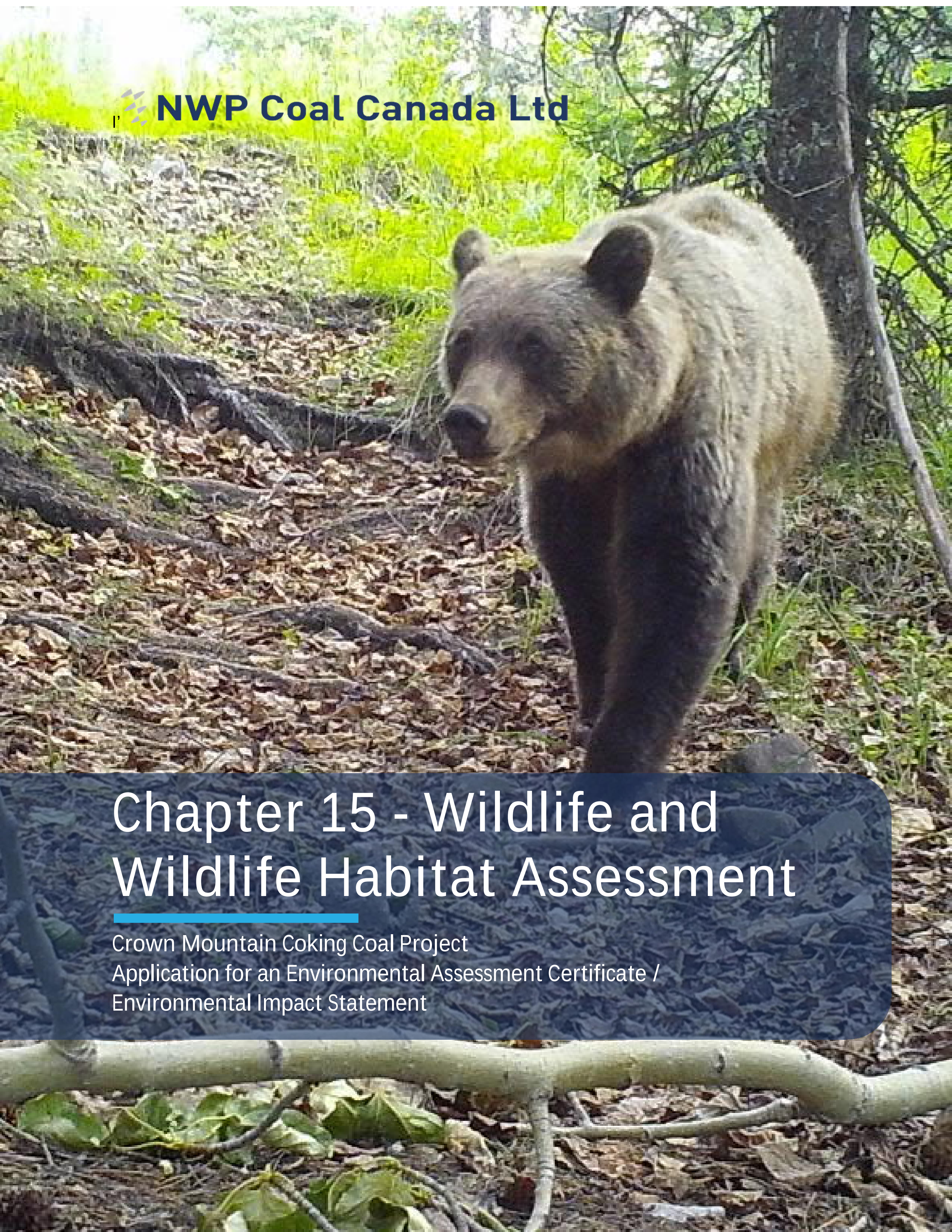

NWP Coal Canada Ltd

Chapter 15 - Wildlife and Wildlife Habitat Assessment

Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate / Environmental Impact Statement

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15. Wildlife and Wildlife Habitat Assessment

15.1 Introduction

Wildlife are critical to the functioning of terrestrial and aquatic ecosystems and are important recreational, economic, heritage, and subsistence resources for the public and Indigenous communities. Wildlife species, particularly those that are considered sensitive or listed, are vulnerable to the cumulative impacts of human activities, including industry, farming, forestry, transportation, urban development, construction of linear features, and high consumption of resources. Given the complex relationships between wildlife, their habitat, and human activities, representative wildlife groups and species that demonstrate sensitivities to disturbance were identified as receptor valued components (VCs) for the Project in the Application Information Requirements (AIR; Environmental Assessment Office [EAO], 2018). These include:

- Ungulate community, represented by:
  - Moose (Alces alces);
  - Elk (Cervus elaphus);
  - Bighorn sheep (*Ovis canadensis*); and
  - Mountain goat (Oreamnos americanus);
- Carnivore community, represented by:
  - Grizzly bear (*Ursus arctos*);
  - Wolverine (*Gulo gulo*);
  - American badger (*Taxidea taxus*);
  - American marten (*Martes americana*); and
  - Canada lynx (*Lynx canadensis*);
- Bat community, represented by:
  - Little brown myotis (*Myotis lucifugus*);
  - Northern myotis (*Myotis septentrionalis*); and
  - Eastern red bat (*Lasiurus borealis*);
- Bird community, represented by:

  - Migratory Birds (as defined under the *Migratory Birds Convention Act* [1994] and represented by Olive-sided Flycatcher (*Contopus cooperi*), Barn Swallow (*Hirundo rustica*), and woodpeckers (family Picidae);
  - Northern Goshawk (*Accipiter gentilis atricapillus*); and
  - Waterbirds (as a VC under aquatic health) represented by American Dipper (*Cinclus mexicanus*), Harlequin Duck (*Histrionicus histrionicus*), Mallard (*Anas platyrhynchos*), Red-winged Blackbird (*Agelaius phoeniceus*), and Spotted Sandpiper (*Actitis macularius*);
- Amphibian community, represented by:
  - Western toad (*Anaxyrus boreas*); and
  - Amphibians within the RSA, represented Columbia spotted frog (*Rana luteiventris*)[1]; and
- Insect community, represented by:
  - Gillette's checkerspot (*Euphydryas gilletti*).

In addition, federally listed species at risk and migratory birds were identified as VCs in the Guidelines for the Preparation of an Environmental Impact Statement for the Crown Mountain Coking Coal Project (EIS Guidelines; Canadian Environmental Assessment Agency, 2015a).

An understanding of the potential effects to wildlife with respect to the Project is critical to the Project design, engineering, operations, and assessment and mitigation of potential environmental effects. Wildlife VCs have linkages with other VCs; these effects are primarily assessed in the following chapters:

- Chapter 6: Atmospheric Environment Assessment;
- Chapter 7: Acoustic Environment Assessment;
- Chapter 8: Soil and Terrain Assessment;
- Chapter 9: Groundwater Assessment;
- Chapter 10: Surface Water Quantity Assessment;
- Chapter 11: Surface Water Quality Assessment;
- Chapter 13: Landscapes and Ecosystems Assessment;
- Chapter 19: Land Use Assessment;
- Chapter 22: Human and Ecological Health Assessment; and
- Indigenous Communities discussed in Chapters 23 through 31.

15.1.1 Regulatory and Policy Setting

Applicable provincial and federal legislation related to the protection of wildlife and wildlife habitat are summarized in Table 15.1-1. Relevant guidelines, including standards and best management practices (BMPs), are summarized in Table 15.1-2.

As part of the Provincial Cumulative Effects Framework, the Elk Valley Cumulative Effects Management Framework (EV-CEMF) aims to assess the historic, current, and potential future conditions of selected valued components and to support natural resource management decisions within the region (Province of British Columbia [Province of B.C.], 2020a). The purpose of EV-CEMF is to develop an approach to understand cumulative effects on the environment from various industries and natural events in the Elk

[1] In the provincial application information requirements (AIR; EAO, 2018), Columbia spotted frog was selected as a VC under Aquatic Health and not under Wildlife and Wildlife Habitat. The assessment for Columbia spotted frog has been included in the Wildlife and Wildlife Habitat Assessment for convenience and consistency and is cross-referenced elsewhere in the application, where relevant.

Valley. Wildlife valued components assessed under EV-CEMF include grizzly bear and bighorn sheep (Province of B.C., 2020a). Grizzly bear was selected as a VC for EV-CEMF because it has high cultural and ecological value and is important for maintaining the visual quality of landscapes (Mowat et al., 2018). Grizzly bear is also a valued component in the Provincial Cumulative Effects Framework (Mowat et al., 2018). Bighorn sheep was selected as a VC for EV-CEMF because it utilizes alpine grasslands, unique habitats that are not reflected in the assessment of other VCs in EV-CEMF (Poole et al., 2018). Bighorn sheep is an iconic species with high harvest and cultural value, particularly to Indigenous communities.

Table 15.1-1: Regulatory Considerations Relevant to Wildlife and Wildlife Habitat VCs

Legislation Name	Year	Description
Federal		
Species at Risk Act	2002	The *Species at Risk Act* (SARA) protects wildlife species listed as extirpated, endangered, or threatened from being killed, harmed, harassed, or captured; and the residences of these at-risk wildlife species on federal land and within federally designated Critical Habitat.
Migratory Birds Convention Act	1994	The *Migratory Birds Convention Act* protects various species of migratory birds, including gamebirds, insectivorous birds, and non-gamebirds. This Act prohibits the disturbance, destruction, or removal of a nest or related shelter or eff of a migratory bird, as well as the possession of a live migratory bird, carcass, nest, or egg.
Canadian Environmental Protection Act	1999	The *Canadian Environmental Protection Act* (*CEPA*) is aimed at pollution prevention and the protection of the environment and human health in order to contribute to sustainable development.
Canadian Environmental Assessment Act (2012)	2012	Provides the legal basis for the federal environmental assessment process. As of August 28, 2019, the 2012 Act has been repealed and replaced by the *Impact Assessment Act* (2019); however, this Project remains under the 2012 legislation.
Provincial		
Forest and Range Practices Act	2002	Outlines how all forest and range practices and resource-based activities are to be conducted on Crown land in B.C., while ensuring the protection of plants, wildlife, and ecosystems.
Wildlife Act	1996	The *Wildlife Act* protects all native and some non-native wildlife species found in B.C. from direct harm or harassment, except as allowed by regulation (e.g., hunting or trapping). Wildlife Management Areas (WMAs) are mapped areas that are necessary to meet the habitat requirements of an Identified Wildlife element. WMAs are an area of land designated under Sec. 42 of the Act for the benefit of regionally and internationally significant fish and wildlife species or their habitats.

Legislation Name	Year	Description
Environmental Management Act	2003	Regulates industrial and municipal waste discharge, hazardous waste, pollution, and contaminated sites remediation. The *Environmental Management Act* (*EMA*) enables the use of permits, regulations, and codes of practice to authorize discharges to the environment.
Environmental Assessment Act	2002; 2018	Provides a framework for the process of reviewing major projects and assessing their potential environmental impacts. As of December 16, 2019, the 2002 Act has been repealed and replaced by the *Environmental Assessment Act* (2018). On May 3, 2023, the Project was transitioned to the EAA (2018) through a Transition Order under Section 78(7) of the 2018 Act.
Mines Act	1996	In combination with the accompanying Health, Safety and Reclamation Code for Mines, this Act provides a foundation for the protection of the land and watercourses by minimizing the environmental risks associated with mining activities, in addition to providing reclamation requirements for disturbed areas.
Land Act	1996	The primary legislation through which the government conveys land to the public for community, industrial, and business use. The Act allows the granting of land and the issuance of Crown land tenure in the form of leases, licences, permits and rights-of-way. Sustainable management of Crown land and natural resources is guided in part by the Land Act and associated Land Use Objectives Regulation, in addition to land use plans, which work to protect species at risk and their habitats within certain regions.

Table 15.1-2: Guidelines and Guidance Documents Relevant to Wildlife and Wildlife Habitat VCs

Guideline Name	Year	Description
Federal		
Guidelines to Reduce Risk to Migratory Birds	2019	Provides information on the risks that development activities may pose to migratory birds and guidance to mitigate such risks (Environment and Climate Change Canada [ECCC], 2019a).
Bird Conservation Strategy for Bird Conservation Region 10 Pacific and Yukon Region: Northern Rockies	2013	The primary aims of this Strategy is to present ECCC's priorities with respect to migratory bird conservation in this region, and to provide a comprehensive overview of the conservation needs of bird populations to practitioners who may then undertake activities that promote bird conservation in Canada and internationally (Environment Canada, 2013).
Wetlands Environmental Assessment Guideline	1998	Incorporates wetland policy and provides guidelines to include wetland functions in environmental assessments (Milko, 1998).

Guideline Name	Year	Description
Provincial		
Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development	2014	Outlines best management practices for protecting special wildlife and species at risk before, during, and after development (British Columbia Ministry of Forests, Lands, and Natural Resource Operations [FLNRO], 2014a).
British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture	2019	Ambient water quality guidelines are used to protect water values, including: wildlife and their habitats, and provide the basis for evaluation of ambient water quality and environmental impact assessments to inform resource management decisions (British Columbia Ministry of Environment and Climate Change Strategy [ENV], 2019).
Riparian Management Area Guidebook	1995	Provides guidance for managing riparian areas to make guidelines easier to follow (British Columbia Ministry of Forests [MOF], 1995).
Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in B.C.	2009	Guidelines for the protection and management of wetlands before, during, and after development (Cox and Cullington, 2009).
Badger Recovery Science: Best Management Practices for Prey Enhancement	2005	Guidelines for enhancing American badger prey populations (Hoodicoff, 2005).
British Columbia Urban Ungulate Conflict Analysis	2010	Outlines ideal habitat, causes of population boom, and options for managing ungulates (Hesse, 2010).
Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia	2013	Outlines current laws, guidelines, and recommendations pertaining to raptors (FLNRO, 2013)
Guidelines for Amphibian and Reptile Conservation in Urban and Rural Development in British Columbia	2014	Outlines legislation protecting amphibians, as well as general guidelines for conservation (FLNRO, 2014b).
Best Management Practices for Amphibian and Reptile Salvages in British Columbia	2016	Outlines catch and release procedures, permitting and current regulations (FLNRO, 2016).
Best Management Practices for Bats in British Columbia	2016	Provides information about potential impacts development has on bats and their habitat and guidelines on how to minimize impacts (British Columbia Ministry of Environment [B.C. MOE], 2016).
Guidelines for Evaluating, Avoiding and Mitigating Impacts of Major Development Projects on Wildlife in British Columbia	2001	Outlines guidelines and recommendations to ensure protection of wildlife and wildlife habitat throughout development (Harper et al., 2001).

Guideline Name	Year	Description
National/International		
Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern United States and Western Canada	2008	Provides amphibian and reptile habitat management guidelines that are practical for resource managers and private landowners to integrate with other management objectives (Pilliod and Wind, 2008).

15.1.1.1 Land Management Plans

The Project is located within the Regional District of East Kootenay and contains areas of Crown land subject to the Kootenay Boundary Land and Resource Management Plan (KBLUP; Kootenay Inter-Agency Management Committee [KIAMC], 1997). Approximately 74,000 square kilometres (km^2) of land is included within the KBLUP, which is subdivided into four land use designation categories identified as Resource Management Zones (RMZ). The land use designations indicate the general land and resource management intent for the area and comparative emphasis of conservation-oriented land-uses to development-oriented land uses. The Project license is within the Cranbrook RMZ. The Cranbrook RMZ is within the Enhanced Resource Management Zone. The Project is located within the intermediate and low biodiversity emphasis options and is not within the mapped grizzly bear habitat and connectivity corridors (Kootenay Inter-Agency Management Committee, 1997). Management objectives of the KBLUP pertaining to wildlife are described in Table 15.1-3.

Table 15.1-3: Regional Management Objectives from the Kootenay Boundary Land Use Plan Implementation Strategy as they Pertain to Wildlife and Wildlife Habitat VCs

Wildlife-related Resource	Management Objectives[2]
General Ecosystem Health	• Maintain healthy, functioning ecosystems that are essential to the diversity, abundance, distribution and life histories of fish, wildlife, vegetation and water resources • Protect, conserve, and reduce risks to rare, threatened and endangered terrestrial and aquatic species • Maintain the quality, integrity and connectivity of grassland habitats so as to support the associated red and blue listed species • Maintain wildland attributes necessary for ecosystem health through coordinated access planning for resource development and associated activities
Terrestrial Ecosystem Health	• Maintain the regional diversity and a suitable abundance of native terrestrial species of plants and animals, and the ecosystems upon which they depend • Maintain the diversity and a suitable abundance of wide-ranging carnivore populations and the ecosystems upon which they depend • Maintain the diversity and a suitable abundance of ungulate species and the habitats on which they depend • Maintain and diversify the recreational value of wildlife

[2] Taken directly from the Kootenay Boundary Land Use Plan: Implementation Strategy (KBLUP, 1997).

Wildlife-related Resource	Management Objectives[2]
Aquatic Ecosystem Health	• Protect and conserve aquatic ecosystem functions and processes • Maintain water quality, quantity and timing of flow at appropriate levels in community and domestic use watersheds
Rangeland Ecosystems	• Maintain highly diverse and contiguous rangelands • Manage rangeland ecosystems within the limits of their sustainable carrying capacity • Restore rangeland by reducing current and historic forest ingrowth • Maintain and restore the integrity of riparian areas • Ensure all rangeland dependent rare species are identified and maintained in a viable state
Ungulate Winter Range	• Maintain the quality, integrity and connectivity of grassland habitats so as to support the associated red and blue listed species
Settlement, utility and Communication Uses of Crown Land	• Recognize environmental conservation and other land use and resource management objectives when making decisions on the disposition of Crown land for settlement and other purposes
Access management	• Prevent or reduce conflicts between resource access developments and sensitive environmental, recreational and cultural heritage resource values and areas
Hunting and outfitting	• Maintain sustainable and harvestable populations of [...] wildlife to provide long term and sustainable economic benefits to the region • Maintain a viable guide outfitting industry to service both resident and non-resident hunters

15.1.1.2 Managed Wildlife Habitats and Habitat Features

Wildlife habitats with associated development guidelines and/or management objectives within the East Kootenay include ecosystems sensitive to disturbance and habitats containing high values to wildlife. Designated high-quality habitats are areas that contain recognized valuable (i.e., limiting) resources for wildlife species and are important for population viability. These habitats are discussed in the following subsections.

15.1.1.2.1 Ungulate Winter Range

Ungulate Winter Ranges (UWRs) are areas that contain habitat necessary to meet the winter requirements of ungulate species. UWRs are authorized under the Government Actions Regulation (GAR) under the *Forest and Range Practices Act (*FRPA; 2002*).* There are currently seven approved UWRs in the Kootenays. The Project overlaps with parts of UWR U-4-006 – Cranbrook Timber Supply Area (TSA). UWRs have legislated management guidelines, including forest cover retention requirements for forestry activities (Ministerial Order U-4-006, 2005).

15.1.1.2.2 Ungulate Mineral Licks

Mineral licks are areas used habitually by ungulates to obtain dietary macroelements (e.g., sodium, calcium, and phosphorous) and trace elements (e.g., manganese, copper, and selenium). Significant mineral licks are considered Wildlife Habitat Features under the Wildlife Habitat Feature Order for the Kootenay Boundary Region (Ministerial Order M213, 2018). Wildlife Habitat Features are protected through the Order under the authority of the GAR under the *FPRA* (2002*).* Significant mineral licks are defined as naturally occurring mineral licks that are used at least annually by one or more species (Ministerial Order No. M213, 2018), as evidenced by well-established or braided trail systems leading to the mineral lick site, and/or extensive excavation, trampling, teeth marks, pellets, tracks, and hair at a mineral licksite.

15.1.1.2.3 Wildlife Habitat Areas

Wildlife Habitat Areas (WHAs) designate critical habitats for identified wildlife. The purpose of WHAs is to protect habitats considered most limiting. The establishment of WHAs are guided by the Identified Wildlife Management Strategy (IWMS), carried out under provisions of the *FRPA* (2002). General requirements for licensees and tenure holders in WHAs are outlined in the Forest Planning and Practices Regulations. There are a number of WHAs identified in the East Kootenay to the south and west of the Project for Project VCs including Gillette's checkerspot, grizzly bear, and listed woodpecker species (British Columbia Conservation Data Centre [B.C. CDC], n.d.a).

15.1.1.2.4 Wildlife Management Units

Wildlife Management Units are used for the purpose of efficient game management in B.C. and are designated under the *Wildlife Act* (1996). Across the province, there are nine administrative regions and a total of 225 Wildlife Management Units (WMUs). The Project occurs with Region 4: Kootenay and the Project study areas (discussed in Section 15.2.3) overlap with WMUs 4-1; 4-2; 4-3; 4-21; 4-22; and 4-23 (B.C. CDC, n.d.a).

15.1.1.2.5 Access Management Areas

Access Management Areas (AMAs) have also been established in the East Kootenay for the protection of wildlife in sensitive areas by controlling and use of vehicles in sensitive wildlife habitat. To date there are over a dozen AMAs in the Elk Valley, including four Motor Vehicle Hunting Closure Areas, and anecdotal evidence has suggested that AMAs have benefited local wildlife populations (Burley, 2020).

As a result of the rapid expansion of the resource road network and the increasing popularity of motorized recreation, there has been a dramatic growth in the public use of forests and forest lands in the East Kootenay. Access Management Areas (AMAs) regulated through the *Wildlife Act* (1996) are a mechanism through which the B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) manages access to sensitive areas and areas of high wildlife habitat values. There are two AMAs that overlap with the Project; Grave Prairie AMA and Alexander Creek AMA.

15.1.1.2.6 Wildlife Habitat Features

The Kootenay Boundary Wildlife Habitat Features Order (2018) regulated under the *FRPA* (2002) identifies 14 Wildlife Habitat Features (WHF) in the Kootenay Boundary region (Ministerial Order M213, 2018). The Order includes provisions to protect WHFs from any activity (as regulated under *FRPA*) that would damage or render that WHF ineffective. The Act also includes agreement holders to seek exemptions from the requirement to protect a WHF. The WHFs in the Order that are directly to the Project wildlife VCs include the following:

- The nests of Lewis's Woodpecker (*Melanerpes lewis*) and Williamson's Sapsucker (*Sphyrapicus thyroideus*);
- American badger burrows;

- Grizzly bear dens;
- Significant mineral licks and wallows;
- Bat hibernacula; and
- Bat nursey roosts.

15.1.1.3 Species of Conservation Concern

Species of conservation concern are species with rare or declining populations or habitats that are provincially blue- or red-listed, federally-listed under the *Species at Risk Act* (SARA; 2002), or identified as at-risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or globally-listed by NatureServe. Species were identified using the B.C. Conservation Data Centre Species and Ecosystems Explorer (B.C. CDC; British Columbia Species and Ecosystems Explorer [B.C. CDC], 2021a). A summary of wildlife species of conservation concern found with the East Kootenays and that have the potential to occur near the Project is provided in Table 15.1-4.

Table 15.1-4: Species of Conservation Concern Likely to Occur within the Project Region

Common Name	Scientific Name	B.C. List[3]	Provincial[4]	Provincial FPRA[5]	COSEWIC[6]	*SARA*[7]
Ungulates						
Bighorn sheep	*Ovis canadensis*	B	S3? (2015)	Y	-	-
Mountain goat	*Oreamnos americanus*	B	S3 (2015)	-	-	-
Carnivores						
American badger	*Taxidea taxus*	R	S2 (2015)	Y	E (2012)	1-E (2018)
Fisher	*Pekania pennant*	No status	S3 (2020)	Y	-	-
Grizzly bear	*Ursus arctos*	B	S3? (2015)	Y	SC (2012)	1-SC (2018)
Wolverine	*Gulo gulo*	B	S3 (2015)	Y	SC (2014)	1-SC (2018)
Small Mammals						
Southern red-backed vole subsp. *galei*	*Clethrionomys gapperi galei*	B	S3S4 (2006)	-	-	-
Northern pocket gopher subsp. *segregatus*	*Thomomys talpoides segregatus*	R	S2 (2006)	-	-	-

[3] B.C. list: Y=yellow (least risk of being lost), B= Blue (special concern), R= Red (risk of being lost (extirpated, endangered or threatened).
[4] NatureServe ranks for the B.C. Provincial Conservation Status Ranks: S1= critically imperiled; S2= imperiled; S3= special concern, vulnerable to extirpation or extinction; S4= apparently secure, with some cause for concern; S5= demonstrably widespread, abundant and secure; ##= range rank- indicates range of uncertainty about conservation status (e.g., S2S3); ? = inexact or uncertain- denotes inexact or uncertain numeric rank.
[5] Formerly Identified Wildlife. Y= species is provincially designated under *FPRA*. More information can be found on the Identified Wildlife Management Strategy site here: http://www.env.gov.bc.ca/wld/frpa/iwms/index.html.
[6] COSEWIC designations E – Endangered; T – Threatened; SC – Special Concern; C – Candidate; NAR – Not at Risk.
[7] SARA Federal Species at Risk Act Schedule number (1-3). 1= Schedule 1, official list of wildlife species at risk.

Common Name	Scientific Name	B.C. List[3]	Provincial[4]	Provincial FPRA[5]	COSEWIC[6]	*SARA*[7]
Least chipmunk subsp. *oreocetes*	*Tamias minimus oreocetes*	B	S3 (2020	-	-	-
Least chipmunk subsp. *selkirki*	*Tamias minimus selkirki*	R	S1 (2006)	-	-	-
Red-tailed chipmunk subsp. *simulans*	Tamias reficaudus simulans	B	S3 (2006)	-	-	-
Red-tailed chipmunk subsp. ruficaudus	*Tamias ruficaudus ruficaudus*	R	S2 (2006)	-	-	-
Little brown myotis	*Myotis lucifugus*	Y	S4 (2015)	-	E (2013)	1-E (2014)
Fringed myotis	Myotis thysanodes	B	S3 (2015)	Y	DD (2004)	3-SC (2005)
Northern myotis	*Myotis septentrionalis*	B	S3S4 (2015)	-	E (2013)	1-E (2013)
Townsend's big-eared bat	*Plecotus townsendii*	B	S3S4 (2015)	-	-	-
Birds						
American Avocet	*Recurvirostra americana*	B	S2S3B (2015)	-	-	-
American Bittern	*Bautaurus lentiginosus*	B	S3B, SNRN (2015)	-	-	-
Barn Swallow	*Hirundo rustica*	B	S3S4B (2015)	-	T (2011)	1-T (2017)
Bobolink	*Dolichonyx oryzivorus*	B	S3B (2015)	-	T (2010)	1-T (2017)
Broad-winged Hawk	*Buteo platypterus*	B	S3?B (2015)	-	-	-
Canyon Wren	*Catherpes maxicanus*	B	S3? (2015)	-	-	-
Common Nighthawk	*Buteo swainsoni*	Y	S4B (2015)	-	SC (2018)	1-T (2010)
Flammulated Owl	*Otus flammeolus*	B	S3B (2015)	Y	SC (2010)	1-SC (2003)
Forster's Tern	*Stern forsteri*	R	S1B (2015)	-	-	-
Grasshopper Sparrow	*Ammodramus savannarum*	R	S1B (2018)	Y	-	-
Great Blue Heron	*Ardea herodias herodias*	B	S3? (2017)	Y	-	-

Common Name	Scientific Name	B.C. List[3]	Provincial[4]	Provincial FPRA[5]	COSEWIC[6]	*SARA*[7]
Lewis's Woodpecker	*Melenerpes lewis*	B	S2S3B (2015)	Y	T (2010	1-T (2012)
Long-billed Curlew	*Numenius americanus*	B	S3B (2018)	Y	SC (2011)	1-SC (2005)
Northern Goshawk subsp. *Atricapillus*	*Accipiter gentilis atricapillus*	B	S3S4 (2017)	-	-	-
Olive-sided Flycatcher	*Contopus cooperi*	B	S3S4B (2015)	-	SC (2018)	1-T (2010)
Peregrine Falcon	*Falco peregrinus*	No status	S3 (2015)	-	SC (2007)	1-SC
Peregrine falcon subsp. *anatum*	*Falco peregrinus anatum*	R	S2?	-	NAR (2017)	1-SC (2012)
Prairie Falcon	*Falco mexicanus*	R	S1 (2018)	Y	-	-
Sandhill Crane	*Antigone canadensis*	Y	S4B (2018)	Y	Nar (1979)	-
Sharp-tailed Grouse subsp. *columbianus*	*Tympanuchus Phasianellus columbianus*	B	S2S3 (2005)	Y	-	-
Short-eared Owl	*Asio otus*	B	S3B, S2N (2015)	Y	SC (2008)	1-SC (2012)
Swainson's Hawk	*Buteo swainsoni*	R	S2B (2015)	-	-	-
Western Grebe	*Aechmorphorus occidentalis*	R	S1B, S2N (2015)	-	SC (2014)	1-SC (2017)
Western Screech Owl subsp. *macfarlanei*	*Otus kennicottii macfarlanei*	B	S3 (2017)	Y	T (2012)	1-T (2005)
Williamson's Sapsucker subsp. *nataliae*	*Sphyrapicus throideus nataliae*	No status	SNR (2012)	Y	E (2017)	1-E (2006)
White-throated Swift	*Aeronautes saxatalis*	B	S3S4B (2015)	-	-	-
Upland Sandpiper	*Bartramia longicauda*	R	S2B (2015)	-	-	-
Amphibians						
Western Toad	*Anaxryus boreas*	Y	S4 (2016)	-	SC	1-SC
Gillette's Checkerspot	*Euphydrya gillettii*	B	S2S3 (2020)	Y	-	-

15.2 Scope of the Assessment

15.2.1 Valued Components and Measurement Indicators

Twenty-four wildlife species or groups were identified as receptor VCs for the Project in the provincial AIR (EAO, 2018. Measurement indicators for each wildlife and wildlife habitat VC/VC group are summarized in Table 15.2-1. Rationale for the selection of the wildlife and wildlife habitat VCs for inclusion in the Application/Environmental Impact Statement is presented in Table 15.2-2.

15.2.2 Indigenous and Stakeholder Consultation

NWP engaged with Indigenous groups and conducted consultation with public stakeholders and government agencies. A summary of all consultation and engagement activities undertaken to date is presented in Chapter 4. A summary of consultation feedback specific to the wildlife VCs is presented in Appendix 15-A. Based on feedback received from the Ktunaxa Nation Council (KNC), NWP has included an effects assessment on mountain goats with the bighorn sheep VC to address concerns around assessing potential project effects on mountain goats. Additional Indigenous and stakeholder consultation feedback presented in Appendix 15-A was used to inform the wildlife baseline programs, evaluate baseline conditions, and inform the occupancy and habitat modelling.

15.2.3 Assessment Boundaries

15.2.3.1 Spatial Boundaries

Five spatial boundaries were considered in the wildlife and wildlife habitat assessment: the Project footprint, the Terrestrial Local Study Area (LSA), the Terrestrial Regional Study Area (RSA), the Grizzly Bear RSA, and the Birds, Bats, and Amphibians RSA. As detailed in Chapter 5, Table 5.3-2, the spatial boundaries for the wildlife VCs have changed from the study areas presented in the AIR. A discussion on the spatial boundaries used in the assessment is provided below.

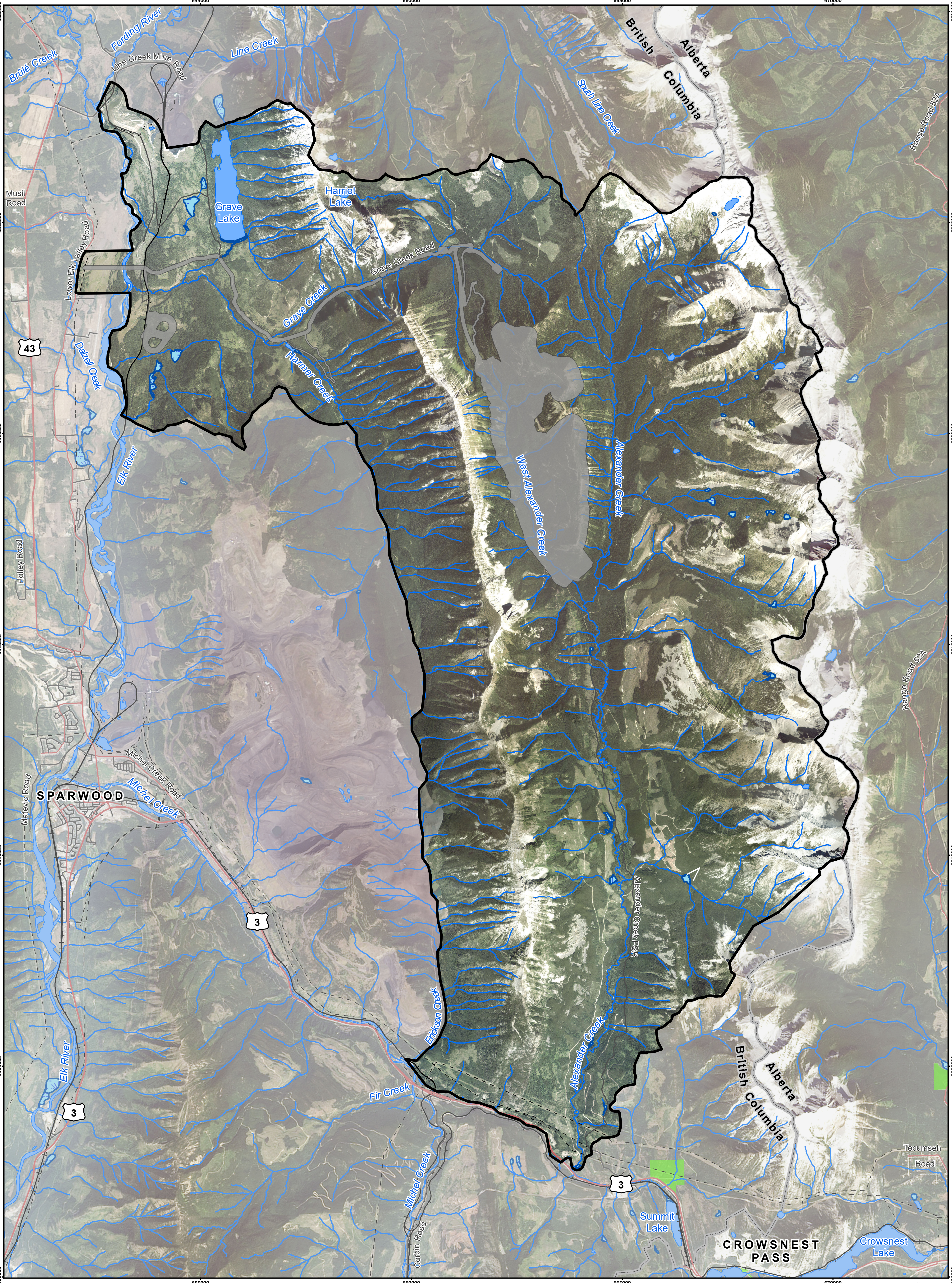
The Project footprint is the area of physical disturbance associated with the Project and encompasses all anticipated Project components, both temporary and permanent, covering approximately 13 square kilometres (km^2) or 1,283 hectares (ha; Figure 15.2-1). The centre of the Project is positioned approximately 12 km northeast of the District of Sparwood and approximately 5 km west of the provincial boundary between B.C. and Alberta (AB; Figure 15.2-1). The Project footprint consists of the proposed surface extraction areas (three pits - North Pit, East Pit, and South Pit); Mine Rock Storage Facility; mine infrastructure and support facilities, including the plant area (raw coal stockpile area and processing plant); clean coal transportation route; rail loadout facility and rail siding; and ancillary facilities (i.e., water supply, power supply, natural gas supply, water, sewage treatment, fuel storage and explosives storage).

Table 15.2-1: Measurement Indicators and Effects Pathways for Wildlife and Wildlife Habitat VCs

Valued Component Group	Measurement Indicators	Effects Pathways
Ungulate community, represented by: • Moose; • Elk; • Bighorn sheep; and • Mountain goat.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat such as structural stage, successional status, species composition, cover, and distribution and connectivity of habitat); and • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations).	VCs or VC groups identified as effects pathways for ungulates include: • Acoustic environment; • Soil quality and quantity; • Terrain; • Groundwater quantity and quality; • Surface water quantity; • Surface water quality; • Landscapes and ecosystems; and • Land use.
Carnivore community, represented by: • Grizzly bear; • Wolverine • American badger; • American marten; and • Canada lynx.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat such as structural stage, successional status, species composition, cover, and distribution and connectivity of habitat); and • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations).	VCs or VC groups identified as effects pathways for carnivores include: • Acoustic environment; • Soil quality and quantity; • Terrain; • Groundwater quantity and quality; • Surface water quantity; • Surface water quality; • Landscapes and ecosystems; and • Land use.
Bat community, represented by: • At-risk bat species (little brown bat, northern myotis, and eastern red bat).	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat and distribution of habitat for this species [including roost sites, hibernacula, and summering areas]); and • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations).	VCs or VC groups identified as effects pathways for bats include: • Acoustic environment; • Soil quality and quantity; • Groundwater quantity and quality; • Surface water quantity; • Surface water quality; • Terrain; • Landscapes and ecosystems; and • Land use.

Valued Component Group	Measurement Indicators	Effects Pathways
Bird community, represented by: • Migratory birds (represented by Olive-sided Flycatcher, Barn Swallow , and woodpeckers); • Northern Goshawk; and • American Dipper.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat such as structural stage, successional status, species composition, cover, and distribution and connectivity of habitat); • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations). • Direct migratory bird mortality from Project activities, such as clearing of sites, or birds and nests being in contact with contaminated waters; • Collision risk of migratory birds with any Project components or activities; • Changes to relative abundance, movements, and use of habitat, including wetlands, by migratory birds due to increased disturbance (e.g., noise, light, presence of workers); and • Direct and indirect effects to migratory birds resulting from increased exposure to contaminants of concern.	VCs or VC groups identified as effects pathways for birds include: • Acoustic environment; • Soil quality and quantity; • Groundwater quantity and quality; • Surface water quantity; • Surface water quality; • Landscapes and ecosystems; and • Land use.
Waterbirds within the RSA (aquatic health VC), represented by: • American Dipper; • Harlequin Duck; • Mallard; • Red-winged Blackbird; and • Spotted Sandpiper.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat, distribution of habitat for this species, changes to quality of habitat such as water quality and benthic invertebrates); and • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations)	VCs or VC groups identified as effects pathways for aquatic health VCs include: • Air quality; • Surface water quality; • Surface water quantity; • Groundwater quality; and • Groundwater quantity.
Amphibian community, represented by: • Western toad.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat such as structural stage, successional status, species richness, composition and cover, and distribution and connectivity of habitat for this species); • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations); and	VCs or VC groups identified as effects pathways for amphibians include: • Acoustic environment; • Soil quality and quantity; • Groundwater quantity and quality; • Surface water quantity; • Surface water quality;

Valued Component Group	Measurement Indicators	Effects Pathways
	• Changes in intermediate components and measurement indicators such as surface water quality and quantity.	• Landscapes and ecosystems; and • Land use.
Amphibians within the RSA (aquatic health VC), represented by: • Columbia spotted frog (amphibian health).	• Water quality parameters (including but not limited to nutrient and potential contaminant concentrations, temperature, pH, conductivity, metals), which incorporates assessment of air, groundwater quality and quantity, and surface water quality and quantity; • Predicted water quality concentrations in comparison to contaminant concentrations relevant to the growth, survival, and reproduction of amphibians; • Sediment quality, which incorporates assessment of air, groundwater quality and quantity, and surface water quality and quantity; • Amphibian presence/not detected as compared to baseline; and • Metal concentrations in tissue samples from a representative amphibian species (i.e., Columbia spotted frog).	VCs or VC groups identified as effects pathways for aquatic health VCs include: • Air quality; • Surface water quality; • Surface water quantity; • Groundwater quality; and • Groundwater quantity.
Insect Community: • Gillette's checkerspot.	• Habitat availability and distribution relative to baseline (e.g., changes to the available habitat such as structural stage, successional status, species composition, and cover, and distribution and connectivity of habitat for this species); and • Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations).	VCs or VC groups identified as effects pathways for Gillette's checkerspot include: • Acoustic environment; • Soil quality; • Soil quantity; • Groundwater quality; • Groundwater quantity; • Surface water quality; • Surface water quantity; • Terrain; • Landscapes and ecosystems; and • Land use.



Crown Mountain Coking Coal Project

Figure 15.2-1
Terrestrial Local Study Area (LSA)

LEGEND

- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

0 2 4
Kilometres
Scale 1:85,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada. Imagery Provided By Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

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Document Path: G:\GIS\2012 and Prior\126231 Crown Mountain\EA_Report\ExistingConditions\Wildlife\126231_EC_WH_TerrestrialLSA.mxd

Table 15.2-2: Rationale for Inclusion of Wildlife and Wildlife Habitat VCs

Valued Component	Rationale for Inclusion
Ungulate Community	
Moose	Moose are culturally valuable to Indigenous communities, important game species for local residents, and provide economic benefits to the guiding and tourism industries. Moose use a broad range of ecosystems including valley bottoms, mountain sides, and riparian habitat, are modifiers of forest ecosystems, and are key prey species for large predators.
Elk	Elk are socio-economically important to subsistence and recreational hunters and are drivers of ecosystem function through herbivory and providing prey for carnivores. Elk utilize a broad range of ecosystems including valley bottoms, mountain sides, grassland, riparian, and forested habitats.
Bighorn Sheep and Mountain Goat	Bighorn sheep are provincially blue-listed (B.C. CDC, 2015a), have high cultural and harvest value, and are associated with unique alpine grasslands. Sheep use re-vegetation areas, natural grasslands, rocky areas, and other habitats for foraging. The Elk Valley encompasses high value winter range habitat, as well as important migration/travel corridors (e.g., between Erickson Ridge and Sheep Mountain). The Elk Valley also encompasses an important population which has no history of wide-spread disease outbreaks that occur in other populations in the region (Poole et al., 2018). The Elk Valley Cumulative Effects Management Framework identifies bighorn sheep as a VC (Province of B.C., 2020a). Mountain goat are provincially blue-listed (B.C. CDC, 2015a), inhabit rugged alpine and subalpine areas, and are known to use the travel corridor between Erickson Ridge and Sheep Mountain. Mountain goat are hunted for recreational purposes in B.C. Given that mountain goat utilize similar habitats as bighorn sheep, impacts will be evaluated under the bighorn sheep VC.
Carnivore Community	
Grizzly Bear	Grizzly bear are provincially blue-listed and listed as Special Concern under SARA (2002; B.C. CDC, 2005a). Grizzly bear are included as a VC due to their high ecological, cultural, and harvest value. Grizzly bear are known to inhabit large ranges and be sensitive to human disturbance and development, which can impact their movement and utilization of habitats. The Elk Valley Cumulative Effects Management Framework identified grizzly bear as a VC (Province of B.C., 2020a).
Wolverine	Wolverine are provincially blue-listed and are listed as Special Concern under SARA (2002; B.C. CDC, 2005b). Wolverine are subject to regulated hunting and trapping in B.C. and are an important species from a conservation perspective. They exist at markedly low population densities as they are predominantly solitary with low reproductive rates and low juvenile survivorship. Wolverines are considered good indicators of ecosystem health due to their dependence on large, connected, and intact ecosystems (COSEWIC, 2014).

Valued Component	Rationale for Inclusion
American Badger	American badger are provincially red-listed and listed as Endangered under SARA (2002; B.C. CDC, 2015a). This sensitive species is known to occur in the Project area in the lower Alexander Creek watershed. Important habitat components for American badger in the Project area include denning, foraging, thermal cover (i.e., burrows used during winter torpor), security habitat and travel corridors (e.g., Grave Creek Canyon, Alexander drainage).
American Marten	American marten are culturally valuable to Indigenous communities and provide economic benefits to trappers. Marten occupy a wide range of forest habitat types and are sensitive to human disturbances (Hatler et al., 2003).
Canada Lynx	Canada lynx are good indicators for forest-dwelling wildlife due to their complex predator-prey dynamics and habitat associations. Canada lynx also have socio-economic importance to hunters and trappers. Canada lynx habitat, movement, and abundance are sensitive to human activity and development, making them a valuable wilderness indicator. They are important indicators of ecosystem health, as their regulation of snowshoe hare (*Lepus americanus*) populations influences vegetation community structure and diversity and trophic dynamics (Hatler and Beal, 2003).
Bat Community	
At-risk Bat Species (represented by little brown myotis, northern myotis, and eastern red bat).	These species of bat are of special conservation concern and the health of bat populations has been impacted by White Nose Syndrome. The northern myotis is provincially blue-listed, and both the northern myotis and little brown bat are listed as Endangered under SARA (2002; B.C. CDC, 2015a). The provincial status of the eastern red bat is unknown (B.C. CDC, 2015a). Bat hibernacula and nursery roosts are designated as Wildlife Habitat Features under the Wildlife Habitat Feature Order for the Kootenay Boundary Region (Ministerial Order M213, 2018).
Bird Community	
Olive-sided Flycatcher	The Olive-sided Flycatcher is provincially blue-listed and listed as Threatened under SARA (2002). This species occupies the edges of open to semi-open mature coniferous or mixed forests containing tall trees or snags for perching and live residual trees for nesting (Environment Canada, 2016a). The main threats to Olive-sided Flycatcher include habitat loss through commercial forestry, fire suppression, anthropogenic disturbances, insect declines, and pesticide use (Environment Canada, 2016a).
Barn Swallow	The Barn Swallow is provincially blue-listed and listed as Threatened under SARA (2002). This species typically nests on artificial structures areas associated with human and rural settings such as barns, garages, houses, bridges, and culverts (COSEWIC, 2011). The main threats to Barn Swallow includes habitat loss and degradation due to the replacement of older wood buildings with metal buildings; changes in insect prey; loss of nesting site to invasive species; parasitism, and human persecution (COSEWIC, 2011).

Valued Component	Rationale for Inclusion
Woodpeckers	Woodpeckers excavate cavities in dead and live trees in order to perform courtship rituals, nest, roost, and forage (Resource Standards Inventory Committee [RISC]; 1999a). This behaviour is a valuable ecosystem service that provides cavities to other species, including birds, insects, and small mammals (Martin et al., 2004). The woodpecker family is included as a representative group for cavity nesters and as an indicator of forest landbird species diversity.
Northern Goshawk	The Northern Goshawk *atricapillus* subspecies found in the East Kootenay is provincially blue-listed (B.C. CDC, 1999). Northern Goshawk are an indicator of old growth and mature forests and rely on late-successional forest for nesting and foraging.
American Dipper (Aquatic Health VC)	American Dipper are dependent on fast-flowing, mountain waterways and riparian habitat (Gillis et al., 2008). American Dipper are indicators of water quality and riparian health and are threatened by deforestation, bank erosion, and industrial pollution (Kingery and Willson, 2020). This species is susceptible to effects from mining operations including habitat degradation, changes in water flow patterns that affect food sources, and direct negative toxicological effects on reproduction or survival from heavy metal accumulation (Henny et al., 2005).
Harlequin Duck (Aquatic Health VC)	Harlequin Duck are migratory waterfowl that breed along steep mountain streams with dense riparian vegetation. This species exhibits delayed sexual maturity, low annual production, variable breeding success, and long lifespans (Goudie et al., 1994). Potential threats to Harlequin Ducks at breeding sites include degradation of riverine habitats by logging and mining projects, and disturbance from white-water rafting, fishing, and other recreational activities (Robertson and Goudie, 1999). Harlequin Duck are an important waterfowl hunting species and have the potential to be affected by selenium concentrations in aquatic prey such as benthic invertebrates.
Mallard (Aquatic Health VC)	Mallard are migratory waterfowl that utilize ponds, lakes, marshes, and flooded field habitats (B.C. CDC, 1994a). Mallard are an important waterfowl hunting species and have the potential to be affected by selenium concentrations in aquatic prey such as benthic invertebrates.
Red-winged Blackbird (Aquatic Health VC)	Red-winged Blackbird inhabit marshes, brushes and small trees along watercourses, and upland cultivated fields (B.C. CDC, 2010a). Although not a species of conservation concern, crop control measures and habitat loss from destruction of wetlands are major sources of mortality in some parts of the species' range (Ryder, 2015). This species has the potential to be affected by selenium concentrations in aquatic prey such as benthic invertebrates.
Spotted Sandpiper (Aquatic Health VC)	Spotted Sandpiper breed along lakes, rivers, and wetlands are the most widespread breeding sandpiper in North America. Localized threats include predation, development and loss of wetland habitat, and compromised water quality (Cornell University, 2019).

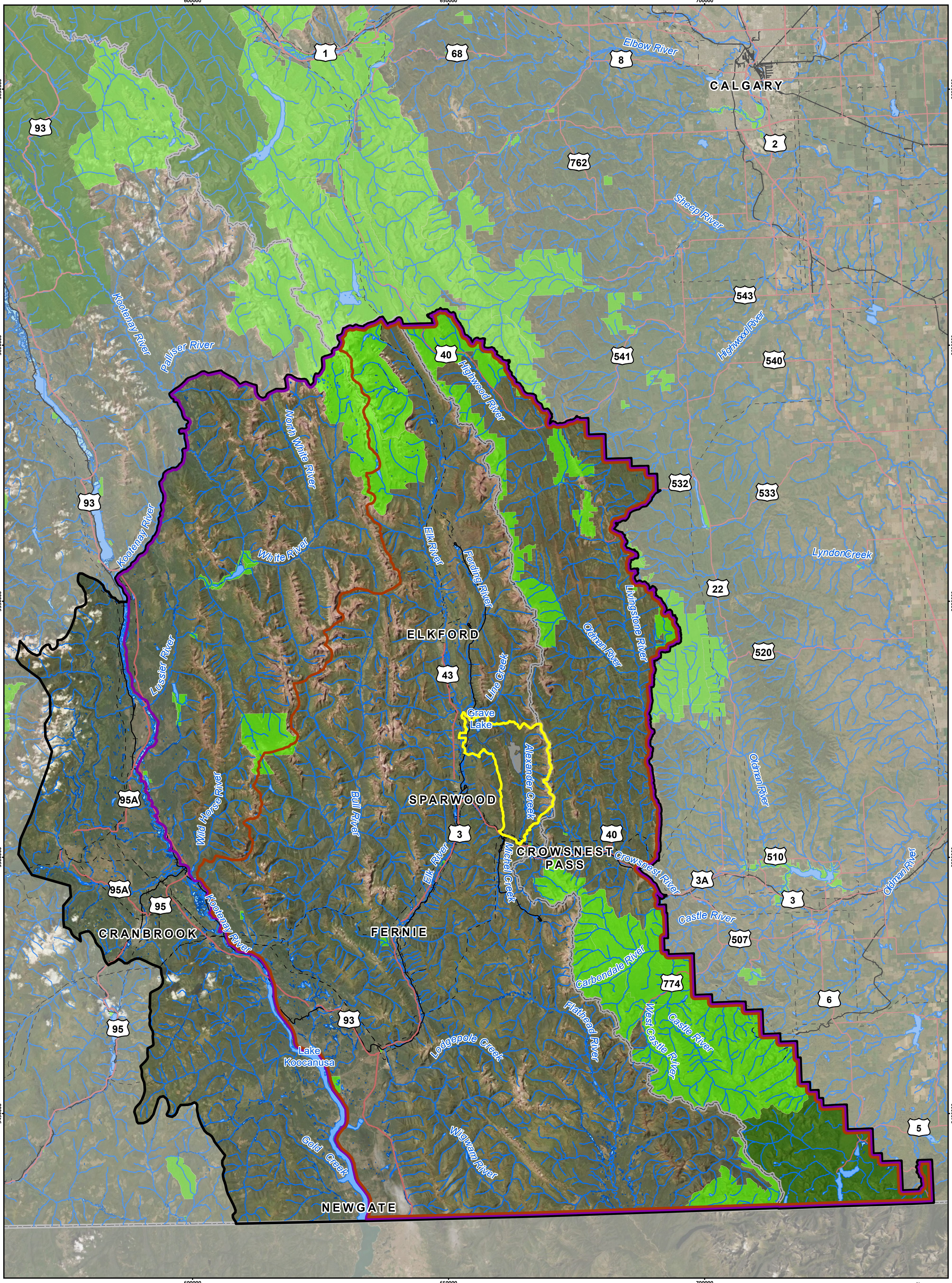
Valued Component	Rationale for Inclusion
Amphibian Community	
Western Toad	Western toad are provincially blue-listed and listed as Special Concern under SARA (2002). This species is known to be vulnerable to habitat deterioration and is a valuable environmental indicator for riparian areas and water quality (COSEWIC, 2002).
Columbia Spotted Frog[8] (Aquatic Health VC)	Columbia spotted frog are one of the most commonly observed amphibians in B.C. and inhabit lakes, ponds, and wetlands in the Elk Valley. This species has the potential to be affected by compromised water quality and selenium concentrations in aquatic prey such as benthic invertebrates.
Insect Community	
Gillette's Checkerspot	Gillette's checkerspot are provincially blue-listed and have designated Wildlife Habitat Areas in the Elk Valley. The Grave Creek provides potentially high quality habitat for this species. The distribution and population size of the species is relatively unknown in southeastern B.C. Habitat requirements, meta-population structure, and restrictive larval diet may contribute to its vulnerability (Cannings, 2004).

The Terrestrial Local Study Area is approximately 241 km^2 (Figure 15.2-1) and extends approximately 2 to 6 km beyond the Project footprint. The Terrestrial LSA was selected to encompass the landscapes, ecosystems and habitats that may experience changes from the Project resulting in direct and/or indirect effects. The Terrestrial LSA is based on the following criteria:

- Includes the maximum Project footprint;
- Includes all watersheds overlapping the Project footprint (i.e., Elk River, Alexander, Michel and Grave Creeks);
- Includes the existing diversity of riparian, forest, grassland, wetland and alpine ecosystems (i.e., wildlife species habitats); and
- Includes all known and anticipated wildlife movement corridors overlapping the Project footprint (e.g., the Continental Divide, the Grave Creek Canyon and Alexander-Michel Creek crossing (Apps et al., 2007; EAO, 2018).

The Terrestrial RSA is approximately 18,760 km^2 and was delineated to be sufficiently large to permit an evaluation of potential cumulative effects to individuals and populations (Figure 15.2-2). It is based upon the Province of B.C. Fish and Wildlife Management Units WMU 4-1, 4-2, 4-3, 4-21, 4-22, and 4-23, transboundary considerations with the Province of Alberta, and known wildlife populations. The Terrestrial RSA includes important landscape features known to facilitate wildlife movement (e.g., Elk River drainage), including mountain passes on the Continental Divide (e.g., Deadman and Racehorse Passes). It also includes all operating and proposed mines within the Elk Valley and several developed areas including the municipal boundaries of Sparwood, Elkford, Cranbrook and Kimberley.

[8] In the provincial application information requirements (AIR; EAO, 2018), Columbia spotted frog was selected as a VC under Aquatic Health and not under Wildlife and Wildlife Habitat. The assessment for Columbia spotted frog has been included in the Wildlife and Wildlife Habitat Assessment for convenience and consistency and is cross-referenced elsewhere in the application where relevant.



Crown Mountain Coking Coal Project

Figure 15.2-2
Terrestrial Regional Study Area (RSA), Grizzly Bear RSA, and Birds, Bats, and Amphibians RSA

LEGEND

- Terrestrial Regional Study Area
- Grizzly Bear Regional Study Area
- Birds/Bats/Amphibians Regional Study Area
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada. Imagery Provided By ESRI.

Map Created By: RB
Map Checked By: HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

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The assessment of cumulative effects for grizzly bear was conducted for the Grizzly Bear RSA, which is approximately 15,805 km^2 and includes both the South Rockies and Flathead) grizzly bear population units, WMUs 404, 402, 303, 400, and Waterton Lakes National Park in Alberta (Figure 15.2-2).

The assessment of cumulative effects for at-risk bat VCs, bird VCs, amphibian VCs, and Gillette's checkerspot was conducted for the Birds, Bats, and Amphibians RSA. The Birds, Bats, and Amphibians RSA is approximately 12,634 km^2 (Figure 15.2-2). It includes all operating and proposed mines within the Elk Valley and several developed areas including the municipal boundaries of Sparwood, Elkford, Fernie, and Crowsnest Pass.

15.2.3.2 Temporal Boundaries

Temporal boundaries include the time periods during which the Project is anticipated to result in potential effects on VCs (EAO, 2013). The temporal boundaries considered in the assessment include the temporal limits of the Project in terms of its Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure phases. The temporal boundaries of the Project used in the effects assessment include the timing of Project phases and activities as outlined in Table 15.2-3. Additional details on the Project phases and activities are provided in Chapter 3.

Table 15.2-3: Temporal Boundaries for the Wildlife and Wildlife Habitat Effects Assessment

Phase	Project Year	Length of Phase (Years)
Construction and Pre-Production	1 – 2	2
Operations	3 – 17	15
Reclamation and Closure	18 – 19	2
Post-Closure	20 – 34	15

15.2.3.3 Administrative Boundaries

Administrative boundaries refer to the limitations imposed on the assessment by political, economic, or social constraints and consider the jurisdiction in which the Project is located. No administrative boundaries were found to constrain the assessment of wildlife VCs.

15.2.3.4 Technical Boundaries

Technical boundaries, constraints imposed on the assessment due to limitations in the ability to predict the effects of the Project, include the following:

- Information on species ranges and population numbers in the region is variable and, in some cases, limited.
- Habitat availability (including habitat suitability, resource selection, and habitat use) was assessed from occupancy and habitat modelling. The models have inherent uncertainty and are an imperfect representation.
- There is limited knowledge of species and individual response to disturbance and the relationship to potential population-level effects are not well-understood.

The Project footprint has rugged topography and accessibility is variable. There were no portions of the Project footprint that could not have been visited or surveyed if there was a benefit or requirement to do so.

Additional technical boundaries relevant to individual wildlife species are identified in the respective VC sections, as applicable and appropriate.

15.3 Regional and Local Overview

The Project is located in the Elk Valley within the front ranges of the southern Rocky Mountains in southeastern B.C. The Elk Valley stretches more than 180 km from the mouth of the Elk River at Lake Koocanusa in the south, north to its headwaters in Elk Lakes Provincial Park near the Continental Divide along the B.C.-Alberta border (EV-CEMF, 2018; George et al., 1987). The Elk Valley forms part of the Continental Ranges of the Rocky Mountains. Elevations in the Terrestrial LSA range from 1,170 m above sea level (m asl) along the Elk River west of Grave Lake up to above 2,700 m asl along the Continental Divide at the northeast corner of the Terrestrial LSA (Figure 15.2-1). Erickson Ridge (2,480 m asl) is a major north-south limestone ridgeline from the Kootenay Group within the Terrestrial LSA that separates the Project from Teck Coal Limited's (Teck) Elkview Operations to the southwest. Immediately north of Erickson Ridge, across the east-west flowing Grave Creek is Sheep Mountain (2,460 m asl), of the same geologic origin. Sheep Mountain parallels Grave Lake as its western shore and is connected via a north-south ridgeline to Mount Salter (2,530 m asl) immediately south of the east-west Line Creek valley.

Current land uses within the Terrestrial LSA and Terrestrial RSA include: residential; recreational (e.g., hunting, all-terrain vehicles [ATVs], trails, fishing, hiking, etc.); exploration; resource; industrial; transportation; rangeland; agriculture; and forestry. Forestry, agriculture, and mining in the East Kootenay region have been ongoing for well over a century, with coal being the dominant resource extracted in the area. Wildfire suppression is practiced in the Elk Valley and there have not been any large wildfires in the last several years (Tourism Fernie, 2021; Province of B.C., 2020b). Controlled burning projects have been carried out to improve wildlife habitat and increase available forage in the Elk Valley, funded through the Fish and Wildlife Compensation Program (e.g., FLNRORD, 2020). Additional information on past and present land uses is provided in Chapter 1, Section 1.3.2.

High density of roads in the Elk Valley are associated with low habitat suitability for key wildlife species and have been highlighted as having high potential for affecting the function of aquatic ecosystem functioning and grizzly bear habitat. Ungulate risk of mortality via direct collisions with vehicles, and indirectly by increasing hunter access and facilitating predator movement (i.e., enhanced predation rates; RISC, 1999b; Guide Outfitters Association of British Columbia [GOABC], 2016). Locations of high collision risk were identified as Mitigation Emphasis Sites (MES; Lee et al., 2019). Two MES are located within proximity to the Terrestrial LSA, based upon significant clusters of animal-vehicle collisions reported during 2012-2017. The MES are located within the Alexander-Michel Creek crossing and approximately three km south of Sparwood (Lee et al., 2019).

Sensitive habitats are ecosystems that are ecologically sensitive or rare on the landscape and have considerable value to biodiversity. Sensitive habitats provide essential resources and features for species at risk and other regionally important wildlife. Within the Terrestrial RSA, sensitive habitats include riparian and wetland ecosystems, alpine ecosystems, avalanche chutes, grasslands, and old-growth forests. Further details on sensitive ecosystems in the Project study areas are provided in Chapter 13.

15.3.1 Biophysical Environment

To present the ecological context for the Project, the area is described using the B.C. (BEC) System (https://www.for.gov.bc.ca/hre/becweb/index.html). The BEC zones present within the Terrestrial RSA and LSA include Montane Spruce (MS), Interior Cedar-Hemlock (ICH), Interior Douglas-Fir (IDF), Engelmann Spruce - Subalpine Fir (ESSF) and Interior Mountain Heather - Alpine (IMA) (FLNRORD, n.d.). The BEC zones and broad ecosystem types present in the Landscapes and Ecosystems LSA are summarized in Table 15.3-1. For more details, refer to Chapter 13.

Table 15.3-1: Summary of Ecosystem Types within the Landscapes and Ecosystems LSA

Broad Ecosystem[1]	Area (ha)					% of Landscapes and Ecosystems LSA
	MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total	
Forested Site Series	4,966.7	3,942.1	1,069.0	0.0	9,977.8	77.4%
Grassland/Brushland Ecosystems	111.5	16.7	20.0	0.0	148.2	1.2%
Wetland Ecosystems	75.7	3.6	1.6	0.0	81.0	0.63%
Avalanche Ecosystems	9.4	371.2	119.4	29.1	529.0	4.1%
Subalpine Shrub Group	0.0	0.0	15.1	199.8	214.9	1.7%
Alpine Ecosystems	0.0	0.0	56.3	144.1	200.4	1.6%
Rock Ecosystems	19.0	252.0	270.8	191.0	732.8	5.7%
Disclimax Sites[2]	1.8	86.0	1.4	0.0	89.3	0.69%
Non-Vegetated Sites	227.2	28.5	0.0	0.0	255.6	2.0%
Anthropogenic Sites	486.5	4.2	0.0	0.0	490.7	3.8%
Flood Ecosystems	166.0	0.0	0.0	0.0	166.0	1.3%
Total	6,063.8	4,704.3	1,553.7	563.9	12,885.7	100.0%

Notes:
1. Ecosystem types based on Project-specific Terrestrial Ecosystem Mapping (TEM; Keefer Ecological Services Ltd., 2021; Appendix 13-A).
2. Disclimax sites refers to ecosystems where vegetation competition rather than environmental constraints maintains the non-forested state. Ecosystems found on steeply-sloping sites that are likely the result of slope failure.

15.4 Ungulate Community

15.4.1 Introduction

Ungulate species are identified as VCs under the provincial application information requirements (AIR; EAO, 2018). There are six ungulate species that are known to occur within the Terrestrial RSA: moose (*Alces alces*), elk (*Cervus elaphus*), bighorn sheep (*Ovis canadensis*), mountain goat (*Oreamnos americanus*), white-tailed deer (*Odocoileus virginianus*), and mule deer (*Odocoileus hemionus*). The ungulate community effects assessment focuses on species at risk, species with large space requirements and demonstrated sensitivities to disturbance, and species of social, cultural and/or economic importance (Table 15.2-2). The ungulate VC species assessed in this chapter are as follows:

- Moose;
- Elk;
- Bighorn sheep; and
- Mountain goat.

These species form the foundation by which potential effects on the ungulate community are evaluated in this Application/EIS.

Ungulates are important for ecosystem health and function through herbivory and providing prey for carnivores (Krebs, 2009; Shackleton, 1999). Ungulates influence vegetation structure, composition, succession, and diversity by grazing and/or browsing, dispersing nutrients, and compacting soils (Kjell et al., 2006; Smit and Putman, 2010; Vavra and Riggs, 2010). As large herbivorous mammals, habitat availability (i.e., quality and quantity) for ungulates is largely determined by forage availability and predation (Williams et al., 2002; Kjell et al., 2006). Winter range habitat is considered the most important factor limiting the carrying capacity of ungulate populations (Demarchi et al., 2000; Demarchi, 2004; Mountain Goat Management Team [MGMT], 2010; Poole, 2013). Ungulates are sensitive to landscape change, resulting in habitat loss (including reduction in the quality and amount of forage), habitat fragmentation (i.e., loss of connectivity) and both direct mortality (e.g., via collisions with vehicles), and indirect mortality (e.g., by increasing hunter access and facilitating predator movement; MGMT, 2010; Poole et al., 2018; B.C. CDC, 2019a).

15.4.1.1 Regulatory and Policy Considerations

Applicable provincial and federal legislation, guidelines, standards and BMPs related to the protection of wildlife and wildlife habitat in general is summarized in Section 15.1.1. Provided below are regulatory and policy considerations specific to ungulate VCs.

15.4.1.1.1 Moose

British Columbia currently supports widespread, abundant, and secure populations of moose (i.e., Yellow-listed; Provincial Conservation Status: S5; B.C. CDC, 1994b). The UWR designations pertaining to moose in the Terrestrial LSA include Alexander Creek and Michel Creek drainages, as well as Elk River tributaries (RISC, 1999b; Executive Order, U-4-006, 2005).

Moose Enhancement and Recovery Strategy

The Moose Enhancement and Recovery Strategy provides guidance for managers to collectively restore or enhance moose populations in the province (GOABC, 2016; Gorley, 2016). Recommendations include developing and adopting coordinated access management practices (reduce road densities, limit road/trail access, deactivation and revegetation of roads), and undertaking targeted habitat enhancement opportunities (increase palatable shrubs) to meet moose populations objectives (GOABC, 2016; Gorley, 2016).

BMPs for moose in the Southern Interior Forest Region include retaining a mosaic of forest stands older than 60 years and greater than 40% canopy closure particularly near important habitat features for moose (Wall et al., 2011). Desired conditions for moose winter range in the southern interior of B.C. have been extensively reviewed and summarized by the ungulate winter range technical committee (Ungulate Winter Range Technical Advisory Team, 2005).

15.4.1.1.2 Elk

British Columbia currently supports widespread, abundant, and secure populations of Elk (i.e., Yellow-listed; Provincial Conservation Status: S5; B.C. CDC, 2019a; 2019b). The UWR designations pertaining to elk in the Terrestrial LSA include the Elk River, Grave Prairie, and southern portions of Sheep Mountain and Crown Mountain (Executive Order, U-4-006, 2005; RISC, 1999b).

Kootenay Region Elk Management Plan

The Kootenay Region Elk Management Plan (B.C. MOE, 2010) focuses on population management and harvest strategies across the region. The stated goals of the Kootenay Region Elk Management Plan are the following:

1. Ensure healthy elk populations;
2. Maximize sustainable hunting and wildlife viewing opportunities;
3. Reduce elk grazing pressure where populations exceed local forage supply; and
4. Reduce elk crop depredation on private land.

The Elk Valley is one of seven Population Management Units (PMUs) in the Kootenay region managed by the Ministry of Environment (B.C. MOE, 2010). Management objectives within each PMU focus on population management, hunting and viewing opportunities, protection and enforcement, ecosystem health, and agriculture. Elk management objectives for the Elk Valley have been summarized in Table 15.4-1.

Table 15.4-1: Priority Wildlife Objectives of the Kootenay Elk Management Plan in the Elk Valley (2010-2014) [9]

Wildlife-related Resource	Priority Objectives	Wildlife-related Management Objectives
Population	High	• Maintain the current elk distribution (i.e., do not allow local population extirpation) • Maintain a post-hunting ratio of > 20 bulls to 100 cows, to ensure early, synchronous and successful breeding • Manage elk populations to provide sustenance and ceremonial needs for First Nations, as long as populations can sustain the harvest • Reduce automobile and train collisions with Elk
	Medium	• Focus population reductions on non-migratory elk where this segment of the population is conflicting with agriculture and/or negatively impacting winter range
Ecosystem Objectives	High	• Minimise negative impacts on grassland and shrub land ecosystem health by managing elk populations within the constraints of available forage (i.e., consider timing of grazing as early spring grazing has a greater impact than other times of the year) • Adjust elk population levels in consideration of the forage and habitat requirements of other wildlife species, such as bighorn sheep

[9] Taken directly from the Kootenay Elk Management Plan 2010-2014. Retrieved from http://www.env.gov.bc.ca/kootenay/emp/Kootenay%20elk%20management%20plan%202010-14%20(final).pdf

Wildlife-related Resource	Priority Objectives	Wildlife-related Management Objectives
Agriculture Objectives	Medium	• Reduce summer crop depredation on private land (caused by non-migratory elk)
Hunting	High	• Maintain or increase hunter days and number of elk hunters over the short term (balanced against the risk of overharvest) • Maintain or increase hunter days and number of elk hunters over the long term (balanced against the risk of overharvest • Increase hunter recruitment and retention
	Medium	• Maintain or increase elk harvest over the short and long term, given conservation constrains
Viewing	High	• Maintain opportunities to appreciate, study and view elk in their natural habitats

Elk Valley Cumulative Effects Management Framework

The Bighorn Sheep Cumulative Effects Assessment Report (Poole et al., 2018) recommends careful management of Elk population numbers and distribution as a method of preventing high grazing pressure in Bighorn sheep winter range habitat (Poole et al., 2018). A review of range conditions indicates that winter range conditions have declined since 1982 in the majority of identified sub-ranges (6 out of 8; Smyth, 2014; Poole et al., 2018).

15.4.1.1.3 Bighorn Sheep and Mountain Goat

Bighorn sheep and mountain goat are both species of Special Concern in B.C.; possessing characteristics that make them particularly vulnerable to human activities and natural events (i.e., Blue-listed; Provincial Conservation Status: S3; B.C. CDC, 2015b; 2015c). Both species are of concern largely due to past population declines and continued habitat loss (particularly winter range) and degradation as a result of land conversion, overgrazing, invasive plant species, and forest encroachment (B.C. CDC, 2015b; 2015c). The UWR designations pertaining to bighorn sheep and mountain goat in the Terrestrial LSA include Erickson Ridge and Sheep Mountain (Executive Order U-4-006, 2005).

Population Management Units (PMUs) have been delineated for bighorn sheep existing in the Kootenay region based on defensible and repeatable biological and ecological criteria (Poole and Ayotte, 2019). For bighorn sheep, a PMU is considered a metapopulation, and individual herds are considered subpopulations (Poole and Ayotte, 2019). The Elk River is a physical barrier for bighorn sheep and two distinct metapopulations are recognized accordingly (Poole and Ayotte, 2019). The Elk Valley West metapopulation exists west of Elk River and extends west of Sparwood in the south, and up to Elk Lakes Provincial Park in the north (PMU 4; Poole and Ayotte, 2019). The Elk Valley East metapopulation exists east of Elk River from Highway 3 in the south, to the upper reaches of Fording River drainage in the north (PMU 3; Poole and Ayotte, 2019).

A draft management plan was developed for the Kootenay Region that details objectives and strategies to maintain viable bighorn sheep populations and to protect and enhance the quality and quantity of habitat (Poole and Ayotte, 2019). For mountain goat in B.C., the province has developed a management plan with goals and objectives aligned with maintaining viable, healthy, and productive populations (MGMT, 2010).

Kootenay Bighorn Sheep Management Plan

The purpose of this management plan is to provide managers and decision makers with scientifically supported guidance for the management of bighorn sheep and their habitat in the Kootenay Region (Poole and Ayotte, 2019). This plan establishes management objectives for bighorn sheep, and identifies objectives, management tools, and harvest regulation alternatives. The management plan focuses objectives on population, harvest, habitat, health, and predation management (Poole and Ayotte, 2019). A summary of management objectives in the Elk Valley East and West populations is provided in Table 15.4-2. The broad-level management goals and objectives are the following:

1. Maintain viable and ecologically sustainable populations throughout suitable native range for ecological, cultural, economic, and social benefits using science-based management;
2. Manage populations to provide quality hunting opportunities;
3. Protect and enhance the quality and quantity of habitat throughout native range, considering human access, forest encroachment, logging, spread of invasive plants, and livestock forage competition; and
4. Manage impacts of predation on populations while preserving ecosystem integrity.

Table 15.4-2: Management Recommendations for Bighorn Sheep Threats and Concerns in the Elk Valley East[10]

Region	Threats/Concerns	Management Recommendations
Elk Valley East	• Habitat loss from coal mining operations will displace sheep, including from critical winter ranges. Mining activity in Castle Mountain/Chauncey Ridge and well as Greenhills Ridge North and Turnbull West are currently being planned • High elevation, red-listed rough fescue and Idaho fescue communities are highly threatened by mining and associated road construction. Within the Elk Valley East, less than 5 km^2 of the rough fescue community exists • High elevation winter range and windswept grasslands cannot be replaced once removed; recovery and remediation are not possible after conversion to open-pit mines as the exposed windswept terrain no longer exists • No current mechanism in place to protect these high-elevation grasslands • Declining forage quality on some ranges due to high elk numbers and the spread of invasive plants • Sheep range habitat quality north of the mines unknown • Disturbance of sheep because of extensive access to high elevations, especially within	• Restrict loss of winter range and critical habitat (primarily directed at coal mining) • Develop a mechanism to protect rare, red-listed, and important high elevation grasslands and bighorn sheep winter range from habitat disturbance • Limit further road development in PMU aligning with the CEMF assessment and recommendations (EV-CEMF Working Group, 2018) combined with delivery of road deactivation • Prevent expansion of current motorized/mechanical use of Weary Ridge • Monitor and restore winter range quality; address invasive plants • Assess winter range condition/health every 3-4 years using the Uplands Function Checklist Assessment Method (Fraser, 2006), and every 8-10 years using full ecological range assessments (such as Smyth, 2014)

[10] Modified from the Kootenay Bighorn Sheep Management Plan (Poole and Ayotte, 2019). Retrieved from https://ferniergc.com/documents/Kootenay%20BHS%20Draft%20mgmt%20plan%20%2023Apr19.pdf

Region	Threats/Concerns	Management Recommendations
	Alexander Creek and access from Alberta, which increases sheep vulnerability during the hunting season • High access from mining and logging roads has increased vulnerability to harvest • Winter snowmobiling in Aldridge Creek • Portions of PMU shared with Alberta, which manages to 4/5 curl regulation • PMU with the highest proportion of private property (19%), which has the potential to increase risk of contact and disease transmission from domestic sheep/goats	• North of the mines, evaluate sheep range habitat condition and conduct habitat enhancement for continued restoration where appropriate • Continue monitoring of ecosystem restoration initiatives • Restore fringe areas adjacent to grasslands through prescribed burning or conifer slashing

Elk Valley Cumulative Effects Management Framework

The Bighorn Sheep Cumulative Effects Assessment considered effects to the East and West Elk Valley populations of bighorn sheep with four measurement indicators; amount and suitability of winter range habitat, amount of annual range habitat, population trend, and human-caused mortality (Poole et al., 2018). Key recommendations to maintain and enhance bighorn sheep populations and their habitat are identified in three levels of management responses: operational, tactical, and strategic (Poole et al., 2018). The objective of these recommendations is to focus on preserving quality and quantity of winter range habitat, especially focusing efforts on improving at-risk winter range. Additionally, careful management of elk population numbers and distribution may be helpful at preventing high grazing pressure in bighorn sheep winter range habitat.

Management Plan for the Mountain Goat in B.C.

The purpose of this management plan is to guide management direction and prevent mountain goats from becoming at risk (B.C. MOE, 2010). The management goal is to “maintain viable, healthy and productive populations of mountain goats throughout their native range in British Columbia” (B.C. MOE, 2010). The stated management objectives of the Management Plan for the mountain goat in B.C. are the following:

1. Effectively maintain suitable, connected mountain goat habitat,
2. Mitigate threats to mountain goat; and
3. Ensure opportunities for non-consumptive and consumptive use of mountain goats are sustainable (Table 15.4-3).

Table 15.4-3: Recommended Management Actions for Mountain Goat Management in B.C.[11]

Management Objective	Specific Recommendation
Habitat Management	Review, update, and validate/refine habitat suitability modelling
	Inventory habitat used by mountain goats
	Identify habitat connectivity

[11] Taken directly from the Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia (Mountain Goat Managements Team, 2010). Retrieved from http://www.env.gov.bc.ca/wld/documents/recovery/management_plans/MtGoat_MP_Final_28May2010.pdf

Management Objective	Specific Recommendation
	Initiate and apply consistent habitat guidelines for mountain goats
	Apply management tools and mitigation techniques consistently to all development
Mitigate Threats: Disturbance Management	Use helicopter disturbance setbacks based on science
	Minimize industrial disturbance
	Minimize recreational disturbance
Mitigate Threats: Access Management	Reduce the amount and persistence of roads in and near mountain goat habitat
	Consider changes in access in harvest management decisions
	Consider the cumulative effects associated with access and integrate access management for all resource and recreational activities

15.4.2 Existing Conditions

This section describes the existing conditions of ungulates VCs in the Terrestrial LSA and Terrestrial RSA in support of the assessment of potential effects.

15.4.2.1 Existing Regional and Local Information

Existing local and regional data for ungulates were compiled by conducting a desktop assessment of background information for ecology and habitat requirements, regional occurrence and abundance, and regional and local connectivity in the Project study areas (i.e., the Project footprint, the Terrestrial LSA, and the Terrestrial RSA). Data and information sources included:

- Canadian Species at Risk Public Registry (Government of Canada, 2019);
- British Columbia Conservation Data Centre iMap Species and Ecosystems Explorer (British Columbia Conservation Data Centre [B.C. CDC], n.d.a.; n.d.b.);
- Scientific literature and government reports;
- Research from local non-governmental organizations (NGOs); and
- Other baseline studies for projects in the region.

15.4.2.1.1 Moose

Ecology and Habitat Requirements

As habitat generalists, moose inhabit a wide variety of ecosystems within the interior of B.C. including deciduous, mixed-wood, and mature coniferous forests, avalanche chutes, wetlands, floodplains and riparian habitats (Timmermann and McNicol, 1988; Poole, 2007; Gillingham and Parker, 2008; Gorley, 2016). Forage and nutrient requirements for moose are provided by a variety of deciduous and coniferous trees, shrubs, aquatic, and herbaceous vegetation (Renecker and Hudson, 1990; Poole, 2007). Optimal habitats are comprised of a diversity of stand types and age classes; providing a mosaic of open areas for browsing and mature coniferous forests for security cover and shelter for bedding and ruminating (Hamilton and Drysdale, 1975; Ontario Ministry of Natural Resources, 1984; Poole and Stuart-Smith, 2005; 2006; Poole, 2007; GOABC, 2016). In order to meet their nutritional requirements, moose also select for dense stands of highly concentrated forage, which largely occur in riparian and floodplain habitats and around wetlands, as well as regenerating burns, previously logged areas, and avalanche chutes (Poole and Stuart-Smith, 2006; Poole, 2007; GOABC, 2016).

Winter resource selection probability function models were developed for moose to support the Environmental Assessment (EA) for the Fording River Swift Project (Teck Coal Limited, 2014). The results showed that moose selected for lower elevation sites, particularly in locations without mature conifer tree cover and tended to avoid elevations above 1,800 m (Teck Coal Limited, 2014). Moose were found to select for valley bottoms with moderate solar exposure, as well as wetland and shrub-dominated conditions. The results indicated that quality moose habitats were located in the Elk Valley corridor and at low elevation tributaries including Coal Creek, Michel Creek, and Alexander Creek (Teck Coal Limited, 2014). Riparian corridors and lower elevations of the Elk River and its major tributaries (e.g., Fording River, Coal Creek, Lodgepole Creek, and Alexander Creek) were identified as potential moose movement corridors (Teck Coal Limited, 2014). Highway 3 and 43 were identified as potential disruptions to seasonal moose habitat connectivity (Teck Coal Limited, 2014).

Landscape disturbance including fires and logging can increase habitat quality for moose by removing overstory cover and creating early seral habitats that provide higher levels of forage (e.g., willows and other nutritious shrubs) than mature stands (Poole and Stuart-Smith, 2006; Poole, 2007; GOABC, 2016; Gorley, 2016). Browse production peaks approximately 15–30 years post disturbance (Peek, 1998). Moose populations have generally expanded within portions of the Kootenays over the last 40 to 50 years, notably in areas associated with early seral habitat resulting from extensive logging, such as in the Elk Valley (Halko et al., 2000; Poole, 2007). Conversely, the removal of old and mature coniferous forest cover (i.e., logging) can be detrimental for moose, as forests provide security cover from predation, access to browse (i.e., reduced snow depths, forage), and shelter from the elements (i.e., sun and severe winters; Ager et al., 2003; Poole and Stuart-Smith, 2005; Poole, 2007; van Beest et al., 2012; FLNRO, 2015; GOABC, 2016).

Roads increase moose mortality risk directly via collisions with vehicles, and indirectly by increasing hunter access and facilitating predator movement (i.e., enhancing predation rates; GOABC, 2016; RISC, 1999b). Further, an increase in the extent of linear access features (e.g., roads and off-road tracks) can result in reduced moose habitat values (e.g., security cover and access to forage) and a reduced population density (RISC, 1999b; Rea, 2003; Fahrig and Ryntwinski, 2009; Harris et al., 2014; FLNRO, 2015; GOABC, 2016; Gorley, 2016).

Mining operations and reclamation practices in the Terrestrial RSA have reduced the availability of deciduous browse and coniferous forest cover for moose (Teck Coal Limited, 2014; Teck Coal Limited, 2015a). Reclaimed mining areas in the Terrestrial RSA are primarily dominated by graminoids or sparse conifers, which offer limited forage value for moose (Teck Coal Limited, 2014). Further, grazing and trampling resulting from high levels of use and selection for early seral habitats by elk and bighorn sheep may impede forest regeneration on mined landscapes, thus reducing moose habitat availability (Teck Coal Limited, 2014; 2015a; GOABC, 2016).

Regional Occurrence and Abundance

Moose are one of the most widely distributed ungulates in B.C. and occur over most of the Kootenay region (GOABC, 2016; FLNRO, 2015). Within the Terrestrial RSA, moose generally undergo seasonal movements that are largely determined by the depth and duration of snow cover and are thus closely tied to elevation (Poole and Stuart-Smith, 2005; Poole and Stuart-Smith, 2006; Poole, 2007; GOABC, 2016). During spring (May-June), cows move to birthing grounds that offer security from predators and quality forage (Gillingham and Parker, 2008). Calving moose in the Kootenay region often use pine dominated and subalpine stands, and less open, logged, and spruce dominated habitats (Poole and Stuart-Smith, 2004). Moose tend to remain at higher elevations (subalpine) until late autumn, when they return to valley bottoms and frequent riparian habitats that cut through burns, older logged areas, and wetland complexes (Poole and Stuart-Smith, 2004; 2006; GOABC, 2016; Gorley, 2016). Winter is an energetically costly season for moose due to limited forage availability and the energy associated with travel through snow (Poole and Stuart-Smith, 2005). Moose movements are impeded at snow depths of 50 to 70 centimetres (cm), which is likely a critical threshold determining moose late winter range distribution in the Elk Valley (Langley, 1993; Van Dyke et al., 1995; D'Eon, 2004; Poole and Mowat, 2005; Poole and Stuart-Smith, 2005; 2006; Poole, 2007). Within late winter ranges, habitat selection is driven by preferred forage (i.e., dense browse stands; Poole and Stuart-Smith, 2005; Poole and Stuart-Smith, 2006; GOABC, 2016).

Moose are primarily solitary in their habits, although the species may form groups when high quality forage is abundant (Poole and Stuart-Smith, 2005; Gorley, 2016). Moose exhibit site fidelity to (seasonal) home ranges which rarely exceed 5-10 km^2 but can vary in size depending on resources in addition to sex, age, and reproductive status of the individual (Poole and Stuart-Smith, 2005; Poole, 2007).

B.C. currently supports an estimated 110,000 to 185,000 moose (GOABC, 2016). Moose densities in B.C. appear to be well below the carrying capacity of the species habitat, and provincial estimates suggest a decline in several populations (FLNRO, 2015; GOABC, 2016). There are approximately 4,000 to 7,000 moose in the Kootenay region with a stable regional population trend (Government of B.C., 2017). In the Elk Valley (WMU 4-23) there is an estimated 509 individuals and a corresponding population density of 0.38 individuals/km^2 (Gooliaff and Stent, 2018). These results indicate an approximately 50% local population decline in the Elk Valley over the past decade (i.e., from 0.6 moose/km^2 in 2005/06; FLNRORD, 2018). Cow-calf ratios indicated high recruitment (41 calves: 100 cows; FLNRORD, 2018) suggesting that population declines are due to low adult survival. Bull-cow ratios in the Elk Valley were 49 bulls to 100 cows in 2018 (Province of B.C., 2020a).

Regional and Local Connectivity

Human activities have the potential to alter the connectivity of moose in the Terrestrial RSA through mortality and landscape changes resulting in a reduction in the quality and amount of habitat. Moose cross highways and railways in the Elk Valley and collisions with vehicles and trains is not uncommon (Clevenger et al., 2010; Lee et al., 2019). The Highway 3 and 43 transportation corridors are recognized as areas of high collision risk and/or potential barriers of movement, which can lead to loss of gene flow and population fragmentation in moose (Clevenger et al., 2010; Lamb et al., 2018; Lee et al., 2019). Other human factors that likely may act as landscape barriers or impede movement by moose include mining and reclamation activities and urban centres (Gorley, 2016; Teck Coal Limited, 2014).

Low resistance movement corridors connect important habitat patches that are used seasonally and facilitate access to important resources including mineral licks and calving sites within daily or seasonal ranges (Poole and Stuart-Smith, 2006; Gorley, 2016). Movement habitats for moose are generally linear, include riparian areas, roads, trails, avalanche chutes, and mountain passes (Bowyer et al., 2003; Poole and Stuart-Smith, 2006). Studies of moose have identified several key linkage areas in the Terrestrial RSA that maintain connectivity between seasonal habitats and populations (Poole and Stuart-Smith, 2004;

Poole and Stuart-Smith, 2006; Poole et al., 2008; Teck Coal Limited, 2014). Some of these are within the Terrestrial LSA, including:

- Southeast and southwest facing slopes along riparian corridors of Alexander Creek and West Alexander Creek; and
- Corridors along Harmer Creek and Erickson Creek drainages.

Additional linkage areas in the Terrestrial RSA include:

- Southeast and southwest facing slopes along riparian corridors of Fording River, Coal Creek, Lodgepole Creek;
- Corridor between upper Flathead and Lodgepole drainages; and
- Corridor from upper Flathead west to the Elk Valley.

Transboundary Considerations

Moose are highly mobile animals with known populations occupying both sides of the border with Alberta. It is therefore highly likely that individuals exhibit seasonal or regular transboundary movements. Known or anticipated movement corridors along the Continental Divide include the Crowsnest, Deadman, and Racehorse passes.

15.4.2.1.2 Elk

Ecology and Habitat Requirements

As habitat generalists, elk utilize a wide variety of ecosystems including upland and lowland forests but show preference for grassy valley benches, floodplains, and grassy slopes (Poole and Mowat, 2005; Naylor et al., 2009; Paton, 2012). In order to meet their nutritional requirements, elk select for graminoid dominated ecosystems (including crops, pasture, and reclaimed mine spoils), as well as dense stands of concentrated forage occurring in riparian, floodplain and wetland habitats, regenerating burns, previously logged areas, and avalanche chutes (Poole and Mowat, 2005; Naylor et al., 2009; Sawyer et al., 2010; Paton, 2012; Szkorupa et al., 2013). Elk habitat can be characterized as a mosaic of forested cover, high visibility habitats (e.g., grasslands, brushlands, sedge meadows), and wooded linear features (corridors). Elk prefer a mosaic of transitional habitats between forests and clearings, including young burns and riparian zones (Safford, 2004; Poole and Mowat, 2005; Naylor et al., 2009; Paton, 2012). Optimal habitats include a mosaic of graminoid dominated vegetation communities, early seral stages (e.g., burns, cutblocks, avalanche chutes), and wooded patches (Thomas and Toweill, 1982; Poole and Mowat, 2005; Naylor et al., 2009; Paton, 2012). Patches of forest provides security cover (e.g., predation, hunting, disturbance) and shelter from the elements, while open areas provide rich sources of grasses, sedges, and forbs (Poole and Mowat, 2005; Hebblewhite and Merrill, 2009).

Forage availability (quality and amount), particularly during winter, is considered the main factor limiting elk populations (Skovlin et al., 2002; Taylor and Brunt, 2007; Sawyer et al., 2010; Smallidge et al., 2010; Philips and Szkorupa, 2011). Summer forage availability contributes to reproductive performance and overwinter survival (Bender et al., 2008; Cook et al., 2013).

Winter resource selection probability function models were developed for elk to support EAs for the Fording River Operations Swift Project (Teck Coal Limited, 2014) and Elkview Operations Baldy Ridge Extension Project (Teck Coal Limited, 2015b). Both models showed that elk selected for areas characterized by low elevations with high greenness vegetation index values (e.g., south-facing grass dominated ecosystems, deciduous forest cover, herbaceous and shrub dominated ecosystems). Elk selected against areas with deep snow, existing coal mine pits, and mine rock dumps (Teck Coal Limited, 2014). Elk also showed a greater selection for grass-dominated ecosystems on mine sites than off mine sites (Teck Coal Limited, 2014). Both of these models showed that during winter, forage availability was more important to elk than sensory disturbance because elk selected for active mines and low elevation valleys with high-human activity (Teck Coal Limited, 2014; 2015b).

Landscape disturbance including fire and logging can increase habitat quality for elk by removing overstory cover and creating early seral habitats that provide higher levels of forage than mature stands (Thomas and Toweill, 1982; Poole and Mowat, 2005; Paton, 2012; Szkorupa et al., 2013). Conversely, the removal of forest cover from logging can diminish landscape level habitat quality for elk by reducing and/or removing required thermal and security cover required for thermoregulation and avoiding predators during rest, rumination, and rearing young (Hebblewhite and Merrill, 2009; Kjell et al., 2006; B.C. MOE, 2010). Forest cover is an important habitat component for elk; providing security cover from predation, access to forage in winter (i.e., reduced snow depths), and shelter from the elements (i.e., sun and severe winters; Thomas and Toweill, 1982; RISC, 1999b).

Modelling of historical fire dynamics indicates that the pre-development landscape (prior to 1890) contained a greater proportion of grasslands, younger forests, and open old forest ecosystems than the 2020 Baseline assessment (Taylor et al., 1998; Davis, 2009). In addition to increasing the quantity of grasslands, old open forests, and early seral habitats, it is likely that wildfires also improved forage quality for elk (White, 2001). Prescribed fires consistently shifted vegetation composition towards forage species preferred by elk and increased the amount of herbaceous forage available (Smyth et al., 2003). It is therefore likely that historical wildfires enhanced grazing and browsing conditions for elk in the Terrestrial RSA.

Increased agriculture and ranching developments in the Terrestrial RSA during the early 1900s resulted in the creation of new grassland habitats that would have benefited elk (Szkorupa and Mowat, 2010; VAST Resource Solutions Inc., 2013). Habitat availability for elk may have been reduced during the mid 1900s as fire suppression became a widely accepted management practice (EV-CEMF Working Group, 2018). The reduction in habitat quality for elk due to fire suppression was likely somewhat compensated by forestry practices that provided a mosaic of forested and early seral habitats preferred by elk (Jenkins and Starkey, 1996; Visscher and Merrill, 2009). Research has shown that logged habitats can provide elk with suitable forage for approximately 30 years (Visscher and Merrill, 2009).

Elk frequently habituate to human disturbance and are often associated with built-up areas and roadways due to the prevalence of early seral habitats and planting of agronomic legumes and grasses (Anderson et al., 2005; Dodd et al., 2007). Conversely, elk are known to avoid humans in regions and/or seasons where they are hunted (Ciuti et al., 2012). In systems where predators are few or absent, grazing patterns for elk become concentrated and include habitats that would be otherwise high-risk (i.e., riparian areas; Ripple and Beschta, 2004; Fortin et al., 2005; Poole et al., 2013; Painter et al., 2015). Such a scenario can lead to elk over-exceeding their local carrying capacity due to increased herding and milling behaviour, resulting in trampled and overgrazed (e.g., riparian) habitats and loss of biodiversity (Ripple et al., 2001; Painter et al., 2015). High grazing pressure (i.e., overgrazing) may cause vegetation composition shifts (including an increase in invasive species; Smyth, 2014) from palatable grasses to woody species or less desirable forbs (Briggs et al., 2005; Poole et al., 2013).

Portions of high elevation grassland elk habitat in the Terrestrial RSA have been removed by coal mining since 1950 (Scales, 2006; Swain, 2007). During the 1960s, reclamation practices on coal mining operations emphasized planting of agronomic grasses to rapidly establish plant cover and to compensate adverse effects on elk (Lowenberger, 1973). Reclaimed mining areas in the 2020 Baseline therefore are primarily represented by agronomic grasslands (Lowenberger, 1973). As a result, reclaimed mining areas tend to be heavily used by elk in the Terrestrial RSA and habitat availability has likely increased (Teck Coal Limited, 2014). Elk show strong selection for grassland habitats on reclaimed mine sites in the Elk Valley, and several herds remain on mining habitats year-round (Gibson and Sheets, 1997). It is likely that elk are selecting for reclaimed mining areas partially due to the vegetation conditions in addition to the inferred protection from predators (Christianson and Creel, 2010; Olsson et al., 2007; Sawyer, et al., 2010; Smallidge et al., 2010).

Although planting of agronomic legumes and grasses can compensate or subsidize forage amounts for elk, winter ranges comprised of native grasses such as rough fescues (*Festuca campestris*) are considered higher quality because these plants retain their protein values through winter months (Willms et al., 1997; Freeze et al., 1999; Clark et al., 2000). Further, planting of agronomic legumes and grasses can result in changes in elk habitat utilization and migratory behaviour, which can result in range degradation, conflict with farmers, and apparent competition with other ungulates including Bighorn Sheep (Hebblewhite et al., 2006; Paton, 2012; Poole et al., 2013; Poole, 2017). Within the Elk Valley, approximately 50% of elk remained within valleys or on individual mines year-round (most likely due to the historic planting of agronomic legumes and grasses) with the remainder returning to high elevational ranges each spring (Poole, 2017). High grazing pressure results in the increase of invasive species, reduced root development, soil creep, and changes to vegetation structure that deteriorate the quality and function of alpine grasslands (Holechek et al., 2001; MacKenzie, 2004; Poole et al., 2018).

Regional Occurrence and Abundance

Within mountainous regions, elk generally undergo seasonal migrations that are driven by access to quality forage; moving from valley bottoms in winter to lush alpine and subalpine basins and avalanche chutes in summer (Safford, 2004; Poole and Mowat, 2005; Hebblewhite and Merrill, 2009; Hebblewhite et al., 2010; Sawyer et al., 2010; Paton, 2012). During summer, elk are more broadly distributed, frequenting southern exposure slopes, grasslands, and alpine habitats that support quality vegetation (Thomas and Toweill, 1982; Safford, 2004; Hebblewhite and Merrill, 2009; Sawyer et al., 2010; Smallidge et al., 2010; Paton, 2012). High elevation calving grounds offer lower risk of predation and quality forage (Gillingham and Parker, 2008; Hebblewhite and Merrill, 2009; Paton, 2012). During winter, elk are limited by snow cover (i.e., <50 cm) and exposed forage (i.e., south facing aspects, low elevation grassy valley benches, and closed canopy forest; Boyce, 1991; Poole and Mowat, 2005; Hebblewhite and Merrill, 2009; Poole et al., 2009; B.C. MOE, 2010; Paton, 2012).

Elk are herd forming ungulates that tend to occupy relatively large home ranges that contain a mosaic of large patches of forage (i.e., grasslands, brushlands, open forests, pastures, crops, young burns) and wooded security cover (Thomas and Toweill, 1982; Hudson and White, 1985; Wemmer, 1987; Shipley, 1999). Home ranges in the region rarely exceed 50 km^2 but vary in size depending on forage quality and quantity in addition to sex, age, and reproductive status of the individual (Thomas and Toweill, 1982; Paton, 2012; Stent and Phillips, 2013; Poole, 2017). As with other ungulates, elk home ranges are smallest during winter as deep snow increases energy expenditure for movement and buries preferred forage (Thomas and Toweill, 1982; Gillingham and Parker, 2008; Krebs, 2009; Poole et al., 2009).

There are approximately 15,000 to 24,000 elk in the East Kootenay region with a stable regional population trend (<20% change over last 3 years; Government of B.C., 2017). Conversely, a local elk population inventory (2017/2018) in the Rocky Mountain Trench resulted in an estimated 6,671 individuals with a corresponding density of 2.1 individuals/km^2 (Gooliaff and Stent, 2018). These results indicate a 53% decline over the past decade (i.e., from 14,115 elk in 2007/2008; Philips et al., 2008). The current elk population in the Rocky Mountain Trench is below the B.C. ENV population management objective of retaining 8,469-11,292 individuals (Philips et al., 2008). The population decline is poorly understood but attributed to legal harvest of cows that was implemented in an effort to reduce conflicts on agricultural lands during 2010-2012, followed by poor calf recruitment during 2013-2017 (Gooliaff and Stent, 2018).

As a result of agricultural conflicts and overgrazing by non-migratory elk, the Sparwood Fish & Wildlife association initiated a study to examine elk movement and survival in the Elk Valley (n = 78 cows; Poole, 2017). Annual survival rates (2015-2017) ranged from 0.86-0.90, which are consistent with survival rates observed in the East Kootenay Trench in prior years (0.92 during 1986-93 and 0.81 during 2007-10; Poole, 2017). Inventory trends suggest winter severity has contributed to low calf survivorship (Gooliaff and Stent, 2018). An elk population inventory (2013) in the Elk Valley (WMU 4-23) resulted in an estimated 2,772 individuals and a corresponding (winter) population density of 1.7 individuals/km^2 (Szkorupa et al., 2013). The inventory observed relatively high calf ratios of 25 calves: 100 cows and bull ratios of 24 bulls: 100 cows (Szkorupa et al., 2013). The desired elk post hunt bull to cow ratio in B.C. is above 20 bulls to 100 cows (B.C. MOE, 2010).

Regional and Local Connectivity

Movement corridors for elk are generally linear and can include riparian areas, roads, trails, avalanche chutes, and mountain passes (Hebblewhite and Merrill, 2009; Paton, 2012; Poole, 2017). Elk are known to exhibit high fidelity to trails and specific routes (Hebblewhite and Merrill, 2009; Sawyer et al., 2010; Paton, 2012). Migrations of up to 63 km between summer and winter range habitats have been recorded within the Elk Valley (Poole and Mowat, 2005). Human activities have the potential to alter the connectivity of elk habitats in the Terrestrial RSA through mortality and changes resulting in a reduction in the quality and amount of habitat. Elk frequently cross highways (e.g., Highway 3 and 43) and railways in the Elk Valley and collisions with vehicles and trains are considerable (Clevenger et al., 2010; Lee et al., 2019). Recorded train strikes of elk in the Elk Valley are substantial (e.g., 30 recorded train strikes in 12 months; Poole, 2017). This high collision risk and/or potential barrier of elk movement may result in habitat fragmentation and a loss of connectivity for elk populations (Clevenger et al., 2010; Lamb et al., 2018; Lee et al., 2019).

Low resistance elk habitats in the East Kootenay region include dry grassland valley bottoms, fields, and open-canopied forests (B.C. MOE, 2010). Studies of elk have identified several key linkage areas in the Terrestrial RSA that maintain connectivity between seasonal habitats and populations (Gibson and Sheets, 1997; B.C. MOE, 2010; Paton, 2012; Teck Coal Limited, 2014; Poole, 2017; Poole, 2018; Lee et al., 2019). Some of these are within the Terrestrial LSA, including:

- A north-south corridor that connects the Erickson Ridge to Sheep Mountain (Grave Creek Canyon);
- Corridors of forested habitat along the Elk River's tributaries;
- A north-south corridor along Natal Ridge;
- Corridor from Natal Ridge to Alexander Creek drainage;
- Corridor from Natal Ridge to Harmer Valley via Erickson Valley; and
- A north-south corridor that connects Alexander Creek and Michel Creek.

Additional linkage areas in the Terrestrial RSA include:

- Rocky Mountain Trench linkage;
- A north-south corridor at low to mid-slopes along the Greenhills Ridge;
- Morrissey to Fernie linkage;
- Hosmer to Sparwood Linkage; and
- Elko to Morrissey Linkage.

Transboundary Considerations

Elk are highly mobile animals that exhibit migratory behaviour. Elk occupy both sides of the B.C.-A.B. border and were recorded using transboundary mountain passes within the Terrestrial LSA. It is therefore highly likely that some individuals or herds exhibit regular transboundary movements. Known or anticipated movement corridors along the Continental Divide include the Crowsnest, Deadman, and Racehorse passes.

15.4.2.1.3 Bighorn Sheep and Mountain Goat

Ecology and Habitat Requirements

Bighorn sheep and mountain goat are both uniquely adapted for life in rugged, high-elevation landscapes and are mixed feeders; adapted for either browsing or grazing (Hofmann, 1989; Clauss et al., 2008). In order to meet their nutritional requirements, both species forage on a wide variety of graminoids, forbs, and shrubs, in descending order of importance (Laundré, 1994; Krausman, 1999; Janis et al., 2005; MGMT, 2010). Habitat selection for both species is primarily determined by access to year-round forage and anti-predation constraints (Festa-Bianchet, 1988; Demarchi et al., 2000; MGMT, 2010). Bighorn sheep and mountain goat both require open, high visibility habitats (i.e., avoid forests) that provide access to quality forage and terrain to escape predators (Geist, 1971; Demarchi et al., 2000; Côté and Festa-Bianchet, 2003; Janis et al., 2005). Bighorn sheep and mountain goats undergo seasonal movements between low alpine habitats in winter to high alpine habitats and avalanche chutes in summer (Geist, 1971; Hofmann, 1989; Krausman, 1999; Côté and Festa-Bianchet, 2003; Demarchi, 2004; Hamel et al., 2009; Poole and Ayotte, 2019). Essential components of winter habitat include access to forage (e.g., warmer solar aspects, snow depth less than 15 cm) in close proximity to escape terrain (Jalkotzy, 2000; DeCesare and Pletscher, 2006; Kinley, 2007; Bleich et al., 2009; Poole et al., 2009; MGMT, 2010; Kuzyk et al., 2012; Poole, 2013).

Winter resource selection probability function models were developed for bighorn sheep using aerial survey locations of bighorn sheep (1979-2009) inhabiting the Elk River valley to support the EAs for the Fording River Operations Swift Project (Teck Coal Limited, 2014) and Elkview Operations Baldy Ridge

Extension Project (Golder Associates Ltd., 2015a). Both models showed bighorn sheep selected for complex terrain and slopes with high solar radiation, reclaimed mine lands, grassland ecosystems, and habitats between 1,700 to 2,500 m. Radio telemetry data indicated extensive use of the Greenhills and Fording River areas. Within the Terrestrial LSA, bighorn sheep were observed most frequently along Erickson Ridge (Teck Coal Limited, 2015a). Bighorn sheep are commonly observed on the Elkview Operations mine and use has increased in recent years, specifically near reclaimed areas and high walls (Teck Coal Limited, 2016). Bighorn sheep winter range/high elevation grasslands were present historically on the Loop Ridge within the Michel Coking Coal Project LSA (CanAus Coal Limited, 2015).

Mining, forestry, hydroelectric, agricultural, and urban developments have resulted in habitat loss and degradation for bighorn sheep and mountain goat in the Terrestiral RSA (Hatler, 2001; Wilson and Shackleton, 2001; Poole and Adams, 2002; Demarchi, 2004; Poole et al., 2006; Poole, 2013). Winter range habitat has been significantly reduced for bighorn sheep across their range in B.C. (Demarchi and Demarchi, 1994). It is estimated that suitable winter range habitat is <50% of the historical distribution due to open-pit mines, highways, forest access roads, forests succession, and competition with livestock (Demarchi, 2004). In addition, both bighorn sheep and mountain goats are sensitive to human disturbances including helicopter activity, ski resorts, roads, and off-highway vehicles (Bleich et al., 1994; MGMT, 2010). Such disturbances can cause stress and a reduction in foraging efficiency leading to displacement and habitat loss (Demarchi, 2004; MGMT, 2010). Mountain goats tend to be more sensitive to human disturbances including helicopter activity and rock blasting associated with forestry, recreation, and/or mining practices (Côté, 1996; MGMT, 2010; White and Gregovich, 2017).

Coal mines in the Elk Valley have reduced habitat availability for bighorn sheep and mountain goat by physical removal, invasive plant spread, and overgrazing (Poole et al., 2006; Smyth, 2014; Poole et al., 2018; Poole and Ayotte, 2019). During the 1960s and early 1970s, portions of bighorn sheep habitat in the Elk Valley were permanently lost and/or damaged during exploration for coal with heavy machinery (Demarchi, 1968; 1977). Other examples of industrial projects that resulted in a permanent loss or alteration of bighorn sheep habitat include the Elko and Aberfeldie Dam projects and open-pit mining and overburden dumping in the Elk Valley (e.g., Line Creek; Demarchi and Demarchi, 1987; Demarchi, 2004). High elevation grasslands used as winter range cannot be replaced or remediated once they have been converted to open-pit mines (Poole and Ayotte, 2019).

During the 1960s, reclamation practices on coal mining operations emphasized planting of agronomic grasses and legumes to rapidly establish plant cover and to compensate for adverse effects on wildlife (Lowenberger, 1973). As a result, active and reclaimed mine sites that possess and/or have reproduced characteristics of effective summer bighorn sheep range (i.e., high visibility grasslands near steep and/or rugged terrain) tend to be heavily used by bighorn sheep (MacCallum and Geist, 1992; Bleich et al., 1997; Jansen et al., 2007; Jansen et al., 2009; Smyth, 2014; Poole et al., 2016). Reclaimed mines can induce changes in habitat use by bighorn sheep leading to range expansion and population growth (MacCallum, 1991; MacCallum and Geist, 1992; Poole et al., 2016; Smyth, 2014). A selection for reclaimed mine habitats by bighorn sheep is likely driven by the abundance of quality forage in proximity to post-mine topographic features that replicate escape terrain (Poole and Ayotte, 2019). The selection for mining habitats (particularly by ewes during lambing) is also likely driven by a reduced predation risk conferred by human activity (Poole and Ayotte, 2019). Although planting of agronomic legumes and grasses can compensate or subsidize forage amounts, winter ranges comprised of native grasses such as rough fescues (*Festuca campestris*) are considered higher quality because these plants retain their protein values through winter months (Willms et al., 1997; Freeze et al., 1999; Clark et al., 2000). Further, planting of agronomic legumes and grasses can result in changes in species habitat utilization and migratory behaviour, which can result in range degradation and increased competition for forage with elk and mule deer (Demarchi, 2004, Poole and Ayotte, 2019).

Winter range conditions have likely declined for bighorn sheep since 1982 in the majority of identified sub-ranges in the Terrestrial RSA (Smyth, 2014; Poole et al., 2018). A loss of bighorn sheep winter range can result in reduced forage availability and increased grazing pressure on remaining winter ranges (Poole and Ayotte, 2019). Declines in winter range conditions in the Elk Valley have been linked to overgrazing by wild (elk and mule deer) and domestic ungulates (Smyth, 2014; Poole et al., 2018). High grazing pressure results in the increase of invasive species, reduced root development, soil creep, and changes to vegetation structure that deteriorate the quality and function of high elevation grasslands (Holechek et al., 2001; MacKenzie, 2004; Poole et al., 2018). Winter ranges that are overgrazed or otherwise degraded produce less forage that healthy ranges (Smyth, 2014), and thus have lower carrying capacity for bighorn sheep (Poole et al., 2018).

Fire suppression starting in the 1930s eventually led to forest encroachment into low-elevation grasslands, reducing winter range quality for bighorn sheep and mountain goat in the Terrestrial RSA (Demarchi et al., 2000; Poole and Ayotte, 2019; MGMT, 2010). During the 1980s, restoration and enhancement projects in the Terrestrial RSA were completed in an effort to improve bighorn sheep habitat conditions and included prescribed burning, selective logging, and slashing (Davidson, 1991; Bond et al., 2013; Poole and Ayotte, 2019).

Agricultural developments in the Terrestrial RSA including along the Bull River and Galton Range have resulted in a loss of bighorn sheep winter range (Demarchi, 2004). Impacts of cattle grazing to bighorn sheep include decreased forage supply and range condition, trampling and fouling of water holes and mineral licks, altered habitat use, and range abandonment (Bissonette and Steinkamp, 1996).

Regional Occurrence

Bighorn sheep occur in five main locations throughout the East Kootenay region (British Columbia Ministry of Environment, Lands, and Parks [MELP], 2000). These include the Kootenay ranges along the east side of the Rocky Mountain Trench (Radium south to the Bull River); the Galton Range; the west side of Elk River (north of Sparwood); west slopes of Rockies (Crownest Pass to Fording River); and the Kootenay River headwaters near Mount Assiniboine Provincial Park (Demarchi et al., 2000; MELP, 2000). Mountain goat distribution is widespread in the Kootenay, with high density populations occurring throughout the Rocky and Purcell mountain ranges (MGMT, 2010; Poole, 2006). Within the Elk Valley, the majority of mountain goat exist along the ranges of the Continental Divide (MGMT, 2010; Poole, 2006).

Bighorn sheep and mountain goat tend to move vertically up mountains from spring to summer, following phenological plant development from low alpine warm aspects to high alpine habitats and avalanche chutes (Côté and Festa-Bianchet, 2003; Demarchi, 2004; Hamel et al., 2009; Poole and Ayotte, 2019; Krausman, 1999). Within the Elk Valley, most herds of bighorn sheep spend their winters and summers on separate mountains (Demarchi et al., 2000; Poole, 2013). Most bighorn sheep populations in B.C. spend their winters on low-elevation, warm aspect bunchgrass habitats (Demarchi et al., 2000; Shackleton, 2013). Bighorn sheep existing east of the Elk River in the Terrestrial RSA are unique in their use of high elevation grasslands as winter range (Poole et al., 2018). During winter, mountain goats often remain at high elevations, relying on high winds across open, tree-less steep terrain to blow away snow and expose forage (Wilson and Ruff, 1999; Poole et al., 2009). In the Elk Valley, bighorn sheep and mountain goat winter ranges comprise only 4.3% and 14% of annual ranges, respectively (Poole et al., 2009; MGMT, 2010; Poole et al., 2016).

Bighorn sheep and mountain goat are both highly dependent on escape terrain, which differs slightly between species but generally is comprised of steep slopes where most mammalian predators would be unable to access. Bighorn Sheep are rarely found >1 km from escape terrain, which generally consists of moderate to steep (40-75%) slopes of broken rock or scree (Demarchi, 2004; Poole et al., 2016). Mountain goat rarely occur more than 400 to 500 m from escape terrain, which generally is comprised of steep slopes (e.g., ≥ 80%) of shear or broken cliffs (Poole and Heard, 2003; Taylor and Brunt, 2007; Poole et al., 2009; MGMT, 2010). Proximity to escape terrain is known to be more important during winter, presumably because movement (and ability to escape attacks by predators) is impeded by snow (Geist, 1971; Poole et al., 2009; MGMT, 2010; White and Gregovich, 2017). Escape terrain is also particularly important for females during the birthing period. Ewes and nannies tend to select for steep, rugged terrain where they seclude themselves to give birth (Shackleton, 1999, Krausman and Boyer, 2003; MGMT, 2010).

Bighorn sheep exhibit strong fidelity to seasonal home ranges (i.e., usually part of a mountain or a whole mountain), which in the Elk Valley range from 33 to 37 km^2 in summer to 3.2-9.5 km^2 in winter but vary in size depending on forage quality and quantity, topography and snow depth, as well as sex, age, and reproductive status of individuals (Demarchi et al., 2000; Demarchi, 2004; Geist, 1971; Poole, 2013; Poole et al., 2016). As with other ungulate VCs, home ranges are smallest during winter as deep snow increases energy expenditure for movement and buries preferred forage (Geist, 1971; Krebs, 2009; Poole et al., 2009; Poole, 2013; Poole and Ayotte, 2019). Mountain goat are generally solitary unless accompanied by their young but migrate in sexually segregated small herds (of up to more than 20 individuals; Wilson and Ruff, 1999; MGMT, 2010). As with bighorn sheep, mountain goats demonstrate high fidelity to seasonal home ranges (e.g., discrete mountains or portions of mountains), which vary in size from 3 to 90 km^2 (Côté and Festa-Bianchet, 2003; Poole and Heard, 2003; Poole et al., 2009; MGMT, 2010).

Regional Abundance

The East Kootenay region contains 80% of the bighorn sheep population in the province, which is composed of approximately 2,200 to 2,600 individuals (Demarchi et al., 2000; Poole et al., 2016). The Project LSA is located within the Elk Valley East PMU (3), which is the largest population of bighorn sheep in the Kootenay region with an estimated number of 515-770 bighorn sheep corresponding to an average density of 16 bighorn sheep/ km^2 on winter ranges (Poole, 2013; Poole and Ayotte, 2019). Within Elk Valley East, 5 subpopulations have been identified that include two subpopulations within the Terrestrial LSA (Erickson-Sheep Mountain and Crowsnest North; Poole et al., 2018). Populations experienced an increase in numbers from the mid-1960s to the early 1980s, followed then by declines in many sub-populations due to disease (acute pneumonia and contagious ecthyma) outbreaks. After populations peaked again in the early 1990s, almost all sub-populations experienced additional population declines up until 2000, reaching the lowest number in 30 years likely due to harsh winters (Stent and Phillips, 2013). It is estimated that the bighorn sheep population in the Elk Valley East population doubled between 2000 and 2010 (Demarchi et al., 2000; Poole et al., 2018). The recent inventory (2019) observed a population decline in the Elk Valley East since 2010; however, it remains within 20% of the median population estimate (the benchmark; Poole et al., 2018; Poole and Ayotte, 2019). Further, relatively high lamb ratios (38 lambs: 100 ewes) and ram numbers (52 rams: 100 ewes) in the Elk Valley East population suggest the population is stable (Poole et al., 2018; Poole and Ayotte, 2019). The desired ram to ewe ratio to represent a stable population is equal or greater than 30 rams to 100 ewes, and equal or greater than 30 lambs per 100 ewes (Poole et al., 2018). The Elk Valley West population has decreased since 2005 and no longer meets the benchmark (Poole et al., 2018).

Mountain goat populations experienced declines during the 1960s and 1970s as a result of increased access and overharvesting of populations (Phelps et al., 1983; Poole, 2006). Further declines occurred in the 1990s were likely due to increased over-harvest (road/access-related), increased predation, severe weather, habitat changes (fire suppression, logging, natural cycles), and increased disturbance from human activity (e.g., hydroelectric development, recreation activities; Hatler, 2001; Wilson and Shackleton, 2001; Poole and Adams, 2002; Poole et al., 2006). Mountain goat populations in the Elk Valley West have increased since the early 2000s, concurrent with the decreasing numbers of bighorn sheep (Poole, 2019). Mountain goat population trends indicate a stable to decreasing trend in southern B.C. (MGMT, 2010). Mountain goat surveys in 2005 estimated 1005 goats in the Elk Valley, with a corresponding density of 1.69 goats per km^2, and a ratio of 30 kids to 100 adults (Poole and Klafki, 2005).

Regional and Local Connectivity

Movements of bighorn sheep in the Elk Valley generally follow (north-south) high elevation mountain ranges and ridges but also include low elevation crossings (e.g., Grave Creek Canyon; Poole, 2013). Seasonal movements for bighorn sheep may be as small as one steep gorge or up to 40 km (Geist, 1971; Wishart, 1978; Demarchi et al., 2000). Within the Elk Valley, movement rates of collared bighorn sheep were greatest during June to August (Poole, 2013). For mountain goats, although most seasonal movements by individuals are characterized by local shifts in elevation, some individuals may move several km between spring and summer ranges (Poole and Heard, 2003; Rice, 2008).

Roads can impact bighorn sheep and mountain goat connectivity by dissecting routes and increasing mortality risk (Demarchi, 2004; MGMT, 2010). Activities including the use of road salts and rock blasting can attract bighorn sheep and mountain goat to roadsides where they are at risk of collisions with vehicles and hunting by humans (Demarchi, 2004; Kroesen et al., 2020). Linear features within bighorn sheep and mountain goat connectivity areas can also lead to enhanced predation rates (Demarchi, 2004; MGMT, 2010).

In addition, the expansion of coal mining on bighorn sheep winter ranges could result in direct loss of habitat and connectivity (Poole et al., 2013). Although reclaimed mining areas can provide forage for grassland species including bighorn sheep and mountain goat, these habitats may also alter natural behaviours including seasonal migrations (Poole et al., 2013). A small proportion (21%) of bighorn sheep in the Elk Valley that reside on reclaimed mine sites do not undergo seasonal movements due to habitat changes and disruption of movement corridors (Poole et al., 2013).

Studies of bighorn sheep and mountain goat have identified several key linkage areas in the Terrestrial RSA that maintain connectivity between seasonal habitats and populations (Poole, 2011; 2013; Poole et al., 2018; Lee et al., 2019). One of these is within the Terrestrial LSA:

- A north-south corridor that connects the Erickson Ridge to Sheep Mountain (Grave Creek Canyon).

Additional linkage areas in the Terrestrial RSA include:

- A north-south corridor along Line Creek Canyon north of Sheep Mountain;
- A north-south corridor along Greenhills Ridge;
- Movement corridors between high-elevation, grassland winter ranges to reclaimed mine areas (Elkview and Greenhills Operations);
- Movement corridors from Greenhills Range, Sheep Mountain and Erickson Ridge across the lower Fording River off the south end of the Greenhills Range;
- Corridors east to the Continental Divide between Brownie and Imperial Ridge;
- A north-south corridor along Imperial Ridge;
- A north-south corridor along Ewin Ridge and a lower-elevation corridor between Ewin Ridge and Line Creek Operations; and
- The Elko to Morrissey linkage.

Transboundary Considerations

Bighorn sheep and mountain goat are highly mobile animals with relatively large home ranges and known populations existing along the Continental Divide. Regular transboundary movements by bighorn sheep and mountain goat herds are documented in the Terrestrial RSA (Poole et al., 2009; Poole et al., 2018). It is therefore highly likely that herds existing along the Continental Divide in the Terrestrial LSA exhibit regular transboundary movements.

15.4.2.2 Baseline Programs

15.4.2.2.1 Summary of Methods

Comprehensive field surveys were conducted in 2014, 2017, 2018, and 2019 to support the Project's baseline studies and the development of the EA. The surveys were completed to obtain information on ungulate occurrence, abundance, distribution and habitat availability within the Terrestrial LSA (Table 15.4-4). The ungulate community baseline surveys were conducted within the Project footprint and the Terrestrial LSA. Survey methods followed provincial survey standards, where applicable, and were conducted during the spring, summer, fall, and winter to capture seasonal variability in habitat selection and distribution (RISC, 1999b; Brennan et al., 2019). Surveys were established to include representative habitat types, while focusing effort on areas where ungulates (and their predators) would be expected to be found if present, including trails, roads and other linear landscape features that facilitate animal movements (RISC, 1999b; Mackenzie et al., 2002; Kelly et al., 2012; Quinn and Klafki, 2015; Chow, 2019; RISC, 2019). To increase the probability of detecting ungulates, the selection of locations included local hunters' input addition to Keefer Ecological Services Ltd.'s knowledge of wildlife use of the Terrestrial LSA (Marcot et al., 2019). As a result, locations included areas of important ungulate winter range and wetlands in the lower western elevations adjacent to the Elk River; at known mountain goat and sheep movement corridors throughout the Grave Creek Canyon; at suspected movement corridors adjacent to creeks on the east side of the canyon.

The ungulate surveys completed as part of the baseline program included the following survey types:

- Remote camera surveys;
- Aerial surveys; and
- Ground transects.

Table 15.4-4: Baseline Field Survey Effort for Ungulates in the Project Terrestrial LSA

Survey Type	Survey Dates	Survey Standards	References	Sample Effort	Data Type
Remote Camera Surveys	February 1 - May 19, 2014 January 31 - May 2, 2015 June 9, 2016 - December 19, 2018	Wildlife Camera Metadata Protocol (RISC, 2019)	• Quinn and Klafki, 2015 • Des Rosiers-Ste. Marie, 2019	8,198 sampling nights across 42 camera stations	Presence/ Non-detection
Aerial Transects	March 11 - October 17, 2014 June 17, 2015	Aerial–based Inventory Methods for Selected Ungulates: bison, mountain goat, mountain sheep, moose, elk, deer, and caribou (RISC, 2002)	• DeMars and Tipper, 2014 • DeMars, 2014 • DeMars, 2015	874.08 km total surveyed	Presence/ Non-detection
Ground Transects	February 6 - 10, 2014 February 24 - 28, 2014 March 27 - 28, 2014 February 13 - 16, 2015 February 23 - 25, 2015 March 7 - 9, 2015 March 17, 2015 March 30 - 31, 2015 July 9 - July 10, 2019 July 15 - July 19, 2019	Ground-based Inventory Methods for Selected Ungulates: moose, elk, and deer. (RISC, 1998a)	Quinn and Klafki, 2015	557.21 km total surveyed	Presence/ Non-detection

A summary of the ungulate community baseline program surveys is outlined in Table 15.4-4 and survey locations are shown in Figure 15.4-1, Figure 15.4-2, and Figure 15.4-3. For additional details on the ungulate community baseline survey methods, refer to Appendix 15-B.

Sex (bull to cow) and cow to calf ratios were calculated from the survey results. Sex ratios represent the proportion of males relative to females in a population. They are expressed as the number of males relative to 100 females, therefore the number of males observed is divided by the number of females observed and multiplied by 100. The same calculation applies to ratios of young to adults (e.g., calf to cow ratios). The number of offspring observed (e.g., calves) is divided by the number of females and multiplied by 100.

15.4.2.2.2 Moose

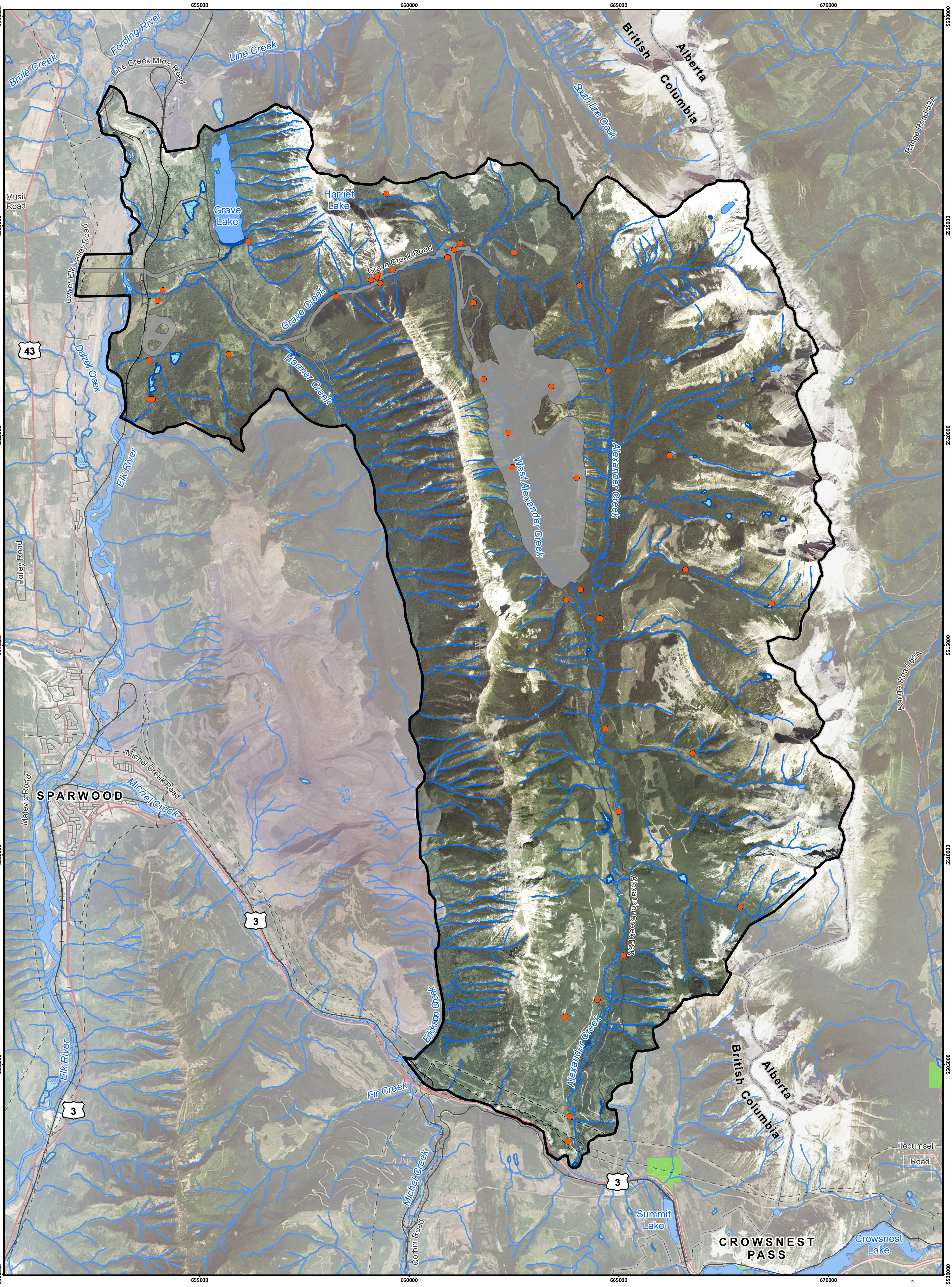
Baseline surveys showed that moose were broadly distributed in the Terrestrial LSA, occurring at various elevations within the Alexander, Grave, and Harmer Creek drainages and transboundary mountain passes (e.g., Deadman Pass). Moose detections occurred most frequently along Alexander Creek, West Alexander Creek, Grave Creek, and along tributaries through Deadman Pass (Figure 15.4-4).

Remote camera survey efforts resulted in a total of 119 unique detections/locations of moose in the Terrestrial LSA. Results showed that moose used the Terrestrial LSA during all seasons; however, the number of individual moose detected was considerably higher during spring/summer than in fall/winter (Table 15.4-5). Detections during spring/summer occurred most frequently in riparian habitats, wetlands, and transboundary mountain passes (Figure 15.4-4). Increased use of the Terrestrial LSA by moose in the spring is consistent with the migratory behaviour of the species (Poole and Stuart-Smith, 2004).

Table 15.4-5: Summary of Moose Detections using Remote Cameras in the Terrestrial LSA

Survey Period	Moose Groups	Moose Individual Detections	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Fall/Winter	19	39	1.18	1-2	14	10	14	1
Spring/Summer	100	461	1.22	1-6	189	126	92	54

During aerial transect surveys, six individual moose were detected in the Terrestrial LSA (Table 15.4-6). One of the moose groups was located within the boundary of the proposed mine footprint while the other group was located on the edge of a regenerating cutblock. A single moose was detected in the winter surveys in the middle third of the Alexander Creek drainage (DeMars, 2014). Moose may be limited by snow depth (as indexed by elevation) and snowmobile activity in the Alexander Creek drainage, resulting in late winter abundance and distribution of moose in the Terrestrial LSA (DeMars and Tipper, 2014). Only a single moose was seen in spring (DeMars, 2015). Moose were recorded on 96 occasions during ground transects in the Terrestrial LSA (Quinn and Klafki, 2015). Moose were encountered on ground transects up to mid-elevations in Alexander and Harmer Creeks (Quinn and Klafki, 2015). During ground transects, moose were more commonly encountered in the mid elevation ESSKdk1 (Quinn and Klafki, 2015). The relative abundance estimate of moose in the 2014 ground transect surveys was 0.116 tracks/km-day, and 0.139 tracks/km-day in the 2015 surveys (see the Baseline Survey Report: Mammals in Appendix 15-B for a breakdown by year).



Crown Mountain Coking Coal Project

Figure 15.4-1
Remote Camera Survey Locations

LEGEND

- Remote Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

Scale 1:85,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: EC
Map Checked By: EM/HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

NWP Coal Canada Ltd

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Date: 2022-01-11

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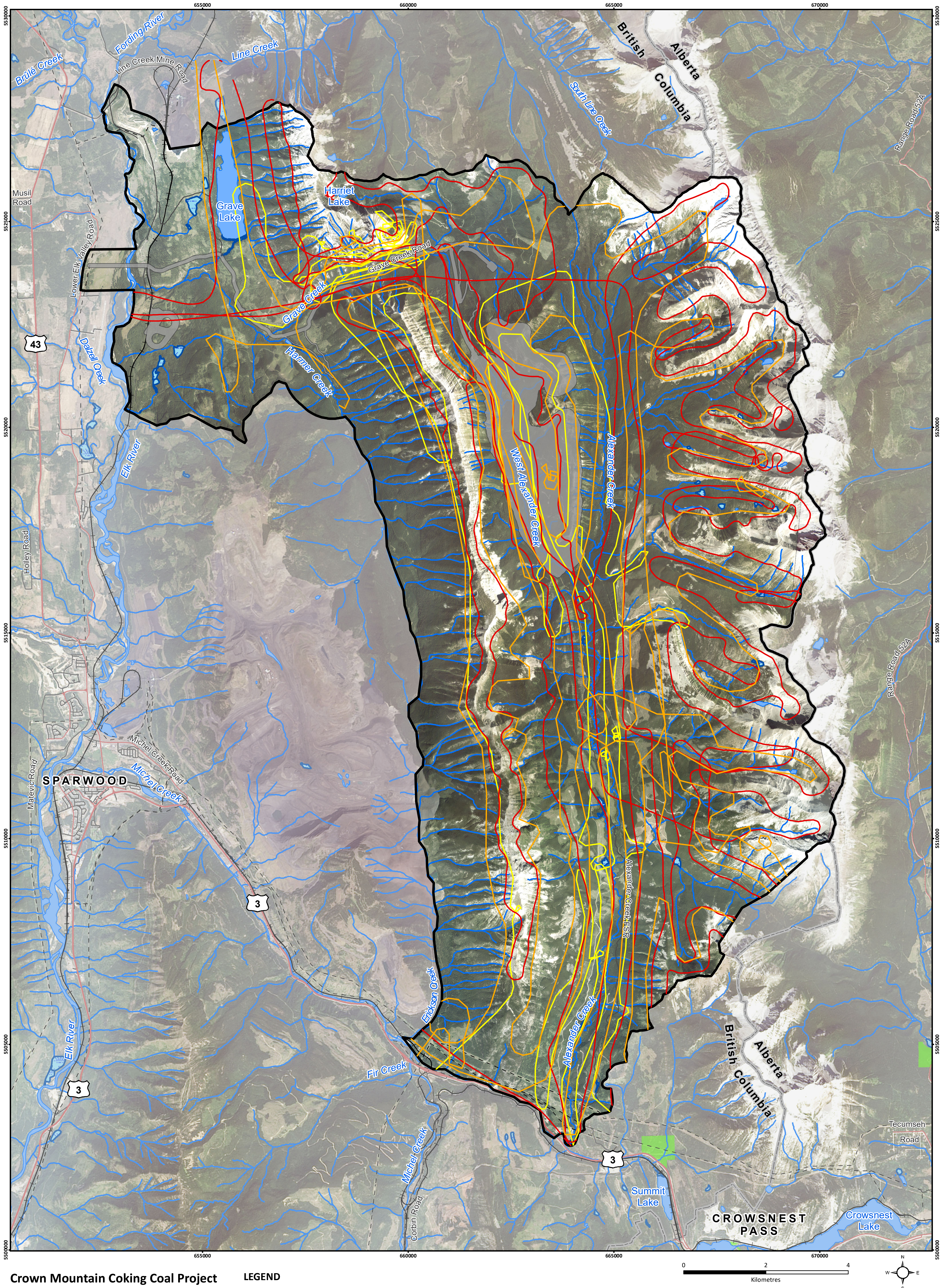

Crown Mountain Coking Coal Project

Figure 15.4-2
Aerial Transect Survey Locations

LEGEND

Aerial Transects

- March 2014
- October 2014
- June 2015
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

Scale 1:85,000

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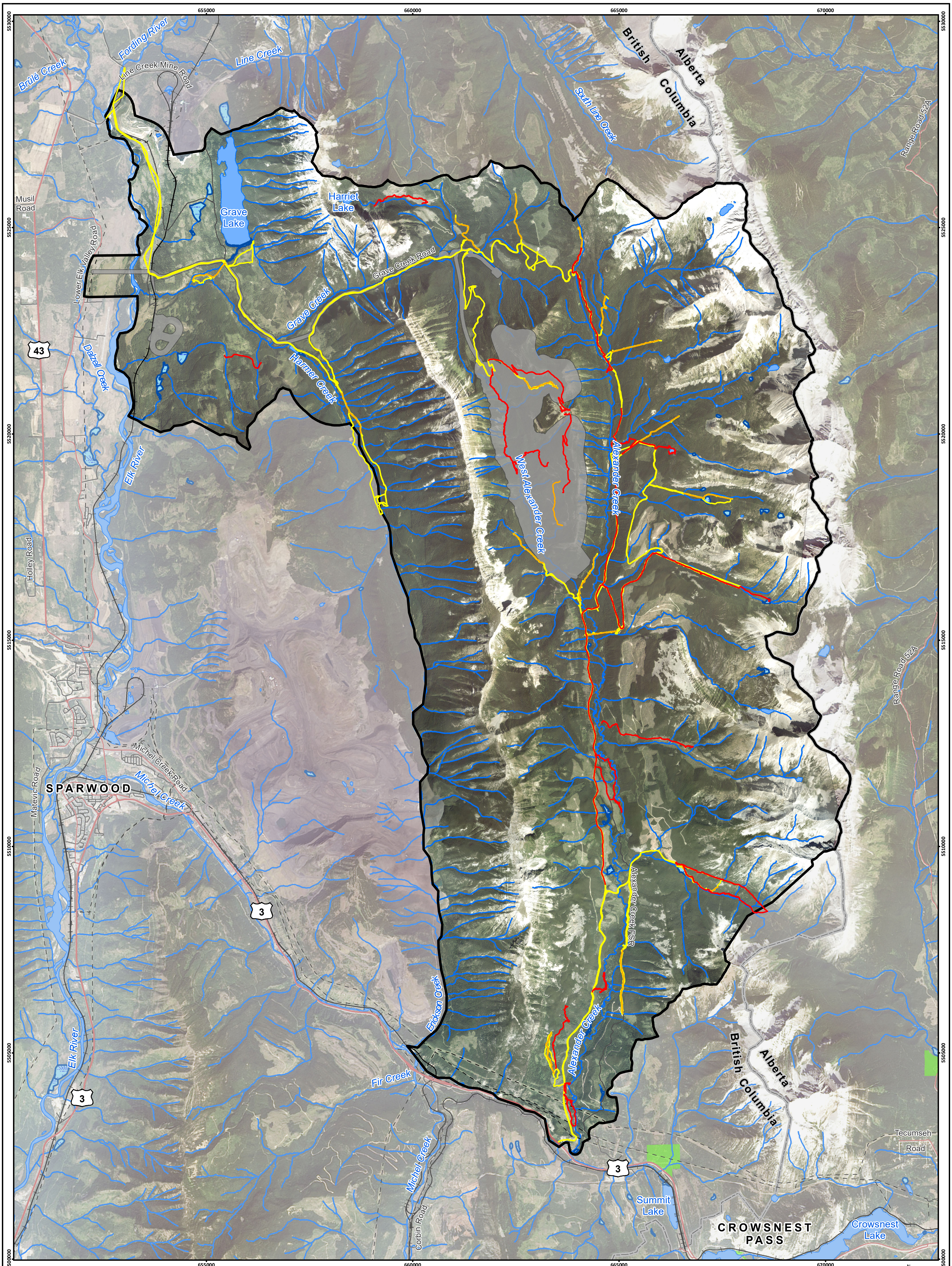

Crown Mountain Coking Coal Project

Figure 15.4-3
Ground Transect Survey Locations

LEGEND

Ground Transects

- 2014
- 2015
- 2019
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

0 2 4
Kilometres

Scale 1:85,000

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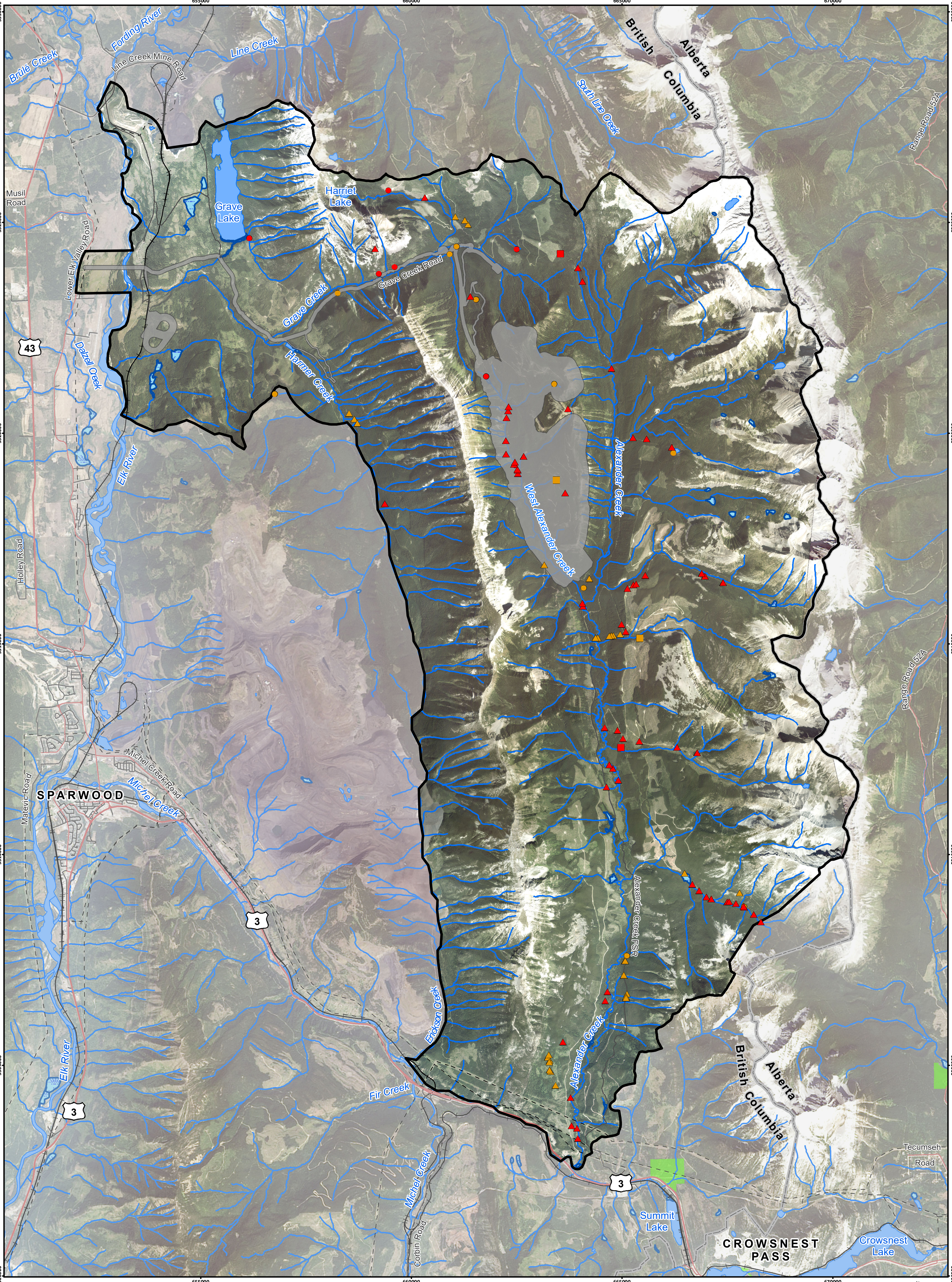

Crown Mountain Coking Coal Project

Figure 15.4-4
Moose Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Transect
- Summer Transect
- Winter Aerial
- Summer Aerial
- Winter Camera
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Table 15.4-6: Summary of Moose Detections During Fall, Winter and Spring Aerial Transect Surveys in the Terrestrial LSA

Survey Period	Moose Group Sized	Moose Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	2	4	-	1	2	1
Winter (March, 2014)	1	1	-	-	1	-
Spring (June, 2015)	1	1	1	-	-	-
Total	4	6	1	1	3	1

Moose detections in the Grave Creek Canyon (within the Project footprint), Alexander Creek drainages and secondary roadways during both winter and summer (Figure 15.4-4) may indicate use of these areas for movement and connectivity. Other connectivity habitats appeared to include the Deadman, Racehorse, and North Fork Passes in the eastern portion of the Terrestrial LSA. Transboundary mountain passes, avalanche chutes, and tertiary streams were used primarily during spring and summer.

The baseline surveys showed seasonal variation in moose detections, bull to cow ratios and cow to calf ratios in the Crown Mountain Terrestrial LSA. There was a greater number of detections of cow moose during summer than in winter, indicating increased animal movement and the value of the Terrestrial LSA during the calving season. The baseline assessment found fall/winter ratios in the Terrestrial LSA to be 71 bulls to 100 cows and 7 calves to 100 cows. The baseline assessment found spring/summer ratios in the Terrestrial LSA to be 67 bulls to 100 cows, and 29 calves to 100 cows. The baseline assessment estimated bull to cow ratio in the Terrestrial LSA to be higher than 2018 reported ratio estimates of 49 bulls to 100 cows in the Elk Valley (FLNRORD, 2018). The spring/summer calf to cow ratios from baseline assessment estimates in the Terrestrial LSA are similar to calf to cow ratios recorded in late-winter (41 calves to 100 cows) in the Elk Valley (FLNRORD, 2018). In the Terrestrial LSA, the bull to cow ratio in all seasons, and the calf to cow ratio in the spring/summer, were within or above the target desired ratio (30 bulls to 100 cows and 25-30 calves per 100 cows post fall harvest), indicating a stable population (FLNRORD, 2018; B.C. MOE, 2010).

High quality moose habitat in the Elk Valley may support a late winter population density of 0.38 individuals/km^2 (Gooliaff and Stent, 2018). Based on this assumption, the high-quality habitat available to moose in the Terrestrial LSA (41.7 km^2) can support approximately 16 moose during late winter.

15.4.2.2.3 Elk

Baseline surveys showed that elk were broadly distributed in the Terrestrial LSA, occurring at various elevations including along the northwest edge of Erickson Ridge, Sheep Mountain, throughout valley bottoms within the Alexander and Grave Creek drainages, and transboundary mountain passes (i.e., Deadman and Racehorse). Elk detections occurred most frequently within Grave Prairie, Grave Creek (between Sheep Mountain and Erickson Ridge), and in the portion of the Alexander Creek drainage near the Crowsnest Highway (Figure 15.4-5).

Remote camera survey efforts resulted in a total of 315 unique detections/locations of elk in the Terrestrial LSA. Results showed that elk used the Terrestrial LSA during all seasons; however, the number of elk detected was higher during spring/summer than in fall/winter (Table 15.4-7). There were more detections of males, females and juveniles during spring/summer, indicating increased use and movement. Detections during spring/summer occurred most frequently in riparian habitats, avalanche chutes and transboundary mountain passes (Figure 15.4-5). Increased use by elk in the spring is consistent with the migratory behaviour of the species (Boyce, 1991).

Table 15.4-7: Summary of Elk Detections using Remote Cameras in the Terrestrial LSA

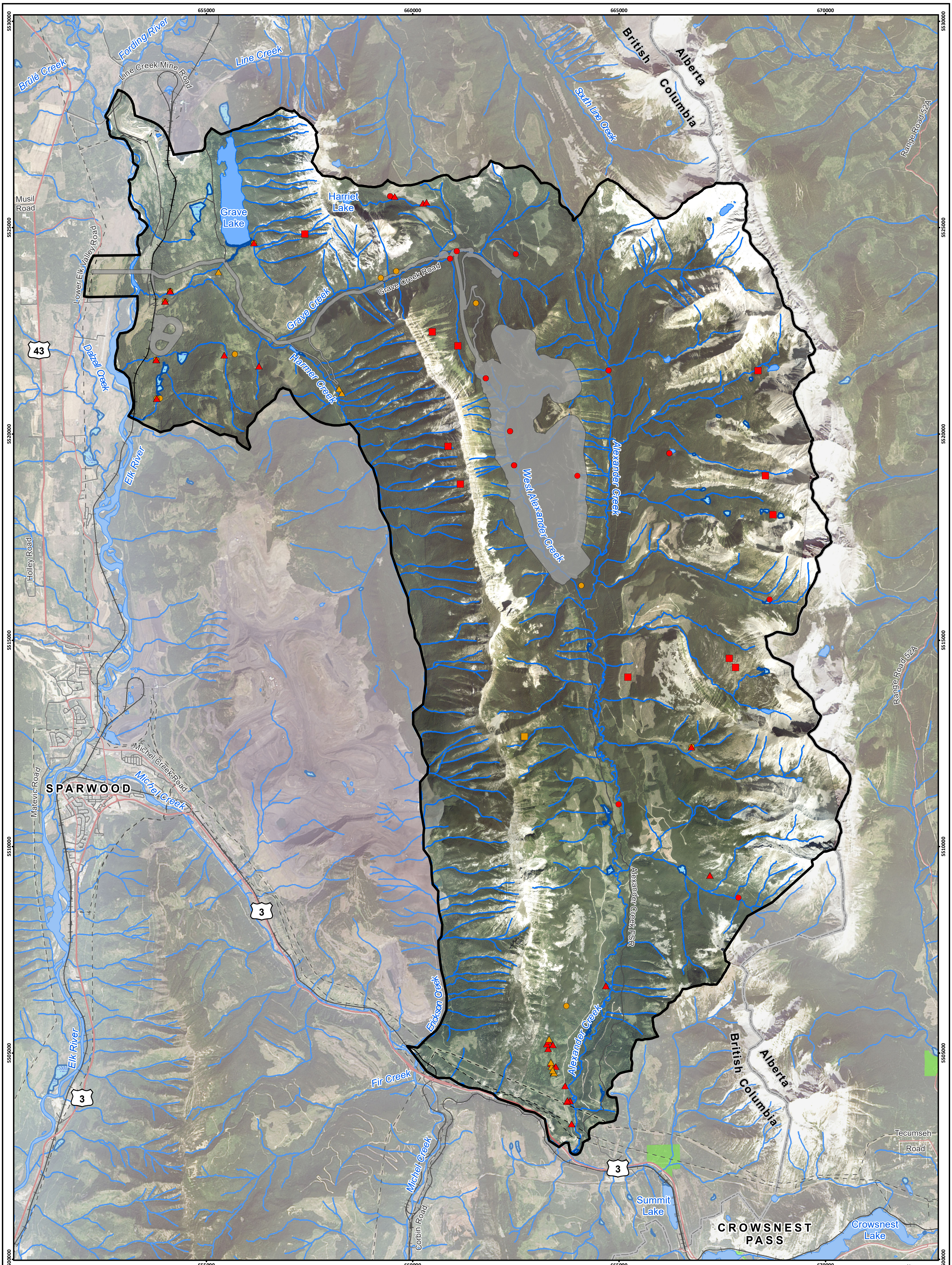
Survey Period	Elk Groups	Elk Individual Detections	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Fall/Winter	156	287	1.38	1-15	107	55	104	21
Spring/Summer	159	749	1.45	1-8	303	216	164	66

Similar to the camera survey results, the number of elk recorded during aerial surveys was considerably higher in the spring, with the majority of elk groups observed within subalpine meadows and open avalanche chutes (DeMars, 2015; Table 15.4-8). In fall, a lone male elk was observed in an alpine basin just above tree line on the eastern aspect of Erickson Ridge (DeMars and Tipper, 2014). Elk were recorded on 28 occasions during ground transects. Elk were commonly encountered in the Terrestrial LSA during ground winter transects but were limited to lower elevations in the MSdk1 (Quinn and Klafki, 2015). There were no relative abundances estimates calculated for elk during the 2014/2015 ground transect surveys (Quinn and Klafki, 2015).

Table 15.4-8: Summary of Elk Detections During Fall, Winter, and Spring Aerial Transect Surveys in the Terrestrial LSA

Survey Period	Elk Groups Detected	Elk Individuals Detected	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	1	1	1	-	-	-
Winter (March, 2014)	0	-	-	-	-	-
Spring (June, 2015)	11	27	2	15	6	4
Total	12	28	3	15	6	4

The baseline surveys showed seasonal variation in elk detections, bull to cow ratios and cow to calf ratios in the Terrestrial LSA (Table 15.4-7). There was a greater number of detections of cow elk during summer than in winter, indicating increased animal movement and the value of the Terrestrial LSA during the calving season. The baseline surveys found fall/winter ratios in the Terrestrial LSA to be 51 bulls to 100 cows and 20 calves to 100 cows. Spring/summer ratios in the Terrestrial LSA were 71 bulls to 100 cows, and 22 calves to 100 cows. The bull to cow ratios for all seasons are higher than previous reported bull to cow ratios (24 bulls to 100 cows) in the Elk Valley (Szkorupa et al., 2013). The cow to calf ratios in the Terrestrial LSA for all seasons is slightly less than the previously reported calf to cow ratios (25 calves to 100 cows) in the Elk Valley (Szkorupa et al., 2013). The bull to cow ratio in the Terrestrial LSA is above the post-hunting target ratio of greater than 20 bulls to 100 cows, which indicates a stable elk population in the Terrestrial LSA (B.C. MOE, 2010).



Crown Mountain Coking Coal Project

Figure 15.4-5
Elk Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Transect
- Summer Transect
- Winter Aerial
- Summer Aerial
- Winter Camera
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

0 2 4
Kilometres

Scale 1:85,000

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High quality elk habitat in the Elk Valley may support a late winter population density of 1.7 individuals/km^2 (Gooliaff and Stent, 2018). Based on this assumption, the high-quality habitat available to elk in the Terrestrial LSA (8.5 km^2) can support approximately 14.5 elk during late winter.

15.4.2.2.4 Bighorn Sheep and Mountain Goat

Baseline surveys showed that bighorn sheep were broadly distributed in the Terrestrial LSA, occurring in high elevation areas along Erickson Ridge and on Sheep Mountain. Efforts also documented bighorn sheep in proximity to steep high elevation features along the Continental Divide (Figure 15.4-6). Mountain goat sightings were distributed similarly to bighorn sheep; in the rugged, high elevation areas of the Terrestrial LSA, including along Erickson Ridge, Sheep Mountain, and along to steep high elevation features along the Continental Divide (Figure 15.4-7).

Remote camera surveys resulted in a total of 77 detections/locations of bighorn sheep and 14 detections/locations of mountain goat in the Terrestrial LSA. Results showed that bighorn sheep used the Terrestrial LSA during all seasons; however, the number of individual bighorn sheep detected was considerably higher during spring/summer than in fall/winter (Table 15.4-9; Table 15.4-10). There were considerably more detections of males, females and juveniles during spring/summer, indicating increased use and movement. Detections of mountain goats and bighorn sheep during spring/summer occurred most frequently in avalanche chutes and transboundary mountain passes (Figure 15.4-6 and Figure 15.4-7).

Table 15.4-9: Summary of Bighorn Sheep Detections using Remote Cameras in the Terrestrial LSA

Survey Period	BHS Groups	BHS Individual Detections	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Fall/Winter	22	33	1.50	1-6	6	10	14	3
Spring/Summer	55	72	1.31	1-5	21	19	29	3

Table 15.4-10: Summary of Mountain Goat Detections using Remote Cameras in the Terrestrial LSA

Survey Period	Mtn Goat Groups	Mtn Goat Individual Detections	Average Group Size	Minimum-Maximum Group Size	Females	Males	Unknown	Juveniles
Fall/Winter	3	3	1	1-1	0	0	3	0
Spring/Summer	11	26	1.44	1-3	3	2	19	2

Aerial transects resulted in a total of 92 individual bighorn sheep and 45 mountain goat detections in the Terrestrial LSA (Table 15.4-11 and Table 15.4-12). Surveys found 5 groups of bighorn sheep and 7 groups of mountain goats in fall surveys (DeMars and Tipper, 2014). Four groups of bighorn sheep and two groups of mountain goats were encountered during the winter survey (DeMars, 2014) and five groups of bighorn sheep and four solitary mountain goats were encountered during spring (DeMars, 2015). Bighorn sheep were recorded on 13 occasions during ground transects (Quinn and Klafki, 2015). No mountain goats were detected during all ground transects (Quinn and Klafki, 2015). There were no relative abundances estimates calculated for bighorn sheep or mountain goat for the 2014/2015 ground transect surveys (Quinn and Klafki, 2015).

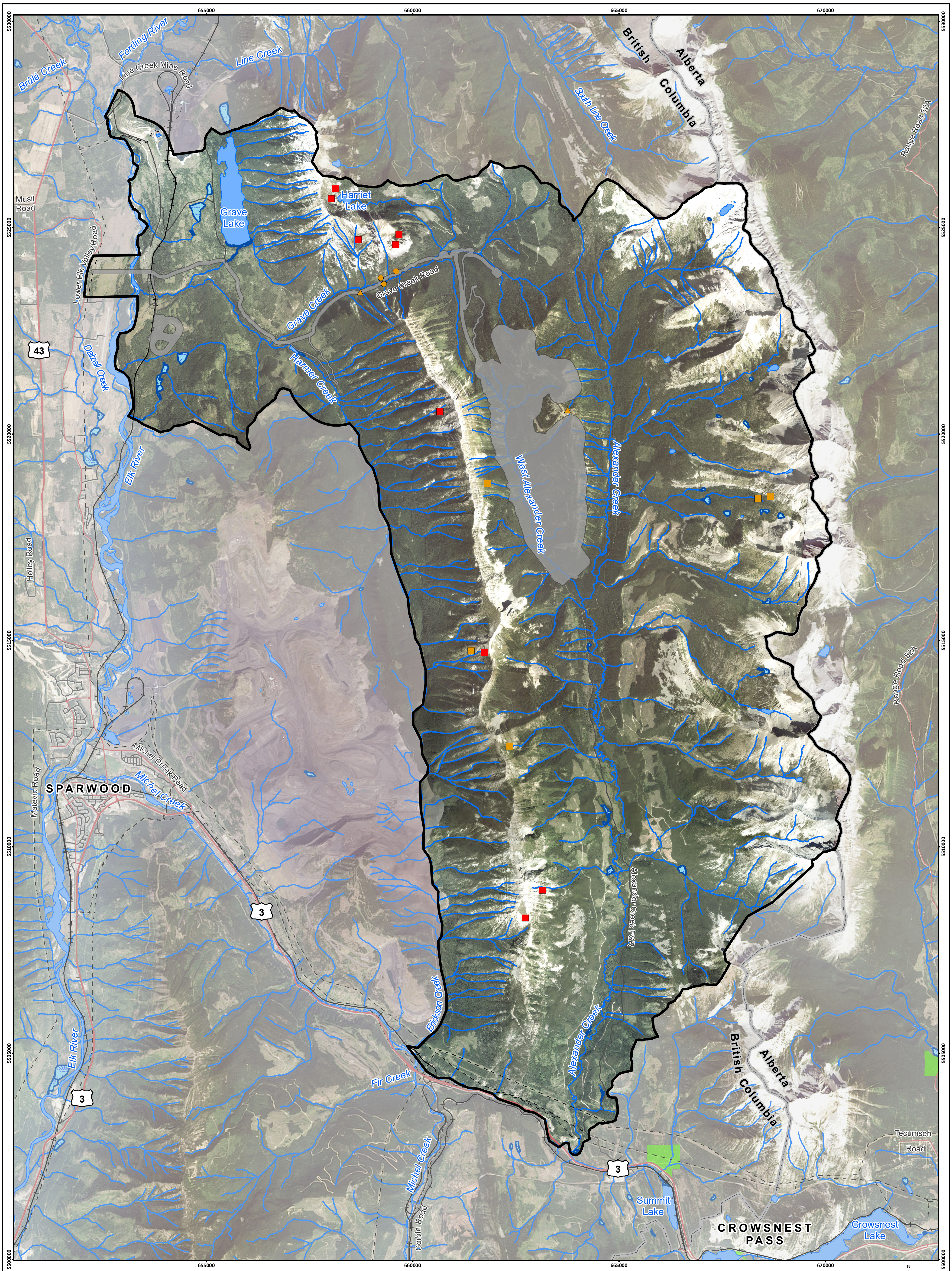

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Figure 15.4-6
Bighorn Sheep Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Transect
- Summer Transect
- Winter Aerial
- Summer Aerial
- Winter Camera
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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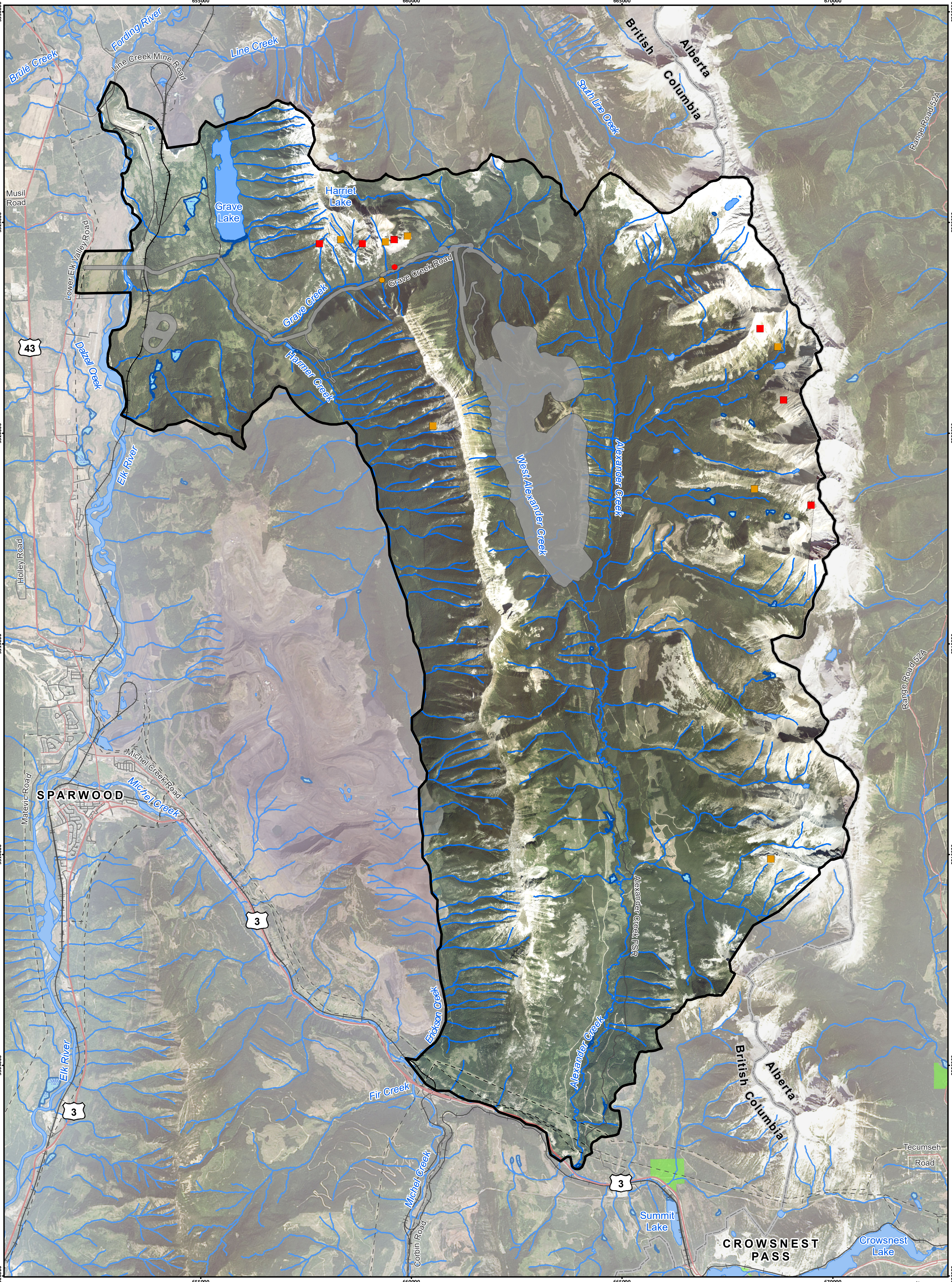

Crown Mountain Coking Coal Project

Figure 15.4-7
Mountain Goat Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Aerial
- Summer Aerial
- Winter Camera
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Kilometres

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Table 15.4-11 : Summary of Bighorn Sheep Detections During Fall, Winter, and Spring Aerial Transect Surveys in the Terrestrial LSA

Survey Period	Bighorn Sheep Group Size	Bighorn Sheep Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	5	36	4	25	0	7
Winter (March, 2014)	4	23	4	15	2	2
Spring (June, 2015)	5	33	10	18	-	5
Total	14	92	18	58	0	12

Table 15.4-12: Summary of Mountain Goat Detections During Fall, Winter, and Spring Aerial Transect Surveys in the Terrestrial LSA

Survey Period	Mountain Goat Group Size	Mountain Goat Individuals	Males	Females	Unclassified	Juveniles
Fall (October, 2014)	7	39	5	4	22	8
Winter (March, 2014)	2	2	-	-	2	-
Spring (June, 2015)	4	4	-	-	4	-
Total	13	45	5	4	28	8

The baseline surveys found fall/winter ratios in the Terrestrial LSA to be 167 rams to 100 ewes and 50 lambs to 100 ewes. Spring/summer ratios in the Terrestrial LSA were 90 rams to 100 ewes, and 14 lambs to 100 ewes. The winter/fall baseline assessment values are higher than a recent winter inventory (2019) in the Elk Valley that observed ratios of 52 rams to 100 ewes and 38 lambs to 100 ewes in the Elk Valley East population (Poole and Ayotte, 2019). The winter/fall bull to cow ratio and calf to cow ratio in the Terrestrial LSA is above the targeted desired ratio, indicating a stable population (≥30 rams to 100 ewes, and ≥30 lambs per 100 ewes; Demarchi et al., 2000; Poole et al., 2019).

The baseline surveys ratios for mountain goat for spring/summer in the Terrestrial LSA were 67 billies to 100 nannies, and 67 kids to 100 nannies; however, there was not enough information to estimate mountain goat ratios for fall/winter. Previous mountain goat surveys in the region estimated a ratio of 30 kids to 100 adults in 2005 in the Elk Valley (Poole and Klafki, 2005). There is a lack of information reported on mountain goat sex ratios for the Kootenay region.

15.4.2.3 Modelling

15.4.2.3.1 Methods

Habitat availability and distribution was quantified using habitat suitability models. Habitat suitability for the ungulate VCs was predicted from occupancy models, developed using field observations and 40 to 60 environmental predictor variables. Variables selected for modelling were chosen based on *a priori* knowledge of factors influencing species survival and reproduction. Variables seek to account for variation of preferred resources (i.e., forage and minerals), winter ranges, movement habitats, security from predators, thermoregulation, and anthropogenic disturbance. To quantify predator avoidance by ungulates, an occupancy model was developed for grey wolf. Both spring-summer and fall-winter models were constructed for moose and elk. The data were not sufficient to construct multi-season models for bighorn sheep or mountain goat (i.e., data were too sparse to permit sound inferences with >90% confidence in results) and so only single season models were constructed for these species. Details of variables and habitat modelling methods are provided in Appendix 15-C.

The occupancy models were used to predict the occupancy (probability of occurrence) across the Terrestrial LSA and Terrestrial RSA using the model coefficients and the mapped environmental variables for each ungulate VC. The resulting map data show probability of occurrence and are interpreted as a measure of habitat suitability. Values (from 0-1) were grouped in to six classes (very high, high, moderate, moderately low, low and nil/unclassified) for summary purposes.

15.4.2.3.2 Results

<u>Moose</u>

Habitat Use

The overall estimate of moose occupancy during fall and winter was 0.447 (standard error [SE] = 0.100), or moose are potentially found in approximately 45% of the Terrestrial LSA in fall and winter. During fall and winter, moose were found to have strong selection for low elevation sites with moderate slopes, tertiary streambeds, old forest patches, 10 to 25-year-old burns and (other) shrub containing habitats and selected against sites in close proximity to primary roads and avalanche chutes. The greatest determining factor of moose occurrence was elevation and primary roads, followed by tertiary rivers and old forest patches.

The overall estimate of moose occupancy during spring and summer was 0.736 (SE = 0.083), or moose are potentially found in approximately 74% of the Terrestrial LSA in spring and summer. During spring and summer, the greatest overall factors influencing moose occurrence across the sampled sites was a strong selection for high elevation sites in proximity to mineral licks and tertiary streambeds and selection against sites in proximity to primary roads. Other influential factors included a positive association with wetlands, mid seral and old seral forest patches and avalanche chutes.

Habitat Suitability

The fall-winter habitat model indicates that the best moose habitats within the Terrestrial LSA are located along the Alexander River, Crown Mountain, and within the Grave Prairie area, in addition to portions of the Grave Creek drainage and Deadman Pass (Figure 15.4-8). The spring-summer habitat model indicates that the best moose habitats within the Terrestrial LSA are broadly distributed but generally associated with the Alexander Creek and transboundary mountain passes (i.e., Racehorse and North Fork Pass) in the eastern portion of the Terrestrial LSA in addition to portions of Erickson Ridge, Sheep Mountain, and Crown Mountain (Figure 15.4-9).

Approximately 148 hectares (ha) of the Project footprint (11%) was predicted as very high or high fall-winter habitat suitability for moose. Within the Project footprint, these high-quality habitats (high and very high habitat suitability) are located on Crown Mountain, in Grave Prairie, and in the Grave Creek Canyon (Figure 15.4-8 and summarized in Table 15.4-13). Approximately 4,172 ha of the Terrestrial LSA (17%) was predicted as high-quality habitat suitability for moose during fall-winter. Areas of high-quality fall-winter habitat for moose within the Terrestrial LSA are primarily located in the lower Alexander Creek drainage, Grave Creek Canyon, and Grave Prairie (Figure 15.4-8 and summarized in Table 15.4-13).

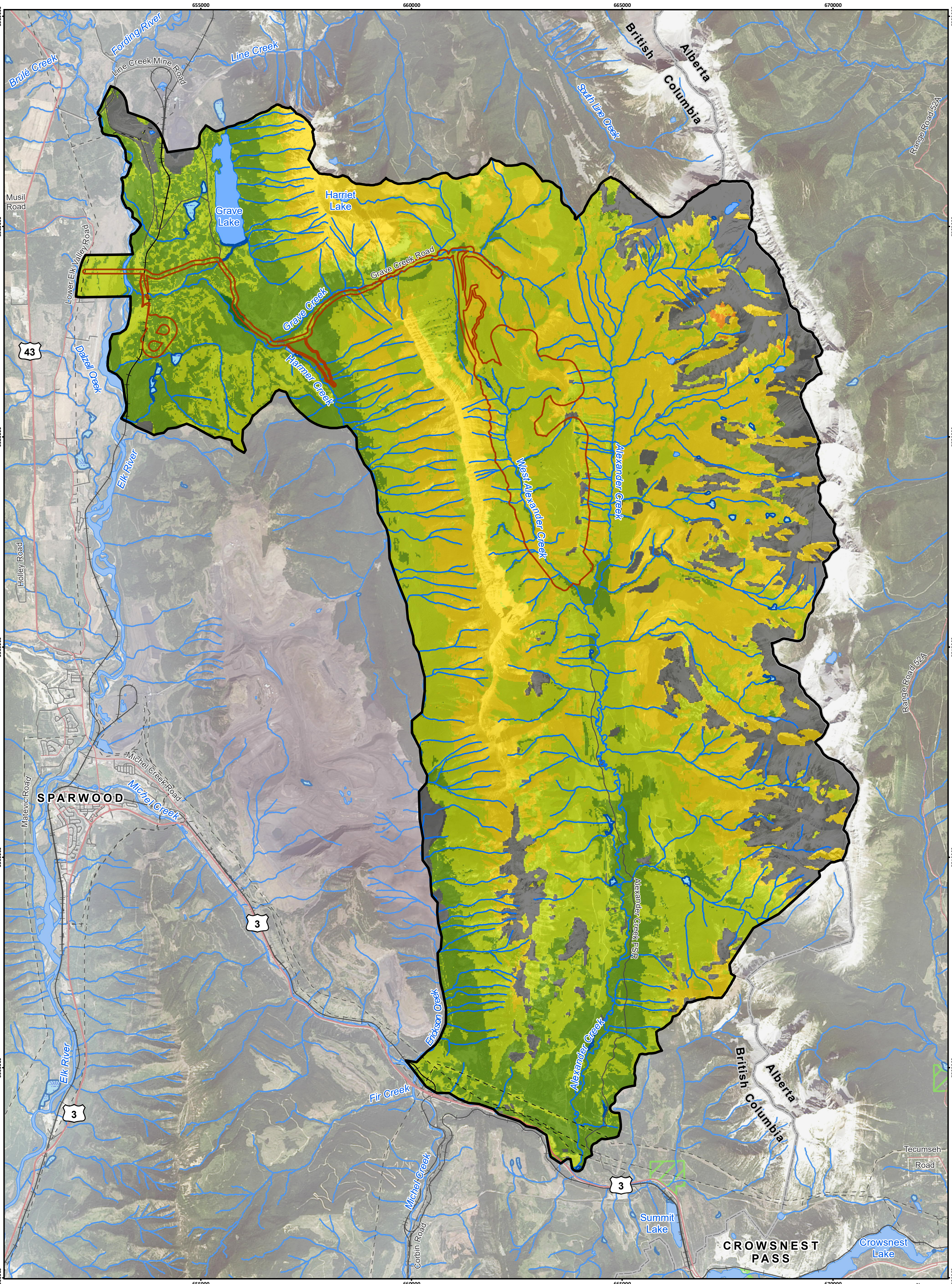

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Figure 15.4-8

Moose Fall-Winter Habitat Suitability in the Terrestrial LSA

LEGEND

Habitat Suitability

- Very High
- High
- Moderate
- Low
- Very Low
- Unclassified
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Kilometres

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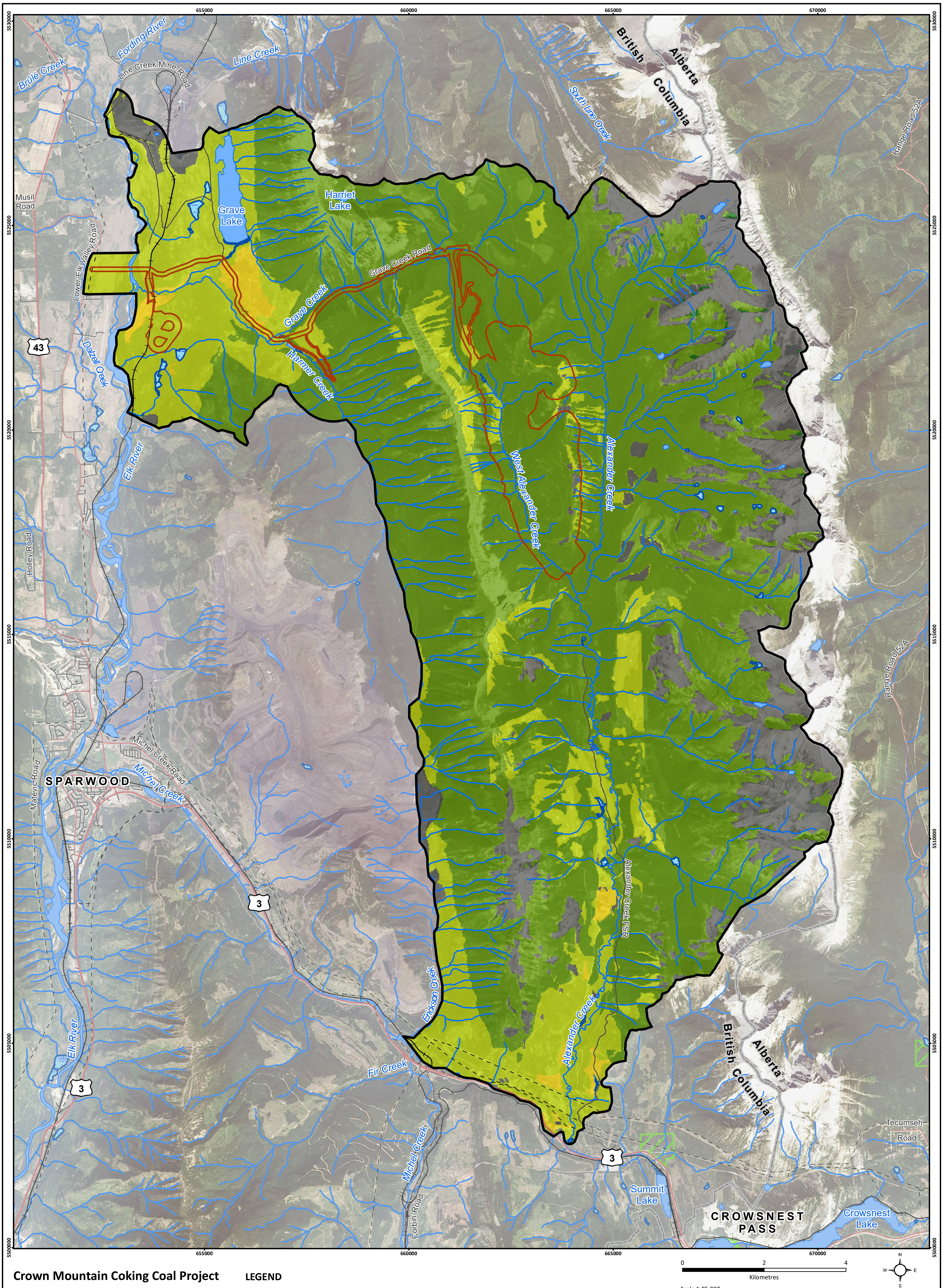

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Figure 15.4-9
Moose Spring-Summer Habitat Suitability in the Terrestrial LSA

LEGEND

Habitat Suitability

- Very High
- High
- Moderate
- Low
- Very Low
- Unclassified
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
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Approximately 1,041 ha of the Project footprint (81%) was predicted as very high or high spring-summer habitat suitability for moose. High-quality spring-summer habitats for moose within the Project footprint are located in the West Alexander Creek valley, and portions of the Erickson Ridge and Crown Mountain (Figure 15.4-9 and summarized in Table 15.4-13). Approximately 16,144 ha of the Terrestrial LSA (67%) was predicted as very high or high habitat quality for moose during spring-summer (Figure 15.4-9 and summarized in Table 15.4-13).

Table 15.4-13: Moose Habitat Suitability in the Terrestrial LSA and Terrestrial RSA

Habitat Suitability	Habitat in the Project Footprint		Habitat in the Terrestrial LSA		Habitat in the Terrestrial RSA	
	Area (ha)	% of Project Footprint	Area (ha)	% of Terrestrial LSA	Area (ha)	% of Terrestrial RSA
Fall-Winter						
Very High (0.8-.1)	4	<1	17	<1	16,174	1
High (0.6-0.8)	144	11	4,155	17	254,075	14
Moderate (0.4-0.6)	785	61	9,433	39	678,461	36
Low (0.2-0.4)	332	26	7,358	30	711,226	38
Very Low (0-0.2)	0	0	21	<1	97,509	5
Unclassified	17	1	3,237	13	118,249	6
Spring-Summer						
Very High (0.8-.1)	0	0	20	<1	165,264	9
High (0.6-0.8)	1,041	81	16,124	67	798,561	43
Moderate (0.4-0.6)	209	16	4,546	19	561,692	30
Low (0.2-0.4)	16	1	302	1	225,591	12
Very Low (0-0.2)	0	0	0	0	7,385	<1
Unclassified	17	1	3,229	13	117,203	6

Elk

Habitat Use

The overall estimate of elk occurrence during fall and winter was 0.504 (SE = 0.098), or elk are potentially found in approximately 50% of the Terrestrial LSA. During fall and winter, elk showed strong selection for low elevation grassland habitats in relative proximity to large rivers (e.g., Elk River) and built-up areas. The greatest determining factor of elk occurrence during fall and winter was the percent area of grassland ecosystems and cultivated habitats. Other strongly determining factors included a negative association with areas with high predator occurrence.

The overall estimate of elk occurrence during spring and summer was 0.927 (SE = 0.042), or elk are potentially in approximately 93% of the Terrestrial LSA. During spring and summer, the greatest overall factors influencing elk occurrence across the sampled sites was a strong selection for greater vegetation greenness and an avoidance of habitats with greater predator occurrence. Elk showed strong selection for burns, cutblocks, open canopy forests, grasslands, pasture and croplands, a general association with habitats in proximity to mines, and a strong avoidance of mid seral forest patches.

Habitat Suitability

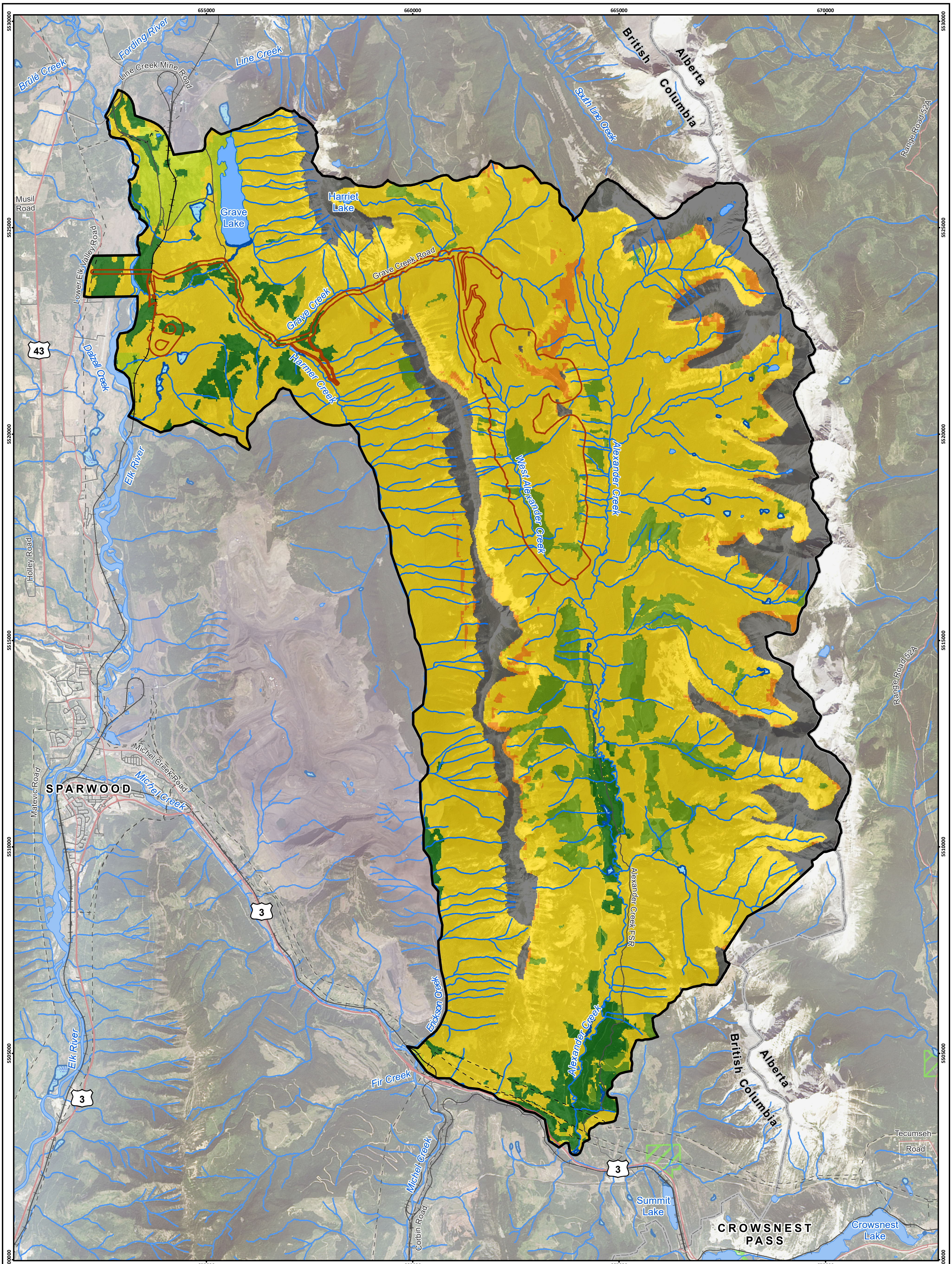
The fall-winter habitat model indicates that the best elk habitats within the Terrestrial LSA are located along the Elk River and within Grave Prairie in addition to portions of the Alexander Creek and Grave Creek drainages and Deadman Pass (Figure 15.4-10 and summarized in Table 15.4-14). The spring-summer habitat model indicates that the best elk habitats within the Terrestrial LSA are broadly distributed but generally associated with the Alexander Creek and Elk River drainages and transboundary mountain passes (i.e., Racehorse and North Fork Pass) in the eastern portion of the Terrestrial LSA in addition to portions of Erickson Ridge, Sheep Mountain, and Crown Mountain (Figure 15.4-11 and summarized in Table 15.4-14).

Approximately 191 ha of the Project footprint (15%) was predicted as very high or high habitat suitability for elk during fall-winter. High quality fall-winter habitats for elk within the Project footprint are located in the southern portion of Crown Mountain, in Grave Prairie, and the Grave Creek Canyon (Figure 15.4-10). Approximately 2,671 ha of the Terrestrial LSA (11%) was predicted as very high or high habitat quality for elk during fall-winter. Areas of quality fall-winter habitat for elk within the Terrestrial LSA are primarily located in the lower Alexander Creek drainage and Grave Prairie (Figure 15.4-10).

Approximately 23 ha of the Project footprint (2%) was predicted as very high or high habitat suitability for elk during spring-summer (Table 15.4-14). High-quality spring-summer habitats for elk within the Project footprint are located in West Alexander Creek, portions of Crown Mountain, and near the rail loadout and natural gas pipeline (Figure 15.4-11). Approximately 863 ha of the Terrestrial LSA (4%) was predicted as very high or high habitat quality for elk during spring-summer.

Table 15.4-14: Elk Habitat Suitability in the Project Footprint, Terrestrial LSA, and Terrestrial RSA

Habitat Suitability	Habitat in the Project Footprint		Habitat in the Terrestrial LSA		Habitat in the Terrestrial RSA	
	Area (ha)	% of Project Footprint	Area (ha)	% of Terrestrial LSA	Area (ha)	% of Terrestrial RSA
Fall-Winter						
Very High (0.8-.1)	53	4	1,202	5	103,639	6
High (0.6-0.8)	138	11	1,469	6	79,210	4
Moderate (0.4-0.6)	0	0	386	2	233,715	12
Low (0.2-0.4)	1,048	82	17,645	73	1,195,105	64
Very Low (0-0.2)	39	3	446	2	41,780	2
Unclassified	6	<1	3,074	13	222,244	12
Spring-Summer						
Very High (0.8-.1)	11	1	279	1%	29,666	2%
High (0.6-0.8)	12	1	584	2%	103,663	6%
Moderate (0.4-0.6)	1,034	81	14,100	58%	1,050,801	56%
Low (0.2-0.4)	218	17	5,747	24%	442,662	24%
Very Low (0-0.2)	2	<1	402	2%	26,551	1%
Unclassified	6	<1	3110	13%	222,301	12%



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N W E S

Crown Mountain Coking Coal Project

Figure 15.4-10

Elk Fall-Winter Habitat Suitability in the Terrestrial LSA

Habitat Suitability

- Very High
- High
- Moderate
- Low
- Very Low
- Unclassified
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: EC
Map Checked By: EM/HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

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Date: 2022-01-11

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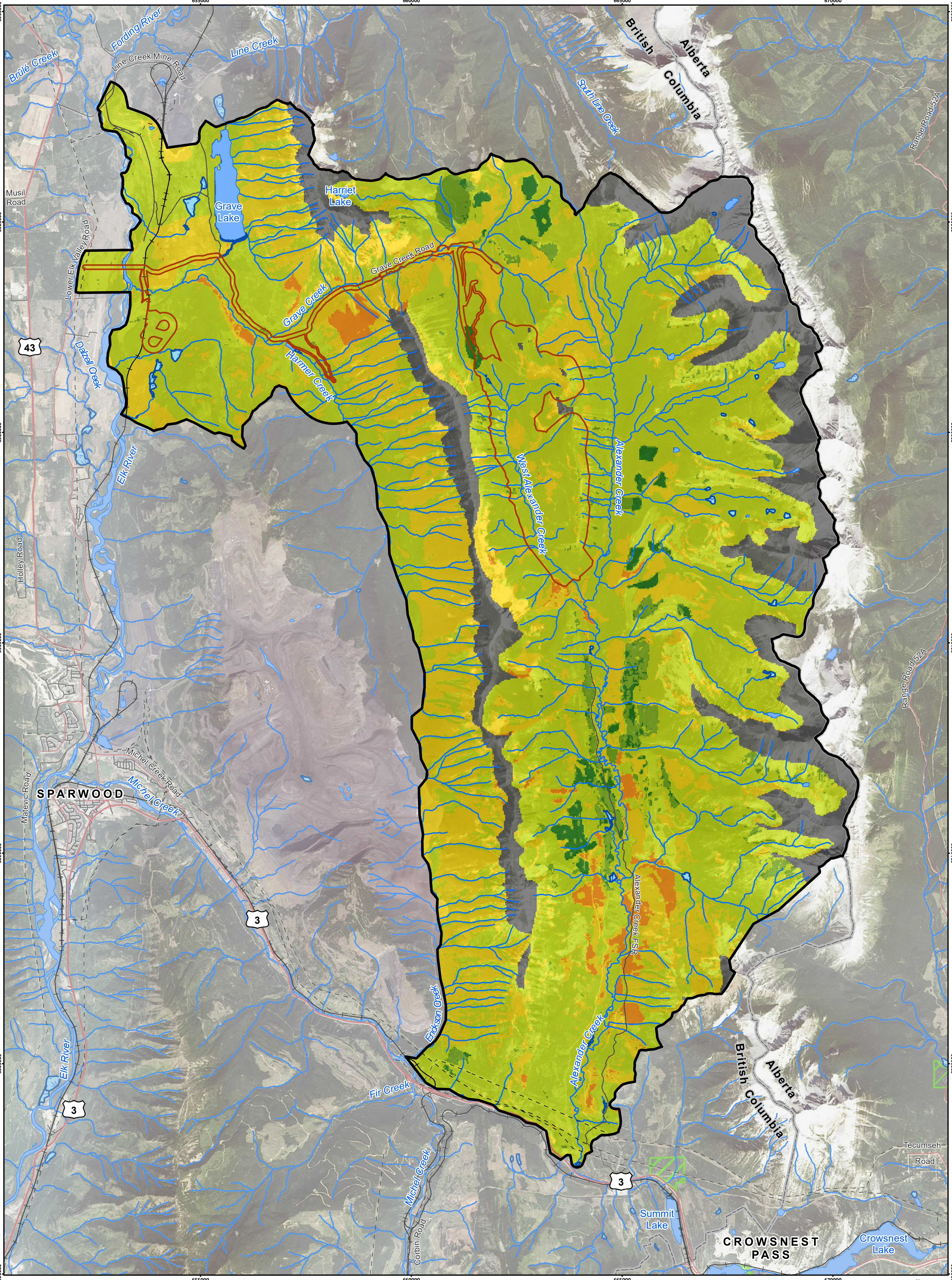

Crown Mountain Coking Coal Project

Figure 15.4-11
Elk Spring-Summer Habitat Suitability in the Terrestrial LSA

LEGEND

Habitat Suitability

- Very High
- High
- Moderate
- Low
- Very Low
- Unclassified
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

0 2 4
Kilometres

Scale 1:85,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
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Map Created By: EC
Map Checked By: EM/HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

NWP Coal Canada Ltd

Project: 12-6231
Status: FINAL
Date: 2022-01-19

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Bighorn Sheep and Mountain Goat

Habitat Use

The overall estimate of bighorn sheep occurrence annually was 0.167 (SE = 0.055), or bighorn sheep are potentially found in approximately 17% of the Terrestrial LSA. Bighorn sheep showed strong selection for terrain ruggedness, proximity to escape terrain (i.e., slopes >60%), mineral licks, and high spring solar radiation. The greatest determining factor of bighorn sheep occurrence was escape terrain, followed by terrain ruggedness. Other strongly determining factors showed that bighorn sheep tended to select for sites containing high elevation graminoids and forbs and avalanche chutes and avoided old and mature forest patches and sites with high predator occurrence.

The overall estimate of mountain goat occurrence was 0.115 (SE = 0.031), or mountain goat are potentially found in approximately 12% of the Terrestrial LSA annually. Mountain goat showed strong selection for escape terrain (i.e., slopes >80%), terrain ruggedness, and south aspects. The greatest determining factor of mountain goat occurrence was escape terrain, which was the most influential factor determining habitat selection annually. Other strongly determining factors included a selection for south aspects and an avoidance of old and mature forest and primary rivers.

Habitat Suitability

The habitat model indicates that the best bighorn sheep habitats within the Terrestrial LSA are located primarily along Erickson Ridge, Sheep Mountain, and transboundary mountain ranges along the Continental Divide. High quality habitats for mountain goat were located along rugged portions of the Continental Divide and portions of Erickson Ridge and Sheep Mountain. Model results are presented in Figure 15.4-12 and Figure 15.4-13 and summarized in Table 15.4-15 and Table 15.4-16.

Table 15.4-15: Bighorn Sheep Habitat Suitability in the Project Footprint, Terrestrial LSA, and Terrestrial RSA

Habitat Suitability	Habitat in the Project Footprint		Habitat in the Terrestrial LSA		Habitat in the Terrestrial RSA	
	Area (ha)	% of Project Footprint	Area (ha)	% of Terrestrial LSA	Area (ha)	% of Terrestrial RSA
Very High (0.8-.1)	6	<1	1,325	5	31,524	2
High (0.6-0.8)	196	15	4,867	20	364,031	19
Moderate (0.4-0.6)	0	0	0	0	4	<1
Low (0.2-0.4)	133	10	3,283	14	88,463	5
Very Low (0-0.2)	947	74	14,586	60	1,358,198	72
Unclassified	1	<1	160	1	33,478	2