	0.066	0.010		0.010	0.066
	Tin	mg/kg	0.02				0.15	<DL	0.314	<DL		0.15	0.31
Titanium	mg/kg	0.02				0.11	<DL	0.071	<DL		0.07	0.11	
Uranium	mg/kg	0.0004				<DL	<DL	<DL	<DL		<DL	-	
Vanadium	mg/kg	0.02				<DL	<DL	<DL	<DL		<DL	-	
Zinc	mg/kg	0.1				44.4	45.5	46.4	47.6		44.4	47.6	
Zirconium	mg/kg	0.04				<DL	<DL	<DL	<DL		<DL	-	

Chemical Group	Chemical Name	Units	EQL	Geometric Mean	Standard Deviation
General Chemistry	Phosphorus	mg/kg	2	10115	974
Metals	Aluminium	mg/kg	0.4	5.4	3.1
	Antimony	mg/kg	0.002	-	-
	Arsenic	mg/kg	0.004	0.026	0.005
	Barium	mg/kg	0.01	26	28
	Beryllium	mg/kg	0.002	-	-
	Bismuth	mg/kg	0.002	-	-
	Boron	mg/kg	0.2	-	-
	Cadmium	mg/kg	0.001	-	-
	Calcium	mg/kg	4	34797	37838
	Cesium	mg/kg	0.001	-	-
	Chromium Total (III+VI)	mg/kg	0.01	-	-
	Cobalt	mg/kg	0.004	0.147	0.068
	Copper	mg/kg	0.02	4.0	0.5
	Iron	mg/kg	0.6	95	19
	Lead	mg/kg	0.004	-	-
	Lithium	mg/kg	0.1	-	-
	Magnesium	mg/kg	0.4	775	335
	Manganese	mg/kg	0.01	2.4	0.8
	Mercury	mg/kg	0.001	0.107	0.031
	Molybdenum	mg/kg	0.004	0.107	0.023
	Nickel	mg/kg	0.04	-	-
	Potassium	mg/kg	4	5611	458
	Rubidium	mg/kg	0.01	1.7	0.1
	Selenium	mg/kg	0.01	4.6	5.4
	Silver	mg/kg	0.001	0.022	0.010
	Sodium	mg/kg	4	5656	786
	Strontium	mg/kg	0.01	40	73
	Tellurium	mg/kg	0.004	-	-
	Thallium	mg/kg	0.0004	0.037	0.024
	Tin	mg/kg	0.02	0.22	0.11
Titanium	mg/kg	0.02	0.09	0.03	
Uranium	mg/kg	0.0004	-	-	
Vanadium	mg/kg	0.02	-	-	
Zinc	mg/kg	0.1	46.0	1.3	
Zirconium	mg/kg	0.04	-	-	



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Date Received: 09-JUL-17
Report Date: 20-SEP-17 12:17 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L1955497
Project P.O. #: NOT SUBMITTED
Job Reference: 126231
C of C Numbers: 15-602165
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

20-SEP-17 12:17 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L1955497-1 Egg 04-JUL-17 15:36 SPSA-E-HCR	L1955497-2 Egg 30-JUN-17 12:30 SPSA-E-MACR	L1955497-3 Egg 06-JUL-17 16:05 SPSA-E-VACR	L1955497-4 Tadpoles 06-JUL-17 17:30 CSF-TP-WL9	L1955497-5 Tadpoles 06-JUL-17 18:00 CSF-TP-WL7
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.3	68.6	72.0	85.5	92.9
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.8	1.2	1.2	351	41.0
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0095	0.0059
	Arsenic (As)-Total (mg/kg wwt)	0.0069	0.0071	0.0092	0.145	0.406
	Barium (Ba)-Total (mg/kg wwt)	4.83	19.9	15.4	15.0	19.3
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0177	0.0030
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0066	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	1.18	0.56
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0613	0.0136
	Calcium (Ca)-Total (mg/kg wwt)	20000	27700	21100	4030	958
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0011	0.0012	0.0408	0.0094
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.424	0.130
	Cobalt (Co)-Total (mg/kg wwt)	0.0230	0.0411	0.0635	0.259	0.183
	Copper (Cu)-Total (mg/kg wwt)	1.11	1.09	1.23	1.06	0.288
	Iron (Fe)-Total (mg/kg wwt)	23.0	25.8	32.6	520	3220
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.343	0.101
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.54	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	259	309	320	292	169
	Manganese (Mn)-Total (mg/kg wwt)	1.08	0.711	0.559	48.6	135
	Mercury (Hg)-Total (mg/kg wwt)	0.0257	0.0310	0.0434	0.0052	0.0069
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0273	0.0276	0.0327	0.104	0.106
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.661	0.172
	Phosphorus (P)-Total (mg/kg wwt)	3040	3120	3190	1540	977
	Potassium (K)-Total (mg/kg wwt)	1600	1650	1560	1390	930
	Rubidium (Rb)-Total (mg/kg wwt)	0.516	0.496	0.497	1.06	3.38
	Selenium (Se)-Total (mg/kg wwt)	4.15	0.879	0.871	0.395	0.170
	Silver (Ag)-Total (mg/kg wwt)	0.0031	0.0074	0.0098	0.0083	0.0026
	Sodium (Na)-Total (mg/kg wwt)	1560	1540	1870	1290	1630
	Strontium (Sr)-Total (mg/kg wwt)	10.4	50.3	33.8	15.5	3.41
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0050	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0137	0.0176	0.0185	0.0234	0.00205
	Tin (Sn)-Total (mg/kg wwt)	0.046	<0.020	0.088	0.072	0.097
	Titanium (Ti)-Total (mg/kg wwt)	0.033	<0.020	0.020	2.16	0.596
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.0179	0.0207
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	1.05	0.151
	Zinc (Zn)-Total (mg/kg wwt)	13.2	14.3	13.0	17.0	8.13
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.166	0.048

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A
<p>This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p>			
HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7
<p>This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.</p>			
MET-WET-CCMS-MID-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A
<p>This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p>			
MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997
<p>This analysis is carried out gravimetrically by drying the sample at <60 deg. C.</p>			
TI-WET-CCMS-N-VA	Tissue	Ti in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A
<p>This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p>			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-602165

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Dillon Consulting Ltd.
ATTN: Mike Russum
200 - 334 11 Ave SE
Calgary AB T2G 0Y2

Date Received: 07-JUL-18
Report Date: 09-AUG-18 17:48 (MT)
Version: FINAL

Client Phone: 403-215-8885

Certificate of Analysis

Lab Work Order #: L2125502
Project P.O. #: NOT SUBMITTED
Job Reference: CROWN MOUNTAIN TISSUE SAMPLING
C of C Numbers: 17-635882
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L2125502-1 TADPOLES 04-JUL-18 18:00 WET21	L2125502-2 EGG (BIRD) 04-JUL-18 18:00 WL1			
Grouping	Analyte				
TISSUE					
Physical Tests	% Moisture (%)	93.7	73.1		
Metals	Aluminum (Al)-Total (mg/kg wwt)	87.9	<1.0		
	Antimony (Sb)-Total (mg/kg wwt)	0.0052	<0.0020		
	Arsenic (As)-Total (mg/kg wwt)	0.0328	0.0069		
	Barium (Ba)-Total (mg/kg wwt)	8.22	2.05		
	Beryllium (Be)-Total (mg/kg wwt)	0.0041	<0.0020		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020		
	Boron (B)-Total (mg/kg wwt)	1.45	<0.20		
	Cadmium (Cd)-Total (mg/kg wwt)	0.0116	<0.0020		
	Calcium (Ca)-Total (mg/kg wwt)	1720	881		
	Cesium (Cs)-Total (mg/kg wwt)	0.0249	<0.0010		
	Chromium (Cr)-Total (mg/kg wwt)	0.275	<0.040		
	Cobalt (Co)-Total (mg/kg wwt)	0.128	0.0546		
	Copper (Cu)-Total (mg/kg wwt)	0.528	1.24		
	Iron (Fe)-Total (mg/kg wwt)	142	29.5		
	Lead (Pb)-Total (mg/kg wwt)	0.125	<0.010		
	Lithium (Li)-Total (mg/kg wwt)	0.24	<0.10		
	Magnesium (Mg)-Total (mg/kg wwt)	197	98.7		
	Manganese (Mn)-Total (mg/kg wwt)	86.5	0.557		
	Mercury (Hg)-Total (mg/kg wwt)	<0.016	0.0264		
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0503	0.0369		
	Nickel (Ni)-Total (mg/kg wwt)	0.191	<0.040		
	Phosphorus (P)-Total (mg/kg wwt)	406	2430		
	Potassium (K)-Total (mg/kg wwt)	279	1690		
	Rubidium (Rb)-Total (mg/kg wwt)	0.706	0.467		
	Selenium (Se)-Total (mg/kg wwt)	0.336	1.03		
	Silver (Ag)-Total (mg/kg wwt)	0.0170	0.0071		
	Sodium (Na)-Total (mg/kg wwt)	557	1600		
	Strontium (Sr)-Total (mg/kg wwt)	9.75	0.996		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg wwt)	0.00360	0.00282		
	Tin (Sn)-Total (mg/kg wwt)	0.198	<0.020		
	Titanium (Ti)-Total (mg/kg wwt)	2.20	<0.10		
	Uranium (U)-Total (mg/kg wwt)	0.0138	<0.00040		
	Vanadium (V)-Total (mg/kg wwt)	0.183	<0.020		
	Zinc (Zn)-Total (mg/kg wwt)	11.3	12.8		
	Zirconium (Zr)-Total (mg/kg wwt)	0.097	<0.040		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Total	B	L2125502-1, -2
Method Blank	Manganese (Mn)-Total	B	L2125502-2
Method Blank	Thallium (Tl)-Total	B	L2125502-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-MICR-HRMS-VA	Tissue	Silver in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			
HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7
This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.			
MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			
Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.			
MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997
This analysis is carried out gravimetrically by drying the sample at <60 deg. C.			
TI-WET-MICR-HRMS-VA	Tissue	Ti in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			

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Report To		Report Format / Distribution			Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)																																																		
Company: Dillon Consulting Ltd.		Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)			Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply																																																		
Contact: Mike Russum		Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			<table border="1"> <tr> <td rowspan="3">PRIORITY (Business Days)</td> <td>4 day [P4-20%]</td> <td><input type="checkbox"/></td> <td rowspan="3">EMERGENCY</td> <td>1 Business day [E-100%]</td> <td><input type="checkbox"/></td> </tr> <tr> <td>3 day [P3-25%]</td> <td><input type="checkbox"/></td> <td>Same Day, Weekend or Statutory holiday [E2-200%]</td> <td><input type="checkbox"/></td> </tr> <tr> <td>2 day [P2-50%]</td> <td><input type="checkbox"/></td> <td>(Laboratory opening fees may apply)</td> <td><input type="checkbox"/></td> </tr> </table>										PRIORITY (Business Days)	4 day [P4-20%]	<input type="checkbox"/>	EMERGENCY	1 Business day [E-100%]	<input type="checkbox"/>	3 day [P3-25%]	<input type="checkbox"/>	Same Day, Weekend or Statutory holiday [E2-200%]	<input type="checkbox"/>	2 day [P2-50%]	<input type="checkbox"/>	(Laboratory opening fees may apply)	<input type="checkbox"/>																											
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Company address below will appear on the final report		Email 1 or Fax: ldilley@dillon.ca			For tests that can not be performed according to the service level selected, you will be contacted.																																																		
Street: 200 - 334 11 Ave SE		Email 2: mrussum@dillon.ca			<table border="1"> <thead> <tr> <th colspan="10">Analysis Request</th> <th rowspan="2">SAMPLES ON HOLD</th> <th rowspan="2">Sample is hazardous (please provide further details)</th> <th rowspan="2">NUMBER OF CONTAINERS</th> </tr> <tr> <th colspan="10">Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below</th> </tr> </thead> <tbody> <tr> <td>Sample Handling + Disposal</td> <td>Sample in Tissue (HR-ICAMS)</td> <td>Mercury in Tissue (CVAFS)</td> <td>Metals in Tissue (HR-ICAMS)</td> <td>Moisture in Tissue</td> <td>Tissue Micro Prep</td> <td>Ti in Tissue (HR-ICAMS)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>										Analysis Request										SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below										Sample Handling + Disposal	Sample in Tissue (HR-ICAMS)	Mercury in Tissue (CVAFS)	Metals in Tissue (HR-ICAMS)	Moisture in Tissue	Tissue Micro Prep	Ti in Tissue (HR-ICAMS)											
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City/Province: Calgary AB		Email 3: _____																																																					
Postal Code: T2G 2P0Z		Invoice To: Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO																																																					
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PO / AFE: _____		Requisitioner: _____																																																					
LSD: _____		Location: _____																																																					
ALS Lab Work Order # (lab use only): _____		ALS Contact: _____ Sampler: _____																																																					
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type																																																			
	WET 21	04-07-2018	18:60	tadpoles																																																			
	WL 1	05-07-2018	17:25	egg (bird)																																																			
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)																																																		
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO					Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>																																																		
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO					Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>																																																		
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