Table 2.4-53 Summary of Wildlife Camera Data Adjacent to the Proposed Overland Conveyor Route – 2015 – 2016

Species	GM11		GM15		GM17		Total	
	Count	%	Count	%	Count	%	Count	%
Moose	11	13.9	3	4.2	2	2.6	16	7.0
Mule Deer	37	46.8	16	22.2	6	7.7	59	25.8
Red Fox	-	-	-	-	1	1.3	1	0.4
White-tailed Deer	19	24.1	23	31.9	43	55.1	85	37.1
Wild Turkey	6	7.6	-	-	9	11.5	15	6.6
Total	**79**	**100**	**72**	**100**	**78**	**100**	**229**	**100**

3.0 WILDLIFE ASSESSMENT

3.1 Key Wildlife Issues

Project development has the potential to interact with wildlife in different ways. The Project may alter wildlife habitat availability, habitat connectivity/movement, and wildlife mortality risk and health, all of which may affect the abundance of wildlife in the area (Table 3.1-1). Effects on habitat availability may be either direct (*e.g.* vegetation clearing) or indirect (*e.g.* avoidance of habitat because of sensory disturbance). Each of these issues will be examined for each VC chosen for the Project. Additionally, methods to mitigate any potential negative effects on wildlife will be discussed.

Table 3.1-1 Potential Interactions Between the Project and Wildlife

Project Activity or Component	Wildlife Issues			
	Habitat Availability	Habitat Fragmentation	Mortality Risk/Health	Abundance
Vegetation Clearing: • Loss of natural vegetation	✓	✓	✓	✓
Construction: • High levels of human activity • Sensory disturbance (noise/light)	✓	✓	✓	✓
Road and Utility Corridors: • Conveyor belt	✓	✓	✓	✓

Table 3.1-1 Potential Interactions Between the Project and Wildlife

Project Activity or Component	Wildlife Issues			
	Habitat Availability	Habitat Fragmentation	Mortality Risk/Health	Abundance
• Railway loop • Linear rights-of-way • Pipelines and transmission lines • Traffic				
Coal Extraction: • Mining operations • Maintenance activities	✓	✓	-	✓
Pollution and Contamination: • Air and water quality • Accidental spills • Light pollution	✓	-	✓	✓
Progressive Reclamation: • Revegetation • Early seral habitats	✓	✓	-	✓
Exploration: • Linear feature creation • Short-term noise • Induced access for hunters/predators	✓	✓	✓	✓
Golf course: • Loss of natural vegetation	✓	✓	✓	✓

3.1.1 Habitat Availability

Habitat availability will be altered by the Project, either directly through habitat loss within the Project footprint, or indirectly through wildlife avoidance as a result of sensory disturbance. Land clearing during Project construction creates a direct loss of habitat, which for some species may represent the greatest single effect of the Project. Wildlife with small home ranges and highly specific habitat requirements may be affected at the local level, depending on population size and Project location. Other species with different seasonal requirements, such as toads which require aquatic habitat in spring and summer and upland habitat in winter, may reduce their use of an area if one seasonal habitat is lost. The effects of habitat loss can continue long after the habitat loss has occurred. Habitat loss is considered to be the leading cause of biodiversity loss by many authorities (Pimm and Raven, 2000 Brooks *et al.,* 2002; Fahrig, 2003).

Sensory disturbance associated with Project development (*e.g.* noise, artificial lighting, blasting, and human activity) will also result in indirect habitat loss. These sensory disturbances, which can be ongoing or periodic, may result in wildlife avoiding otherwise suitable habitat, particularly species sensitive to human disturbances such as marten, wolverine, and various species of birds. Sensory disturbance may also affect reproductive success (Habib *et al.,* 2007) or foraging ability of some wildlife species (Bird *et al.,* 2004; Longcore and Rich, 2004; Buchanan, 2006; De Molenaar *et al.,* 2006; Navara and Nelson, 2007). Lights may even alter bird and bat movement behaviour, which in turn could potentially increase energy expenditures and mortality risk (Gauthreaux and Besler, 2006; American Bird Conservancy, 2007). Some wildlife species, such as grizzly bears, may also avoid areas with high levels of human activity (Gibeau *et al.,* 2002). For some sensitive species, indirect habitat losses may account for a greater loss of effective habitat than results from direct loss through vegetation removal.

3.1.2 Habitat Fragmentation and Connectivity

Like other coal projects, the Project has the potential to adversely affect wildlife by disrupting their movement patterns and reducing access to seasonally important habitats. For most species, the ability to move among patches of habitat is crucial. For example, toads move between breeding and hibernation habitats in spring and fall (Garcia *et al.* 2004). Landscape permeability is particularly important for species with larger home ranges such as moose, elk, and grizzly bear. Inability to access requisite habitats may result in use of lower quality habitats with sub-optimal forage and shelter, leading to impaired health and lower reproduction rates.

Construction of open pit coal mines, access roads, coal conveyors, and utility corridors (*e.g.* pipelines, transmission lines) can function as physical barriers to the movement of certain animals, while sensory disturbance associated with use of access roads and construction and operation of Project facilities can prevent animals from effectively moving across the landscape. The effects of these physical and sensory barriers, together with effects of habitat loss through vegetation clearing, can lead to habitat fragmentation and loss of connectivity within a species' home range.

Habitat fragmentation occurs when a continuous block of suitable habitat is divided into smaller blocks separated by barriers to wildlife movement. These barriers can include physical structures, strips of unsuitable habitat, or areas with high levels of noise and human activity. Habitat fragmentation can have especially negative effects on species with low population densities and large home ranges, such as grizzly bears. Without access to a sufficiently large area to meet their needs, such species may suffer from lowered reproduction and survival rates. A major barrier to movement can also prevent gene flow among adjacent populations (Proctor *et al.*, 2002). This can lead to the extirpation of wildlife populations if isolated populations become too small to avoid inbreeding depression. In contrast, wildlife movement across the landscape is often facilitated by natural corridors such as valleys and riparian zones associated with wetlands and watercourses. Disrupting movement along natural corridors may prevent gene flow among adjacent populations. Maintaining the integrity of valleys and riparian zones can help preserve the natural movement patterns of wildlife.

In addition to disrupting gene flow among populations, habitat fragmentation can also increase the ratio of habitat 'edge' to habitat 'interior' in a patch of forest. Fragmentation may reduce habitat quality for species that nest in forest interiors, such as the Townsend's warbler (Wright *et al.*, 1998).

Effects on wildlife movements tend to be species specific. Species with small home ranges tend to be less vulnerable to fragmentation effects than species with large home ranges, and birds generally are considered to be affected less by physical barriers than mammals. Within the WLSA and surrounding area, a major concern is maintaining the integrity of riparian corridors. Linear corridors associated with watercourses are often used by wildlife to move across the landscape.

3.1.3 Wildlife Mortality Risk and Health

The Project has the potential to indirectly increase mortality risk for wildlife through several mechanisms. The first is increased mortality associated with clearing/removal of natural habitat. Mortality risks are greatest for nesting and denning animals and for small mammals and amphibians that have limited mobility. This concern can be mitigated for the most part, with the use of timing windows designed to avoid sensitive breeding and nesting periods. The effects of habitat clearing on species with limited mobility are difficult to mitigate.

Mortality can also result from wildlife-vehicle collisions during Project construction and operation (Jalkotzy *et al.*, 1997). This is a concern that would apply primarily to access roads/utility corridors that provide access to Project facilities. The slower speeds of vehicles travelling within the Project footprint itself will minimize the risk of wildlife mortality. The much higher speeds that are typically associated with resource access roads and highways can pose a substantial risk to wildlife, depending on the route selected and its relationship to wildlife movement corridors (*i.e.* riparian corridors).

Indirectly, seismic lines, roads, and other rights-of-way, can increase access to the area potentially leading to increased levels of hunting, trapping, and predation. Increased mortality rates are a particular concern for species that occur at very low densities and are therefore vulnerable to relatively small population declines.

Wildlife species associated with streams and wetlands are also vulnerable to water contamination that may result from accidental spills of deleterious substances. Since the potential exists for increased selenium and other pollutants in water downstream of the Project, strategies to minimize the potential problem are being developed. A water management program has been developed to treat and remove selenium to ensure that water quality parameters do not have significant effects on wildlife health (Section C.8).

Air emissions associated with Project development may affect forage quality for herbivorous species and indirectly affect wildlife health. Contamination of water or forage can lead to decreased fitness, and in extreme cases, reduced survival. Potential effects of contamination from air emissions on wildlife species were assessed in CR #12 – Human Health and Wildlife Screening.

3.1.4 Wildlife Abundance

Changes in habitat availability (direct and indirect habitat losses), habitat connectivity (habitat fragmentation and movement), and wildlife health and mortality rates can affect the abundance of wildlife. Reduced abundance or diversity could result from increased mortality, reduced reproductive rates, or displacement of animals from the WLSA. If persistent, these changes could affect landscape-level population processes (*i.e.* metapopulation dynamics), particularly for those species with small or declining populations.

As with mortality risk and health, changes in wildlife abundance related to Project development are difficult to predict quantitatively at both the WLSA and WRSA scales. Wildlife abundance will most likely be influenced by the loss of suitable habitat, but might also be related to changes in movement behaviour, habitat fragmentation, and mortality risk. Where possible, published species densities were used to determine potential loss of individuals from changes in habitat availability associated with the Project. Changes in wildlife abundance related to other factors were evaluated qualitatively.

3.2 Approach to Effects Assessment

3.2.1 Assessment Boundaries

3.2.1.1 Wildlife Local Study Area

The WLSA occupies 5,646.4 ha and is comprised of the proposed Mine Permit Boundary with a minimum 500 m zone established around major disturbance features (primarily the southern one-third of the WLSA). The WLSA was established to account for potential disturbance effects of Project development on wildlife that may extend beyond the proposed Mine Permit Boundary (Figure 1.2-2).

3.2.1.2 Regional Study Areas

A regional study area (RSA) encompasses an area within which Project-specific effects on wildlife can be assessed at a broader spatial context. Two wildlife RSAs were defined for use in the Application Case and PDC assessments. These RSAs were considered appropriate to assess regional effects on wildlife from existing, approved, and planned developments such as mining, oil and gas, and forestry activities.

The Wildlife RSA (WRSA) was defined as the area within 10 km of the WLSA boundary, covering a total of 73,547.0 ha (73 km^2; Figure 1.2-3). This diameter was selected to reflect the approximate average size of two elk winter home ranges. Elk was the widest ranging ungulate species detected in the WLSA during baseline surveys with known mean winter home range sizes ranging from to 23 km^2 in west-central Alberta (Jones, 1997) to 512 km^2 in southeastern British Columbia (Arc Wildlife Services, 2005). The WRSA was considered to include the home ranges of most wildlife species expected to occur in the region.

The Grizzly Bear RSA (GBRSA) was defined as the area within 25 km of the WLSA boundary (Figure 1.2-3), covering a total of 284,024.7 ha (284 km^2). The GBRSA was selected to represent the average area of an adult female grizzly bear home range and other wildlife species with very large home ranges (*e.g*. wolverine). Adult female grizzly bear home ranges are smaller than those of adult males, and home ranges of both sexes can vary depending on food availability and habitat quality (COSEWIC, 2012). Mean adult female home range size in the central and southern Canadian Rockies has been found to vary between 179 km^2 to 336 km^2 (Russell *et al.*, 1979; Carr, 1989; Carra, 2010; COSEWIC, 2012). A summary of grizzly bear home range sizes throughout their Canadian distribution is provided by COSEWIC (2012). The GBRSA was also used for the soils, vegetation, and biodiversity components of the EIA. Project-related effects on wildlife were not expected to occur beyond the WRSA and GBRSA.

3.2.1.3 Temporal Boundaries

Temporal boundaries were defined as lasting approximately 27 years, concomitant with the life of the Project (baseline, construction, operation, reclamation, mitigation, and post-reclamation phases).

3.2.2 Effects Assessment Scenarios

For the wildlife assessment, three scenarios were assessed: Year 0 (baseline, pre-construction conditions), Year 14 (operations, expected maximum mine disturbance spatial extent), and Year 27 (end of mine) (Table 3.2-1). Assessment methods varied based on species-specific differences in habitat use and movement patterns but included quantitative analyses such as habitat suitability modeling and core habitat/movement analyses. The Baseline Case scenario was based on existing, pre-construction environmental conditions (*i.e.* Year 0). The Application Case scenario reflected the Baseline Case plus expected maximum mine disturbance extent (Year 14) and end of mine (Year 27). Year 38 was originally proposed to be included in the Assessment Case but was not included because habitat availability in the WLSA and WRSA at Year 38 was found to be negligibly different from Year 27. As such, Year 38 did not provide additional meaningful information for the modelled VCs over the short time span. The Planned Development Case (PDC) (*i.e.* cumulative effects) scenario included baseline conditions, the Project, and all planned development and activities in the foreseeable future (Table 3.2-1).

Table 3.2-1 Assessment Scenarios Considered During the Wildlife Assessment

Scenario	Description	Assessment Methods
Baseline Case	Includes existing environmental conditions and existing disturbances (industrial and urban development).	• Habitat suitability modeling (all VCs) • Core habitat/movement analyses for moose and elk • Mortality risk and habitat states modelling for grizzly bears
Application Case	Includes the Baseline Case plus the Project at Application Case time steps Year 14 and Year 27	
Planned Development Case (PDC)	Includes the Baseline Case, the Project, and any other planned industrial and urban developments at two time steps - Year 14 and Year 27.	

3.2.3 Valued Components

In accordance with current practice in Alberta, this wildlife assessment was focused on a number of species that were selected as Valued Components (VCs) that may be affected by the Project development. It is not feasible to assess all wildlife species; therefore, Benga selected a set of wildlife VCs that are representative of wildlife in the area. Similarly, while Benga appreciates the traditional value of many wildlife species to Aboriginal Groups, not all species with traditional value identified in the available TU reports or from Aboriginal Consultation sessions could be individually assessed. The species of traditional value that were identified were carefully considered during the establishment of the wildlife VCs for the Project.

The approach taken for the Project to identify wildlife VCs focussed on the selection of species that representative species for other wildlife species/groups that exhibit similar use of various habitat types at various spatial (foraging) and temporal (*e.g.* breeding, overwintering) scales. To determine the representative wildlife species the following criteria was used:

- known or reported occurrence in and overlap with the WLSA;
- reported to have value to traditional (Aboriginal Groups), recreational (hunters), subsistence (trappers), and/or non-consumptive (wildlife viewing) users;
- provincial (“At Risk”, “May Be At Risk”, or “Sensitive”) and/or federal (Schedule 1 *SARA* species, “Endangered”, “Threatened”, or “Special Concern”) status, or is known to be declining in the region;
- use of major habitats and/or reliance on habitat types that are limited in geographic extent and that may be affected by Project development; and
- is a “keystone” species that has a disproportionate effect on the ecosystems it is found in or other species require its presence to persist in the area.

Based on this approach, ten wildlife VCs consisting of two amphibian, two avian, and six mammalian species were selected for the wildlife Baseline Assessment (Section 4) and Application Assessment (Section 5). Before commencing with the assessment based on these 10 VCs, the VCs were presented to the Treaty 7 First Nations groups included in the Aboriginal Consultation process for their approval or recommended additions or alternatives. No additions or changes were suggested by any of the First Nations; therefore, Benga commenced the wildlife assessment based on the chosen ten VCs. These VCs were assessed in detail. An additional eight species were included in a higher level assessment to provide supplemental information to the wildlife assessment. These eight species were chosen based on the same criteria as the VCs, and are considered special status species.

The VCs and the justification for choosing them are outlined in Table 3.2-2. The special status species are outlined in Table 3.2-3. For the PDC, a subset of these VCs was chosen, based on the results of the Application Assessment. The PDC VCs and the rationale for their selection are provided in Section 6.3.1.

Table 3.2-2 Summary of Valued Components Used to Assess Project Effects on Wildlife

Species	Status	Recorded in WLSA	Rationale for Selection
Amphibians			
Columbian Spotted Frog	**Alberta:** Sensitive	Yes	Known to occur in WLSA; indicator of wetland/aquatic/riparian-dependent species; sensitive to changes in water quality; relies on breeding ponds which are of limited availability and distribution; vulnerable to human disturbance; provincially listed species.

Table 3.2-2 Summary of Valued Components Used to Assess Project Effects on Wildlife

Species	Status	Recorded in WLSA	Rationale for Selection
Western Toad	**Alberta:** Sensitive **COSEWIC:** Special Concern	Yes	Known to occur in WLSA; indicator of wetland/aquatic-dependent species; sensitive to changes in water quality, vulnerable to human disturbance; provincially and federally listed species.
Birds			
Olive-sided Flycatcher	**Alberta:** May be at Risk **COSEWIC:** Threatened **SARA:** Schedule 1	Yes	Known to occur in WLSA; indicator of mature coniferous/riparian forests, burned woodlands, and edge habitat bird species; provincially and federally listed species
Great Grey Owl	**Alberta:** Sensitive	Yes	Known to occur in WLSA; indicator of mature and old-growth forest bird species; vulnerable to habitat loss and forestry practices; cultural importance to First Nations; provincially listed species.
Mammals			
Little Brown Myotis	**Alberta:** Secure **COSEWIC:** Endangered **SARA:** Schedule 1	Yes	Known to occur in WLSA; indicator of mature and old growth forest species; federally listed species.
American Marten	**Alberta:** Secure	Yes	Known to occur in WLSA; important fur harvest and First Nations traditional use species, vulnerable to habitat fragmentation and human disturbance; indicator of late succession coniferous forest.
Canada Lynx	**Alberta:** Sensitive	Yes	Known to occur in WLSA; important fur harvest and First Nations traditional use species; vulnerable to habitat fragmentation/human disturbance; indicator of early succession forest species; provincially listed species.
Grizzly Bear	**Alberta:** Threatened **COSEWIC:** Special Concern **SARA:** Schedule 3	Yes	Known to occur in WLSA; culturally important to First Nations; potentially declining population in the Castle-Livingstone region; susceptible to industrial activities and vulnerable to conflicts with humans; provincially and federally listed species.
Moose	**Alberta:** Secure	Yes	Known to occur in WLSA; important recreational hunting and traditional use species; culturally important to First Nations important prey for large predators; indicator of riparian and early to mid-successional habitats.

Table 3.2-2 Summary of Valued Components Used to Assess Project Effects on Wildlife

Species	Status	Recorded in WLSA	Rationale for Selection
Elk	**Alberta:** Secure	Yes	Known to occur in the WLSA; important recreational hunting species; culturally important to First Nations; important prey for large predators; indicator of grassland/early successional habitats.

Table 3.2-3 Summary of Special Status Species Used to Assess Project Effects on Wildlife

Species	Status	Recorded in WLSA	Rationale for Selection
Birds			
Barn Swallow	**Alberta:** Sensitive **COSEWIC:** Threatened	Yes	Known to occur in WLSA; indicator of open wetlands, fields, and meadows; provincially and federally listed species
Common Nighthawk	**Alberta:** Sensitive **COSEWIC:** Threatened **SARA:** Schedule 1	Yes	Known to occur in WLSA; vulnerable to habitat loss; provincially and federally listed species.
Short-eared Owl	**Alberta:** May be at Risk **COSEWIC:** Species of Concern **SARA:** Schedule 1	Yes	Known to occur in WLSA; cultural importance to First Nations; provincially and federally listed species.
Bald eagle	**Alberta:** Sensitive **COSEWIC:** Not at Risk	Yes	Significant cultural and spiritual importance to Treaty 7 First Nations
Golden eagle	**Alberta:** Sensitive **COSEWIC:** Not at Risk	Yes	Significant cultural and spiritual importance to Treaty 7 First Nations
Mammals			
Mountain Goat	**Alberta:** Secure	Yes	Prized game species by hunters, traditional value/use (Piikani Nation)
Bighorn Sheep	**Alberta:** Secure	Yes	Traditional value/use (Kainai, Piikani, and Tsuut'ina, Siksika, Samson Cree Nations); prized game species by hunters

Table 3.2-3 Summary of Special Status Species Used to Assess Project Effects on Wildlife

Species	Status	Recorded in WLSA	Rationale for Selection
Wolverine	**Alberta:** May be at Risk **COSEWIC:** Special Concern	Yes	Known to occur in the WLSA; provincially and federally listed species, traditional value/use (Samson Cree Nation).

3.2.4 Evaluation Criteria for Environmental Effects

The level of an environmental effect was determined only after considering any mitigation measures. Residual effects were considered to be those effects that occurred after mitigation. A VC's sensitivity and ability to recover from residual effects was then considered. The geographic extent, magnitude, duration, frequency, and reversibility of the effects resulting from Project activities were all considered. Magnitude was quantified for change in habitat availability as the change in effective habitat area (in hectares) between the Baseline and Application cases. Potential Project effects on wildlife VCs were assessed based on a number of criteria (Table 3.2-4).

Table 3.2-4 Evaluation Criteria for Assessing the Environmental Effects of the Project

Criteria	Criteria Definition	
Geographic Extent of Impact	Local	Effects occurring mainly within or close proximity to the proposed development area.
	Regional	Effects extending outside of the Project boundary to regional surroundings.
	Provincial	Effects extending outside of the regional surroundings, but within provincial boundary.
	National	Effects extending outside of the provincial surroundings, but within national boundary.
	Global	Effects extending outside of national boundary.
Duration of Impact	Short	Effects occurring within development phase.
	Long	Effects occurring after development and during operation of facility.
	Extended	Effects occurring after facility closes but diminishing with time.
	Residual	Effects persisting after facility closes for a long period of time.
Frequency	Continuous	Effects occurring continually over assessment periods.
	Isolated	Effects confined to a specified period (*e.g.* construction).

Table 3.2-4 Evaluation Criteria for Assessing the Environmental Effects of the Project

Criteria	Criteria Definition	
	Periodic	Effects occurring intermittently but repeatedly over assessment period (*e.g.* routine maintenance activities).
	Occasional	Effects occurring intermittently and sporadically over assessment period.
Ability for Recovery	Reversible in short-term	Effects which are reversible and diminish upon cessation of activities.
	Reversible in long-term	Effects which remain after cessation of activities but diminish with time.
	Irreversible - Rare	Effects which are not reversible and do not diminish upon cessation of activities and do not diminish with time.
Magnitude	Nil	No change from background conditions anticipated after mitigation.
	Low	Disturbance predicted to be somewhat above typical background conditions, but well within established or accepted protective standards and normal socio-economic fluctuations, or to cause no detectable change in ecological, social or economic parameters.
	Moderate	Disturbance predicted to be considerably above background conditions but within scientific and socio-economic effects thresholds, or to cause a detectable change in ecological, social or economic parameters within range of natural variability.
	High	Disturbance predicted to exceed established criteria or scientific and socio-economic effects thresholds associated with potential adverse effect, or to cause a detectable change in ecological, social or economic parameters beyond the range of natural variability.
Project Contribution	Neutral	No net benefit or loss to the resource, communities, region or province.
	Positive	Net benefit to the resource, community, region or province.
	Negative	Net loss to the resource, community, region or province.
Confidence Rating	Low	Based on incomplete understanding of cause-effect relationships and incomplete data pertinent to study area.
	Moderate	Based on good understanding of cause-effect relationships using data from elsewhere or incompletely understood cause-effect relationship using data pertinent to study area.
	High	Based on good understanding of cause-effect relationships and data pertinent to study.

Table 3.2-4 Evaluation Criteria for Assessing the Environmental Effects of the Project

Criteria	Criteria Definition	
Probability of Occurrence – Ecological Context	Low	Unlikely.
	Moderate	Possible or probable.
	High	Certain.
Significance	Not Significant	Effects are predicted to be within the range of natural variability and below guideline or threshold levels.
	Significant	Effects of the Project are predicted to cause irreversible changes to the sustainability or integrity of a population or resource.

3.2.5 Assessment Techniques

3.2.5.1 Wildlife Diversity and Regional Wildlife Habitats

Ecosite phase mapping (CR#8 – Vegetation and Wetlands) was used for the WLSA while Ecological Land Classification (ELC) information was used to map wildlife habitats and wildlife diversity across the WRSA and GBRSA and WRSA, for the Baseline and Application cases. Anthropogenic features in the ELC layer were supplemented with linear features identified during a more detailed disturbance mapping exercise conducted for the GBRSA using high-resolution satellite imagery and ABMI Human Disturbance data (ABMI, 2015). Water bodies were assumed to include some adjacent vegetation, and therefore, were considered to be of value to species that use riparian habitat. It should be noted that ELC categories could not always be related to an ecosite phase and in these cases, some discrepancies in the areal extent of some habitats occurred. This simply reflects the different mapping scales and vegetation classifications used.

Habitat use was defined as nesting habitat for most birds, and annual living requirements for amphibians, reptiles, and mammals. Species lists were not limited to those reported during baseline surveys since certain species may be under represented because of low densities, irruptive occurrences, local distribution, and/or survey effort or timing. Other resources used to supplement the field data included the FWMIS (AEP, 2015), ABMI (2015), Pattie and Fisher (1999), FAN (2007), COSEWIC, Russell and Bauer (2002), and the Birds of North America Online (http://bna.birds.cornell.edu/bna/species).

The total number of potential birds, mammals, amphibians, and reptiles was summed for each ecosite or ELC category. Wildlife diversity values were then classified into the following classes: high (≥91 species), moderate-high (71-90 species), moderate (45-70 species), moderate-low (20-44 species), and low (≤19 species). The areas of each diversity class were also calculated and summarized for the WLSA and GBRSA.

Project effects on habitat availability were assessed using two sources of groundcover information. Data were analyzed using ecosite phase mapping in the WLSA, while wildlife habitat in the WRSA was described in the context of the ELC (Table 3.2-4).

Table 3.2-5 Ecological Land Classification and Characteristics in the Wildlife and Grizzly Bear Regional Study Areas

Ecological Land Classification	Canopy Closure (%)	Succession Stage	Age (Years)	Age Class	% Conifer1
Upland Forested Communities:					
Dense Deciduous Mature Forest	71 - 100	Dense Forest	61 - 99	Mature	≤20
Dense Deciduous Old Forest	71 - 100	Dense Forest	≥100	Old	≤20
Dense Mixed Young Forest	71 - 100	Dense Forest	30 - 60	Young	21 - 79
Dense Mixed Mature Forest	71 - 100	Dense Forest	61 - 99	Mature	21- 79
Dense Mixed Old Forest	71 - 100	Dense Forest	≥100	Old	21 - 79
Dense Conifer Young Forest	71 - 100	Dense Forest	30 - 70	Young	80 - 100
Dense Conifer Mature Forest	71 - 100	Dense Forest	71–119/71-139	Mature	80 - 100
Dense Conifer Old Forest	71 - 100	Dense Forest	≥120/≥140	NA	80 - 100
Dense Deciduous Young Forest	71 - 100	Dense Forest	30 - 60	NA	≤20
Closed Deciduous Young Forest	51 - 70	Closed Forest	30 - 60	Young	≤20
Closed Deciduous Mature Forest	51 - 70	Closed Forest	61 - 99	Mature	≤20
Closed Deciduous Old Forest	51 - 70	Closed Forest	≥100	Old	≤20
Closed Mixed Young Forest	51 - 70	Closed Forest	30 - 60	Young	21 - 79
Closed Mixed Mature Forest	51 - 70	Closed Forest	61 - 99	Mature	21 - 79
Closed Mixed Old Forest	51 - 70	Closed Forest	≥100	Old	21 - 79
Closed Conifer Young Forest	51 - 70	Closed Forest	30 - 70	Young	80 - 100
Closed Conifer Mature Forest	51 - 70	Closed Forest	71–119/71-39	Mature	80 - 100
Closed Conifer Old Forest	51 - 70	Closed Forest	≥120/≥140	Old	80 - 100

Table 3.2-5 Ecological Land Classification and Characteristics in the Wildlife and Grizzly Bear Regional Study Areas

Ecological Land Classification	Canopy Closure (%)	Succession Stage	Age (Years)	Age Class	% Conifer1
Moderate Deciduous Young Forest	31 - 50	Moderate Forest	30 - 60	Young	≤20
Moderate Deciduous Mature Forest	31 - 50	Moderate Forest	61 - 99	Mature	≤20
Moderate Deciduous Old Forest	31 - 50	Moderate Forest	≥100	Old	≤20
Moderate Mixed Young Forest	31 - 50	Moderate Forest	30 - 60	Young	21 - 79
Moderate Mixed Mature Forest	31 - 50	Moderate Forest	61 - 99	Mature	21- 79
Moderate Mixed Old Forest	31 - 50	Moderate Forest	≥100	Old	21 - 79
Moderate Conifer Young Forest	31 - 50	Moderate Forest	30 - 70	Young	80 - 100
Moderate Conifer Mature Forest	31 - 50	Moderate Forest	71–119/71-139	Mature	80 - 100
Moderate Conifer Old Forest	31 - 50	Moderate Forest	≥120/≥140	Old	80 - 100
Open Deciduous Young Forest	6 - 30	Open Forest	30 - 60	Young	≤20
Open Deciduous Mature Forest	6 - 30	Open Forest	61 - 99	Mature	≤20
Open Deciduous Old Forest	6 - 30	Open Forest	≥100	Old	≤20
Open Mixed Young Forest	6 - 30	Open Forest	30 - 60	Young	21 - 79
Open Mixed Mature Forest	6 - 30	Open Forest	61 - 99	Mature	21 - 79
Open Mixed Old Forest	6 - 30	Open Forest	≥100	Old	21 - 79
Open Conifer Young Forest	6 - 30	Open Forest	30 - 70	Young	80 - 100
Open Conifer Mature Forest	6 - 30	Open Forest	71–119/71-139	Mature	80 - 100
Open Conifer Old Forest	6 - 30	Open Forest	≥120/≥140	Old	80 - 100
Wetland Communities:					
Natural Graminoid Wetland	<6	Graminoid	NA	Non-Forest	NA
Natural Shrub Wetland	<6	Shrubby	NA	Non-Forest	NA
Treed Wetland	≥6	Treed/Forested	NA	Non-Forest	NA
Open Water	NA	NA	NA	Non-Forest	NA

Table 3.2-5 Ecological Land Classification and Characteristics in the Wildlife and Grizzly Bear Regional Study Areas

Ecological Land Classification	Canopy Closure (%)	Succession Stage	Age (Years)	Age Class	% Conifer1
Natural Non-Forested Land:					
Lush Herb	NA	Herbaceous	NA	Non-Forest	NA
Natural Shrub	<6	Shrubby	NA	Non-Forest	NA
Natural Upland Herbaceous	<6	Herbaceous	NA	Non-Forest	NA
Barren Land	0	Non-vegetated	Variable	Non-Forest	NA
Disturbed Land:					
Agriculture	NA	NA	NA	Non-Forest	NA
Open Regeneration - Herbaceous	0 - 5	Herbaceous	0 - 5	Non-Forest	NA
Open Regeneration - Shrub	<6	Shrubby	6 - 14	Non-Forest	NA
Closed Regeneration - Forest	6 - 29	Treed	15 - 29	Non-Forest	NA
Settlements	NA	NA	NA	Non-Forest	NA
Linear Disturbance	NA	NA	NA	Non-Forest	NA
Industrial (Mining)	NA	NA	NA	Non-Forest	NA

[1]NA – Not applicable

3.2.5.2 Habitat Availability and Habitat Suitability Modelling

3.2.5.2.1 Wildlife Local Study Area and Wildlife Regional Study Area

Habitat availability of wildlife VCs was determined with the use of species-specific habitat suitability models. A detailed description of the modeling process and species accounts is presented in Appendix C, but a brief summary of the process is provided below. The habitat suitability modeling approach used for this wildlife assessment was based on an 'expert opinion/literature review-based' process (RIC, 1999; Muir *et al.*, 2011) where professional biologists assign ratings to ecological or habitat units for each species of interest based on a detailed review of literature and field data. Suitability ratings reflect the relative importance of current habitat to the persistence of a population in a given area. An acknowledged limitation of the habitat modeling approach is that a number of factors other than habitat suitability, including predation, disease, and social interactions, can also affect wildlife abundance of an area. This modeling approach was used for nine of the ten VCs selected for the wildlife assessment in the WLSA (Columbia spotted frog, western toad, olive-sided flycatcher, great gray owl, American marten, Canada lynx, moose, and elk) and three of the nine species in the WRSA (Canada lynx, moose, and elk).

The modeling process involved a number of steps, the first of which was to develop species accounts and species-specific habitat ratings. Species accounts summarize the state of knowledge on the status, ecology, and life history for selected wildlife VCs. Specific times of the year (winter *vs.* spring/summer) and life requisites (critical life process corresponding with the season) were selected for each wildlife VC (Table 3.2-5). Information on the species' ecology (including existing literature and field data) was used to rate the predicted use and value of habitat units within the WLSA and WRSA. Ratings were then applied using a 4 or 6-class system, depending on the level of information that was available. For example, the 4-class system was used for species with a moderate level of information, where habitat units were rated as having high (1), moderate (2), low (3), or nil (4) suitability.

Table 3.2-5 Seasons and Life Requisites Modelled for Selected Wildlife VCs

Wildlife VC	Seasons	Life Requisites	Model Type
Columbia Spotted Frog	Year-Round	Reproduction, Dispersal, Hibernation	Habitat Suitability
Western Toad	Spring and Summer	Reproduction, Dispersal, Foraging	Habitat Suitability
Olive-sided Flycatcher	Summer	Reproduction	Habitat Suitability
Great Grey Owl	Late Spring/ Early Summer	Reproduction, Foraging	Habitat Suitability
Little Brown Myotis	Summer	Roosting, Foraging, Reproduction	Habitat Suitability
American Marten	Winter	Foraging	Habitat Suitability
Canada Lynx	Winter	Foraging	Habitat Suitability
Grizzly Bear	Spring, Summer, Fall	Foraging, Mortality Risk	Resource Selection Function
Moose	Winter	Foraging	Habitat Suitability
Elk	Winter	Foraging	Habitat Suitability

Rating adjustments factoring the proximity of disturbance features were also incorporated through the use of Zones of Influence (ZOIs), which are areas surrounding disturbances that wildlife may avoid because of sensory disturbance. This allows for an accounting of indirect habitat loss. Disturbance ZOIs for the Project were based on the operations phase, under the assumption that the construction phase will be short-term. Once incorporated, the remaining proportions of suitable habitat for a given season and life requisite was calculated, and compared between baseline (existing) and predicted scenarios.

The arrangement and distribution of habitat can be just as important as the quantity of habitat available to wildlife. A core habitat analysis was conducted for moose and elk to determine the availability of effective habitat (*i.e.* habitat which is rated moderate or higher for suitability) that provides security from human disturbance and predation, while providing adequate forage resources. Core habitat was therefore defined as effective habitat (high to moderate suitability) that occurred outside of the disturbance ZOIs. It was assumed that patches needed to be at least 5 ha in size to be considered as core habitat.

3.2.5.2.2 Grizzly Bear Regional Study Area

A resource selection function (RSF) model was used to assess Project-related effects on grizzly bears in the WLSA and GBRSA, rather than developing a habitat suitability model, as was done for the other wildlife VCs. RSF models are based on more detailed data and therefore yield more robust predictions than habitat suitability models. The detailed data requirements, however, limit the use of RSF to species for which such data are available. The RSF used for grizzly bear in this assessment was developed by the Foothills Research Institute (FRI), and consisted of GIS layers describing various aspects of the landscape, including those related to grizzly bear habitat quality such as land cover, canopy closure, and conifer/broadleaf mix. Other layers included habitat models that predicted or described grizzly bear occupancy, human-caused mortality risk, probability of denning, forage availability, and the locations of sources and sinks (*i.e.* the "habitat states" model). A more detailed description of the grizzly bear RSF model is presented in Appendix C.

Available data for the RSF model covered a contiguous area of 53.0% (150,674.0 ha) of the GBRSA and excluded 30.1% (85,390.9 ha) and 16.9% (47,960.1 ha) of the eastern and western portions of the GBRSA, respectively. The region east of the modelled RSF area was assumed to be non-critical habitat (*i.e*. an area where grizzly bears were not expected to occur) because of the predominant agricultural landscape (Northrup *et al.*, 2012). In contrast, the region of the GBRSA located west of the RSF model is in British Columbia and provides source and sink habitats for grizzly bears based on existing information available for the region. Despite this exclusion, the RSF was believed to provide the most robust predictions of Project effects based on available data and was used to assess grizzly bears within 53% of the GBRSA.

3.2.5.3 Movement

Wildlife movement was assessed using permeability mapping for moose and elk, which are species whose movements are most likely to be affected by the Project. Potential changes in the movement behaviour of the remaining VCs were assessed qualitatively, without permeability mapping.

Twenty-five disturbance features were classified (Table 3.2-6) using data from the ELC and the Alberta Biodiversity Monitoring Institute Human Footprint Inventory (ABMI 2012) for the WLSA and WRSA (CR# 8 – Vegetation and Wetlands). Disturbance features may act as barriers to wildlife movement because of the presence of physical impediments such as buildings or fences, high levels of human activity, presence of predators or hunters/poachers, or unsuitable habitat. Disturbances were assigned a permeability rating based on the degree to which they were presumed to act as barriers (*e.g.* high permeability = 0, moderate permeability = 1, low permeability = 2, and impermeable = 3). Patches of core habitat were then examined in relation to the disturbance features to determine their accessibility for moose and elk.

Table 3.2-6 Permeability Ratings in the Wildlife Local Study Area and Wildlife Regional Study Area for Moose and Elk

Disturbance Feature	Permeability Rating[1]
Active Well Site	2
CHPP Facilities	3
Clearing-Other	0
Coal Conveyor System	2
Cutblock	0
Existing Surface Coal Mine	2
Golf Course	0
Highway	2
Inactive Well Site	0
Industrial Activity	3
Pasture	0
Pipeline	1
Railway	2
Railway Loop	3

Table 3.2-6 Permeability Ratings in the Wildlife Local Study Area and Wildlife Regional Study Area for Moose and Elk

Disturbance Feature	Permeability Rating[1]
Reclaimed Areas	0
Residential/Commercial	3
Roads	2
Rural Residence	1
Sedimentation Ponds and Ditches	1
Seismic Line	0
Topsoil Salvage	0
Topsoil Storage	0
Transmission Line	1
Ultimate Dump Extent	3
Ultimate Pit Extent	3
Vegetated Trail	0

[1.] 3 = Impermeable, 2 = Low permeability, 1 = Moderate impermeability, 0 = High permeability.

3.2.5.4 Thresholds

Effects ratings were determined largely based on threshold values identified for each of the VCs. Thresholds, if present, are likely to vary by species, area, disturbance type, and scale. Effects ratings were influenced by the conservation status and perceived vulnerability of the species, reflecting federal guidance addressing species at risk. Listed species were considered to be more sensitive and therefore more likely to be affected at the population level than more stable, generalist species (Mönkkönen and Reunanen, 1999; Radford *et al.*, 2005). Therefore, threshold values were more stringent for species at risk (*i.e.* those listed under SARA) than for valued species (*e.g.* moose, elk).

3.2.5.4.1 Changes in Habitat Availability

Species are expected to withstand the loss of habitat up to a critical threshold, above which their populations would begin to decline. Radford *et al.* (2005) found that boreal bird diversity dropped rapidly when landscapes had <10% cover. According to Andrén (1994), species are not necessarily at the risk of regional extirpation even when only 10 – 30% of the landscape remains effective habitat, although these species are still affected by the loss and fragmentation of habitat through reduced body condition, reduced reproductive potential, and declining populations. Several other studies have reported considerably higher thresholds (*e.g.* pond-breeding amphibians; Homan *et al.*, 2004). Some studies suggest that residual thresholds from 10 – 60% may be necessary to prevent rapid population decline (Villard *et al.*, 1999; Swift and Hannon, 2002), but a recent review (Swift and Hannon, 2010) concluded that most empirical studies support Andrén's (1994) initial proposed range of 10 – 30%. Benga Mining adopted a precautionary approach for assessing habitat change, and used a threshold of 20% (*i.e.* a species will tolerate up to a 20% loss of effective habitat) for valued species at the WRSA and GBRSA levels.

3.2.5.4.2 Changes in Movement Patterns

There is a lack of information directly pertaining to thresholds for movement patterns of most wildlife species, so the assessment of Project effects was qualitative for these species. Thresholds were employed for assessing changes in ungulate movement behaviour. Moose response to roads appears to vary relative to road density at a regional scale. Moose have been found to cross roads less frequently at road densities greater than 0.4 km/km^2 in winter (Beyer *et al.*, 2013). Lyon (1983) determined that elk habitat effectiveness declined by 25% at a road density of 0.62 km/km^2 and by 50% at a density of 1.24 km/km^2 as areas of core habitat became isolated and movement patterns were altered (Table 3.2-7). An effect was considered significant if road densities were above these threshold values, regardless of its reversibility. If road density was already above the threshold at baseline, any increase because of the Project was assessed as non-significant.

Table 3.2-7 Movement Risk Ratings in Relation to Road Density for Moose and Elk

Risk Rating	Moose Road Density	Elk Road Density
High	>1.6 km/km^2	>1.2 km/km^2
Moderate	0.4 – 1.6 km/km^2	0.6 – 1.2 km/km^2
Low	<0.4 km/km^2	<0.6 km/km^2

3.2.5.4.3 Changes in Wildlife Mortality Risk and Health

Habitat loss and fragmentation related to linear features, as well as the increased human activity that often accompanies them, can increase the risk of wildlife mortality. Road densities >2.4 km/km^2 were considered to be of high risk to grizzly bear persistence (Table 3.2-8), and therefore of high impact, particularly when in combination with other risk factors such as low population numbers, low reproductive potential, and the expected degree of planned development. All road types were included in calculating disturbance feature densities. Road densities were expressed as km/km^2 within the WLSA, WRSA and GBRSA for each assessment scenario. Wildlife health was assessed on the basis of the air quality assessment (CR #1 – Air Quality) and a screening level wildlife risk assessment (CR #12 – Human Health and Wildlife Screening).

Table 3.2-8 Mortality Risk Ratings for Grizzly Bear in Relation to Road Density

Risk Rating	Road Density
High	>2.4 km/km^2
Moderate	0.6 – 2.4 km/km^2
Low	<0.6 km/km^2

3.2.5.4.4 Changes in Abundance

As with mortality risk and health, changes in wildlife abundance related to Project development are difficult to predict quantitatively at the WLSA, WRSA, and GBRSA scales. Wildlife abundance will most likely be influenced by the loss of suitable habitat, but might also be related to changes in movement, behaviour, habitat fragmentation, and mortality risk. Where possible, published species densities were used to determine potential loss of individuals from changes in habitat availability associated with the Project. Otherwise, changes in wildlife abundance related to other factors were evaluated qualitatively.

4.0 BASELINE CASE ASSESSMENT

The baseline case assessment includes existing environmental conditions and all existing projects and disturbances in the WLSA, WRSA, and GBRSA. Existing disturbances in the WLSA, WRSA, and the GBRSA were typically comprised of linear features (*i.e.* roads, pipeline ROWs, transmission lines, trails, and railways), well pads, agricultural lands (*e.g.* cultivated, pasture, *etc.*), rural residential areas, towns, and recreational areas (golf courses and ski hills).

4.1 Wildlife Health

Wildlife health was assessed on the basis of the air quality assessment (CR #1 – Air Quality) and a screening level wildlife risk assessment (CR #12 – Human Health and Wildlife Screening, Appendix H) conducted for the Project.

The air quality assessment modeled the contribution to key air quality concerns and parameters resulting from operation of the Project, including sulphur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter ($PM_{2.5}$, PM_{10}, and TSP), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and metals and particulate deposition. The