

Appendix 4.9-A Avian Baseline Report



Tenas Project

Avian Baseline Report

December 2021

VERSION 3.0

Submitted to: Telkwa Coal Limited

Submitted by: EDI Environmental Dynamics Inc.

EXECUTIVE SUMMARY

Telkwa Coal Ltd. is proposing to develop the Tenas Project (the Project), a surface coal mine 25 kilometres (km) south of the town of Smithers and 7 km southwest of the village of Telkwa in northwestern BC. This report summarizes the avian portion of the baseline program completed for the Project. The objectives of the baseline program were to identify potential constraints related to avian species and to collect data for the subsequent analyses of effects on avian species. The occurrences and habitat of the avian community were characterized using published and unpublished data, Traditional Knowledge, and baseline survey data. The study areas for the baseline program were centered around the Project Area, which encompasses the proposed infrastructure and activities of the Project. The most detailed surveys were completed within the Wildlife Local Study Area (LSA), with some surveys extended into the Wildlife Regional Study Area (RSA).

After consideration of the existing data available, a program of field surveys was designed and conducted in the Wildlife RSA between 2017 and 2019. The program included: point counts, call playback surveys, waterbird surveys, acoustic monitoring, habitat suitability modelling, habitat assessment and density analyses for the occurrence of selected species. These studies were designed to characterize the focal species that occur or use habitat that overlaps the Project Area. The focal species are discussed individually and in the general groups: landbirds, waterbirds, raptors, and species of conservation concern. The occurrences and habitat of the focal species are discussed with reference to three groups of features included in the Project Area: mine features, linear features, and rail features. The purpose for this discussion is to summarize key points from the data that will be analyzed in further detail in the effects assessment.

The Wildlife RSA provides a wide array of habitat for resident and migratory bird species. Baseline surveys confirmed the presence of 105 avian species within the Wildlife RSA including 68 landbird species, 26 waterbird species, and eleven raptor species. This included three species of conservation concern (barn swallow [*Hirundo rustica*], olive-sided flycatcher [*Contopus cooperi*], and northern goshawk [*Accipiter gentilis atricapillus*]) and one Identified Wildlife species (sandhill crane [*Antigone canadensis*]). The desktop review identified another 95 species that have been previously documented in the Wildlife RSA, resulting in a list of 200 bird species that may be found in the Wildlife RSA. Habitat availability and patterns of bird diversity and abundance vary across the study areas. Overall, the Project Area and Wildlife LSA, while providing a variety of habitats for birds, occur over a narrower range of elevation and habitat types than is represented in the Wildlife RSA; consequently, the diversity of species in these areas is slightly less than in the Wildlife RSA as a whole.

Landbird species present in the Wildlife RSA include game birds (grouse, ptarmigan), woodpeckers, hummingbirds, and passerines (songbirds); passerine species include a variety of flycatchers, vireos, tanagers, jays and crows, swallows, chickadees, creepers and nuthatches, kinglets, thrushes, waxwings, warblers, wrens, sparrows, and finches. More than half of the Wildlife RSA is composed of forested habitats; correspondingly, the most common landbird species detected during baseline surveys were predominantly forest-dwelling and generalist species. Common species included Swainson's thrush, dark-eyed junco, American redstart, black-capped chickadee, American robin, warbling vireo, varied thrush, pine siskin, yellow-rumped warbler, and orange-crowned warbler. Observed bird densities were highest in the SBSdk subzone and decreased with increasing elevation (i.e., SBSdk > SBSmc2 > ESSFmc). Overall, the density of all birds within the Wildlife RSA was estimated to be 5.56 birds/ha, resulting in an estimated total of 684,995 birds present in the Wildlife RSA.

Waterbirds (i.e., waterfowl, riverine birds, shorebirds, loons, grebes) are predominantly found in the lower elevations of the Wildlife RSA, corresponding to the distribution of suitable aquatic habitats (e.g., lakes,

rivers, wetlands). Available habitat for waterbirds within the Project Area is limited to streams, associated riparian areas, and small wetlands. A total of 57 waterbird species have been documented within the Wildlife RSA, 26 of which were detected during baseline surveys, mostly during the spring migration/staging season.

Raptor species found within the Wildlife RSA include a variety of hawks, falcons, eagles, osprey, and owls. A total of 22 raptor species have been confirmed present in the Wildlife RSA, with 11 species observed during baseline surveys. Within the Project Area and Wildlife LSA, the raptor community is dominated by tree-nesting and ground-nesting species. Five raptor nests were located during Project surveys including two osprey (*Pandion haliaetus*) nests, two red-tailed hawk nests (*Buteo jamaicensis*), and one Cooper's hawk (*Accipiter cooperii*) nest.

In addition to the broad species groups, focal species identified and discussed in this Avian Baseline Report include bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), black swift (*Cypseloides niger*), common nighthawk (*Chordeiles minor*), northern goshawk (*Accipiter gentilis atricapillus*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus*), and short-eared owl (*Asio flammeus*).

ACKNOWLEDGEMENTS

The avian baseline program for the Tenas Project was completed by Ardea Biological Consulting Ltd. (Ardea) of Smithers, BC, with the support of several other local consulting firms. Specific individuals that contributed to the avian baseline surveys included:

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- ▶ Lis Rach (Terraniche Environmental Solutions) — Landbird & Waterfowl Surveys
- ▶ Frank Doyle (Wildlife Dynamics Consulting) — Raptors & Waterfowl Surveys
- ▶ Theresa White (Cedrus Consulting) – Landbird Surveys

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Tenas Project

Avian Baseline Report

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ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
°C	degrees Celsius
%	percent
ARU	Automated Recording Unit
BAFAun	Boreal Altai Fescue Alpine Undifferentiated
BBA	Breeding Bird Atlas
BBS	Breeding Bird Survey
BC	British Columbia
BCR	Bird Conservation Region
BEC	Biogeoclimatic Ecosystem Classification
BGC	Biogeoclimatic
BMP	best management practice
BUB	Bulkley Basin
BUR	Bulkley Ranges
CBC	Christmas Bird Count
CDC	Conservation Data Centre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CUS	Cultural Use Study
CWHws2	Coastal Western Hemlock Wet Submaritime Subzone Montane Variant
ECCC	Environment and Climate Change Canada
ECCS	Ministry of Environment and Climate Change Strategy
ESSFmc	Engelmann Spruce – Subalpine Fir Moist Cold
ESSFmcp	Engelmann Spruce – Subalpine Fir Moist Cold Parkland
ESSFmcw	Engelmann Spruce – Subalpine Fir Moist Cold Woodland
ESSFmk	Engelmann Spruce – Subalpine Fir Moist Cool
ESSFmkp	Engelmann Spruce – Subalpine Fir Moist Cool Parkland
ESSFmkw	Engelmann Spruce – Subalpine Fir Moist Cool Woodland
ESSFwv	Engelmann Spruce – Subalpine Fir Wet Very Cold
ESSFwvp	Engelmann Spruce – Subalpine Fir Wet Very Cold Parkland
ESSFww	Engelmann Spruce – Subalpine Fir Wet Very Cold Woodland
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
<i>FRPA</i>	<i>Forest and Range Practices Act</i>
ha	hectares
ICHmc1	Interior Cedar Hemlock Moist Cold Subzone Nass Variant

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
km	kilometre
km/h	kilometre per hour
LSA	Local Study Area
m	metre
MAP	mean annual precipitation
MAT	mean annual temperature
<i>MBCA</i>	<i>Migratory Birds Convention Act</i>
mm	millimetre
Project	Tenas Project
RSA	Regional Study Area
<i>SARA</i>	<i>Species at Risk Act</i>
SBSdk	Sub-Boreal Spruce Dry Cool
SBSmc2	Sub-Boreal Spruce Babine Moist Cold
TCL	Telkwa Coal Limited
TEM	Terrestrial Ecosystem Mapping
TK	Traditional Knowledge
TRIM	Terrain Resource Information Management

1. INTRODUCTION

Telkwa Coal Limited (TCL) is proposing to develop the Tenas Project (the Project), a surface coal mine designed to produce approximately 15 million tonnes of washed metallurgical coal product, at about 0.750 million saleable tonnes per year, to be used in the manufacture of steel. The Project requires a Certificate under the British Columbia (BC) *Environmental Assessment Act* and major mines permitting under the BC *Mines Act* and *Environmental Management Act*, and subsequent permitting. These requirements trigger the need for baseline studies followed by assessment of potential effects of the Project on avian species and other Valued Components.

The proposed Project is located in northwestern BC, approximately 25 kilometres (km) south of the town of Smithers and 7 km southwest of the village of Telkwa. The Project is on provincial Crown Land, on three freehold land parcels owned by TCL and nine coal licences held by TCL and Bulkley Valley Collieries Ltd. (who have agreed to allow TCL to access their licenses for mine infrastructure). The Project Area falls within Wet'suwet'en traditional territories: the mine site is located in Cas'Yex House territory; the rail loop and loadout are located in Kwen Bea Yex House territory (Budhwa et al. 2020).

The Project will be a conventional shovel and truck operation like other rock quarry and surface mine operations in the region. Coal will be extracted using heavy machinery and sent to an on-site coal processing plant. Following processing, the coal will be trucked to a rail loadout facility and associated rail loop connecting to the existing main Canadian National Railway line. In addition to the mine pit, coal processing plant and rail infrastructure, the Project will include the following major components: a materials handling system, various rock and soil storage piles, water management features, mine access and haul roads, a powerline, a water pipeline, propane storage, explosives storage, administrative and warehouse buildings, and various other supporting infrastructure. The Project life will be approximately 25 years including the construction, operation, and reclamation phases.

The objective of the avian baseline program was to characterize the bird community in the vicinity of the Project; specifically, to document the occurrence, relative abundance and habitat associations of birds across the Project Area within a local and regional context. This information was collected to support a subsequent assessment of the potential effects of the Project on birds and to identify potential constraints to the Project related to bird species. This Avian Baseline Report summarizes the current knowledge and baseline conditions for bird species associated with the proposed Project based on a review of existing information and the results of Project-specific surveys and habitat modelling. The various components of the baseline program are defined in Section 2 and the results are summarized in Section 3.

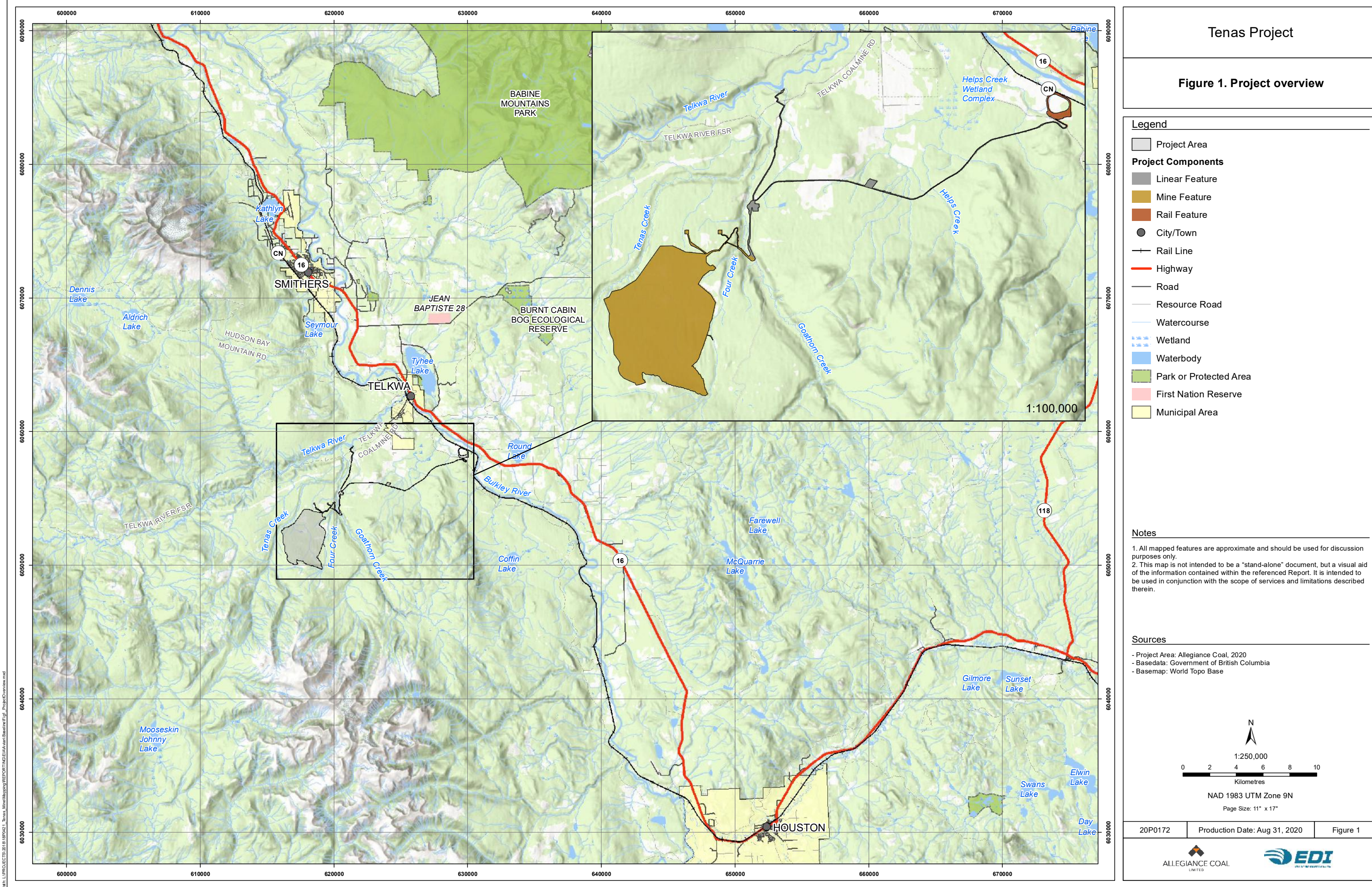
1.1 Study Area

The Project Area is approximately 1,095 ha and encompasses the area that would potentially be directly disturbed by Project activities (i.e., the Project footprint). To facilitate data analyses and discussions in this baseline report, Project components within the Project Area were divided into three general areas: mine features, linear features, and rail features (Figure 1). Mine features include the mine infrastructure, coal preparation infrastructure, and explosives infrastructure areas; linear features include Project roads, the pipeline, and the powerline, and rail features include the rail loop, rail loadout, and associated rail infrastructure.

The Wildlife Local Study Area (LSA) is approximately 35,726 ha and encompasses a minimum 5 km buffer around the Project Area (Figure 2). The Wildlife LSA represents the area within which potential Project

effects are expected to occur on avian species and is the area within which most fine-scale baseline data were collected for analyses. The Wildlife LSA includes the village of Telkwa and part of Tyhee Lake to the north; Round Lake to the east; the lower slopes of Hunter Basin to the south, and the lowest reaches of Pine Creek to the west. It overlaps portions of both the Telkwa and Bulkley rivers, as well as Tenas and Goathorn creeks. The Wildlife LSA has a notable anthropogenic footprint including the village of Telkwa and overlap with the Highway 16 corridor. Agricultural development and rural residences are common in the lower elevations of the Wildlife LSA, while higher elevation areas show a history of forest harvest activities.

The Wildlife RSA is 194,651 ha and encompasses the Wildlife LSA plus the intersection of all watersheds that overlap with a 10 km buffer around the Project Area, with the exception of major watersheds (e.g., the Telkwa River, the Bulkley River; Figure 2). The Wildlife RSA is used to provide regional context on the spatial distribution and abundance of avian species and is the area within which potential Project effects are expected to interact with the effects of other past, present, and reasonably foreseeable future projects or activities. The Wildlife RSA is characterized by a mixed landscape of Crown and private lands. Pre-existing habitat loss and fragmentation due to road development, forest harvesting, and mineral exploration activities have altered habitats within the Wildlife RSA over time. The Wildlife RSA overlaps or is adjacent to the traditional territories of seven indigenous groups, and also includes the village of Telkwa and is adjacent to the town of Smithers. Elevation within the Wildlife RSA ranges from approximately 470 to 2,300 metres (m).



Legend

-  Project Area
-  General Wildlife LSA
-  General Wildlife RSA
-  City/Town
-  Rail Line
-  Highway
-  Road
-  Resource Road
-  Watercourse
-  Wetland
-  Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base



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Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

-  Project Area
-  General Wildlife LSA
-  General Wildlife RSA
-  City/Town
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-  Highway
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- Basemap: World Topo Base

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1.2 Ecological Overview

The Project is located within the Bulkley Basin (BUB) and Bulkley Ranges (BUR) ecosections of northwestern BC. The BUB ecosection occurs at lower elevations and spans a broad lowland area in the rainshadow of the Kitimat and Nass ranges of the Coast Mountains (Demarchi 2011). This ecosection contains many lakes (Demarchi 2011), including Tyhee Lake, Round Lake, Seymour Lake, and Coffin Lake within the Wildlife RSA. Major drainages in the BUB ecosection that intersect the Wildlife RSA include the Bulkley and Telkwa rivers and Goathorn and Tenas creeks. The BUR ecosection occurs at higher elevations and spans a narrow, rounded range of mountains on the leeward side of the Kitimat Ranges (Demarchi 2011); mountains/mountain ranges that overlap the Wildlife RSA include parts of the Telkwa Mountain Range and Hudson's Bay Mountain. Many small lakes occur across this upland area and the ecosection is drained by numerous small streams that flow into larger streams and rivers such as the Telkwa and Morice rivers (Demarchi 2011).

Most of the Project Area overlaps the Sub-Boreal Spruce Dry Cool (SBSdk) and the Sub-Boreal Spruce Babine Moist Cold (SBSmc2) biogeoclimatic (BGC) subzones. A small portion of the Project Area overlaps the Engelmann Spruce – Subalpine Fir Moist Cold (ESSFmc) BGC subzone. The SBSdk occurs at lower elevations and transitions into the SBSmc2 and then into the ESSFmc as elevation increases; elevation ranges from 700 to 1,050 m in the SBSdk, from 850 to 1,350 m in the SBSmc2, and from 950 to 1,500 m in the ESSFmc (Banner et al. 1993). These same BGC subzones are found throughout the Wildlife LSA and RSA, along with several additional BGC subzones/variants, including the Interior Cedar Hemlock Moist Cold Subzone Nass Variant (ICHmc1); the Coastal Western Hemlock Wet Submaritime Subzone Montane Variant (CWHws2); the Boreal Altai Fescue Alpine Undifferentiated (BAFAun); and various subzones/variants within the Engelmann Spruce – Subalpine Fir (ESSF) zone, including the Moist Cold Parkland (ESSFmcp); the Moist Cold Woodland (ESSFmcw); the Moist Cool (ESSFmk); the Moist Cool Parkland (ESSFmkp); the Moist Cool Woodland (ESSFmkw); the Wet Very Cold (ESSPwv); the Wet Very Cold Parkland (ESSFwvp); and the Wet Very Cold Woodland (ESSFwvw).

In the SBSdk the main conifer tree species are Interior spruce and lodgepole pine, with lesser amounts of subalpine fir, but there is a significant presence of deciduous tree species with deciduous and seral ecosystems containing trembling aspen, black cottonwood, and paper birch. Douglas maple and Rocky Mountain juniper occur in moist and dry habitats, respectively. The SBSdk is known for the diversity of its shrub and herb layers that are typically well developed (Banner et al. 1993). This diversity of plant species has led to a high diversity of ecosystems in its coniferous and deciduous forests, floodplains, wetlands and non-forested shrublands. Much of the vegetation in the SBSdk has been impacted by agricultural development, forest harvesting and cattle grazing. These disturbances, along with the fire regime has led to old forests being uncommon in the SBSdk.

In the SBSmc2 deciduous forests are relatively uncommon, with Interior spruce, lodgepole pine and subalpine fir being the dominant tree species. These coniferous stands may have a component of trembling aspen, black cottonwood, or paper birch. The shrub and herb layers are not as well-developed or diverse as the SBSdk, and moss layer is better developed and may be dominant (Banner et al. 1993). Old forests are relatively common in areas that have escaped fire, though forest harvesting has been extensive in the Project Area.

The ESSFmc is located at higher elevations than the SBSmc2; it is the dominant ESSF subzone present in the Wildlife RSA and the only ESSF subzone overlapping the Project Area and Wildlife LSA (the ESSFmk and ESSFwv subzones are also present in the Wildlife RSA, in the western sections adjacent to the Coast Mountains). The ESSFmc is characterized by coniferous forests dominated by subalpine fir, Interior spruce, and lodgepole pine (Banner et al. 1993). The various ESSF subzones are split into forested (e.g., ESSFmc), woodland (e.g., ESSFmcw) and parkland (e.g., ESSFmcp) as forests get progressively more open at higher

elevations before the BAFA zone begins where forests are unable to grow. In the woodland forests have low productivity and are relatively open. The lower boundary of the woodland zone usually represents the upper limit of forest harvesting operability (Trowbridge and Banner 2002). The parkland is characterized by clumps of trees that are separated by areas of heath, meadow, and grassland (Banner et al. 1993).

The BAFA has long cold winters and short cool summers. The snowpack is usually thin and windblown but may be deeper in some areas. The vegetation can be diverse, with a mosaic of krummholz tree patches, heather, meadows, and tundra. Dwarf willows, grasses, sedges, and lichens can be common (Mackenzie 2006).

The regional climate of the area is reflected in the Biogeoclimatic Ecosystem Classification (BEC), with the SBS zone having a mostly continental climate, with some coastal influences in the Bulkley Valley (Banner et al. 1993). The Sub-boreal climate has winters that are snowy and severe and short summers that warm and moist. The closest long-term weather station is at the Smithers Airport, approximately 25 km to the north, and in the SBSdk subzone (Environment and Climate Change Canada 2019); the information presented below are from 1981 to 2010. The mean annual precipitation (MAP) at this weather station is 508 millimetres (mm), with 367 mm as rainfall and 182 mm as snow. The wettest month is October with 65 mm and the driest month is March with 21 mm. The mean annual temperature (MAT) is 4.2°C, with July being the warmest month with an average temperature of 15.2°C, and January being the coldest month at -7.2°C (Environment and Climate Change Canada 2019). The ClimateBC program (Wang et al. 2016), was used to determine the climate of the SBSmc2 in the study area. The MAP is 631 mm with November being the wettest month is with 75 mm and the driest month being April with 32 mm. The MAT is 2.2°C, with July being the warmest month with an average temperature of 12.4°C, and January being the coldest month at -7.6°C.

The valley bottom, which contains the SBSdk, has a longer growing season than higher elevation areas containing the SBSmc2 due to being drier and warmer in summer, and has a much thinner snowpack that is present for a shorter duration. Winter temperatures in the SBSdk may not colder than those in the SBSmc2. Wildfire, which is climate driven and is more frequent in the SBSdk than the SBSmc2, has contributed to the development of deciduous stands in the valley bottoms, which in turn has enhanced to value of the forests for passerines, grouse, and other bird species (Banner et al. 1993).

2. METHODOLOGY

2.1 Desktop Review

The desktop study included a review of available published and unpublished scientific data, Traditional Knowledge (TK) and local knowledge, as well as an examination of federal and provincial legislation, regulations, strategies, guidelines, plans, best management practices (BMPs), and land use plans applicable to avian species within the Project region.

The literature review was used to create a comprehensive avian species list for the Wildlife RSA, and to provide additional spatial and habitat information on the occurrence of species of conservation concern that may occur within the Wildlife RSA. The data sources used to characterize bird occurrence and distribution in the Wildlife RSA are summarized in Table 1. The BC Species and Ecosystems Explorer online tool (BC Conservation Data Centre 2020) was then used to create a list of bird species or subspecies of conservation concern (i.e., federally and provincially listed species) that nest in BC. This list was then refined to those that may nest within the Wildlife RSA by examining public datasets (e.g., eBird, BC Breeding Bird Atlas [BBA]) for occurrence records during the breeding season (Davidson et al. 2015, eBird 2020). Species or subspecies with occurrence records within the Wildlife RSA and those found adjacent but with suitable habitat likely present within the Wildlife RSA, were included on the list of species of conservation concern that may occur within the Project Area.

Table 1: Existing Data Sources Used to Create a Comprehensive Species List for the Avian Baseline Report

Title	Content	Reference
British Columbia Breeding Bird Atlas (BC BBA)	Point count survey results and general occurrence records within the Wildlife RSA	(Davidson et al. 2015)
Breeding Bird Survey (BBS)	Point count survey results for the Wildlife RSA	(Smith et al. 2019)
Birds of British Columbia	Generalized overview of birds within BC and some local information.	(Campbell et al. 1997, 2001, 1990a, 1990b)
Christmas Bird Count (CBC)	Generalized occurrence records for overwintering birds in or adjacent to the Wildlife RSA (the Smithers CBC partially overlaps the Wildlife RSA)	(National Audubon Society 2020)
COSEWIC Status Reports	Distribution and habitat information, with some local occurrence information	(COSEWIC 2008, 2013a, 2018a, b)
eBird	Occurrence records for birds within the Wildlife RSA	(eBird 2020)
iMapBC	Occurrence records for birds within the Wildlife RSA	(Government of British Columbia 2020a)

Notes: RSA=Regional Study Area; COSEWIC=Committee on the Status of Endangered Wildlife in Canada

2.2 Baseline Program

Field baseline surveys for birds were conducted within the Wildlife LSA and RSA between 2017 and 2019 and included various species inventories and habitat use assessments (Table 2). Focal species identified for the Project baseline studies include those species that have potential to interact with the Project and

are either species of conservation concern or species with distinct social, cultural, or economic values. Consideration for the selection of focal species or species groups included:

- ▶ Species occurrence or habitat overlap with the Wildlife RSA;
- ▶ Species of conservation concern including federal and provincial listings;
- ▶ Species of interest to Indigenous, regulatory agencies, or the public; and
- ▶ Species raised as a concern during Project consultation.

With the exception of waterbirds, surveys and habitat modelling for avian species targeted the summer breeding season given that (1) most of the bird species present in the Wildlife RSA are migratory and are only present during the summer season, and (2) most concerns regarding potential interactions between the Project and birds relate to nesting birds and/or habitats used by nesting birds. Waterbird surveys focused on the spring migration/staging season based on local knowledge which indicated that certain parts of the Project Area may provide stopover sites for large numbers of migrating waterfowl and other waterbirds.

Table 2: Focal Species/Groups and Rationale for Selection

Focal Species/Groups	Rationale for Selection	Baseline Program(s)
Landbirds	Landbirds include a variety avian species that live mostly on or over land; these include various species of upland game birds, passerines (i.e., songbirds), woodpeckers and other non-passerine species (for the purposes of this report, raptors are considered separate from other landbird species). As a group, landbirds include both migratory and resident species; migratory birds, such as passerines, are protected under the federal <i>Migratory Birds Convention Act (MBCA)</i> . Additionally, upland game birds (i.e., grouse and ptarmigan) are harvested by First Nations and other local harvesters.	Point Count Surveys, Acoustic Monitoring, Incidental Observations, Habitat Suitability Modelling, Density Analysis
Waterbirds	Waterbirds are those avian species that live on or adjacent to water; these include various species of waterfowl (i.e., ducks, swans and geese), shorebirds, and other waterbirds (e.g., loons, grebes). Most waterbirds in the Project Area are migratory and are protected under the federal <i>MBCA</i> .	Waterbird Migration Surveys, Incidental Observations, Habitat Suitability Modelling
Raptors	Raptors are birds of prey; raptor species present in the Project Area include a variety of eagles, hawks, falcons and owls. Active raptor nests are protected under the BC <i>Wildlife Act</i> , and nests of certain raptor species (e.g., bald eagle (<i>Haliaeetus leucocephalus</i>), osprey (<i>Pandion haliaetus</i>), peregrine falcon (<i>Falco peregrinus</i>)) are protected year-round. Several raptor species also have cultural importance to Indigenous people. Northern goshawk (<i>Accipiter gentilis atricapillus</i>) was selected as a focal species for baseline studies due to potential overlap with the Project Area and local conservation concerns as evidenced by their identification as a focal species within the Morice Land and Resource Management Plan (Government of British Columbia 2004).	Northern Goshawk Surveys, Waterbird Migration Surveys, Acoustic Monitoring, Incidental Observations, Habitat Suitability Modelling
Listed avian species	Several avian species listed federally (COSEWIC and/or SARA) and/or provincially (BC CDC) use habitats within the Project Area. Focal listed species listed below include those listed species that were identified as having a potential interaction and those that were brought forward through consultation during Pre-Application phase of the BC Environmental Assessment process. - Bank Swallow (<i>Riparia riparia</i>) - Barn Swallow (<i>Hirundo rustica</i>) - Black Swift (<i>Cypseloides niger</i>) - Common Nighthawk (<i>Chordeiles minor</i>) - Olive-sided Flycatcher (<i>Contopus cooperi</i>) - Rusty Blackbird (<i>Euphagus carolinus</i>) - Short-eared Owl (<i>Asio flammeus</i>)	Point Count Surveys, Acoustic Monitoring, Incidental Observations, Habitat Suitability Modelling, Qualitative Habitat Assessments, Density Analysis

Notes: COSEWIC=Committee on the Status of Endangered Wildlife in Canada; SARA=Species at Risk Act; BC CDC=British Columbia Conservation Data Centre

Baseline surveys and habitat suitability modelling were conducted in accordance with provincial standards including:

- ▶ British Columbia Wildlife Habitat Rating Standards, Version 2.0 (Resources Inventory Committee 1999a)
- ▶ Inventory Methods for Forest and Grassland Songbirds, Version 2.0 (Resources Inventory Committee 1999b)
- ▶ Inventory Methods for Raptors, Version 2.0 (Resources Inventory Committee 2001)
- ▶ Inventory Methods for Waterfowl and Allied Species: Loons, Grebes, Swans, Geese, Ducks, American Coot and Sandhill Crane, Version 2.0 (Resources Inventory Committee 1999c)

Georeferenced field maps were created for baseline surveys using ArcMap and consisted of Terrain Resource Information Management (TRIM), proposed Project infrastructure, and pre-determined survey location point grids over ortho-images. The field maps were loaded on to GPS activated tablets that were used for navigation and data collection in the field. During the baseline surveys, all survey points and tracks were recorded on the tablets and a handheld Garmin GPS unit was used to provide more accurate locations for post-field mapping as well as in-field back-up. Photos were taken of survey locations and any observed animals and habitat features were recorded with field notes outlining habitat characteristics. Visual assessments were conducted opportunistically when suitable habitats, features, or avian species were encountered incidentally during non-target avian surveys or other wildlife or ecosystem surveys.

2.2.1 Point Count Surveys

Songbird relative abundance surveys were conducted between early June and mid-July in 2017 and 2018 using variable radius point count and transect survey methods (Resources Inventory Committee 1999b). Survey locations and routes were selected to cover the representative habitat types within the Project Area. All point count data were recorded on standardized data forms using standard songbird survey codes and entered in a database containing corresponding fields.

The point count surveys began at sunrise and typically continued for four hours. Survey time was extended by one additional hour if singing continued; this decision was based on the weather, the chronology of the breeding season (i.e., birds sing longer into the morning earlier in the breeding season), and the professional judgement of surveyors. At each point count station, a single observer conducted an eight-minute survey and recorded all visual and aural detections by species including the estimated distance and direction of each bird from the observer. The sex and behaviour/activity of each bird detected were also recorded when possible. A second observer recorded the date and time of the survey, a UTM location of plot centre, and the weather conditions at the time of the survey (temperature, wind speed, cloud cover, cloud ceiling, precipitation) at each point count station.

Habitat characteristics were also recorded at each point count station. Basic habitat information was collected in 2017 including structural stage, stand age, and dominant tree and shrub species. A Site Visit Form (SIVI FS1333) was completed to the ground inspection level at each point count station in 2018. The locations of the point count stations were later overlaid with Terrestrial Ecosystem Mapping (TEM) data for a more detailed habitat analysis.

A presence/not detected transect survey was conducted between each point count station and all species detected were recorded. Several additional transect surveys were conducted in potentially unique or especially productive habitats to locate any other avian species that may be associated with these habitat types.

Diversity Analysis

A species accumulation curve was used to provide a visual representation of the accumulation of species detected with increasing sampling effort. Analysis of the data included only those species documented during point count surveys (i.e., excluded transect observations, species detected outside of point count plots, and incidental observations). The ecosystems sampled within the Wildlife RSA were relatively similar and as a result all point counts were grouped together. The species accumulation curve analysis was conducted in R (version 3.6.3) (R Development Core Team 2020) using the vegan package (Miller et al. 2019). The "random" method (i.e., adding sites in a random order) was used, which finds the mean species accumulation curve and its standard deviation from 1,000 random permutations of the data.

2.2.2 Northern Goshawk Surveys

Raptor presence/not detected surveys consisted of call playback surveys for northern goshawk (*Accipiter gentilis atricapillus*) (Resources Inventory Committee 2001). Call playback surveys were conducted in conjunction with point count surveys between early June and mid-July in 2017 and 2018. When potential goshawk breeding habitat (mature to old forest) was encountered or in the nearby vicinity, a call playback survey was conducted at the point count station after the point count survey was completed.

The suitability of northern goshawk nesting habitat was rated at each call playback station. Key habitat variables recorded included stand age, stand height, canopy closure, and tree species. These habitat variables relate to trees with branch form and size adequate to support a nest (primarily related to stand age and species), and stands that offer good sub-canopy flyways (primarily related to stand height, canopy closure, and species composition), which goshawks use to access their nests (Stuart-Smith et al. 2012). A 4-class rating system (Nil, Low, Moderate, and High) was recorded for each playback station as well as at wildlife habitat assessments completed at TEM plots (Resources Inventory Committee 1999a). These habitat suitability ratings were then used to inform the development of the northern goshawk habitat suitability model (Section 2.3.6, Appendix A).

2.2.3 Waterbird Migration Surveys

Aerial and ground-based spring migration surveys were conducted in April and May 2019 to document waterbird species and habitat use within representative habitat types in the Wildlife LSA and RSA. Spring migration and breeding surveys for waterbirds were conducted between two and four hours of sunrise on good weather days (no rain and low wind).

Aerial surveys were conducted over the local and regional watercourses and wetlands within the Wildlife LSA and RSA using a Bell 206 Jet Ranger helicopter following provincial standards (Resources Inventory Committee 1999c). The helicopter was flown at 60 to 80 m above the water at speeds between 60 to 90 km/h. A minimum of two observers were present to search for waterbirds on or adjacent to aquatic habitats. Flight tracks and bird observations were recorded, and information was collected on the species, number, age group, sex, activity, and habitat type for all species observed. While the survey was focused on waterbirds, observers also documented any observations of raptors or raptor nests (e.g., bald eagle, osprey) made during the survey.

Ground-based surveys were conducted in areas accessible by foot within the Wildlife LSA following provincial standards (Resources Inventory Committee 1999c). Survey locations were identified during the aerial surveys based on habitat present and observed waterbird use. Surveys consisting of observation stations and transects between stations were completed to search for waterbirds on or adjacent to aquatic habitats. Time spent at observation stations was dependent on the number of birds present at each location (all birds present were recorded). Transects were traversed at a speed that enabled detection of all birds.

Survey tracks and bird observations were recorded, and information was collected on the species, number, age group, sex, activity, and habitat type for all species observed.

Baseline surveys did not include targeted surveys for riverine species (e.g., harlequin duck (*Histrionicus histrionicus*), belted kingfisher (*Megaceryle alcyon*), and American dipper (*Cinclus mexicanus*)) as the proposed Project is not expected to directly interact with suitable habitats (i.e., footprint does not overlap with those habitats). However, surveyors watched for these species when conducting other survey work in the Wildlife LSA including during aerial surveys and the wildlife habitat assessment work associated with TEM and wetland function assessments.

2.2.4 Bird Acoustic Monitoring

Acoustic recordings of bird species were collected from 2017 to 2019 in nine locations throughout the Wildlife LSA. Three to four full spectrum bioacoustic and ultrasonic recorders (model SM3BAT), manufactured by Wildlife Acoustics, Inc. were deployed to collect bird songs and calls for potential future monitoring purposes. These Automated Recording Units (ARUs) were capable of 16-bit digital high-speed sampling and each was outfitted with a single acoustic microphone (Wildlife Acoustics Inc. 2018a). Sampling parameters varied between, and in some cases within years, to provide opportunities to monitor different species guilds (i.e., breeding birds or owls) as well as attempt to determine optimal recording strategies to maximize battery life and memory storage. The various parameters are provided in Table 3 with the locations of the acoustic monitoring stations. Some locations were used in multiple years to provide multi-year sampling data sets.

Table 3: Acoustic Monitoring Locations, Operating Dates, and Recording Parameters (2017 to 2019)

Year	Location ID	General Area	Operating Dates	Parameters ¹
2017	17-ARU 1-1	Mine Features Area	May 29 to July 20	Starting 1 hour before sunrise, record 15 minutes per hour for 3 hours; providing 45 minutes of breeding bird recordings per day. Starting 3 hours after sunset, record 15 minutes per hour for 2 hours; providing 30 minutes of owl and night bird recordings per day.
	17-ARU 1-2	Mine Features Area	July 28 to September 18	
	17-ARU 2-1	Mine Features Area	May 29 to September 18	
	17-ARU 3-1	Mine Features Area	May 29 to September 5	
	17-ARU 4-1	Rail Features Area	June 3 to September 4	
2018	18-ARU 2-1	Mine Features Area	May 31 to June 12	Starting 1 hour before sunrise, record in 10-minute intervals for 2 hours; providing 120 minutes of breeding bird recordings per day.
	18-ARU 2-1	Mine Features Area	June 14 to September 10	Starting 1 hour before sunrise, record in 10-minute intervals for 2 hours; providing 120 minutes of breeding bird recordings every third day.
	18-ARU 3-1	Linear Features Area	July 27 to September 26	Starting at sunset, record in 10-minute intervals for 2 hours; providing 120 minutes of owl and night bird recordings every third day.
	18-ARU 4-1	Linear Features Area	July 27 to September 11	
2019	19-ARU 2-1	Mine Features Area	April 24 to May 24	Starting 2 hours after sunset, record in 15-minute intervals for 2 hours; providing 120 minutes of owl and night bird recordings.
	19-ARU 3-1	Mine Features Area	April 24 to May 23	
	19-ARU 4-1	Linear Features Area	April 24 to May 20	
	19-ARU 2-1	Mine Features Area	May 24 to August 15	Starting at sunset, record 25 minutes then pause 30 minutes for 4 hours; providing 100 minutes of owl and night bird recordings.
	19-ARU 3-1	Mine Features Area	May 24 to September 22	
	19-ARU 4-1	Linear Features Area	May 31 to September 29	

¹ Recording parameters were programmed using the SM3 Configurator, as per the methods outlined in the Wildlife Acoustics SM3BAT Bioacoustic Recorder User Guide (Wildlife Acoustics Inc. 2018b).

Batteries and SD memory cards were replaced approximately monthly, with the data downloaded and stored separately for each unit and sampling session. The data underwent a preliminary review to identify any issues with recording parameters or the acoustic monitor operation and allow corrections or repairs to be made.

A preliminary cluster analysis and simple classification of the data was undertaken following the methods outlined in the *Kaleidoscope Pro 5 User Guide* (Wildlife Acoustics Inc. 2018b) to attempt to identify if species of conservation concern such as olive-sided flycatcher, barn swallow or common nighthawk could be identified within the recordings. Visual and auditory sampling of the data from several of the ARUs from 2017 to 2019 was also completed, with the idea of trying to understand the best way to find identify if species such as common nighthawk, owls or swallows could be detected.

2.2.5 Incidental Observations

Incidental observations of birds were recorded during a variety of other terrestrial baseline work completed within the Wildlife LSA and RSA from 2017 to 2019. Information on the location, date, species, number, age group, sex, activity, and habitat type were recorded for each observation.

2.2.6 Habitat Suitability Modelling

Quantitative habitat suitability models were created to identify available habitat for four species: common nighthawk, olive-sided flycatcher, northern goshawk, and short-eared owl, and three migratory bird habitat guilds: open and successional habitats (open habitat), young through old forest (forest habitat), and wetlands or riparian areas (wetland/riparian habitat). The species selected were considered likely to be key species or groups evaluated as part of the Project effects assessment. As a group, the three migratory breeding bird habitat guilds were also modelled to provide an indication of the overall amount of habitat and density of breeding birds throughout the Wildlife RSA.

Habitat suitability models used a combination of spatial datasets of ecosystems, vegetation, and anthropogenic features and life history information to identify suitable habitat. The models were developed using a four-class rating system as a predictor of habitat quality and included high, moderate, low, and nil suitability. The specific methods used to develop the habitat suitability models are provided in Appendices A to E. The models developed were not focused exclusively on nesting habitat but are intended to include all habitats used during the breeding season including those used for foraging, security/thermal, and nesting.

2.2.7 Qualitative Habitat Assessments

In addition to the habitat suitability modelling conducted for select focal species, qualitative habitat descriptions were used to identify habitat for four other focal species: bank swallow, barn swallow, black swift, and rusty blackbird. Habitat suitability modeling was not completed for these species due to their preference for specific habitat features that are not generally identifiable using available spatial data (i.e., bank swallow, barn swallow and black swift) or because the other habitat suitability models already covered focal habitats used by the species (i.e., rusty blackbird habitat is covered by the wetlands habitat guild model). The full qualitative habitat assessments are provided in Appendix F.

The qualitative habitat assessment consisted of a literature review to describe the status and key threats to the species, as well as the species distribution and typical habitat use. A review of aerial imagery for the Wildlife RSA was then used in conjunction with observations from baseline field surveys to identify and spatially describe the location of potentially suitable nesting habitat.

2.2.8 Density Analysis

To estimate bird densities within the Wildlife RSA, point count survey data collected for the Project was combined with point count data within the Wildlife RSA from the BC BBA. A density calculation was made for each species detected during the point count surveys by dividing the total number of birds detected by the total area surveyed assuming a 75 m effective detection radius. All birds detected within 75 m of the observer during both the Project baseline and BC BBA point count surveys were included in the analysis; birds detected past the 75 m distance were removed from the analysis. Species densities were calculated for the Wildlife RSA, each habitat guild, and each BGC subzone within each habitat guild. A mean density for all species within each guild was then calculated; this mean density was then used to calculate an abundance for each guild for the Wildlife RSA, each habitat, and each BGC subzone by habitat. A more detailed description of the methods used in the density analysis is provided in Appendix E.

3. RESULTS

3.1 Desktop Review

3.1.1 Regulatory and Policy Context

The Pacific/Yukon Region of Environment and Climate Change Canada (ECCC) administers or shares responsibility for several Acts addressing legislation and regulations related to avian species. The BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) is responsible for administering provincial legislation and regulations related to avian species. Legislation and regulations applicable to avian species are summarized in Table 4.

Table 4: Applicable Legislation and Regulations Related to Avian Species

Name	Year	Description
<i>Migratory Birds Convention Act</i>	1994	The federal <i>Migratory Birds Convention Act (MBCA)</i> protects and conserves migratory birds (as individuals and populations), their eggs, and their nests in Canada through the implementation of the Migratory Birds Regulations (Government of Canada 2018). As per the <i>MBCA</i> , removal of migratory birds, their eggs, or nests from a site is only permissible if the migratory birds are causing or may cause damage to property and equipment (subject to permitting). Deposit of harmful substances to birds in areas or waters frequently visited by migratory birds is prohibited.
<i>Species at Risk Act</i>	2002	The federal <i>Species at Risk Act (SARA)</i> provides for the legal protection of plant and wildlife species to conserve their biological diversity and prevent extirpation or extinction (Government of Canada 2016). Under <i>SARA</i> , the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identifies and assesses plant and wildlife species considered at risk, which may then qualify for legal protection and recovery under <i>SARA</i> . Once listed under <i>SARA</i> , species management plans or recovery strategies are legal requirements to secure the necessary actions for species recovery and management.
<i>Wildlife Act</i>	1996	The BC <i>Wildlife Act</i> defines wildlife as all native (and some non-native) amphibians, birds, mammals, and reptiles that live in BC (BC Ministry of Forests, Lands and Natural Resource Operations 2020). The <i>Wildlife Act</i> provides for the protection, conservation, and management of wildlife populations and wildlife habitats within BC. Under Section 34 of the <i>Act</i> , it is an offence to possess, take, injure, molest, or destroy a bird, its egg(s), or a nest that is occupied by a bird or its egg(s). The nests of certain species ¹ are protected year-round. Wildlife species can be legally designated as endangered, threatened, or special concern under the <i>Act</i> , which enables penalties for killing or harming wildlife, or the establishment of Critical Wildlife Habitats in Wildlife Management Areas. ¹ Eagle, peregrine falcon, gyrfalcon (<i>Falco rusticolus</i>), osprey, heron, or burrowing owl (<i>Athene cunicularia</i>).
<i>Forest and Range Practices Act</i>	2002	The BC <i>Forest and Range Practices Act (FRPA)</i> outlines standards and requirements for how forest and range practices and natural resource activities should be conducted on Crown land in BC in a manner that protects natural resources, including avian species (Government of British Columbia 2020b). Mechanisms under the <i>FRPA</i> that protect listed species include Wildlife Habitat Areas and Identified Wildlife species (BC Ministry of Environment 2020a). Identified Wildlife includes species legally designated as endangered, threatened, or special concern under the BC <i>Wildlife Act</i> (BC Ministry of Environment 2020b). Identified Wildlife also includes species considered important to a region of BC, species that rely on habitats not otherwise protected under the <i>FRPA</i> , or species that may be adversely affected by forest and range practices.

Strategies, Guidelines, Plans, and Best Management Practices

In addition to the federal and provincial legislation and regulations identified above, there are additional federal and provincial strategies, guidelines, plans, and BMPs relevant to avian species.

- ▶ Identified Wildlife Management Strategy – Accounts and Measures for Managing Identified Wildlife: Northern Interior Forest Region (BC Ministry of Water, Land and Air Protection 2004a)
- ▶ Identified Wildlife Management Strategy – Procedures for Managing Identified Wildlife (BC Ministry of Water, Land and Air Protection 2004b)
- ▶ A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (BC Ministry of Forests, Lands and Natural Resource Operations 2014)
- ▶ Bird Conservation Strategy for Bird Conservation Region 10 Pacific and Yukon Region: Northern Rockies (Environment Canada 2013)
- ▶ Action Plan for Recovery and Conservation of Interior Northern Goshawks in the Skeena Region (Eamer 2018)
- ▶ A Scientific Basis for Managing Northern Goshawk Breeding Areas in the Interior of British Columbia: Best Management Practices (Stuart-Smith et al. 2012)
- ▶ Science-Based Guidelines for Managing Northern Goshawk Breeding Areas in Coastal British Columbia (McClaren et al. 2015)
- ▶ Recovery Strategy for the Common Nighthawk (*Chordeiles minor*) in Canada (Environment Canada 2016a)
- ▶ Recovery Strategy for the Olive-sided Flycatcher (*Contopus cooperi*) in Canada (Environment Canada 2016b)
- ▶ Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Canada (Environment Canada 2015)
- ▶ Management Plan for the Short-eared Owl (*Asio flammeus*) in Canada (Environment and Climate Change Canada 2018a)

Land Use Plans

The Wildlife RSA overlaps portions of the Bulkley Valley Sustainable Resource Management Plan (BC Ministry of Agriculture and Lands 2005), the Bulkley Land and Resource Management Plan (Government of British Columbia 1998), and the Morice Land and Resource Management Plan (Government of British Columbia 2004). Avian-related management goals in these land use plans that are relevant to the baseline report are presented in Table 5.

Table 5: Avian Species Management Goals and Objectives Established in Applicable Land Use Plans

Land Use Plan	Wildlife Resource	Goals	Objectives
Bulkley Valley Sustainable Resource Management Plan	Nothing specific to avian species	N/A	N/A
Bulkley Land and Resource Management Plan	Wildlife	Maintain wildlife habitat diversity	Maintain a wildlife corridor (for wetlands)
Morice Land and Resource Management Plan	Northern Goshawk	Protection of known nest sites	Buffer around nest trees, limitations on nearby industrial activities during nesting and fledging seasons

3.1.2 Species Overview and Conservation Status

The Wildlife RSA provides habitat for a variety of bird species that utilize a wide range of aquatic and terrestrial habitats. The desktop review identified 195 species that have previously been detected in the Wildlife RSA (Appendix G). Most of these species are migratory and occur during the summer breeding season (i.e., late April to mid August) (Environment and Climate Change Canada 2018b). The earliest spring migrants arrive as early as February or March; however, most migrants arrive during April (raptors and waterfowl) and May (songbirds and shorebirds) (Campbell et al. 1997, 2001, 1990a, 1990b, eBird 2020). Fall migration begins in late July and is complete for most songbirds and shorebirds by the end of September, and for most waterfowl and raptors by early November, with the latest fall migrants departing by December (e.g., northern shrike [*Lanius borealis*]) (Campbell et al. 1997, 2001, 1990a, 1990b, eBird 2020). The relatively harsh winter weather in the Project region results in a lower diversity of wintering species; however, approximately 50 avian species may be found in the region year-round including a variety of raptors, corvids (jays and crows), grouse, ptarmigan, and select passerine species (e.g., chickadees [*Poecile* sp.], crossbills [*Loxia* sp.]) (eBird 2020, National Audubon Society 2020).

Bird Conservation Strategy for BCR 10

The Wildlife RSA is located within Bird Conservation Region (BCR) 10 (Pacific and Yukon Region: Northern Rockies). Within Canada, this BCR covers the Columbia and Rocky Mountains from the Canada-US border in the south to the southern edge of the boreal forest in the north; from the Rocky Mountains it extends westward over the central plateau in interior BC to the Coast Mountains (Environment Canada 2013). BCR 10 is an ecologically diverse region resulting in an equally diverse bird fauna. An estimated 230 bird species regularly breed, overwinter, and/or reside here year-round, of which, 77 species are identified as priority species for conservation in the region (Environment Canada 2013). The priority species list for this BCR is dominated by landbirds (50 species, including 11 raptor species), but also includes various waterbirds (including 12 waterfowl species, 4 shorebird species, and 11 other species of waterbirds) (Environment Canada 2013). Comparison of the BCR 10 priority species list with the list of species present within the Wildlife RSA identified 52 priority species which many be expected to occur in the Wildlife RSA (Appendix G).

Federal and Provincial Species at Risk

Cross-referencing the BC Species and Ecosystems Explorer search results (BC Conservation Data Centre 2020) for avian species or subspecies of conservation concern with the list of species that either have occurred in the Wildlife RSA or have been found adjacent to the Wildlife RSA, and for which suitable breeding habitat is likely present within the Wildlife RSA, identified 17 species of conservation concern that

may be found in within the Wildlife RSA (Table 6). These include seven landbird, six waterbird and four raptor species listed as Special Concern, Threatened or Endangered either provincially and/or federally.

The location of provincially or federally listed species of conservation concern previously documented within the Wildlife RSA is displayed on Figure 3. Most records of species of conservation concern were along the major roads and recreation areas associated with the village of Telkwa and town of Smithers, and likely reflect the amount of observer effort and not the actual distribution of these species in the Wildlife RSA.

Table 6: Species of Conservation Concern Recorded in the Wildlife Regional Study Area

Species Name		Conservation Status			Dataset(s)	Records	Comments
Common	Scientific	Provincial	Federal				
		BC CDC ¹	COSEWIC ²	SARA ³			
American Bittern	<i>Botaurus lentiginosus</i>	Blue	--	--	eBird	3	All records from same location; potentially breeding
Bank Swallow	<i>Riparia riparia</i>	Yellow	Threatened	Threatened	eBird, BBS	18	Potentially breeding
Barn Swallow	<i>Hirundo rustica</i>	Blue	Threatened	Threatened	eBird, BBS, BC BBA	91	Potentially breeding
Black Swift	<i>Cypseloides niger</i>	Blue	Endangered	Endangered	eBird	8	Potentially breeding
Common Nighthawk	<i>Chordeiles minor</i>	Yellow	Special Concern	Threatened	eBird	6	Potentially breeding
Eared Grebe	<i>Podiceps nigricollis</i>	Blue	--	--	eBird	1	Potentially breeding
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Yellow	Special Concern	Special Concern	eBird, BC BBA	66	Potentially breeding
Great Blue Heron, <i>herodias</i> subspecies	<i>Ardea herodias herodias</i>	Blue	Special Concern	Special Concern	eBird	1	Detected in early August, unknown if breeding
Horned Grebe	<i>Podiceps auritus</i>	Yellow	Special Concern	Special Concern	eBird	14	All records were during migration; unknown if breeding
Long-billed Curlew	<i>Numenius americanus</i>	Blue	Special Concern	Special Concern	eBird	1	Detected in April and likely a migrant
Northern Goshawk, <i>atricapillus</i> subspecies	<i>Accipiter gentilis atricapillus</i>	Blue	Not at Risk	--	eBird, BBS	16	Nine potential breeding records; seven records from migration or winter
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Blue	Special Concern	Threatened	eBird, BBS, BC BBA	85	Potentially breeding
Peregrine Falcon, <i>anatum</i> subspecies	<i>Falco peregrinus anatum</i>	Red	Not at Risk	Special Concern	eBird, BBS/BC BBA	2	One record in unsuitable breeding habitat; one record during migration

Species Name		Conservation Status			Dataset(s)	Records	Comments
Common	Scientific	Provincial	Federal				
		BC CDC ¹	COSEWIC ²	SARA ³			
Rusty Blackbird	<i>Euphagus carolinus</i>	Blue	Special Concern	Special Concern	eBird	7	Two potential breeding records; all others were migrants
Short-eared Owl	<i>Asio flammeus</i>	Blue	Special Concern	Special Concern	eBird, BBS	7	Two potential breeding records; all other records detected during migration or winter
Swainson's Hawk	<i>Buteo swainsoni</i>	Red	--	--	eBird, BC BBA	3	Two potential breeding records; one likely a migrant

¹ British Columbia Conservation Data Centre (BC CDC): Red=species that are Endangered or Threatened; Blue=species that are Special Concern (BC Conservation Data Centre 2020).

² Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered=species facing imminent extirpation or extinction; Threatened=species that are likely to become endangered if limiting factors are not reversed; Special Concern=species with characteristics that make them particularly sensitive to human activities or natural events; Not At Risk=species that have been evaluated and found to be not at risk.

³ Species at Risk Act (SARA): species that are listed under the federal SARA; uses the same ranking system as COSEWIC.

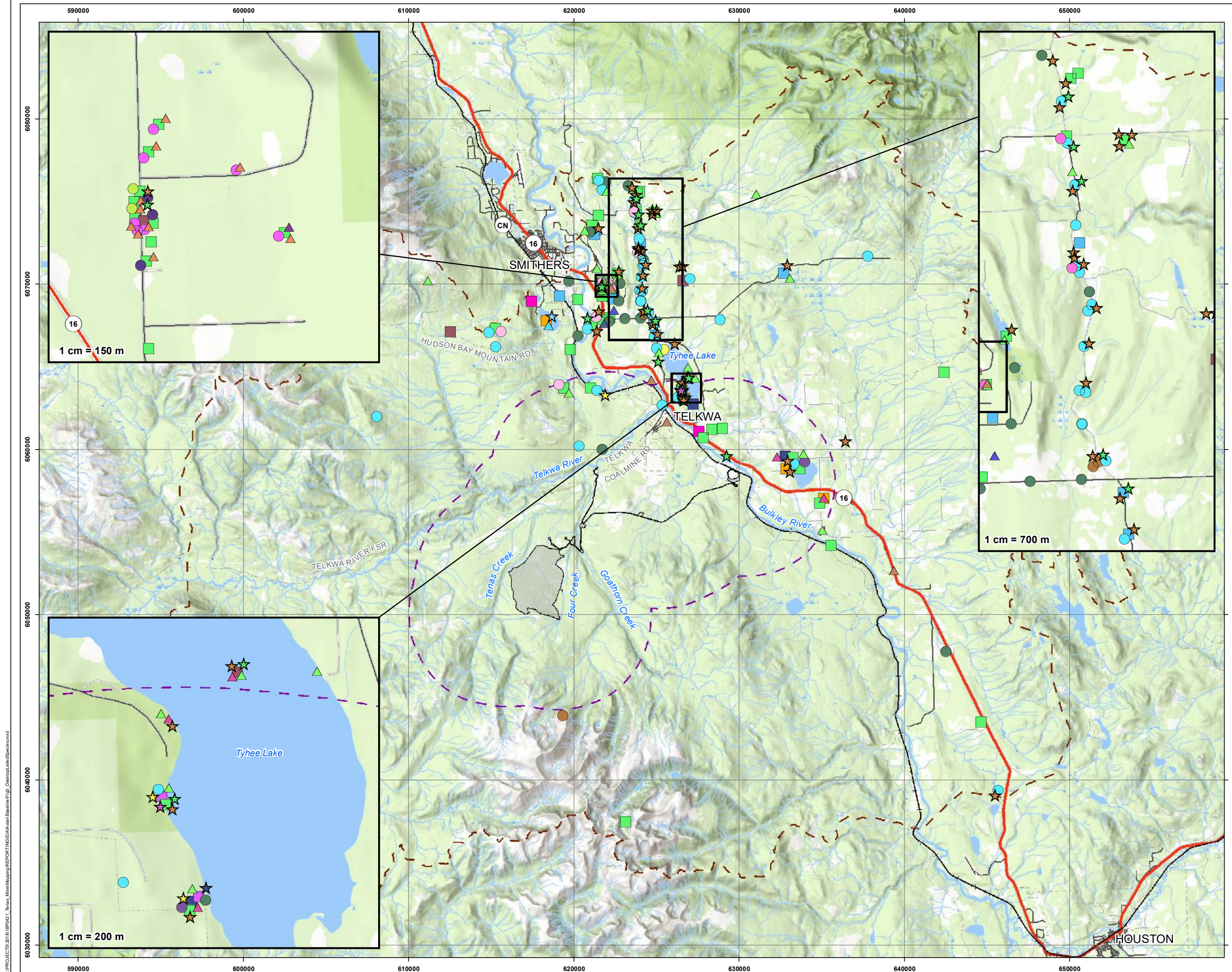
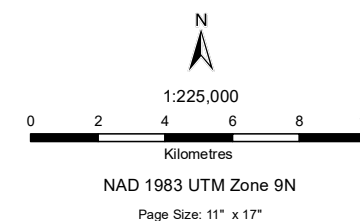
Historical Detections

- ## Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Historical Detections: Government of British Columbia
- Basedata: Government of British Columbia
- Basemap: World Topo Base



Other Provincially or Regionally Identified Species

The review of provincially and regionally identified species of concern noted several species that have previously been observed within the Wildlife RSA:

- ▶ Great blue heron — listed as an Identified Wildlife species under the BC *Forest and Range Practices Act (FRPA)* (Government of British Columbia 2020b),
- ▶ Long-billed curlew — listed as an Identified Wildlife species under the BC *FRPA* (Government of British Columbia 2020b),
- ▶ Northern goshawk — listed as a species of conservation concern within the Morice Land and Resource Management Plan (Government of British Columbia 2004),
- ▶ Sandhill crane — listed as an Identified Wildlife species under the BC *FRPA* (Government of British Columbia 2020b), and
- ▶ Short-eared owl — listed as an Identified Wildlife species under the BC *FRPA* (Government of British Columbia 2020b).

3.1.3 Traditional Knowledge

The Cultural Use Study (CUS) compiled a baseline inventory of cultural heritage resources pertaining to Wet'suwet'en communities by examining pre-existing cultural, social, historic, and economic data (Budhwa et al. 2020). The CUS and other relevant sources of TK (Warner 1983, Rescan Environmental Services Ltd 2008) were reviewed for information relating to avian species. The review found limited information specific to birds. However, more broadly, recognition of the value of the natural environment, which extends to birds, is intrinsic throughout the available TK:

“The Wet'suwet'en continue to maintain a substantial connection to their hereditary lands by way of *Yintah*. For the Wet'suwet'en, *Yintah* is a central factor in their culture; it is the physical and spiritual connection that everything has to their territories (Morris et al. 2006:27; OW 2013a:14) ... [*Yintah* is] a concept in which all environmental components—from plants and animals to waterways and mountains—are all interconnected and linked with the human world (OW 2011:111)” (Budhwa et al. 2020).

Available information specific to birds is primarily related to harvest species and the importance of hunting within the First Nations' culture:

“The Wet'suwet'en maintain a special relationship with the wildlife that inhabit their territories. This relationship manifests in the traditional activities of hunting and trapping, as well as in the prominent use of wildlife in the feast system ... Respect for animals and territories is among the traditional values and methods of hunting that are integrated into oral histories and are part of the transmission of knowledge between elders and children (Jenness 1943:522)” (Budhwa et al. 2020).

Specific details of avian species harvested within the Wildlife RSA are primarily focused on the past and present harvest of grouse, including ruffed grouse (*Bonasa umbellus*), spruce grouse (*Falcipennis canadensis*), and dusky/sooty grouse (*Dendragapus* sp.) (Rescan Environmental Services Ltd 2008, Budhwa et al. 2020). The Telkwa Pass is specifically referenced as an area within the Wildlife RSA where Wet'suwet'en hunt grouse (Budhwa et al. 2020). Reference is also made to past harvest of migratory birds in the spring (Budhwa et al. 2020), presumably waterfowl and/or other waterbirds during the spring migration, and past harvest of migrating waterfowl during the fall migration (Warner 1983).

3.2 Point Count Surveys

Point count surveys were completed on six survey days between June 8 and July 10, 2017 and on 14 survey days between June 4 and July 13, 2018. A total of 104 point counts were conducted in 2017 and 144 point counts were conducted in 2018 for a total of 248 point counts overall. All of the point count surveys conducted were within the Wildlife LSA, with surveys concentrated along the Project Area (Figure 4). Given that point count surveys were targeting habitats within the Project Area, most point count locations were in the SBSdk and SBSmc2 (Table 7).

Table 7: Point Count Survey Locations by Biogeoclimatic Subzone

BGC Subzone	Proportion of Wildlife LSA by BGC Subzone	Proportion of Project Area by BGC Subzone	Number of Point Counts
SBSdk	53%	7%	111
SBSmc2	30%	93%	131
ESSFmc	16%	<1%	6
Other (i.e., ESSFmcp and BAFAun)	<2%	--	--

Notes: BGC=biogeoclimatic; SBSdk=Sub-Boreal Spruce Dry Cool; SBSmc2=Sub-Boreal Spruce Babine Moist Cold; ESSFmc=Engelmann Spruce – Subalpine Fir Moist Cold; ESSFmcp=Engelmann Spruce – Subalpine Fir Moist Cold Parkland; BAFAun= Boreal Altai Fescue Alpine Undifferentiated; LSA=Local Study Area; %=percent

Overall, 65 species were detected during the point count surveys (Appendix H). These included 55 passerines (i.e., songbird) species, four woodpecker species, one hummingbird species, one grouse species, one waterfowl species, one shorebird species and two raptor species. The passerine species recorded included a variety of flycatchers, vireos, tanagers, jays and crows, swallows, chickadees, creepers and nuthatches, kinglets, thrushes, waxwings, warblers, wrens, sparrows, and finches. Most of the species detected were typical of the region; however, two extralimital species were detected. On June 6, 2018 a single Vesper's sparrow (*Pooecetes gramineus*), a singing male, was detected at a point count along a powerline right of way in the SBSdk. Additionally, yellow-bellied flycatcher (*Empidonax flaviventris*) was detected on a few different point counts between June 5-18, 2018. All observations were of singing males in regenerating cutblocks or other young forest habitats within the SBSdk and SBSmc2 subzone variants. Olive-sided flycatcher was the only species of conservation concern detected during the point count surveys. Olive-sided flycatcher were documented in six observations in 2017, and five observations in 2018. The observations were predominantly located in coniferous forest habitats within the SBSmc2 subzone variant, with most occurring among a matrix of regenerating cutblock and remnant patches of mature forest. Nine of the 11 olive-sided flycatcher detections were located within the mine features area. Locations of species of conservation concern detected during all baseline surveys are shown in Figure 5.

The most common species detected across all subzones were predominantly forest-dwelling and generalist species (Table 8). In decreasing order of abundance, the most common species were Swainson's thrush, dark-eyed junco, American redstart, black-capped chickadee, American robin, warbling vireo, varied thrush, pine siskin, yellow-rumped warbler, and orange-crowned warbler. Comparison of the species richness between the BGC subzones shows a similar number of species detected in each of the SBS subzone variants (SBSdk – 56 species, SBSmc2 – 58 species) and few species detected in the ESSFmc (13 species); however, the low number of species recorded in the ESSFmc is likely due to the limited number of surveys in this subzone (Table 8). Comparison of the most common species detected in the two SBS subzone variants shows a relatively similarly list of species (Table 8); however, differences in the bird community of the SBSdk and SBSmc2 were apparent among the less commonly observed species. Several

species were commonly located in only one of the two subzones; for example: cedar waxwing (*Bombycilla cedrorum*), common yellowthroat (*Geothlypis trichas*), dusky flycatcher (*Empidonax oberholseri*), northern waterthrush (*Parkesia noveboracensis*), red-breasted sapsucker (*Sphyrapicus ruber*), Savannah sparrow (*Passerculus sandwichensis*), tree swallow (*Tachycineta bicolor*) and white-throated sparrow (*Zonotrichia albicollis*) were located solely or predominantly (i.e., ≥80% observations) in the SBSdk, while Canada jay (*Perisoreus canadensis*), mountain chickadee (*Poecile gambeli*) and olive-sided flycatcher were located solely or predominantly in the SBSmc2¹.

Comparison of point survey results across the different BGC subzones shows a potential trend towards slightly higher bird densities and species diversity at lower elevations (i.e., the SBSdk) as compared to higher elevations (i.e., the SBSmc2); however, the difference is not statistically significant (Table 8). A more detailed analysis of bird densities within the Wildlife RSA, based on the results of the point count surveys, is presented in Section 3.9.

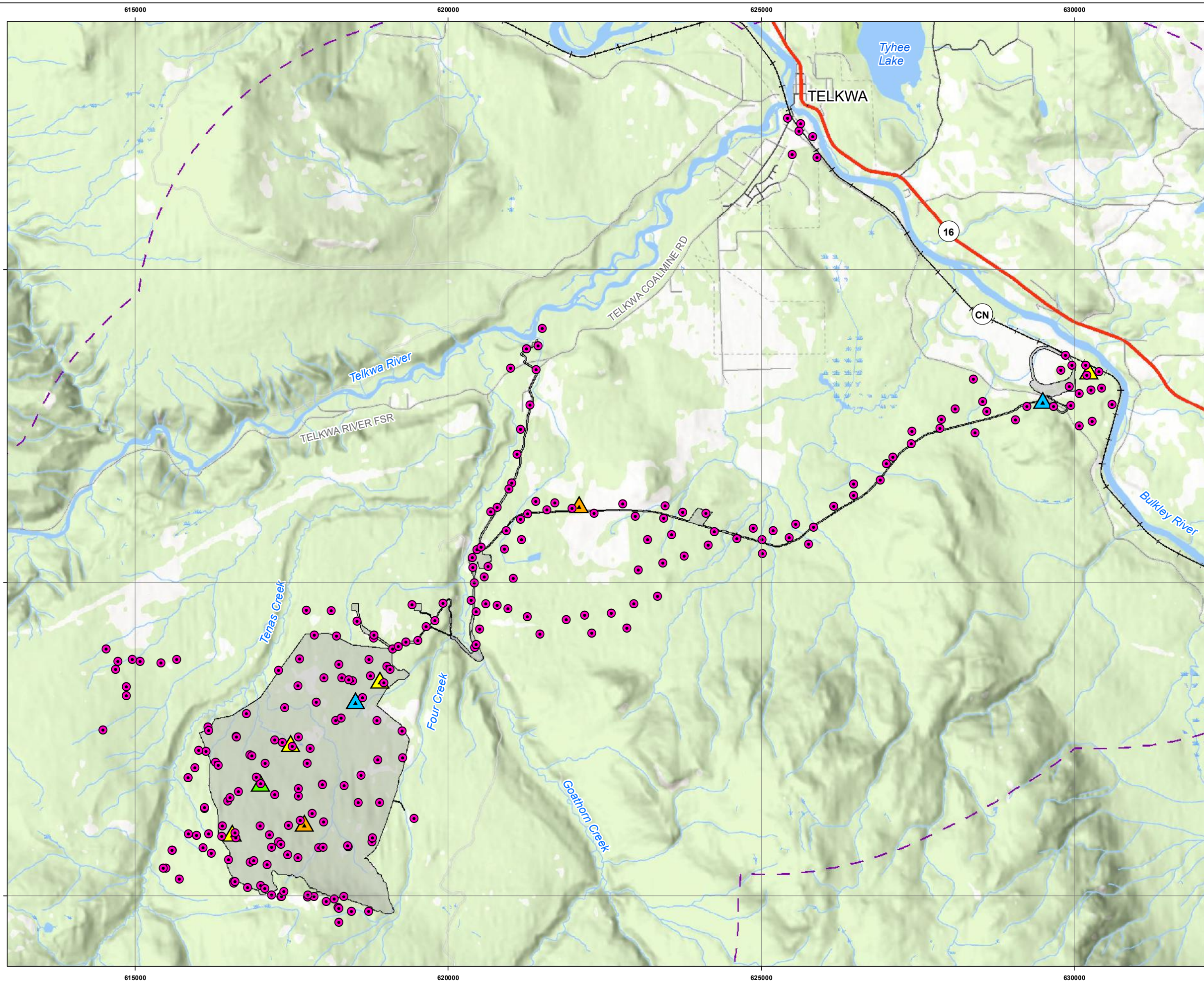
¹ List of species commonly observed in only one of the SBS subzone variants is restricted to those species with at least five observations during point count surveys. Additional species unique to a single subzone variant include those species with ≤3 observations.

Table 8: Most Common Species Detected During Point Count Surveys by Biogeoclimatic Subzone

BGC Subzone	Number of Species/ Birds Detected	Most Common Species Detected		
		Common Name	Scientific Name	Individuals Detected
SBSdk (n=111 plots)	<u>Number of Species Detected</u> Total: 56 species Average: 6.2 ± 2.3 species/plot <u>Number of Birds Detected</u> Total: 847 individuals Average: 9.2 ± 4.3 birds/plot	Swainson's Thrush	<i>Catharus ustulatus</i>	109
		American Redstart	<i>Setophaga ruticilla</i>	101
		Dark-eyed Junco	<i>Junco hyemalis</i>	66
		Black-capped Chickadee	<i>Poecile atricapillus</i>	55
		Warbling Vireo	<i>Vireo gilvus</i>	42
		American Robin	<i>Turdus migratorius</i>	38
		MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	29
		Pine Siskin	<i>Spinus pinus</i>	22
		Yellow-rumped Warbler	<i>Setophaga coronata</i>	21
		Orange-crowned Warbler	<i>Leiothlypis celata</i>	20
		Ruby-crowned Kinglet	<i>Regulus calendula</i>	20
SBSmc2 (n=131 plots)	<u>Number of Species Detected</u> Total: 58 species Average: 5.6 ± 2.7 species/plot <u>Number of Birds Detected</u> Total: 842 individuals Average: 7.9 ± 4.1 birds/plot	Swainson's Thrush	<i>Catharus ustulatus</i>	105
		Dark-eyed Junco	<i>Junco hyemalis</i>	94
		Varied Thrush	<i>Ixoreus naevius</i>	65
		American Redstart	<i>Setophaga ruticilla</i>	40
		Pine Siskin	<i>Spinus pinus</i>	38
		Yellow-rumped Warbler	<i>Setophaga coronata</i>	35
		American Robin	<i>Turdus migratorius</i>	34
		Orange-crowned Warbler	<i>Leiothlypis celata</i>	33
		Warbling Vireo	<i>Vireo gilvus</i>	30
		Golden-crowned Kinglet	<i>Regulus satrapa</i>	29
		Red-breasted Nuthatch	<i>Sitta canadensis</i>	29
ESSFmc (n=6 plots)	<u>Number of Species Detected</u> Total: 13 species Average: 3.3 ± 0.9 species/plot <u>Number of Birds Detected</u> Total: 34 individuals Average: 5.7 ± 2.0 birds/plot	Swainson's Thrush	<i>Catharus ustulatus</i>	11
		Dark-eyed Junco	<i>Junco hyemalis</i>	9
		Hermit Thrush	<i>Catharus guttatus</i>	2
		Orange-crowned Warbler	<i>Leiothlypis celata</i>	2
		Yellow Warbler	<i>Setophaga petechia</i>	2

Notes: BGC=biogeoclimatic; SBSdk=Sub-Boreal Spruce Dry Cool; SBSmc2=Sub-Boreal Spruce Babine Moist Cold; ESSFmc=Engelmann Spruce – Subalpine Fir Moist Cold

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Tenas Project

**Figure 4. Point count survey and
accoustic monitoring station
locations, 2017-2019**

Legend

● Point Count Location

Automated Recording Unit

▲ 2017

▲ 2017, 2019

▲ 2018

▲ 2018, 2019

■ Project Area

--- General Wildlife LSA

— Rail Line

— Highway

— Road

— Resource Road

— Watercourse

— Wetland

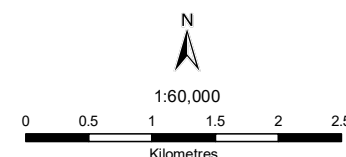
■ Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map



NAD 1983 UTM Zone 9N

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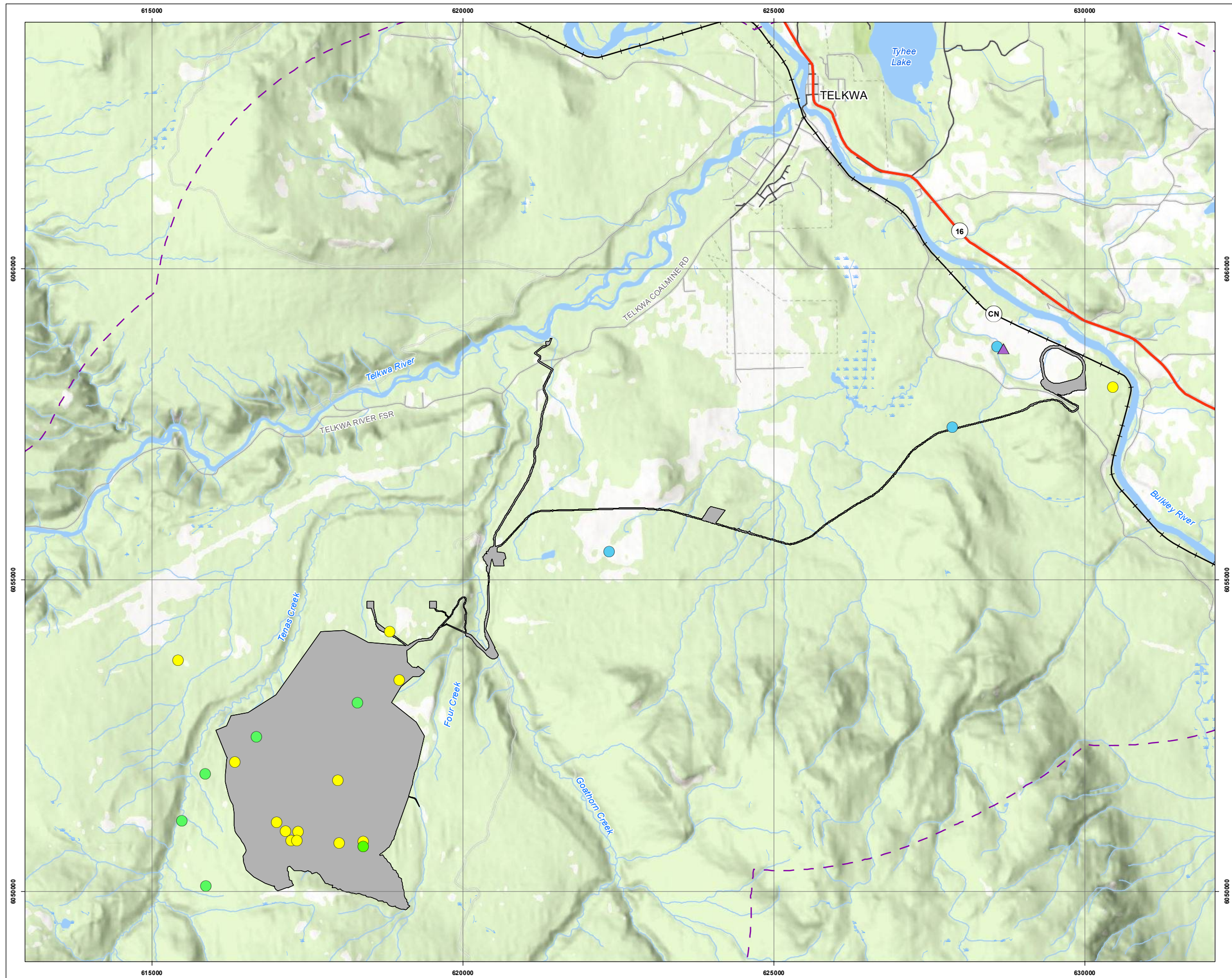
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Figure 4



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Tenas Project

Figure 5. Locations of species of conservation concern detected during baseline surveys

Legend

Baseline Detections

- Northern Goshawk
- Olive-sided Flycatcher
- Sandhill Crane

Breeding Detections

- Barn Swallow
- Project Area
- Wildlife Local Study Area

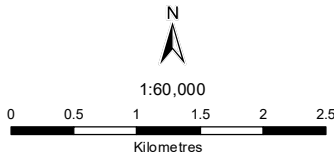
- Rail Line
- Highway
- Road
- Resource Road
- Watercourse
- Wetland
- Waterbody

Notes

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Production Date: Apr 06, 2021

Figure 5



3.2.1 Diversity Analysis

The species accumulation curve shows that the rate of new species detections during point count surveys had begun to plateau, suggesting that the sampling was likely sufficient to detect most of the upland bird species present in the Wildlife LSA (Figure 6).

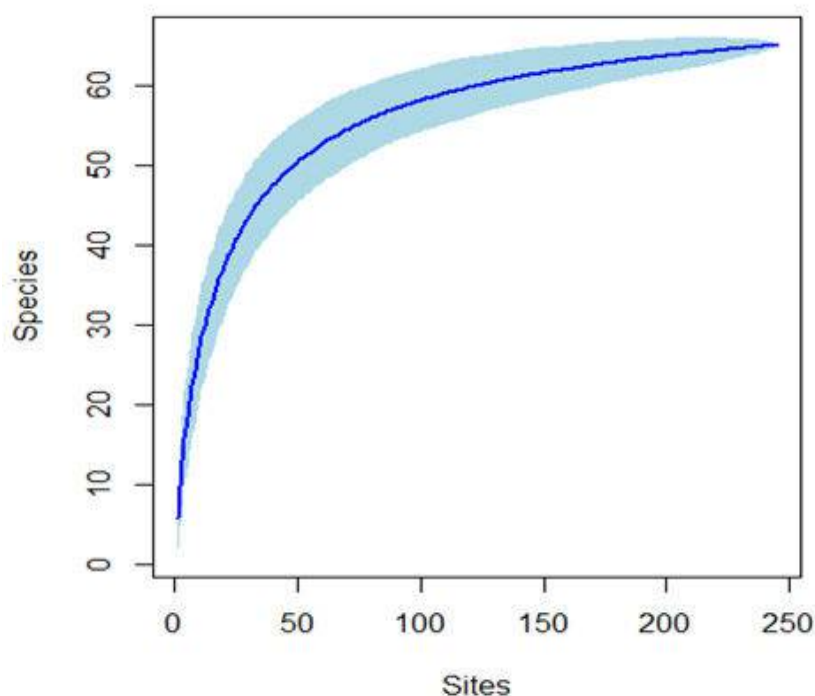
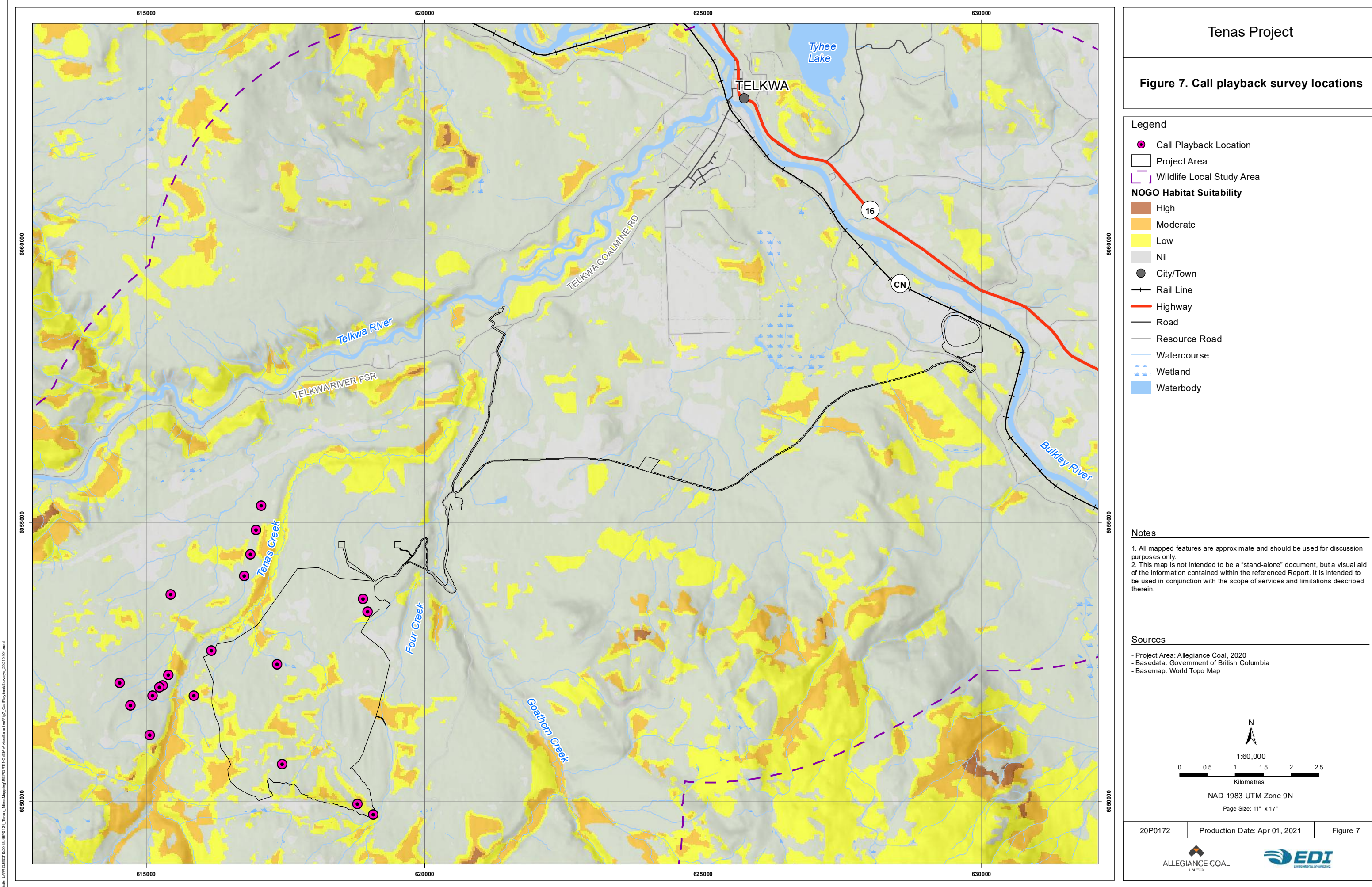


Figure 6: Species accumulation curve and standard deviation for avian species detected during point count surveys within the Wildlife Local Study Area

3.3 Northern Goshawk Surveys

Twenty call playback surveys for northern goshawk were completed between the 2017 (i.e., three surveys each in June and July) and 2018 (i.e., 14 surveys in June) field seasons. Two survey locations were in low suitability habitat and the remaining survey locations were in nil suitability habitat (as identified by the northern goshawk habitat suitability model; refer to Section 3.7.3). The survey locations ranged from 62 to 961 m from suitable habitat (i.e., moderate and high suitability). All survey locations were situated within or adjacent to the proposed mine area (Figure 7). Two survey locations were in the SBSdk subzone and the remaining survey locations were in the SBSmc2 subzone. No northern goshawks were detected during the call playback surveys. However, northern goshawk detections were made within the mine infrastructure area during other baseline surveys (refer to Section 3.6.2 for further details on these detections). Although northern goshawks were detected during other baseline surveys, no support for an active breeding territory (i.e., repeated territorial calling or sightings) within or adjacent to the Wildlife LSA was observed.



3.4 Waterbird Migration Surveys

Two aerial surveys were completed for waterfowl and other aquatic birds within the Wildlife LSA and adjacent sections of the Wildlife RSA. The first aerial survey was conducted on April 24 and covered portions of the Bulkley River, Telkwa River, Tenas Creek, and Goathorn Creek in addition to the Helps Creek, Southern Lakes, and Coffin Lake wetland complexes. The Tenas Pit, Goathorn Creek, Haul Road, and Rail Loadout areas were also surveyed. A second aerial survey was conducted on May 24 that covered the Helps Creek wetland complex and the Tenas Pit, Goathorn Creek, Haul Road, and Rail Loadout areas. Ground-based surveys were conducted at seven locations within the Wildlife LSA and RSA on April 16 and 25 and May 4 and 22. These survey locations were primarily associated with the rail features area where most spring migration activities were observed. All aerial and ground-based waterbird survey locations are shown in Figure 8.

Twenty-two waterbird species were detected during the aerial and ground-based waterbird surveys (Table 9), with a total of 753 individual waterbirds identified. The most common species detected was Canada goose (*Branta canadensis*), followed by American wigeon (*Mareca americana*) and sandhill crane (Table 9). The only species of conservation concern detected during the waterbird surveys was the sandhill crane which is listed as an *Identified Wildlife* species under the BC *FRPA*. Waterbird surveys overlapped with the migratory period for many species and some detections were obvious migrants (e.g., cackling goose [*Branta hutchinsii*], snow goose [*Anser caerulescens*]); however, other detections (e.g., mallard [*Anas platyrhynchos*], ring-necked duck [*Aythya collaris*]) may represent both breeding and migratory individuals. No riverine species were detected during the waterbird surveys.

The waterbird surveys covered watercourses and wetlands in the SBSdk, SBSmc2, and ESSFmc subzones; however, all waterbird detections were made at lower elevations in the SBSdk subzone (Figure 9). Approximately 61% of waterbirds detected during the baseline surveys were in seasonally flooded ponds in cultivated fields (Plate 1). Another 26% were in pond habitats and 11% were in wetland habitats. The remaining 2% were in cultivated field, stream, or river habitats (Table 9). Species diversity was highest in seasonally flooded ponds in cultivated fields, pond habitats, and wetland habitats with 10–12 species documented in each habitat type. Species diversity was much lower in the cultivated field, stream, and river habitats. Mallard was the most widely distributed species across all habitat types.

While not the focus of the waterbird surveys, raptors and raptor nests were documented as incidental observations whenever they were encountered during the aerial and ground-based surveys. Survey observations included two osprey nests located along the Bulkley River (see Section 4.2.3) and a couple observations of bald eagles along the Bulkley River and near the rail features area.



Plate 1: Seasonally flooded pond in a cultivated field Habitat near the Rail Features Area

Table 9: Summary of Waterbird Survey Results by Habitat

Common Name	Scientific Name	Total Observed by Habitat Type						Total
		Seasonal Pond ¹	Pond	Wetland	River	Stream	Cultivated Field	
Canada Goose	<i>Branta canadensis</i>	156	21	17	--	--	--	194
American Wigeon	<i>Mareca americana</i>	20	100	1	--	--	--	121
Sandhill Crane	<i>Antigone canadensis</i>	100	--	--	--	--	5	105
Mallard	<i>Anas platyrhynchos</i>	21	56	10	--	2	4	94
Ring-necked Duck	<i>Aythya collaris</i>	32	2	30	--	--	--	64
Snow Goose	<i>Anser caerulescens</i>	50	--	--	--	--	--	50
Trumpeter Swan	<i>Cygnus buccinator</i>	50	--	--	--	--	--	50
Cackling Goose	<i>Branta hutchinsii</i>	12	--	--	--	--	--	12
Killdeer	<i>Charadrius vociferus</i>	12	--	--	--	--	--	12
Redhead	<i>Aythya americana</i>	4	4	--	--	--	--	8
Lesser Scaup	<i>Aythya affinis</i>	--	--	7	--	--	--	7
Green-winged Teal	<i>Anas crecca</i>	--	4	2	--	--	--	6
Bufflehead	<i>Bucephala albeola</i>	--	--	2	--	3	--	5
Greater Yellowlegs	<i>Tringa melanoleuca</i>	--	3	2	--	--	--	5
Northern Shoveler	<i>Spatula clypeata</i>	--	4	--	--	--	--	4
Red-necked Grebe	<i>Podiceps grisegena</i>	--	--	2	--	--	--	2
Common Loon	<i>Gavia immer</i>	--	--	1	--	--	--	1
Common Merganser	<i>Mergus merganser</i>	--	--	1	--	--	--	1
Eurasian Wigeon	<i>Mareca penelope</i>	1	--	--	--	--	--	1
Greater White-fronted Goose	<i>Anser albifrons</i>	--	1	--	--	--	--	1
Northern Pintail	<i>Anas acuta</i>	--	1	--	--	--	--	1
Unspecified Scaup	<i>Aythya sp.</i>	1	--	--	--	--	--	1
Unspecified Goldeneye	<i>Bucephala sp.</i>	--	--	6	--	--	--	6
Unspecified Diving Duck		--	--	--	2	--	--	2

¹ Seasonal pond refers to seasonally flooded pond habitats located in cultivated fields.

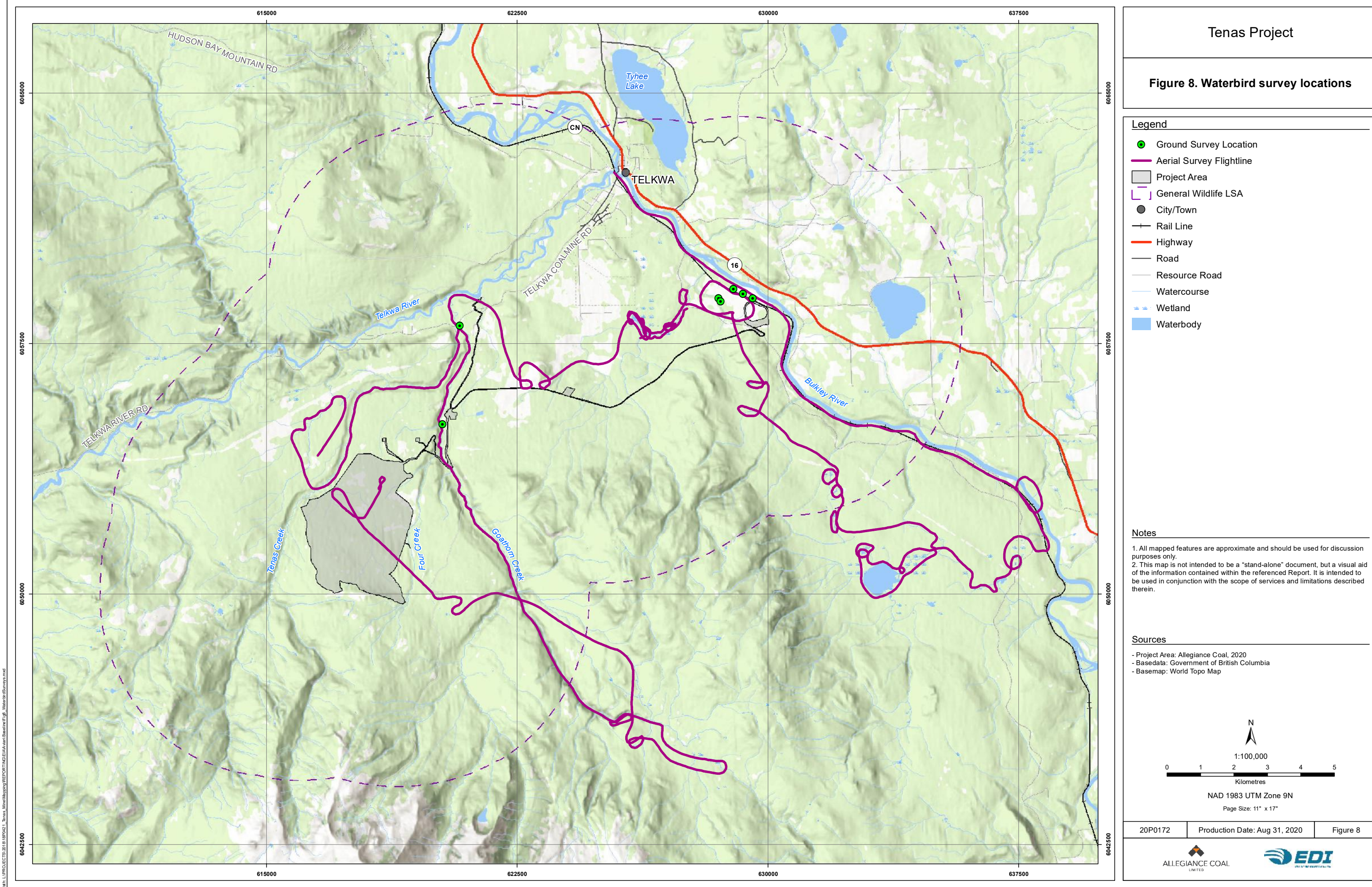


Figure 9. Waterbird survey results

Legend

Survey Type

● Ground

● Aerial (April 24)

● Aerial (May 24)

Group Size

○ 1-5

○ 6-20

○ 21-50

○ 50+

■ Project Area

■ General Wildlife LSA

● City/Town

— Rail Line

— Highway

— Road

— Resource Road

— Watercourse

■ Wetland

■ Waterbody

Species

AMWI - American Wigeon

BUFF - Bufflehead

CAGO - Canada Goose

CKGO - Cackling Goose

COLO - Common Loon

COME - Common Merganser

EUWI - Eurasian Wigeon

GRYE - Greater Yellowlegs

GWFG - Greater White-fronted Goose

GWTE - Green-winged Teal

KILL - Killdeer

LESC - Lesser Scaup

MALL - Mallard

NOPI - Northern Pintail

NOSH - Northern Shoveler

REDH - Redhead

RNDU - Ring-necked Duck

RNGR - Red-necked Grebe

SACR - Sandhill Crane

SNGO - Snow Goose

TRUS - Trumpeter Swan

UDID - Unspecified Diving

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

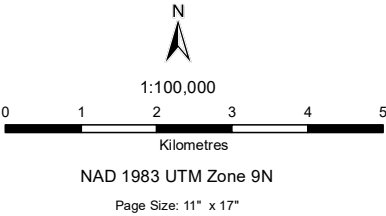
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Map



3.5 Bird Acoustic Monitoring

A total of 2,616 acoustic recording files with approximately 34,680 minutes of recordings were obtained from the ARUs in 2017 and 2018 during the morning period, which was one hour before dawn to two hours after dawn. From 2017 to 2019, the ARUs obtained 2,993 acoustic recording files (approximately 55,425 minutes of recordings) during the night period, which varied from starting at sunset to starting three hours after sunset and recording for two to four hours. Various locations and habitats were monitored within the Wildlife LSA as outlined in Table 10, with most of the recordings occurring within the Mine Features Area, followed by the Linear Features Area (Figure 4).

Table 10: General Area and Habitat Description of Automated Recording Unit Locations (2017 to 2019)

Year	Location ID	General Area	Habitat Description
2017	17-ARU 1-1	Mine Features Area	Mature forest adjacent to wetland bog
	17-ARU 1-2	Mine Features Area	Mature conifer forest adjacent to cutblock
	17-ARU 2-1	Mine Features Area	Pole-sapling conifer forest
	17-ARU 3-1	Mine Features Area	Mature conifer forest near cutblock
	17-ARU 4-1	Rail Feature Area	Young coniferous forest/cutblock area near railway tracks
2018	18-ARU 2-1	Mine Features Area	Mature conifer forest adjacent to cutblock
	18-ARU 3-1	Linear Features Area	Young mixed forest adjacent to pasture, overlooking rail feature area
	18_ARU 4-1	Linear Features Area	Mature mixed forest adjacent to cultivated field
2019	19-ARU 2-1	Mine Features Area	Mature conifer forest adjacent to cutblock (same location as 18-ARU 2-1)
	19-ARU 3-1	Mine Features Area	Pole-sapling conifer forest (same location as 17-ARU 2-1)
	19-ARU 4-1	Linear Features Area	Young mixed forest beside pasture, overlooking rail feature area (same location as 18-ARU 3-1)

Notes: ARU=Automated Recording Unit

A more detailed breakdown of the number of recorded minutes for the morning bird acoustic monitoring is provided in Figure 10, showing the number of minutes by year, month and feature area. In 2017, the majority of the morning recordings were obtained within the Mine Feature Area, with over 5000 minutes of recordings obtained by three AURs in June, July and August, and over 1500 minutes collected by one ARU within the Rail Features Area. In 2018, over 2000 minutes of morning recordings were obtained by one ARU in the Mine Features area in June and August, with less in July due to a change in recording frequency and battery depletion prior to the battery change. A delay in deployment of two ARUs in the Linear Features Area until late July resulted in less than 500 minutes recorded in that month and 1500 to 2000 minutes of data collected in September and August, respectively.

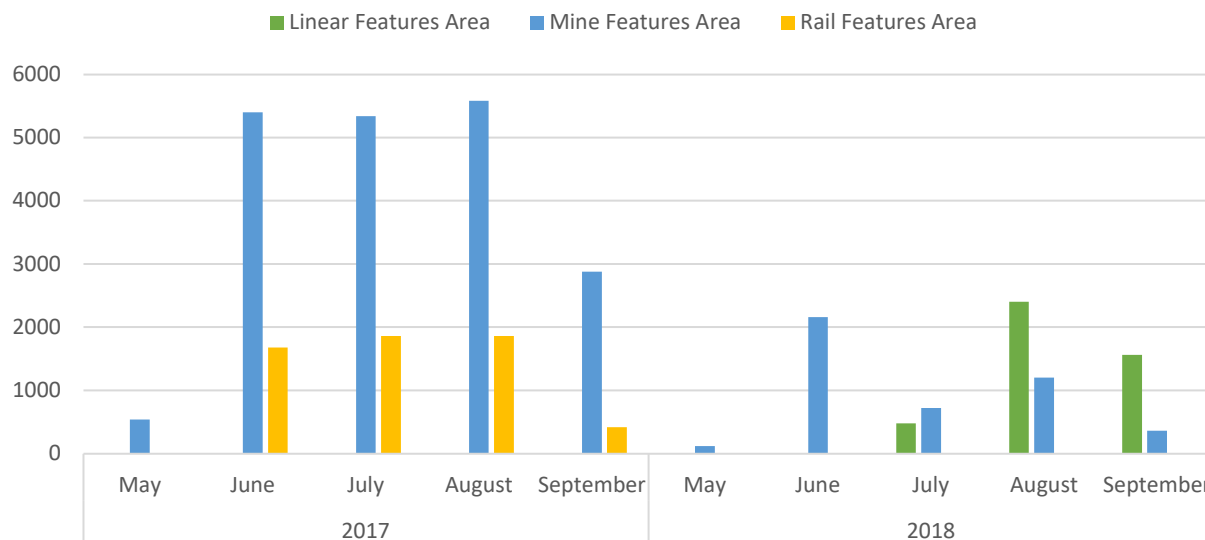


Figure 10: Number of minutes of recordings during morning bird acoustic monitoring within the Wildlife Local Study Area (2017 to 2019)

Nighttime bird acoustic monitoring for the feature areas, years and months is provided in Figure 11. In 2017, most of the data was collected for both the Mine and Linear Feature Areas in June to August, with less in May and September due to deployment and recovery of the ARUs. The data in 2018 was collected in the Mine Features Area from June to September, with approximately 1000 minutes collected in June to August and the majority of the data collected within the Linear Features Area during August and September. Data collection in 2019 was initiated in April to obtain data on breeding owls in the area, with between 1000 and 6000 minutes of data collected from April to September by two ARUs in the Mine Features Area and 1000 to almost 4000 minutes of data collected over that same time frame by one ARU in the Linear Features Area.

The preliminary cluster analysis and simple classification (Wildlife Acoustics Inc. 2018b) assessed the June 2017 data to identify selected species of conservation concern: olive-side flycatcher, barn swallow and common nighthawk. Only olive-sided flycatcher was able to be classified as detected at two ARU locations, 17-ARU 1-1 and 17-ARU 1-2, as no recordings of barn swallow or common nighthawk were found within the data to be used as training data. Given the extensive time required to conduct the initial analysis and classification, no further cluster analysis and classifications for other species were completed at this time.

Visual and auditory sampling reviews detected several bird species already confirmed present in the study area through other baseline sampling (e.g., Swainson's thrush, ruby-crowned kinglet). Two additional species, great-horned owl and northern saw-whet owl, not recorded in other surveys, were confirmed present in the Wildlife LSA through acoustic monitoring.

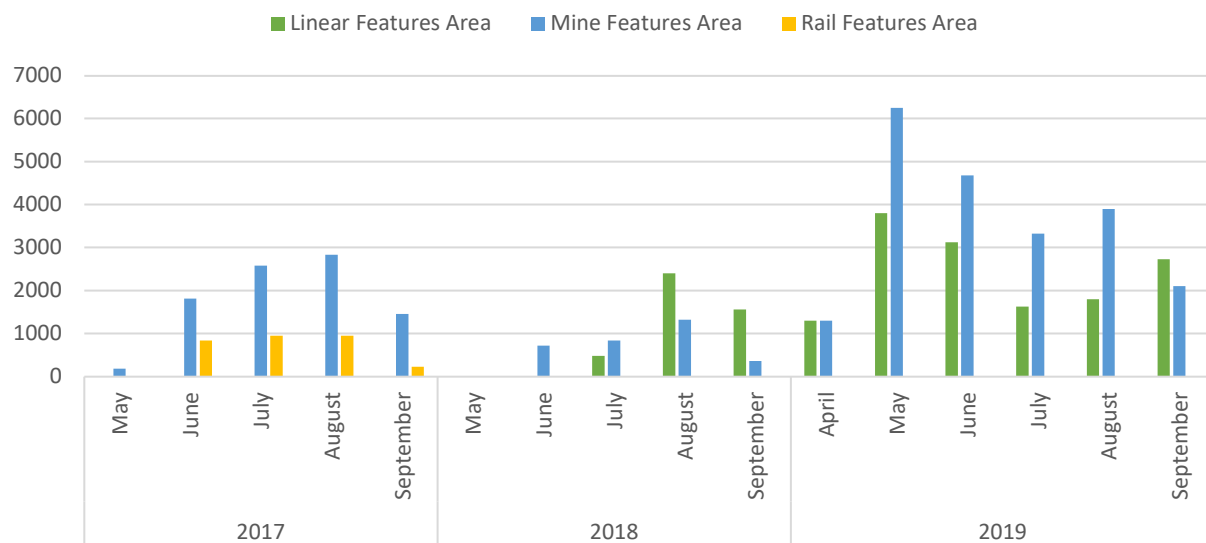


Figure 11: Number of minutes of recordings during night bird acoustic monitoring within the Wildlife Local Study Area (2017 to 2019)

3.6 Incidental Observations

Incidental observations were recorded for 77 avian species during baseline surveys. Detections included both breeding and migratory birds; however, it was not always possible to determine the status of individuals observed. The most common species detected are presented in Table 11. Appendix H contains a full list of all species detected in incidental observations.

Table 11: Most Common Species Detected as Incidental Observations

Common Name	Scientific Name	Individuals Detected
Savannah Sparrow	<i>Passerculus sandwichensis</i>	100
Swainson's Thrush	<i>Catharus ustulatus</i>	88
American Robin	<i>Turdus migratorius</i>	40
Varied Thrush	<i>Ixoreus naevius</i>	39
Warbling Vireo	<i>Vireo gilvus</i>	39
Red-breasted Nuthatch	<i>Sitta canadensis</i>	27
Yellow-rumped Warbler	<i>Setophaga coronata</i>	27
Common Raven	<i>Corvus corax</i>	23
Northern Waterthrush	<i>Parkesia noveboracensis</i>	23
Dark-eyed Junco	<i>Junco hyemalis</i>	22

Incidental observations of species of conservation concern included barn swallow (*Hirundo rustica*), northern goshawk, olive-sided flycatcher, and sandhill crane (*Antigone canadensis*) (Figure 5). These observations are detailed in the following sections.

3.6.1 Barn Swallow

Ten barn swallows were detected at a single location during ground-based surveys in May 2019. The swallows were nesting in outbuildings on a rural farm property approximately 720 m west of the rail features. The detection occurred in the open habitat, characterized by cultivated fields and ponds, within the SBSdk subzone.

3.6.2 Northern Goshawk

Four adult goshawk detections were made between the 2017 and 2018 field seasons. Three detections (i.e., one each in July and September 2017, and one in June 2018) occurred at separate locations along the western side of the Project Area within the mine features area. The fourth detection (i.e., July 2018) occurred along the eastern side of the Project Area within the mine features area. Of the three detections made along the western side of the Project Area, one detection was in moderate suitability habitat and the other two detections were in nil suitability habitat (as identified by the northern goshawk habitat suitability model; refer to Section 3.7.3). These two detections were located 144 m and 154 m from suitable habitat (i.e., moderate and high suitability). The fourth detection was in nil suitability habitat at 258 m from suitable habitat. All detections occurred within the SBSmc2 subzone.

Additionally, northern goshawk feathers were found at two separate locations within the mine features area in 2017. One detection was located near the north end of the mine features area and the other along the western side. These detections were located 390 m and 430 m from suitable habitat and were situated within the SBSmc2 subzone.

3.6.3 Olive-sided Flycatcher

Olive-sided flycatcher was recorded nine times in incidental observations during the 2017-2019 baseline surveys. Seven of these observations were located within the mine features area, while the remaining two observations were located within the broader Wildlife LSA. Most olive-sided flycatcher observations were made within the SBSmc2 subzone; however, two observations occurred within the SBSdk subzone. All observations were of singing males during the breeding season.

3.6.4 Sandhill Crane

One incidental observation of a single adult sandhill crane was made within the linear features area near the Tenas Access Corridor in July 2018; this detection occurred in the SBSdk subzone in the forest-wetland habitat guild.

3.7 Habitat Suitability Modelling

3.7.1 Common Nighthawk Model Summary

The common nighthawk is a crepuscular aerial insectivore that requires open habitat for most of its life requisites. Nesting occurs in a variety of open habitats such as grasslands, agricultural areas, dry bogs, rocky areas, open forest, clear cuts or burns, and anthropogenic areas (Brigham et al. 2020). The common nighthawk habitat suitability model indicated that within the Wildlife RSA, high and moderate rated habitats were mostly present at low to mid elevations in areas of low intensity agriculture (e.g., pasture, hayfields), recently harvested forest, and open forest with very low canopy cover (Appendix B). The modelling showed a higher percentage of high and moderate rated habitats present in the Wildlife LSA than the Wildlife RSA, likely due to the higher occurrence of these low elevation habitats (Table 12). In total, high and moderate rated habitats encompass approximately 30% of the Wildlife LSA and approximately 22% of the Wildlife

RSA. Habitats rated as nil or low value in the model for common nighthawk included forest with moderate to high canopy cover, areas adjacent to active anthropogenic features, and alpine habitat.

Table 12: Common Nighthawk Habitat Suitability by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
High	4,502.13	12.60	17,343.92	8.91
Moderate	6,366.28	17.82	25,091.45	12.89
Low	13,880.80	38.85	60,668.05	31.17
Nil	10,976.66	30.72	91,547.07	47.03
Total	35,725.88	100.00	194,650.49	100.00

Notes: LSA=Local Study Area; RSA=Regional Study Area; ha=hectare; %=percent

3.7.2 Olive-sided Flycatcher Model Summary

The olive-sided flycatcher is a medium-sized songbird that breeds in the Wildlife RSA. They prefer open-coniferous habitats with tall snags and live trees for nesting and perching, and open areas for foraging (Kotliar 2007, Altman and Sallabanks 2012). Olive-sided flycatchers nest in coniferous, mixed, and riparian forests; typical breeding habitat requires tall snags and living trees along high contrast edges between two distinct habitat types (COSEWIC 2018b). The habitat suitability model indicated that high and moderate value habitats for olive-sided flycatcher are relatively abundant, comprising approximately 33% of the Wildlife LSA and 47% of the Wildlife RSA (Table 13, Appendix C). These high and moderate rated habitats are found throughout the Wildlife RSA but are most common at mid to upper elevations — this coincides with a higher occurrence of open, mature, and old-growth coniferous forest habitats. Low and nil rated habitats in the Wildlife RSA are more prevalent at lower elevations where forest has been cleared for agriculture and urban areas, and at higher elevations in alpine habitats devoid of trees.

Table 13: Olive-sided Flycatcher Habitat Suitability by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
High	3,034.55	8.49	19,161.72	9.84
Moderate	8,732.18	24.44	72,430.75	37.21
Low	13,560.31	37.96	53,817.96	27.65
Nil	10,398.83	29.11	49,240.06	25.29
Total	35,725.88	100.00	194,650.49	100.00

Notes: LSA=Local Study Area; RSA=Regional Study Area; ha=hectare; %=percent

3.7.3 Northern Goshawk Model Summary

Northern goshawks are a forest-dwelling raptor that typically nest in mature and old-growth coniferous stands with a closed canopy and open understory (Cooper and Stevens 2000, Mahon 2009). Habitat suitability modelling for northern goshawk showed suitable habitat within the Wildlife LSA and RSA is fragmented and that few contiguous patches of moderate and high suitability habitat are available. The large degree of fragmentation is likely due to the extensive history of forest harvest, forest fire activity (particularly in the southern Wildlife RSA), and the mountain pine beetle epidemic that has affected preferred lodgepole pine nesting habitat. Additionally, in the remaining forest, there is a predominance of

secondary tree species (i.e., subalpine fir, spruce), which are not preferred nesting trees for northern goshawk. Consequently, habitat suitability modelling rated only 6% of the Wildlife LSA and 10% of the Wildlife RSA as high or moderate value habitat for northern goshawk (Table 14, Appendix A).

Based on the observed territory scale habitat requirements of goshawk breeding territories (Doyle et al. 2020), it is unlikely that an active breeding territory is located within or adjacent to the Wildlife LSA (Doyle 2020). The results of habitat suitability modelling for northern goshawk indicate that the closest predicted or known active breeding territory is likely located approximately 10 km west of the Wildlife LSA (Appendix A) (Doyle 2020). This modelling assumption is supported by baseline studies, with no indication (i.e., repeated territorial calling or sightings) that an active breeding territory is located within or adjacent to the Wildlife LSA (Doyle 2020). A single report of a calling goshawk in June 2018 was subsequently followed up by call playback surveys throughout the detection area; however, no support for an active breeding territory was observed (Doyle 2020).

Table 14: Northern Goshawk Habitat Suitability by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
High	100.1	0.28	1,741.1	0.89
Moderate	2,188.6	6.13	16,901.3	8.68
Low	5,713.3	15.99	40,388.7	20.75
Nil	27,723.8	77.60	135,619.3	69.67
Total	35,725.88	100.00	194,650.49	100.00

Notes: LSA=Local Study Area; RSA=Regional Study Area; ha=hectare; %=percent

3.7.4 Short-eared Owl Model Summary

Short-eared owls are a ground-nesting species that inhabit open country (e.g., grasslands, tundra, wetlands, agricultural areas). Their reproduction and population dynamics are closely linked to the density of small mammals and breeding densities and success may vary widely depending on small mammal populations (Wiggins et al. 2020). Habitat suitability modeling for short-eared owl indicated that high and moderate rated habitats were present at all elevations; however, most high rated habitats were located at higher elevations in alpine areas. Suitable habitats at lower elevations (e.g., agricultural areas) were predominately rated as moderate, largely due to their proximity to other anthropogenic disturbance. Cutblocks, mostly at mid-elevations, were rated as low quality habitat and nil habitat was assumed present across the Wildlife RSA where forest was present. In total, approximately 11 % of the Wildlife LSA and 13% of the Wildlife RSA were rated as high or moderate value habitat for short-eared owls (Table 15, Appendix D).

Table 15: Short-eared Owl Habitat Suitability by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
High	145.04	0.41	9,746.81	5.01
Moderate	3,954.85	11.07	14,748.01	7.58
Low	6,941.66	19.43	22,888.31	11.76
Nil	24,684.33	69.09	147,265.58	75.66
Total	35,725.88	100.00	194,648.71	100.00

Notes: LSA=Local Study Area; RSA=Regional Study Area; ha=hectare; %=percent

3.7.5 Migratory Bird Habitat Guild Models Summary

Habitat suitability models were developed for three migratory bird habitat guilds: open and early successional (open habitat), young through old forest (forest habitat), and wetlands or riparian areas (wetland/riparian habitat). These habitat guilds were developed as comprehensive habitat strata to represent the dominant habitat associations used by bird assemblages within the Wildlife RSA. While most of the bird species present in the Wildlife RSA can be categorized as belonging to one of the three habitat guilds, it is recognized that many species may depend on more than one type of habitat to satisfy all their life requisites, while some species may also select habitat at a much finer scale than is represented by these models.

Species in the open habitat guild use a diversity of habitats that include alpine meadows, agriculture areas, clearcuts, and shrubby thickets. Some species may nest in habitat devoid of vegetation (e.g., killdeer [*Charadrius vociferus*]), whereas other species prefer grass-dominated (e.g., savannah sparrow) or shrub-dominated habitats (e.g., orange-crowned warbler). Open habitats totaled 20% of the Wildlife RSA (38,948 ha, Table 16); however, the distribution and composition of open habitats varies across the Wildlife RSA. The highest occurrence of open habitats is found at low elevations (e.g., the SBSdk) where clearing for agriculture and forestry has reduced forest cover, and at higher elevations (e.g., the BAFA) where large patches of alpine habitat are present. Open habitats within the other BGC subzones are generally present as early-seral cutblocks, where habitat is regenerating forest and typically shrub-dominated.

Forest guild species are found in coniferous (e.g., Townsend's warbler [*Setophaga townsendi*], golden-crowned kinglet) mixed (e.g., brown creeper [*Certhia americana*], western tanager [*Piranga ludoviciana*]), and deciduous (e.g., warbling vireo) forests. Within forested habitats, these species may nest anywhere from the ground (e.g., Pacific wren [*Troglodytes pacificus*]) to upper tree branches (e.g., ruby-crowned kinglet). The habitat modelling found that forest habitats comprise 54% of the Wildlife RSA (104,605 ha, Table 16). Forest habitats is found at all but the highest elevations; however, larger patches are present at the mid to upper elevations, while smaller habitat patches are generally present at lower elevations, mostly between agricultural fields and harvested areas. Forest habitat in the SBSdk includes a mix of deciduous, coniferous and mixed forest stands; forest habitat in the SBSmc2 also includes a combination of all three forest types, but with a higher proportion of coniferous forest; forest habitat in the ESSF subzones is primarily coniferous with minimal amounts of deciduous or mixed forest.

Species in the wetland/riparian habitat guild nest in bogs, fens, swamps, and marshes (e.g., common yellowthroat, Wilson's snipe [*Gallinago delicata*]), but also along shorelines and in adjacent terrestrial habitats (e.g., yellow warbler). Habitat modelling for wetland and riparian habitats identified approximately 17% of the Wildlife RSA as wetland/riparian habitat (33,164 ha, Table 16); however, the vast majority of this (i.e., 90%) is present as riparian habitat. Riparian areas were classified as Riparian-Open (i.e., areas

of overlap between wetland/riparian and open habitat) and Riparian-Forest (i.e., areas of overlap between wetland/riparian and forest) and totaled 3.0% (5,747 ha) and 12.4% (24,055 ha) of the Wildlife RSA respectively. Larger wetlands and riparian areas along larger watercourses were found primarily within the SBSdk and SBSmc2 subzones and contributed to most of the overall wetland/riparian habitat present in the Wildlife RSA. Smaller wetlands were present in the other BGC subzones, mostly at higher elevations (i.e., bogs in the ESSFmc).

Table 16: Amount of Suitable Open, Forest, and Wetland/Riparian Habitat Present Within the Wildlife Regional Study Area by Biogeoclimatic Subzone

BGC Subzone/ Variant ¹	Habitat (ha)						Total
	Open	Forest	Wetland/ Riparian	Riparian- Open	Riparian- Forest	Likely No Value ²	
SBSdk	15,209.3	22,145.0	2,022.6	1,905.6	8,294.3	5,501.1	55,077.9
SBSmc2	12,543.4	33,131.8	458.2	3,644.6	11,714.0	2,548.9	64,041.0
ESSFmc	1,635.1	32,605.3	397.2	38.3	2,499.5	345.8	37,521.1
Other ESSF variants	1,728.4	16,052.9	427.6	61.4	1,540.4	5,823.2	25,633.9
CWH and ICH	19.8	492.6	0	0.03	5.3	5.4	523.1
Alpine variants	7,812.0	176.9	56.6	97.1	1.7	3,707.4	11,851.8
Total	38,948.0	104,604.6	3,362.0	5,747.1	24,055.3	17,931.7	194,648.7

Notes: BGC=biogeoclimatic; SBSdk=Sub-Boreal Spruce Dry Cool; SBSmc2=Sub-Boreal Spruce Babine Moist Cold; ESSFmc=Engelmann Spruce – Subalpine Fir Moist Cold; ESSF=Engelmann Spruce – Subalpine Fir; CWH=Coastal Western Hemlock; ICH=Interior Cedar Hemlock; ha=hectares

¹ BGC variants present within the Wildlife Regional Study Area (RSA) include: BAFAun, CWHws2, ESSFmc, ESSFmcp, ESSFmcw, ESSFmk, ESSFmcp, ESSFmkw, ESSFwv, ESSFwvp, ESSFwvw, ICHmc1, SBSdk, and SBSmc2. However, BGC variants that were not present in the Wildlife Local Study Area and represent a small proportion of the Wildlife RSA were grouped for this analysis.

² Habitats classified as Likely No Value represent areas without nesting features, foraging, or security/thermal habitat (i.e., areas of rock, ice, or urban).

3.8 Qualitative Habitat Assessment

3.8.1 Bank Swallow

Bank swallows are an aerial insectivore that are found sporadically across the interior of BC; they are most commonly found at lower elevations between 250 and 500 m, although they have been recorded to at least 1,500 m elevation (Campbell et al. 1997, Howie 2015). Bank swallows are a colonial nesting species which use both natural and man-made habitats for nesting; nesting sites are typically steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows (COSEWIC 2013b, Howie 2015), and are often located adjacent to slow-moving or still waterbodies (Garrison 1999, Howie 2015). Foraging habitats during the breeding season include a variety of open habitats such as lakes and ponds, rivers, wetlands, grasslands, and agricultural areas; however, open forest is also occasionally used (Garrison 1999, COSEWIC 2013b).

The steep sand, silt, or clay embankments selected for nesting by bank swallows are frequently subject to erosion or slumping and as such, the location of nesting colonies can be highly ephemeral (Garrison 1999, COSEWIC 2013b). Furthermore, suitable habitats often occur in small patches at a finer scale than can be assessed through regional-level habitat modelling. Consequently, a qualitative assessment was used to identify potential nesting areas within the Wildlife LSA. The assessment used aerial imagery and observations made during baseline surveys to assess for nesting habitat. Potential nesting habitat for bank swallows was identified at several locations in the Wildlife LSA including along sections of the Bulkley and Telkwa rivers, and Goathorn and Tenas creeks. Specific locations near the proposed Project Area include banks along the Bulkley River near the rail loadout, along Goathorn Creek near the pipeline and haul road, and along Tenas Creek near the NAG pile, although substrate material may not be suitable for nesting in some of the identified banks (Appendix F).

3.8.2 Barn Swallow

Barn swallows are an aerial insectivore that nest in suitable habitats throughout BC; they are most commonly found at elevations below 250 m, although they have been recorded to at least 2,400 m elevation (Campbell et al. 1997, Hearne 2015). Barn swallow nest sites are usually near water, mud, and foraging habitat, such as grasslands, agricultural areas and riparian areas (COSEWIC 2011, Hearne 2015, Brown and Brown 2020). The nest site is typically a vertical or horizontal surface that is often enclosed with some form of cover directly overhead; anthropogenic features such as barns, houses, and other buildings, bridges, wharfs, and large culverts are typically used; however prior to European settlement nests were in caves, crevices, cliff ledges, and large hollow trees (COSEWIC 2011, Hearne 2015, BC Conservation Data Centre 2020, Brown and Brown 2020).

A qualitative assessment was used to identify potential nesting areas for barn swallows within the Wildlife LSA due to the difficulty in mapping anthropogenic features used as nest sites. The assessment used aerial imagery and observations made during baseline surveys to assess for suitable nesting habitat (i.e., anthropogenic features) adjacent to potential open foraging habitat and water. Potential nesting habitat for barn swallows was identified at several locations in the Wildlife LSA including in the agricultural areas along Highway 16, south of the Telkwa River, and east of Goathorn Creek; along the railway; adjacent to the Bulkley and Telkwa rivers in the northeast portion of the Wildlife LSA; and around the village of Telkwa (Appendix F). Baseline surveys confirmed nesting by barn swallows in one location within the Wildlife LSA where a group of approximately 10 barn swallows were observed nesting in outbuildings on a rural farm property approximately 720 m west of the rail features (Section 3.3.4.1). The desktop review also found numerous observations of barn swallows present in the Wildlife RSA during the breeding season from existing data sources (Section 3.1).

3.8.3 Black Swift

The black swift is an aerial insectivore which is generally rare or uncommon across most of BC, although it can be locally fairly common in mountainous areas such as the mainland coast north of Vancouver Island, on northern Vancouver Island, in the Coast Mountains, in the Rocky Mountains, and other mountain ranges of southeastern interior (Boyd 2015, Campbell et al. 1990b). They typically occur from sea level to approximately 1,800 m elevation (Boyd 2015); however, they have been recorded up to 2,600 m elevation (Campbell et al. 1990b). Most of the black swift nests discovered in BC have been on rock ledges behind montane waterfalls, although nests have also been on ledges of steep rock faces, cliffs, and caves (Boyd 2015).

Baseline surveys within the Wildlife LSA did not identify any suitable nesting habitat for black swift. It is expected that suitable habitat may be present in other parts of the Wildlife RSA; however, within the Wildlife

LSA neither field surveys nor a desktop review of aerial imagery located notable waterfalls or other cliffs/rock faces suitable for nesting (Appendix F).

3.8.4 Rusty Blackbird

Rusty blackbirds are widely distributed across central and northern BC east of the Coast Mountains, where they are typically found at low densities between 500 to 1,250 m elevation (Di Corrado 2015). Breeding habitat for rusty blackbirds is generally characterized by wet coniferous and mixed forests adjacent to wetlands, beaver ponds, and riparian areas along slow-moving streams and swampy lakeshores (Di Corrado 2015, COSEWIC 2017, Avery 2020). In BC, rusty blackbirds are typically found in shrubby wetlands, black spruce and tamarack bogs, muskegs, lake islands, and the flooded riparian edges alongside beaver ponds, swampy lakeshores, slow-moving streams, and river oxbows and back channels (Campbell et al. 2001, Avery 2020). The nest site is almost always over or close to water (<75 m) and placed within 1 m of the ground in thickets of short coniferous or deciduous shrubs, both living and dead (Powell et al. 2010, Avery 2020). The characteristics of the wetlands habitat guild mapping overlap with rusty blackbird breeding habitat, and as a result, this model was chosen to represent potential breeding habitat within the Wildlife RSA (Section 0).

3.9 Density Analysis

Project point count data and existing data from the BC BBA were used to estimate densities for individual species and the habitat guilds within the Wildlife RSA. Overall, the density of all birds across the Wildlife RSA was estimated to be 5.56 birds/ha (Table 17), resulting in an estimated total of 684,995 birds present in the Wildlife RSA (Appendix E). Density estimates were only developed for three BGC subzones where a sufficient number of point counts were located in suitable habitat; as these three subzones represent 91.7% of the Wildlife RSA, the estimate is still considered a reasonable approximation of the overall abundance. Individual species densities and estimated abundances are presented in Appendix E.

Overall, bird density was highest in the SBSdk subzone, which is lowest in elevation, and decreased with an increase in elevational BGC subzones (i.e., SBSdk > SBSmc2 > ESSFmc). Riparian-forest habitat in the SBSdk had the highest estimated density of migratory breeding birds across the various habitat guilds, followed by forest habitat in the SBSdk. Riparian-open habitat had the lowest estimated density of birds (Table 17).

Table 17: Density and Abundance Estimates for the Wildlife Regional Study Area by Habitat Guild and Biogeoclimatic Subzone

Habitat Guild	Estimated Density (birds/ha)				Estimated Total Abundance (birds)			
	SBSdk	SBSmc2	ESSFmc	Wildlife RSA Total¹	SBSdk	SBSmc2	ESSFmc	Wildlife RSA Total¹
Open	5.18	5.44	4.72	5.31	78,756	68,264	7,720	154,739
Forest	5.85	4.68	4.18	5.30	129,467	155,168	136,197	420,833
Wetland ²	--	--	--	--	--	--	--	--
Riparian-Open	3.31	3.23	--	3.24	6,308	11,781	--	18,089
Riparian-Forest	6.75	3.02	--	5.56	55,961	35,373	--	91,335
Total	6.53	4.68	4.36	5.56	270,492	270,587	143,916	684,995

Notes: SBSdk=Sub-Boreal Spruce Dry Cool; SBSmc2=Sub-Boreal Spruce Babine Moist Cold; ESSFmc=Engelmann Spruce – Subalpine Fir Moist Cold; RSA=Regional Study Area; ha=hectares

¹ Analysis includes only those biogeoclimatic subzones where sufficient point count data were available.

² Density and abundance estimates were not calculated for the wetland habitat guild due to an insufficient number of points counts conducted within this habitat guild.

4. SUMMARY

4.1 Habitat

The Wildlife RSA provides a wide array of habitat for resident and migratory bird species, ranging from lakes and riparian habitats along major rivers, to extensive forest habitats, to rocky alpine peaks. However, the Wildlife RSA also has an extensive anthropogenic footprint including the village of Telkwa and overlap with the Highway 16 corridor. Agricultural development and rural residences are common in the lower elevations throughout the Wildlife RSA, while higher elevation areas show a history of forest harvest activities and other industrial development. Elevation within the Wildlife RSA ranges from approximately 470 to 2,300 m. The Project Area and Wildlife LSA, while also providing a variety of habitat for birds, occur over a narrower range of elevation (from approximately 525 to 1,100 m within the Project Area), consequently the diversity of habitats is slightly lower in these areas than in the Wildlife RSA.

The mine features area encompasses the proposed footprint for a majority of the mine components, including the pit, the coal processing plant, and associated support infrastructure. It is located on a terrace of land situated between, and approximately 75–100 m above, Goathorn and Tenas creeks, at an elevation of approximately 1,100 m. The mine area is almost entirely located within the SBSmc2 subzone, with only a very minor portion found in the ESSFmc and the SBSdk subzones. The area is dominated by coniferous forest habitats; however, timber harvesting has occurred over much of the mine area, with large areas harvested approximately 40 years ago, and the most recent harvesting occurring approximately 10 years ago. Consequently, the mine site is currently dominated by regenerating coniferous forest (in a shrub or pole/sapling structural stage) interspersed with remnant patches of mature/old-growth coniferous forest (Plate 2); smaller areas of deciduous or mixed forest, shrub, and wetland habitats (predominantly small, forested bogs) are also present. The habitat modelling results reflect the coniferous forest environment and the past history of the mine area. The migratory bird habitat guild models characterize this area as a complex of forest habitat and open habitat (primarily recent cutblocks), with only small areas of wetland/riparian habitat. Species-specific models indicate that mine area overlaps nil to moderate-value habitats for northern goshawk and short-eared owl, with only small areas of moderate value habitat primarily in the southern and western areas of the mine area. The habitat suitability models for olive-sided flycatcher and common nighthawk show a wider range of habitat values in the mine area with moderate and high-rated habitats present in localized areas.



Plate 2: Example of mature forest habitat interspersed with regenerating cutblocks in the Mine Features Area

The linear features area includes those portions of the proposed Project footprint associated with the Project roads, power line and pipeline. These infrastructure areas are located primarily within the SBSdk subzone and overlap a diverse assemblage of habitat types including cultivated field and pasture, coniferous forest, deciduous forest, mixed forest, tall/low shrub, floodplain and wetland. Forested habitats range from young pole/sapling stands to mature or old forest. Wetland habitats within the linear features areas are mostly small marshes and swamps; however, floodplain ecosystems are more common, particularly along Goathorn Creek and the Telkwa River. Anthropogenic disturbance is relatively prominent along the linear features corridor including overlap with areas of agricultural field and pasture, rural residences, transmission line, natural gas pipeline, access roads, and trails. The migratory bird habitat guild models classify this area as a mix of forest and open habitats (predominantly forest habitat in the north and a combination of open and forest habitats in the south [Plate 3]). Wetland/riparian habitats are present throughout, primarily associated with riparian habitat along local streams and rivers. Species-specific models suggest that high and moderate value habitats for common nighthawk are abundant throughout the linear features area. High and moderate value habitats for short-eared owl and olive-sided flycatcher are less common but also present throughout the area, although substantial portions of the liner features area are rated as low or nil value for these species. Habitat suitability modelling for northern goshawk indicates that the linear features area crosses mostly nil value habitat, with only a small amount of moderate or high value habitat present.



Plate 3: Example of open habitat interspersed with forest habitat along the Linear Features Area

The rail features area, including the proposed footprint for the rail loop, rail loadout, and associated infrastructure, is located adjacent to the Bulkley River approximately 6 km upstream of the Telkwa River confluence. This infrastructure area is located at lower elevations within the SBSdk subzone in a predominantly rural/farmland landscape. The habitat is characterized by a patchy distribution of young to mature forests scattered amongst cultivated fields and pasture. The forested areas tend to contain dry or mesic ecosystems, although upland and floodplain deciduous forests are also present. Several ponds created via snowmelt and surface water runoff provide staging grounds for migrating birds during spring and a wetland comprised of three manmade ponds located northwest of the proposed infrastructure area provides breeding habitat for aquatic birds during summer. The migratory bird habitat guild modelling classifies the rail features area as predominantly open habitats, with patches of forest particularly in the southern sections. The Project Area also overlaps habitats classified as wetland/riparian habitat in localized areas. Species-specific habitat suitability models indicate that nil to moderate rated habitat are present for olive-sided flycatcher and short-eared owl in the rail features area. Low and moderate rated habitat are also present for common nighthawk. No suitable habitat for northern goshawk overlaps the Project Area in the rail features area, although small patches of low suitability habitat are present nearby.

4.2 Species

The desktop review identified 195 bird species that had previously been documented in the Wildlife RSA (Appendix G). Baseline surveys for the Tenas Project detected a total of 105 species (Appendix H), including five species that had not been previously identified in the Wildlife RSA during the desktop review. These five species were cackling goose (*Branta hutchinsii*), Eurasian wigeon (*Mareca penelope*), short-billed dowitcher (*Limnodromus griseus*), vesper sparrow, and yellow-bellied flycatcher. The first three species were detected during the spring waterfowl surveys or as incidental observations during the fall;

these species are not expected to breed in the Wildlife RSA but may be present during migration. Vesper sparrow and yellow-bellied flycatcher were detected during point count surveys — both species are considered extra-limital species within the Wildlife RSA but based on survey observations could be breeding in the area. Collectively, the desktop review and baseline field surveys identified a list of 200 bird species that may be present in the Wildlife RSA.

Most of the species found in the Wildlife RSA are migratory and occur only during the summer breeding season. The first spring migrants arrive as early as February or March; however, most migrants arrive during April (raptors and waterfowl) and May (songbirds and shorebirds) (Campbell et al. 1990a, 1990b, 1997, 2001, eBird 2020). Fall migration begins in late July and is complete for most songbirds and shorebirds by the end of September, and for most waterfowl and raptors by early November (Campbell et al. 1990a, 1990b, 1997, 2001, eBird 2020). The relatively harsh winter weather in the Project region results in a lower diversity of wintering species; however, approximately 50 avian species may be found in the region year-round, including a variety of raptors, corvids, grouse, ptarmigan, and select passerine species (e.g., chickadees, crossbills) (eBird 2020, National Audubon Society 2020).

Of the 200 bird species confirmed present in the Wildlife RSA through the desktop review and baseline studies:

- ▶ 52 are listed as priority species within Bird Conservation Region 10 (Appendix G);
- ▶ 12 are listed as species at risk (i.e., Special Concern, Threatened, or Endangered) under the federal *Species at Risk Act* (SARA) (Table 6);
- ▶ 13 are listed as species of conservation concern (i.e., Red or Blue-listed) by the BC Conservation Data Center (Table 6)²; and,
- ▶ five are listed as identified species under the BC *FRPA* or within regional land use plans (Section 3.1.2).

4.2.1 Landbirds

Landbirds (i.e., songbirds, woodpeckers, hummingbirds, grouse, and other non-passerine species) includes migratory and resident species that inhabit a variety of terrestrial habitats (e.g., grassland, shrubland, wetland, forested, subalpine, alpine). Many of these species and their nests are protected under the federal *Migratory Birds Convention Act* (MBCA); some species of conservation concern are also protected under the federal *SARA*. Additionally, upland game birds (i.e., grouse and ptarmigan) are believed to be the primary bird species harvested within the Wildlife RSA. Species that are reported to be currently, or historically, harvested by First Nations include ruffed grouse, spruce grouse, and dusky/sooty grouse (Rescan Environmental Services Ltd 2008, Budhwa et al. 2020).

Baseline data for landbirds within the Wildlife RSA were primarily obtained through point count surveys conducted within the Wildlife LSA, with additional information acquired through acoustic monitoring, incidental observations, and the desktop review. Analysis of landbird data included habitat suitability modelling and a density analysis.

Sixty-eight landbird species were detected during baseline surveys, including two species of conservation concern (i.e., barn swallow and olive-sided flycatcher) and two grouse/ptarmigan species (i.e., dusky grouse [*Dendragapus obscurus*] and ruffed grouse). An additional 50 species were identified within the Wildlife

² In addition to the 12 species of conservation concern listed by the BC CDC which were identified during the desktop review (as shown in Table 6), short-billed dowitcher is ranked as a blue-listed species in BC (BC Conservation Data Centre 2020)

RSA through the desktop review, including six grouse/ptarmigan species (i.e., dusky grouse, ruffed grouse, sooty grouse [*Dendragapus fuliginosus*], spruce grouse, white-tailed ptarmigan [*Lagopus leucura*], and willow ptarmigan [*Lagopus lagopus*]), resulting in a total of 118 landbird species reported within the Wildlife RSA.

Regarding harvested species (i.e., grouse and ptarmigan), it must be noted that the baseline surveys conducted were not specific to these species, which likely influenced the low numbers of grouse/ptarmigan species observed. As such, although few grouse/ptarmigan detections were made within the Wildlife LSA and RSA during baseline surveys, this likely does not reflect actual grouse/ptarmigan densities on the landscape, which are anticipated to be much higher.

Most of the species detected during baseline surveys are expected to nest within the Wildlife RSA; however, breeding was confirmed for 23 species, including the listed barn swallow and two grouse species (i.e., dusky grouse and ruffed grouse). Active nests and/or fledglings were identified during baseline surveys for the following landbird species:

- ▶ American Redstart (*Setophaga ruticilla*)
- ▶ American Robin (*Turdus migratorius*)
- ▶ American Three-toed Woodpecker (*Picoides dorsalis*)
- ▶ Barn Swallow (*Hirundo rustica*)
- ▶ Black-capped Chickadee (*Poecile atricapillus*)
- ▶ Dark-eyed Junco (*Junco hyemalis*)
- ▶ Dusky Grouse (*Dendragapus obscurus*)
- ▶ Gray Jay (*Perisoreus canadensis*)
- ▶ Golden-crowned Kinglet (*Regulus satrapa*)
- ▶ Hermit Thrush (*Catharus guttatus*)
- ▶ Mountain Chickadee (*Poecile gambeli*)
- ▶ Pacific Wren (*Troglodytes pacificus*)
- ▶ Pine Siskin (*Spinus pinus*)
- ▶ Purple Finch (*Haemorhous purpureus*)
- ▶ Red-breasted Nuthatch (*Sitta canadensis*)
- ▶ Red-breasted Sapsucker (*Sphyrapicus ruber*)
- ▶ Ruby-crowned Kinglet (*Regulus calendula*)
- ▶ Ruffed Grouse (*Bonasa umbellus*)
- ▶ Savannah Sparrow (*Passerculus sandwichensis*)
- ▶ Swainson's Thrush (*Passerculus sandwichensis*)
- ▶ Tennessee Warbler (*Leiothlypis peregrina*)
- ▶ Varied Thrush (*Ixoreus naevius*)
- ▶ Warbling Vireo (*Vireo gilvus*)

The most common landbird species detected during baseline surveys were predominantly forest-dwelling and generalist species. Common species included Swainson's thrush, dark-eyed junco, American redstart, black-capped chickadee, American robin, warbling vireo, varied thrush, pine siskin, yellow-rumped warbler, and orange-crowned warbler (Section 3.2). Bird densities were highest in the SBSdk subzone and decreased with an increase in elevational BGC subzones (i.e., SBSdk > SBSmc2 > ESSFmc), with the highest estimated densities found in riparian-forest habitat within the SBSdk (Section 3.9). Overall, the density of all birds within the Wildlife RSA was estimated to be 5.56 birds/ha, resulting in an estimated total of 684,995 birds present in the Wildlife RSA (Section 3.9, Appendix E).

Landbird species use a variety of habitats during the breeding season. These summer nesting areas are important habitats for terrestrial birds and the periods during which these habitats are used are often when these species are the most sensitive to disturbance. To assess the availability of breeding habitat present within the Wildlife RSA, habitat suitability models were developed for three migratory bird habitat guilds: open and early successional (open habitat), young through old forest (forest habitat), and wetlands or riparian areas (wetland/riparian habitat). The modelling indicated that more than half of the Wildlife RSA (approximately 54%) is composed of forest habitats. Open habitats represent approximately 20% of the Wildlife RSA and wetland/riparian habitat represent approximately 17% of the Wildlife RSA. The remaining

areas within the Wildlife RSA were classified as Likely Not Suitable for nesting birds (e.g., rock, ice or urban).

4.2.2 Waterbirds

Waterbirds, including waterfowl, riverine birds, shorebirds, and other waterbird species (e.g., loons, grebes), are migratory species that inhabit a variety of aquatic habitats (e.g., rivers, streams, lakes, ponds, wetlands). Migratory waterbirds and their nests are protected under the federal *MBCA*; additionally, some species of conservation concern are protected under the federal *SARA* and the BC *Wildlife Act*. Some species of waterfowl may also be harvested by resident hunters and Indigenous peoples (Section 3.1.3).

Important habitats for waterbirds include both migration stopover sites and summer breeding areas. The periods during which these habitats are used are often when these species are most sensitive to disturbance. Migration stopover sites are often characterized by wetland habitats that provide seasonal foraging opportunities and safe resting sites in spring (April to June) and fall (August to October). Some species may require different habitat types during the spring migration compared to the fall migration, necessitating the use of a wide range of aquatic habitats across the likely range of migration dates. Waterbirds also utilize a variety of aquatic habitats during the breeding season for courtship and reproduction. The breeding season in the Bulkley Valley is generally defined as late April to mid-August (Environment and Climate Change Canada 2018b); however, for some aquatic species, the breeding season may begin earlier in April and extend later into August. Within the Wildlife RSA, available aquatic habitats are found primarily in the lower elevations and along the valley bottoms (i.e., within the SBSdk subzone). At higher elevations, aquatic habitats consist predominantly of streams, associated riparian areas, and smaller wetlands.

Twenty-six waterbird species were detected during baseline surveys, including one species of conservation concern (i.e., sandhill crane); an additional 31 species, including five species of conservation concern, were identified through the desktop review. The waterbird species present in the Wildlife RSA include a mixture of breeding residents and migrants. Only a couple of winter waterbird records (e.g., mallard and Canada goose) were found in the desktop review, suggesting that most waterbirds depart the Wildlife RSA by freeze-up at the end of the fall. Approximately thirty-six waterbird species may nest in the Wildlife RSA.

Baseline surveys for the proposed Project included targeted surveys during the spring migration/staging season based on local knowledge which indicated that certain parts of the Wildlife LSA may provide stopover sites for large numbers of migrating waterfowl and other waterbirds. These surveys documented 22 waterbird species, including large numbers of Canada goose, American wigeon, sandhill crane, mallard, ring-necked duck, snow goose and trumpeter swan (Section 3.4). All waterbirds observed during the spring migration surveys were located in the lower elevations in the SBSdk subzone, and more than 60% of the birds observed were documented in seasonally available habitats, specifically, in cultivated fields and seasonal ponds that were temporarily flooded due to snow melt (Section 3.4). While large concentrations of waterbirds were observed in parts of the Wildlife LSA, no large concentrations were found in areas overlapping the Project Area (Figure 9).

Although less abundant than spring staging habitat, waterbird nesting habitat is found throughout the Wildlife LSA and RSA, albeit most commonly at lower elevations and along the valley bottoms. Suitable habitat overlapping the Project Area is relatively limited — there are no lakes, rivers or large wetlands within the Project Area, and available nesting habitat is mostly limited to riparian areas along streams and smaller wetlands. Due to the limited overlap with suitable breeding habitat, targeted waterbird surveys were not conducted during the nesting season; however, the available habitats were visited during other Project baseline surveys (e.g., point count surveys, wetland surveys and amphibian surveys) and any waterbird observations made during these surveys were documented in the incidental sightings database. Baseline

observations of waterbirds made during the nesting season included a single observation of a Wilson's snipe in a wetland within the mine features area, an observation of a single adult sandhill crane within the linear features area, and a couple of observations of barrow's goldeneye associated with pond/wetland habitats within the Wildlife LSA. Breeding was confirmed for one waterbird species, killdeer, which was found in an open habitat (i.e., a cultivated field with ponds) in the SBSdk subzone.

4.2.3 Raptors

Raptors, or birds of prey, encompass a wide range of species including osprey, eagles and hawks, owls, and falcons. All raptors and their nests are legally protected under the BC *Wildlife Act* and several raptor species are listed federally and provincially.

The desktop review identified 22 species of raptors that had previously been documented in the Wildlife RSA (Appendix G); these include both migratory species and year-round residents. Many of the raptor species listed in Appendix G are expected to nest in the Wildlife RSA; however, the list of species documented in the Wildlife RSA also includes a few species which are expected to only migrate through the area (e.g., rough-legged hawk [*Buteo lagopus*]) or may be only winter residents (e.g., snowy owl [*Bubo scandiacus*]). Those species that nest in the Wildlife RSA are expected to inhabit a wide variety of habitat types ranging from alpine to valley bottom; suitable habitats include alpine and subalpine cliffs for cliff-nesting raptors (e.g., peregrine falcon), mature and old-growth forests for tree-nesting raptors (e.g., American kestrel, great-horned owl), riparian forests along major lakes and rivers for aquatic-associated species (e.g., osprey, bald eagle), and meadows, wetlands or other open habitats for ground-nesting species (e.g., northern harrier). Available habitats within the Project Area and Wildlife LSA are slightly less diverse than within the broader Wildlife RSA; nesting raptors within these areas are expected to be predominantly tree-nesting and ground-nesting species (as large waterbodies, extensive cliffs, and alpine habitats are lacking in the Wildlife LSA).

During baseline surveys for the Project, 11 raptor species were documented in the Wildlife RSA. These included:

- ▶ American Kestrel (*Falco sparverius*)
- ▶ Barred Owl (*Strix varia*)
- ▶ Great-Horned Owl (*Bubo virginianus*)
- ▶ Northern Harrier (*Circus hudsonius*)
- ▶ Northern Saw-whet Owl (*Aegolius acadicus*)
- ▶ Red-tailed Hawk (*Buteo jamaicensis*)
- ▶ Bald Eagle (*Haliaeetus leucocephalus*)
- ▶ Cooper's Hawk (*Accipiter cooperii*)
- ▶ Northern Goshawk (*Accipiter gentilis atricapillus*)
- ▶ Northern Pygmy-owl (*Glaucidium gnoma*)
- ▶ Osprey (*Pandion haliaetus*)

Raptor observations were made during aerial waterbird surveys, call-playback surveys, acoustic monitoring, and as incidental observations during other project surveys. Baseline surveys were mostly limited to the Wildlife LSA, consequently most raptor observations made during these surveys were located within the Wildlife LSA.

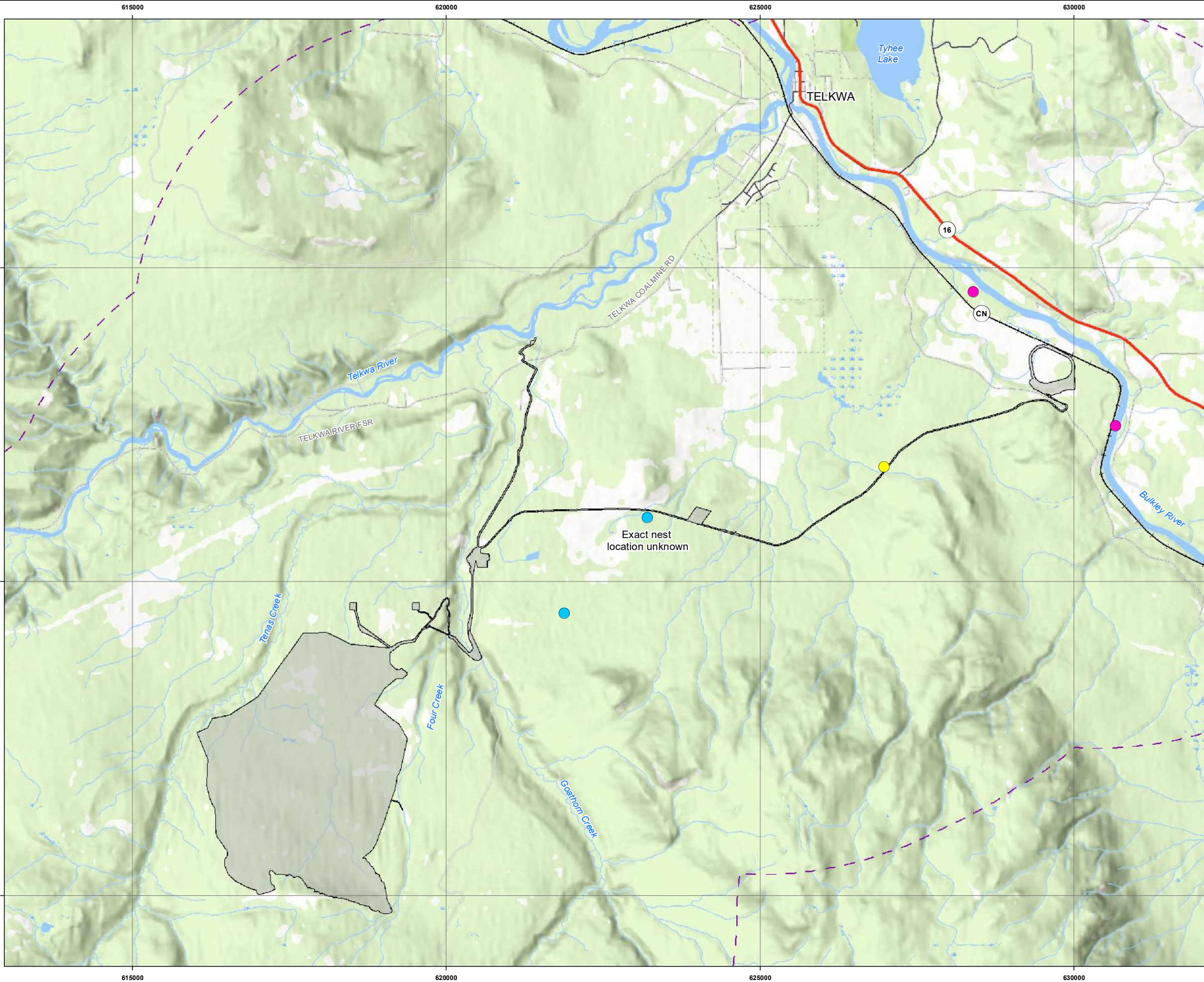
Breeding was confirmed for three raptor species during baseline surveys (Table 18, Figure 12). Four occupied raptor nests and one suspected nesting territory were identified within the Avian Species LSA but outside the Project Footprint (i.e., the area expected to be directly disturbed by Project activities).

Table 18: Raptor Nests Detected During Baseline Surveys

Raptor Species	Distance from Project Footprint (m)	Nest Status	Nest Location
Cooper's hawk	32	Occupied in 2018	The nest is located along the eastern portion of the proposed Tenas Access Corridor in a deciduous tree. The surrounding habitat is characterised by mature mixed forest that is relatively open. The nest is located 20 m west of an existing one-lane dirt road that is likely an older secondary forestry road. The road may still be passable and may be used for recreational purposes.
Osprey	820	Occupied in 2019	The nest is located along the Bulkley River in riparian forest habitat. The surrounding habitat is characterised by mature mixed forest and agricultural fields. An existing rail line parallels the west side of the river, and an existing agricultural field parallels the east side of the river.
Osprey	1,320	Occupied in 2019	The nest is located along the Bulkley River in riparian forest habitat. The surrounding habitat is characterised by mature mixed forest and agricultural fields. An existing agricultural field parallels the south side of the river. An existing rail line is located approximately 200 m southwest of the nest location.
Red-tailed hawk	95 ¹	Occupied in 2017, 2018, 2019	The suspected nesting territory is located along the western portion of the proposed Tenas Access Corridor. The surrounding habitat is characterised by mature mixed forest and open agricultural fields. The suspected nesting territory is located 51 m west of an old cutblock (1976). An existing one-lane dirt road is located 116 m north of the nest. This road is likely an older utility road or secondary forestry road given its proximity to an existing powerline rights-of-way (ROW) and its connection to the cutblock previously mentioned. The road may still be passable and may be used for recreational purposes. An existing agricultural field is located 130 m north of the suspected nesting territory.
Red-tailed hawk	1,425	Occupied in 2018	The nest is located along the western portion of the proposed Tenas Access Corridor in a deciduous tree. The surrounding habitat is characterised by mature mixed forest and open agricultural fields. The nest is located along an existing two-lane dirt road. This road is likely a farm road given its proximity to an existing agricultural field, which is located 20 m north of the nest.

¹The exact location of the nest was not determined during baseline studies; however, an estimated location was provided.

Path: L:\PROJECTS\2018\BP0021_Tenas_Mine\Map\REPORTING\ENR\Map\Baseline\Fig12_RaptorNests.mxd



Tenas Project

Figure 12. Locations of raptor nests detected during baseline surveys

Legend

Raptor Nest

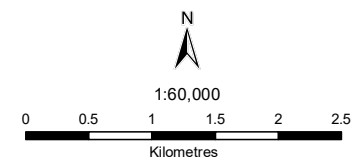
- Cooper's Hawk
- Osprey
- Red-tailed Hawk
- Project Area
- General Wildlife LSA
- Rail Line
- Highway
- Road
- Resource Road
- Watercourse
- Wetland
- Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map



4.2.4 Listed Avian Species — Focal Species

The following sections summarize baseline observations related to the focal species within the “Listed Avian Species” group identified for avian baseline surveys (refer to Table 2 located in Section 0).

Bank Swallow

Project baseline surveys did not locate any bank swallow within the Wildlife LSA, although the desktop review did identify previous detections within the Wildlife RSA during the breeding season (Figure 3). The qualitative habitat assessment identified potentially suitable nesting habitats for bank swallows at several locations in the Wildlife LSA, including along sections of the Bulkley and Telkwa rivers, and Goathorn and Tenas creeks. However, given their tendency to nest in colonies (ranging in size from approximately 10 to 100+ active nests [Garrison 1999, Howie 2015]) and their association with typically open habitats (i.e., near open water), active bank swallow colonies tend to readily detectable. The lack of detections during baseline surveys suggests the species may not be nesting near the Project Area, although, based on the desktop review, nesting by bank swallows is considered likely within the broader Wildlife RSA.

Barn Swallow

Barn swallows were detected once during Project baseline surveys; however, the desktop review found regular detections in the agricultural areas along the Bulkley River from the town of Smithers to Round Lake (Figure 3). The qualitative habitat assessment determined that suitable nesting habitat is present within both the Wildlife LSA and RSA, mostly to the north and east of the Project Area where human activity has cleared forests and suitable structures for nesting (e.g., barns, bridges) are present (Hearne 2015, eBird 2020). The single observation made during Project baseline surveys was of approximately ten barn swallows nesting on outbuildings associated with a rural farm property approximately 720 m west of the proposed rail features area (Figure 5; Section 3.6.1).

Black Swift

Baseline surveys did not detect black swift and the qualitative habitat assessment did not identify any suitable nesting habitat for black swift within the Wildlife LSA. The desktop assessment did locate previous observations of black swift within the Wildlife RSA during the breeding season including near the south end of Tyhee Lake, approximately 4 km west of the village of Telkwa adjacent to the Bulkley River, at the confluence of the Bulkley and Telkwa rivers, and near the town of Smithers on the Bulkley River (Figure 3). It is expected that suitable habitat may be present in other parts of the Wildlife RSA; however, within the Wildlife LSA neither field surveys nor a desktop review of aerial imagery located notable waterfalls or other cliffs/rock faces suitable for nesting.

Common Nighthawk

Common nighthawk were not detected during Project baseline surveys; however, targeted surveys for the species were not conducted and common nighthawk are not often detected during standard diurnal surveys (e.g., point count surveys). The desktop assessment confirmed the presence of common nighthawk in the Wildlife LSA and RSA during the breeding season (Figure 3) and habitat suitability modelling classified approximately 22% of the Wildlife RSA as moderate or high quality nesting habitat for common nighthawk, including parts of the Project Area (Section 3.7.1). Therefore, the species is considered a possible breeding resident within the Wildlife LSA and RSA despite the lack of baseline survey observations.

Northern Goshawk

Habitat suitability modelling for northern goshawk found that suitable habitat within the Wildlife RSA is fragmented and that few contiguous patches of moderate and high suitability habitat are available. Consequently, only 6% of the Wildlife LSA and 10% of the Wildlife RSA was rated as high or moderate value habitat for northern goshawk (Section 3.7.3). Nevertheless, baseline surveys did document northern goshawk present in the Wildlife LSA. Call-playback surveys for northern goshawk did not result in any detections; however, northern goshawk observations were made incidentally during other Project surveys (Section 3.6.2). All observations were within or adjacent to the mine features area, with most observations occurring to the west of the mine features area (Figure 5). Four adult goshawk detections were made between the 2017 and 2018 field seasons, three at separate locations along the western side of the mine features area and one along the eastern side of the mine features area. One detection was in moderate suitability habitat and the other three detections were in nil suitability habitat (as identified by the northern goshawk habitat suitability modelling; refer to Section 3.7.3). These three detections were located 144 to 258 m from suitable habitat (i.e., moderate and high suitability). Additionally, northern goshawk feathers were found at two separate locations within the mine features area in 2017; one near the north end of the mine features area and the other along the western side (the detections were located 390 m and 430 m from suitable habitat). The desktop review also located several other potential breeding records for northern goshawk within the broader Wildlife RSA (Figure 3).

Olive-sided Flycatcher

Baseline surveys and the desktop review documented olive-sided flycatcher in several locations within both the Wildlife LSA and RSA (Figure 3, Figure 5). Observations made during baseline surveys were predominantly in coniferous forest habitats within the SBSmc2 subzone variant, with most occurring among a matrix of regenerating cutblock and remnant patches of mature forest. Several of the baseline observations were made within or adjacent to the Project Area, particularly in the mine features area (Section 3.2, Section 3.6.3). Habitat suitability modelling found that moderate and high-quality habitat for olive-sided flycatcher is relatively abundant, comprising approximately 33% of the Wildlife LSA and 47% of the Wildlife RSA. Nesting was not confirmed during the Project baseline studies; however, the presence of suitable nesting habitat and repeated detections of birds, including multiple birds at some point count locations, suggests that nesting is likely within both the Wildlife LSA and RSA.

Rusty Blackbird

Rusty blackbirds were not detected directly or incidentally during baseline surveys; however, they have previously been identified during the breeding season within other parts of the Wildlife RSA (Figure 3). Suitable nesting habitat for rusty blackbird (as represented by the wetlands habitat guild mapping) was identified in both the Wildlife LSA and RSA (Section 0), although the lack of baseline detections suggest that, if present, the species is uncommon in the Wildlife LSA.

Short-eared Owl

Short-eared owl were not detected during baseline surveys; however, targeted surveys during the crepuscular period were not conducted for the Project. The desktop assessment confirmed the presence of short-eared owl in the Wildlife RSA during the breeding season (Figure 3) and habitat suitability modelling classified approximately 12% of the Wildlife LSA and 13% of the Wildlife RSA as moderate or high quality nesting habitat for short-eared owl (Section 3.7.4). Consequently, the species is considered a possible breeding resident within the Wildlife LSA and RSA despite the lack of baseline survey observations.

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Appendix A Northern Goshawk Species Account and Habitat Model Report

Tenas Project

Northern Goshawk Species Account and Habitat Model Report

March 2020

VERSION 1

Submitted to: Telkwa Coal Limited
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ACKNOWLEDGEMENTS

Pablo Jost and Todd Mahon were the primary authors. Todd Mahon designed model parameters and Pablo Jost reviewed the model parameters and model results. Christina Tennant provided GIS analysis and mapping support. Laurence Turney and Ardea Biological Consultants collected wildlife habitat suitability ratings in the field. Anne MacLeod and Frank Doyle completed senior review.

Tenas Project

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1. INTRODUCTION

This report describes the northern goshawk (*Accipiter gentilis*, goshawk) habitat suitability model developed as baseline information for the assessment of the Tenas Project (the Project).

Modeling for goshawk was completed for the General Wildlife Regional Study Area (RSA; 194,650 ha) as this is the area that will be used for the assessment of direct and indirect Project effects. The RSA contains the Wildlife Local Study Area (LSA) which is the area that is expected to contain all direct effects of the Project. The Project RSA and LSA were developed to be biologically meaningful, integrate with baseline work and be consistent with similar projects. The LSA is generally the area in which a local population may interact with the Project while the RSA is considered the area where regional populations may interact with the LSA.

Habitat suitability modelling was completed for northern goshawk in the RSA in order to assess potential effects of the Project on current northern goshawk habitat. The species' ecology was reviewed, and variables considered in the development of the model are summarized. This includes the known threats to the species and its known habitat requirements in context with the most current available data in the region.

2. SPECIES ACCOUNT

Numerous documents provide comprehensive accounts of the ecology, management and conservation of the northern goshawk internationally (Squires and Reynolds 1997) provincially (Cooper and Stevens 2000) and regionally (Iverson et al. 1996, Mahon and Doyle 2003, McClaren 2005, Stuart-Smith et al. 2012, McClaren et al. 2015). For detailed background information readers should refer to these documents. A brief synopsis of key information is provided below.

2.1 Description, Distribution, and Ecology

The northern goshawk is a raven-sized forest raptor with a circumpolar distribution, and is found in both temperate and boreal forests (Brown and Amadon 1968). Across its range there are several morphologically different sub-species. Within BC two subspecies are recognized the larger interior subspecies (*Accipiter gentilis atricapillus*) is found throughout the interior of the province (Campbell et al. 1990, Cooper and Stevens 2000) and the smaller coastal subspecies (*Accipiter gentilis laingi*) is found on Haida Gwaii (Geraldes et al. 2019). Along the mainland coast and Vancouver Island there is only subtle differentiation in nuclear DNA signatures from populations from other parts of North America (Geraldes et al. 2019). Geraldes et al. (2019) recent genetic study is in contrast with the prevailing understanding of the distribution of the two subspecies in British Columbia but provides the strongest evidence for the distribution of the two subspecies in BC. Only *A.g. atricapillus* is likely to occur throughout the RSA but habitat modeling will be based on the different habitat requirements of interior and coastal goshawk as habitat use patterns differ between these areas regardless of subspecies designation.

The goshawk is primarily adapted to forest habitats where its short, rounded wings, long tail, and powerful flying action make it an effective direct pursuit hunter, capable of quick acceleration and excellent maneuverability through the forest. Across their broad range goshawks take a variety of mid-sized forest prey ranging from small mammals and passerines to hares (Squires and Reynolds 1997). Both interior and coastal goshawk main prey during the breeding season are red squirrels, forest passerines (e.g., thrushes, woodpeckers and jays) and grouse (Roberts 1997, Ethier 1999, Mahon and

Doyle 2003).

Goshawks typically nest in mature and old-growth coniferous stands that have a closed canopy and open understory (Cooper and Stevens 2000, Penteriani 2002, McGrath et al. 2003). Within homogenous mature forest habitat goshawks are relatively evenly distributed (Reynolds and Joy 1998, Reich et al. 2004) with the distance between territories being primarily driven by prey and habitat availability within landscapes (Doyle and Smith 1994, 2001, Reich et al. 2004). In the interior west-central BC goshawk territories are spaced 4-6 km apart corresponding to an average breeding territory size of approximately 2400 ha (Mahon and Doyle 2003). In Coastal BC nest area spacing ranges from approximately 7 km on Vancouver Island (McClaren 2005) to approximately 11 km on Haida Gwaii (Doyle 2005). These spacing distances correspond to territory sizes of 3800 ha – 9200 ha, respectively, which are substantially larger than territories in interior BC (2400 ha)(Mahon and Doyle 2003) and in the southwestern United States (1200 ha)(Reynolds et al. 1994). Both goshawk subspecies are year-round residents throughout most of its range (Squires and Reynolds 1997, McClaren 2005, McClaren et al. 2015).

Potential habitat was mapped in each of the ecosystem units that occur in the study area for the Project (Table 1).

Table 1: Study Area of Northern Goshawk Habitat Mapping

Study Area:	General Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecosections:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun), Coastal Mountain-heather Alpine undifferentiated (CMAun), Coastal Western Hemlock wet submarine Montane variant (CWHws2), Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc), Engelmann Spruce – Subalpine Fir moist-cold parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk), moist-cool parkland (ESSFmkp), Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv), Engelmann Spruce – Subalpine Fir wet-very cold parkland (ESSFwvp), Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1), Sub-Boreal Spruce dry-cool (SBSdk), Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

2.2 Threats and Status

Based on recent studies Gerald et al (2019) a single subspecies (*A. g. atricapillus*) of northern goshawk has the potential to occur within the RSA. In contrast to the morphometric studies, genomic analysis reveals that the distribution of *A. g. laingi* occurs only Haida Gwaii (Gerald et al. 2019). Along the mainland coast and Vancouver Island there is only subtle differentiation in nuclear DNA signatures from populations from other parts of North America (Gerald et al. 2019).

A. g. atricapillus is considered Not at Risk at national level and is Blue-listed in BC (BC Conservation Data Centre 2019). The northern goshawk is widely considered a mature forest indicator species and is frequently used as a focal species in landscape planning processes (e.g. Morice Land and Resource Management Plan (LRMP) (Government of British Columbia 2004).

Table 2: Status of Northern Goshawk (*Accipiter gentilis*)

Species / Code	<i>Accipiter gentilis atricapillus</i> / B-NOGO-AT(interior)
Provincial Status	S3S4 (2017)
B.C. List	Blue
Identified Wildlife (Province of British Columbia 2019)	N
COSEWIC Status	NAR (1995)
Species at Risk Act (SARA) status	N/A

Before the mid 1990s very few goshawk nest areas were known in BC. In 1995 both subspecies were listed as “Identified Wildlife Species” under the former Forest Practices Code and several systematic inventory projects were initiated throughout the province. As a result of these programs and a generally heightened awareness of goshawks at least 250 nest areas have been reported in the interior of the province and approximately 165 nest areas have been discovered in coastal areas.

Loss of mature forest breeding habitat (nesting and foraging) from logging is probably the most significant factor threatening goshawks (Cooper and Stevens 2000, NGRT 2008, COSEWIC 2013, Doyle et al. 2017). Some European populations of goshawks have declined 50-60% in response to broad-scale forest harvesting (Widen 1997). Dramatic declines in breeding area occupancy (>85%) has occurred within the Skeena Region, which includes the RSA, and are linked to the harvest quantities (>40% harvested) and rate of harvest (majority within last 40 years) within the predicted 2400 ha territory centred on the known breeding area (Doyle et al. 2017). Within the Bulkley TSA approximately 30 areas are potentially capable of supporting breeding territories, in an area that historically (pre-industrial harvesting) could have supported 200-300 pairs (F.I. Doyle, pers com).

3. HABITAT REQUIREMENTS

3.1 Territory Components

A goshawk territory is traditionally described as having several hierarchically arranged components. At the smallest scale is the nest tree, which is surrounded by the nest site (<1 ha). Most goshawk territories have 2-6 nest trees and combined these are the nest area, although a small proportion of territories contain a single nest tree. Typically surrounding each nest tree is a post-fledging area (PFA), which is used by fledgling goshawks, within a given year, from fledging until dispersal.

The breeding area is defined as the primary ecological unit for all goshawk breeding activities, including courtship, nesting, fledging, and movements of fledglings before dispersal. This area includes nest trees (historic, current, and potential future ones), plucking posts, roosts, and post-fledging areas associated with each nest tree over multiple years and is estimated to be 30-100 ha (Stuart-Smith et al. 2012). Breeding home range is the area used by a pair of goshawks during the breeding season, which encompasses both the breeding area and foraging areas and is approximately 2400 ha (Squires and Kennedy 2006, Harrower 2007, Mahon 2009). The largest territory scale is the annual home range, which includes the total area used by an adult goshawk pair throughout the year. At the annual home range scale there is considerable overlap among adjacent goshawk pairs. During the breeding season, space use contracts to a smaller breeding home range with reduced overlap among neighbouring pairs (Squires and Reynolds 1997).

3.2 Nesting Habitat

Goshawks consistently select key structural attributes for their nesting habitat despite significant variation in forest types used for nesting across their geographic range. These attributes include mature/old-growth stand structure and relatively closed canopies with corresponding open sub-canopy flyways (Cooper and Stevens 2000, Penteriani 2002, McGrath et al. 2003, NGRT 2008). At the regional level the selection of forest species composition is also evident (Schaffer et al. 1999, Mahon and Doyle 2003, McClaren 2005, Stuart-Smith et al. 2012). Nesting habitat use patterns by goshawks are well known for the biogeoclimatic ecosystem classification (BEC) zones in the RSA including the sub-boreal spruce (SBS) and coastal western hemlock (CWH). In the SBS nest areas are typically in even-age, mature pine-dominated stands in structural stage 6, with canopy closure >45%, stand age >120 years, and stand heights >20 m (Mahon and Doyle 2003). In the CWH nest stands are dominated by western hemlock or co-dominated by western red-cedar and western hemlock and are typically >90 years, >32 m in height, and have >50% canopy closure.

3.3 Foraging Habitat

Foraging habitat can occur throughout the annual home range. Habitats used by goshawks for foraging are similar to those used for nesting, although foraging habitat is more variable (depending on fluctuating prey populations) and generally broader (i.e., a broader range of levels for a given habitat variable are suitable for foraging than they are for nesting). However, foraging habitat selection by goshawks is less well-understood than nesting habitat and patterns of selection for some foraging habitat variables (Mahon 2009) appear to be contradictory, possibly reflecting high regional or temporal variation. In Alaska Iverson et al. (1996) found selection for habitats within 300 m of shoreline and a negative relationship between habitat use and elevation; however, on Vancouver Island goshawks did not select for shoreline areas and some moved into moderate to high elevation areas over the winter (McClaren 2005).

Notwithstanding regional and temporal variation, goshawks primarily forage in mature and old forests across their range (Squires and Reynolds 1997). In a review of goshawk habitat selection outside of the nest stand, Greenwald et al. (2005) identified 12 studies that compared used habitat types to those available. All studies showed selection for mature and old-growth habitats compared to non-forested or early seral habitats. Nine of the 12 studies demonstrated selection for stands with higher canopy closures and larger trees than in random stands. It has also been shown that goshawks preferentially use forest stands where the structure makes prey more available than stands where prey is more abundant (Beier and Drennan 1997, Good 1998, Drennan and Beier 2003). This favours hunting primarily in mature/old growth forest areas with high canopy closure, and an open understory; habitats that allows goshawks to move freely under the canopy, see their prey and have abundant opportunities for perching to ambush prey (Squires and Reynolds 1997). Many studies have demonstrated a positive relationship between amount of mature forest within the territory (defined at various scales) and nest area occupancy (Crocker-Bedford 1990, 1995, Ward et al. 1992, Finn et al. 2002, Doyle et al. 2017).

4. MODEL DEVELOPMENT

The northern goshawk habitat model was based on the habitat suitability index (HSI) methodology (U.S. Fish and Wildlife Service 1981). This methodology is commonly used in habitat assessment and has been used in several goshawk habitat mapping and supply analyses in British Columbia (e.g. North Coast LRMP (Mahon and Doyle 2003), Morice LRMP (Government of British Columbia 2004, Mahon 2009, Stuart-Smith et al. 2012)).

HSI methodology involves three key steps:

1. Selection of relevant habitat variables to include in the model;
2. Development of rating scores for each habitat variable; and
3. Building a mathematical relationship among habitat variables to produce overall habitat suitability scores.

The variables used in the model and ratings assigned for each variable were developed based on relevant literature, and the opinions of provincial northern goshawk experts.

Numeric ratings were used at two levels within the HSI model: 1) to rate individual variables included in the model, and 2) as final scores for the model. Biological interpretation of the final habitat scores are provided (Table 12).

Although both nesting and foraging habitat provide critical life requisites to goshawks, only nesting habitat (life requisite: reproduction, season: breeding) of the northern goshawk (*A. g. atricapillus* and *A. g. laingi*) was assessed for the Project because:

1. Nesting habitat has more specific conditions and is therefore more limited; foraging habitat can encompass a broader range of structural stages and cover types and would provide comparatively little predictive information;
2. Nesting and foraging habitat are often similar in value; good nesting habitat is almost always good foraging habitat, but the reverse is not necessarily true; and
3. There is local data describing nesting habitat selection, but less data to support a foraging model.

For modeling purposes, the RSA was divided into two subsections – coastal and interior, which corresponds to the approximate ranges of *A. g. laingi* and *A. g. atricapillus*, respectively. The primary biogeoclimatic zones within the coastal portion are CWH, interior cedar-hemlock (ICH) and coastal mountain-heather alpine (CMA)(Banner et al. 1993). The primary biogeoclimatic zones within the Interior portion are the SBS, Englemann spruce – subalpine Fir (ESSF), and boreal alpine fescue alpine (BAFA) (Banner et al. 1993, DeLong et al. 1993).

4.1 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the northern goshawk model are described below (Table 3). A digital elevation model (DEM) was used to generate the elevation and slope thresholds. Forest cover attributes were acquired from a Vegetation Resource Index (VRI) dataset with post infestation polygons used to adjust forest composition ratings. The remainder of the datasets were used to generate an anthropogenic disturbance layer which was incorporated into the VRI to adjust forest stand attributes.

Table 3: Datasets Used in the Development of the Northern Goshawk Model

Dataset Name	Description	Source
Digital Elevation Model (DEM)	Raster	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain

Dataset Name	Description	Source
Vegetation Resource Inventory	Polygons representing vegetated and non-vegetated land classifications	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-layer-1 Acquired by: Tenas Coal - 2019
Pest Infestation Polygons	Forest disturbance by pests, by year, disturbance agent, severity and host.	https://catalogue.data.gov.bc.ca/dataset/pest-infestation-polygons
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
GeoBase 250K Land Cover, Circa 2000	Polygons identifying land classifications (e.g., annual cropland, snow/ice, developed)	https://catalogue.data.gov.bc.ca/dataset/other-land-cover-1-250-000-geobase-land-cover#edc-pow
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
OpenStreetMap	Point sources for buildings to represent building corners.	https://osmbuildings.org/data/
TRIM Enhanced Base Map	Polygons representing building footprints	https://catalogue.data.gov.bc.ca/dataset/buildings-trim-enhanced-base-map-ebm
Mineral Titles Online Tenure	Data for minder, placer claims and leases, and coal licence applications/licences/leases	https://catalogue.data.gov.bc.ca/dataset/mta-mineral-placer-and-coal-tenure-spatial-view
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow
Oil and Gas Commission Pipeline Right-of-Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits

Dataset Name	Description	Source
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
GBA Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Telkwa Motor Vehicle Closure	Road closures due to caribou habitat protections	ftp://ftp.geobc.gov.bc.ca/publish/Regional/Smit hers/Telkwa%20motor%20vehicle%20closure/
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line

4.2 Habitat Variables

Potentially relevant nesting habitat variables were identified from the published literature, regional studies and professional experience. The variables selected include age, height, forest composition, canopy closure, edge, elevation, and slope. Table 4 outlines how each variable relates to the life requisite and its data source.

Table 4: Nesting Habitat Variables and Data Source

Habitat Variable	Data Source	Relationship to Selection or Use
Stand Age	Vegetation Resource Index	Used to assess structural maturity of a stand.
Height	Vegetation Resource Index	Used to assess structural maturity of a stand.
Forest Composition	Vegetation Resource Index	Suitability of branching platforms for nests and subcanopy flyways are related to the form of different tree species.
Canopy Closure	Vegetation Resource Index	Mid-high canopy closures were consistently identified as a common characteristic of used nesting habitat (relates to subcanopy flyways)

Habitat Variable	Data Source	Relationship to Selection or Use
Distance from Edge	Vegetation Resource Index (derived)	Data from Coastal BC show strong avoidance of edges for nest sites.
Elevation	Digital Elevation Model	Local data indicates avoidance of higher elevations.
Slope	Digital Elevation Model (derived)	Nest sites often on low-moderate slopes. Local data indicate no nests on slopes >60%.

4.2.1 Stand Age and Height

The structural maturity of a stand, and trees within a stand, form the fundamental basis for nesting suitability for goshawks (Squires and Reynolds 1997). Individual trees must have large enough branches to support the nest structure. Suitable stands will have progressed through the self-thinning stage and be tall enough to provide open flyways below the main canopy layer (Penteriani 2002). "Structural Stage" (as classified in: Field Manual for Describing Terrestrial Ecosystems (B.C. Ministry of Environment, Lands, and Parks, and B.C. Ministry of Forests 1998) would probably provide the best scheme for categorizing this characteristic; however, it was not available in the existing inventory information. As a surrogate to structural stage, stand age and height were used as criteria. Because the two variables are so strongly correlated, an average of the ratings for the two variables was used to avoid overweighting the model by these factors. The ratings estimates applied to stand age and height for both subspecies are provided in Table 5 and Table 6, respectively. The ratings for the Interior are based primarily on research in the Morice and Lakes Timber Supply Area (TSA) (Mahon and Doyle 2003) while coastal ratings are based on Mahon et al (2019).

Table 5: Stand Age Rating for Interior and Coastal Northern Goshawk Nesting Model.

Interior			Coastal		
Stand Age (years)	Rating	Equation	Stand Age (years)	Rating	Equation
<=40	0		<=40	0	
40-120	0-1	$= (\text{Age}-40) * (1/80)$	40-115	0-1	$= (\text{Age}-40) * (1/75)$
>=120	1		>=115	1	

Table 6: Stand Height Rating for Interior and Coastal Northern Goshawk Nesting Model

Interior			Coastal		
Stand Height (m)	Rating	Equation	Stand Height (m)	Rating	Equation
0-12	0		0-14	0	
12-24	0-1	$= (\text{Height}-12) * (1/12)$	14-32	0-1	$= (\text{Height}-14) * (1/18)$
>24	1		>32	1	

4.2.2 Forest Composition

Suitability ratings for forest species in Table 7 are based on the associations of tree species observed at nest areas. Suitability depends on the form and structure of the trees and the stands they make up and can therefore vary substantially among sites. Most known nest areas in the SBS zone are in lodgepole pine leading stands. Pine appears to be preferred because it often forms even-aged stands with closed canopies and open subcanopy flyways. Other species such as spruce and fir tend to have more broken canopies, greater vertical stand structure with less open subcanopy flyways, and poorer branch structures for nests. Although pine is currently the preferred nest tree and nest stand species in the interior, the mountain pine beetle (MPB) epidemic throughout the BC interior has reduced the value of these areas. To reflect the lower suitability of MPB killed and damaged stands a downgrade was incorporated into pine-leading stands based on the cumulative severity of MPB attack across years.

In coastal areas nesting areas are usually in western hemlock dominated and western hemlock/balsam fir co-dominated stands. Stands that are dominated by western-redcedar and balsam fir often do not provide open understories and good branch structure for nests. Yellow cedar and lodgepole pine stands have the lowest suitability due to both tree form and stand-level heterogeneity (i.e., multi-storied canopy with low canopy closure). The major reduction in coastal lodgepole pine suitability is because it is typically either associated with hygric bogs or dry ridges in coastal areas and it has poor nest tree and nest stand structure in both habitats.

Table 7: Forest Composition Rating for Interior and Coastal Northern Goshawk Nesting Model

Interior			Coastal		
Tree Species	Condition	Rating	Tree Species	Condition	Rating
Cottonwood		0.5	Cottonwood		0.6
Aspen	≤20% species composition	1	Aspen		0.5
Aspen	>20% species composition	0.6	Birch		0.5
Birch		0.5	Red Alder		0.8
Sub-alpine Fir		0.6	Amabilis/Sub-alpine Fir		0.8
Douglas Fir		1	Douglas Fir		1
Lodgepole Pine ¹		1	Pine		0.6
Spruce		0.8	Spruce		1
Hemlock		0.8	Hemlock		1
Black Spruce		0.5	Black Spruce		0.5
			Western Red Cedar		0.6
			Yellow Cedar		0.4

¹ A MPB cumulative severity rating was used to adjust pine leading stands, severity ratings, $Pine_{MPB} = 1 - (0.5 * \text{Severity Score} / 100)$, severity score Trace=1, light=10, moderate=35, severe=70, very severe=100

Suitability ratings for stands with multiple species were calculated by multiplying the species percentages by their rating from the above table and summing the products. An example calculation for an interior stand:

$$70\%Pine + 20\%Spruce + 10\%Aspen = 0.7(1.0) + 0.2(0.8) + 0.1(1.0) = 0.96$$

4.2.3 Canopy Closure

Canopy closure is probably the single most important structural variable relating to nest area suitability, after the fundamental requirement of a mature forest stand age (Penteriani 2002). Stands with <30% canopy closure are generally too open for nesting, and optimal canopy closure values in BC's interior are 45 -75% (Gyug 2001, Mahon and Doyle 2003, Harrower 2007). Suitability ratings are similar for both subspecies. Corresponding suitability ratings for the canopy closure classes available in the forest cover database are provided below (Table 8).

Table 8: Canopy Closure Rating for Northern Goshawk Nesting Model

Canopy Closure Class	Canopy Closure %	Rating
0-1	0-15	0
2	16-25	0.2
3	26-35	0.4
4	36-45	0.7
5-7	46-75	1
8-9	>75	0.9

4.2.4 Distance from Edge

Data from both coastal and interior studies in BC indicates that goshawks avoid nesting near abrupt or 'hard' edges (i.e., where mature forest meets non-forested or early seral habitats)(Mahon and Doyle 2003, McClaren et al. 2015). In addition, goshawks on the coast appear to abandon existing nests when a new cutblock edge is created near them (E.L. McClaren, pers. obs.).

A height difference of >10 m between adjacent stands with the shorter stand <14 m, was used in this model to define a hard edge. The effect of a hard edge on the suitability of adjacent stands was assessed based on proximity to the edge, a stronger edge effect was applied to habitats within 0 - 50 m compared to habitats within 50 - 100 m (Table 9).

Table 9: Edge Rating for Northern Goshawk Nesting Model

Edge Distance (m)	Rating
0-50	0.4
50-100	0.7
>100	1

4.2.5 Elevation

The observed pattern of goshawk nest sites across British Columbia suggest the avoidance of higher elevation areas; however, this pattern is relative to the range of elevations present rather than to absolute elevations (Mahon and Doyle 2003, McClaren 2005, Harrower 2007). This likely relates, at least in part, to correlations between elevation and tree species (e.g., subalpine fir) and BEC variants (e.g. ESSF), which generally offer suboptimal nesting habitat. Another possible reason is the greater energy expenditures required to carry prey upslope to higher elevation nests (Finn et al. 2002). In this model, elevation was treated as a weak variable to avoid overweighting the model with factors correlated to elevation(such as forest composition and BEC variant); however, it was included because forest

composition and BEC alone did not appear to adequately account for the observed pattern of nest area selection. The ratings below were intended to cover the general range elevation of the ESSF within the RSA nesting habitat was assumed to be good at the lower range but decreases with increasing elevation (Table 10).

Table 10: Elevation Rating for Northern Goshawk Nesting Model

Elevation	Rating	Equation
<= 1000	1	
1000-1600	0.5-1	$=1+(Elevation-1000)*(-0.5/600)$
>1600	0.5	

4.2.6 Slope

All known BC goshawk nest sites occur on slopes <45° (100%) and most are on slopes <31° (60%) (Mahon and Doyle 2003, McClaren 2005, Harrower 2007). Nests that occur on slopes between 31 – 45° tend to occur in areas with broken slopes with small benches as opposed to areas of straight slope. To account for this, the habitat model applied a weak downgrade based on slope to areas steeper than 31° (Table 11).

Table 11: Slope Rating for Northern Goshawk Nesting Model

Slope (degrees)	Rating	Equation
0-30°	1	
>30-70°	0-1	$= 1+(Slope-30)*(-1/40)$
>70°	0	

4.3 Model Equation

The nesting habitat model was developed using a limiting factor, non-compensatory structure. From an ecological perspective this means that when the suitability rating of one variable falls below its optimal range it decreases the overall suitability by that amount. Further, suboptimal ratings in two or more variables are combined, through a multiplicative function, to decrease the overall value. The function is non-compensatory in that the value of one variable cannot compensate for a deficiency in another.

The equation used to calculate the nesting suitability ratings was:

Nesting HSI = mean(Stand Ager, Stand Height) * Canopy Closure * Edger * Forest Cover * Elevation * Slope

r=rating

4.4 HSI Rating Interpretations

For interpretation purposes the final HSI scores were categorized into a 4-class rating scheme (Table 12).

Table 12: Interpretation of Final HSI Rating for Northern Goshawk Nesting Habitat

HIS Ratings	Class	Interpretation
≥ 0.750	High	Suitable. All habitat variables meet optimal conditions. Majority of nest sites are expected to occur in High class habitat.
0.500-0.749	Moderate	Suitable. Suitability of one or two habitat variables is slightly lower than optimal conditions but minimum requirements still exceeded. Goshawks will nest in Moderate class habitat; however, a minority of nest sites are expected to occur here.
0.250-0.499	Low	Suitability Unknown. Habitat provides theoretical minimum requirements for supporting a nest but use by goshawks is rarely observed. Suitability of two or more habitat variables is suboptimal, substantially reducing the overall suitability of the stand. Goshawks are not normally expected to use Low class habitats, but may do so if that is all that is available.
≤ 0.249	Nil	Unsuitable. Habitat fails to provide minimum requirements for nesting.

4.5 Model Evaluation

The model was evaluated for accuracy by comparing field observations and model predictions for each site to provide an estimate of stand-level accuracy. The model prediction was only considered correct when it matched the field rating; no partial points were scored for 'close' predictions (e.g. Moderate versus High).

A total of 114 field ratings and habitat verification plots were assessed during baseline studies within the Project Footprint and LSA (Table 13). The initial evaluation of stand-scale level accuracy (i.e., comparison of field observation and model predictions at each site) was quite low (37%); however, when the "Low" and "Nil" categories were combined, the stand level accuracy was high (78%).

Table 13: Stand-scale Accuracy of the Northern Goshawk Nesting Suitability Mapping

Field Observations	Model Predictions				Field Totals
	High	Moderate	Low	Nil	
High	0	0	1	0	1
Moderate	0	1	8	13	22
Low	0	2	6	47	55
Nil	0	1		35	36
Model Totals	0	4	15	95	114

The discrepancy between field and model predictions can be explained by the field ratings methodology and the habitat model edge variable. Field ratings for northern goshawk used a plot-type assessment, which rates the vegetation characteristics at a plot and is tied to the ecosystem field form. The plot-type assessment usually helps in developing ratings assumptions for the species of interest. In contrast a plot-in-context habitat ratings uses similar attributes for assessment, but an adjustment is made to the field rating based on surrounding habitats and features (e.g. cutblocks, roads, openings etc.). Plot-in-context ratings are generally used in verifying habitat suitability mapping as it gives a more accurate representation of the habitat effectiveness. Each of the 13 plots that were field rated as “Moderate” in the field and “Nil” by mapping were reviewed 12 of 13 of these plots were on or near an edge and therefore the habitat was downgraded to “Nil” within the model when combined with other habitat variables. The single remaining plot was a recently disturbed site which was likely forested when the plot was completed.

5. LIMITATIONS/CONFIDENCE

The northern goshawk model is a knowledge-based model; consequently, biases in the knowledge and opinions of the authors are reflected in the model. Existing goshawk occurrence data, both from baseline surveys and a desktop review for the area was good reliance was placed on numerous studies across the province and local are to guide model development. Model development relied on spatial data: VRI, anthropogenic disturbance, and pest infestation datasets which were not field verified prior to model use, and as a result inconsistency between datasets and real-world conditions may vary. Habitat requirements that were used as part of the model were obtained from a literature review that did not find any studies from the region on the specific effects of mine development and operation on goshawk; however, regional habitat requirements for goshawk are relatively well known. The overall confidence in the model is high because of the relatively well-known habitat requirements and relative confidence in the spatial data.

The model development focused on nesting habitat but without a suitable quantity and quality of foraging habitat surrounding a nest it is unlikely that the suitable nesting habitat as per the model will support breeding goshawks. Based on preliminary regional studies (Bulkley TSA draft ongoing habitat research), there are no high potential areas that have a large enough area of suitable supporting habitat located within or adjacent to the LSA.

6. SUMMARY OF MODELLING RESULTS

Table 14 and Appendix A detail northern goshawk habitat suitability by study area. Within the RSA and LSA the landscape is fragmented, and few contiguous patches of moderate and high suitability habitat are available. The large degree of fragmentation is likely due to the extensive history of forest harvest, forest fire activity (particularly in the south of the RSA), and the MPB epidemic that has affected preferred lodgepole pine nesting habitat. Additionally, in the remaining forest there is a predominance of secondary tree species (i.e. balsam fir, spruce) which are not preferred nesting for northern goshawk.

Table 14: Northern Goshawk Nesting Model Habitat Suitability by Study Area

	Study Area (ha)			
	Wildlife LSA (ha)	Wildlife LSA (%)	General Wildlife RSA (ha)	General Wildlife RSA (%)
	High	0.28	1,741.1	0.89
	Moderate	6.13	16,901.3	8.68
Habitat suitability	Low	15.99	40,388.7	20.75

Nil	27,723.8	77.60	135,619.3	69.67
Total	35,725.9	100.0	194,650.5	100.0

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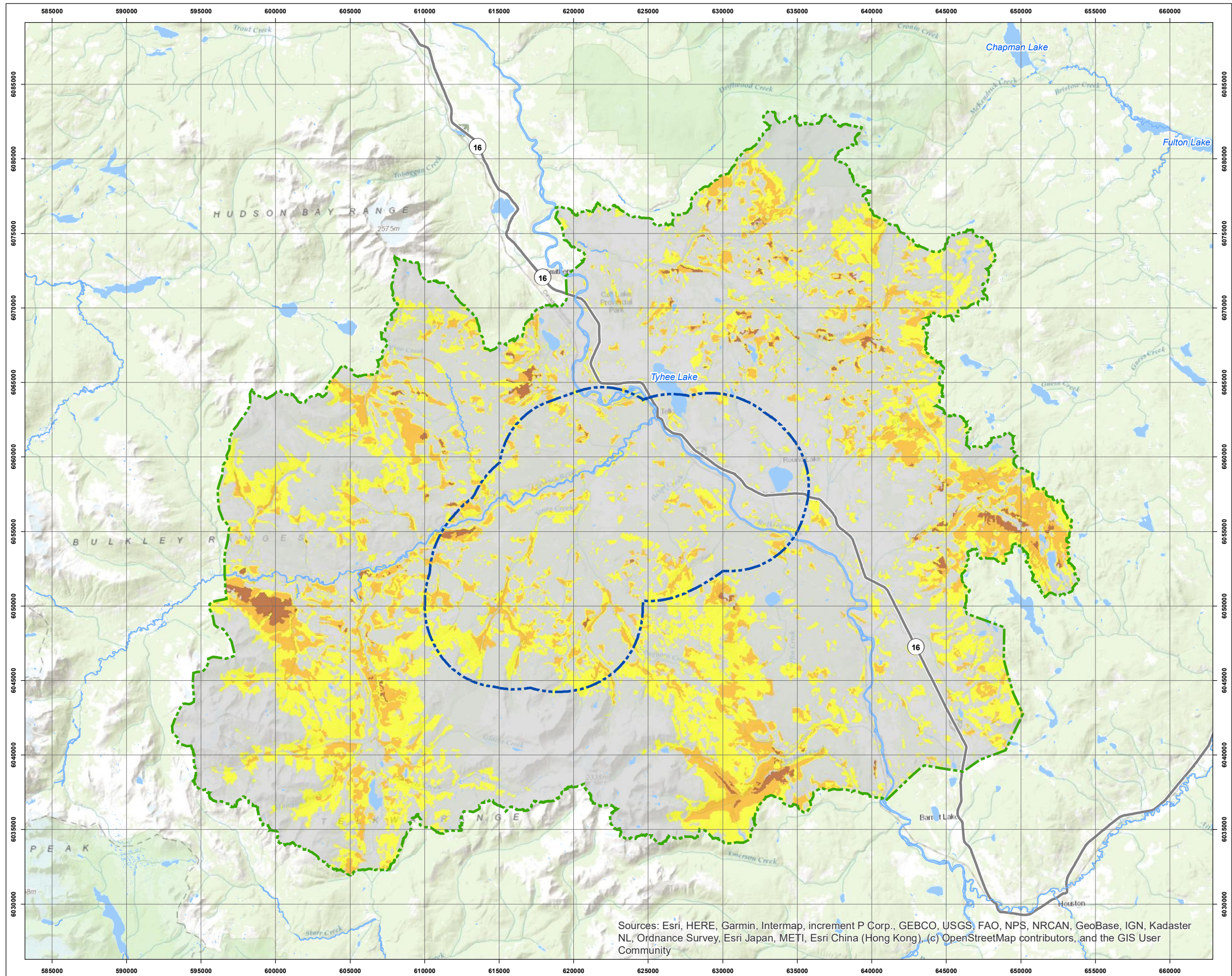
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Appendix A Northern Goshawk Nesting Habitat Suitability Mapping

Path: L:\PROJECTS\2018\BP0421_Tenas_Maps\Mapping\Reporting\Habitat_Suitability_Map\180724_Habitat_Suitability_RSA_UOCO_20200219.mxd



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Tenas Project

**Northern Goshawk Habitat Suitability
within the Generalized Wildlife RSA**

Legend

Wildlife LSA

Generalized Wildlife RSA

Habitat Suitability

High

Moderate

Low

Nil

Highway

River

Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basedata: Government of British Columbia

- Basemap: ESRI World Topographic Map

Scale

North Arrow

Projection

Page Size

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Production Date: Feb 19, 2020

Figure 1

Allegiance Coal Limited

EDI

Appendix B Common Nighthawk Species Account and Habitat Model Report

Tenas Project

Common Nighthawk Species Account and Habitat Model Report

March 2020

VERSION 1

Submitted to: Telkwa Coal Limited
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ACKNOWLEDGEMENTS

Mike Boyd was the primary author and designed the model. Anne MacLeod reviewed the report, and both Anne MacLeod and Todd Mahon reviewed the model design. Christina Tennant provided GIS analysis and mapping support. Anne MacLeod and Cathy Mackay completed senior review.

Tenas Project

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1. INTRODUCTION

The common nighthawk (*Chordeiles minor*) habitat suitability model was developed as baseline information for assessment of the Tenas Project (the Project). This report summarizes the species ecology, development of the habitat suitability model, and model output. The habitat model was bounded by the Generalized Wildlife Regional Study Area (RSA), which is the area that will be used to assess the context of the direct and indirect effects of the Project on common nighthawk. The RSA is 357,571 hectares (ha) and encompasses the Project footprint plus the intersection of all watersheds that overlap with a 10 km buffer around the Project Footprint.

2. DISTRIBUTION AND STATUS

2.1 Distribution

Common nighthawks regularly occur throughout the province of British Columbia (BC) including Vancouver Island, but not Haida Gwaii, the outer coast north of Vancouver Island, and alpine areas (Boyd 2015, eBird 2019). While common nighthawks are widespread across BC, most observations are concentrated in the southern half of the province (Campbell et al. 1990, Boyd 2015, eBird 2019). The highest probability of observation values for the BC Breeding Bird Atlas (BCBBA) was in the valleys of the Central Interior, Southern Interior, and Southern Interior Mountains (Boyd 2015).

In BC, breeding has been documented in all biogeoclimatic (BGC) zones, except Alpine-Tundra, wherever open areas occur (Campbell et al. 1990). Across the Southern Interior, the BCBBA found the highest probability of observation and abundance values occurred in Interior Douglas-fir, Ponderosa Pine, and Bunchgrass BGC zones.

2.2 Threats and Status

The common nighthawk was formerly considered common across much of its range in BC and Canada but was listed as Threatened under the federal Species at Risk Act (SARA) in 2010 due to declines between 1968 and 2005 of up to 80% on the Breeding Bird Survey (COSEWIC 2018, ECCC 2018). There is uncertainty around the true extent of the population declines due to a lack of surveys during its main activity periods and limited survey coverage across the boreal region where much of the Canadian population breeds (Brigham et al. 2011, Van Wilgenburg et al. 2015). Changes in analysis, targeted surveys, and improved coverage for the boreal region resulted in a reassessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2018 (Boyd 2015, COSEWIC 2018, Noble-Dalton and Knight 2018). The species is now listed as a Species of Special Concern under COSEWIC and as Threatened under Schedule 1 of SARA (Table 1). In British Columbia, the common nighthawk is on the provincial yellow-list (considered at least risk of being lost — apparently secure or demonstrably widespread, abundant and secure; BC CDC 2019).

Threats to the common nighthawk are generally poorly known; however, most hypothesized threats relate to declining aerial insect populations (Nebel et al., Smith et al. 2015, English et al. 2017). Pesticide use alters insect abundance and community composition. The use of pesticides in Canada and abroad may impact nighthawks; however, a lack of data has made it difficult to quantify this threat. Artificial lighting may also reduce insect populations; however, concentrations of insects at lights are also frequently exploited by nighthawks and it is unknown if this yields a net benefit (Bruce-White and

Shadlow 2011, Gaston et al. 2013). An additional threat is an increase in mortality risk from collisions with vehicles when nighthawks roost or forage on or near roads and collisions with transmission lines when performing aerial courtship displays (Erikson 2005, Brigham et al. 2011). Nighthawks have also been found to call less frequently along roads, suggesting avoidance due to road traffic volume (Knight 2016).

Table 1: Status of Common Nighthawk (*Chordeiles minor*).

Species Code	B-CONI
Provincial Status	S4B – Apparently secure, breeding
B.C. List	Yellow
Identified Wildlife (Province of British Columbia 2019)	No
COSEWIC Status	Special Concern
Species at Risk Act (SARA) status	Threatened (Schedule 1, SARA)

3. HABITAT REQUIREMENTS

The common nighthawk is a crepuscular aerial insectivore that requires open habitat for most of its life requisites. It is one of the latest spring migrants to BC, often arriving in early June, and most birds depart the province by mid-September (eBird 2019).

3.1 Reproductive Habitat

Common nighthawks require open habitats for nesting such as grasslands, agricultural areas (e.g. pasture, cropland), dry bogs, rocky areas (e.g. bedrock outcrops, gravel pits), open forest (e.g. coniferous, deciduous, and mixed stands), clear cuts or burns, and anthropogenic features (e.g. rail or roadsides, oil-well pads, pipelines, gravel roofs). Although, lower calling rates, potentially due to road traffic disturbance, suggest that the areas around roads may be avoided (Knight 2016). In burned areas nighthawks were found to be most abundant in forests younger than 20 years, with detections three times higher than in forests older than 20 years, and were negatively associated with denser tree canopy cover (Sidler 2017). Sidler (2017) also anticipated that these patterns apply to areas harvested for timber, due to habitat structural similarities. A study in the Ontario boreal forest found that nighthawks were significantly more abundant in burned areas than unburned areas; additionally, the detection frequency in unburned forest was highest within 10 km of a burn edge, and detection decreased with distance from a burn edge (Foley 2018). Increasing canopy cover was also a significant predictor of decreasing nighthawk abundance at the landscape scale and decreasing presence at a territory scale (Foley 2018); however, limited data exists for canopy cover at the nest site level. Nighthawks in Saskatchewan were more abundant at grassland sites that were adjacent to waterbodies, which were frequently used for foraging (Ng 2009, Brigham et al. 2011). Microhabitat requirements for nesting were more specific and were typically open sites with dry, well-drained substrates and nearby shade (COSEWIC 2018). Nests in BC are typically in the open, but have also been found near logs, boulders, grass clumps, and shrub, and substrates included gravel, sand, bare rock, wood chips, forest duff, leaves, needles, and occasionally living vegetation (Campbell et al. 1990).

3.2 Foraging Habitat

The common nighthawk is an opportunistic aerial insectivore, aggregating in areas that attract concentrations of aerial insects (Brigham et al. 2011). Foraging frequently occurs over wetlands, waterbodies, and other open areas, although the species has also been documented using areas up to 80 m above the forest canopy (Boyce 1980, Brigham et al. 2011).

3.3 Home Range

The area required for nesting has varied widely across studies. Males may defend territories from 1.5 to 28 ha, and areas used for roosting and foraging may be up to 6 km from the nest site (Ng 2009, Brigham et al. 2011, Farrell et al. 2017). In northwestern Ontario, nighthawks were not detected in patches less than 3 ha; however, in Idaho patches used for nesting were 0.2 – 0.4 ha (Rust 1947, Farrell et al. 2017).

4. MODEL DEVELOPMENT

4.1 Life Requisites and Seasons

The common nighthawk is a breeding resident of the Project area in the Growing season (summer). Migrants likely arrive in early June and reproduction (nesting) occurs from June through August. Nighthawks likely depart the Project area in August and early September (Campbell et al. 1990, eBird 2019).

The life requisite that will be evaluated for common nighthawk in the Tenas Project is Reproduction for the Growing season, as reproductive is the most limiting habitat and foraging may take place over a wide variety of habitats including those unsuitable for nesting (e.g., rivers, closed canopy forest) (Table 2). Common nighthawk is an opportunistic forager and foraging habitat could include much of the Project area; as a result, foraging habitat is not as informative about Project effects.

Table 2: Monthly Life Requisites for Common Nighthawk

Month	Season	Life Requisite
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	-
June	Summer	Reproductive
July	Summer	Reproductive
August	Summer	Reproductive
September	Early Fall	-
October	Late Fall	-
November	Winter	-
December	Winter	-

4.2 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the common nighthawk model are described in Table 3. A digital elevation model (DEM) was used to generate the maximum elevation threshold. The ecosystem attributes were acquired from an updated dataset developed by combining provincial Predictive Ecosystem Mapping (PEM) and Vegetation Resource Index (VRI) datasets and clipping the extend of the combined dataset to the RSA. The remainder of the datasets were used to generate an anthropogenic disturbance layer that was incorporated into the VRI to adjust forest stand attributes.

Table 3: Datasets Used in the Development of the Common Nighthawk Model

Dataset Name	Description	Source
Digital Elevation Model	Raster file of elevation data	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain
Vegetation Resource Index	Polygons representing vegetated and non-vegetated land classifications	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer
Predictive Ecosystem Mapping	Large scale classification and mapping of ecosystem units across BC	https://catalogue.data.gov.bc.ca/dataset/predictive-ecosystem-mapping-pem-detailed-polygons-with-short-attribute-table-20-000-spatial-view
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
GeoBase 250K Land Cover, Circa 2000	Polygons identifying land classifications (e.g., annual cropland, snow/ice, developed)	https://catalogue.data.gov.bc.ca/dataset/other-land-cover-1-250-000-geobase-land-cover#edc-pow
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
OpenStreetMap	Point sources for buildings to represent building corners.	https://osmbuildings.org/data/
TRIM Enhanced Base Map	Polygons representing building footprints	https://catalogue.data.gov.bc.ca/dataset/buildings-trim-enhanced-base-map-ebm
Mineral Titles Online Tenure	Data for minder, placer claims and leases, and coal licence applications/licences/leases	https://catalogue.data.gov.bc.ca/dataset/mta-mineral-placer-and-coal-tenure-spatial-view
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow

Dataset Name	Description	Source
Oil and Gas Commission Pipeline Right-of-Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
GBA Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Telkwa Motor Vehicle Closure	Road closures due to caribou habitat protections	ftp://ftp.geobc.gov.bc.ca/publish/Regional/Smit_hers/Telkwa%20motor%20vehicle%20closure/
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop 10.3 with the Spatial Analyst extension (ESRI 2013).

4.3 Model Rating Scheme

There is an intermediate level of knowledge on the habitat requirements of common nighthawk in British Columbia; therefore, a 4-class rating scheme was used in the habitat model (Table 4). Habitat suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species (Resources Inventory Committee 1999). No provincial benchmark has been established for this species (Resources Inventory Committee 1999); to be conservative, the modelling assumed that high value habitat may be available in the Project area.

Table 4: Habitat Suitability Rating Scheme used for Common Nighthawk

Percent of Provincial Best	Rating	Code
76 – 100%	High	H
26 – 75%	Moderate	M
1 – 25%	Low	L
0%	Nil	N

4.4 Habitat Variables

Potentially relevant habitat variables for the development of the common nighthawk model were identified from studies of common nighthawk in BC, western Canada, or similar ecosystems to the extent possible; however, because local information is limited, studies of common nighthawk in other regions of North America were also considered. Habitat variables identified in the literature as being important to nesting common nighthawk, and which were considered for this model, are summarized in Table 5. Details about each variable, including references, are provided in the sections following.

Table 5: Habitat Variables Considered for Common Nighthawk Model

Variable	Dataset	Relationship to Selection or Use
Elevation	Digital Elevation Model	Use of habitat below an elevation threshold
Canopy Cover	Vegetation Resource Index	Preference for open forest
Final Stand Age	Vegetation Resource Index	Preference for open habitat (e.g., harvested cutblocks, burns, fields)
Anthropogenic Feature	Anthropogenic Feature Layer	Minimum setback distance from anthropogenic disturbances

Potential habitat was mapped in each of the ecosystem units that occur in the study area for the Project (Table 6**Error! Reference source not found.**).

Table 6. Study Area of Common Nighthawk Habitat Mapping.

Study Area:	General Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecosections:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun), Coastal Mountain-heather Alpine undifferentiated (CMAun), Coastal Western Hemlock wet subarctic Montane variant (CWHws2), Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc), Engelmann Spruce – Subalpine Fir moist-cold parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk), moist-cool parkland (ESSFmkp), Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv), Engelmann Spruce – Subalpine Fir wet-very cold parkland (ESSFwvp), Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1), Sub-Boreal Spruce dry-cool (SBSdk), Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

Elevation

Within British Columbia common nighthawks have been observed during the breeding season from sea level to 1,397 m, although most observations for the BCBBA were between 250 – 1,000 m (Boyd 2015); consequently, all areas above 1,397 m were assigned a Nil rating in the model based on the assumption that nighthawks would not nest in habitat above this maximum threshold.

Ecosystem Attributes

Common nighthawks nest primarily in open areas (Boyd 2015). Within the RSA, ecosystems that provided open area habitat were either forests with a low canopy cover or were young in age. The VRI land cover dataset was the only land cover dataset available across the RSA that contained canopy cover and vegetation age class data. It was evaluated for patterns of correspondence between canopy cover and vegetation age class and areas of potential nighthawk habitat identified on satellite imagery. Forest with a canopy cover greater than 55% were considered to be too contiguous to provide potential nesting habitat based on their preference for open areas. In addition, nighthawks have not been detected in fragments less than 0.2 ha. Therefore, a minimum threshold of 0.2ha of contiguous habitat was used, and all potential habitats below this threshold was rated Nil based on the assumption it would be too small to provide nesting habitat.

Anthropogenic Features

The RSA has substantial anthropogenic footprint from existing urban development, transportation, agriculture, and other industrial development. To account for this, an anthropogenic disturbance layer was compiled from a variety of sources as described in Section 4.2. Anthropogenic features that were assumed to provide habitat (e.g., agricultural areas, transmission line right-of-way, infrequently used road right-of-ways) that had little or open vegetation were rated from low to high, and others were assumed not to provide habitat (e.g., highways, railways) due to being active anthropogenic features were assigned a nil rating (Brigham et al. 2011, Hausleitner and Wallace 2012).

No information is available on the distance at which nesting common nighthawks respond to anthropogenic disturbance; however, based on studies of other migratory bird species, effect distances associated with industrial activity and/or roads in a forested landscape typically range from approximately 50-300 m (Reijnen et al. 1995, Habib et al. 2007, Bayne et al. 2008). Suggested setback buffer distances for common nighthawk nests range from 200 m to 500 m (Government of Northwest Territories 2015, Government of Saskatchewan 2017). As a result, a 300 m zone of influence (ZOI) was used to estimate the reduction in habitat suitability adjacent to active anthropogenic features due to sensory disturbance. Not all anthropogenic features were assumed to result in a ZOI — for example, an existing oil and gas pipeline was assumed to create very little sensory disturbance that might impact nesting in the adjacent habitats. Table 7 lists the various anthropogenic features present within the RSA and notes which were assigned a ZOI in the habitat model. Suitable habitat within a ZOI were downgraded by one ratings class, to a minimum of low, to account for the effects of sensory disturbance.

Table 7: Anthropogenic Features and If Used to Downgrade Suitable Habitat

Anthropogenic Feature Type	Downgrade Due to ZOI
Roads - Highway 2	Yes
Roads - Highway 3	Yes
Roads - Highway 4	Yes
Roads - Haul	Yes
Roads - Primary 1	Yes
Roads - Primary 2	Yes
Roads - Secondary 1	Yes
Roads - Secondary 2	Yes
Buildings - Commercial	Yes
Buildings - Residential	Yes

Anthropogenic Feature Type	Downgrade Due to ZOI
Buildings - Recreation	Yes
Urban Areas	Yes
Roads - Tertiary 1	No
Roads - Tertiary 2	No
Roads - Quaternary Closure Rough	No
Roads - Quaternary Closure Loose	No
Trails	No
Rail Yard	No
Rail Main	No
Rail Spurs	No
Agriculture	No
Roads - Tertiary Seasonal	No
Roads - Quaternary	No
Powerlines	No
Pipelines	No

4.5 Ratings Assumptions

Each ecosystem unit was evaluated and assigned a suitability rating class based on its ability to provide the life requisites for common nighthawk for the growing season (summer). The following assumptions were applied to habitat suitability modelling for common nighthawk:

1. All BGC zones below 1,397 m elevation have the potential to contain suitable Reproductive habitat and were rated up to High.
2. Stand age class 0 or 1 was rated up to High.
3. Stands of age class 2 – 9 and crown closure $\leq 15\%$ was rated up to High; stands of age class 2 – 9 and crown closure of 16 – 25% was rated up to Moderate; and stands of age class 2 – 9 and crown closure of 26 – 55% was rated up to Low.
4. Drier wetlands were rated up to Moderate.
5. Some anthropogenic features (e.g., power lines, pipelines, low use roadsides) were rated up to Moderate.
6. Waterbodies, wetlands with standing water, and some anthropogenic features (e.g. road surface) were rated Nil.

4.6 Model Evaluation

The number of common nighthawk detections in the RSA during baseline surveys were insufficient to validate model performance. Consequently, two stages of model evaluation were conducted. The first stage consisted of iterative reviews of model outputs and adjustment of parameter ratings during model

development. Information used during evaluation and calibration exercises included a review of satellite imagery and field conditions observed by biologists conducting wildlife surveys. The goal of model calibration exercises were to specify model parameters so that the model included all, or almost all, areas with potential open reproductive habitat (i.e. to minimize errors of omission) while avoiding ratings that were too liberal, which would result in overestimating the amount of reproductive that really occurred (i.e. committing errors of commission).

5. LIMITATIONS/CONFIDENCE

The common nighthawk model is a knowledge-based model; consequently, biases in the knowledge and opinions of the authors are reflected in the model. Existing nighthawk occurrence data, both from baseline surveys and a desktop review, was insufficient to guide model development or to conduct quantitative validation of the model. Additionally, model development relied on spatial ecosystem data from PEM and VRI datasets which were not field verified prior to use in the model, and as a result inconsistency between datasets and real-world conditions may vary. Habitat requirements that were used as part of the model were obtained from a literature review that did not find any studies from the region or on the effects of mine development and operation on nighthawks; however, basic habitat requirements for nighthawks are relatively well known. Therefore, while overall confidence in the common nighthawk model was limited by the nature of the model development approach and lack of validation, the overall confidence in the model is moderate because of the relatively well-known habitat requirements and relative confidence in the ecosystem spatial data.

6. SUMMARY OF MODELLING RESULTS

The output from the common nighthawk suitability mapping indicated that more high and moderate rated habitat was present in the Wildlife Local Study Area (LSA) than the RSA (Table 8, Appendix 1). High and moderate rated habitat were mostly present at low to mid-elevations in areas of low intensity agriculture (e.g., pasture, hayfields), recently harvested forest, and open forest with very low canopy cover. Within the RSA, Low and Nil habitats included forest with moderate to high canopy cover, areas adjacent to active anthropogenic features, and alpine habitat.

Overall the model output suggests that the model is biased towards overestimating the availability of high and moderate habitat. Existing occurrence data and field habitat ratings were insufficient to provide input into the model; however, impressions field visits and satellite imagery suggest that less habitat may be present than indicated in the model. Some of the overestimation was driven by errors within the VRI dataset, where some vegetated polygons may be older than as labelled in the dataset (e.g., cutblocks), and the type of agriculture, which was not classified, within the RSA. The suitability of habitat is generally limited to areas of recently disturbed habitat, that also have the potential to mature to non-suitable habitat within a short time frame, and the age classifications covered a broader time frame that potentially included suitable and non-suitable habitat. Also, the classification of agricultural areas did not specify the type of agriculture present and a conservative approach was used that may have overestimated the actual availability of habitat.

Table 8: Amount of Suitable Common Nighthawk Habitat Rating by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	RSA (ha)	RSA (%)
High	4,502.13	12.60	17,343.92	8.91
Moderate	6,366.28	17.82	25,091.45	12.89
Low	13,880.80	38.85	60,668.05	31.17
Nil	10,976.66	30.72	91,547.07	47.03
Total	35,725.88	100.00	194,650.49	100.00

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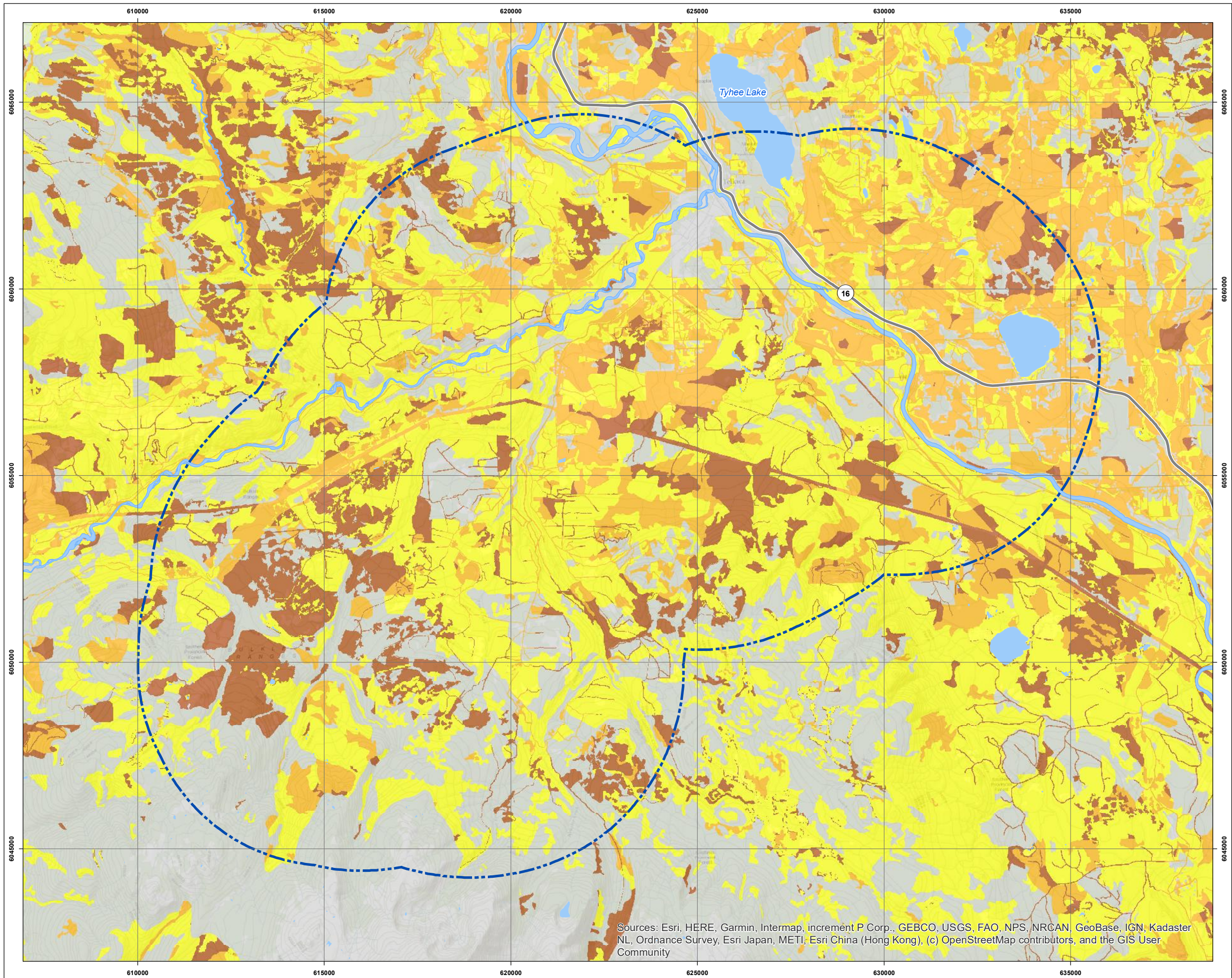
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Appendix A Common Nighthawk Habitat Suitability Mapping

Path: L:\PROJECTS\2018\BP0421_Tenas_Maps\MapInfo\Reporting\Habitat_Suitability_Map\180724_Tenas_Habitat_Suitability_LSA_CON_20200214.mxd



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Tenas Project

Common Nighthawk Nesting Habitat Suitability within the Wildlife LSA

Legend

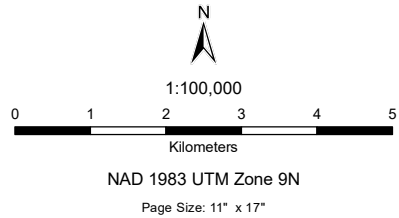
Wildlife LSA	Highway
Habitat Suitability High	River
Moderate	Waterbody
Low	
Nil	

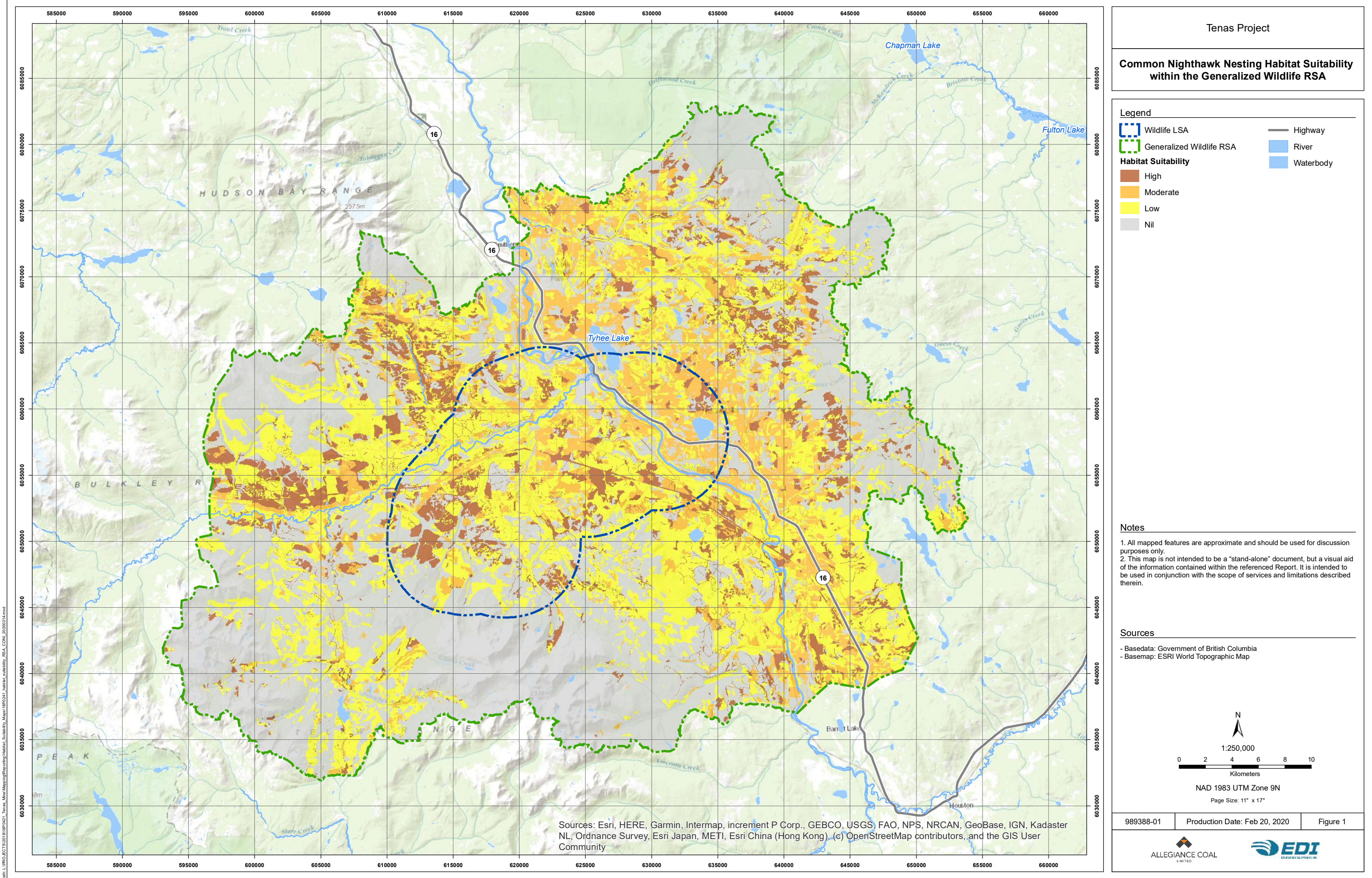
Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basedata: Government of British Columbia
- Basemap: ESRI World Topographic Map





Appendix C Olive-sided Flycatcher Species Account and Habitat Model Report

Tenas Project

Olive-sided Flycatcher Species Account and Habitat Model Report

March 2020

VERSION 1.4

Submitted to: Telkwa Coal Limited
Suite 1410 – 409 Granville Street
Vancouver, BC V6C 1T2

Submitted by: EDI Environmental Dynamics Inc.
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ACKNOWLEDGEMENTS

Mike Boyd was the primary author and designed the model. Anne MacLeod reviewed the report, and both Anne MacLeod and Todd Mahon reviewed the model design. Christina Tennant provided GIS analysis and mapping support. Anne MacLeod and Cathy Mackay completed senior review.

Tenas Project

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Appendix A	Olive-sided Flycatcher Habitat Suitability Mapping
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1. INTRODUCTION

This report summarizes the ecology, habitat suitability model development process, and output for the olive-sided flycatcher (*Contopus cooperi*) model for the assessment of the Tenas Project (the Project). The area used to assess the context of the direct and indirect effects of the Project on olive-sided flycatcher is the Generalized Wildlife Regional Study Area (RSA) and is the extent of the spatial area for the habitat suitability model. The RSA encompasses the Project footprint plus the intersection of all watersheds that overlap with a 10 km buffer around the Project footprint and is 194,649 hectares (ha).

2. DISTRIBUTION AND STATUS

2.1 Distribution

Olive-sided flycatchers are a migratory songbird found during the breeding season throughout mountainous western North America and the boreal forest (Altman and Sallabanks 2012). They typically winter in Central American and western and northern South America and migrate north through BC in April and May and south in August and September (Campbell et al. 1997, eBird 2019). During the breeding season, olive-sided flycatchers are found in coniferous forest habitats across British Columbia (BC), except Haida Gwaii (Campbell et al. 1997, Weber 2015); and are known to occur within the RSA (eBird 2019).

Within BC, olive-sided flycatchers have been found in all biogeoclimatic (BGC) zones, except for the Alpine Tundra and Bunchgrass zones (BC Ministry of Environment 2019). The BC Breeding Bird Atlas found the highest probability of observation was on the plateaus and mountain ranges of the Central Interior, Sub-Boreal Interior, and parts of the Southern Interior and Southern Interior Mountains (Weber 2015). The highest abundances have been found in the Georgia Depression (Campbell et al. 1997, Weber 2015). Olive-sided flycatchers have been observed during the breeding season from sea level to 2,669 m elevation; however they are most commonly encountered between 1,000 to 2,000 m (Weber 2015, Environment Canada 2016, Environment and Climate Change Canada 2019).

2.2 Threats and Status

The Canadian olive-sided flycatcher population has declined by 72% between 1970 and 2016, with an annual decline of -2.91% in BC. Population declines have resulted in a decrease in occupancy across the southern parts of their range across North America and Canada, although it is unknown whether the BC range has contracted either by latitude or elevation (Environment and Climate Change Canada 2019).

The threats to olive-sided flycatchers are thought to be habitat loss and degradation on both the breeding and wintering grounds, as well as a decline and/or change in availability of insect prey on the breeding, migratory, and wintering ranges (Environment and Climate Change Canada 2019). However, loss of wintering habitat may be the most significant factor in population declines for olive-sided flycatcher (Altman and Sallabanks 2012).

On the breeding grounds, threats to habitat may include the loss of forested habitats through conversion to non-forested environments, and habitat alteration due to forest management practices (Altman and Sallabanks 2012). Additionally, changes in forest fire frequency may result in the elimination of habitat either due to the severity of burns or through fire suppression allowing the regeneration of denser forests (Cumming 2005, Balshi et al. 2009).

The availability of prey, specifically flying insects, is also hypothesized to be a significant threat. This species and many other aerial insectivores are declining, likely due to declining aerial insect populations (Nebel et al., Smith et al. 2015, English et al. 2017). Pesticide use alters insect abundance and community composition and use of pesticides in Canada and abroad may impact olive-sided flycatchers; however, specific effects on this species have not been demonstrated (Environment and Climate Change Canada 2019). Artificial lighting and increasing forest fire frequency and severity may also be affecting insect populations (Balshi et al. 2009, Bruce-White and Shadlow 2011, Gaston et al. 2013).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists the olive-sided flycatcher as a Species of Special Concern and listed as Threatened under Schedule 1 of the federal Species at Risk Act (Table 1). In British Columbia, the olive-sided flycatcher is on the provincial yellow-list (BC CDC 2019).

Table 1: Status of Olive-sided Flycatcher (*Contopus cooperi*).

Species Code	B-OSFL
Provincial Status	S3S4B – Special concern, vulnerable to extirpation or extinction/Apparently secure, breeding
B.C. List	Blue
Identified Wildlife (Province of British Columbia 2019)	No
COSEWIC Status	Special Concern
Species at Risk Act (SARA) status	Threatened (Schedule 1, SARA)

3. HABITAT REQUIREMENTS

The olive-sided flycatcher is a medium-sized songbird with muddy olive-gray plumage and a white throat and belly (Altman and Sallabanks 2012). The olive-sided flycatcher is well known by its distinctive three-note song, Quick, THREE BEERS!, and its tendency to perch conspicuously at the top of tall trees or snags while foraging for flying insects (Environment and Climate Change Canada 2019). They prefer open-coniferous habitats (< 40% canopy closure) with tall snags and live trees for nesting and perching, and open areas for foraging (Kotliar 2007, Altman and Sallabanks 2012).

3.1 Reproductive Habitat

Olive-sided flycatchers nest in coniferous, mixed, and riparian forests; typical breeding habitat requires tall snags and living trees along high contrast edges between two distinct habitat types (Environment and Climate Change Canada 2019). This habitat includes open mature and old growth forest, and burns, harvested forest, wetlands, waterbodies, shrub fields, meadows, or other natural openings when adjacent to mature and old growth forest (Altman and Sallabanks 2012).

Optimal habitat has been reported as late successional forest with less than 40% canopy cover; birds are typically absent when canopy cover exceeds 94% (Verner 1980, Scott and Crouch 1988, Altman and Sallabanks 2012, Westwood 2016). Abundance is higher in burns compared to adjacent unburned mature forest and reported to be highest in moderate or heavily burned forest compared to understory-burned forest or unburned forest. Densities have been reported highest two or more years following a burn, and lower densities, or absence, reported in burns 1-2 years old. In areas where fire suppression has reduced the availability of burned forest, wetlands, riparian areas, and meadows are favoured, and muskeg and

wetlands are preferred in boreal areas.

Harvested forest may have similar structural features to early post-fire habitat and be attractive as breeding habitat; however, this habitat may be an ecological trap where nesting birds may experience lower breeding success (Environment and Climate Change Canada 2019). The type, location, and timing of harvesting may also influence abundance and nesting success. In Montana and Oregon nesting success was up to twice as high in burned areas compared to harvested areas, although this is contrasted in northern California by higher nesting success in harvested areas (Altman 1999, Meehan and George 2003, Robertson and Hutto 2007).

3.2 Foraging Habitat

Foraging occurs in forest openings and areas near and above the forest canopy where exposed perches are present. Exposed perches are typically at the top of a snag, bare/dead uppermost branches, or the tip of live trees that are typically taller than the surrounding canopy (Wright 1997, Anctil et al. 2017). Foraging may occur at lower heights when aerial insects are less prominent during windy or cool weather (Altman and Sallabanks 2012). Insect abundance and foraging rates have been found to be higher in unburned habitat compared to burned habitat (Meehan and George 2003).

3.3 Security/Thermal Habitat

Little is known about the security and thermal habitat requirements for olive-sided flycatchers; however, it is thought that large, tall conifers are used for roosting (Gaines 2005).

Home Range

Territory size is typically 10 – 20 ha, although territory sizes up to 40 – 45 ha have been reported in conifer and mixed-conifer forest (Bock and Lynch 1970, Raphael et al. 1987, Altman 1997), while habitat patches as small as 1.2 ha have been used in logging cutblocks in spruce/fir forests (Scott et al. 1982). Territory configuration and proximity are associated with landscape features, including the location of unsuitable habitat (e.g., dense stands of trees) (Wright 1997, Altman and Sallabanks 2012), and territories may occur along linear corridors of suitable habitat (e.g. along creeks and lakes). In Washington, olive-sided flycatcher densities were estimated at 1 pair/1.6 km of shoreline (Bent 1942).

4. MODEL DEVELOPMENT

4.1 Life Requisites and Seasons

The olive-sided flycatcher is a breeding resident of the Project area in the Growing season (late spring/summer). Migrants likely arrive in late April and May and reproduction (nesting) occurs from May through August; flycatchers likely depart the area in August and early September (Campbell et al. 1990, eBird 2019).

The life requisite that will be evaluated for olive-sided flycatcher in the Tenas Project is Living during the Growing season, as reproductive, foraging, and security/thermal habitats are similar (Table 2).

Table 2: Monthly Life Requisites for Olive-sided Flycatcher

Month	Season	Life Requisite
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	Living
June	Summer	Living
July	Summer	Living
August	Summer	Living
September	Early Fall	-
October	Late Fall	-
November	Winter	-
December	Winter	-

4.2 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the olive-sided flycatcher model are described in Table 3. A digital elevation model (DEM) was used to generate the elevation threshold. The ecosystem attributes were obtained from an updated dataset developed by combining provincial Predictive Ecosystem Mapping (PEM) and Vegetation Resource Index (VRI) datasets and clipping the combined dataset to the RSA. The remainder of the datasets were used to generate an anthropogenic disturbance layer that was incorporated into the VRI to adjust forest stand attributes.

Table 3: Datasets Used in the Development of the Olive-sided Flycatcher Model

Dataset Name	Description	Source
Digital Elevation Model	Raster file of elevation data	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain
Vegetation Resource Index	Polygons representing vegetated and non-vegetated land classifications	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer
Predictive Ecosystem Mapping	Large scale classification and mapping of ecosystem units across BC	https://catalogue.data.gov.bc.ca/dataset/predictive-ecosystem-mapping-pem-detailed-polygons-with-short-attribute-table-20-000-spatial-view
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
GeoBase 250K Land Cover, Circa 2000	Polygons identifying land classifications (e.g., annual cropland, snow/ice, developed)	https://catalogue.data.gov.bc.ca/dataset/other-land-cover-1-250-000-geobase-land-cover#edc-pow

Dataset Name	Description	Source
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
OpenStreetMap	Point sources for buildings to represent building corners.	https://osmbuildings.org/data/
TRIM Enhanced Base Map	Polygons representing building footprints	https://catalogue.data.gov.bc.ca/dataset/buildings-trim-enhanced-base-map-ebm
Mineral Titles Online Tenure	Data for minder, placer claims and leases, and coal licence applications/licences/leases	https://catalogue.data.gov.bc.ca/dataset/mta-mineral-placer-and-coal-tenure-spatial-view
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow
Oil and Gas Commission Pipeline Right-of- Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
GBA Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Telkwa Motor Vehicle Closure	Road closures due to caribou habitat protections	ftp://ftp.geobc.gov.bc.ca/publish/Regional/Smit_hers/Telkwa%20motor%20vehicle%20closure/

Dataset Name	Description	Source
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop 10.3 with the Spatial Analyst extension (ESRI 2013).

4.3 Model Rating Scheme

There is an intermediate level of knowledge on the habitat requirements of olive-sided flycatcher in British Columbia, therefore a 4-class rating scheme was used in the habitat model (Table 4). No provincial benchmark has been established for this species (Resources Inventory Committee 1999).

Table 4: Habitat Suitability Rating Scheme used for Olive-sided Flycatcher

Percent of Provincial Best	Rating	Code
76 – 100%	High	H
26 – 75%	Moderate	M
1 – 25%	Low	L
0%	Nil	N

4.4 Habitat Variables

The olive-sided flycatcher model was based on information from literature on habitat selection and habitat use during the nesting season. It was pulled primarily from studies of olive-sided flycatcher in BC and western Canada, but, where relevant, also considered studies from similar ecosystems in other regions of North America.

Habitat variables identified in the literature as being important to olive-sided flycatchers, and which were considered for this model, are summarized in Table 5. Details about each variable, including references, are provided in the sections following.

Table 5: Habitat Variables Considered for Olive-sided Flycatcher Model

Variable	Dataset	Relationship to Selection or Use
Elevation	Digital Elevation Model	Use of habitat below an elevation threshold
Canopy Cover	Vegetation Resource Index	Preference for open forest
Final Stand Age	Vegetation Resource Index	Preference for open habitat (e.g., wetlands, burns)

Variable	Dataset	Relationship to Selection or Use
Anthropogenic Feature	Anthropogenic Feature Layer	Minimum setback distance from anthropogenic disturbances

Potential habitat was mapped in each of the ecosystem units that occur in the study area for the Project (Table 6).

Table 6: Study Area of Olive-sided Flycatcher Habitat Mapping.

Study Area:	General Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecosections:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun), Coastal Mountain-heather Alpine undifferentiated (CMAun), Coastal Western Hemlock wet subarctic Montane variant (CWHws2), Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc), Engelmann Spruce – Subalpine Fir moist-cold parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir moist-cold Woodland (ESSFmcw), Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk), moist-cool parkland (ESSFmkp), Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv), Engelmann Spruce – Subalpine Fir wet-very cold parkland (ESSFwvp), Engelmann Spruce – Subalpine Fir wet-very cold Woodland (ESSFwvw), Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1), Sub-Boreal Spruce dry-cool (SBSdk), Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

Elevation

Olive-sided flycatchers have been observed during the breeding season from sea level to 2,669 m elevation (Weber 2015, Environment Canada 2016, Environment and Climate Change Canada 2019). All areas above 2,669 m in the model were assigned a nil rating based on the assumption that flycatchers would not nest in habitat above this maximum threshold.

Ecosystem Attributes

Olive-sided flycatchers nest primarily in open, mature forest and in open areas with mature trees (Weber 2015). They are typically associated with coniferous forests, but may also occur in mixed stands (Altman and Sallabanks 2012). Within the RSA, high value habitats were either mature to old-growth coniferous forests with a low canopy cover (<40%) or open areas (e.g., burns, wetlands) adjacent to mature to old-growth forest (i.e., open edges along mature forest). Based on the assumption that open, mature to old-growth forests would contain snags or residual tall trees. The VRI land cover dataset was the only land cover dataset available across the RSA that contained canopy cover and vegetation age class data. Forest with a canopy cover greater than 98% were considered to be too contiguous to provide potential nesting habitat based on their preference for open mature forest.

In addition, flycatchers have not been detected in fragments less than 12 ha. Therefore, a minimum threshold of 12,000 m² of contiguous habitat was used, and all potential habitat below this threshold was rated Nil based on the assumption it would be too small to provide habitat for a territory.

Anthropogenic Features

The footprint from anthropogenic disturbance (e.g., transportation, forestry, agriculture) is large at low to mid-elevations within the RSA. A spatial layer was created from a variety of data sources as described in Section 4.2. to account for anthropogenic disturbances present during baseline conditions. Anthropogenic features that could provide suitable habitat (e.g., forestry cutblocks) that were open habitat with the potential for some mature to old-growth trees were rated from low to high. Other features that were either active in disturbance or did not provide suitable habitat due to a lack of mature to old-growth trees (e.g., urban areas, roads) were assumed not to provide habitat and were assigned a nil rating (Brigham et al. 2011, Hausleitner and Wallace 2012).

No information is available on the disturbance distances from active anthropogenic features; however, suggested setback buffer distances for olive-sided flycatcher nests in the Northwest Territories, Saskatchewan, and Manitoba are 300 m (Manitoba Conservation Data Centre 2014, Government of the Northwest Territories 2015, Government of Saskatchewan 2017). As a result, a ZOI of 300 m was used that presumes there could be suitable nesting habitat for olive-sided flycatcher that would be reduced in effectiveness within 300 m of active anthropogenic features due to sensory disturbance (Table 7).

Table 7: Anthropogenic Features and If Used to Downgrade Suitable Habitat

Anthropogenic Feature Type	Downgrade
Roads - Highway 2	Yes
Roads - Highway 3	Yes
Roads - Highway 4	Yes
Roads - Haul	Yes
Roads - Primary 1	Yes
Roads - Primary 2	Yes
Roads - Secondary 1	Yes
Roads - Secondary 2	Yes
Buildings - Commercial	Yes
Buildings - Residential	Yes
Buildings - Recreation	Yes
Urban Areas	Yes
Roads - Tertiary 1	No
Roads - Tertiary 2	No
Roads - Quaternary Closure Rough	No
Roads - Quaternary Closure Loose	No
Trails	No
Rail Yard	No
Rail Main	No
Rail Spurs	No

Anthropogenic Feature Type	Downgrade
Agriculture	No
Roads - Tertiary Seasonal	No
Roads - Quaternary	No
Powerlines	No
Pipelines	No

4.5 Ratings Assumptions

Each ecosystem unit was evaluated and assigned a suitability rating class based on its ability to provide the Living (reproductive, foraging, and security/thermal) life requisites for olive-sided flycatcher for the Growing season. The following assumptions were applied in the determination of habitat suitability:

1. Stand age class 5, 6, 7, 8, and 9 with low crown closure (<40%) were rated up to High.
2. Stand age class 5, 6, 7, 8, and 9 with moderate crown closure (≥ 40 and <70%) were rated up to Moderate.
3. Stand age class 5, 6, 7, 8, and 9 with high crown closure (≥ 70 and <94%) were rated up to Low.
4. Stand age class of 4 with low crown closure (<40%) was rated up to Low.
5. Stand age class of 1 – 3 (e.g., were rated Nil, unless they were the result of forest fire —rated up to High, or were previously logged — rated up to Moderate.
6. Polygons located in parkland ecosystems were rated up to Moderate.
7. Polygons with coniferous ($\geq 75\%$ coniferous trees) rated up to High.
8. Polygons with mixed forest (neither broadleaf or coniferous trees represent $\geq 75\%$ of stand) were rated up to Moderate.
9. Polygons with deciduous forest ($\geq 75\%$ broadleaf trees) were rated up to Low.
10. A 100 m buffer was created around polygons with stand age class of 1 – 3 and any polygons with stand age class of 6 – 7 within the buffer were rated High.
11. Polygons in alpine areas were rated Nil.
12. Polygons above 2,669 m in elevation were rated Nil.

4.6 Model Evaluation

Olive-sided flycatcher detections during baseline surveys in the RSA were insufficient to validate model performance. Two stages of model evaluation were conducted. The first stage consisted of iterative reviews of model outputs and adjustment of parameter ratings during model development. Information used during evaluation and calibration exercises included a review of satellite imagery and field conditions observed by biologists conducting wildlife surveys. The goal of model calibration exercises were to specify model parameters so that the model included all, or almost all, areas with potential open reproductive habitat (i.e. to minimize errors of omission) while avoiding ratings that were too liberal, which would result in overestimating the amount of reproductive that really occurred (i.e. committing errors of commission).

5. LIMITATIONS/CONFIDENCE

The olive-sided flycatcher is a knowledge-based model and was developed to assess potential the context of the direct and indirect effects of the Project. Potential biases and limitations may be present in the model due to limitations in knowledge and the opinions of the authors. In addition, a literature review did not find any previous studies from within the RSA, and it was assumed that habitat use within the RSA would be similar to habitat use elsewhere. Model development and verification did not use desktop or baseline survey occurrence data due to insufficient detections. Spatial ecosystem data was not verified prior to use in model development, and inconsistencies may be present between PEM and VRI datasets and between datasets and real world conditions. Overall confidence in the model is considered moderate, due to the relatively well known habitat requirements and the limitations of insufficient occurrence data and lack of verification of ecosystem data.

6. SUMMARY OF MODELLING RESULTS

The output from the olive-sided flycatcher suitability modelling indicated that relatively more high and moderate rated habitat is present in the RSA than the Wildlife Local Study Area (LSA) (Table 8, Appendix 1). High and moderate rated habitat is present at all elevations, but is more common at mid to upper elevations — this coincides with a higher occurrence of open, mature and old-growth coniferous forest habitats. Olive-sided flycatchers are most often associated with open to semi-open forest and along natural and anthropogenic forest openings (e.g, burned forest, cutblocks); however, birds anthropogenically altered habitats may have lower breeding success. As a result, low and nil habitat in the RSA are more prevalent at lower elevations, where cutblocks are more prevalent and forest has been cleared for agriculture and urban areas, and at higher elevations in alpine habitats devoid of trees.

Review of the model output suggests that the model may be biased towards overestimating the potential effects of secondary roads on suitable habitat. The amount of traffic on these roads within the RSA was unknown, and a conservative approach was used that assumed the effects of disturbance along these roads would be similar to highways, primary roads, and haul roads.

Table 8: Amount of Suitable Olive-sided Flycatcher Habitat Rating by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	RSA (ha)	RSA (%)
High	3,034.55	8.49	19,161.72	9.84
Moderate	8,732.18	24.44	72,430.75	37.21
Low	13,560.31	37.96	53,817.96	27.65
Nil	10,398.83	29.11	49,240.06	25.29
Total	35,725.88	100.00	194,650.49	100.00

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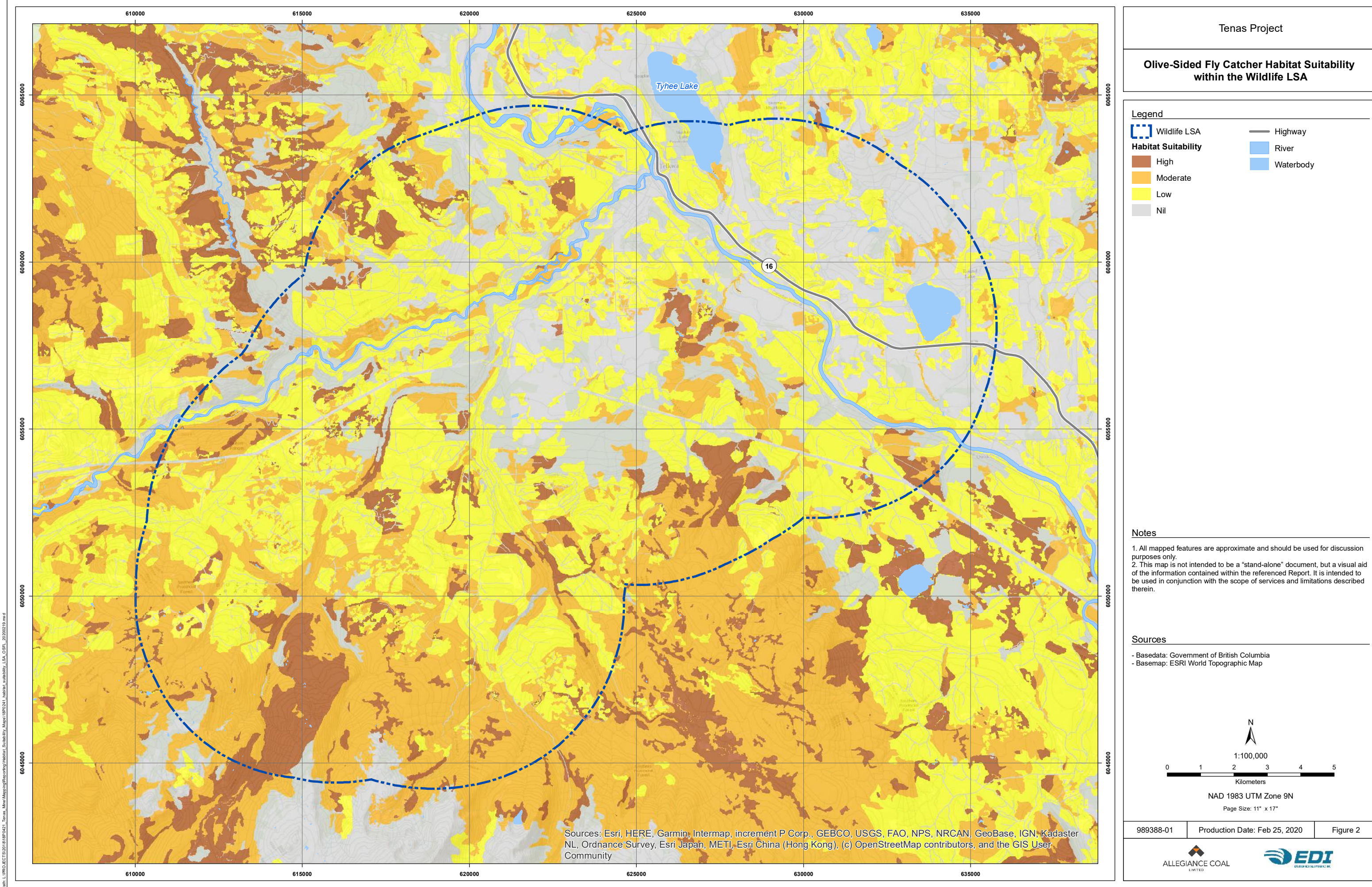
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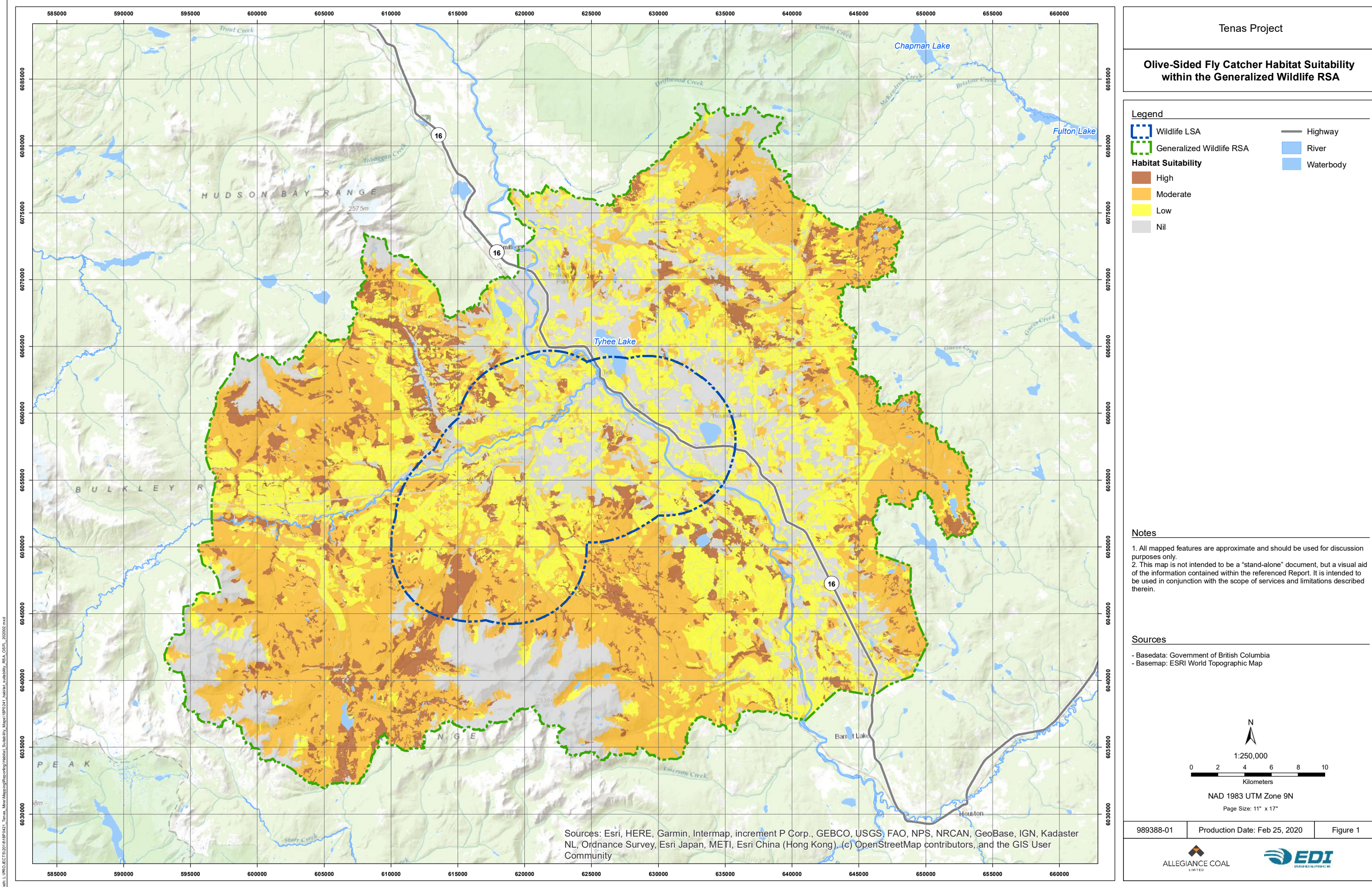
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Appendix A Olive-sided Flycatcher Habitat Suitability Mapping





Appendix D Short-eared Owl Species Account and Habitat Model Report

Tenas Project

Short-eared Owl Species Account and Habitat Model Report

March 2020

VERSION 1.4

Submitted to: Telkwa Coal Limited
Suite 1410 – 409 Granville Street
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ACKNOWLEDGEMENTS

Mike Boyd was the primary author and designed the model. Anne MacLeod reviewed the report, and both Anne MacLeod and Todd Mahon reviewed the model design. Christina Tennant provided GIS analysis and mapping support. Anne MacLeod and Cathy Mackay completed senior review.

Tenas Project

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1. INTRODUCTION

This report describes the short-eared owl (*Asio flammeus*) habitat suitability model developed as baseline information for assessment of the Tenas Project (the Project). Short-eared owl habitat was modelled within the Generalized Wildlife Regional Study Area (RSA), which is the area that will be used to assess the context of the direct and indirect effects of the Project on short-eared owl. The RSA is 194,649 hectares (ha) and encompasses the Project footprint plus the intersection of all watersheds that overlap with a 10 km buffer around the Project footprint.

Habitat suitability modelling was completed for short-eared owl in the RSA in order to assess potential effects of the Project on current short-eared owl habitat. The species ecology was reviewed and is summarized here in context of the factors that are required in developing the habitat suitability model. This includes the known threats to the species and its known habitat requirements in context with the most current available data in the region.

2. DISTRIBUTION AND STATUS

2.1 Distribution

Short-eared owls are a cosmopolitan species that are found on most continents and many oceanic islands around the world (Wiggins et al. 2006). They are an uncommon and local breeding resident across British Columbia; however, they are generally absent along the coast north of the Lower Mainland (Cannings 2015). Wintering owls are found across southern valleys and lowlands and very rarely in the Central Interior and Peace regions (Campbell et al. 1990, Cannings 2015, eBird 2019). This overlap in breeding and wintering areas potentially obscures migratory patterns, but they are thought to migrate north in March and April and south in October and November (Campbell et al. 1990, eBird 2019). Overall, they are likely more widely distributed in all seasons than records indicate due to low detectability (Campbell et al. 1990, Calladine et al. 2010).

Several factors including population movements in response to a fluctuating prey base, local distribution, and low detectability during the breeding season, have made it difficult to assess areas of higher abundance or increased probability of observation (Campbell et al. 1990, Cannings 2015, B.C. Conservation Data Centre 2019). A long term decline in wintering owls, principally in the Fraser River delta, has thought to have been caused by habitat loss and degradation (Campbell et al. 1990, COSEWIC 2008).

Short-eared owls have been observed during the breeding season from sea level to 2,138 m, although breeding usually occurs below 1,000 m (Campbell et al. 1990, Cannings 2015).

2.2 Threats and Status

A continuing population decline over the past 40 years, including a 23% decline from 1998 – 2008 has resulted in their listing as Special Concern under the Species At Risk Act (SARA)(COSEWIC 2008, Government of Canada 2014). Habitat loss and degradation are thought to be the main threats on both the breeding and wintering grounds, secondary threats include pesticide use and collisions with vehicles, equipment, and fences (COSEWIC 2008).

Habitat loss and degradation has been correlated with the population declines of short-eared owls in parts of BC, across the southern Prairie Provinces, and southern Ontario; although it is probably negligible in central and northern Canada (Campbell et al. 1990, Smith 1996, Hunt 2004, COSEWIC 2008). The main cause of habitat loss and degradation has been the conversion of open areas (e.g., prairie, old field) to cropland and intensive grazing (Campbell et al. 1990, Fondell and Ball 2004, COSEWIC 2008). Although short-eared owls may nest in cropland, harvesting prior to young fledging can be a significant source of nest mortality and breeding success is lower than in native habitat (Campbell et al. 1990, Arroyo and Bretagnolle 1999, Keyes 2011).

Other threats to short-eared owl include mortality resulting from collisions with vehicles, buildings, barbed-wire fences, and transmission lines, particularly during winter (Fitzer 1975, Preston and Powers 2006, Bevanger 2008). Pesticide use may also pose a threat to short-eared owls; however, no negative effects on reproduction have been detected and more data on the potential effects are needed (Mendelssohn and Paz 1977, Cadman and Page 1994, Wiggins et al. 2006).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists the short-eared owl as a Species of Special Concern and they are also listed as Special Concern under Schedule 1 of the federal Species at Risk Act (Table 1). In British Columbia, the short-eared owl is on the provincial Blue-list (BC CDC 2019).

Table 1: Status of Short-eared Owl (*Asio flammeus*)

Species Code	B-SEOW
Provincial Status	S3B,S2N – Special concern, vulnerable to extirpation or extinction during the breeding season; imperiled during the non-breeding season
B.C. List	Blue
Identified Wildlife (Province of British Columbia 2019)	Yes
COSEWIC Status	Special Concern
Species at Risk Act (SARA) status	Special Concern (Schedule 1, SARA)

3. HABITAT REQUIREMENTS

Short-eared owls are a ground-nesting species that inhabit open country (e.g., grasslands, tundra, wetlands, agricultural areas). They are typically crepuscular, but may be diurnal or nocturnal depending on prey density, weather conditions, season, and provisioning of food to young (Bosakowski, Mikkola 1983, Wiggins et al. 2006). Their reproduction and population dynamics are closely linked to the density of small mammals (e.g., *Microtus voles*) and breeding densities and success may vary widely depending on small mammal populations (Wiggins et al. 2006). Birds may be eaten in small numbers, particularly in coastal areas or during winter when small mammals are not available (Mikkola 1983, Wiggins et al. 2006).

3.1 Reproductive Habitat

The main requirements for nesting are open habitats near a reliable source of small mammals (COSEWIC 2008). Nesting habitats may include grasslands, meadows, agricultural areas (e.g., pasture, cropland),

bogs, marshes, arctic or alpine tundra, cleared forest, regenerating forest, and anthropogenic features (e.g., airport fields) (Semenchuk 1992, Shaw 1995, Cooper and Beauchesne 2004, Wiggins et al. 2006, COSEWIC 2008). Newly cleared forest (i.e., cutblocks) and young coniferous plantation have been used for breeding, with territory size and the length of use during regeneration has been suggested to be in response to prey density (Village 1987, Shaw 1995). Nest sites are typically on raised dry areas such as small knolls, ridges, steep slopes, and hummocks, although wet areas are occasionally used (Roberts and Bowman 1986, Wiggins et al. 2006). Nests are placed directly on the ground in clumps of dense or high grass and occasionally in shrubby thickets, and have been noted on steep slopes; in British Columbia most nests were in shrubby fields with grass heights from 25 – 90 cm (Campbell et al. 1990, Fondell and Ball 2004, Cannings 2015).

Short-eared owls generally avoid intensive agriculture, housing developments, or industrial areas (Herkert et al. 1999). Lower breeding success in agricultural areas, caused by mortality from crop harvesting and avoidance of actively grazed areas, suggests that agricultural areas may be of reduced suitability for nesting habitat (Campbell et al. 1990, Kantrud and Higgins 1992, Cadman and Page 1994). Nesting may occur near some anthropogenic features such as airport runways, parking lots, and roads; however, one study found that nests were a minimum of 250 m and on average 789 m from buildings, suggesting that vertical interference from buildings may reduce habitat suitability (Campbell et al. 1990, Combs-Beattie 1993). Best management practices in British Columbia suggest that short-eared owls have a moderate tolerance of activity near the nest site and recommend a 500 m buffer and additional 100 m 'quiet' buffer around nest sites (Caskey and Chutter 2013).

3.2 Foraging Habitat

Short-eared owls forage primarily in open country, including grasslands, tundra, cleared and regenerating forest, shrub-steppe, agricultural areas, and wetlands (Wiggins et al. 2006). Overall they prefer areas with short and dense, but not complete, vegetation cover; thresholds of 11 cm in thatch height and 80% of thatch cover were found to limit abundance on a study in the Fraser River delta (Huang et al. 2010). Areas used for foraging vary with prey density and short-eared owls will concentrate activity in habitats where prey density is higher (i.e., small mammal outbreaks) (Pitelka et al. 1955). In particular, short-eared owls may use cleared forest in response to prey densities, and may continue to use regenerating forest so long as prey densities remain above certain thresholds (Village 1987, Shaw 1995).

3.3 Security/Thermal Habitat

Roosting and sleeping occurs primarily on the ground in open areas, although snow or moisture may cause roosting in trees (Clark 1975, Village 1987). Short-eared owls have also been found roosting on abandoned stone quarries, gravel pits, wrecked cars, and stump piles (Clark 1975).

3.4 Home Range

A wide range in breeding territory size have been reported — in North America it ranges from 20 ha in Alaska to 126 ha in coastal Massachusetts (Pitelka et al. 1955, Reid et al. 2012). Territory size and territorial behaviour are heavily influenced by prey availability, and territoriality may be relaxed in times of food abundance, when nest densities of 5.5 ha/nest have been reported (Wiggins 2004, Wiggins et al. 2006). Smaller fragments of habitat may be used if located close to larger blocks of habitat, with a minimum foraging patch size of 8 ha (Banner 1999, Herkert et al. 1999).

4. MODEL DEVELOPMENT

4.1 Life Requisites and Seasons

The short-eared owl is a potential breeding resident of the Project area in the Growing season (Spring-Summer). Migrants likely arrive in April, nesting occurs from April through July, and most owls likely depart the area in September and October, although some have been found through the winter (Campbell et al. 1990, eBird 2019).

The life requisite that will be evaluated for short-eared owl in the Tenas Project is Living during the Growing season, as reproductive, foraging, and security/thermal habitats are similar. The Growing season (spring/summer) is the critical season for reproduction and the time when they are resident on their breeding territories (Table 2).

Table 2: Monthly Life Requisites for Short-eared Owl

Month	Season	Life Requisite
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	Living
May	Late Spring	Living
June	Summer	Living
July	Summer	Living
August	Summer	Living
September	Early Fall	-
October	Late Fall	-
November	Winter	-
December	Winter	-

4.2 Data Acquisition and Preparation

The spatial datasets, with their sources, used to develop the short-eared owl model are described in Table 3. A digital elevation model (DEM) was used to generate the maximum elevation threshold. The ecosystem attributes were acquired by combining provincial Predictive Ecosystem Mapping (PEM) and Vegetation Resource Index (VRI) datasets and clipping the extend of the combined dataset to the RSA. The remainder of the datasets were used to generate an anthropogenic disturbance layer that was incorporated into the VRI to adjust forest stand attributes.

Table 3: Datasets Used in the Development of the Short-eared Owl Model

Dataset Name	Description	Source
Digital Elevation Model	Raster file of elevation data	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain
Vegetation Resource Inventory	Polygons representing vegetated and non-vegetated land classifications	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer
Predictive Ecosystem Mapping	Large scale classification and mapping of ecosystem units across BC	https://catalogue.data.gov.bc.ca/dataset/predictive-ecosystem-mapping-pem-detailed-polygons-with-short-attribute-table-20-000-spatial-view
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
GeoBase 250K Land Cover, Circa 2000	Polygons identifying land classifications (e.g., annual cropland, snow/ice, developed)	https://catalogue.data.gov.bc.ca/dataset/other-land-cover-1-250-000-geobase-land-cover#edc-pow
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
OpenStreetMap	Point sources for buildings to represent building corners.	https://osmbuildings.org/data/
TRIM Enhanced Base Map	Polygons representing building footprints	https://catalogue.data.gov.bc.ca/dataset/buildings-trim-enhanced-base-map-ebm
Mineral Titles Online Tenure	Data for minder, placer claims and leases, and coal licence applications/licences/leases	https://catalogue.data.gov.bc.ca/dataset/mta-mineral-placer-and-coal-tenure-spatial-view
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow

Dataset Name	Description	Source
Oil and Gas Commission Pipeline Right-of-Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
GBA Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Telkwa Motor Vehicle Closure	Road closures due to caribou habitat protections	ftp://ftp.geobc.gov.bc.ca/publish/Regional/Smit hers/Telkwa%20motor%20vehicle%20closure/
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop 10.3 with the Spatial Analyst extension (ESRI 2013).

4.3 Model Rating Scheme

Habitat suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species (Resources Inventory Committee 1999). There is an intermediate level of knowledge on the habitat requirements of short-eared owl in British Columbia, therefore a 4-class rating scheme was used in developing the model (Table 4). No provincial benchmark has been established for this species (Resources Inventory Committee 1999).

Table 4: Habitat Suitability Rating Scheme used for Short-eared Owl

Percent of Provincial Best	Rating	Code
76 – 100%	High	H
26 – 75%	Moderate	M
1 – 25%	Low	L
0%	Nil	N

4.4 Habitat Variables

Information used to develop the short-eared owl model was pulled primarily from literature about nesting habitat use and selection. Studies and information about short-eared owls in BC, western Canada, or similar ecosystems were used to the extent possible; however, because local information is limited, studies of short-eared owls in other regions of North America and elsewhere around the world were also considered where applicable.

Habitat variables identified in the literature as being important to short-eared owl, and which were considered for this model, are summarized in Table 5 and described in more detail in the sections following.

Table 5: Habitat Variables Considered for Short-eared Owl Model

Variable	Dataset	Relationship to Selection or Use
Elevation	Digital Elevation Model	Use of habitat below an elevation threshold
Final Stand Age	Vegetation Resource Index	Preference for open habitat (e.g., fields)
Anthropogenic Features	Anthropogenic Feature Layer	Minimum setback distance from anthropogenic disturbances

Potential habitat was mapped in each of the ecosystem units that occur in the study area for the Project (Table 6**Error! Reference source not found.**).

Table 6: Study area of Short-eared Owl Habitat Mapping

Study Area:	Tenas Project General Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecosections:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun), Coastal Mountain-heather Alpine undifferentiated (CMAun), Coastal Western Hemlock wet subarctic Montane variant (CWHws2), Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc), Engelmann Spruce – Subalpine Fir moist-cold parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk), moist-cool parkland (ESSFmkp), Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv), Engelmann Spruce – Subalpine Fir wet-very cold parkland (ESSFwvp), Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1), Sub-Boreal Spruce dry-cool (SBSdk), Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

Elevation

Within British Columbia short-eared owls have been observed during the breeding season from sea level to 2,138 m (Cannings 2015). To account for this, all areas above 2,138 m were assigned a Nil rating in the model based on the assumption that short-eared owls would not nest in habitat above this maximum threshold.

Ecosystem Attributes

Short-eared owls nest primarily in open areas (Cannings 2015). Within the RSA, ecosystems that provided open area habitat were defined by the age class. The VRI land cover dataset was considered the most reliable land cover dataset available across the RSA that contained vegetation age class data. It was evaluated for patterns of correspondence between vegetation age class and areas of potential short-eared owl habitat identified on satellite imagery. Vegetation with an age greater than 40 years was considered to represent regenerating forest and was not considered potential habitat. In addition, short-eared owls were not considered to use habitat fragments less than 80,000 m². Therefore, a minimum threshold of 80,000 m² of contiguous habitat (i.e., high, moderate, and low suitable habitat that was connected) was used, and all potential habitat below this threshold (i.e., the sum area of connected high, moderate, and low suitable habitat) was rated Nil based on the assumption it would be too small to provide reproductive, foraging, and/or security/thermal habitat.

Anthropogenic Features

Anthropogenic development (e.g., agriculture, forestry, urban development) has resulted in a large disturbance footprint in the low to mid-elevations of the RSA. To account for the potential of baseline anthropogenic disturbance a spatial layer was created from a variety of data sources as described in Section 4.2. Anthropogenic features that were assumed to provide habitat (e.g., agricultural areas, transmission line right-of-way) that had little shrubby or treed vegetation were rated from low to high, and other active features (e.g., highways, railways) were assumed not to provide habitat and were assigned a nil rating (Brigham et al. 2011, Hausleitner and Wallace 2012).

A 600 m zone of influence (ZOI) for short-eared owl was used to downgrade suitable habitat adjacent to active anthropogenic features (Table 7) due to the potential for sensory disturbance. This was based on

the Province of British Columbia's recommendation of a minimum 500 m buffer in undeveloped areas for nesting short-eared owls plus an additional 100 m breeding season 'quiet' buffer (Caskey and Chutter 2013). This buffer around specific nest sites applied as the ZOI is a precautionary approach that presumes there could be suitable nesting habitat for short-eared owl that would be reduced in effectiveness within 600 m of active anthropogenic features due to sensory disturbance.

Table 7: Anthropogenic Features and If Used to Downgrade Suitable Habitat

Anthropogenic Feature Type	Downgrade
Roads - Highway 2	Yes
Roads - Highway 3	Yes
Roads - Highway 4	Yes
Roads - Haul	Yes
Roads - Primary 1	Yes
Roads - Primary 2	Yes
Roads - Secondary 1	Yes
Roads - Secondary 2	Yes
Buildings - Commercial	Yes
Buildings - Residential	Yes
Buildings - Recreation	Yes
Urban Areas	Yes
Roads - Tertiary 1	No
Roads - Tertiary 2	No
Roads - Quaternary Closure Rough	No
Roads - Quaternary Closure Loose	No
Trails	No
Rail Yard	No
Rail Main	No
Rail Spurs	No
Agriculture	No
Roads - Tertiary Seasonal	No
Roads - Quaternary	No
Powerlines	No
Pipelines	No

4.5 Ratings Assumptions

Each ecosystem unit was evaluated and assigned a suitability rating class based on its ability to provide the Living (reproductive, foraging, and security/thermal) life requisite for short-eared owl for the Growing

season. The following assumptions were applied to habitat variables in the development of the short-eared owl model:

1. All ecosystem units below 2,139 m elevation have the potential to provide suitable Reproductive habitat and were rated up to High.
2. Stand age class 1 was rated up to High.
3. Stand age class 1 that was previously harvested was rated up to Moderate.
4. Stand age class 2 was rated up to Low.
5. Polygons that were open and drier wetlands were rated up to Moderate, polygons that were open and wetter wetlands were rated Low.
6. Stand age class 4 – 7 were rated Nil.
7. Waterbodies, ice, and some anthropogenic features (e.g. road surface, urban/suburban) were rated Nil.

4.6 Model Evaluation

Detections of short-eared owls during baseline surveys in the RSA were insufficient to validate model performance. Two stages of model evaluation were conducted. The first stage consisted of iterative reviews of model outputs and adjustment of parameter ratings during model development. Information used during evaluation and calibration exercises included a review of satellite imagery and field conditions observed by biologists conducting wildlife surveys. The goal of model calibration exercises were to specify model parameters so that the model included all, or almost all, areas with potential open reproductive habitat (i.e. to minimize errors of omission) while avoiding ratings that were too liberal, which would result in overestimating the amount of reproductive that really occurred (i.e. committing errors of commission).

5. LIMITATIONS/CONFIDENCE

Potential biases may be present within the short-eared owl model due to limitations in the knowledge of habitat use in the local area, unverified ecosystem data, and insufficient field data for model verification. A literature review of habitat requirements that were used to develop the model were based on studies from outside the region and the authors knowledge of short-eared owl ecology, and it was assumed that local use of habitat was similar to habitat used elsewhere. Spatial ecosystem data was not field verified prior to use in the model, and inconsistencies may be present both between the PEM and VRI datasets, as well as between datasets and real world conditions (e.g., stand ages, location of ecosystem units). Also, model development and validation was unable to use short-eared owl desktop and baseline occurrence data due insufficient detections. Overall, basic habitat requirements for short-eared owl are reasonably well known and while overall confidence in the short-eared owl model was limited by the nature of the modelling approach and lack of field validation, the overall confidence in the model is considered moderate.

6. SUMMARY OF MODELLING RESULTS

Suitability mapping for the short-eared owl showed that relatively more high and moderate rated habitat

was present in the RSA than in the Wildlife Local Study Area (LSA) (Table 8, Appendix 1). High and moderate rated habitat was present at all elevations; however, most high rated habitat was located at higher elevations in alpine areas, and moderate habitat at lower elevations in agricultural areas. Cutblocks, mostly at mid-elevations, contained low quality habitat and nil habitat was present across the RSA where forest was present.

The model output suggested that the amount of high and moderate habitat may be overestimated, indicating a potential model bias. Areas in the RSA where potential overestimation was present include agricultural areas, cutblocks, and alpine areas. Agricultural areas did not include a classification of the type of agriculture, which may annually change, and the approach used may have overestimated the availability of suitable habitat. The amount of suitable habitat present within cutblocks in the RSA may have also been overestimated due to the limited time frame before the maturation of vegetation results in the habitat becoming unsuitable, anticipated during stand age class 2. Also, the suitability of alpine habitat was unknown due to the lack of occurrence data and field habitat ratings and a conservative approach was used that may have overestimated its suitability. Field visits and satellite imagery suggested less habitat may be present; however, occurrence data and field habitat ratings were inadequate to guide adjustments to the model and may have also resulted in biases in the model output.

Table 8: Amount of Suitable Short-eared-Owl Habitat Rating by Study Area

Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	RSA (ha)	RSA (%)
High	145.04	0.41	9,746.81	5.01
Moderate	3,954.85	11.07	14,748.01	7.58
Low	6,941.66	19.43	22,888.31	11.76
Nil	24,684.33	69.09	147,265.58	75.66
Total	35,725.88	100.00	194,648.71	100.00

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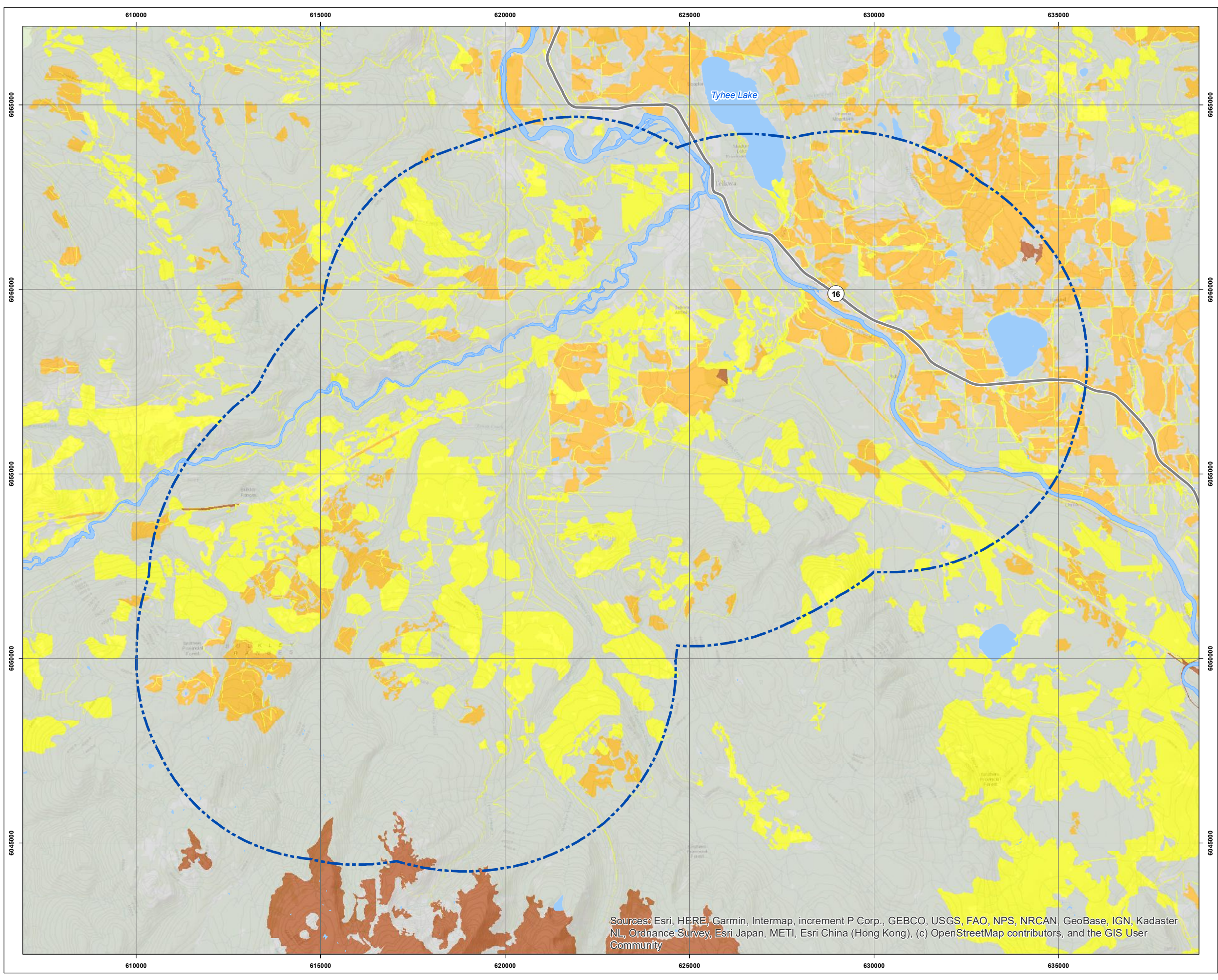
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Appendix A Short-eared Owl Habitat Suitability Mapping

Path: L:\PROJECTS\2018\BP0421_Tenas_Maps\Map\Tenas_Maps\habitat_suitability_LSA_SEOW_20200224.mxd



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Tenas Project

Short-Eared Owl Habitat Suitability
within the Wildlife LSA

Legend

Wildlife LSA

Habitat Suitability

High

Moderate

Low

Nil

Highway

River

Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basedata: Government of British Columbia
- Basemap: ESRI World Topographic Map

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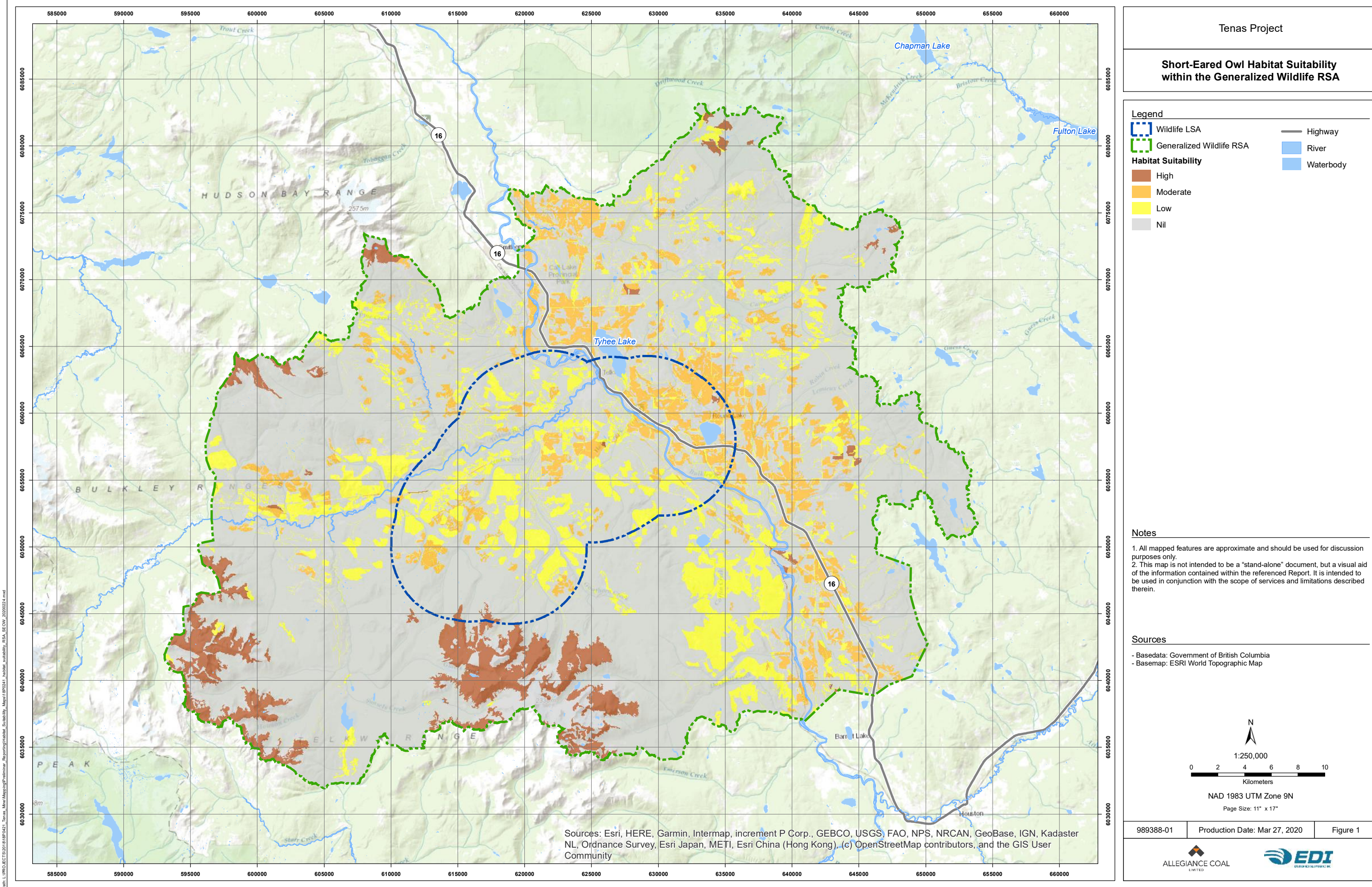
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Figure 2

ALLEGIANCE COAL
LIMITED

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ENVIRONMENTAL DEVELOPMENT INC.



Appendix E Migratory Breeding Bird Account and Habitat Models Report

Tenas Project

Migratory Breeding Bird Account and Habitat Models Report

October 2020

VERSION 7

Submitted to: Telkwa Coal Limited
Suite 1410 – 409 Granville Street
Vancouver, BC V6C 1T2

Submitted by: EDI Environmental Dynamics Inc.
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ACKNOWLEDGEMENTS

Mike Boyd was the primary author and designed the model. Laurence Turney and Lis Rach provided baseline data. Anne MacLeod, Jeff Meggs, and Todd Mahon reviewed the report. Christina Tennant provided GIS analysis and mapping support. Anne MacLeod and Cathy Mackay completed senior review.

Tenas Project

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1. INTRODUCTION

This report summarizes habitat models and a density analysis for migratory breeding birds that were completed for the purpose of informing the assessment of potential effects for the proposed Tenas Project (the Project). As part of baseline investigations, habitat suitability modelling and a density analysis were completed to characterize the existing habitat suitability for migratory breeding birds. Habitat guilds were used to group the migratory breeding bird species known to occur within the RSA for the purpose of creating these models. Three guilds were used: open and early successional (open habitat), young through old forest (forest habitat), and wetlands or riparian areas (wetland/riparian habitat). Independent of these models, short-eared owl (*Asio flammeus*), northern goshawk (*Accipiter gentilis atricapillus*), olive-sided flycatcher (*Contopus cooperi*), and common nighthawk (*Chordeiles minor*) habitats were modelled using species-specific suitability ratings (see Avian Baseline Report Appendices A to D).

These habitat guilds are intended to represent the dominant habitat associations within the RSA; however, it is recognized that many, perhaps most, species may depend on more than one type of habitat to satisfy all their life requisites. Additionally, many species select habitat at a much finer scale than can be represented by the guild models; guilds are a coarse-scale approach to characterize breeding bird habitats that occur on a local and regional context of the Project. A total of 65 species were detected during point count survey for the Project baseline; these were grouped into guilds based on known habitat preferences or labelled as a generalist if they occurred in multiple habitats. Species that are generalists or do not have well defined breeding habitat associations were not categorized according to habitat guilds and were excluded from the migratory breeding bird habitat suitability models.

The migratory breeding bird habitat models and density analysis were completed for the General Wildlife Regional Study Area (RSA) that is 194,650 hectares (ha) and encompasses the watersheds that occur within a 10 km radius of the Project Area. The RSA contains the Local Study Area (LSA) that is 35,726 ha and encompasses a 5 km radius around the Project Area. The LSA encompasses all aspects of the Project that may affect the component (i.e. migratory breeding birds) in question.

2. DISTRIBUTION AND STATUS

2.1 Distribution

Migratory birds in British Columbia (BC) are known to breed in all biogeoclimatic (BGC) zones, from sea level to the summer snow/ice limit (Campbell et al. 1990a, 1990b, 1997, 2001, Davidson et al. 2015). The greatest diversity of breeding species in the province is in the Southern Interior ecoprovince (70% of provincial breeding species), followed by the Southern Interior Mountains (62% of species), and the Central Interior ecoprovince (61% of species) (Campbell et al. 1990a).

2.2 Threats and Status

A total of 16 avian species and subspecies that may occur within the RSA are provincially listed as having a conservation status and not secure (i.e., Red-listed or Blue-listed) or are listed by the Committee On the Status of Endangered Species In Canada (COSEWIC) or under the Species at Risk Act (SARA)(B.C. Conservation Data Centre 2020). Of these, 12 are considered migratory species and are listed under the

Migratory Birds Convention Act (1994). The State of Canada's Birds found that since the 1970s populations of aerial insectivores, grassland birds, and shorebirds have declined by 40 - 59%, mostly due to habitat loss and pesticide use; in contrast, populations of waterfowl and birds of prey have increased by 110 - 150% as a result of the banning of DDT, managed hunting, and habitat restoration (North American Bird Conservation Initiative Canada 2019).

3. HABITAT REQUIREMENTS

Migratory birds require Living habitat, which includes Reproductive, Foraging, and Security/Thermal habitats, to successfully nest and raise young. Each species may have slightly different habitat requirements; however, the species in each of the guilds have similar habitat requirements that can be broadly summarized in habitat suitability models.

3.1 Living Habitat

Species in the open habitat guild use a diversity of habitats that include alpine meadows, agriculture areas, clearcuts, and shrubby thickets. Some species may nest in habitat devoid of vegetation (e.g., killdeer [*Charadrius vociferus*]), whereas others prefer habitat transitioning to forest (e.g., orange-crowned warbler [*Vermivora celata*], fox sparrow [*Passerella iliaca*]) (Boyd 2015, Gilbert et al. 2020a, Jackson and Jackson 2020, Weckstein et al. 2020).

Forest guild species are found in coniferous (e.g., Townsend's warbler [*Setophaga townsendi*], golden-crowned kinglet [*Regulus satrapa*]), mixed (e.g., brown creeper [*Certhia americana*], western tanager [*Piranga ludoviciana*]), and deciduous (e.g., warbling vireo [*Vireo gilvus*]) forests. These species may nest anywhere from the ground (e.g., Pacific wren [*Troglodytes pacificus*]) to upper tree branches (e.g., ruby-crowned kinglet [*Regulus calendula*]) (Boyd 2015, Phinney 2015, Poulin et al. 2020, Swanson et al. 2020a, b, Toews and Irwin 2020a, Wright et al. 2020a).

Species in the wetland/riparian habitat guild nest in bogs (e.g., Lincoln's sparrow [*Melospiza lincolni*]), fens (e.g., yellow warbler [*Setophaga petechia*]), swamps (e.g., northern waterthrush [*Parkesia noveboracensis*]), and marshes (e.g., common yellowthroat [*Geothlypis trichas*]), but also along shorelines and adjacent riparian and terrestrial habitats (e.g., American redstart [*Setophaga ruticilla*]) (Ammon 2020, Guzy and Ritchison 2020a, Lowther et al. 2020a, Whitaker and Eaton 2020).

4. MODEL DEVELOPMENT

4.1 Life Requisites and Seasons

Most migratory breeding birds in BC nest during the growing season months of May, June, July, and August, although several species may initiate nesting earlier or later and a few species may nest year-round (Environment and Climate Change Canada (ECCC) 2018). The habitats represented by each guild are broad and there is overlap within each guild among the Reproductive, Foraging, and Security/Thermal habitats. Therefore, the life requisite that was evaluated for migratory breeding birds in the Project was Living (Reproduction, Foraging, and Security/Thermal) for the growing season.

4.2 Data Acquisition and Preparation

The spatial datasets used to develop the migratory breeding bird models are described in Table 1. The ecosystem attributes were acquired from an updated dataset developed by combining provincial Predictive Ecosystem Mapping (PEM) and Vegetation Resource Index (VRI) datasets and clipping the combined dataset to the RSA. The remainder of the datasets were used to generate an anthropogenic disturbance layer that was incorporated into the VRI to adjust forest stand attributes to the current conditions.

Table 1: Datasets Used in the Development of the Migratory Breeding Bird Models

Dataset Name	Description	Source
Digital Elevation Model	Raster file of elevation data	https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/terrain
Vegetation Resource Index	Polygons representing vegetated and non-vegetated land classifications	https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer
Predictive Ecosystem Mapping	Large scale classification and mapping of ecosystem units across BC	https://catalogue.data.gov.bc.ca/dataset/predictive-ecosystem-mapping-pem-detailed-polygons-with-short-attribute-table-20-000-spatial-view
Digital Road Atlas	Road dataset for BC	https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads
GeoBase 250K Land Cover, Circa 2000	Polygons identifying land classifications (e.g., annual cropland, snow/ice, developed)	https://catalogue.data.gov.bc.ca/dataset/other-land-cover-1-250-000-geobase-land-cover#edc-pow
Recreation Tenure Alpine Ski Areas	Polygon and point features for ski areas	https://catalogue.data.gov.bc.ca/dataset/recreation-tenure-alpine-ski-areas
Municipalities – Legally Defined Administrative Areas of BC	Polygons outlining legally defined municipalities in BC	https://catalogue.data.gov.bc.ca/dataset/municipalities-legally-defined-administrative-areas-of-bc#edc-pow
CanVec	Point sources for anthropogenic features (e.g., dam, dike/levee, sewage pipeline)	https://open.canada.ca/data/en/dataset/fd4369a4-21fe-4070-914a-067474da0fd6
OpenStreetMap	Point sources for buildings to represent building corners.	https://osmbuildings.org/data/
TRIM Enhanced Base Map	Polygons representing building footprints	https://catalogue.data.gov.bc.ca/dataset/buildings-trim-enhanced-base-map-ebm
Mineral Titles Online Tenure	Data for minder, placer claims and leases, and coal licence applications/licences/leases	https://catalogue.data.gov.bc.ca/dataset/mta-mineral-placer-and-coal-tenure-spatial-view
Forest Tenure Road Section Lines	Roads under the BC Forest and Range Act Tenures	https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-section-lines
GeoBase National Railway Network	Contains railway track classification, use type, and operator data.	https://catalogue.data.gov.bc.ca/dataset/railway-track-line#edc-pow
Oil and Gas Commission Pipeline Right-of-Way Permits	Polygon data for approved and post-construction pipeline right-of-ways	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-right-of-way-permits

Dataset Name	Description	Source
Oil and Gas Associated Ancillary Permit	Polygons of associated oil and gas activities (e.g., campsites, staging areas, work spaces)	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-associated-and-ancillary-permits
Oil and Gas Pipeline Segment Permit	Polygons representing segments of non-continuous pipeline	https://catalogue.data.gov.bc.ca/dataset/oil-and-gas-commission-pipeline-segment-permits
GBA Transmission Lines	High voltage electrical transmission lines for power distribution	https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines
Telkwa Motor Vehicle Closure	Road closures due to caribou habitat protections	ftp://ftp.geobc.gov.bc.ca/publish/Regional/Smit_hers/Telkwa%20motor%20vehicle%20closure/
Recreation Polygons	Polygons of a recreation feature (e.g., recreation reserve, recreation site, interpretive forest)	https://catalogue.data.gov.bc.ca/dataset/recreation-polygons
Recreation Line	Linear spatial representation for recreation features (e.g., recreation trails)	https://catalogue.data.gov.bc.ca/dataset/recreation-line

All analyses were completed using NAD83 BC Albers projected coordinate reference system (EPSG: 3005). Analyses and management of spatial data was completed using ArcGIS Desktop 10.3 with the Spatial Analyst extension (ESRI 2013).

4.3 Model Rating Scheme

There are no Provincial benchmarks for migratory bird guilds habitat; therefore, habitat ratings were based on breeding site attributes described in literature. Ecosystem attributes were generalized to represent broad habitat types used by migratory bird guilds. A two-class rating scheme (Useable, Likely No Value¹) was used for habitat ratings to accommodate a broad range of nesting habitat requirement for all species within each guild (Table 2).

Table 2: Habitat Suitability Rating Scheme Used for Each Migratory Breeding Bird Guild

Relative Quality	Rating	Code
6 – 100%	Useable	U
0 - 5%	Likely No Value	X

4.4 Habitat Variables

Potentially relevant habitat variables for the development of the migratory breeding bird models were identified from studies of migratory breeding birds in BC, western Canada, or similar ecosystems and are summarized in Table 3. The model rated all potentially relevant habitat variables, and no ecosystem units (e.g., ice, urban) were removed from the ecosystem dataset prior to mapping. Details about each variable,

¹ The methodology for modelling habitat guilds followed the standard approach for wildlife habitat ratings (RIC 1999) including use of the two class system, Useable/Likely No Value, selected to meet the coarse resolution/small map scale required for the objective.

including references, are provided in the sections following. Potential habitat was mapped in each of the ecosystem units that occur in the RSA for the Project (Table 4).

Table 3: Habitat Variables Considered for Each Migratory Breeding Bird Guild Model

Guild	Dataset	Variable	Relationship to Selection or Use
Open	Vegetation Resource Index	Canopy Cover	Preference open habitats (i.e., <20% canopy cover)
	Vegetation Resource Index	Final Stand Age	Preference for open or early successional habitats (i.e., vegetated areas ≤40 years old)
	Anthropogenic Feature Layer	Anthropogenic Feature	Preference for open habitats at infrequently used anthropogenic features (e.g., pipelines, transmission lines)
Forest	Vegetation Resource Index	Canopy Cover	Preference for forest (i.e., ≥20% canopy cover)
	Vegetation Resource Index	Final Stand Age	Preference for forest (i.e., forested stands >40 years)
Wetland/ Riparian	Vegetation Resource Index	Biogeoclimatic Zone Ecosystem Units	Preference for waterbodies, wetlands, and riparian habitats (e.g., marshes, swamps, upland areas within 30 m of a named waterbody, wetland)

Table 4: Study Area of Migratory Breeding Bird Habitat Mapping.

Study Area:	General Wildlife Regional Study Area
Ecoprovince:	Central Interior
Ecoregion:	Eastern Hazelton Mountains (EHM) and Fraser Plateau (FAP)
Ecoregions:	Bulkley Basin (BUB) and Bulkley Ranges (BUR)
Biogeoclimatic Zones:	Boreal Altai Fescue Alpine undifferentiated (BAFAun), Coastal Mountain-heather Alpine undifferentiated (CMAun), Coastal Western Hemlock wet submarine Montane variant (CWHws2), Engelmann Spruce – Subalpine Fir moist-cold (ESSFmc), Engelmann Spruce – Subalpine Fir moist-cold parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir moist-cool (ESSFmk), moist-cool parkland (ESSFmcp), Engelmann Spruce – Subalpine Fir wet-very cold (ESSFwv), Engelmann Spruce – Subalpine Fir wet-very cold parkland (ESSFwvp), Interior Cedar – Hemlock moist-cold – Nass variant (ICHmc1), Sub-Boreal Spruce dry-cool (SBSdk), Sub-Boreal Spruce moist-cold Babine variant (SBSmc2)

Elevation

Migratory breeding birds were detected during the BC Breeding Bird Atlas up to 2,473 m, which exceeds the upper elevation limit for the RSA (Davidson et al. 2015). As a result, all elevations were considered to be potential Useable habitat.

Ecosystem Attributes

Habitat preferences for each of the migratory breeding bird guilds were described by the ecosystem unit's age or ecosystem type. All ecosystem units that lacked nesting, food, shelter, or security habitat were assigned a 'Likely Not Used' value.

- ▶ Open habitat guild — Birds in the open habitat guild are typically found in ecosystems classified as ages 0 – 40 years, which cover a broad range of habitats, including alpine, clearcuts, agricultural areas, and riparian thickets.
- ▶ Forest habitat guild — Forest guild species occur in ecosystems classified as ages >40 years, and include coniferous, mixed, and deciduous forests. Parkland ecosystems in the Engelmann Spruce – Subalpine Fir (ESSF) represent a transition from forest to open (alpine) ecosystems in the Boreal Altai Fescue Alpine (BAFA) BGC zone. Habitats in these subzones were separated by canopy cover. When canopy cover equalled or exceeded 20% the habitat was treated as forest, and ecosystem units with less than 20% canopy cover were considered to be open habitat.
- ▶ Wetland/riparian habitat guild — Birds in the wetland/riparian guild were classified according to the ecosystem unit type, which included wetlands (e.g., bog, fen, swamp, marsh), open water, lakes, and rivers. In addition, some wetland/riparian guild species nest in terrestrial habitats adjacent to waterbodies, wetlands, and watercourses; therefore a 30 m buffer around waterbodies, wetlands, and four major streams/rivers watercourses known to have riparian habitat (e.g., Bulkley River, Telkwa River) was used to capture these areas of Useable habitat.

Anthropogenic Features

The RSA has a substantial anthropogenic footprint from existing urban development, transportation, agriculture, forestry and other industrial development. To account for this, an anthropogenic disturbance layer was compiled from a variety of sources as described in Section 4.2. Infrequently used anthropogenic features (e.g., agricultural areas, transmission line right-of-way, infrequently used road right-of-ways) were assumed to potentially provide habitat for open or wetland guilds and were rated as Useable. Active anthropogenic features (e.g., highways, railways) were assumed not to provide habitat (e.g., highways, railways) and were assigned a 'Likely Not Used' rating for the each of the guilds.

4.5 Ratings Assumptions

Each ecosystem unit was evaluated and assigned a suitability rating class based on its ability to provide the life requisites for each migratory breeding bird guild for the growing season (summer).

The following assumptions were applied to the habitat suitability model for the open habitat guild:

1. Stand ages of 0 – 40 were rated as Useable.
2. Within the BAFA undifferentiated, ESSF moist cold parkland, ESSF moist cool parkland, and ESSF very wet cold parkland BGC subzones, all stands that had a canopy closure <20% were rated as Useable.
3. All other habitats were rated as Likely No Value.

The following assumptions were applied to habitat suitability modelling for the forest habitat guild:

1. Stand ages of >40 years were rated as Useable.

2. Within the ESSF moist cold parkland, ESSF moist cool parkland, and ESSF very wet cold parkland BGC subzones, all stands that had a canopy closure at $\geq 20\%$ were rated as Useable.
3. All other habitats were rated as Likely No Value.

The following assumptions were applied to the habitat suitability model for the wetland/riparian habitat guild:

1. All BGC ecosystem units that were wetland (e.g., bog, marsh, fen, swamp), open water (e.g., ponds, lakes), or moving water (e.g., streams, rivers) were rated as Useable habitat.
2. Terrestrial habitats within 30 m of features of waterbodies, wetlands, and the Bulkley River, Telkwa River, Tenas Creek, and Goathorn Creek were rated as Useable.
3. All other habitats were rated as Likely No Value.

4.6 Model Evaluation

Models were evaluated using a qualitative two-stage process, consisting of iterative reviews of model outputs and the adjustment of parameters during model development. Information used during evaluation and calibration exercises included a review of satellite imagery and field conditions observed by biologists conducting wildlife surveys. The goal of model evaluation exercises were to specify model parameters so that the model included all, or almost all, areas with potential open reproductive habitat (i.e. to minimize errors of omission) while avoiding ratings that would result in overestimating the amount of reproductive habitat present in the real world (i.e. committing errors of commission).

5. LIMITATIONS/CONFIDENCE

The migratory breeding bird models may reflect biases that are based on the knowledge and opinions of the authors. The models represent groupings of species that may not entirely share the same habitat preferences; however, they share broad habitat preferences that allowed them to be grouped together and guide the model development process. Occurrence data of migratory breeding birds, from baseline surveys and a desktop review, was not used to guide model development or to conduct quantitative validation of the model due to the simplistic nature of the models that encompass a broad classification of habitat types to capture as many species as possible. Additionally, model development relied on spatial ecosystem data from PEM and VRI datasets which were not field verified prior to use in the model, so consistency between datasets and real-world conditions may vary. Habitat requirements that were used in the models were summarized from a literature review that focused on the habitat preferences of species and habitats present within the RSA. Overall, the general habitat preferences of birds found in open, forest, and wetland/riparian habitats are considered to be well known. Therefore, while overall confidence in the migratory breeding bird models was limited by the lack of validation and ecosystem spatial data, the overall confidence in the model is high for each individual guild because the habitat requirements for each were relatively well-known and encompassing of many species.

6. SUMMARY OF MODELLING RESULTS

Overall, 176,717 ha (90.8%) of the RSA is considered Useable habitat and 17,932 ha (9.2%) was considered Likely No Value (Table 5, Appendices A, B, C). Most of the areas considered Likely No Value to migratory birds are areas without nesting features, foraging, or security/thermal habitat (i.e., areas of rock, ice, or urban).

Table 5: Amount of Useable Open, Forest, and Wetland Habitat by Biogeoclimatic Subzone

BGC Subzone/ Variant ¹	Habitat (ha)						Total
	Open	Forest	Wetland/ Riparian	Riparian- Open	Riparian- Forest	Likely No Value	
SBSdk	15,209.30	22,145.03	2,022.55	1,905.64	8,294.30	5,501.07	55,077.89
SBSmc2	12,543.43	33,131.83	458.19	3,644.61	11,714.03	2,548.90	64,040.99
ESSFmc	1,635.08	32,605.28	397.17	38.3	2,499.49	345.82	37,521.14
Other ESSF Variants	1,728.42	16,052.91	427.55	61.4	1,540.44	5,823.15	25,633.87
CWH/ICH	19.75	492.6	0	0.03	5.28	5.41	523.07
Alpine Variants	7,811.97	176.94	56.58	97.13	1.74	3,707.39	11,851.75
Total	38,947.95	104,604.59	3,362.04	5,747.11	24,055.28	17,931.74	194,648.71

¹ BGC variants present in the RSA include: BAFAun, CWHws2, ESSFmc, ESSFmcp, ESSFmcw, ESSFmk, ESSFmkp, ESSFmkw, ESSFwv, ESSFwvp, ESSFwvw, ICHmc1, SBSdk, and SBSmc2; however, BGC variants that were not present in the LSA or represent a small proportion of the RSA were grouped for this analysis.

Useable open habitats within the RSA totaled 38,948 ha (20.0% of the RSA). Useable open habitat at lower elevations within the SBSdk subzone is mostly agricultural fields, although some cutblocks are present, and within the BAFAun subzone most of the Useable habitat is alpine. Useable open habitat within most of the other BGC subzones is present as cutblocks, where habitat is regenerating forest and typically more shrubby than agricultural areas or alpine (Appendix A). Overall, a qualitative evaluation of the final model suggests that it may be biased towards overestimating the availability of open habitat and that it was potentially driven by errors within the VRI dataset, where some vegetated polygons (e.g., cutblocks) may be older than as labelled in the dataset. Also, the suitability of habitat is generally limited to areas of recently disturbed habitat that also have the potential to mature to non-open habitat within a shorter time frame than modelled, with the regenerating forest age classification covering a relatively broad time frame that potentially included suitable and non-suitable habitat for open guild species.

Useable forest habitats within the RSA totaled 104,605 ha (53.7%). Useable habitats were found at all but the highest elevations; however, larger patches were present at the mid to upper elevations and smaller patches were present at lower elevations, mostly between agricultural fields and logged areas. Forest habitat in the SBSdk, SBSmc2, CWHws2, and ICHmc1 subzones included deciduous and mixed forest stands, as well as coniferous forest; however, the remaining forested BGC subzones were primarily coniferous with minimal amounts of deciduous or mixed forest (Appendix B).

Useable wetland/riparian habitats within the RSA totaled 3,362 ha (1.7%). Riparian areas were classified under the wetland guild as Riparian-Open (i.e., areas of overlap between wetlands and open habitat) and Riparian-Forest (i.e., areas of overlap between wetlands and forest) and totaled 5,747 ha (3.0%) and 24,055 ha (12.4%), respectively. Larger wetlands and riparian areas along larger watercourses were found primarily within the SBSdk and SBSmc2 subzones and contributed to most of the overall Useable habitat present in the RSA. Smaller wetlands were present in the other BGC subzones, mostly at higher elevations (i.e., bogs in the ESSFmc), and no wetlands were mapped within the CWHws2 or ICHmc1 subzones (Appendix C). Overall, a qualitative evaluation of the final model suggests that the model may be biased towards overestimating the availability of Useable habitat. Field habitat ratings were not collected and could not provide input into the models; however, impressions from field visits and satellite imagery suggest that less wetland/riparian habitat may be present than indicated in the models. Overestimation is likely driven

by the classification of riparian areas (i.e., habitats within 30 m of wetlands and other waterbodies) that includes areas that may not be Useable habitat (e.g., talus slopes).

7. DENSITY ANALYSIS

Existing baseline point count data and data from the BC Breeding Bird Atlas (BC BBA) were used to estimate densities for individual species and the habitat guilds within the RSA.

7.1 Background

Point count sampling is a method extensively used to monitor birds in terrestrial habitats and is widely employed to establish indices of relative abundance or density estimates (Ralph et al. 1995; Buckland et al. 2001). The Canadian Wildlife Service has previously identified migratory breeding birds as a group of management concern and as a result this group was identified as a sub-component under the avian valued component. To provide a bird abundance context to distribution and amount of each habitat guild in the RSA a density analysis was conducted for migratory breeding birds.

7.2 Data Acquisition, Preparation, and Analysis

The density analysis used point count observation data obtained during baseline surveys (see Avian Baseline Report, Section 2.3.1 for methodology) and point count data collected for the BC BBA 2008 – 2012 (Davidson et al. 2015). Point count data from the BC BBA was obtained through a data request from Nature Counts (Nature Canada 2016) for all point count data within the Smithers area, which was then refined to point counts within the RSA. The point count observation data from the two different datasets was then pooled for analysis.

All birds detected (i.e., seen or heard) during both the baseline and BC BBA point count surveys were recorded; however, the effective detection radius for the baseline point count surveys was estimated to be 75 m (L. Turney pers. comm.). It was assumed that all birds present within this distance were detected (i.e., 100% detectability), and that the number of birds detected above this threshold was less than 100%. This assumption was not tested and may be incorrect; however, a preliminary detectability analysis using distance sampling (Buckland 2001) found that the sample sizes were too small for most species to reliably calculate their individual detectability, with only nine species detected ≥ 60 times. Birds detected past the 75 m distance were removed from the analysis. It was assumed that all BC BBA detections were within the 75 m effective detection distance. The effective sampling area for each point count was calculated using the 75 m detection radius, which was then summed to determine the total area surveyed for the RSA, each of the three habitat guilds, and for each BGC subzone within the three guilds. The area sampled for most point counts (baseline and BBA surveys combined) overlapped with multiple habitat types and BGC subzones, as a result the habitat or BGC subzone that a bird was detected in was not always known. To assign this information to each observation, the habitat that made up the majority of the area at each point count and the BGC subzone that the point count was centered on was assigned to all detections at that point count. Due to this labelling process, some species may have been assigned to non-typical habitats (i.e., a savannah sparrow detected in forest habitat) or BGC subzones, so the analysis represents an approximation of the migratory breeding bird communities present in the RSA.

A density calculation was made for each species detected during the point count surveys by dividing the total number of birds detected by the total area surveyed. Species densities were calculated for the RSA, each habitat type, and each BGC subzone within each habitat type, and a mean density for all species

within each guild. The mean density for each guild was then used to calculate an abundance for each guild for the RSA, each habitat, and each BGC subzone for each habitat.

All species with at least one detection were included in the density estimate. This could lead to biased estimates for individual species with low detections (e.g. 336 Peregrine Falcons). However, numerous species had low numbers of detection's and collectively they represented a substantial number of birds. Therefore, they were included in the estimate.

Point counts did not sample all BGC subzones within the RSA, so the results are limited to the BGC subzones where data was available; therefore, the RSA totals only reflect the totals for these BGC subzones, which may underestimate true density.

7.3 Summary of Density Analysis Results

Overall, the density of all birds within the RSA was estimated to be 5.56 birds/ha (Table 6) and the abundance was 684,995 birds (Table 7), although these estimates were only for three BGC subzones where point counts were located in suitable habitat. While point count surveys were conducted in only five of the 15 BGC subzone types present within the RSA, these types represent 91.7% of the RSA area. Most point counts were conducted in the RSA's three main BGC subzones by area: ESSFmc, SBSdk, and SBSmc2. Small sampling sizes in the BAFAun and ESSFmcp subzones lead to unrealistic density and abundance estimates (i.e., American tree sparrow density of 0.79 birds/ha and abundance of 7,036 birds in the BAFAun subzone) and have been excluded from the results. In addition, some point count habitats were mapped and labelled as predominantly unsuitable habitat (e.g., anthropogenic features) and were left out of the analysis.

Riparian-forest habitat in the SBSdk had the highest estimated density of migratory breeding birds. The highest abundance was of forest birds in the SBSmc2 subzone, accounting for 22.7% of the total for the RSA. No point counts were conducted in habitat where the majority was classified as wetland, likely due to the small amount of this habitat in the RSA (1.8%). As a result, density or abundances could not be estimated for this habitat. Overall, density was highest in the SBSdk subzone, which was lowest in elevation, and abundance was approximately the same in the SBSdk and SBSmc2. Density decreased with an increase in elevational BGC subzones (i.e. SBSdk > SBSmc2 > ESSFmc); however, abundance did not due to more Useable habitat in the SBSmc2 compared to the ESSFmc and SBSdk. Comparison of density estimates between habitat guilds is limited due to the differences in the species in the assemblages and habitats; however, individual species densities and estimated abundances are presented in Appendix D.

Table 6: Density Estimates (birds/ha) for Each Habitat Guild, BGC Subzone, and RSA¹

Habitat	BGC Subzone			Total
	ESSFmc	SBSdk	SBSmc2	
Open	4.72	5.18	5.44	5.31
Forest	4.18	5.85	4.68	5.30
Wetland ²	-	-	-	-
Riparian-Open	-	3.31	3.23	3.24
Riparian-Forest	-	6.75	3.02	5.56
Total	4.36	6.53	4.68	5.56

¹ RSA total is only for the BGC subzones where point count data was available. ² No point counts were conducted in habitat where the majority was classified as wetland, and as a result no density estimates exist for this guild.

Table 7: Abundance Estimates for Each Habitat Guild, BGC Variant, and RSA¹

Habitat	BGC Subzone			Total
	ESSFmc	SBSdk	SBSmc2	
Open	7,719.52	78,755.77	68,263.93	154,739.22
Forest	136,196.85	129,467.25	155,168.45	420,832.54
Wetland ²	-	-	-	-
Riparian-Open	-	6,307.53	11,781.01	18,088.53
Riparian-Forest	-	55,961.41	35,373.42	91,334.84
Total	143,916.36	270,491.96	270,586.81	684,995.13

¹ RSA total is only for the BGC subzones where point count data was available. ² No point counts were conducted in habitat where the majority was classified as wetland, and as a result no abundance estimates exist for this guild.

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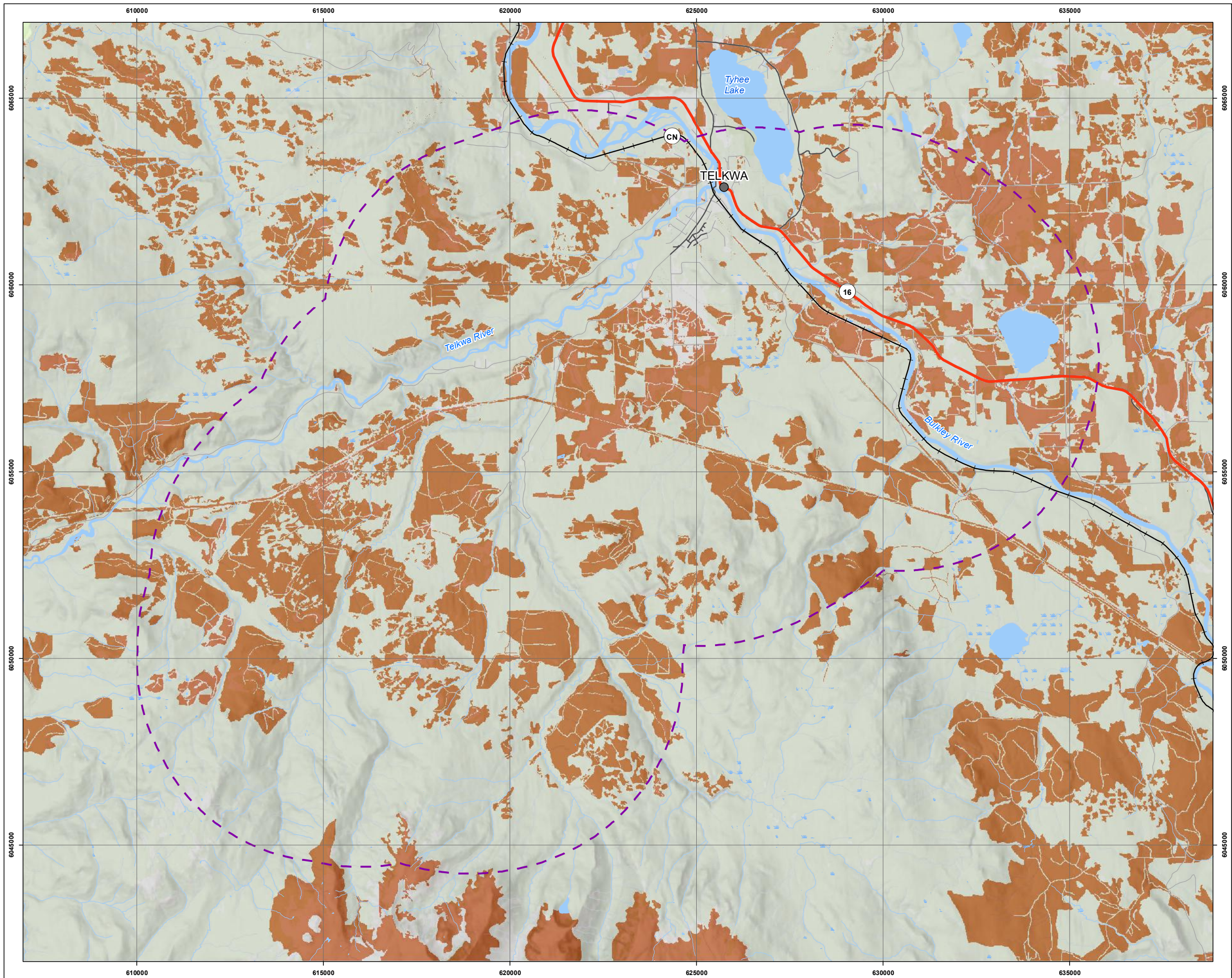
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Appendix A Open & Early Successional Habitat Suitability Mapping

P:\H1_U\PROJECTS\2018\BP0421_Tenas_Mine\Mapings\Primar Reporting\Labels Suitability_Maps\180421_habitat_suitability_LSA_MBB_Open_20080327.mxd



Tenas Project

Open/Early Successional/Alpine Habitat within the Wildlife LSA

Legend

General Wildlife LSA

Habitat Suitability

Suitable

Not Suitable

City/Town

Rail Line

Highway

Road

Resource Road

Watercourse

Wetland

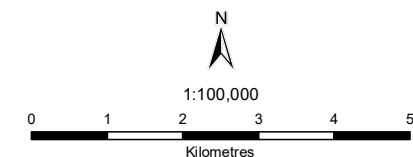
Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map



NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

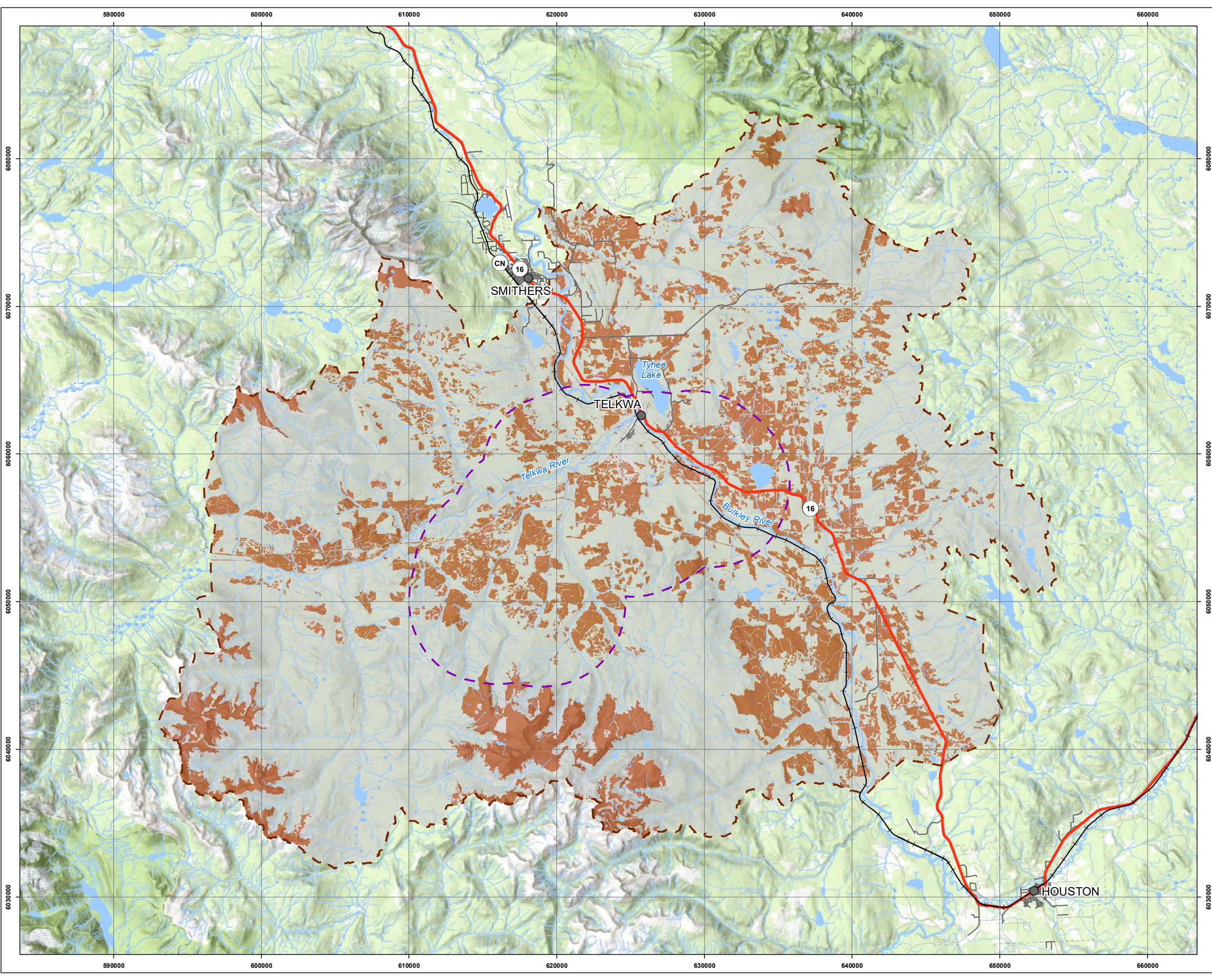
20Y0172

Production Date: Aug 28, 2020

Figure 1



P:\H1_U\PROJECTS\2018\BP0421_Tenas_Mine\Mapings\Palmar_Rapporting\label_Suitability_Map\190241_habitat_suitability_RSA_MBB_Open_20200821.mxd



Tenas Project

Open/Early Successional/Alpine Habitats
within the General Wildlife RSA

Legend

General Wildlife LSA

General Wildlife RSA

Habitat Suitability

Suitable

Not Suitable

City/Town

Rail Line

Highway

Road

Resource Road

Watercourse

Wetland

Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Base

1:250,000

Kilometres

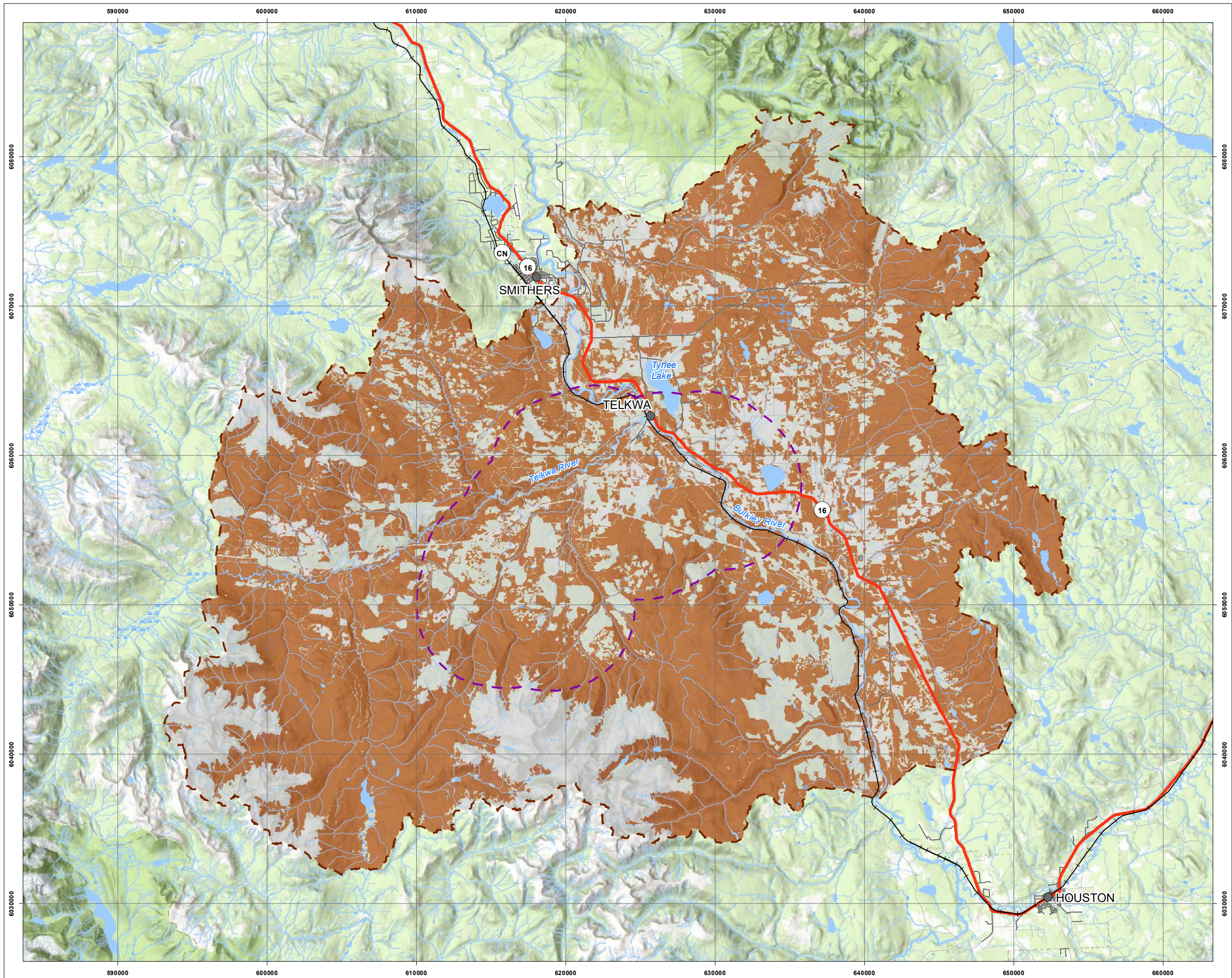
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Page Size: 11" x 17"

Project No.	Production Date: Aug 28, 2020	Figure 2
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Appendix B Forest Habitat Suitability Mapping

P:\m\PROJECTS\2018\BIP\2021_Tenas_MinMap.mxd;Palmer_Report\fig\habitat_suitability_Map\BIP2021_Tenas_habitat_suitability_RSA_MBI_Forest_20200821.mxd



Tenas Project

Forest Habitat within the General Wildlife RSA

Legend

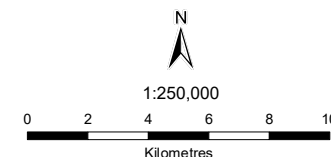
- General Wildlife LSA
- General Wildlife RSA
- Habitat Suitability**
 - Suitable
 - Not Suitable
- City/Town
- Rail Line
- Highway
- Road
- Resource Road
- Watercourse
- Wetland
- Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base



NAD 1983 UTM Zone 9N

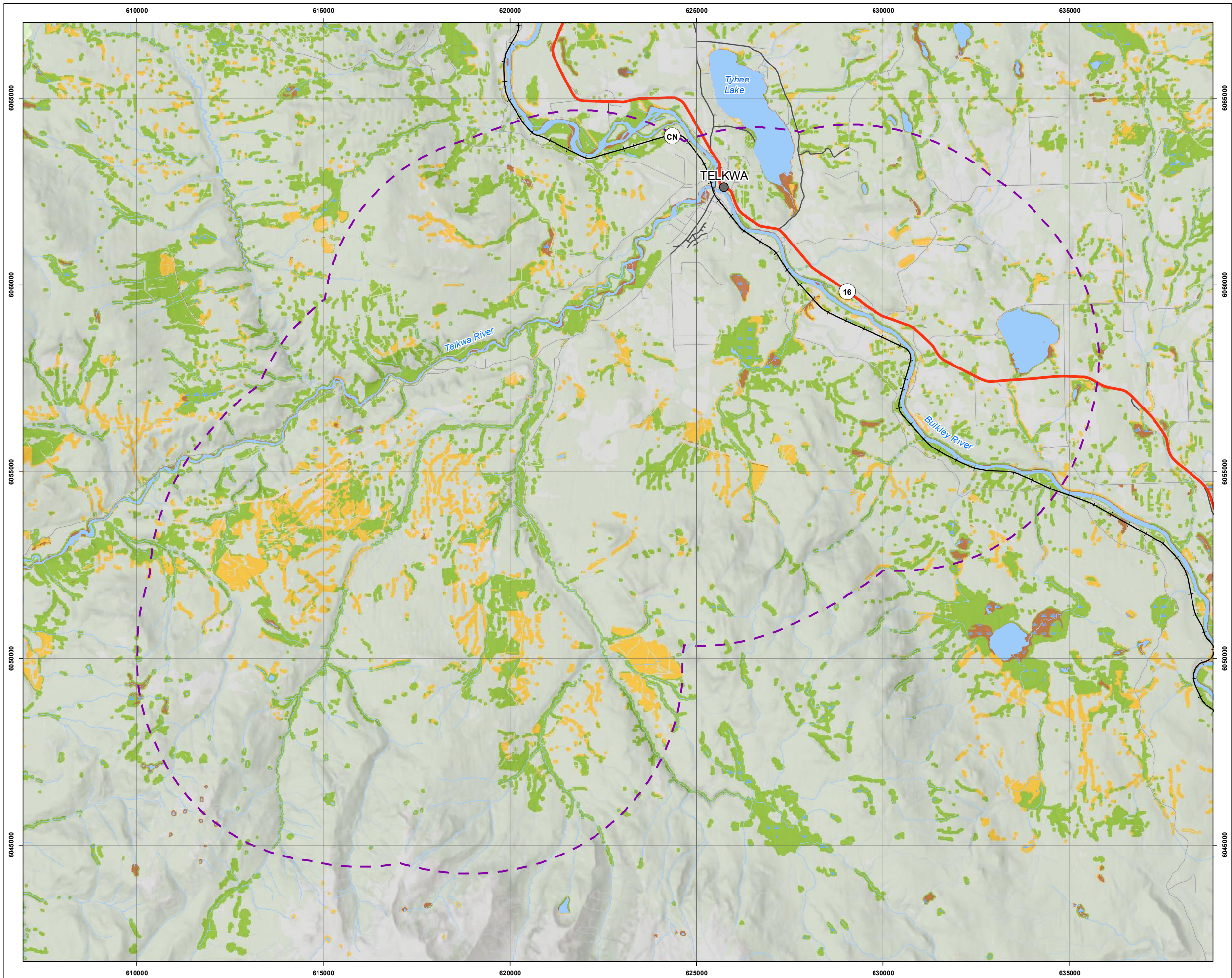
Page Size: 11" x 17"

Project No. Production Date: Aug 24, 2020 Figure 2



Appendix C **Wetland Habitat Suitability Mapping**

P:\HLS\PROJECTS\2018\18P0421_Tenas_Mine\Map\Map\Primar_Reporting\Labels_Suitability_Map\18P0421_habitat_suitability_LSA_MBB_Vetland_20200821.mxd



Tenas Project

Wetlands/Riparian Habitat within the Wildlife LSA

Legend

General Wildlife LSA

Habitat Suitability

Wetland/Riparian

Riparian-Forest

Riparian-Open

Not Suitable

City/Town

Rail Line

Highway

Road

Resource Road

Watercourse

Wetland

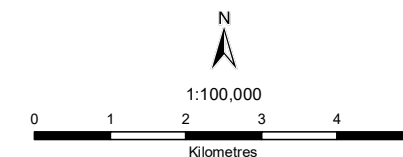
Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Map



NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

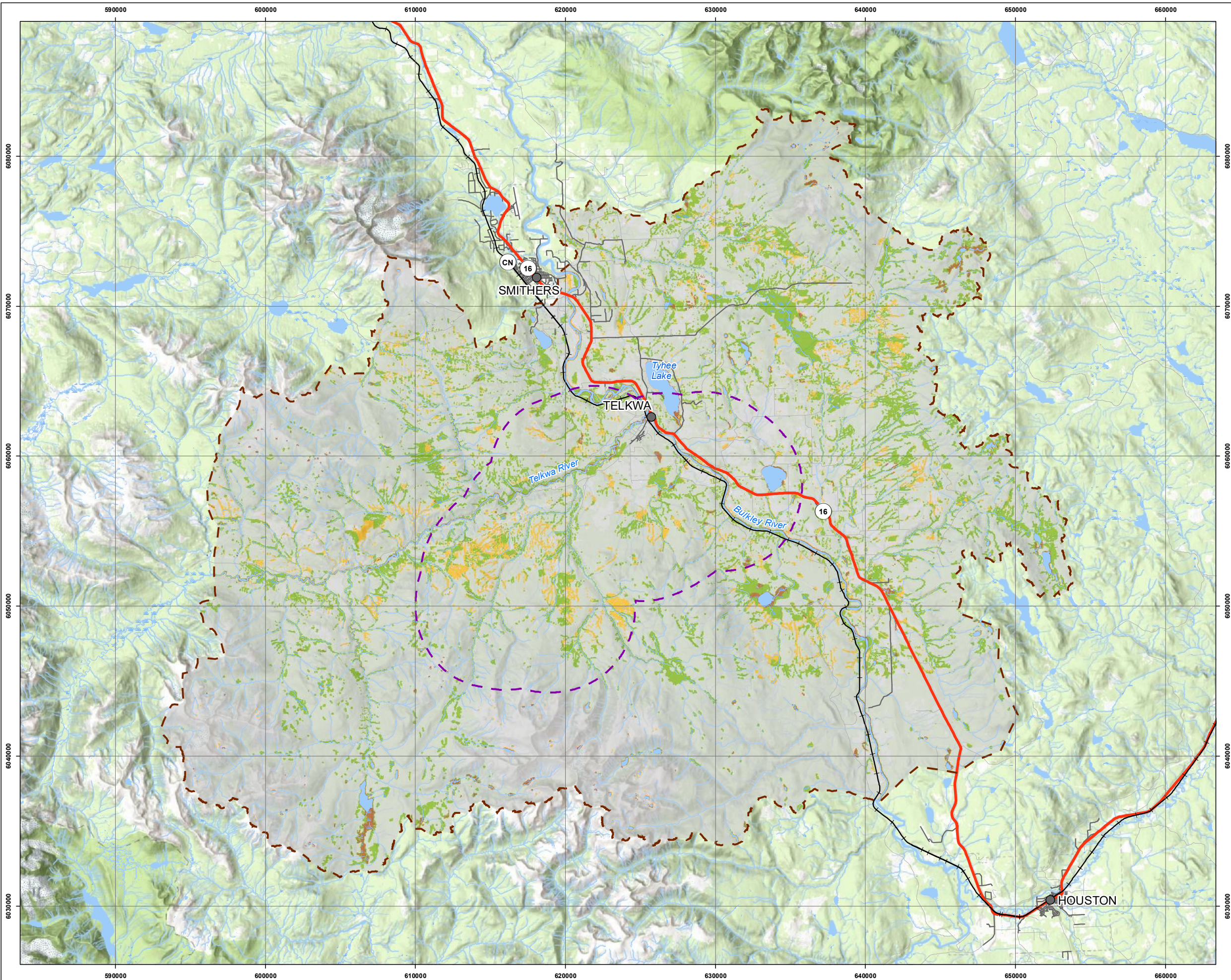
20Y0172

Production Date: Sep 04, 2020

Figure 1



P:\11. LIPROJECTS\2018\BP0421_Tenas_Mine\Map\Map\Reporting\Labels_Suitability_Map\180421_Tenas_Mine\habitat_suitability_RSA_MBB_Vetland_20200821.mxd



Tenas Project

Wetlands/Riparian Habitats
within the General Wildlife RSA

Legend

General Wildlife LSA

General Wildlife RSA

Habitat Suitability

Wetland/Riparian

Riparian-Forest

Riparian-Open

Not Suitable

City/Town

Rail Line

Highway

Road

Resource Road

Watercourse

Wetland

Waterbody

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020

- Basedata: Government of British Columbia

- Basemap: World Topo Base

1:250,000

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

Project No.	Production Date: Aug 28, 2020	Figure 2
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Appendix D Density and Abundance Estimates for Individual Species by Habitats and Biogeoclimatic Subzones

Density and Abundance of Species in Open Habitat by BGC Subzone.

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
ESSFmc	American Three-toed Woodpecker	1	0.11	176.28
ESSFmc	Black-capped Chickadee	1	0.11	176.28
ESSFmc	Blackpoll Warbler	1	0.11	176.28
ESSFmc	Dark-eyed Junco	11	1.21	1939.05
ESSFmc	Gray Jay	3	0.33	528.83
ESSFmc	Hermit Thrush	2	0.22	352.55
ESSFmc	Olive-sided Flycatcher	1	0.11	176.28
ESSFmc	Orange-crowned Warbler	2	0.22	352.55
ESSFmc	Red-breasted Sapsucker	1	0.11	176.28
ESSFmc	Rufous Hummingbird	1	0.11	176.28
ESSFmc	Swainson's Thrush	11	1.21	1939.05
ESSFmc	Varied Thrush	3	0.33	528.83
ESSFmc	Wilson's Warbler	2	0.22	352.55
ESSFmc	Yellow Warbler	2	0.22	352.55
ESSFmc	Yellow-rumped Warbler	1	0.11	176.28
SBSdk	Alder Flycatcher	1	0.02	336.56
SBSdk	American Crow	5	0.11	1682.82
SBSdk	American Redstart	8	0.18	2692.50
SBSdk	American Robin	17	0.38	5721.57
SBSdk	Bald Eagle	1	0.02	336.56
SBSdk	Barn Swallow	8	0.18	2692.50
SBSdk	Black-capped Chickadee	9	0.20	3029.07
SBSdk	Cassin's Vireo	1	0.02	336.56
SBSdk	Chipping Sparrow	9	0.20	3029.07
SBSdk	Clay-colored Sparrow	4	0.09	1346.25
SBSdk	Common Raven	6	0.13	2019.38
SBSdk	Common Yellowthroat	2	0.04	673.13
SBSdk	Dark-eyed Junco	9	0.20	3029.07
SBSdk	Dusky Flycatcher	5	0.11	1682.82
SBSdk	Eastern Kingbird	4	0.09	1346.25
SBSdk	Hairy Woodpecker	2	0.04	673.13
SBSdk	Killdeer	2	0.04	673.13
SBSdk	Least Flycatcher	6	0.13	2019.38
SBSdk	Lincoln's Sparrow	11	0.24	3702.19
SBSdk	MacGillivray's Warbler	3	0.07	1009.69
SBSdk	Mallard	1	0.02	336.56

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	Mountain Bluebird	1	0.02	336.56
SBSdk	Northern Flicker	2	0.04	673.13
SBSdk	Northern Waterthrush	7	0.15	2355.94
SBSdk	Olive-sided Flycatcher	2	0.04	673.13
SBSdk	Orange-crowned Warbler	2	0.04	673.13
SBSdk	Peregrine Falcon	1	0.02	336.56
SBSdk	Pine Siskin	14	0.31	4711.88
SBSdk	Red-breasted Nuthatch	1	0.02	336.56
SBSdk	Red-breasted Sapsucker	2	0.04	673.13
SBSdk	Red-tailed Hawk	1	0.02	336.56
SBSdk	Red-winged Blackbird	1	0.02	336.56
SBSdk	Ruby-crowned Kinglet	3	0.07	1009.69
SBSdk	Ruffed Grouse	1	0.02	336.56
SBSdk	Rufous Hummingbird	6	0.13	2019.38
SBSdk	Savannah Sparrow	12	0.27	4038.76
SBSdk	Song Sparrow	5	0.11	1682.82
SBSdk	Swainson's Thrush	5	0.11	1682.82
SBSdk	Tennessee Warbler	1	0.02	336.56
SBSdk	Tree Swallow	11	0.24	3702.19
SBSdk	Violet-green Swallow	2	0.04	673.13
SBSdk	Warbling Vireo	19	0.42	6394.70
SBSdk	Western Tanager	2	0.04	673.13
SBSdk	Western Wood-Pewee	7	0.15	2355.94
SBSdk	White-crowned Sparrow	5	0.11	1682.82
SBSdk	White-throated Sparrow	1	0.02	336.56
SBSdk	Wilson's Snipe	3	0.07	1009.69
SBSdk	Yellow-rumped Warbler	3	0.07	1009.69
SBSmc2	Alder Flycatcher	14	0.17	2086.67
SBSmc2	American Crow	2	0.02	298.10
SBSmc2	American Redstart	17	0.20	2533.81
SBSmc2	American Robin	25	0.30	3726.20
SBSmc2	American Three-toed Woodpecker	1	0.01	149.05
SBSmc2	Black-capped Chickadee	7	0.08	1043.34
SBSmc2	Blackpoll Warbler	3	0.04	447.14
SBSmc2	Cedar Waxwing	2	0.02	298.10
SBSmc2	Chestnut-backed Chickadee	1	0.01	149.05
SBSmc2	Chipping Sparrow	11	0.13	1639.53

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSmc2	Clay-colored Sparrow	1	0.01	149.05
SBSmc2	Common Raven	2	0.02	298.10
SBSmc2	Common Yellowthroat	1	0.01	149.05
SBSmc2	Dark-eyed Junco	70	0.83	10433.35
SBSmc2	Dusky Flycatcher	2	0.02	298.10
SBSmc2	Golden-crowned Kinglet	1	0.01	149.05
SBSmc2	Gray Jay	3	0.04	447.14
SBSmc2	Hairy Woodpecker	3	0.04	447.14
SBSmc2	Hammond's Flycatcher	1	0.01	149.05
SBSmc2	Hermit Thrush	7	0.08	1043.34
SBSmc2	Least Flycatcher	2	0.02	298.10
SBSmc2	Lincoln's Sparrow	11	0.13	1639.53
SBSmc2	MacGillivray's Warbler	5	0.06	745.24
SBSmc2	Magnolia Warbler	3	0.04	447.14
SBSmc2	Mountain Chickadee	1	0.01	149.05
SBSmc2	Northern Flicker	2	0.02	298.10
SBSmc2	Olive-sided Flycatcher	1	0.01	149.05
SBSmc2	Orange-crowned Warbler	24	0.29	3577.15
SBSmc2	Pacific Wren	1	0.01	149.05
SBSmc2	Pacific-slope Flycatcher	1	0.01	149.05
SBSmc2	Pine Grosbeak	1	0.01	149.05
SBSmc2	Pine Siskin	20	0.24	2980.96
SBSmc2	Purple Finch	1	0.01	149.05
SBSmc2	Red Crossbill	3	0.04	447.14
SBSmc2	Red-breasted Nuthatch	5	0.06	745.24
SBSmc2	Ruby-crowned Kinglet	13	0.15	1937.62
SBSmc2	Ruffed Grouse	1	0.01	149.05
SBSmc2	Rufous Hummingbird	6	0.07	894.29
SBSmc2	Song Sparrow	4	0.05	596.19
SBSmc2	Steller's Jay	1	0.01	149.05
SBSmc2	Swainson's Thrush	57	0.68	8495.73
SBSmc2	Tennessee Warbler	7	0.08	1043.34
SBSmc2	Townsend's Warbler	2	0.02	298.10
SBSmc2	Varied Thrush	34	0.40	5067.63
SBSmc2	Warbling Vireo	29	0.34	4322.39
SBSmc2	Western Tanager	2	0.02	298.10
SBSmc2	Western Wood-Pewee	8	0.10	1192.38

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSmc2	White-throated Sparrow	1	0.01	149.05
SBSmc2	Wilson's Snipe	2	0.02	298.10
SBSmc2	Wilson's Warbler	12	0.14	1788.57
SBSmc2	Yellow Warbler	3	0.04	447.14
SBSmc2	Yellow-bellied Flycatcher	3	0.04	447.14
SBSmc2	Yellow-rumped Warbler	18	0.21	2682.86

Density and Abundance of Species in Forest Habitat by BGC Subzone.

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
ESSFmc	American Redstart	2	0.32	10476.68
ESSFmc	American Robin	2	0.32	10476.68
ESSFmc	American Three-toed Woodpecker	1	0.16	5238.34
ESSFmc	Brown Creeper	2	0.32	10476.68
ESSFmc	Dark-eyed Junco	2	0.32	10476.68
ESSFmc	Golden-crowned Kinglet	4	0.64	20953.36
ESSFmc	Gray Jay	2	0.32	10476.68
ESSFmc	Hairy Woodpecker	1	0.16	5238.34
ESSFmc	Red-breasted Nuthatch	1	0.16	5238.34
ESSFmc	Red-breasted Sapsucker	1	0.16	5238.34
ESSFmc	Swainson's Thrush	3	0.48	15715.02
ESSFmc	Townsend's Warbler	1	0.16	5238.34
ESSFmc	Varied Thrush	2	0.32	10476.68
ESSFmc	Western Wood-pewee	1	0.16	5238.34
ESSFmc	Yellow-rumped Warbler	1	0.16	5238.34
SBSdk	Alder Flycatcher	3	0.02	551.71
SBSdk	American Crow	14	0.12	2574.63
SBSdk	American Kestrel	1	0.01	183.90
SBSdk	American Redstart	85	0.71	15631.70
SBSdk	American Robin	39	0.32	7172.19
SBSdk	American Three-toed Woodpecker	2	0.02	367.80
SBSdk	Barrow's Goldeneye	1	0.01	183.90
SBSdk	Black-billed Magpie	3	0.02	551.71
SBSdk	Black-capped Chickadee	37	0.31	6804.39
SBSdk	Blackpoll Warbler	1	0.01	183.90
SBSdk	Cassin's Vireo	4	0.03	735.61
SBSdk	Cedar Waxwing	9	0.07	1655.12
SBSdk	Chestnut-backed Chickadee	2	0.02	367.80
SBSdk	Chipping Sparrow	8	0.07	1471.22
SBSdk	Common Raven	5	0.04	919.51
SBSdk	Common Yellowthroat	2	0.02	367.80
SBSdk	Dark-eyed Junco	40	0.33	7356.09
SBSdk	Dusky Flycatcher	20	0.17	3678.05
SBSdk	Golden-crowned Kinglet	17	0.14	3126.34
SBSdk	Golden-crowned Sparrow	1	0.01	183.90
SBSdk	Hairy Woodpecker	4	0.03	735.61

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	Hammond's Flycatcher	5	0.04	919.51
SBSdk	Hermit Thrush	5	0.04	919.51
SBSdk	Killdeer	3	0.02	551.71
SBSdk	Lazuli Bunting	6	0.05	1103.41
SBSdk	Least Flycatcher	7	0.06	1287.32
SBSdk	Lincoln's Sparrow	9	0.07	1655.12
SBSdk	MacGillivray's Warbler	26	0.22	4781.46
SBSdk	Magnolia Warbler	15	0.12	2758.54
SBSdk	Mountain Chickadee	1	0.01	183.90
SBSdk	Northern Flicker	4	0.03	735.61
SBSdk	Northern Waterthrush	9	0.07	1655.12
SBSdk	Olive-sided Flycatcher	4	0.03	735.61
SBSdk	Orange-crowned Warbler	13	0.11	2390.73
SBSdk	Pacific Wren	2	0.02	367.80
SBSdk	Pacific-slope Flycatcher	2	0.02	367.80
SBSdk	Pine Siskin	15	0.12	2758.54
SBSdk	Purple Finch	8	0.07	1471.22
SBSdk	Red-breasted Nuthatch	7	0.06	1287.32
SBSdk	Red-breasted Sapsucker	7	0.06	1287.32
SBSdk	Red-tailed Hawk	1	0.01	183.90
SBSdk	Red-winged Blackbird	1	0.01	183.90
SBSdk	Ruby-crowned Kinglet	18	0.15	3310.24
SBSdk	Ruffed Grouse	4	0.03	735.61
SBSdk	Rufous Hummingbird	9	0.07	1655.12
SBSdk	Savannah Sparrow	3	0.02	551.71
SBSdk	Song Sparrow	16	0.13	2942.44
SBSdk	Swainson's Thrush	82	0.68	15079.99
SBSdk	Tennessee Warbler	3	0.02	551.71
SBSdk	Townsend's Warbler	7	0.06	1287.32
SBSdk	Tree Swallow	21	0.17	3861.95
SBSdk	Varied Thrush	1	0.01	183.90
SBSdk	Violet-green Swallow	2	0.02	367.80
SBSdk	Warbling Vireo	36	0.30	6620.48
SBSdk	Western Tanager	7	0.06	1287.32
SBSdk	Western Wood-Pewee	12	0.10	2206.83
SBSdk	White-throated Sparrow	4	0.03	735.61
SBSdk	Wilson's Snipe	6	0.05	1103.41

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	Wilson's Warbler	6	0.05	1103.41
SBSdk	Yellow Warbler	5	0.04	919.51
SBSdk	Yellow-rumped Warbler	14	0.12	2574.63
SBSmc2	Alder Flycatcher	3	0.03	1048.44
SBSmc2	American Crow	1	0.01	349.48
SBSmc2	American Redstart	15	0.16	5242.18
SBSmc2	American Robin	23	0.24	8038.01
SBSmc2	American Three-toed Woodpecker	7	0.07	2446.35
SBSmc2	Black-backed Woodpecker	2	0.02	698.96
SBSmc2	Black-capped Chickadee	8	0.08	2795.83
SBSmc2	Boreal Chickadee	2	0.02	698.96
SBSmc2	Cassin's Vireo	1	0.01	349.48
SBSmc2	Chipping Sparrow	8	0.08	2795.83
SBSmc2	Common Loon	1	0.01	349.48
SBSmc2	Common Raven	1	0.01	349.48
SBSmc2	Common Yellowthroat	1	0.01	349.48
SBSmc2	Dark-eyed Junco	30	0.32	10484.35
SBSmc2	Dusky Flycatcher	1	0.01	349.48
SBSmc2	Golden-crowned Kinglet	24	0.25	8387.48
SBSmc2	Gray Jay	6	0.06	2096.87
SBSmc2	Hairy Woodpecker	4	0.04	1397.91
SBSmc2	Hermit Thrush	1	0.01	349.48
SBSmc2	Least Flycatcher	2	0.02	698.96
SBSmc2	Lincoln's Sparrow	5	0.05	1747.39
SBSmc2	MacGillivray's Warbler	3	0.03	1048.44
SBSmc2	Magnolia Warbler	6	0.06	2096.87
SBSmc2	Mountain Chickadee	8	0.08	2795.83
SBSmc2	Northern Flicker	3	0.03	1048.44
SBSmc2	Northern Waterthrush	2	0.02	698.96
SBSmc2	Olive-sided Flycatcher	3	0.03	1048.44
SBSmc2	Orange-crowned Warbler	9	0.09	3145.31
SBSmc2	Pacific Wren	8	0.08	2795.83
SBSmc2	Pacific-slope Flycatcher	1	0.01	349.48
SBSmc2	Pine Grosbeak	1	0.01	349.48
SBSmc2	Pine Siskin	34	0.36	11882.27
SBSmc2	Purple Finch	5	0.05	1747.39
SBSmc2	Red-breasted Nuthatch	22	0.23	7688.53

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSmc2	Red-breasted Sapsucker	1	0.01	349.48
SBSmc2	Ruby-crowned Kinglet	17	0.18	5941.13
SBSmc2	Ruffed Grouse	1	0.01	349.48
SBSmc2	Rufous Hummingbird	1	0.01	349.48
SBSmc2	Swainson's Thrush	62	0.65	21667.67
SBSmc2	Tennessee Warbler	2	0.02	698.96
SBSmc2	Townsend's Warbler	26	0.27	9086.44
SBSmc2	Varied Thrush	39	0.41	13629.66
SBSmc2	Warbling Vireo	8	0.08	2795.83
SBSmc2	Western Tanager	2	0.02	698.96
SBSmc2	Western Wood-Pewee	4	0.04	1397.91
SBSmc2	White-throated Sparrow	1	0.01	349.48
SBSmc2	White-winged Crossbill	1	0.01	349.48
SBSmc2	Wilson's Snipe	2	0.02	698.96
SBSmc2	Wilson's Warbler	9	0.09	3145.31
SBSmc2	Yellow Warbler	1	0.01	349.48
SBSmc2	Yellow-bellied Flycatcher	1	0.01	349.48
SBSmc2	Yellow-rumped Warbler	15	0.16	5242.18

Density and Abundance of Species in Riparian-Forest Habitat by BGC Subzone.

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	Alder Flycatcher	1	0.02	158.08
SBSdk	American Crow	2	0.04	316.17
SBSdk	American Redstart	36	0.69	5690.99
SBSdk	American Robin	15	0.29	2371.25
SBSdk	American Three-toed Woodpecker	1	0.02	158.08
SBSdk	Black-capped Chickadee	23	0.44	3635.91
SBSdk	Brewer's Blackbird	1	0.02	158.08
SBSdk	Brown-headed Cowbird	1	0.02	158.08
SBSdk	Canada Goose	10	0.19	1580.83
SBSdk	Cassin's Vireo	3	0.06	474.25
SBSdk	Cedar Waxwing	5	0.10	790.42
SBSdk	Chipping Sparrow	2	0.04	316.17
SBSdk	Cliff Swallow	3	0.06	474.25
SBSdk	Common Raven	5	0.10	790.42
SBSdk	Common Yellowthroat	3	0.06	474.25
SBSdk	Dark-eyed Junco	28	0.53	4426.33
SBSdk	Dusky Flycatcher	6	0.11	948.50
SBSdk	Eared Grebe	8	0.15	1264.66
SBSdk	Eastern Kingbird	8	0.15	1264.66
SBSdk	Golden-crowned Kinglet	3	0.06	474.25
SBSdk	Golden-crowned Sparrow	1	0.02	158.08
SBSdk	Hairy Woodpecker	1	0.02	158.08
SBSdk	Hammond's Flycatcher	3	0.06	474.25
SBSdk	Hermit Thrush	3	0.06	474.25
SBSdk	Least Flycatcher	11	0.21	1738.91
SBSdk	Lincoln's Sparrow	3	0.06	474.25
SBSdk	MacGillivray's Warbler	9	0.17	1422.75
SBSdk	Magnolia Warbler	6	0.11	948.50
SBSdk	Northern Flicker	1	0.02	158.08
SBSdk	Northern Pygmy-Owl	1	0.02	158.08
SBSdk	Northern Waterthrush	6	0.11	948.50
SBSdk	Olive-sided Flycatcher	2	0.04	316.17
SBSdk	Orange-crowned Warbler	4	0.08	632.33
SBSdk	Pine Siskin	11	0.21	1738.91
SBSdk	Red-breasted Nuthatch	6	0.11	948.50
SBSdk	Red-breasted Sapsucker	7	0.13	1106.58

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	Red-tailed Hawk	1	0.02	158.08
SBSdk	Red-winged Blackbird	9	0.17	1422.75
SBSdk	Ring-necked Duck	1	0.02	158.08
SBSdk	Ruby-crowned Kinglet	3	0.06	474.25
SBSdk	Ruffed Grouse	1	0.02	158.08
SBSdk	Rufous Hummingbird	2	0.04	316.17
SBSdk	Savannah Sparrow	2	0.04	316.17
SBSdk	Song Sparrow	4	0.08	632.33
SBSdk	Swainson's Thrush	32	0.61	5058.66
SBSdk	Tennessee Warbler	5	0.10	790.42
SBSdk	Tree Swallow	6	0.11	948.50
SBSdk	Varied Thrush	3	0.06	474.25
SBSdk	Violet-green Swallow	2	0.04	316.17
SBSdk	Warbling Vireo	17	0.32	2687.41
SBSdk	Western Tanager	4	0.08	632.33
SBSdk	Western Wood-Pewee	6	0.11	948.50
SBSdk	White-crowned Sparrow	2	0.04	316.17
SBSdk	White-throated Sparrow	4	0.08	632.33
SBSdk	Wilson's Warbler	6	0.11	948.50
SBSdk	Yellow Warbler	3	0.06	474.25
SBSdk	Yellow-rumped Warbler	2	0.04	316.17
SBSmc2	American Redstart	2	0.08	982.60
SBSmc2	American Robin	1	0.04	491.30
SBSmc2	Barn Swallow	4	0.17	1965.19
SBSmc2	Black-capped Chickadee	3	0.13	1473.89
SBSmc2	Brown Creeper	1	0.04	491.30
SBSmc2	Canada Goose	2	0.08	982.60
SBSmc2	Dark-eyed Junco	3	0.13	1473.89
SBSmc2	Golden-crowned Kinglet	5	0.21	2456.49
SBSmc2	Magnolia Warbler	1	0.04	491.30
SBSmc2	Northern Flicker	1	0.04	491.30
SBSmc2	Northern Waterthrush	1	0.04	491.30
SBSmc2	Olive-sided Flycatcher	1	0.04	491.30
SBSmc2	Pacific Wren	2	0.08	982.60
SBSmc2	Pine Siskin	1	0.04	491.30
SBSmc2	Purple Finch	1	0.04	491.30
SBSmc2	Red-breasted Nuthatch	6	0.25	2947.79

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSmc2	Ruby-crowned Kinglet	5	0.21	2456.49
SBSmc2	Rufous Hummingbird	1	0.04	491.30
SBSmc2	Song Sparrow	1	0.04	491.30
SBSmc2	Swainson's Thrush	4	0.17	1965.19
SBSmc2	Tennessee Warbler	1	0.04	491.30
SBSmc2	Townsend's Warbler	5	0.21	2456.49
SBSmc2	Varied Thrush	11	0.46	5404.27
SBSmc2	Warbling Vireo	2	0.08	982.60
SBSmc2	Western Tanager	1	0.04	491.30
SBSmc2	Western Wood-pewee	1	0.04	491.30
SBSmc2	Wilson's Warbler	1	0.04	491.30
SBSmc2	Yellow Warbler	2	0.08	982.60
SBSmc2	Yellow-rumped Warbler	2	0.08	982.60

Density and Abundance of Species in Riparian-Open Habitat by BGC Subzone.

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSdk	American Crow	1	0.09	180.21
SBSdk	American Redstart	1	0.09	180.21
SBSdk	American Robin	7	0.66	1261.50
SBSdk	Cassin's Vireo	1	0.09	180.21
SBSdk	Common Yellowthroat	2	0.19	360.43
SBSdk	Dark-eyed Junco	2	0.19	360.43
SBSdk	Dusky Flycatcher	1	0.09	180.21
SBSdk	Lincoln's Sparrow	1	0.09	180.21
SBSdk	Northern Waterthrush	1	0.09	180.21
SBSdk	Pacific Wren	2	0.19	360.43
SBSdk	Pacific-slope Flycatcher	1	0.09	180.21
SBSdk	Red-breasted Sapsucker	1	0.09	180.21
SBSdk	Ruby-crowned Kinglet	1	0.09	180.21
SBSdk	Rufous Hummingbird	1	0.09	180.21
SBSdk	Song Sparrow	1	0.09	180.21
SBSdk	Swainson's Thrush	5	0.47	901.07
SBSdk	Warbling Vireo	2	0.19	360.43
SBSdk	Western Tanager	1	0.09	180.21
SBSdk	Western Wood-pewee	1	0.09	180.21
SBSdk	White-throated Sparrow	1	0.09	180.21
SBSdk	Yellow Warbler	1	0.09	180.21
SBSmc2	American Redstart	3	0.11	406.24
SBSmc2	American Robin	4	0.15	541.66
SBSmc2	Black-capped Chickadee	9	0.33	1218.72
SBSmc2	Chipping Sparrow	1	0.04	135.41
SBSmc2	Common Raven	1	0.04	135.41
SBSmc2	Common Yellowthroat	1	0.04	135.41
SBSmc2	Dark-eyed Junco	8	0.30	1083.31
SBSmc2	Least Flycatcher	2	0.07	270.83
SBSmc2	MacGillivray's Warbler	2	0.07	270.83
SBSmc2	Magnolia Warbler	2	0.07	270.83
SBSmc2	Northern Flicker	1	0.04	135.41
SBSmc2	Northern Waterthrush	1	0.04	135.41
SBSmc2	Orange-crowned Warbler	2	0.07	270.83
SBSmc2	Pacific Wren	1	0.04	135.41
SBSmc2	Pine Siskin	1	0.04	135.41

BGC Subzone	Species	Sum of Detected Individuals	Density	Abundance
SBSmc2	Red-breasted Nuthatch	1	0.04	135.41
SBSmc2	Ruby-crowned Kinglet	2	0.07	270.83
SBSmc2	Ruffed Grouse	2	0.07	270.83
SBSmc2	Swainson's Thrush	15	0.56	2031.21
SBSmc2	Tennessee Warbler	2	0.07	270.83
SBSmc2	Varied Thrush	6	0.22	812.48
SBSmc2	Warbling Vireo	6	0.22	812.48
SBSmc2	Western Tanager	1	0.04	135.41
SBSmc2	Wilson's Warbler	3	0.11	406.24
SBSmc2	Yellow Warbler	2	0.07	270.83
SBSmc2	Yellow-rumped Warbler	8	0.30	1083.31

Appendix F Qualitative Habitat Assessments for Bank Swallow, Barn Swallow, Black Swift and Rusty Blackbird

Bank Swallow

The bank swallow (*Riparia riparia*) is a colonial landbird with a Holarctic breeding distribution (Garrison 1999). In North America, the species breeds from the northern boreal forest south to the Gulf of Mexico, including in all Canadian provinces and territories except Nunavut, and winters primarily in South America with a few populations wintering on the Pacific side of southern Mexico and in Central America (Garrison 1999, COSEWIC 2013, Howie 2015). The bank swallow is listed as Threatened under Schedule 1 of SARA and COSEWIC and is yellow-listed in BC (B.C. Conservation Data Centre 2019). A 98% population decline in Canada over a 40-year period from 1970 to 2011 resulted in its current listing under SARA (COSEWIC 2013). The causes of this severe population decline are poorly understood, but the cumulative effects of multiple threats are likely responsible (COSEWIC 2013). The main suspected threats include nesting and foraging habitat loss due to erosion control, flood control, and land conversion for agricultural purposes, nest destruction during aggregate extraction activities, collisions with vehicles, pesticide use affecting insect prey abundance, and climate change (COSEWIC 2013).

Bank swallows have a patchy distribution across BC east of the Coast Mountains that is weighted strongly towards the southern interior and boreal plains (Campbell et al. 1997, Howie 2015). They are most commonly found at lower elevations between 250 and 500 m, although they have been recorded to at least 1,500 m elevation (Campbell et al. 1997, Howie 2015). Bank swallows have been observed in most biogeoclimatic (BGC) zones below 1,200 m elevation. Bank swallows typically arrive in the BC interior in April or May depending on latitude and breed throughout the summer before migrating south in August or September (Campbell et al. 1997).

Bank swallows utilize both natural and man-made habitats for nesting, and sites are typically steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows (COSEWIC 2013, Howie 2015). Nesting areas are often adjacent to lowland (i.e., $\leq 1,250$ m) slow-moving or still waterbodies (e.g., low gradient rivers, lakes), although this may be due to the role these waterbodies play in soil deposition or erosion (Garrison 1999, Howie 2015). Foraging habitats during the breeding season include a variety of open habitats such as lakes and ponds, rivers, wetlands, grasslands, and agricultural areas; however, open forest is also occasionally used (Garrison 1999, COSEWIC 2013).

The steep sand, silt, or clay embankments selected for nesting by bank swallows are frequently subject to erosion or slumping and as such, the location of nesting colonies can be highly ephemeral (Garrison 1999, COSEWIC 2013). Furthermore, suitable habitats often occur in small patches at a finer scale than can be assessed through regional-level habitat modelling. Consequently, a qualitative assessment was used to identify potential nesting areas within the Wildlife LSA. The assessment used aerial imagery and data collected during baseline field surveys to assess for nesting habitat characterized by steep embankments with a sand, silt, or clay substrate.

Potential nesting habitat for bank swallows was identified at several locations in the Wildlife LSA including along sections of the Bulkley and Telkwa rivers, and Goathorn and Tenas creeks. Specific locations near the proposed Project Area included banks along the Bulkley River near the rail loadout, along Goathorn Creek near the pipeline and haul road, and along Tenas Creek near the NAG pile; however substrate material along the Tenas Creek may not be suitable for nesting. Bank swallows were not detected directly or incidentally during baseline field surveys; however, they have previously been detected during the breeding season within the Generalized Wildlife RSA (Howie 2015, eBird 2019).

Barn Swallow

The barn swallow (*Hirundo rustica*) is a colonial landbird found on every continent except Antarctica (COSEWIC 2011, Brown and Brown 2019). The species breeds throughout North America south of the treeline down into central Mexico, including in all Canadian provinces and territories, and winters in Central and South America (COSEWIC 2011, Hearne 2015, Brown and Brown 2019). The barn swallow is listed as Threatened under Schedule 1 of SARA and COSEWIC and is blue-listed in BC (B.C.

Conservation Data Centre 2019). A 76% population decline in Canada over a 40-year period from 1970 to 2009 resulted in its current listing under SARA (COSEWIC 2011). Although the causes of this large population decline are poorly understood, the main suspected threats include nesting and foraging habitat loss due to land conversion for agricultural purposes, large-scale declines in insect populations, and direct and indirect mortality related to climate change and extreme weather events (COSEWIC 2011, Hearne 2015).

Barn swallows breed throughout BC in suitable habitats, including on Haida Gwaii and Vancouver Island (Campbell et al. 1997, B.C. Conservation Data Centre 2019, Brown and Brown 2019). They are most commonly found at lower elevations below 250 m, although they have been recorded to at least 2,400 m elevation, and are more common in coastal BGC zones compared to interior BGC zones (Campbell et al. 1997, Hearne 2015). They do not occur in high mountain, dense forest, or open ocean environments (Campbell et al. 1997). Barn swallows typically arrive in the BC interior in April or May depending on latitude and breed throughout the summer before migrating south in September or October (Campbell et al. 1997).

Barn swallow nest sites are located near water, mud, and foraging habitat, such as grasslands, agricultural areas and farmlands, shorelines, floodplains, wetlands, riparian areas, and cleared rights-of-way (Campbell et al. 1997, COSEWIC 2011, Hearne 2015, B.C. Conservation Data Centre 2019, Brown and Brown 2019). The nest site is typically located on a vertical or horizontal surface that is often enclosed with some form of cover directly overhead (COSEWIC 2011, B.C. Conservation Data Centre 2019, Brown and Brown 2019). Anthropogenic features such as barns, houses, and other buildings, bridges, wharfs, and large culverts are typically used; however prior to European settlement nests were located in caves, crevices, cliff ledges, and large hollow trees (COSEWIC 2011, Hearne 2015, B.C. Conservation Data Centre 2019). Barn swallows may re-use old nests and typically return to the same nesting area each year (Campbell et al. 1997, Hearne 2015, B.C. Conservation Data Centre 2019, Brown and Brown 2019).

A qualitative assessment was used to identify potential nesting areas for barn swallows within the Wildlife LSA due to the difficulty in mapping anthropogenic features used as nest sites. The assessment used aerial imagery and data collected during baseline field surveys to assess for potential nest sites (i.e., anthropogenic features) adjacent to potential open foraging habitat and water.

Potential nesting habitat for barn swallows was identified at several locations in the Wildlife LSA including in the agricultural areas around Highway 16, south of the Telkwa River, and east of Goathorn Creek; along the railway; adjacent to the Bulkley and Telkwa river in the northeast portion of the Wildlife LSA; and around the Village of Telkwa. Barn swallows were not detected directly or incidentally during baseline field surveys; however, they have previously been identified during the breeding season within the Generalized Wildlife RSA (Hearne 2015, eBird 2019).

Black Swift

The black swift (*Cypseloides niger*) is the largest and least studied swift species in North America (Lowther and Collins 2002, Boyd 2015, COSEWIC 2015). The species occurs only in the Americas with a breeding distribution that extends from southeastern Alaska down through the mountains of western North America to Costa Rica and the Caribbean; however, this is largely based on breeding season observations as few nests have been discovered (Lowther and Collins 2002, Boyd 2015, COSEWIC 2015, B.C. Conservation Data Centre 2019). According to limited data, the black swift appears to winter in northern and western South America and parts of the Caribbean (Lowther and Collins 2002, Boyd 2015, COSEWIC 2015, B.C. Conservation Data Centre 2019). The black swift is listed as Endangered under Schedule 1 of SARA and COSEWIC and is blue-listed in BC (B.C. Conservation Data Centre 2019). The Canadian population appears to have declined by >50% (perhaps as high as 89%) over a 40-year period from 1973 to 2012 (COSEWIC 2015). Although the causes of this large population decline are largely

unknown, the main suspected threats include changes in aerial insect food availability due to airborne pollutants and climate change (COSEWIC 2015).

Approximately 80% of the global population of black swifts occurs in Canada with the vast majority breeding in BC (COSEWIC 2015). Black swifts have been observed across BC during the breeding season, except for the far north and on Haida Gwaii (Boyd 2015, COSEWIC 2015). They are widely distributed across southern BC especially west of the Coast Ranges (Campbell et al. 1990). Black swifts occur from sea level to approximately 1,800 m elevation (Boyd 2015); however, they have been recorded up to 2,600 m elevation (Campbell et al. 1990). Black swifts typically arrive in the BC interior in May and breed throughout the summer before migrating south in August or September (Campbell et al. 1990).

Most of the black swift nests discovered in BC have been located on rock ledges behind montane waterfalls, although nests have also been located on ledges of steep rock faces, cliffs, and caves (Boyd 2015). Recent research demonstrates that black swifts have specific microclimate requirements for nest sites, with mean temperatures between 9.4°C and 13.4°C and relative humidity between 89.7% and 92.8% (Gunn et al. 2012). Black swifts are aerial insectivores. In fair weather, they frequently forage at high altitudes, up to 4,300 m; however, they have also been observed at lower altitudes, potentially due to stormy weather or insect concentrations, and they will forage over both forested and open habitats (e.g., wetlands, urban areas) (Knorr 1961, Lowther and Collins 2002, COSEWIC 2015).

Baseline surveys within the LSA did not identify any suitable nesting habitat for black swift. A review of aerial imagery within the Wildlife LSA also did not locate any potential nesting habitat characterized by waterfalls and streams flowing over steep cliffs or montane areas. It is expected that suitable habitat may be present in other parts of the RSA; however, within the LSA, suitable habitat appears to be absent.

Black swifts were not detected directly or incidentally during baseline field surveys; however, they have previously been identified during the breeding season within the Generalized Wildlife RSA near the south end of Tyhee Lake, approximately 4 km west of the Village of Telkwa adjacent to the Bulkley River, at the confluence of the Bulkley and Telkwa rivers, and near Smithers on the Bulkley River (Boyd 2015, eBird 2019).

Rusty Blackbird

The rusty blackbird (*Euphagus carolinus*) occurs only in the Americas with a breeding distribution that extends from the tree line south through Alaska and all Canadian provinces and territories down into the northeastern United States (Avery 2013, Di Corrado 2015, COSEWIC 2017). The species winters in eastern North America from the Great Lakes region down through the Southern Coastal Plains (Avery 2013, Di Corrado 2015, COSEWIC 2017). The rusty blackbird is listed as Special Concern under Schedule 1 of SARA and COSEWIC and is blue-listed in BC (B.C. Conservation Data Centre 2019).

According to Breeding Bird Survey and Christmas Bird Count data, the rusty blackbird appears to be one of the most rapidly declining bird species in Canada with a population decline of 85-90% since 1970 (COSEWIC 2017). Reasons for this significant population decline are likely most strongly correlated to changes in wintering areas, including habitat loss and degradation due to wetland conversion and damming activities, blackbird control programs in agricultural areas, and mortality caused by agricultural pesticides (COSEWIC 2017). Other factors contributing to the population decline include changes in breeding areas due to mercury contamination of wetlands, wetland acidification, and wetland degradation caused by climate change (COSEWIC 2017).

Approximately 87% of the global population of rusty blackbirds occurs in Canada (COSEWIC 2017).

Rusty blackbirds are widely distributed across central and northern BC east of the Coast Mountains with the main centres of abundance in the Nechako Plateau, Omineca, Skeena, and Cassiar mountains, and Fort Nelson lowlands (Di Corrado 2015). They are most commonly associated with the Sub-Boreal Spruce (SBS), Sub-Boreal Pine-Spruce (SBPS), and Boreal White and Black Spruce (BWBS) BGC zones in central and northern BC where they are typically found between 500 to 1,250 m elevation (Di Corrado

2015). A few breeding individuals have been recorded in the southern interior (Campbell et al. 2001, Di Corrado 2015). Rusty blackbirds typically arrive in the BC interior in April or May depending on latitude and breed throughout the summer before migrating south in July (Campbell et al. 2001).

Breeding habitat for rusty blackbirds is generally characterized by wet coniferous and mixed forests adjacent to wetlands, beaver ponds, and riparian areas along slow-moving streams and swampy lakeshores (Avery 2013, Di Corrado 2015, COSEWIC 2017). In BC, rusty blackbirds are typically found in shrubby wetlands, black spruce and tamarack bogs, muskegs, lake islands, and the flooded riparian edges alongside beaver ponds, swampy lakeshores, slow-moving streams, and river oxbows and back channels (Campbell et al. 2001, Avery 2013). The nest site is almost always located over or close to water (<75 m) and placed within 1 m of the ground in thickets of short coniferous or deciduous shrubs, both living and dead (Powell et al. 2010, Avery 2013).

The characteristics of the wetlands guild habitat model overlap with rusty blackbird breeding habitat, and as a result, this model was chosen to represent potential breeding habitat within the Wildlife LSA.

Rusty blackbirds were not detected directly or incidentally during baseline field surveys; however, they have previously been identified during the breeding season within the Generalized Wildlife RSA (Di Corrado 2015, eBird 2019).

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Appendix G Previously Detected Species Identified Through Desktop Review

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Alder Flycatcher	<i>Empidonax alnorum</i>	--	Yellow	--	--	--
American Bittern	<i>Botaurus lentiginosus</i>	X	Blue	--	--	--
American Coot	<i>Fulica americana</i>	--	Yellow	--	--	--
American Crow	<i>Corvus brachyrhynchos</i>	--	Yellow	--	--	--
American Dipper	<i>Cinclus mexicanus</i>	X	Yellow	--	--	--
American Kestrel	<i>Falco sparverius</i>	--	Yellow	--	--	--
American Pipit	<i>Anthus rubescens</i>	--	Yellow	--	--	--
American Redstart	<i>Setophaga ruticilla</i>	--	Yellow	--	--	--
American Robin	<i>Turdus migratorius</i>	--	Yellow	--	--	--
American Three-toed Woodpecker	<i>Picoides dorsalis</i>	--	Yellow	--	--	--
American Tree Sparrow	<i>Spizella arborea</i>	--	Yellow	--	--	--
American Wigeon	<i>Mareca americana</i>	X	Yellow	--	--	--
Baird's Sandpiper	<i>Calidris bairdii</i>	--	Yellow	--	--	--
Bald Eagle	<i>Haliaeetus leucocephalus</i>	--	Yellow	--	--	--
Bank Swallow	<i>Riparia riparia</i>	--	Yellow	--	Threatened	Threatened
Barn Swallow	<i>Hirundo rustica</i>	X	Blue	--	Threatened	Threatened
Barred Owl	<i>Strix varia</i>	--	Yellow	--	--	--
Barrow's Goldeneye	<i>Bucephala islandica</i>	X	Yellow	--	--	--
Belted Kingfisher	<i>Megasceryle alcyon</i>	--	Yellow	--	--	--
Black Swift	<i>Cypseloides niger</i>	X	Blue	--	Endangered	Endangered

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Black-backed Woodpecker	<i>Picoides arcticus</i>	--	Yellow	--	--	--
Black-billed Magpie	<i>Pica hudsonia</i>	--	Yellow	--	--	--
Black-capped Chickadee	<i>Poecile atricapillus</i>	--	Yellow	--	--	--
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	--	Yellow	--	--	--
Blackpoll Warbler	<i>Setophaga striata</i>	--	Yellow	--	--	--
Blue Jay	<i>Cyanocitta cristata</i>	--	Yellow	--	--	--
Blue-winged Teal	<i>Anas discors</i>	--	Yellow	--	--	--
Bohemian Waxwing	<i>Bombycilla garrulus</i>	--	Yellow	--	--	--
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>	--	Yellow	--	--	--
Boreal Chickadee	<i>Poecile hudsonicus</i>	--	Yellow	--	--	--
Boreal Owl	<i>Aegolius funereus</i>	--	Yellow	--	--	--
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	--	Yellow	--	--	--
Brown Creeper	<i>Certhia americana</i>	--	Yellow	--	--	--
Brown-headed Cowbird	<i>Molothrus ater</i>	--	Yellow	--	--	--
Bufflehead	<i>Bucephala albeola</i>	X	Yellow	--	--	--
California Gull	<i>Larus californicus</i>	X	Yellow	--	--	--
Calliope Hummingbird	<i>Selasphorus calliope</i>	X	Yellow	--	--	--
Canada Goose	<i>Branta canadensis</i>	X	Yellow	--	--	--
Canada Jay	<i>Perisoreus canadensis</i>	--	Yellow	--	--	--
Canvasback	<i>Aythya valisineria</i>	--	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Cassin's Vireo	<i>Vireo cassinii</i>	X	Yellow	--	--	--
Cedar Waxwing	<i>Bombycilla cedrorum</i>	--	Yellow	--	--	--
Chestnut-backed Chickadee	<i>Poecile rufescens</i>	--	Yellow	--	--	--
Chipping Sparrow	<i>Spizella passerina</i>	--	Yellow	--	--	--
Cinnamon Teal	<i>Anas cyanoptera</i>	X	Yellow	--	--	--
Clark's Nutcracker	<i>Nucifraga columbiana</i>	X	Yellow	--	--	--
Clay-colored Sparrow	<i>Spizella pallida</i>	--	Yellow	--	--	--
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	--	Yellow	--	--	--
Common Goldeneye	<i>Bucephala clangula</i>	--	Yellow	--	--	--
Common Loon	<i>Gavia immer</i>	X	Yellow	--	--	--
Common Merganser	<i>Mergus merganser</i>	--	Yellow	--	--	--
Common Nighthawk	<i>Chordeiles minor</i>	X	Yellow	--	Special Concern	Threatened
Common Raven	<i>Corvus corax</i>	--	Yellow	--	--	--
Common Redpoll	<i>Acanthis flammea</i>	--	Yellow	--	--	--
Common Tern	<i>Sterna hirundo</i>	--	Yellow	--	--	--
Common Yellowthroat	<i>Geothlypis trichas</i>	--	Yellow	--	--	--
Cooper's Hawk	<i>Accipiter cooperii</i>	--	Yellow	--	--	--
Dark-eyed Junco	<i>Junco hyemalis</i>	--	Yellow	--	--	--
Downy Woodpecker	<i>Picoides pubescens</i>	--	Yellow	--	--	--
Dusky Flycatcher	<i>Empidonax oberholseri</i>	X	Yellow	--	--	--
Dusky Grouse	<i>Dendragapus obscurus</i>	X	Yellow	--	--	--
Eared Grebe	<i>Podiceps nigricollis</i>	--	Blue	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Eastern Kingbird	<i>Tyrannus tyrannus</i>	--	Yellow	--	--	--
Eastern Phoebe	<i>Sayornis phoebe</i>	--	Yellow	--	--	--
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	--	Yellow	--	--	--
European Starling	<i>Sturnus vulgaris</i>	--	Yellow	--	--	--
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	X	Yellow	--	Special Concern	Special Concern
Fox Sparrow	<i>Passerella iliaca</i>	--	Yellow	--	--	--
Golden Eagle	<i>Aquila chrysaetos</i>	--	Yellow	--	--	--
Golden-crowned Kinglet	<i>Regulus satrapa</i>	X	Yellow	--	--	--
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>	--	Yellow	--	--	--
Gray-crowned Rosy-Finch	<i>Leucosticte tephrocotis</i>	--	Yellow	--	--	--
Great Blue Heron	<i>Ardea herodias</i>	X	Blue	Yes	Special Concern	Special Concern
Great Gray Owl	<i>Strix nebulosa</i>	--	Yellow	--	--	--
Great Horned Owl	<i>Bubo virginianus</i>	--	Yellow	--	--	--
Greater Scaup	<i>Aythya marila</i>	--	Yellow	--	--	--
Greater White-fronted Goose	<i>Anser albifrons</i>	--	Yellow	--	--	--
Greater Yellowlegs	<i>Tringa melanoleuca</i>	--	Yellow	--	--	--
Green-winged Teal	<i>Anas carolinensis</i>	--	Yellow	--	--	--
Hairy Woodpecker	<i>Leuconotopicus villosus</i>	--	Yellow	--	--	--
Hammond's Flycatcher	<i>Empidonax hammondi</i>	X	Yellow	--	--	--
Hermit Thrush	<i>Catharus guttatus</i>	--	Yellow	--	--	--
Herring Gull	<i>Larus argentatus</i>	--	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Hooded Merganser	<i>Lophodytes cucullatus</i>	X	Yellow	--	--	--
Horned Grebe	<i>Podiceps auritus</i>	X	Yellow	--	Special Concern	Special Concern
Horned Lark	<i>Eremophila alpestris</i>	X	Yellow	--	--	--
House Finch	<i>Haemorhous mexicanus</i>	--	Yellow	--	--	--
House Sparrow	<i>Passer domesticus</i>	--	Yellow	--	--	--
House Wren	<i>Troglodytes aedon</i>	--	Yellow	--	--	--
Killdeer	<i>Charadrius vociferus</i>	--	Yellow	--	--	--
Lapland Longspur	<i>Calcarius lapponicus</i>	--	Yellow	--	--	--
Lazuli Bunting	<i>Passerina amoena</i>	X	Yellow	--	--	--
Least Flycatcher	<i>Empidonax minimus</i>	--	Yellow	--	--	--
Least Sandpiper	<i>Calidris minutilla</i>	--	Yellow	--	--	--
Lesser Scaup	<i>Aythya affinis</i>	X	Yellow	--	--	--
Lesser Yellowlegs	<i>Tringa flavipes</i>	--	Yellow	--	--	--
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	--	Yellow	--	--	--
Long-billed Curlew	<i>Numenius americanus</i>	X	Blue	Yes	Special Concern	Special Concern
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	--	Yellow	--	--	--
Long-eared Owl	<i>Asio otus</i>	--	Yellow	--	--	--
Long-tailed Duck	<i>Clangula hyemalis</i>	--	Yellow	--	--	--
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	--	Yellow	--	--	--
Magnolia Warbler	<i>Setophaga magnolia</i>	--	Yellow	--	--	--
Mallard	<i>Anas platyrhynchos</i>	X	Yellow	--	--	--
Merlin	<i>Falco columbarius</i>	--	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Mew Gull	<i>Larus canus</i>	--	Yellow	--	--	--
Mountain Bluebird	<i>Sialia currucoides</i>	--	Yellow	--	--	--
Mountain Chickadee	<i>Poecile gambeli</i>	--	Yellow	--	--	--
Mourning Dove	<i>Zenaida macroura</i>	--	Yellow	--	--	--
Northern Flicker	<i>Colaptes auratus</i>	--	Yellow	--	--	--
Northern Goshawk	<i>Accipiter gentilis</i>	X	Blue (<i>atricapillus</i> subspecies)	--	Not at Risk	--
Northern Harrier	<i>Circus hudsonius</i>	X	Yellow	--	--	--
Northern Pintail	<i>Anas acuta</i>	--	Yellow	--	--	--
Northern Pygmy-Owl	<i>Glaucidium californicum</i>	X	Yellow	--	--	--
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	--	Yellow	--	--	--
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	X	Yellow	--	--	--
Northern Shoveler	<i>Spatula clypeata</i>	--	Yellow	--	--	--
Northern Shrike	<i>Lanius borealis</i>	--	Yellow	--	--	--
Northern Waterthrush	<i>Parkesia noveboracensis</i>	--	Yellow	--	--	--
Olive-sided Flycatcher	<i>Contopus cooperi</i>	X	Blue	--	Special Concern	Threatened
Orange-crowned Warbler	<i>Vermivora celata</i>	--	Yellow	--	--	--
Osprey	<i>Pandion haliaetus</i>	--	Yellow	--	--	--
Pacific Wren	<i>Troglodytes pacificus</i>	--	Yellow	--	--	--
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	--	Yellow	--	--	--
Pectoral Sandpiper	<i>Calidris melanotos</i>	--	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Peregrine Falcon, <i>anatum</i> subspecies	<i>Falco peregrinus anatum</i>	X	Red	--	Not at Risk	Special Concern
Pied-billed Grebe	<i>Podilymbus podiceps</i>	--	Yellow	--	--	--
Pileated Woodpecker	<i>Dryocopus pileatus</i>	--	Yellow	--	--	--
Pine Grosbeak	<i>Pinicola enucleator</i>	--	Yellow	--	--	--
Pine Siskin	<i>Spinus pinus</i>	X	Yellow	--	--	--
Purple Finch	<i>Haemorhous purpureus</i>	--	Yellow	--	--	--
Red Crossbill	<i>Loxia curvirostra</i>	X	Yellow	--	--	--
Red-breasted Nuthatch	<i>Sitta canadensis</i>	--	Yellow	--	--	--
Red-breasted Sapsucker	<i>Sphyrapicus ruber</i>	--	Yellow	--	--	--
Red-eyed Vireo	<i>Vireo olivaceus</i>	--	Yellow	--	--	--
Redhead	<i>Aythya americana</i>	--	Yellow	--	--	--
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	X	Yellow	--	--	--
Red-necked Grebe	<i>Podiceps grisegena</i>	--	Yellow	--	--	--
Red-tailed Hawk	<i>Buteo jamaicensis</i>	--	Yellow	--	--	--
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	--	Yellow	--	--	--
Ring-necked Duck	<i>Aythya collaris</i>	X	Yellow	--	--	--
Rock Pigeon	<i>Columba livia</i>	--	Yellow	--	--	--
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	--	Yellow	--	--	--
Rough-legged Hawk	<i>Buteo lagopus</i>	--	Yellow	--	--	--
Ruby-crowned Kinglet	<i>Regulus calendula</i>	--	Yellow	--	--	--
Ruffed Grouse	<i>Bonasa umbellus</i>	X	Yellow	--	--	--
Rufous Hummingbird	<i>Selasphorus rufus</i>	X	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Rusty Blackbird	<i>Selasphorus rufus</i>	X	Blue	--	Special Concern	Special Concern
Sandhill Crane	<i>Grus canadensis</i>	--	Yellow	Yes	Not At Risk	--
Savannah Sparrow	<i>Passerculus sandwichensis</i>	--	Yellow	--	--	--
Say's Phoebe	<i>Sayornis saya</i>	--	Yellow	--	--	--
Semipalmated Plover	<i>Charadrius semipalmatus</i>	--	Yellow	--	--	--
Sharp-shinned Hawk	<i>Accipiter striatus</i>	--	Yellow	--	--	--
Short-eared Owl	<i>Asio flammeus</i>	X	Blue	Yes	Special Concern	Special Concern
Snow Goose	<i>Chen caerulescens</i>	--	Yellow	--	--	--
Snowy Owl	<i>Bubo scandiacus</i>	--	Yellow	--	--	--
Solitary Sandpiper	<i>Tringa solitaria</i>	--	Yellow	--	--	--
Song Sparrow	<i>Melospiza melodia</i>	--	Yellow	--	--	--
Sooty Grouse	<i>Dendragapus fuliginosus</i>	--	Yellow	--	--	--
Sora	<i>Porzana carolina</i>	--	Yellow	--	--	--
Spotted Sandpiper	<i>Actitis macularius</i>	--	Yellow	--	--	--
Spruce Grouse	<i>Falcapennis canadensis</i>	--	Yellow	--	--	--
Steller's Jay	<i>Cyanocitta stelleri</i>	--	Yellow	--	--	--
Surf Scoter	<i>Melanitta perspicillata</i>	--	Yellow	--	--	--
Swainson's Hawk	<i>Buteo swainsoni</i>	X	Red	--	--	--
Swainson's Thrush	<i>Catharus ustulatus</i>	X	Yellow	--	--	--
Tennessee Warbler	<i>Leiothlypis peregrina</i>	--	Yellow	--	--	--
Townsend's Solitaire	<i>Myadestes townsendi</i>	X	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Townsend's Warbler	<i>Setophaga townsendi</i>	X	Yellow	--	--	--
Tree Swallow	<i>Tachycineta bicolor</i>	--	Yellow	--	--	--
Trumpeter Swan	<i>Cygnus buccinator</i>	X	Yellow	--	--	--
Turkey Vulture	<i>Cathartes aura</i>	--	Yellow	--	--	--
Varied Thrush	<i>Ixoreus naevius</i>	--	Yellow	--	--	--
Veery	<i>Catharus fuscescens</i>	--	Yellow	--	--	--
Violet-green Swallow	<i>Tachycineta thalassina</i>	--	Yellow	--	--	--
Warbling Vireo	<i>Vireo gilvus</i>	--	Yellow	--	--	--
Western Grebe	<i>Aechmophorus occidentalis</i>	X	Yellow	--	--	--
Western Kingbird	<i>Tyrannus verticalis</i>	--	Yellow	--	--	--
Western Meadowlark	<i>Sturnella neglecta</i>	--	Yellow	--	--	--
Western Tanager	<i>Piranga ludoviciana</i>	X	Yellow	--	--	--
Western Wood-Pewee	<i>Contopus sordidulus</i>	--	Yellow	--	--	--
White-breasted Nuthatch	<i>Sitta carolinensis</i>	--	Yellow	--	--	--
White-crowned Sparrow	<i>Zonotrichia albicollis</i>	--	Yellow	--	--	--
White-tailed Ptarmigan	<i>Lagopus leucura</i>	X	Yellow	--	--	--
White-throated Sparrow	<i>Zonotrichia albicollis</i>	--	Yellow	--	--	--
White-winged Crossbill	<i>Loxia leucoptera</i>	--	Yellow	--	--	--
White-winged Scoter	<i>Melanitta deglandi</i>	X	Yellow	--	--	--
Willow Ptarmigan	<i>Lagopus lagopus</i>	--	Yellow	--	--	--
Wilson's Snipe	<i>Gallinago delicata</i>	--	Yellow	--	--	--
Wilson's Warbler	<i>Cardellina pusilla</i>	--	Yellow	--	--	--

Common Name	Scientific Name	BCR 10 Priority Species ¹	Conservation Status			
			Provincial		Federal	
			BC CDC ²	FRPA ³	COSEWIC ⁴	SARA ⁵
Wood Duck	<i>Aix sponsa</i>	--	Yellow	--	--	--
Yellow Warbler	<i>Setophaga petechia</i>	X	Yellow	--	--	--
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	--	Yellow	--	--	--
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	--	Yellow	--	--	--
Yellow-rumped Warbler	<i>Setophaga coronata</i>	--	Yellow	--	--	--

¹ Priority species identified under the Bird Conservation Region (BCR) Strategy for Region 10 (Environment Canada 2013).

² British Columbia Conservation Data Centre (BC CDC): Red=species that are Endangered or Threatened; Blue=species that are Special Concern.

³ Identified Wildlife under the BC Forest and Range Practices Act (FRPA).

⁴ Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered=species facing imminent extirpation or extinction; Threatened=species that are likely to become endangered if limiting factors are not reversed; Special Concern=species with characteristics that make them particularly sensitive to human activities or natural events; Not At Risk=species that have been evaluated and found to be not at risk.

⁵ Species at Risk Act (SARA): species that are listed under the federal SARA; uses the same ranking system as COSEWIC.

Appendix H Avian Species Detected During Baseline Surveys

Common Name	Scientific Name	Species Group	Survey Type				Total ²
			Point Count	Call Playback	Waterbird ¹	Incidental	
Alder Flycatcher	<i>Empidonax alnorum</i>	Landbird	18	0	0	8	26
American Crow	<i>Corvus brachyrhynchos</i>	Landbird	10	0	0	8	18
American Kestrel	<i>Falco sparverius</i>	Raptor	0	0	0	1	1
American Redstart	<i>Setophaga ruticilla</i>	Landbird	141	0	0	19	160
American Robin	<i>Turdus migratorius</i>	Landbird	72	0	0	40	112
American Three-toed Woodpecker	<i>Picoides dorsalis</i>	Landbird	12	0	0	11	23
American Wigeon	<i>Mareca americana</i>	Waterbird	0	0	121	0	121
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Raptor	0	0	0	3	3
Barn Swallow	<i>Hirundo rustica</i>	Landbird	0	0	0	10	10
Barred Owl	<i>Strix varia</i>	Raptor	0	0	0	1	1
Barrow's Goldeneye	<i>Bucephala islandica</i>	Waterbird	1	0	0	3	4
Black-capped Chickadee	<i>Poecile atricapillus</i>	Landbird	77	0	0	13	90
Blackpoll Warbler	<i>Setophaga striata</i>	Landbird	5	0	0	0	5
Boreal Chickadee	<i>Poecile hudsonicus</i>	Landbird	2	0	0	0	2
Brown Creeper	<i>Certhia americana</i>	Landbird	3	0	0	1	4
Bufflehead	<i>Bucephala albeola</i>	Waterbird	0	0	5	0	5
Cackling Goose	<i>Branta hutchinsii</i>	Waterbird	0	0	12	0	12
Canada Goose	<i>Branta canadensis</i>	Waterbird	0	0	194	5	199
Canada Jay (formerly Gray Jay)	<i>Perisoreus canadensis</i>	Landbird	9	0	0	17	26
Cassin's Vireo	<i>Vireo cassinii</i>	Landbird	5	0	0	1	6
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Landbird	15	0	0	4	19
Chestnut-backed Chickadee	<i>Poecile rufescens</i>	Landbird	3	0	0	0	3
Chipping Sparrow	<i>Spizella passerina</i>	Landbird	23	0	0	3	26

Common Name	Scientific Name	Species Group	Survey Type				Total ²
			Point Count	Call Playback	Waterbird ¹	Incidental	
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Landbird	0	0	0	1	1
Clay-colored Sparrow	<i>Spizella pallida</i>	Landbird	1	0	0	1	2
Common Loon	<i>Gavia immer</i>	Waterbird	0	0	1	0	1
Common Merganser	<i>Mergus merganser</i>	Waterbird	0	0	1	0	1
Common Raven	<i>Corvus corax</i>	Landbird	7	0	0	23	30
Common Yellowthroat	<i>Geothlypis trichas</i>	Landbird	12	0	0	4	16
Cooper's Hawk	<i>Accipiter cooperii</i>	Raptor	0	0	0	5	5
Dark-eyed Junco	<i>Junco hyemalis</i>	Landbird	169	0	0	22	191
Dusky Flycatcher	<i>Empidonax oberholseri</i>	Landbird	20	0	0	2	22
Dusky Grouse	<i>Dendragapus obscurus</i>	Landbird	0	0	0	4	4
Eurasian Wigeon	<i>Mareca penelope</i>	Waterbird	0	0	1	0	1
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Landbird	48	0	0	9	57
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>	Landbird	2	0	0	0	2
Great Horned Owl ²	<i>Bubo virginianus</i>	Raptor	0	0	0	0	0
Greater White-fronted Goose	<i>Anser albifrons</i>	Waterbird	0	0	1	0	1
Greater Yellowlegs	<i>Tringa melanoleuca</i>	Waterbird	0	0	5	0	5
Green-winged Teal	<i>Anas crecca</i>	Waterbird	0	0	6	0	6
Hairy Woodpecker	<i>Dryobates villosus</i>	Landbird	12	0	0	1	13
Hammond's Flycatcher	<i>Empidonax hammondi</i>	Landbird	6	0	0	1	7
Hermit Thrush	<i>Catharus guttatus</i>	Landbird	16	0	0	8	24
Killdeer	<i>Charadrius vociferus</i>	Waterbird	0	0	12	0	12
Least Flycatcher	<i>Empidonax minimus</i>	Landbird	20	0	0	3	23
Lesser Scaup	<i>Aythya affinis</i>	Waterbird	0	0	7	0	7

Common Name	Scientific Name	Species Group	Survey Type				Total ²
			Point Count	Call Playback	Waterbird ¹	Incidental	
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	Landbird	17	0	0	5	22
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	Landbird	44	0	0	18	62
Magnolia Warbler	<i>Setophaga magnolia</i>	Landbird	29	0	0	8	37
Mallard	<i>Anas platyrhynchos</i>	Waterbird	0	0	94	0	94
Mountain Chickadee	<i>Poecile gambeli</i>	Landbird	10	0	0	6	16
Northern Flicker	<i>Colaptes auratus</i>	Landbird	7	0	0	9	16
Northern Goshawk, <i>atricapillus</i> subspecies	<i>Accipiter gentilis atricapillus</i>	Raptor	0	0	0	4	4
Northern Harrier	<i>Circus hudsonius</i>	Raptor	0	0	0	3	3
Northern Pintail	<i>Anas acuta</i>	Waterbird	0	0	1	0	1
Northern Pygmy-owl	<i>Glaucidium gnoma</i>	Raptor	2	0	0	2	4
Northern Saw-whet Owl ²	<i>Aegolius acadicus</i>	Raptor	0	0	0	0	0
Northern Shoveler	<i>Spatula clypeata</i>	Waterbird	0	0	4	0	4
Northern Waterthrush	<i>Parkesia noveboracensis</i>	Landbird	15	0	0	23	38
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Landbird	4	0	0	9	13
Orange-crowned Warbler	<i>Leiothlypis celata</i>	Landbird	55	0	0	12	67
Osprey	<i>Pandion haliaetus</i>	Raptor	0	0	0	4	4
Pacific Wren	<i>Troglodytes pacificus</i>	Landbird	15	0	0	13	28
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	Landbird	5	0	0	1	6
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Landbird	0	0	0	2	2
Pine Grosbeak	<i>Pinicola enucleator</i>	Landbird	1	0	0	2	3
Pine Siskin	<i>Spinus pinus</i>	Landbird	60	0	0	15	75
Purple Finch	<i>Haemorhous purpureus</i>	Landbird	11	0	0	1	12

Common Name	Scientific Name	Species Group	Survey Type				Total ²
			Point Count	Call Playback	Waterbird ¹	Incidental	
Red Crossbill	<i>Loxia curvirostra</i>	Landbird	3	0	0	0	3
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Landbird	41	0	0	27	68
Red-breasted Sapsucker	<i>Sphyrapicus ruber</i>	Landbird	19	0	0	14	33
Redhead	<i>Aythya americana</i>	Waterbird	0	0	8	0	8
Red-necked Grebe	<i>Podiceps grisegena</i>	Waterbird	0	0	2	1	3
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Raptor	1	0	0	9	10
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Landbird	0	0	0	3	3
Ring-necked Duck	<i>Aythya collaris</i>	Waterbird	0	0	64	0	64
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Landbird	39	0	0	12	51
Ruffed Grouse	<i>Bonasa umbellus</i>	Landbird	6	0	0	4	10
Rufous Hummingbird	<i>Selasphorus rufus</i>	Landbird	22	0	0	1	23
Sandhill Crane	<i>Antigone canadensis</i>	Waterbird	0	0	105	1	106
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Landbird	5	0	0	100	105
Short-billed Dowitcher	<i>Limnodromus griseus</i>	Waterbird	0	0	0	3	3
Snow Goose	<i>Anser caerulescens</i>	Waterbird	0	0	50	0	50
Solitary Sandpiper	<i>Tringa solitaria</i>	Waterbird	0	0	0	1	1
Song Sparrow	<i>Melospiza melodia</i>	Landbird	14	0	0	4	18
Spotted Sandpiper	<i>Actitis macularius</i>	Waterbird	0	0	0	1	1
Steller's Jay	<i>Cyanocitta stelleri</i>	Landbird	1	0	0	5	6
Swainson's Thrush	<i>Catharus ustulatus</i>	Landbird	225	0	0	88	313
Tennessee Warbler	<i>Leiothlypis peregrina</i>	Landbird	14	0	0	5	19
Townsend's Warbler	<i>Setophaga townsendi</i>	Landbird	36	0	0	12	48
Tree Swallow	<i>Tachycineta bicolor</i>	Landbird	8	0	0	0	8

Common Name	Scientific Name	Species Group	Survey Type				Total ²
			Point Count	Call Playback	Waterbird ¹	Incidental	
Trumpeter Swan	<i>Cygnus buccinator</i>	Waterbird	0	0	50	0	50
Varied Thrush	<i>Ixoreus naevius</i>	Landbird	69	0	0	39	108
Vesper Sparrow	<i>Poocetes gramineus</i>	Landbird	1	0	0	0	1
Warbling Vireo	<i>Vireo gilvus</i>	Landbird	72	0	0	39	111
Western Tanager	<i>Piranga ludoviciana</i>	Landbird	14	0	0	4	18
Western Wood-pewee	<i>Contopus sordidulus</i>	Landbird	18	0	0	9	27
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Landbird	0	0	0	3	3
White-throated Sparrow	<i>Zonotrichia albicollis</i>	Landbird	12	0	0	11	23
White-winged Crossbill	<i>Loxia leucoptera</i>	Landbird	0	0	0	8	8
Wilson's Snipe	<i>Gallinago delicata</i>	Waterbird	1	0	0	0	1
Wilson's Warbler	<i>Cardellina pusilla</i>	Landbird	27	0	0	7	34
Yellow Warbler	<i>Setophaga petechia</i>	Landbird	16	0	0	1	17
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	Landbird	4	0	0	6	10
Yellow-rumped Warbler	<i>Setophaga coronata</i>	Landbird	57	0	0	27	84

¹ Six unspecified goldeneye were also detected during the waterbird surveys. Since no specified goldeneye species were detected during the waterbird surveys, these detections were counted as an additional species in Section 3.4.

² Reported totals do not include recordings collected from Automated Recording Units (ARUs); however, the list of species detected during baseline surveys includes those species confirmed present in acoustic monitoring data. This includes two species not detected during other baseline surveys: great-horned owl and northern saw-whet owl.